THE SPRING RESEARCH AND MANUFACTURERS' ASSOCIATION

CLOCK SPRING FATIGUE TESTING MACHINE

Report No 368

by

C J Rushton, B.Sc.

JANUARY 1984

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SUMMARY

This report describes the design and development of a machine built to fatigue test clock type springs. The reason for building the machine was so that in the future data on the fatigue life of clock type springs can be generated.

The machine is capable of cycling springs over ± 278 turns with a maximum torque of up to 100 Nm at a test speed of up to 140 rpm. Springs of up to 600 mm caged diameter can be tested.

Automatic failure detection has been inbuilt so that the machine shuts down on spring failure. Because this system works by sensing when the torque falls off, the machine can also be used as a torque testing machine.

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1. INTRODUCTION

A present, fatigue data for clock-type springs is almost non-existent, and it is not possible for designers to design a clock spring for a specified life.

For this reason it was decided to design and develop a fatigue testing machine for clock type springs so that at a later date the machine could be used to generate basic data on the fatigue life of this type of spring.

2. GENERAL DESCRIPTION OF MACHINE

The basic machine construction is similar to that of a centre lathe - there is a fixed headstock containing the drive gear and mounted to the base unit, and a moving carriage.

The base unit is a heavy fabrication, designed to be torsionally very rigid. The base also houses the drive controller and transformer. The headstock is mounted on the base and houses the drive shaft, gearbox, and underslung stepping motor. The tailstock houses a fixed shaft, to which is attached a torque transducer. The tailstock is driven along the machine bed by a rack and pinion and can be locked in position.

Both the driven and the fixed shaft carry self centring four jaw chucks to allow location of test jigs and specimen. The control box is mounted on top of the headstock and contains all the electrical circuitry and controls.

The drive is by stepping motor through timing pulleys and a reduction gearbox. The stepping motor is used because this type of motor can give precise angles of rotation. This fact coupled with the use of an exact ratio gearbox allows the drive to index the output shaft, and therefore the test specimen, through exact whole angles of rotation in one degree increments.

3. CONTROL GEAR

Facility is available to preset the angle of rotation, in degrees, and a display of angle of rotation in constantly operational while testing is under way. An 'inch' button coupled with direction buttons allows manual operation of the drive in either direction of loading. While cycle testing, there is a cycle count display.

The torque display registers in metric units, and there is facility for use of a 10:1 range; there is a tare control for 'zeroing' the torque readout prior to testing.

Failure detection, which allows the machine to run overnight - ie while unattended, is set by means of a load trip. This control is set while cycle testing - the control being turned so that its light comes on just before the spring reaches its

peak torque. Having done this the timer is set to a value slightly greater than the cycle time. When the spring breaks, the torque readout will decrease such that the load trip light will not come on during the time interval preset on the timer. When this happens, the machine will automatically 'trip out', ie, switch off and hold its cycle count.

4. FURTHER MACHINE DEVELOPMENT

The machine as originally built was capable of testing at a maximum speed of about 65 rpm. It was immediately realised that to fatigue test clock type springs would take an extremely long period of time.

The limiting factor on maximum test speed is the interia of the drive and so smaller timing pulleys were fitted, and a thinner oil is now used in the gearbox. With these modifications, the maximum possible test speed has been increased to 150 rpm.

This has therefore considerably reduced the time required to perform a given fatigue test.

5. GENERAL SPECIFICATION

Capacity

100Nm

Maximum Spring Dimensions

Caged Diameter - 600 mm

Caged Width - 375 mm

Maximum Test Speed

Variable up to 150 rpm

Maximum Presetable Angular Deflection

Up to 278 turns in one degree increments

Other Features

There is a 10:1 torque range available, ie 0-10 Nm. Automatic failure detection is inbuilt so that the machine can be run unattended 24 hours a day, 7 days a week, thereby minimising total test time.

6. CONCLUSIONS

The machine has been built and developed so that it fulfills and exceeds its design requirements - the machine can be used for torque testing as well as for fatigue testing.

After some initial problems, the machine has by continual testing proved itself capable of carrying out long term fatigue tests faultlessly, and switching itself off upon sensing spring failure.

