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Structural Analysis of Wobble Plate Engine Configuration

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Abstract:- In this paper we provide a detailed analysis and Design on a Wobble plate. This invention relates to internal combustion engine of the type that employs a wobble plate to transfer power from parallel piston to the central shaft. The design of the engine s done by using CATIA and analysis by ANSYS. A wobble plate includes a cylinder block, a plurality of pistons, a drive shaft, a weight, an oscillating member, a plurality of rods connecting the pistons to the oscillating member, a pair of bevel gears and a plurality of thrust bearing assemblies wherein the plurality of thrust bearing assemblies are installed at the cylinder block and the oscillating member to support the straight shaft, the weight and the declined shaft and reduce a rotational velocity transferred there form. The connections between the wobble plate, connecting rod and pistons incorporate spherical bearings. Also a wobble plate internal combustion engine incorporating the wobble plate engine assembly is presented.

The wobble effect produced by the wobble plate rotation automatically open and closes the inlet and outlet valves. Stroke of the engine is determined by the angle inclination of the wobble plate relative to the main shaft. The angle inclination of the wobble plate effects efficiency of the engine.

Key Words: Wobble plate, plurality, declined shaft, incorporate.

1. INTRODUCTION

A wobble plate engine includes a cylinder block, a plurality of pistons, a drive shaft, a weight, an oscillating member, a plurality of rods connecting the pistons to the oscillating member, a pair of bevel gears and a plurality of thrust bearing assemblies wherein the plurality of thrust bearing assemblies are installed at the cylinder block and the oscillating member to support the straight shaft, the weight and the declined shaft and reduce a rotational velocity transferred there from.

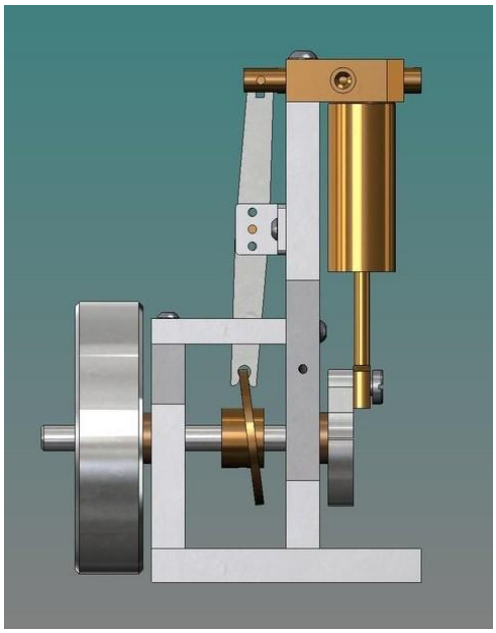

Fig-1 : Wobble plate engine

2. WORKING PRINCIPLE OF THE TORPEDO

A plate is mounted on a shaft and set at an angle to it so that as the shaft rotates, the plate moves laterally in relation to any given point on either side of it. The end of the push rod is placed in a guide plate that lays against the wobble plate.

The rotation of the wobble plate then causes the guide plate to wobble, thus moving the push rod back and forth. The rotary metering valve is driven by the same shaft that drives the wobble plate. The rotary valve consists of a lapped cylindrical shaft that is fitted closely.

3. DESIGN OF WOBBLE PLATE ENGINE

This isn't a model of any large engine and it does have the usual construction and appearance of small steam engines. Bernard Leahy told of a model he saw with a cylinder made from the tube of a bicycle tire pump and fitted with a valve across the end. This is a showoff engine using this idea and an unusual valve mechanism. You surly can see a lot of action. The construction is not difficult. It is important to avoid too much looseness in the valve linkage. Getting 1/8" of travel in the wobble disk is important and requires a bit of careful soldering. The bar from the bearing over to the column serves to back up the valve lever against the disk thrust and it adds support to the tall slender column. We hope this small model appeals to the owners of 3 and 5 inch lathes. If all dimensions are doubled it makes a good model for those who don't like to work quite so small. Most of the parts are straight machine shop practice.

On the COLUMN it is good to have the 13/32",7/16" and 5/16" hole spacing accurately straddle the centerline. This applies to the bolt spacing on the BASE, LEVER, GUIDE, LEVER PIVOT and VALVEBODY which are all related and affect the alignment and freedom of the VALVE LEVER.

