THE SPRING RESEARCH AND MANUFACTURERS' ASSOCIATION

THE APPLICATION OF PRE SET TOOLING TO AUTOMATIC COMPRESSION SPRING COILING MACHINES

by

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SUMMARY

When a repeat order for a specific spring design is received then a coiling machine will have to be set to produce the same spring design as that specified by the original order. Depending on the batch size the setting up time may take a significant portion of the overall running time of the machine.

Consequently S.R.A.M.A. developed a presetting device to reduce the setting time for repeat orders, which has the additional advantage of deskilling the resetting procedure.

The preset device developed by S.R.A.M.A. was for a specific coiling machine and the object of this report is to ascertain the suitability of this device for other coiling machines. The conclusion of this work is that the pre set tooling principal can be applied to the vast majority of two point coiling machines along the lines of the S.R.A.M.A. device. The pre set tooling concept can be applied to a single point coiling machine but the benefits would not be as great as those achieved with a two point system.

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1. INTRODUCTION

The setting up of an automatic spring coiling machine to reproduce a specific spring may be very time consuming, depending upon the type of coiling machine and the spring design. For small batches of spring the setting time may be large in comparison with the production time (and hence the setting up cost may be a large proportion of the total production cost). The set up time is thus a critical factor in terms of overall machine usage and production costs. Frequently, a coiling machine is set to produce a batch of springs and is then altered to produce various other spring designs. However, at a later date, when a repeat order is received the coiling machine needs resetting for the earlier spring design. Consequently, in the long term the coiling machine may be set up many times for one particular spring design. In order to reduce this time for resetting a coiling machine, we have designed a pre set tooling device for the Wafios UFM8 autocoiling machine. The device accurately records the position of each coiling pin after the machine has been correctly set up to facilitate resetting at a later date.

Testing of the device was performed at our laboratories and by a member company in an industrial application. The tests not only included resetting of the device but also the effect of different bundles of wire upon the spring produced when no adjustments are

made to the coiling pin arrangement. The conclusion of the tests was that resetting of the coiling machines caused no greater change in the required spring design than is encountered when replacing a bundle of wire. Also after resetting the adjustments necessary to regain the required spring design were very small and related mainly to the pitch tool mechanism.

This report is a study of autocoiling machines for the production of helical compression springs and the application of the pre set tooling theory to those machines.

2. COILING MACHINES

There are many manufactures and models of autocoiling machines, were each machine has many adjustable parts. Unlike the majority of engineering machines the adjustable parts of autocoilers are not all calibrated. However, some machine manufacturers have done more than others to aid setting up by attaching scales and numbering interchangble items, so that each item and its position can be recorded. Unfortunately, the degree of calibration is restricted and to our knowledge, apart from ourselves no one has attempted to calibrate the movements of coiling pins, which can be the most critical and versatile parts of a coiling machine. Even with the advent of computer aided autocoiling machines there is still no calibration of coiling pins.

In order to achieve a system whereby a coiling machine can be set to produce a particular spring design and then later be reset to reproduce that spring design quickly and accurately, without for knowledge of a repeat order all adjustable parts of a coiling machine need to be calibrated. This was the system developed by S.R.A.M.A. for the Wafios UFM8.

To determine the suitability of the pre set tooling theory to other models of autocoiling machine, the various methods of autocoiling compression springs must be considered.

There are two basic systems for the coiling of compression springs these being the single-point and two-point systems. The relative advantages and disadvantages of these two systems have been debated for many years but from the stand point of pre set tooling the two point system has approximately double the movements of the single point system. Thus a pre set device for a two point system would be a more complicated problem but would show far greater benefit in time saving.

2.1 Two Point Coiling System (Fig.1)

This system has been widespread in Europe for many years and consists of two coiling pins which form the wire, and a centre anvil to support the wire during the spring cut off sequence. One of these coiling pins can move in three dimensions and rotate whilst the other pin can only move in two dimensions and rotate. Variations between the two point systems from one manufacture to another are very small. The major differences being the method of clamping the coiling pin and the movement of the coiling pin mounting block. Some coiling machines have separate adjusters for positioning the coiling pin mounting blocks, whilst other machines have a main adjuster connected directly to one mounting block and linked via a lever arm and secondary adjuster to the other mounting block.

