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Optimization of Flywheel Design for 5hp Lubricated Air Compressor

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ABSTRACT: Flywheel is a mechanical component which stores rotational energy and release that energy when machine need. A heavy rim or disk type flywheel used for avoiding the fluctuation due to rotating velocity. It is also useful to maintain revolution per minute. A flywheel is a spinning wheel or disc with a fixed axle so that rotation is only about one axis. Cast iron is suitable material for flywheel because of no need of accurate properties in flywheel.There are two types of flywheel one is Rimmed/Arm type and second is Disk type. In proposed design, consider disk type flywheel.For basic industial purpose selecting 5hp motor for proposed design.Revolution of motor is considered as 700rpm.Seimens motor consider for designing of flywheel.

Keywords: Compact design,DiskFlywheel,Powersaving,Material and cost saving,More efficient

1. INTRODUCTIONS

A flywheel is used to control the variations in speed during each cycle of engine.A flywheel of suitable dimensions attached to the crankshaft,makes the moment of inertia of the rotating parts quite large and thus,acts as a reservoir of energy.During the periods when the supply of energy is more than required,it stores energy and during the periods the requirements is more than the supply, it releases energy.

For the designing of flywheel taking data's from available data.

Given data:

L=connecting rod length= 170mm

R= crank radius= 35mm

T=motor torque= 50N.m = 50,000N.mm

P=motor power= 5hp

Fp=piston force= A * P_{max} = $\left(\pi * \frac{D^2}{4}\right) * P_{max}$ = 5400N

Where, D= 90 mm, P_{max}= 0.85 N/mm^2

Let,

$$n = \frac{Conrod\ length}{Crank\ radius}$$

$$\therefore n = \left(\frac{170}{35}\right)$$

$$\therefore n = 4.86$$

We have Motor Torque T = 50 N.m

In working Condition,

When piston at TDC and BDC,at that time θ = 0˚ or 180˚

So, T= 0 N.m

Now, study of different torques as per crank angle θ,

Case: 1) take, θ = 45˚

T= F_p x r x $\left(sin\theta + \left(\frac{sin\,2\theta}{2*\sqrt{n^2-\sin^2\theta}}\right)\right)$

= 114065.2 N.mm

= 114.06 N.m

Case: 2) take, $\theta = 90^\circ$

T= F_p x r x $\left(sin\theta + \left(\frac{sin\,2\theta}{2*\sqrt{n^2-\sin^2\theta}}\right)\right)$

