

# UNITED STATES PATENT OFFICE

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## APPARATUS FOR SHOT BLASTING LEAF SPRINGS

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9 Claims. (Cl. 29—90)

This invention relates generally to the manufacture of leaf springs, and, more particularly, concerns conveyor apparatus including spring plate holding carriers for conveying spring leaves through a stream of shot blast.

It has been determined heretofore that shot blasting of spring leaves was very beneficial and increased the fatigue life thereof many times against failures resulting from scores in the surface of the spring due to rolled-in scale or grooves and small crevices of other types, which provided points of incipient premature fatigue or fracture. It has also been determined that the cold working of spring leaves by shot blasting, as above mentioned, could be improved upon if instead of the indiscriminant blasting of both the tension and compression sides of the spring leaves only the tension side was so treated, and this is covered in the co-pending application of William H. Wallace for "Leaf spring and method of making same," Serial Number 286,880, filed July 27, 1939.

It has further been demonstrated that by providing a directional control to the spring leaf in passing through the shot stream, so as to maintain the longitudinal axis of the spring plate parallel to the shot stream, that superior and more uniform results were obtained, and this is covered in the co-pending application of William H. Wallace for "Apparatus for shot blasting leaf springs," Serial Number 354,578, filed August 28, 1940. This last mentioned application covers particularly the method of moving the spring leaf through the shot stream, while the present application is a continuation in part thereof directed to conveyor apparatus and fixture means therefor affording a carrier for rockably transporting a spring plate through the shot stream.

Among the objects of the present invention is the provision of shot blasting equipment including a cabinet therefor and an endless conveyor means supporting spring plate holders so constructed and arranged as to provide a rocking movement of the spring plate in its passage through the shot stream; the provision in leaf spring conveyor equipment as above described in which the longitudinal length of the leaf spring is positively held parallel to the length of the holder, which is of such cross dimensions as to be substantially shielded thereby from the shot stream so as to prevent excessive wear on the moving parts of the holder or conveyor; the provision of conveyor equipment, as above described, in which said spring plate holders provide means for accommodating spring plates of

various widths and afford limited rocking thereof along its length but prevents any fore and aft movement relative to the holder thereby assuring uniform treatment of every portion of the upper surface of the spring plate as the conveyor, moving at a constant speed, conducts each leaf uniformly through all portions of the shot stream; the provision in conveyor apparatus, as above described, of spring plate holder means, having adjustable lateral guide means for maintaining the length of the plate positively in line with a fanned out stream of blasted shot including finger means associated therewith overlying one side of the spring plate limiting rocking movement thereof, and a central locating pin preventing fore and aft movement relative to the holder; the provision in conveyor equipment, as above described, of spring plate holder means providing rocking of the supported plate so that its upper concave tension side is rocked substantially normal to the pattern of the shot stream and every section of the upper surface receives uniform treatment.

Another object of the invention is the provision of a simplified form of spring plate holder having a minimum number of parts and so constructed and arranged as to afford ready replacement of the parts most severely affected by the continuous and repeated passage through the shot stream.

Further and other objects and advantages of the present invention reside in the novel combination and arrangement of parts to be hereinafter described, which in conjunction with the drawings form a part of this specification, and are more particularly pointed out in the appended claims.

In the drawings like reference characters denote corresponding parts throughout the several views, and in which:

Fig. 1 is a side elevational view of one form of conveyor apparatus according to this invention; and

Fig. 2 is a transverse sectional view through the conveyor apparatus on the line 2—2 of Fig. 1, certain parts being shown in section; and

Fig. 3 is an end elevational view on an enlarged scale of one of the spring plate carriers; and

Fig. 4 is a plan view of a portion of a spring leaf with transversely extending grooves or scores as they might exist in the leaf surface before being shot-blasted according to the teaching of this invention; and

Fig. 5 is a similar view showing the desired

effect of the shot-blasting on the grooves or scores of the spring leaf of Fig. 4.

Fig. 6 is an end view of a modified spring plate carrier similar to Fig. 3; and

Fig. 7 is a side elevational view of the spring carrier of Fig. 6 illustrating the carriage and a U bracket upon the upper surface of the holder, having finger means laterally disposed on the arms thereof to limit maximum rocking movement of the spring plate.

