FILTERS

The output of rectifier is pulsating DC (DC component + ac component). The filters are used to convert pulsating DC to pure DC. The full wave rectifier gives ac component of 0.482 times the dc component. Where are HWR has ac component =1.21 times the dc component. Therefore it is better to connect output of FWR to filter circuit.

Ideally the output of filter is pure DC (the AC component should be zero). But practically the filter circuit will minimize the ripples at output as far as possible. (amount of AC ripple is less and negligible in comparison with AC ripple at output of rectifier).

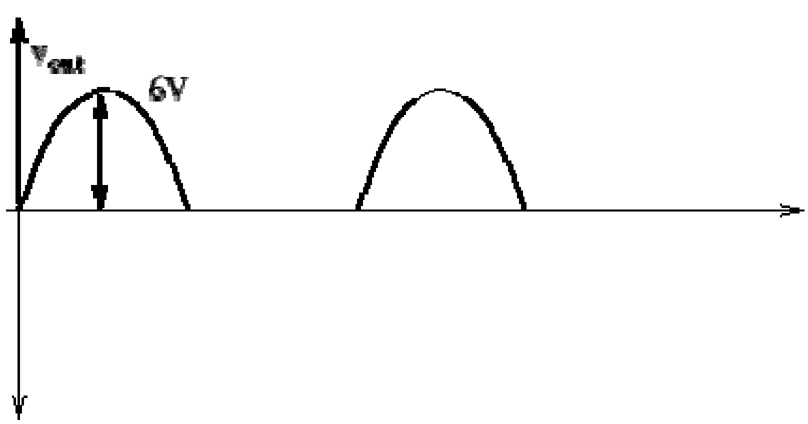
There are different types of filters:

1. Inductor filter
2. Capacitor filter
3. LC or L-Section filter
4. CLC or π-section filter
5. Multiple L-Section filter
6. Multiple π-section filter

Harmonic components in the rectifier circuits :

A mathematical representation of output current waveform in rectifier is obtained by means of Fourier series.

FOR HWR:



$$i = I_m\left[\frac{1}{\pi} + \frac{1}{2}\sin\omega t - \frac{2}{\pi}\sum_{k=2,4,6...}\frac{\cos k\omega t}{(k+1)(k-1)}\right]$$

The DC component Here is $\frac{I_m}{\pi}$

The lowest angular frquency present in active equation is that of primary source of AC power (fundamental frquency).

All other terms in above expression are even harmonics of power frequency.

For FWR

$$i = I_m\left[\frac{2}{\pi} - \frac{4}{\pi}\sum_{k=2,4,6...}\frac{\cos k\omega t}{(k+1)(k-1)}\right]$$

Problems:

1. A 230V, 60Hz voltage is applied to 5:1 step down centre tapped transformer used in FWR circuit having a load of $900\,\Omega$. If diode resistance and secondary coil resistance together has $100\,\Omega$. Calculate

i. dc voltage across load.

ii. dc current flowing load

iii. dc power delivered to load

iv. PIV across each diode

v. ripple voltage

sol. $\frac{e_1}{e_2} = \frac{N_1}{N_2}$

$\frac{230}{e_2} = \frac{5}{1} \Rightarrow e_2 = 46V$

Secondary voltage of transformer $= 46V$

Voltage from centre tapping to each end $= 23V$

Load resistance, $R_L = 900\Omega$

$Rf + R_S = 100\Omega$

Total resistance $= 1k\Omega$

i. $V_m = V_{rms} \cdot \sqrt{2}$

$= 23\sqrt{2} = 32.52$ $\qquad V_{dc} = \dfrac{2V_m}{\pi} = 20.7$

ii. $I_{dc} = \dfrac{V_{dc}}{R} = \dfrac{20.7}{10^3}$

$= 20.7mA$

iii. $P_{dc} = I_{dc} \cdot V_{dc}$

$= (20.7)(20.7 \times 10^{-3})$

$= 428.64 \times 10^{-3} = 0.428W$

iv. $PIV = 2V_m$

$= 2(32.52)V = 65.04V$

v. Ripple voltage $= V_{ac} =$

$$= V'_{rms}$$
$$= \sqrt{V^2{}_{rms} - V^2{}_{dc}}$$
$$= \sqrt{(23)^2 - \left(\frac{2(23\sqrt{2})}{\pi}\right)^2}$$
$$= \sqrt{(23)^2 - (20.7)^2}$$
$$= 10.02V$$

Since here ripple voltage means rms value of ac component in output of rectifier.