The machine is therefore capable of being used to accummulate fatigue data for clock type springs.

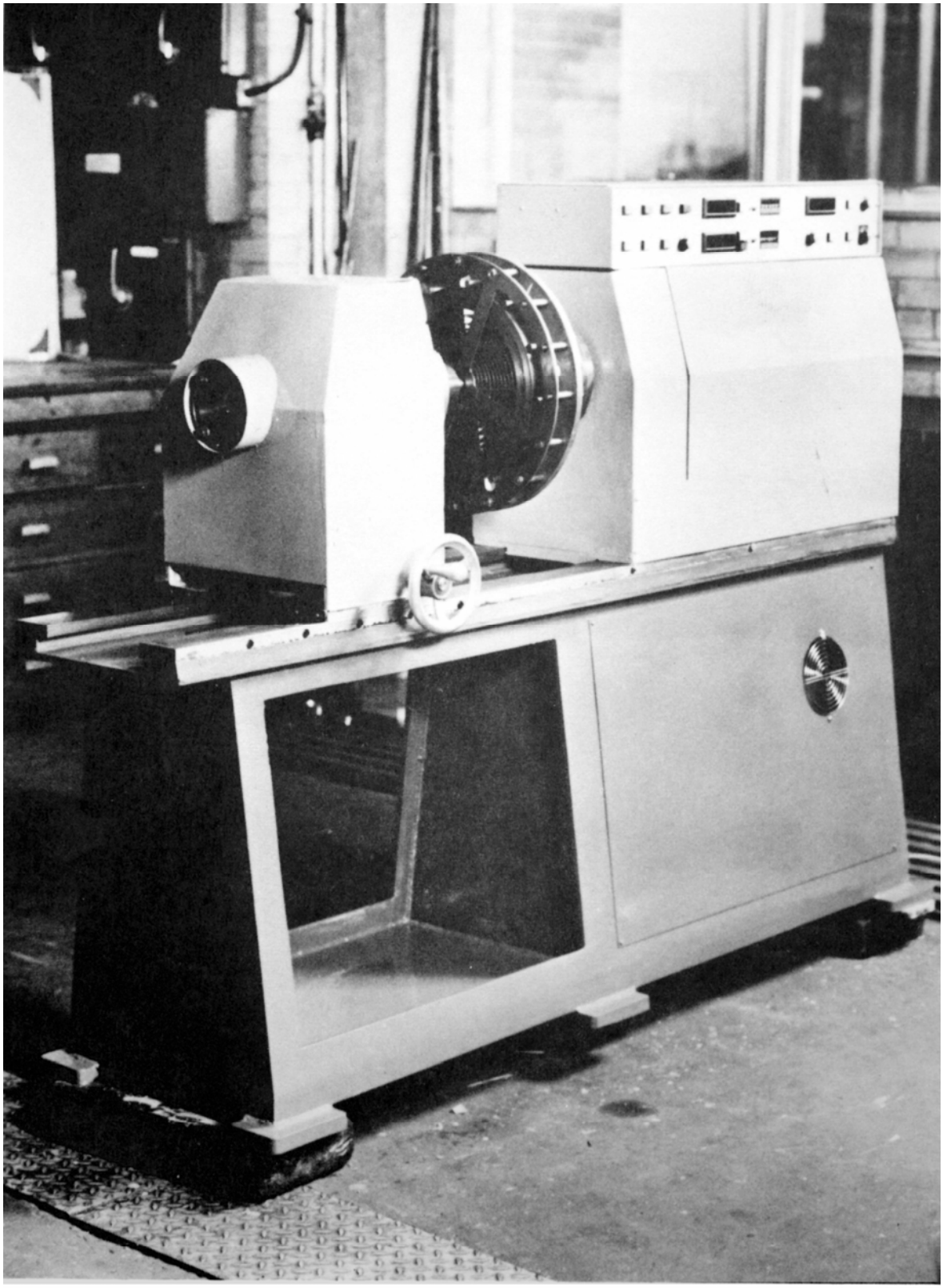

Figure 1: Clock Spring Fatigue Testing Machine