1. INTRODUCTION

Phase control converter has been using Thyristor for the switching device that can able to be control short circuit. There are uses for height voltage system but the mainly problem of them are harmonic distortion of output voltage and so many inputs current. For solution concern harmonic distortion in old day used fitter to adjust frequency for variable inductors reactance equation capacitor reactance.

This article presently technique of intervene firing method, comparisons with normally intervening firing that use passive filter. Technique of intervene firing at the 6-pulse phase-controlled converter. We use this technique for drive DC motor. There were from obtained from the experiment was analyzed on the spectrum of the current, voltage, and the total harmonic distortion. The double firing method causes zero vectors of output voltage and input current. Designing the mechanism of the converter based on the idea of Park Vector Theory, the number of harmonic distortion in the intervening firing method were compared to those in normal firing method.

Computing factor of the passion harmonic filter consist of

1. Define any parameter of system that use for harmonic filter.
2. Define reactance power.
\[ Q_{com} = kW \left( \tan \theta_1 - \tan \theta_2 \right) \] (5)

\[ Q_{com} \text{ Reactive power (kVAR)} \]
\[ kW \text{ Real power (kW)} \]
\[ \theta_1 \text{ angle of old power factor} \]
\[ \theta_2 \text{ angle of new power factor} \]
3. Analyze information harmonic current from exactly measurement or estimate and define number of filter.
4. Separate \( Q_{com} \) from follow the number of filter.
5. Define turning point of harmonic filter.
6. Define voltage of capacitor.
\[ V_c \geq \frac{n_3}{n_3 - 1} \times V_{sys} \] (6)

\[ V_c \text{ voltage system} \]
\[ n_3 \text{ turning value} \]
\[ V_{sys} \text{ capacitor voltage} \]
7. Define reactive power of capacitor that use.
\[ Q_C = \left[ \frac{n_3}{n_3 - 1} \right] \left( \frac{V_{sys}}{V_r} \right)^2 \] (7)

\[ Q_{com} \text{ compensation reactive power} \]
\[ Q_C \text{ capacitor reactive power} \]
8. Find capacitor, inductor, and resistor.
\[ X_C = \frac{V_r^2}{Q_C \times 10^8} \] (8)
\[ C = \frac{1}{2\pi f \times X_C} \] (9)
Installation harmonic filter with system and analyze harmonic current in the path of system and inspects performance of harmonic filter.

\[ I_{\text{filter,1}} = \sqrt{(I_{\text{filter}} \times 1.1)^2 + \sum I_{\text{harmonic,1}}^2} \] (12)

**Technique of intervening firing method**

The basic modal of phase control converter, that uses for experiment show in fig.3 can able show below.

\[ v_i(t) = [S_a(t), S_b(t), S_c(t)] \]

\[ i_n(t) = [S_a(t), S_b(t), S_c(t)] \]

\[ i_{\text{out}}(t) = [S_a(t), S_b(t), S_c(t)] \]

**Table 1 value of switching function**

<table>
<thead>
<tr>
<th>Conducting Switches</th>
<th>( S_a(t) )</th>
<th>( S_b(t) )</th>
<th>( S_c(t) )</th>
<th>( S(t) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Q_1 ) on ( Q_6 )</td>
<td>0</td>
<td>-1</td>
<td>1</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_2 ) on ( Q_5 )</td>
<td>1</td>
<td>-1</td>
<td>0</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_1 ) on ( Q_4 )</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_2 ) on ( Q_3 )</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_3 ) on ( Q_6 )</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_1 ) on ( Q_2 )</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_1 ) on ( Q_6 )</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>( S_i )</td>
</tr>
<tr>
<td>( Q_2 ) on ( Q_4 )</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>( S_i )</td>
</tr>
</tbody>
</table>