The overall effect of such variations between coiling machines in their operation is negligible except where a movement of a coiling pin has been restricted.

The principle of operation for the two point system does not vary with wire size but individual components are either scaled down for small wire sizes or scaled up for large wire sizes. The pre set method developed by the Association (Fig.2) for a two point system was tested on a Wafios UFM8 (wire range 0.1 - 0.8 mm). The major problem with developing a device for this machine was its small size which did not leave much room for any calibration equipment. However the position of each point was recorded in the following manner:-

a) A vernier scale was attached to the adjusting screw at the rear of the mounting block to record the depth (Direction C. Fig. 3) of the coiling pin the block.

b) Tilting of the mounting block (Direction A. Fig. 3) was recorded by dial test indicators.

c) Twisting (Direction D. Fig. 3) the mounting block was recorded by a pointer and protractor. Only one of the coiling pins had this movement.

d) The mounting block for each coiling pin was modified so that the pin could be rotated (Direction B. Fig. 3) by means of a lever at the rear of the mounting block and the rotation recorded by a dial test indicator. Coiling points were modified so that they could be removed and then replaced in the mounting block in the correct rotational position relative to the dial test indicator reading.

e) The movement of the mounting block holders was recorded using barrel micrometers.

All the above recording methods except 'e' can be scaled up for use on larger coiling machines and similarly with small modifications they can be used on autocoilers produced by a different manufacturer. For large autocoilers method 'e' would use the normal screw adjuster and a vernier scale because the barrel micrometer cannot sustain a large load. This alternative method would also be employed on systems where both coiling points are moved by one adjuster in conjunction with a connecting rod between the coiling point mounting blocks.

2.2 Single Point Coiling System (Fig. 4)

The method of operation is to bend the wire using one coiling point, an arbor and the final wire guide whose position is adjustable in only one direction. Consequently, the arbor is a critical component in the formation of a particular spring design. As the arbor cannot be adjusted apart from being ground to a new shape, its position need not be recorded though for a repeat order the arbor should be retained undamaged if there is to be a major saving in the resetting operation.

The coiling pin moves in three dimensions and rotates which is the same as the second pin in a two point system. However, the mounting arrangements for the single point is quite different to that of a twin pin system. But the principle of locating and rotating the coiling pin remains the same. The major difference between the systems is the depth of the coiling pin in the mounting block as there is no adjuster for this on a single point system. Though a screw thread and vernier scale can easily be incorporated into the system to record this movement.

The final wire guide moves in only one dimension and thus its position can easily be calibrated though there is very limited space in which to attach a recording instrument.

3. DISCUSSION

In general the pre set tooling theory can easily be applied to the two point system adopted by the vast majority of coiling machine manufacturers. The pre set tooling device developed by S.R.A.M.A. solved the coiling point calibration problems in a certain manner. Very slight modifications to the device would result in that device being universal. So that, the same solutions could be applied to any twin point coiling system and a pre set device developed for any twin point coiling machine.

Pre set tooling for a single point coiling system would be simple from the aspect of calibrating the coiling point positions. However, the final wire guide is adjustable and would also need calibration. This would not be so easy as the coiling point but is possible to achieve. Finally the mandrel is used in the actual coiling operation and thus must be identical in the original set up. The most accurate way of ensuring an identical set up is to retain the original mandrel unused for intermediate designs. In order to satisfy this requirement without collecting a vast number of mandrels, advance warning of repeat orders would be necessary. Thus subjecting any pre set device developed for a single point system to constraints which are not imposed on a two point system. The alternative solution to retaining mandrels for specific designs is to use stock sizes of mandrels which would still involve a large number of mandrels being kept in stock. The disadvantage of this system is that stock mandrels must not have their shape

altered by the coiling machine setter. Also when the coiling machine is originally set with a new mandrel and is later reset using a partially worn mandrel the time saving achieved using a pre set device would be reduced, because the setter would have to counteract the effect of the worn mandrel. The solution of always resetting the machine with new mandrels would be unviable from a financial point of view.

