THE SPRING RESEARCH AND MANUFACTURERS' ASSOCIATION

SINGLE STATION FATIGUE MACHINES

Report No. 347

by

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1. INTRODUCTION

Fatigue testing is becoming increasingly requested by users of equipment where a spring plays a vital role in the operation of a component part. The majority of the fatigue testing equipment used tends to be simply modified presses or lash-ups consisting of bits and pieces that happened to be at hand. Neither of which are usually accurate enough to give a high confidence value to the results obtained. Thus it was felt that there was a need for a specially developed spring fatigue testing machine which would give the required adaptability needed for the vast range, shape and sizes of springs produced and still be highly accurate.

The machine as described in this report is capable of testing spring elements up to 1000 N at a maximum stroke of 30 mm.

2. GENERAL REQUIREMENTS FOR SPRING FATIGUE TESTING MACHINES

As in any piece of equipment a user requires certain facilities so that the machine will be of optimum use. Some of these requirements are listed below.

1. Ease of setting up the machine with an infinitely variable and as large as possible stroke.
2. A high load capacity.
3. A high speed of testing that can be variable if required.
4. Method of detecting spring failure with automatic shut down.
5. Means of counting number of cycles to failure.
6. Ability to test both compression and extension springs and to be able to have a variety of jigs attached for specialised work.

3. GENERAL DESCRIPTION OF THE MACHINE

The machine consists of an infinitely adjustable overslung crank shaft supported on rolling element bearings. The push rod is connected to the crank shaft by means of an aluminimum con-rod which is also supported on rolling element bearings. All the bearings are oil fed from a remote electric oil pump and reservoir. The variable throw crank gives a testing stroke range of 0 - 30 mm with a maxmimum design load of 1000 N. The preload is applied by means of an adjustable crosshead. The crosshead also being fitted with thrust bearings to allow for the rotation of the end coils relative to each other if needed.

Each machine is free standing on its own stand, however, if so desired, several machines can be used on a single larger stand and utilise a single oil pump.

4. MOTOR REQUIREMENTS

The major motor requirement of the machine is that it requires a high starting torque which can generally be obtained from motors of 1 H.P. capacity. However, when running, the flywheel action of the machine means that only some 1/2 H.P. is used. As the machine was designed to run up to a maximum of 3000 rpm, a choice of motors can be used depending on particular requirements. The standard machines are equipped with 3 phase motors giving a single speed of 1425 or 2850 rpm. However, a D.C. motor and controller can be used to give an infinitely variable speed range of 500 - 3000 rpm. A revcounter is fitted to this unit to measure the set speed.

5. THE CONTROL BOX AND SPRING FAILURE SENSING DEVICE

The control box houses the motor contactors and switching equipment with, in the case of the D.C. motor units the solid state speed controllers. The control box is also fitted with an electronic counter and its associated power supplies to record the cycles to failure. An option is to use a predetermining counter which allows the required number of test cycles to be set so that the machine will switch off after completing the preset number of test strokes if spring failure does not occur first. Spring failure is detected by passing a small electric current through the spring to complete a circuit. On failure

of the spring the circuit is broken and the machine stopped. The machine cannot be restarted until the trip is manually reset.

6. TESTING SPRINGS AT ELEVATED TEMPERATURES

Testing springs at elevated temperatures is a very common requirement for automotive and similar springs where dynamic relaxation due to high operating temperatures can be significant. To facilitate this a hot box was developed to allow testing at a maximum temperature of 200^{o}C with minimal machine modification. The hot box is constructed of stainless steel and is heated by two 200 watt cartridge heaters. These are controlled by thermocouple feedback to the temperature controller to give an accuracy about the set temperature of $\pm$ 3^{o}C.