Referring to the drawings and more particularly to Fig. 4, the spring leaf 10 after being cambered and heat treated may have, at its tension surface, which ordinarily is on the concave side of the cambered leaf, minute scores or grooves extending transversely of the leaf as indicated at 11. In shot-blasting apparatus the shot are usually discharged at a very high velocity from a wheel in a stream which is fan-shaped in planes at right angles to the axis of rotation of the wheel, and, if the leaf is passed through the shot stream in such direction that the scores 11 are parallel with the planes in which the shot stream is fanned out the effect of the shot will be to lengthen the scores, whereas if the leaf is passed through the shot stream with the longitudinal dimension of the leaf parallel with the planes in which the shot stream is fanned out, then the effect on the scores 11 is to widen them or flatten them out as shown at 12 in Fig. 5. The result will be to improve the fatigue life of the leaves and the apparatus to be described carries out this principle.

In this apparatus there is an elongated frame 13 which may be built up of structural steel or in any other preferred manner. Adjacent the ends of the frame 13 are shafts 14 mounted in suitable bearings and carrying sprocket wheels 15 over which runs a chain conveyor 16. One of the shafts 14 may be driven by any suitable source of power, not shown. The upper part of the frame 13 (see Fig. 3) carries a track 17 on which the rollers 18 of the chain 16 run and, to guide the lower portion of the chain a sprocket 19 may be provided, this sprocket being mounted on a shaft 20 which is supported in suitable bearings, one of which is indicated at 21. Extending upwardly from the frame 13 is a sheet metal housing 22 for the stream of shot, a shot-throwing wheel 23 of well known construction being provided and suitably supported in the upper part of the housing 22 and being adapted to throw a stream of shot as indicated by the lines 24, this stream being fanned out longitudinally of the chain 16. The direction of rotation of the shot wheel 23, that is, either clockwise or counterclockwise, may be regulated at will according to the desire of the operator. In the counterclockwise rotation the shot stream, after striking the leading edge of the leaf, will be scattered along the inclined upper trailing surface thereof and effect minor initial cleaning before the main blast of the shot strikes the rest of spring surface. In one practical embodiment of this apparatus a wheel of 19½ inches in diameter by 2½ inches wide was used and provided a shot pattern fan shape in longitudinal length and approximately 4 inches of effectiveness in thickness, or transverse to the longitudinal dimension of the chain. It will be apparent that this width shot stream will accommodate all automotive vehicle springs, usually 2 inches wide, and if a greater coverage is desired it is only necessary to use a wheel 5 inches wide instead of 2½ inches. It will be understood of course that

the size shot, the delivery speed, and volume of shot, as well as the conveyor speed, may be varied to suit the particular operation and material condition, being matters within the skill and control of the operator.

At intervals along the chain 16 there are provided carriers or holders for the spring leaves these being generally indicated in Fig. 1 at 25 and being suitably spaced to support the spring leaves which are indicated at 27. In actual use the spring leaves are located on respective carriers so that the adjacent ends of the leaves are nearly touching, so as to shield the idle carriers on the chain, and the conveyor chain itself, intermediate the occupied ones from the deleterious effects of the shot stream. Referring to Fig. 3 it will be noted that each of the carriers or leaf holders 26 comprises a block 28 which is secured to horizontal extensions 29 of the chain links by bolts 30. The blocks 28 have a lengthwise recess 31 of sufficient width to accommodate various sizes of spring leaves, one of which is shown in section at 27 in Fig. 3. The leaves 27 are usually provided with a hole 32 for a spring center bolt and use is made of this hole for reception of an upwardly projecting locating pin 33, in the recess 31, to fix the spring in position against fore and aft movement relative to the carrier. An angled bracket 34 is adjustably secured through slotted openings therein to one side of the upper face of the block 28 by fastening means 34a. The bracket 34 has a depending leg 34b extending into the recess 31 a sufficient distance to provide a lateral guide for the spring plate so as to permit it to rock along its longitudinal axis but to prevent any angular rotation about the pin 33. Fingers 35, which in this instance are secured to a lateral surface of the bracket 34, are located fore and aft of the carrier 26 so as to have their outer free ends overlie one side of the recess 31 and a portion of the spring leaf therein, but being spaced from the leaf as shown to permit deflection of the opposite ends thereof to a position where the upper surface of the leaf is substantially at right angles to the shot stream. The pin 33 should be sufficiently smaller than the hole 32 to permit the leaf to freely rock thereon.