Althought the pre set device accurately sets the coiling pin positions these are relative to the coiling machine. Consequently, if considerable wear has occurred on the final wire guide during the time span from the original set up to the resetting operation, then any deviation of the re set spring to the original will be increased. So it is advised to use final wire guides manufactured from tungsten carbide to obtain a more accurate spring upon resetting of the coiling machine.

4. CONCLUSIONS

1. The preset principal is applicable to the vast majority of two point coiling systems.
2. Any device built along the lines of the pre set device developed by S.R.A.M.A. would solve the calibration problems for two point coiling systems.
3. The setting of a coiling machine requires highly skilled labour. The use of the pre set tooling device enables a quick and accurate spring to be produced by a lower skilled operator. This benefit applies to both the single and the two point coiling system.

4. Although the pre set theory can be applied to single point coiling machines the benefit of reduced resetting cost would not be so great as is achieved with a two point system due to the additional coiling mandrels that would be necessary.

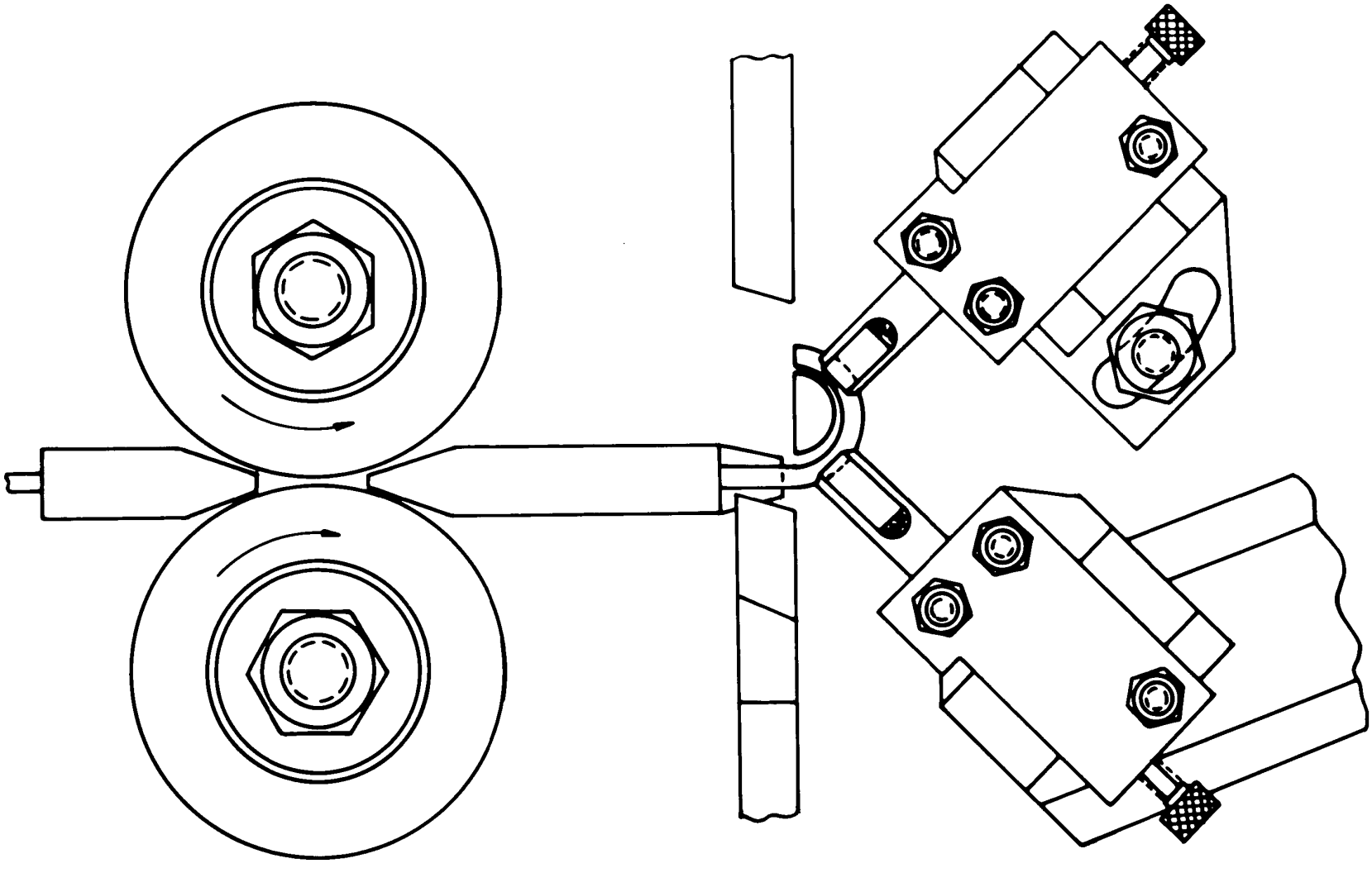
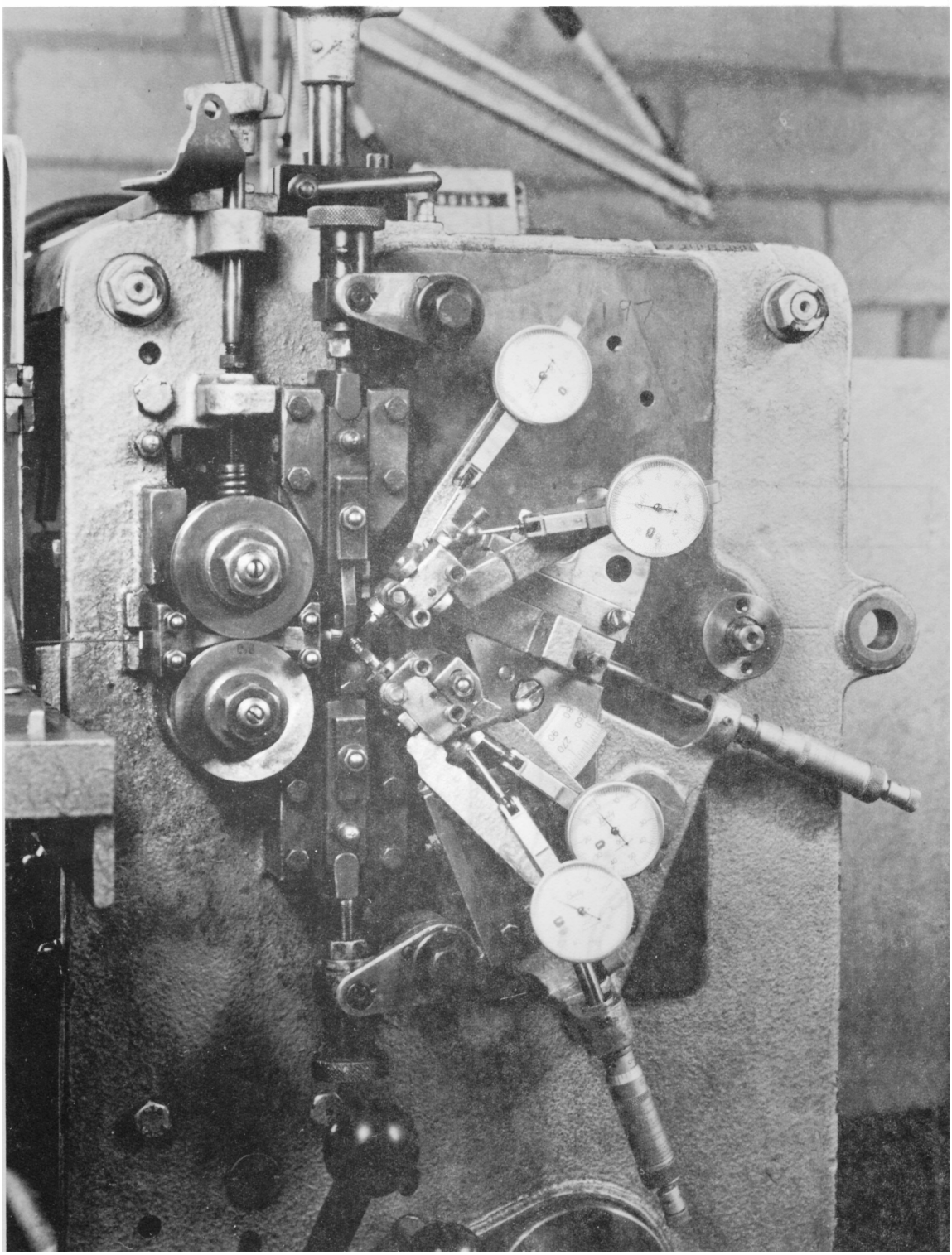