The VALVE LEVER and LEVER PIVOT are made with three pivot holes. If you lack a bit of valve travel, mount the pin in the lower holes. If there is too much travel, use the upper holes. The valve travel is centered by moving the WOBBLE PLATE along the shaft. By watching close in the ports you can see the edge of the 3/16" neck in the valve as it passes each port. One extreme position of the valve is shown in the top view of the engine assembly. Notice that the position of the wobble plate and lever apply to this top view. The brake in the valve in the main view is related to the piston shown. The wobble plate is 90 degrees out of position on the main assembly drawing.

The wobble plate is made first with a clean, sharp 7/16"hole. The WOBBLE PLATE HUB is turned until its just enters this 7/16" hole. By reducing the diameter a thousandth and trying the disk each time, you repeat until the 1/8" dimension is reached as shown. This diameter is approximately432". With pliers is in one hand, twisting the disk has far as it will go and measuring you can produce a wobble close to 1/8". Hold the disk with pliers in this same way and soldering them together.

The VALVE LEVER is not too difficult. When making the 3/32" hole the first and then form the surfaces as near spherical as you can by eye. Try for the closest possible fit on the disk that you can get. You will need tiny needle files for job. Hold the 1/16" dimension close. You will assemble and disassemble several times before you are satisfied. The center of the disk should be the same distance from the column as the hole in the lever pivot during these trials.

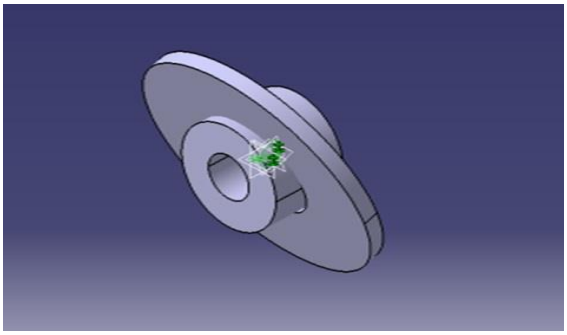

Fig-2 : Wobble plate

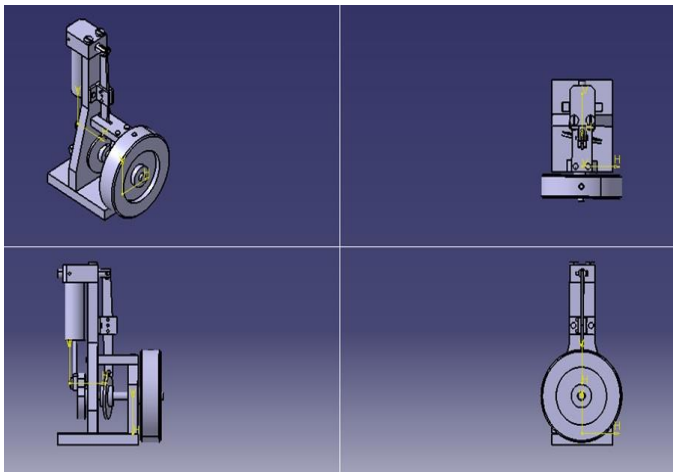

Fig-3 : Isometric view

4. DIFFERENT TYPES OF TORPEDOES

Single piston wobble plate engine with an angle limit of 16^0 has taken into consideration for the development of the engine which are working by wobble plate. As long as the engine's introduced into the manufacturing field they faces a heavy losses as the failure occurred in the wobble plate while engine working at different speed limits. Considering these losses these type of engines are replaced with an different angles like 10^0,12^0,14^0,16^0 and 18^0 of wobble plate enging is get to consideration and experiments are doing to overcome the failure.

5. MATERIAL OF WOBBLE PLATE

Steel, aluminum, brass are used as the material for the different components in the engine, and those material properties are discussed below, Properties of materials used for the engine components.

6. STATIC STRUCTURAL ANALYSIS

ANSYS Workbench combines access to ANSYS applications with utilities that manage the product workflow.

