Design of Low Cost Digital Spring Pressure Testing Machine

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Abstract— Mechanical Engineering is useful and inseparable from industry and industry. The production and manufacturing process entails converting raw materials into final items that meet required parameters while utilizing cutting-edge technologies. The stiffness, modulus of rigidity, and bulk modules are determined using a spring load testing machine in our project. A variety of inspection machines are utilized in the spring working business. Because the sector is broad and growing, several types of machinery are employed for various processes. The spring rolling machine in our concept is relatively simple to operate thanks to the use of a microcontroller and a digital display. This machine is used to perform several types of spring load tests on springs of varying diameters and lengths. This equipment has a wide range of applications. The building and operation of this machine are straightforward.

Industries buy springs for their hydraulic valves, but they have a hard time evaluating the rigidity of the springs. We conceived and developed a digital spring stiffness testing machine after learning about the industry's challenges with spring testing. We can determine spring stiffness using only two parameters: load and deflection. The machine is designed to meet the needs of a company that manufactures various valves. As a result, a digital spring testing equipment has been designed to meet the needs of the organisation.

***Keywords*— Machine design, spring pressure testing machine, low cost design, spring stiffness, digital caliper**

I. *INTRODUCTION*

A spring testing kit is a machine that allows you to stretch or compress springs while monitoring load and displacement. A spring for tensile tests and another spring for compression tests are included in the kit. A spring is a pliable object that can be used to store mechanical energy.[2] Spring steel is the most common material used to make springs. Small springs can be wound from pre-hardened material, whereas bigger springs are fabricated from annealed steel and then hardened. Phosphor bronze and titanium are utilised for parts that require corrosion resistance, and beryllium copper is utilised for springs that transmit electrical current (because of its low electrical resistance) . The force exerted by a spring when compressed or extended is proportional to its length change. A spring's rate, or spring constant, is equal to the change in force it exerts divided by the change in deflection. That is, it is the force against deflection curve's gradient.[3] The units of force in an extension or compression spring are split by distance, units of force multiplied by distance divided by angle in torsion springs. Compliance is the inverse of spring rate, therefore if a spring has a rate of 10, it has a plaice of 0.1. The stiffness (or rate) of springs in series is additive to the stiffness (or rate) of springs in parallel. Any material can be used to make a spring, depending on the design and operating environment, as long as the material has the requisite combination of stiffness and elasticity: theoretically, a wooden bow is a type of spring.[4]

For the determination of the spring constant, several research projects and experiments were carried out. For atomic force microscopy, a method for calculating the spring constant of cantilevers was developed.

II. *LITERATURE SURVEY*

- ***P. D. BELAPURKAR*** mechanical springs used in any machine hold its own stiffness value. This stiffness/ spring rate changes consistent with different springs and its application. Stiffness of any spring is a crucial factor as far as its application is taken into account . Hence in industries many methods are wont to test and calibrate springs. Many methods are been wont to test springs like hydraulic actuators or by applying external load etc. In search of the foremost advanced machinery to check springs, basic mechanisms are under looked. This leads to inefficient growth of machines. Considering this factor spring testing machine is developed.[1]

- ***CHANDGUDE VIRESH V*** administered the CAD modelling and preparation of test setup of digital spring stiffness testing machine. the foremost components used are Frame (outer & inner), Cantilever Load Cell, lever, LM guide and Magnetic scale. Load cell utilized during this setup features a capacity of 500 kg. i.e. 4905 N of force and it gives quick response to vary in load magnitude, and cargo cell utilized during this setup is cantilever type, and is additionally attached to the electronic circuit and display which is well calibrated and shows the proper reading of the load at any instant. Load cell features a excellent least count for load i.e. 10 gm. Hydraulic jack utilized during this setup is single acting quite cylinder and it's a capacity to exert 2 many force i.e. 2000 kg. A linear guide ways (LM Guide) allows a sort of linear motion that utilizes rolling balls. The linear encoder used is based on the magneto resistive sensing principle. Using the lever, load is applied gradually to compress the spring and thus the readings of load and displacement are noted.[2]

