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Performance Investigation of IC Engine Inlet and Exhaust Valve Spring using FEM

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ABSTRACT

This paper discusses helical valve springs used in IC engines that are subjected to fluctuating loads, static loads, and changing loads. It compresses and absorbs energy during valve opening and releases energy during valve shutting. Spring stiffness is important in the design of helical valve springs since it helps to increase dependability and fatigue life. This stiffness valve can be managed using elasticity of modules in software, but in practise, we must manage stiffness value using heat treatment process; there are many various types of heat treatment available depending on stiffness value. As a result, in our research, we additionally detail the heat treatment in relation to our stiffness requirement. In addition, a physical test using a stiffness testing equipment was detailed.

Keywords: Valvespring,HeatTreatment, Highspeedengines,Fatiguelife

1.INTRODUCTION

Internal combustion engines are ones in which the combustion of fuel occurs within the engine cylinder. The chemical energy of fuel is first turned into heat energy, which is then converted into mechanical energy in an internal combustion engine. The combustion chamber of an internal combustion engine produces high pressurized gases and high temperatures as a result of fuel combustion, and this chemical energy of fuel is finally converted into mechanical power, which is transferred to the wheels to power the vehicle via the power train system. Internal combustion engines are classified into two types based on the fuel they use: petrol engines and diesel engines. In case of IC engine there are 2 types of valve intake valve which is used to operate flow of fuel inside the engine cylinder whereas6 exhaust valve is used to control the exhaust gases flow also opening and closing of inlet and exhaust valve is done with the help of cam shaft.A valve spring is an elastic element that deforms when a load is applied and returns to its original shape and size when the load is withdrawn. Because ordinary helical springs cannot sustain this type of file loading, we build several types of valve springs that work in high fluctuation load and high stress.

PROBLEM FORMULATION

The mechanical valve train system uses valve springs to keep the pressure on the inlet and exhaust valves so that they are closed. As a result of failing to retract the valve quickly enough to release the pressure on the piston during the exhaust stroke and having to withstand fluctuating loads while operating in extremely high temperatures due to the valve spring being subjected to thousands of cycles per minute, some valve springs in high rotational engines suffer damage or failure.

- The helical spring in the valve is under considerable fluctuation load
- The valve helical spring is severely restricted in space.
- The valve's helical spring operates in a hot environment.
- Such loading and stress cannot be supported by a nearby spring.

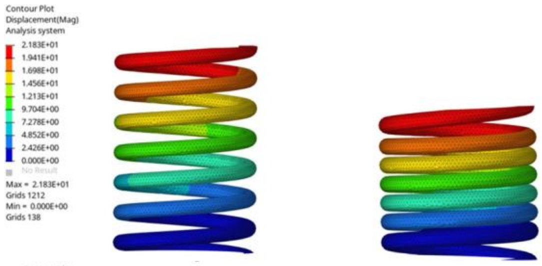
OBJECTIVE OF RESEARCH

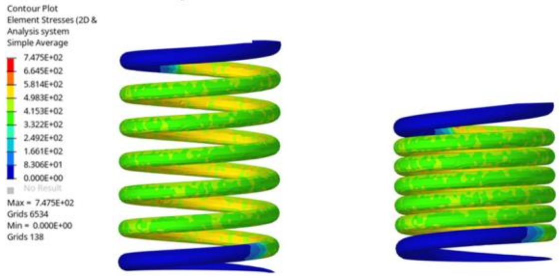
The goal of this work is to create and analyse valve springs in order to increase their performance for high-speed engines. The most recent CAE solutions for valve springs ensure that valve springs fulfil customers' expectations for exceptional performance. We can produce lightweight valve helical springs with less assembly space thanks to the development of new products, the discovery of efficient materials, and the resulting continuous optimization methods. This improves more aerodynamic vehicles with lower drag coefficients, which improve high performance, high torque, and lower fuel consumption. It also lowers the manufacturing cost. Greater dependability and long-term CO2 reduction for motor vehicles are ensured by the use of optimization techniques at all phases of development and production.

RESULT

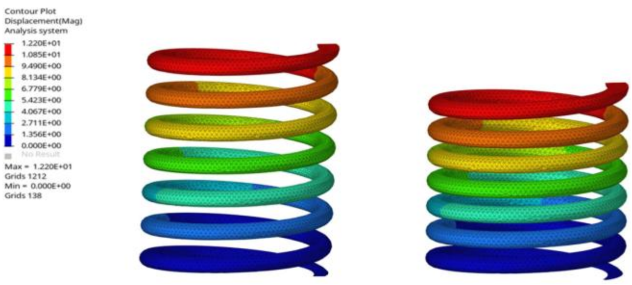
In this research analysis we select valve spring material is Chromium-Vanadium Steel and apply a load of 250.0 N load on the valve when it is in closed condition. We get 21.830 mm maximum displacement in this condition and the value of maximum stress which we get is 747.0 Mpa.

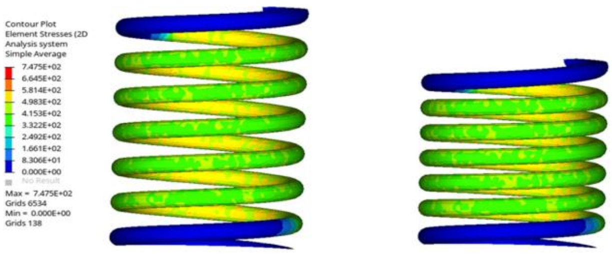
MaximumDisplacement–21.830 mm
MaximumStress–747.50Mpa



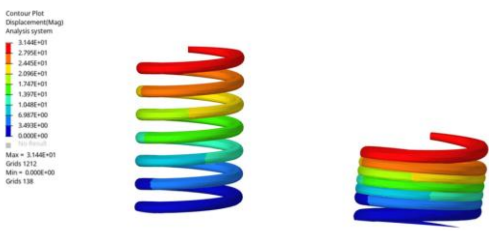


In the direction of going through the max displacement valve to 12.0 mm I have to consider some other material in this case we increase the modulus of elasticity from 1.9E 05 with a value of 3.4E 05.
MaximumDisplacement–12.20 mm





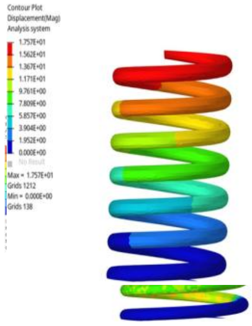
MaximumStress–747.50Mpa
In this research analysis we select valve spring material is Chromium-Vanadium Steel and apply a load of 360.0 N load on the valve when it is in open condition. We get 31.444 mm maximum displacement in this condition and the value of maximum stress which we get is 1076.0 Mpa.
MaximumDisplacement–31.444mm



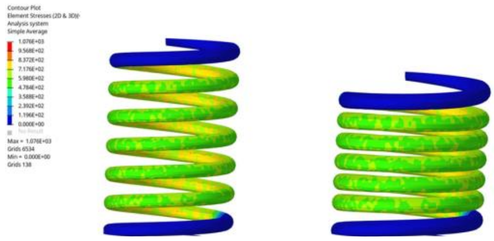
MaximumStress–1076.0M

As such we should first keep in mind the updated material characteristics resulting in a maximum displacement of 1757 mm and a stress of 1076 MPa.

MaximumDisplacement–17.57mm



MaximumStress–1076Mpa



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