Hydraulic Spring Stiffness Testing Machine

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Abstract- *In many engineering machines and mechanisms spring is an essential component used for proper functioning of that machine for maximum efficiency, there are many applications of springs in automobile suspension system, IC engine valves, two wheeler horns, brakes, clutches, measurements of weights, for storing energy such as in spring type accumulator, in shock absorber, in hydraulic components such as hydraulic cylinders, pressure relief valves, flow control valves etc. But according to our market survey and observations sometimes spring used in above applications having a many defects such as manufacturing defects, processing defects like defects occurs at the time of hardening sometimes this causes the more hardened spring which has more stiffness value and sometimes causes a less stiffness value of spring, hence this creates a problems on the applications of the springs for proper uses and creates a problems in working of that machine components.(1)By considering this problem we can easily measure spring stiffness by using this machine in low cost compare to digital machine.*

Keywords- Hydraulic cylinder, Pascal's law, Hydraulic jack, Load and Deflection, Compression.

I. INTRODUCTION

At the same time, quality and accuracy factor is considered, a spring is defined as an elastic machine element,which deflect under the action off the load and returns to its original shape when the load is removed. Stiffness and spring index are the main parameters are considered for defining the spring testing machine, these parameters is considered. Hydraulic principle considered while designing and developing the stiffness machine. The most common method for checking the performance of shock absorbers is for the owner or mechanic to jump up and down on the car bumper and observe whether the car motion appears to be adequately damped. all over the world and they are primary machine elements of suspension system of vehicles, measurements system such as in weighing machine, IC engine valves, different hydraulic valves etc. But spring used in above applications have different configuration such as different diameters of coil, solid length, free length, stiffness values etc. So it must be necessary that to manufacture a testing rig. This can have wide range of testing of spring. An engineer is always focused towards challenges of bringing ideas and concepts to life. Therefore, sophisticated machines and modern techniques must be constantly developed and implemented for economical manufacturing of products.

II. PROBLEM STATEMENT

In today's growing market there are many complain which uses the springs and spring are the maincomponents in their products/machines components in which they installed the springs but one major problem arises reference to the checking the stiffness of the spring because spring uses for installation have different diameters, Different height and different shapes and also for checking the stiffness of spring more time is required and initial investment hence ultimately the cost of testing more. And also testing machine has high maintenance and operational Cost and also time is very important factor which affects the productivity of industries and it is very important factor which affects the productivity of industries and it is important to achieve precision and accuracy hence we manufactured this machine to optimize everything with new methods.For checking stiffness of spring, we require such machine with lowcost.Digital spring stiffness testing machine have high cost as compared to hydraulic spring stiffness testing machine.

Methodology

- Frame Material is collected.
- Hydraulic cylinder is assembling.
- Making the frame in specific size.
- Mounting the hydraulic jack bottom surface base.
- Produced Drilling hole upper side in the frame.
- Mounting the hydraulic cylinder, the upper side on the frame the supporting bolt in cylinder.
- Steel rule is mounted to left side on the frame.
- Pointer is located to hydraulic jack plate to attached.

Objectives

- To design the hydraulically operated spring stiffness testing machine to find out the stiffness of different helical springs. Test rig are to check the stiffness of spring with higher accuracy and precision.

- To fabricate the designed machine as per specifications.
- To check the performance of hydraulically operated spring stiffness machine.
- To reduce the time required for testing and increase the profit of small-scale industries and also to reduce inventory and investment cost.
- Low initial cost of machine and easily operated.

III. WORKING OF HYDRAULIC SPRING STIFFNESS TESTING MACHINE

Hydraulic spring stiffness testing machine

- First of all close the pressure relief valve.
- Then Put the spring in between hydraulic jack and hydraulic cylinder.
- By using handle operates the hydraulic jack and press spring under testing. By manual pumping hydraulic piston move forward and compress spring.
- Compression the spring, till the spring gap is zero.
- This pressure is displayed on pressure gauge in psi then we need to convert that into kg/cm square.
- Take pressure gauge reading and measure spring change in length.
- By measuring spring deflection and pressure we calculate stiffness.
- Formula for calculating spring stiffness.