The direction of movement of the leaves is indicated by the arrow 36 in Fig. 1 and as they enter the housing 22 endwise through the narrow opening 37 the leading end of the leaf will first enter the shot stream and the force of the impact will cause the leading end of the leaf to be depressed, or in other words, the leaf will rock on its carrier so that the upper side of the leaf will be deflected substantially normal to the direction in which the shot are moving. As the leaf continues its movement through the shot stream the shot will finally impinge upon the whole concave upper surface of the leaf and as the leading edge of the leaf emerges from the shot stream the leaf will be rocked in the opposite direction by the force of the shot acting upon the trailing edge of the leaf. In this manner the entire upper surface of the leaf will be presented in a uniform manner to the shot stream, from the center to the outer ends thereof, and thus receive uniform treatment by the entire fanned pattern of the shot-blast.

In Figs. 6 and 7 there is shown a modified form of the spring plate carrier of Fig. 3, and which forms an important specific part of the present invention as distinguished from the broad coverage on the general apparatus embodied in the aforementioned copending application of this in-

ventor. In this instance the altered parts of the carrier have been designated by reference characters with a subscript to distinguish from the corresponding parts of the carrier 26 of Fig. 3. The channeled block 28, of Fig. 3, has been omitted and instead a flat plate 28a which forms a bed or support for a spring leaf 27 is secured to the horizontal extensions 29 of the chain links by fastening means 30. Upon the upper surface of the plate 28a, a U shaped bracket 34c is adjustably secured, through slotted openings there-in lengthwise along one side of the plate, by fastening means 34e. The arms 34d, of the U bracket 34c, have laterally disposed fingers 35 welded, or otherwise suitably secured, to their outer ends and which project over a portion of the plate 28a adjacent to the pin 33, extending upwardly therefrom, so as to position the spring leaf 27 thereon, in lateral, angular and selected tilting movement. That is to say, the pin 33 restricts fore and aft movement of the spring leaf relative to the carrier; the adjustable U bracket 34c accommodates various size spring leaves and restricts angular movement about the pin 33; and the fingers 35 limit the maximum rocking movement of the ends of the spring leaf along its longitudinal axis and normal to the plane of the carrier. The advantages of such a carrier over the form shown in Fig. 3 are less weight, more economical to make, and the individualized pieces 28a, 34c and 35, especially the bed or support 28a, provide separate parts easily replaced upon the carrier frame when the useful life thereof has been exhausted by the deleterious effect of the repeated shot blasting through which it is continuously moved.

As first mentioned, since the spring leaf must be moved endwise through a fanned out stream of shot, which is in a plane at right angles to the transverse dimension of the spring, in order to flatten out small scores or grooves extending crosswise of the spring leaf, if the desired results of compacting the skin surface of the metal are to be achieved, and not aggravated by a transverse movement of the leaf through the shot, it is important that means such as taught by the present invention be employed to keep the spring leaves substantially uniformly in line during the shot treatment. Furthermore, uniformity of treatment of every portion of the entire upper concave tension side of the spring leaf is the essence of this apparatus. It will be appreciated that as the factors of time, uniformity and degree of heat, control the quality of a piece of spring steel being heat treated, so do the factors of time, force and intensity of shot treatment control the quality necessary to produce the desired and consistent results in cold working of the surfaces of spring leaves. That is to say, as improper heat treatment may impair the physical properties of spring steel, so may irregular and improper shot treatment damage the surfaces of spring leaves and cause a concentration of stress rather than the desired result of decentralizing stress concentrations through which fatigue fractures are started.

Having the above principles in mind the fanned out shot pattern will be understood to have different velocities within itself and consequently will vary in force and intensity from its extremities to an intermediate area where the maximum force and intensity are found. Likewise, when it is understood the upper surface of the spring leaf presents a concave surface that varies in distance along its longitudinal dimension from the

source of blasted shot, the necessity for subjecting each and every portion uniformly to all phases of the shot pattern will be appreciated. The spring carriers used in the conveyor apparatus of the present invention provide simple and expedient means for utilizing these important factors by affording adjustable directional control to endwise movement of spring leaves of selected widths; restriction of fore and aft movement of the leaf relative to the holder, and yet permitting rocking movement of the opposite ends of the leaf normal to the holder within predetermined limits, so that all portions of the concave upper surface are subjected uniformly to all sections of the shot stream.

While there has been illustrated and described what is considered to be a preferred form of apparatus for practicing this invention, it will be apparent that changes may be made in the details of construction without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. An apparatus for the cold working of spring leaves, the combination with a shot blasting means and a housing therefor; of an endless conveyor for conducting spring leaves endwise through a continuous fanned out stream of shot from said blasting means disposed in a plane parallel to the longitudinal axes of the spring leaves, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement along their longitudinal axes under said shot stream but preventing fore and aft movement thereof relative to said carriers, and said carrier means each having a locating pin for fixing said spring leaves relatively to said carriers but permitting said rocking movement.