7. GENERAL SPECIFICATIONS

Maximum Stroke: 30 mm
Maximum Spring Load: 1000 N
Maximum Speed: 3000 rpm (50 H_z)

Maximum Spring Dimension: 75 mm dia. x 225 mm long.
Motors: 1425 rpm, 2850 rpm, 3 ph 415 v motor; 500-3000 rpm D.C. motor.
Cycle Counting: Electronic counter counting in 10s with predetermining option.
Oil Requirements: SAE 20 - 50 motor oil supplied at a nominal pressure of 15 - 20 psi.
Power Requirements: 3 phase motors: 415 v 0.75 Kw 3 ph
: 240 v 0.1 Kw 1 ph
D.C. motors : 240 v 3.2 Kw 1 ph
Overall Dimension: 0.3 m wide x 0.75 m long x 1.0 m high
Weight: 70 Kg

8. CONCLUSIONS

1. The machine after many hundreds of hours running has proved to be extremely reliable and accurate.

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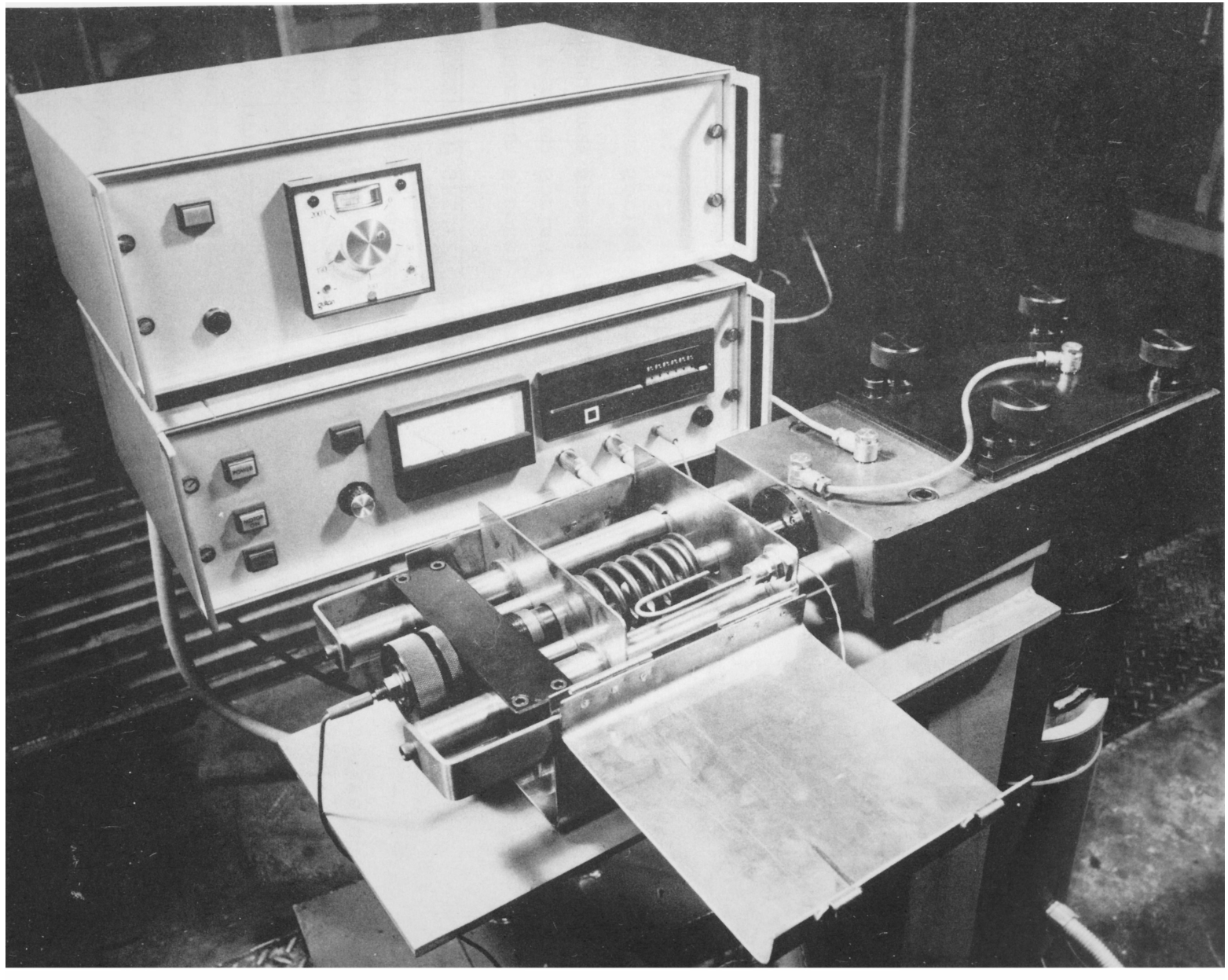

FIG 1. SINGLE STATION MACHINE FITTED WITH VARIABLE SPEED MOTOR AND HAT BOX.