**Technique of intervene fining method at the pulse of the 6 pulse phase control converter in every 1/6 period.**

This article \( S_i \) will be create. Consider the first 1/6 period before intervening firing of \( i_G1 \), at \( \omega t = 0 \). Thyristor \( Q_1 \), \( Q_4 \) enable a both and when there are intervening firing of \( i_G1 \), at \( \omega t = 0 \) Thyristor Q1 Trig when \( v_a \) in 1/6 period. \( v_i \) will be turned on and \( Q_4 \) turn off then vector of o/p, \( v_i \) and input current \( i_{\text{in}} \) \( i_{\text{in}} = 0 \) when \( i_{\text{in}} \) Trig and \( Q_4 \). When \( v_{a,0} \) in 1/6 period, \( Q_1 \) turn on and \( Q_4 \) turn off when output voltage, \( v_a \) become to \( v_{a,0} \). The sequence of Trig will be repeat. The result is value distortion in o/p voltage \( v_i \) reduction.
The value of distortion harmonic, \( dV \), \( d_{max}V \), \( a_I \), \( S \) and \( \text{ripple}_V \) compute from equation below.

\[
v_d(t) = v_0 + \sum_{n=1}^{\infty} \sqrt{2} V_n \sin(n\omega t + \psi_n)
\]

(17)

\[
v_{ab}(t) = \sqrt{2} V_{ab} \sin(\omega t + \frac{\pi}{6})
\]

(18)

\[
V_{ripple} = \sqrt{\sum_{n=1}^{\infty} V_n^2}
\]

(19)

\[
I_d = \sqrt{\sum_{n=1}^{\infty} I_n^2}
\]

(20)

\[
S = 3V_{rms}I_d
\]

(21)

**Result of experiment**

Fig 2 at \( \alpha = 80^\circ, \beta = 20^\circ \)

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**Result of experiment**

Fig 3 graph and current spectrum before take filter at \( \alpha = 0^\circ \)

Fig 4 graph and current spectrum behind take filter at \( 5^\circ, 7^\circ \) and line reactor at \( \alpha = 0^\circ \)

**Table 2 percentage of current harmonic \( THD_i(\%) \) at \( \alpha = 0^\circ, 30^\circ, 60^\circ \)**

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>( \alpha = 0^\circ )</th>
<th>( \alpha = 30^\circ )</th>
<th>( \alpha = 60^\circ )</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Filters</td>
<td>24.61</td>
<td>27.16</td>
<td>27.36</td>
</tr>
<tr>
<td>Harmonic Filter</td>
<td>2.98</td>
<td>4.35</td>
<td>4.65</td>
</tr>
</tbody>
</table>

**The result of intervene firing**

Fig 5 current graph \( i_d, i_a, i_c \) and voltage \( V_d \) at \( \alpha = 80^\circ, \beta = 60^\circ \)

Fig 6 current graph \( i_d, i_a, i_c \) and voltage \( V_d \) at \( \alpha = 120^\circ, \beta = 20^\circ \)
Table 3 value of current harmonic $THD_i$ (%) at
$\alpha = 30^\circ - 120^\circ, \beta = 0^\circ - 60^\circ$ comparison with normally trig

<table>
<thead>
<tr>
<th>Double Firing</th>
<th>$THD_\alpha$ (%)</th>
<th>Firing</th>
<th>$THD_\beta$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>$\beta$</td>
<td>$\alpha$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
<td>30</td>
<td>27.16</td>
</tr>
<tr>
<td>60</td>
<td>0</td>
<td>60</td>
<td>27.36</td>
</tr>
<tr>
<td>60</td>
<td>30</td>
<td>60</td>
<td>27.36</td>
</tr>
<tr>
<td>80</td>
<td>60</td>
<td>80</td>
<td>28.81</td>
</tr>
<tr>
<td>120</td>
<td>30</td>
<td>120</td>
<td>32.03</td>
</tr>
<tr>
<td>120</td>
<td>60</td>
<td>120</td>
<td>32.03</td>
</tr>
</tbody>
</table>

From fig. 3 and 4 $\alpha = 0^\circ, 30^\circ, 60^\circ$ harmonic filter passive can able reduction distortion harmonic but we consider THD(%) when the value of Trig’s angle increase to much then input current and output voltage reduction the quality of filter reduction also.

**Summarize**

Reduction distortion harmonic from 6-pulse phase control converter show by to change space vector then can able make zero vector of output voltage and input current become to zero via every 1/6 period when comparison with passive harmonic filter

**Reference**

