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MULTILEVEL CURRENT WAVEFORM GENERATION BY USING H-BRIDGE INDUCTOR CELLS

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ABSTRACT

The paper aims to generate the staircase output current waveform by a multilevel current source H-bridge inverter using inductor cells. The novelty in this paper is, with less number of switches the higher output levels are possible and the total harmonic distortion levels are presented in the acceptable levels. The chopper circuit is utilized to give the consistent smoothing current to the data side inductor. To control the middle of the road level activity PI regulator is utilized. The circuit is designed in MATLAB/SIMULINK and result shows the robustness of the proposed strategy.

Keywords: Current-Source Inverter (CSI), H-Bridge, Inductor Cell, Multilevel.

I. INTRODUCTION

The power within the battery is in DC mode and also the motor that drives the wheels typically uses AC power, thus there ought to be a conversion from DC to AC by an influence device. Inverters will do that conversion. The best topology which will be used for this conversion is that the two-level electrical converter that consists of 4 switches. Every switch wants Associate in need anti-parallel diode, thus there ought to be conjointly four anti-parallel diodes. There are alternative topologies for inverters. A structure electrical converter could be a power electronic system that synthesizes a curving voltage output from many DC sources. These DC sources are often fuel cells, star cells, ultra-capacitors, etc. the most plans of structure inverters is to possess a much better curving voltage and current within the output by exploitation switches asynchronous. Since several switches square measure place asynchronous the shift angles square measure vital within the structure inverters because of all of the switches ought to be switched in such the simplest way that the yield voltage and current have low harmonic distortion. Multilevel inverters have 3 varieties. Diode clamped structure inverters, flying condenser structure inverters, and cascaded H-bridge structure electrical converter. The THD are going to be diminished by increasing the amount of levels. It's obvious that Associate in output voltage with low THD is fascinating, however increasing the amount of levels wants a lot of hardware, and conjointly the management is going to be a lot of sophisticated. It's a trade-off between value, weight, complexity, and a really smart output voltage with lower THD

II. CSI TOPOLOGY MULTI LEVEL H-BRIDGE INDUCTOR CELL

Figure 1, show the five level current source inverter geography with inductor cell framework. The CSI has the four switches named as Q_1, Q_2, Q_3, and Q_4 and they are unidirectional in nature. The output terminals of CSI connected to the inductor cell system. The multilevel number is completely depends on the eq.1,

$$M = 2^{(N+1)} + 1 \qquad (1)$$

Where, M is the required output current waveform and N is the number of inductor cells.

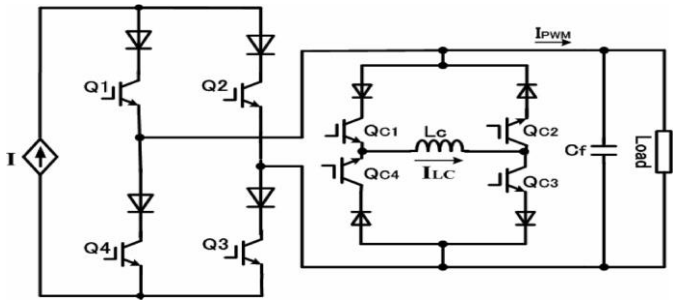

Fig 1: Five-level CSI Hybrid configuration

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The figure 2 shows the inductor cell system which is used in multilevel current waveform generation and associated in arrangement with the inverter.

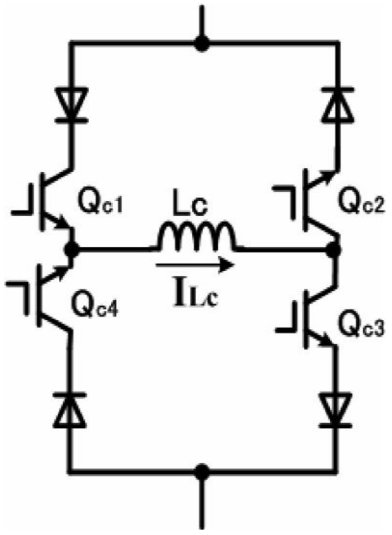

Fig 2: single H-bridge cell with inductor

The inductor system consists of four switches which are unidirectional in nature and they are named as Q_{C1}, Q_{C2}, Q_{C3} and Q_{C4} and an inductor *LC* connected across the cell circuit. The inductor H – bridge is used to increase the level of the yield current waveform and in that case the H-bridge inductor circuit is placed side by side. Now the paper aims to develop the five level current waveforms so a single H-bridge inverter is sufficient along with inverter topology.