FIG. 1. TWO POINT SYSTEM.

FIG.2. MODIFIED DEVICE



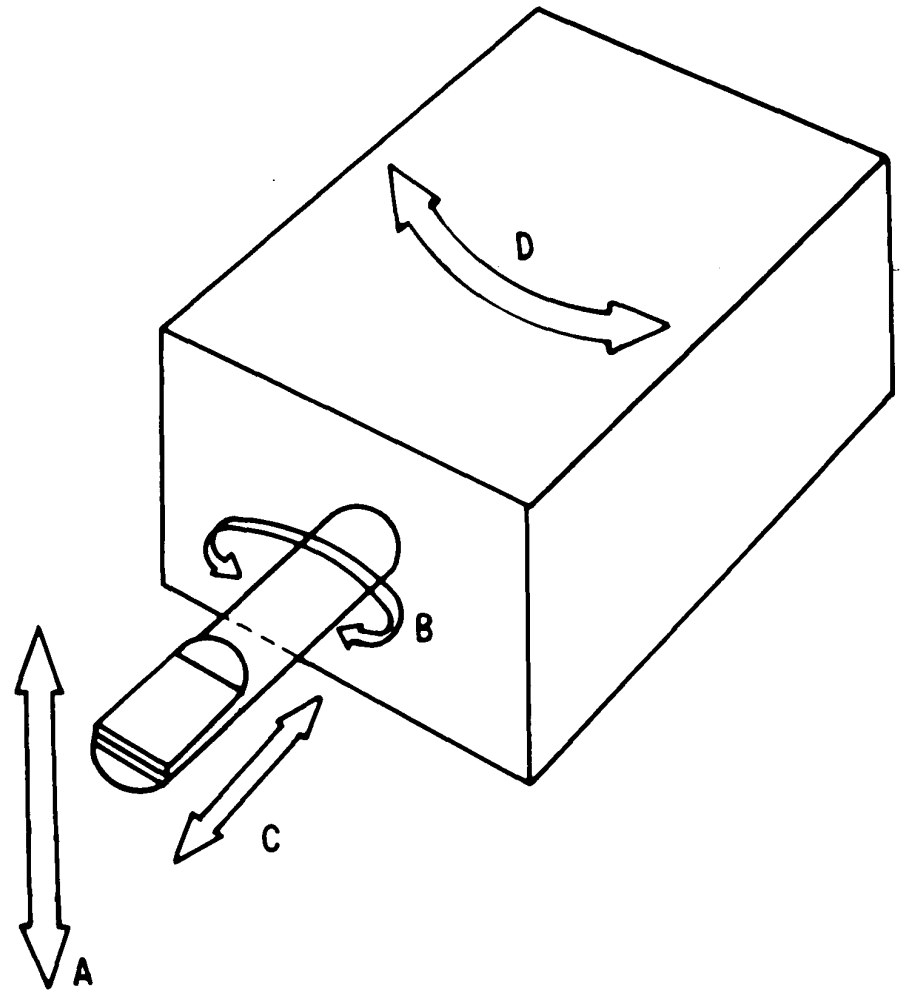


FIG. 3. MOVEMENT OF COILING POINT.