= 189000 N.mm

= 189.00 N.m

Case: 3) take, θ = 135˚

T= 114 N.m

Case: 4) take, θ = 225˚

T= -114 N.m

Case: 5) take, θ = 270˚

T= -189 N.m

Case: 6) take, θ = 315˚

T= -153.30N.m

Energy Produced by system,

$E = P_c * r$

= 5520 * 0.035

= 193.2 N.m

$\Delta E = 2 * E * C_s$

$= 2 * 193.2 * 0.002 = 0.7728\ N.m$

$\Delta E = m * R^2 * w^2 * C_s$

$\therefore 0.7728 = m * (0.100^2) * 5667 * 0.002$

$\underline{m = 6.714\ kg}$

Area of Flywheel = A = b x t =$2t^2$

Now,

$m = A * 2\pi R * \rho$

$\therefore 6.714 = 2t^2 * 2\pi * 0.1 * 7250$

$\underline{t = 27.14\ mm}$

So, b = 2t

<u>b = 54.3 mm</u>

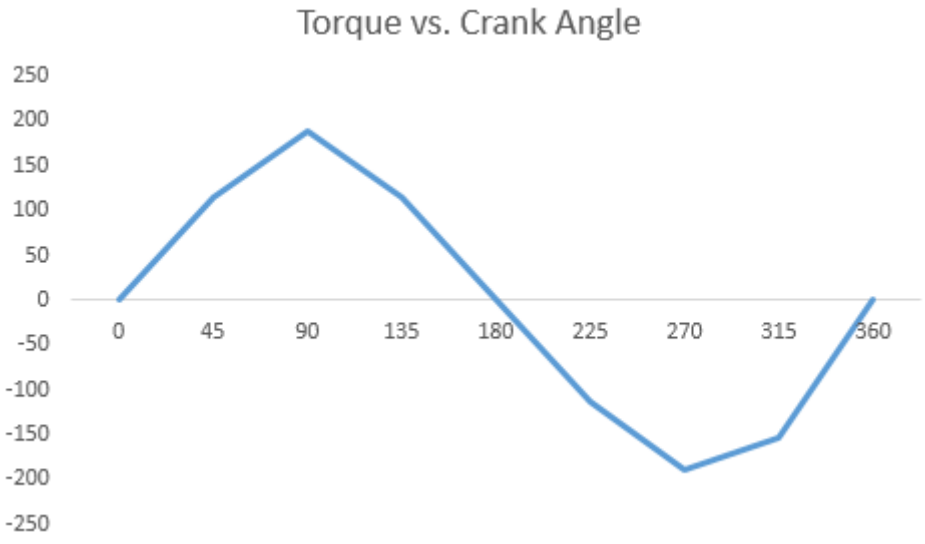

Figure 4.50: Torque vs. Crank angle

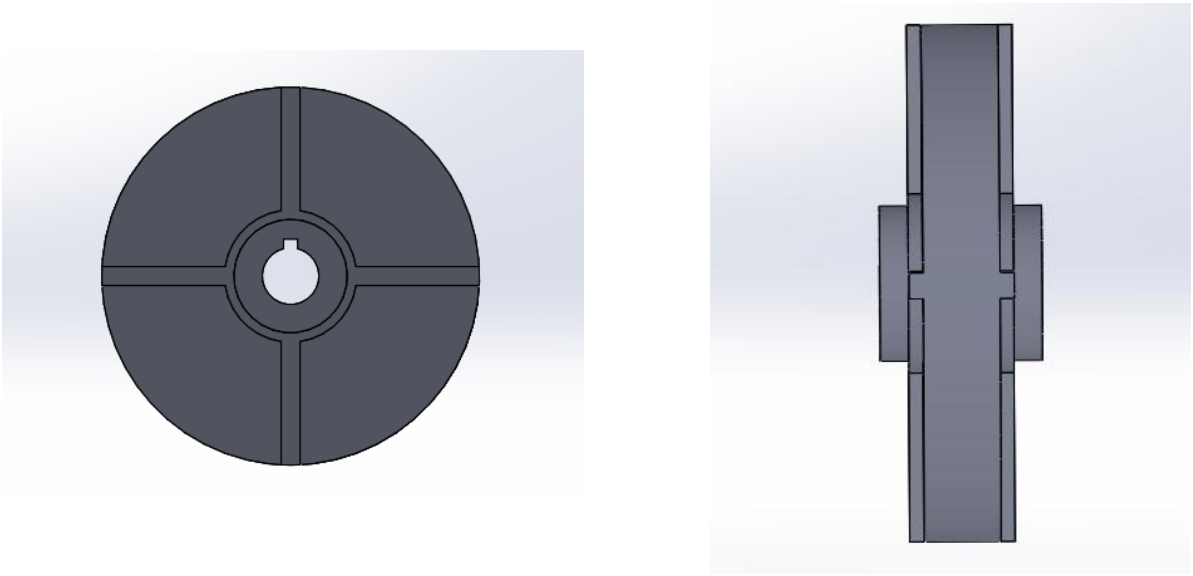

Figure 4.51: Flywheel design in Solidworks

CONCLUSION:

Flywheel is design from cast iron material. Mass of the flywheel calculated from torque and crank angle graph, which is 6.714 kg. Thickness and width of the flywheel is 27.14 mm and 54.3 mm.

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