The current flow in the inductor is represented as $I_{LC(i)}$ is expressed in terms of source current (I):

$$I_{Lc}(i) = I/2i \text{ , where } i = 1, 2, 3, \ldots, N \qquad (2)$$

The output-current levels of the five-level CSI are $+I$, $+I/2$, 0, $-I/2$, and $-I$.

III. OPERATION OF INDUCTOR CELL BASED CSI

The CSI generates the three levels current waveform and it is connected with H-bridge inductor cell system and it generates the intermediate levels, finally the at the load current multilevel current waveform. The charging activity method of the inductor Lc is directed when the switches QC 1 and QC 3 are turned on, while the switches QC 2 and QC 4 are turned off. A current ILc = I/2 moves through the force switches QC 1 and QC 3 that invigorates the inductor Lc .The releasing activity mode is accomplished by turning on the switches QC 2 and QC 4 and by killing QC 1 and QC 3 .The put away energy in the inductor is released to the heap as a current I/2.The flowing current modes happen when the inductor cell convey an invalid current to keep a steady current in the inductor cell. Comparable activity modes happened for the negative pattern of the yield current waveform.

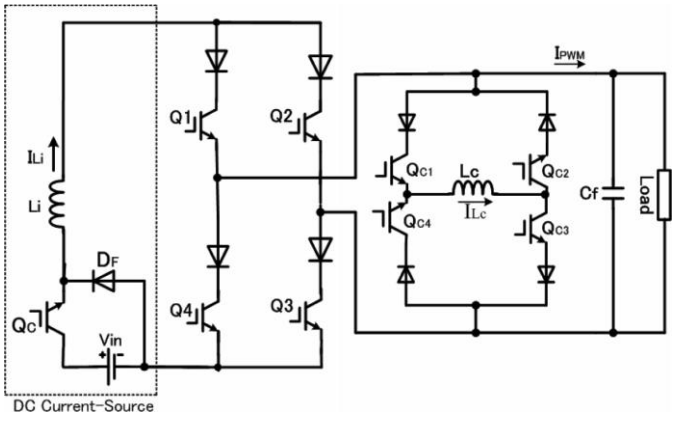

Fig 3: chopper controlled source of CSI

The source may contain the ripples in current by placing an inductor in series with source and helps to reduce the ripples and freewheeling diode (D_F) is used to help the continuous current flow through the inductor. The

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combination of source voltage, freewheeling diode, switch Q_C are used for the chopping and the voltage source is converted as current source.

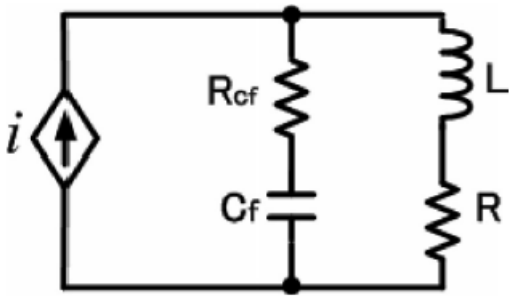

Fig. 4: Equivalent circuit model of CSI, filter capacitor, and load.

The CSI output may contain harmonics in the output current waveform by placing of RC filter across the load; the output current must be harmonic free/less harmonic and it improves the power quality.

Table-1: Switch States Of Five Level Csi

Q1	Q2	Q3	Q4	QC1	QC2	QC3	QC4	Output	operating mode of inductor connected H-cell
1	0	1	0	1	1	0	0	+I	circulating mode
1	0	1	0	0	0	1	1	+I	circulating mode
1	0	1	0	1	0	1	0	+I/2	charging of inductor cell
1	0	0	1	0	1	0	1	+I/2	discharging of inductor cell
1	0	0	1	0	0	1	1	0	circulating mode
1	0	0	1	1	1	0	0	0	circulating mode
0	1	0	1	0	1	0	1	-I/2	charging of inductor cell
0	1	1	0	1	0	1	0	-I/2	discharging of inductor cell
0	1	0	1	0	0	1	1	-I	circulating mode
0	1	0	1	1	1	0	0	-I	circulating mode

Table 2: Parameters

S. No.	Parameter	Value
1	Source Voltage	160 V
2	Switching Frequency	22 KHZ
3	Capacitor	5 μF
4	Inductance L_C	5 mH
5	Smoothing Inductance L_i	1 mH
6	Load Resistance	8 ohms
7	Load Inductance	1.2 mH
8	Operating Frequency	50 Hz