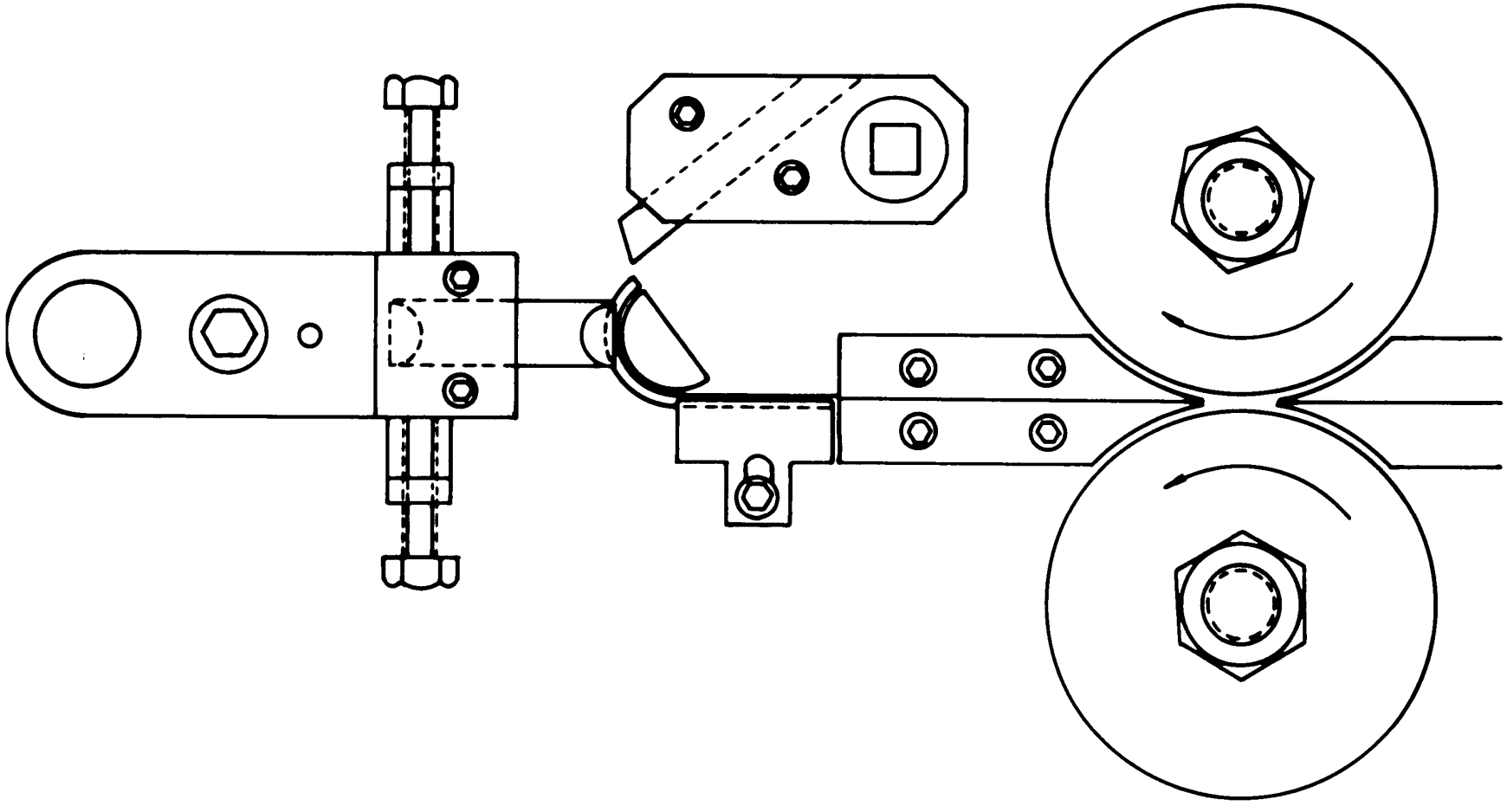


FIG. 4. SINGLE POINT SYSTEM.