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METHOD AND APPARATUS FOR PRODUCING TAPERED LEAF SPRINGS

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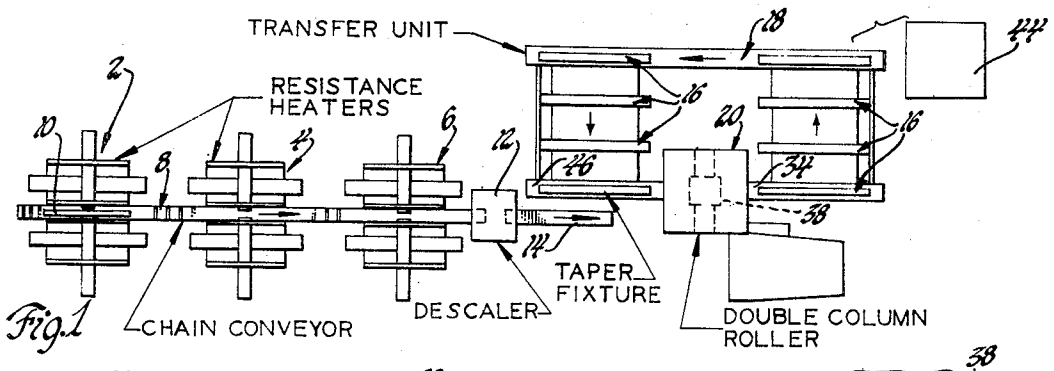