Tab-1: Comparison Results

ANGLE (Degree)	DEFORMATION (mm)	MAX PRINCIPLE STRESS (Mpa)	MAX PRINCIPLE ELASTIC STRAIN
16^0	0.12177	104.92	0.0012741
14^0	0.11882	104.06	0.0012692

STATIC ANALYSIS OF WOBBLE PLATE ENGINE AT DIFFERENT ANGLES

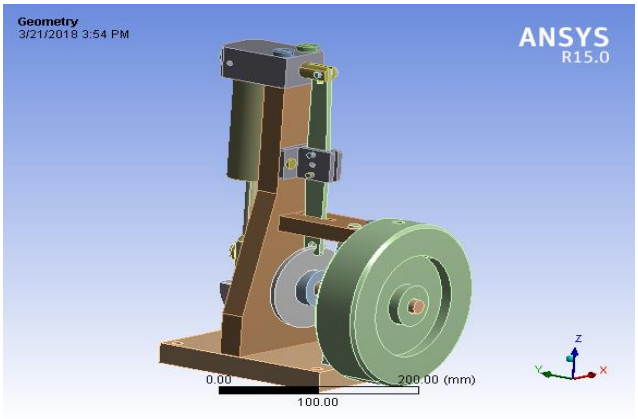

Fig-4: Geometry Diagram

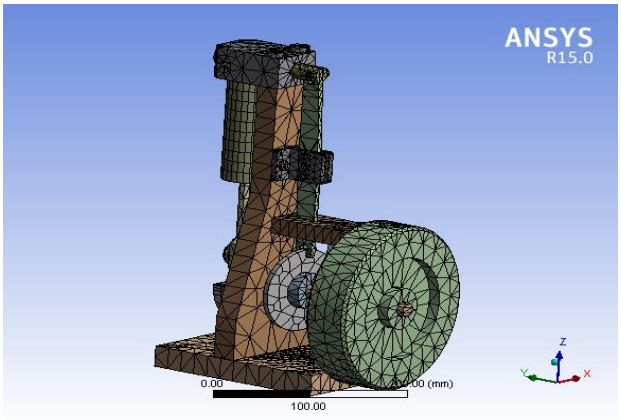

Fig-5: Mesh diagram

A) Resultant values at 16^0 angle

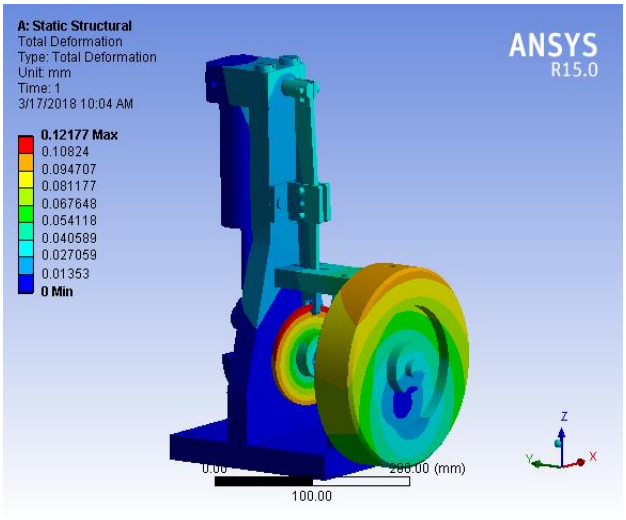

Fig-6: Maximum deformation

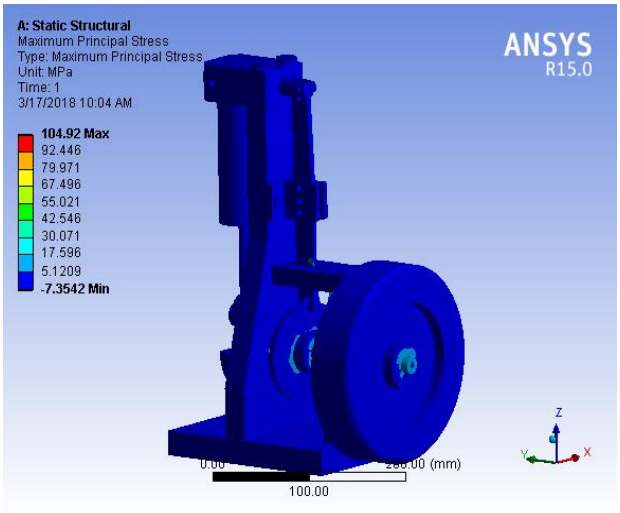

Fig-7: Maximum principle stress

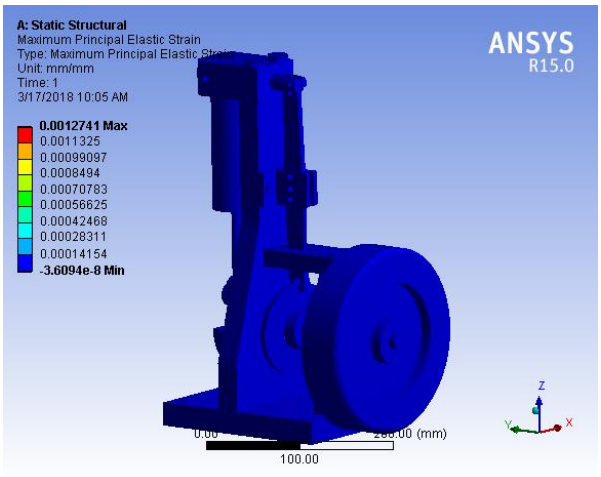

Fig-8: Maximum principle elastic strain

B) Resultant values at 14^0 angle

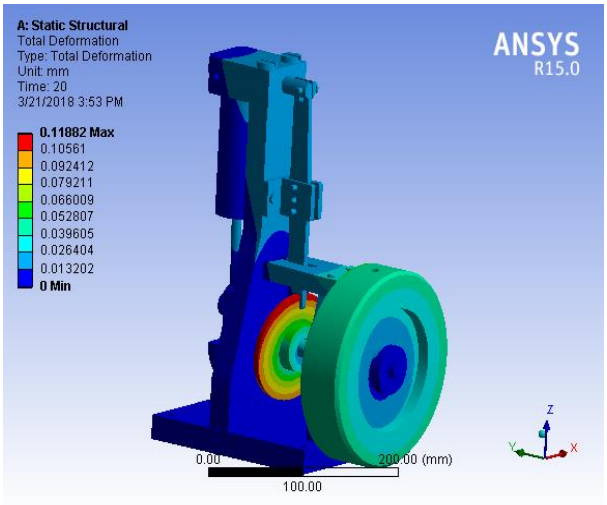

Fig-9: Maximum deformation

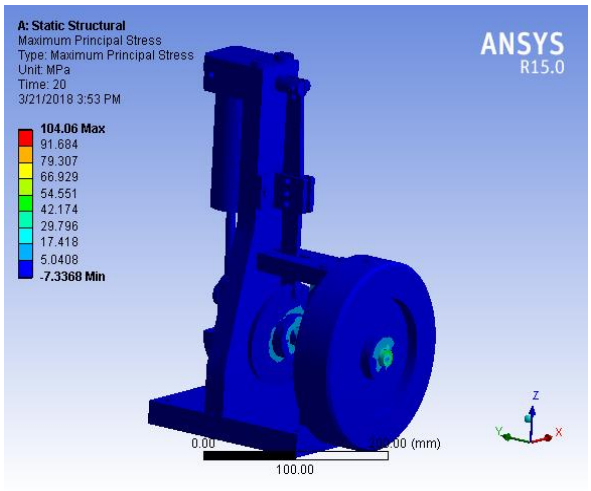

