THE SPRING RESEARCH ASSOCIATION

A Low Cost Pneumatic Machine for the Prestressing of Light Helical Compression Springs

Report No. 175

by

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and
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SUMMARY

This paper describes a low cost automation device for prestressing 'as coiled' springs of various sizes between 7/32 in and 13/16 in inside diameter.

Readily available pneumatic parts were used and the machine was of simple construction. Productivity can be increased at least fourfold when using this machine compared with a hand operated system, so that the cost of manufacture is quickly recovered.

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1. INTRODUCTION

The prototype of the machine described in this report was designed and built by The Spring Research Association. It has been further developed by a member firm and is now in production use. It is set to index every 18 seconds, which gives a theoretical rate of 200 machine operations per hour. The number of springs that may be prestressed per hour is governed by the number that can be placed on the support mandrels and therefore by the free length of the springs. The pneumatic cylinder which is used to prestress the springs has a stroke of 9 inches and the support mandrels are long enough to accommodate a column of springs up to a total free length of 8 inches. At present the machine is indexed manually but this could be modified to make the indexing automatic. This has been tried on the existing machine but it has been found that, with the particular locating system being used, hand indexing is more positive.

2. EQUIPMENT AND MATERIALS

2.1 General Description

Basically the machine consists of two units, the 'prestressing unit' and the 'spring carrier unit'. Both these are built up on a base of channel section as illustrated in Figure 1.

2.2 The Prestressing Unit

This is the name given to the 4 in bore, 9 in stroke pneumatic cylinder together with the crosshead which is attached to the piston rod. The spring carrier mandrels pass through flanged bushes set into the crosshead. These bushes may be changed for others of different bore size in order to accommodate mandrels of different diameters. The clearance between the bushes and mandrels is 0.015 in to 0.020 in.

2.3 The Spring Carrier Unit

This is the name given to the capstan-like assembly on the left hand side of the illustration (Fig. 1). It consists of a rectangular block with two mandrels projecting from each of the four faces. These four faces were also bored to accept flanged bushes which in turn carry split collars thus providing an interference fit with the mandrels.

The two units are suspended between side plates $\frac{5}{8}$ in thick which are bolted to the channel base. In addition to acting as a bearing housing for the spring carrier unit the side plates also act as guides for the cross-head, to prevent it from rotating, thus ensuring good alignment.

2.4 Seating Unground Springs

In order to prestress 'as coiled' springs it was necessary to devise a method to seat the bottom spring at the base of each column. This was achieved by using close coiled springs of the same index and wire diameter as the springs being prestressed, one end being left 'as coiled' and the other end ground in the normal manner. This fitment, which fits tightly to the mandrel, provides a seating which matches the 'as coiled' end of the production springs. As the springs are loaded onto the mandrels they are rotated so that each end abuts its neighbour.

In practice it has been found unnecessary to have any special seating at the top end of the spring column but this could be provided in a similar manner to those already described. However, two factors would have to be borne in mind when considering the provision of these, viz; the seatings must fit freely on the mandrel for ease of removal and replacement, and they must be physically attached to the spring carrier unit in some way to prevent them being lost each time a column of springs is ejected into the collecting box.

2.5 Pneumatic Circuit

The pneumatic circuit used on the prototype machine incorporated a cascade counting system to control the number of prestressing cycles, but this type of system uses a large number of valves. Two circuits are given, one using a cascade counting circuit (Fig. 2) and one using a timing cylinder (Fig. 3). It is possible that the circuit given in Fig. 3 may be difficult to set and maintain depending on the spring load being prestressed.

In both circuits pressure regulating valves control the maximum load that can be applied to the two columns of springs and rapid exhaust valves are specified to minimise the recycling time. A variable restrictor and reservoir system provides an adjustment for the dwell time at each end of the piston stroke.

The number of prestressing operations is either controlled by four pilot trip valves or by a timing cylinder and these control the number of prestressing operations. The trip valves count the number of cycles whilst the timing cylinder controls the length of time between operations and hence the number of strokes made by the main cylinder. (A cylinder of $1\frac{1}{2}$ inch bore and 12 inch stroke should be sufficient.)