- ***G. S. JAGUSHTE, S. S. JOSHI*** springs isolate the drive from road imperfections by allowing the tyre to maneuver over a bump without drastically disturbing the chassis. If the chassis remains slightly steady then the tyres are better ready to follow road contours automatically. While springs do an impressive job of smoothing over bumps, they are going to remain bouncing once started. In other words, the chassis continues swaying and thus the tyres keep hopping long after the vehicle strikes a bump .Left uncontrolled, springs give an uncomfortable ride with very poor tyre to road contact.[3]

Summary of Literature Review: Different literature have been studied and analyzed in great detail. After analyzing and understanding the various aspects of coil springs, testing and their applications particularly in automotive valves it can be concluded that there is a need for spring testing systems which are adaptive in nature. It is important that a spring testing setup be designed for further analysis and comparison of the results with analytical to validate the design before actual fabrication.

III. *DESIGN*

Various items such as a digital calliper on two columns, a led screw, and a digitally operated spring stiffness machine are designed in this area. We can calculate the diameters, thickness, and applied force of lead screws by assuming various factors.

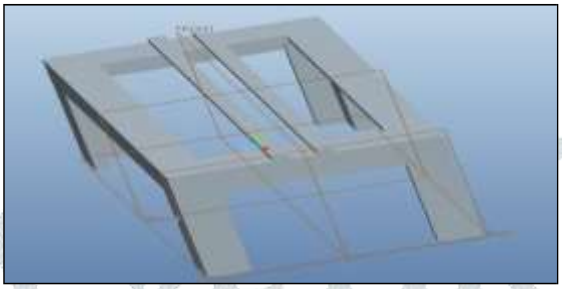


Fig. 3D Drawing of manufacturing of base frame

- **Frame:**. The production process begins with the building of a base, which is supported by a frame on which components are installed. The base dimensions are determined by the component's design and measurements. A frame with dimensions

Fig. CAD model of setup

similar to those depicted in fig. The frame is made up of a central support on which the component is mounted.

- Using boots, attach the lower and upper wings to the end block.
- The assembled assembly is then placed on the stand.
- After that, place all of the parts, including the vernier calliper and load cell, into the base stand housing. The spring stiffness testing machine is now complete.

- **Lead Screw:**

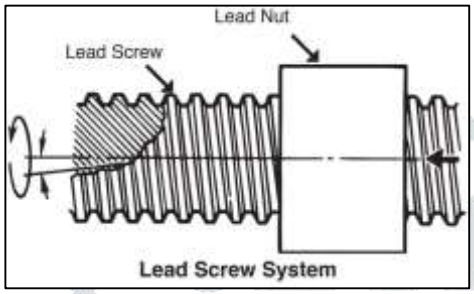
Fig. Lead Screw Autocad Model

Lead screws are threaded rods with a nut on the end. There are numerous different thread types, but the acme lead screw is the most used in industry because of the acme lead screw. The thread is easily interchangeable with parts from a variety of manufacturers because it is an industry defined thread style. The main purpose of a screw is to transform rotary input motion into linear output motion by moving the nuts back and forth along the shaft's length. Because the friction on the nut is a function of the environment, lubrication, load, and duty cycle, it is impossible to define the practical life cycle.

Lead screw/nut drive systems come in a wide range of sizes and tolerances. Because the contact is mostly sliding, the efficiency is low and the wear rate is related to the number of uses.

Advantages: In back drive mode, include the self-locking capabilities. The diameter should be at least three times that of the lead, which is beneficial for vertical applications, low initial costs, near-silent operations, manufacturing convenience, and a diverse range of materials.

Disadvantages : Lower efficiencies (usually 30 percent to 50 percent, depending on the nut preload) necessitate larger motor drives, and acme screws have an unpredictable service life.



IV. *CONCLUSION*

- Low-cost machine manufacturing
- At the same time, the machine measures weight and length.
- The data will be shown in a digital format on an LCD panel.
- Many different forms of spring force can be simply tested.

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