Fig-10: Maximum principle stress

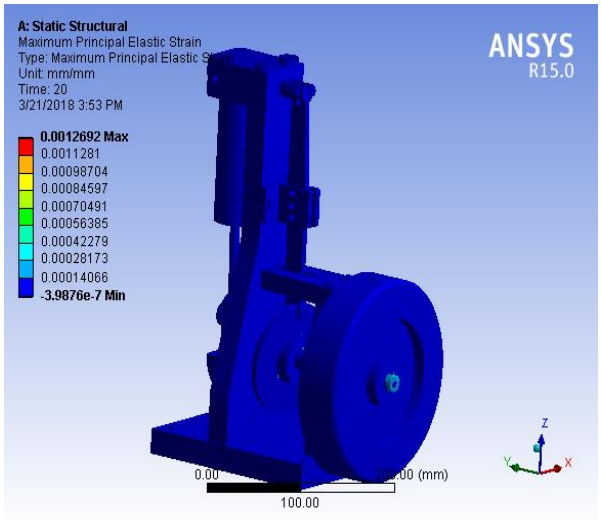

Fig-11: Maximum principle elastic strain

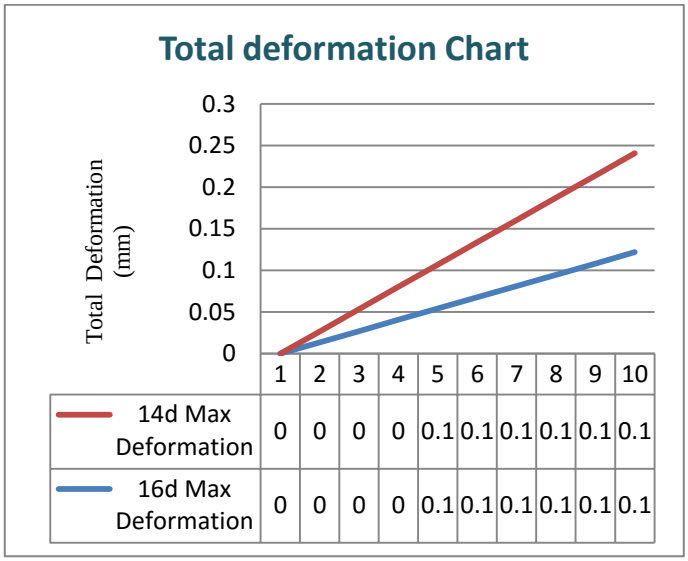

Chart-1: Maximum deformation with respect to different angles

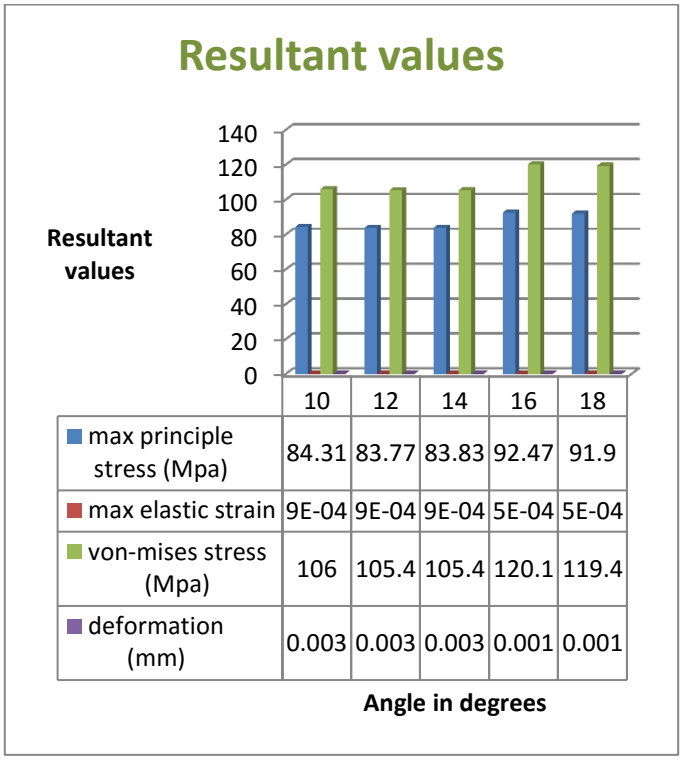

Chart-2: Comparison graph

CONCLUSIONS

In our project we have redesigned a wobble plate using theoretical calculations. The three dimensional wobble plate drawing is created and modeling using CATIA V5, we have done structural and model analysis on IC engine using three materials steel,

aluminum, brass to validate our design. By observing the results, for all the materials the strength values are less than their respective yield strength values. So our design is safe.

We have also done model analysis for different angles as number of model to see the displacement of wobble plate by comparing the results for five angles, the strength of 14^0 angle is less than 16^0 angle.

So we conclude that for our design, wobble plate 14^0 angle is better model for IC engine.

REFERENCES

[1] 1985 Joseph scalzo of wobble engine with stabilizer mechanism with patent right US4727761A.

[2] 1990 Weston W. Henry had published an article "wobble plate internal combustion engines".

[3] Noel Quayle, Cornelius koppenol in 1995 " wobble plate engine" 1st edition.

[4] In 2000 by John tom "Wobble plate engine design"

[5] In 2004 "wobble plate engine" by Yoon jeen mok.

BIOGRAPHY

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