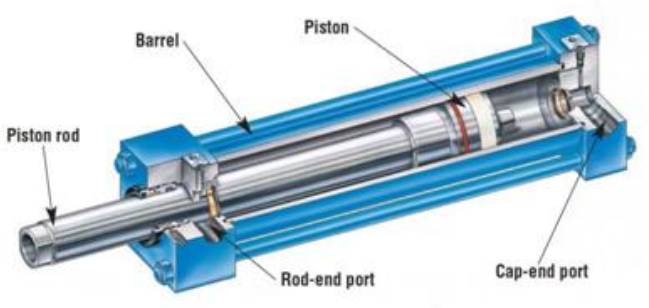
k = force / deflection N/mm.

3.1 The main component of this machine

1. Hydraulic cylinder

A double-acting hydraulic cylinder has a port at each end, supplied with hydraulic fluid for both the retraction and extension of the piston. A double-acting cylinder is used where an external force is not available to retract the piston or it can be used where high force is required in both directions of travel.

Single Acting cylinder only extends by pressure from a pump and then retracts by the weight of the load or by an inbuilt spring. A Double Acting cylinder uses hydraulic power to both extend and retract. A simple way to tell the cylinders apart is by looking at the number of ports.



Hydraulic cylinder

- **Specification**

- Bore diameter 40 mm
- Stroke Length 100 mm
- Pressure 1000 psi or 70 kg

2. Hydraulic jack

Hydraulic jack

A jack is a device that uses force to lift heavy loads. The primary mechanism with which force is applied varies, depending on the specific type of jack, but is typically a screw thread or a hydraulic cylinder. Jacks can be categorized based on the type of force they employ mechanical or hydraulic.

- **Specification**

  - Capacity: Classic 2 TON Compact (5mm)
  - Closed height: 87mm
  - Jack length: 167mm
  - Hydraulic lift: 88mm

3. Spring Used

Compression spring

Compression spring are open coil helical spring wound or construction to compression long the axis of wind. When you put a load and a compression coil spring making is shorter, it pushes back against the load and tries to get back to its original length Compression Spring Uses. Compression springs are devices made up of helically formed coils with pitch in between used to push back on an applied force or load to return to its original position when the force or load is released. They are the Most used type of spring as well as the most economical.

IV. RESULTS

Procedure for Calculation of Stiffness by Using Hydraulic Spring Stiffness Testing Machine.

1. Spring length = 84 mm
2. Wire diameter = 4.5 mm
3. Pressure = 0.2 kg/cm²
   = 0.2 X 0.0981= 0.01962 N/mm²
4. Deflection = 50mm
5. Force = Pressure X Area
   = 0.01962 X 1256
   = 24.6427 N

6. Stiffness (K) = Force/Deflection
   = 24.6427/10
   = 2.464 N/mm.

Following values are calculated by above procedure.

Table.1 Result of Spring Stiffness

Sr. No	Deflection mm	Pressure kg/cm²	Area mm²	Stiffness N/mm	Avg. stiffness N/mm
1	65	3.5	1256	10.47	13.4
2	50	3	1256	25.13	
3	19	2.5	1256	11.02	
4	18	1	1256	6.98	

V. DISCUSSION

From the result obtained it can be deduced sample table 1 is within tolerance limit 2.5 cm deflection when subjected to various loading at 2,4,6,8…kg/cm2. The spring stiffness within the limit this suggests that the spring will give the optimal performance if used together with other spring of the same stiffness and properties. Is with in tolerance limit when subjected to only 4.

VI. CONCLUSION

Hydraulic principal is considered while designing and developing the stiffness machine. This machine can make testing spring stiffness easier by automobile industries and other industries. For a spring the most important characteristic is stiffness under load. The result obtained from this machine is verified with standard value.

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