When using the timing cylinder the total prestressing time for each column of springs is controlled by restricting the exhaust on the forward stroke of the control cylinder thus affecting the time taken for the piston rod of the control cylinder to reach the trip valve and stop the prestressing operation. It also resets the pneumatics ready for the next cycle. Further control of the cycle can be achieved by adjusting the distance through which the piston travels before it meets the trip valve (V3).

3. CONCLUSIONS

The machine described in this paper was designed as a low cost automation device which could be used to prestress a range of helical compression springs at higher production rates than the hand methods already in use. This has been achieved but is it not possible to give a single figure to represent increase in productivity because this will depend on the spring design, the number of prestressing operations required and the dexterity of the operator. However, the member firm, where the machine is now in use, reports that productivity has increased by at least 400%.

4. ACKNOWLEDGEMENT

The Association wishes to thank Messrs Turton Brothers and Matthews Ltd. for co-operating in the development of this machine and for supplying information related to their additional development based on shop floor experience.

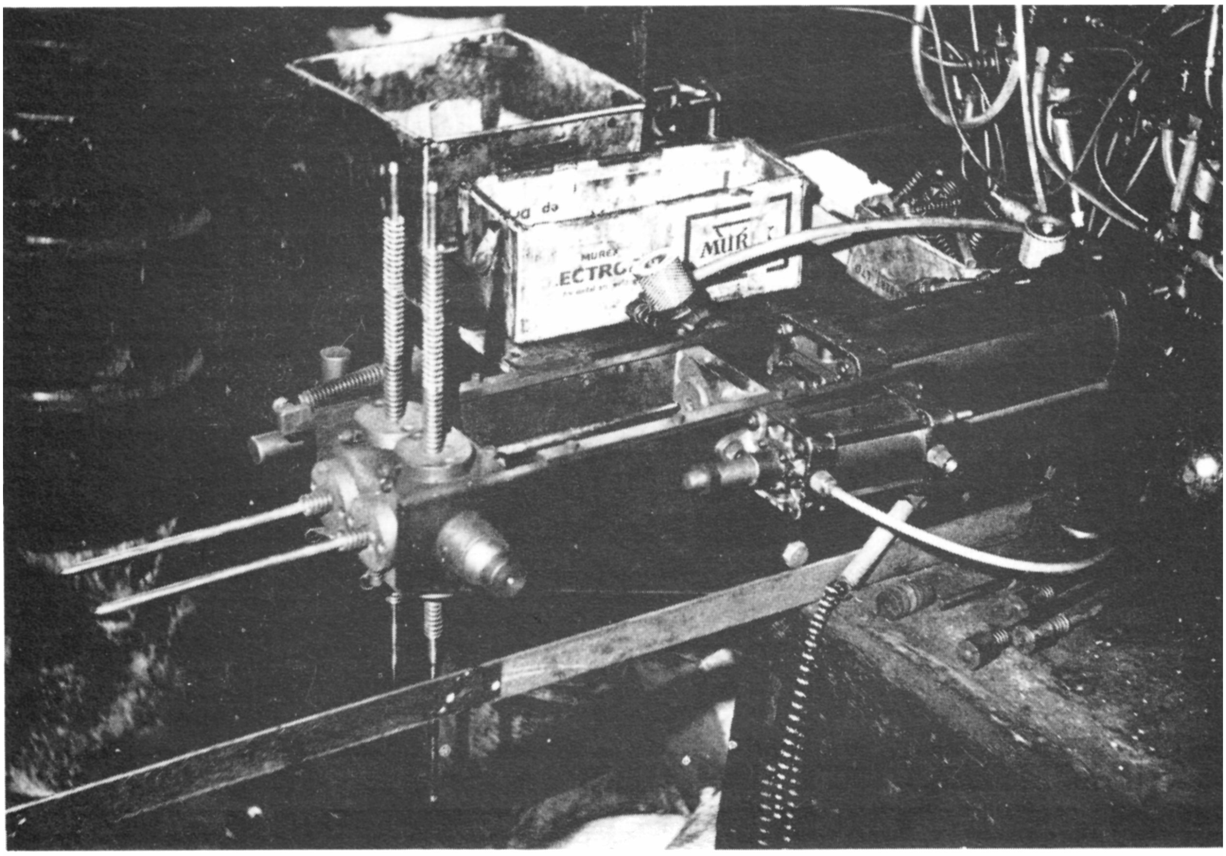
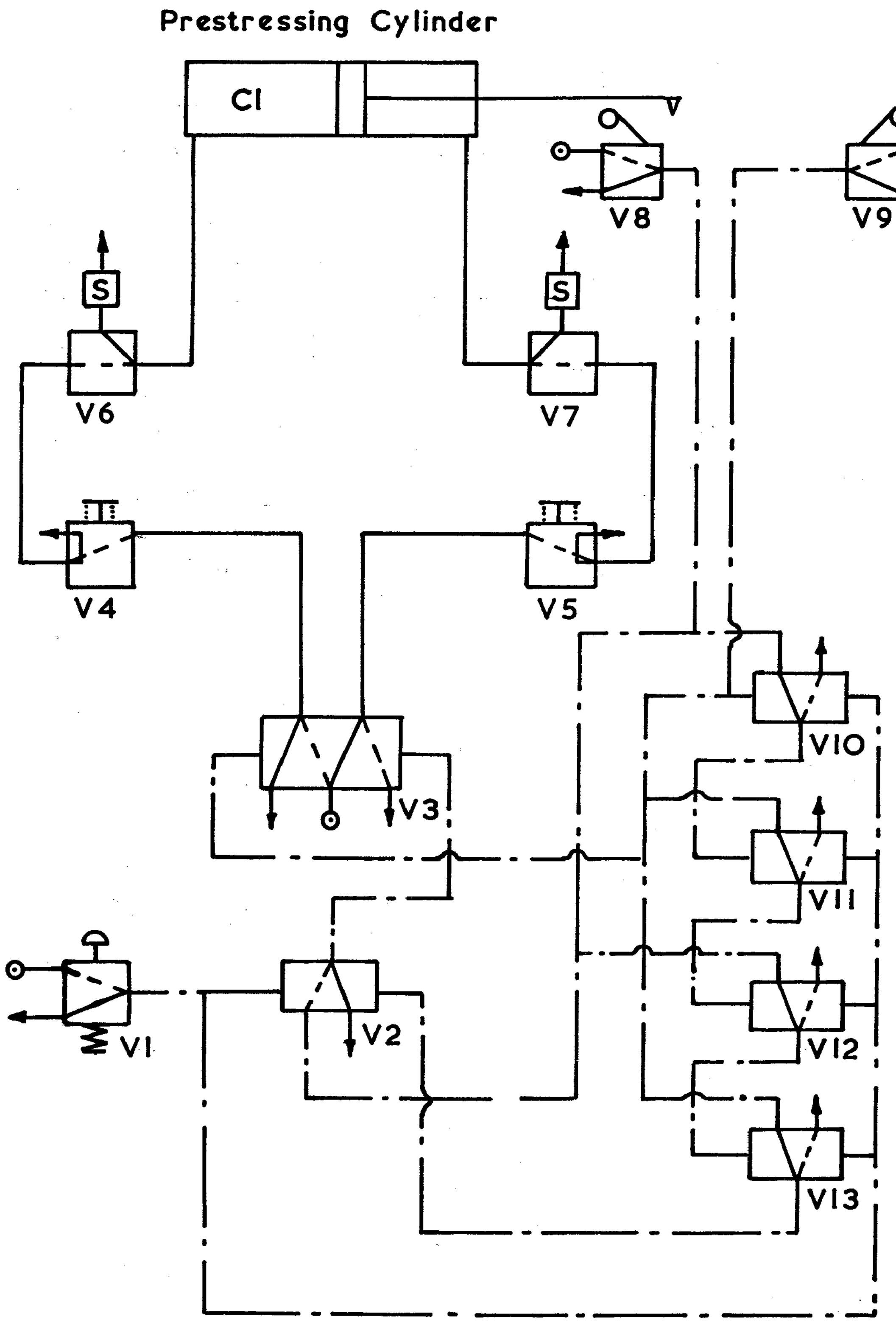
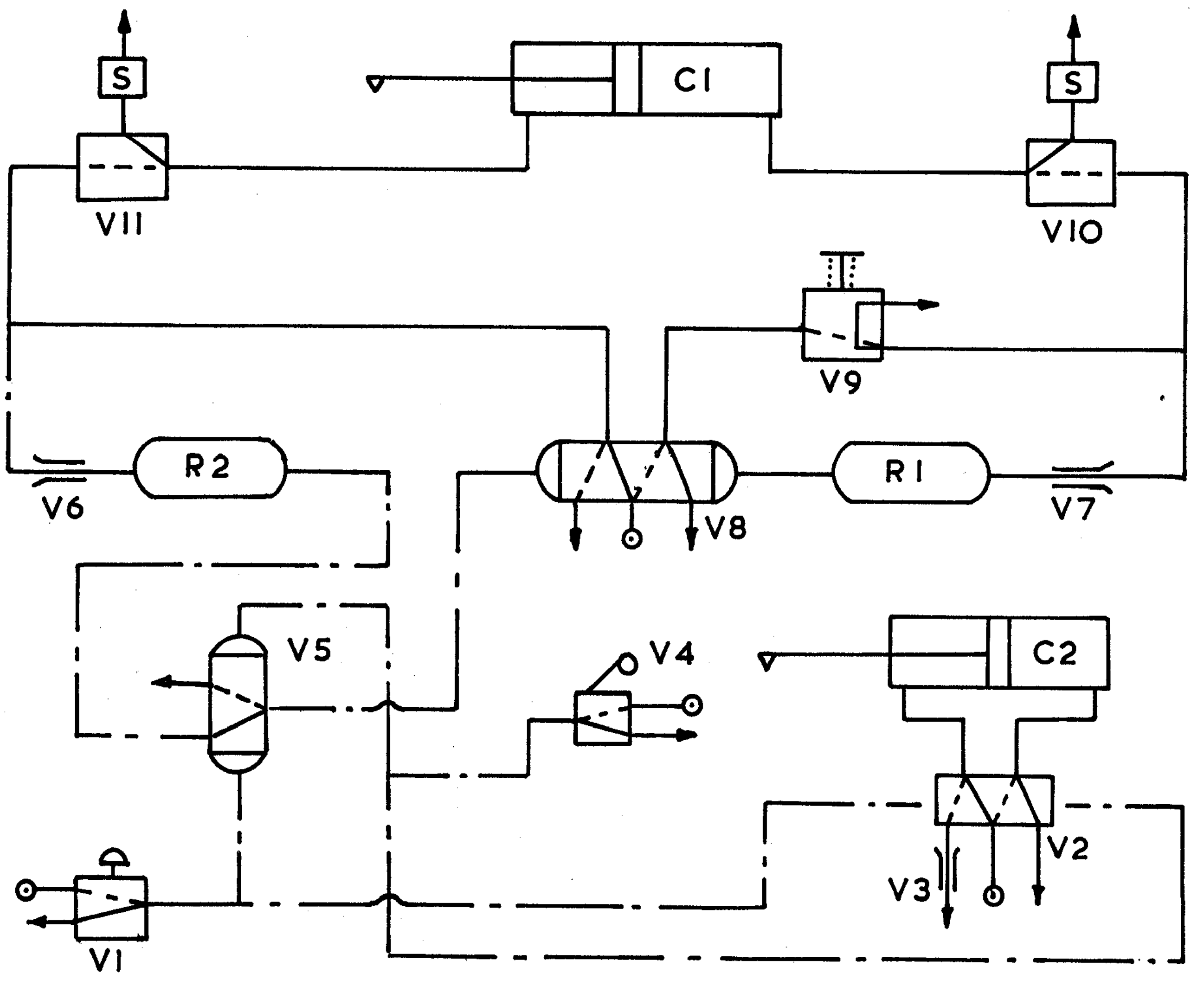


FIG. 1. THE PROTOTYPE MACHINE



MARTONAIR CAT. No.	
V1	S 560/1
V2	S 560/3
V3	S 563/3
V4	R 300/4
V5	R 300/4
V6	S 514
V7	S 514
V8	S 556/11
V9	S 556/11
V10	S 560/3
V11	S 560/3
V12	S 560/3
V13	S 560/3
C1	S 1040/12

FIG.2. PNEUMATIC CIRCUIT USING A CASCADE



MARTONAIR CAT. No.	
V1	S 560/1
V2	S 556/3
V3	S 636
V4	S 556/11
V5	S 560/3
V6	S 636
V7	S 636
V8	S 563/3
V9	R 300/4
V10	S 514
V11	S 514
R1	S 810/4
R2	S 810/4
C1	S1040/12
C2	S9125/12

FIG.3 PNEUMATIC CIRCUIT USING A TIMING CYLINDER