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IV. RESULTS & DISCUSSIONS

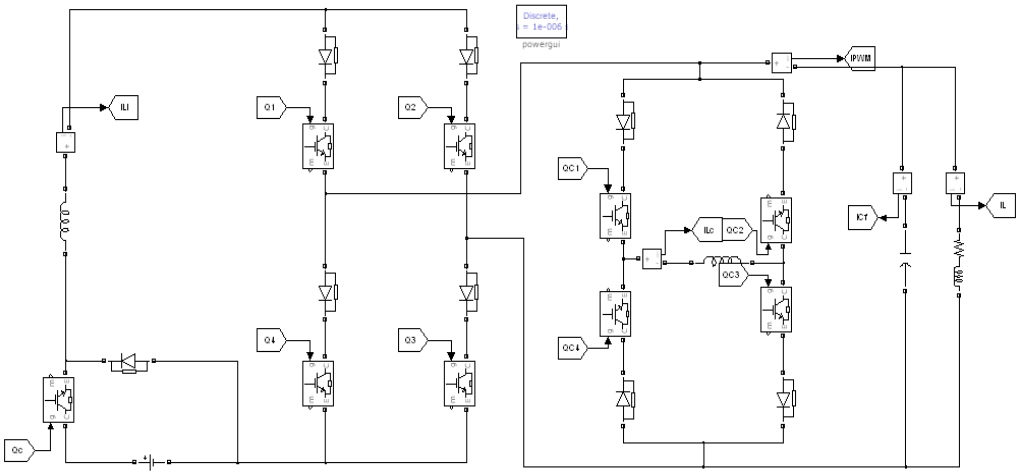

Fig. 5: Five- level H-bridge CSI using inductor cell system.

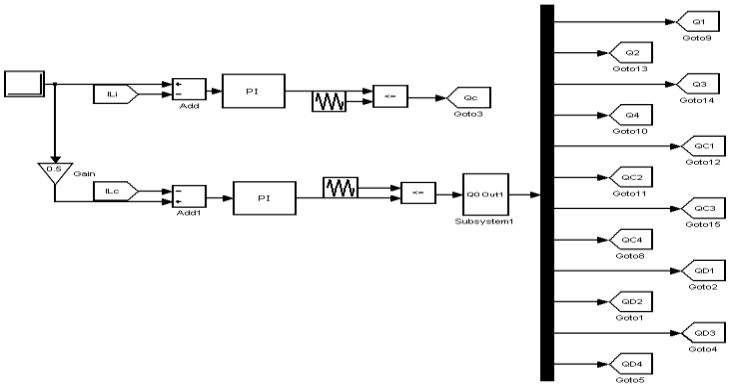

Fig. 6: Control diagram of proposed five-level CSI

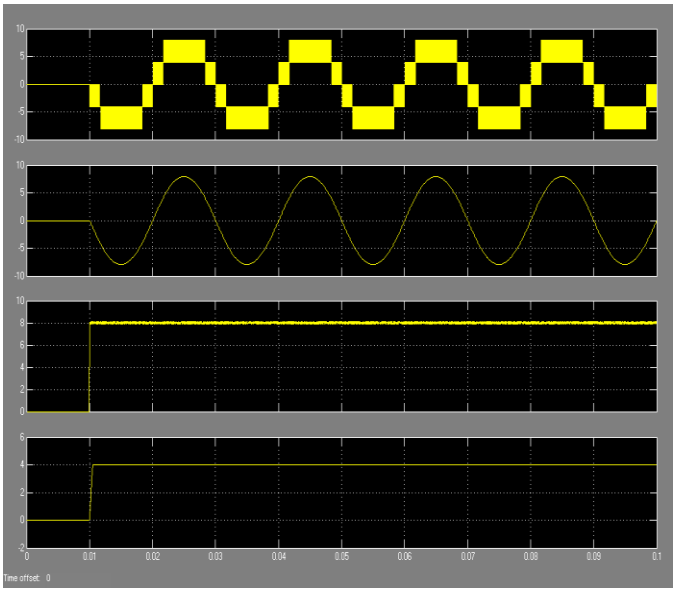

Fig. 7: Five level current without filter, current through the load after RC filter, input DC current, and the inductor cell current responses

V. CONCLUSION

The results shows the proposed topology accuracy and reliability in multilevel current waveform generation and the mathematical equations satisfies the levels obtained by the inverter topology is same and the current passing through the inductor cell is also same quantity. The CSI has the advantages when compared voltage

source inverter in terms of low di/dt, it doesn't need any additional power sources, and simple inductors are used for the generation of intermediate levels.

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