Fig. 1

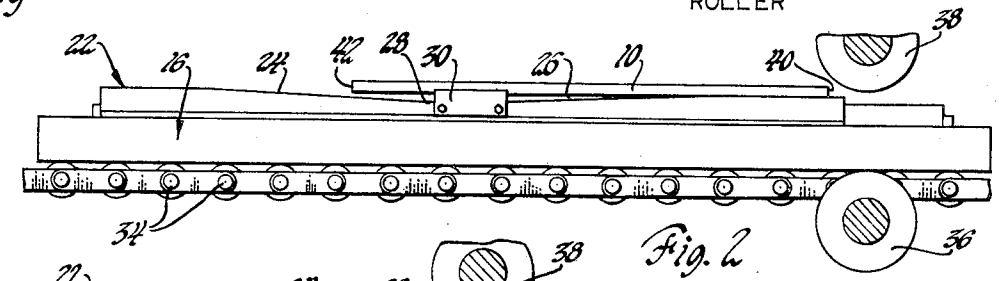


Fig. 2

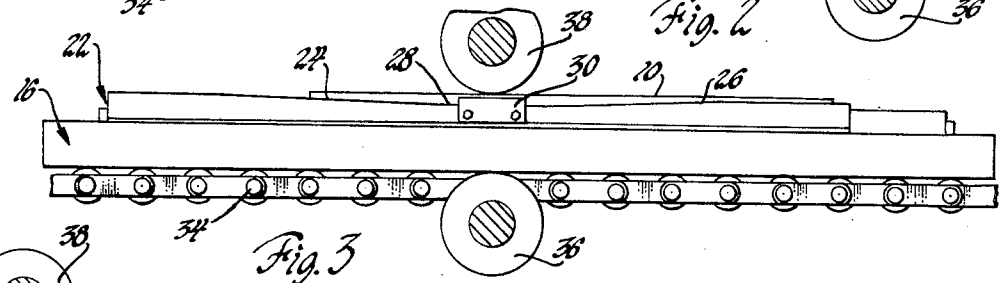


Fig. 3

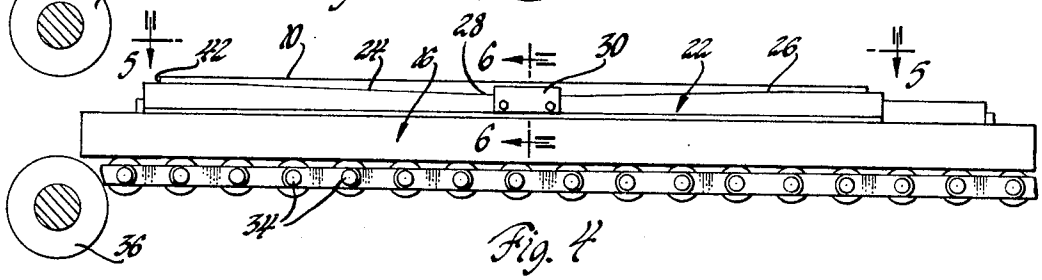


Fig. 4

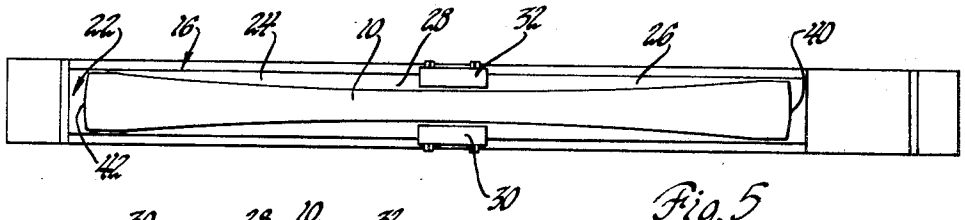


Fig. 5

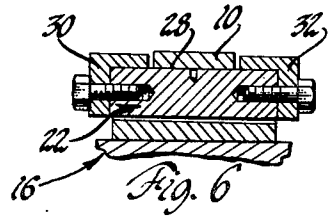


Fig. 6

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METHOD AND APPARATUS FOR PRODUCING TAPERED LEAF SPRINGS

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U.S. Cl. 72—207 7 Claims

ABSTRACT OF THE DISCLOSURE

For repetitive production of leaf springs tapered from the center both laterally and longitudinally, a heated rectangular billet is disposed on a fixture having a flat lower surface and a profiled upper surface. The fixture is passed linearly along a roller track defining a plane tangent to the lower roll of a double column rolling mill. As the fixture and billet proceed between the rolls, the upper roll causes the material of the billet to be displaced both longitudinally and laterally. This longitudinal and lateral flow of metal cooperates with the predetermined profile of the fixture to produce a symmetrical bi-tapered leaf spring.

Tapered leaf springs are well known in the prior art. Presently in general use are two principal types—first, those wherein the spring tapers in thickness from the center toward each end but has a constant width from end to end, and second, the so-called bi-tapered leaf spring wherein center to end tapering occurs in conjunction with gradual increase in width from the center toward each end. The present process and apparatus are concerned with production of the latter type.

In the past, the so-called bi-tapered leaf spring has been manufactured in large quantities by a mill rolling process in which bar stock is fed continuously through a double column rolling mill wherein one of the rolls is monted eccentric to its axis of rotation. The effect of this eccentric roll is to provide a strip of recurrent undulation which when cut off at the proper locations produces the desired symmetrical tapered leaf spring configuration. Although satisfactory in manufacturing of bi-tapered leaf springs of a single size, this process presents certain disadvantages where short runs of a relatively large number of different size leaves are required, since the set-up must be shut down for installation and adjustment of a different eccentric roll whenever a change of size of spring is required. This need for equipment change not only involves considerable down-time, but also limits production to a single size of spring while the equipment is in operation.

An object of the present invention is to provide apparatus and processing techniques permitting repetitive manufacture of either a single size of bi-tapered leaf spring or repetitive manufacture of random sizes of tapered leaf springs without significant discontinuity of operation of the equipment, or down-time.

The foregoing and other objects, advantages and features of the invention will become more readily apparent as reference is had to the accompanying specification and drawing wherein:

FIGURE 1 is a schematic view of a manufacturing installation incorporating apparatus in accordance with the invention;

FIGURE 2 is a side elevation view of a profiled fixture utilized in conjunction with the inventon and showing the initial position of the billet;

FIGURE 3 is a view similar to FIGURE 2 showing

the position of the billet and tapered fixture at an intermediate stage of manufacture;

FIGURE 4 is a view similar to FIGURES 2 and 3 showing the spring in relation to the fixture upon completion of the operation;

FIGURE 5 is a plan view looking in the direction of arrows 5—5 of FIGURE 4; and

FIGURE 6 is a sectional end elevation looking in the direction of arrows 6—6 of FIGURE 4.

Referring now to the drawing and particularly FIGURE 1, there is shown an arrangement of manufacturing apparatus wherein the numerals **2**, **4** and **6** designate pairs of resistance heaters arranged in opposed relation to a chain conveyor **8**. These heaters elevate the temperature of rectangular billet **10** to approximately 2100° F. in approximately one minute. The heating cycle for each heater is staggered in 10 second intervals to that a fully heated billet is deposited on the chain conveyor every 10 seconds. The chain conveyor passes the heated billet through a high pressure water descaler unit **12** to a loading station **14**. From loading station **14**, each billet is placed on an adjacent floating fixture **16**. A plurality of such fixtures are disposed at spaced intervals around a transfer unit **18** disposed in a generally racetrack fashion relative to a double column rolling mill **20**. Thus, as the fixture **16** at the loading station progresses linearly between the rolls of the double column rolling mill, the clockwise preceding fixture moves into the loading position and each of the other fixtures in turn progresses one station forwardly in counterclockwise fashion about the racetrack pattern provided by transfer unit **18**. Each sequence or cycle of the fixtures is timed to correspond to the 10 second interval at which heated billets pass through the descaler **12**.

In order to utilize the manufacturing apparatus illustrated in FIGURE 1 to produce bi-tapered leaf springs in accordance with the invention, each fixture **16** has secured on the upper surface thereof a profiled insert **22**. As shown in FIGURE 2, the upper surface of insert **22** is formed with oppositely vertically inclined faces **24** and **26** which proceed longitudinally outwardly from the center **28** thereof. Inclined faces **24** and **26** of insert **22** are planar in transverse section and thus totally laterally unconfining with respect to the billet **10**. At the loading station, the billet **10** is disposed on the upper surface of insert **22** in the position shown in FIGURE 2 with a major portion of the entire length (approximately ⅔) of the billet disposed on the right-hand or leading end of the insert. A pair of lateral guides **30** and **32** shown best in FIGURE 6 are secured on the sides of insert **22** at the midportion thereof for the purpose of obtaining linear alignment of the billet with the working face of the insert. After placement of the billet **10** in the position shown in FIGURE 2, fixture **16** is traversed linearly along the roller track **34** of transfer unit **18** which forms a guiding plane tangent to the upper extremity of the lower roll **36** of the double column mill **20**. Approximately simultaneously with initial engagement of fixture **16** with lower roll **36**, upper roll **38** engages the leading end **40** of billet **10**. Thereafter, progress of the fixture and billet through rolls **36** and **38** results from frictional driving engagement produced by the powered operation of the rolls. As will be evident from FIGURE 2, initial plastic flow displacement of billet **10** is relatively great since the final thickness of the spring is minimal at its opposite ends. As the fixture proceeds forwardly, dislacement of billet material progressively decreases as the fixture reaches the midpoint shown in FIGURE 3 and then progressively builds up again as the terminal end **42** of the billet leaves the double column roller. After ejection from the rolling mill, the fixture and completed

spring blank are transferred laterally toward a trimming station **44** where the spring blank is removed and the empty fixture continues to follow the sequencing pattern previously described.

Although the inserts **22**, as previously mentioned, are profiled only in side elevation thus allowing the billet material unconfined transverse plastic flow when subjected to pressure by the upper roll, the resulting spring leaf exhibits a high degree of both lateral and longitudinal symmetry of taper. Additionally, linearity or absence of snaking has been found to be well within normal manufacturing tolerances thus requiring minimal straightening operations, which to the extent necessary are performed simultaneously with the trimming operation at trimming station **44**.

Of most significance in the present invention is the fact that a change from one shape or size of bi-tapered leaf spring to another may be accomplished with virtually no down-time since all that is required is the substitution of differently dimensioned and contoured inserts **22**. Since the inserts **22** are permanently mounted on fixtures **16**, which in turn are arranged in floating engagement on transfer unit **18**, the time required to make such a change is minimal. Furthermore, the present apparatus and process permits, if desired, production in random sequence of more than one size and shape of spring by "mixing" the form of insert mounted on each of the sequencing fixtures. Under these circumstances, production of different sizes of springs may be attained on a continuous operational basis.

While but one embodiment of the invention has been shown and described, it will be apparent that other changes and modifications may be made therein. It is, therefore, to be understood that it is not intended to limit the invention to the embodiment shown, but only by the scope of the claims which follow.

I claim:

1. Apparatus for manufacture of bi-tapered leaf springs from heated rectangular billets comprising, a pair of powered rollers mounted for concentric rotation about parallel horizontally extending vertically spaced axes, a linear feed mechanism extending in a plane tangent to the surface of revolution of one of said rollers, a plurality of fixtures carried by said feed mechanism, and means for supporting said fixtures on said feed mechanism so that any one or a number of said fixtures can be interchanged with other fixtures carrying and adapted for billets of various sizes without shutting down said apparatus, each of said fixtures having a billet supporting insert presenting an upper surface which is oppositely inclined from the center in longitudinal elevation and flat in transverse elevation, said upper surface being located at a level above said tangent plane such that the billet material is displaced both laterally and longitudinally as the fixture and insert pass linearly between said rollers to simultaneously form both tapers in said bi-tapered leaf springs during each pass through said pair of powered rollers.

2. The apparatus of claim **1** including laterally opposed guide means mounted on said billet support longitudinally midway thereof for initially aligning said billet on said support.

3. The apparatus of claim **1** wherein said fixtures are arranged in spaced relation on a sequencing transfer mechanism cooperating with said linear feed mechanism.

4. The apparatus of claim **3** wherein said inserts are identically profiled and levelled.

5. The apparatus of claim **3** wherein said inserts are non-uniformly profiled and levelled whereby springs of different dimension and configuration are produced on a continuous repetitive basis.

6. The method of making a bi-tapered leaf spring which comprises the steps of, heating a rectangular billet to approximately 2100° F., descaling the heated billet, placing the descaled billet on a billet support having a longitudinally oppositely inclined laterally unconfined upper surface, linearly passing the support and billet into engagement with a powered double column roller at a level whereby one of said rollers displaces the billet into conformity with the longitudinal opposite inclination of said surface while simultaneously inducing lateral and longitudinal displacement of the billet material to produce symmetrical tapering of the spring in plan view.

7. The method of claim **6** wherein said billet is initially placed on said billet supporting surface with approximately two-thirds of its length overlying the leading half of said surface.

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29—173; 72—202, 240, 251