2. In apparatus for the cold working of cambered spring leaves, the combination with a shot blasting means and a housing therefor; of an endless conveyor for conducting spring leaves endwise through a continuous fanned out stream of shot from said blasting means disposed in a plane parallel to the longitudinal axes of the spring leaves, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement along their longitudinal axes under said shot stream but preventing fore and aft movement thereof relative to said carriers, said carrier means each having a locating pin for fixing said spring leaves relatively to said carriers but permitting said rocking movement, and guide means fixed to said carriers restricting angular movement of said spring leaves.

3. In apparatus for the cold working of cambered spring leaves, the combination with a shot blasting means and a housing therefor; of an endless conveyor for conducting spring leaves endwise through a continuous fanned out stream of shot from said blasting means, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement thereon relative to said carriers under the action of said shot stream, and finger means fixed to said carriers limiting the maximum rocking movement of said spring leaves whereby the upper surfaces of the spring leaves are progressively rocked substantially normal to the plane of the shot stream when subjected to the action thereof.

4. In apparatus for the cold working of cambered spring leaves, the combination with a shot

blasting means and a housing therefor, of an endless conveyor for conducting spring leaves endwise through a continuous fanned out stream of shot from said blasting means, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement thereon normal to their longitudinal dimensions under said shot stream but preventing fore and aft movement thereof relative to said carriers, said carrier means each having a locating pin for fixing said spring leaves relatively to said carriers but permitting said rocking movement, guide means fixed to said carriers restricting lateral movement of said spring leaves, and said guide means being adjustable to accommodate spring leaves of selected widths and including finger means attached thereto for limiting the maximum rocking movement of said spring leaves.

5. In apparatus for the cold working of cambered spring leaves, the combination with a shot blasting means and a housing therefor; of an endless conveyor for conducting spring leaves endwise through a continuous fanned out stream of shot from said blasting means, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement thereon relative to said carriers under the action of said shot stream, adjustable guide means comprising a U shaped member secured to each of said carriers maintaining the longitudinal length of said spring leaves and the plane of said fanned out shot stream in parallelism, and including fingers laterally fixed to the arms of said U member overlying one side of the spring leaves for limiting rocking movement thereof.

6. In apparatus for the cold working of cambered spring leaves, the combination with a shot blasting means and a housing therefor; of an endless conveyor for conducting spring leaves through a fanned out stream of shot from said blasting means, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement thereon relative to said carriers under the action of said shot stream, said spring leaves conveyed lengthwise of said conveyor through said shot stream with the major axes of the leaves and the plane of said fanned out stream of shot maintained constantly in alignment, and said carriers each having a

frame structure including movable parts thereof associated with said conveyor being of such cross dimensions as to be shielded from the deleterious effects of the shot blast impinging upon the spring leaves supported lengthwise thereupon.

7. Apparatus according to claim 6 characterized by the frame structure of said carriers including a lateral bed or support for said spring leaves which constitutes a separately replaceable member when the useful life thereof is exhausted by the shot blasting action.

8. As a new article of manufacture a spring leaf fixture or holder for conveyor apparatus of the class described; comprising frame structure including depending roller means to be associated with said conveyor, a bed or support plate secured laterally to and overlying said frame structure, an adjustable guide means secured lengthwise to one side of the bed plate and having laterally disposed fingers extending therefrom spaced above said plate, and an upstanding pin disposed centrally of said bed plate for reception of a spring leaf to be placed thereon and which in conjunction with the said guide means and fingers position the spring leaf fore and aft, angularly, and limits the maximum rocking movement of the leaf, respectively, and relatively to the fixture.

9. In apparatus for the cold working of cambered spring leaves, the combination with a shot blasting means and a housing therefor; of an endless conveyor arranged to conduct spring leaves endwise through a continuous fanned out stream of shot from said blasting means, a plurality of carrier means mounted on said conveyor and supporting said spring leaves for rocking movement thereon relative to said carriers under the action of said shot stream, finger means fixed to said carriers limiting the maximum rocking movement of said spring leaves whereby the upper tension surfaces of the spring leaves are progressively rocked a substantially uniform amount normal to the plane of the shot stream when subjected to the action thereof, and said spring leaves being supported at their mid-points on their convex surfaces with their opposite cambered ends projecting freely upward with every portion of the upper tension surfaces thereof subject to said progressive rocking equally and uniformly along their longitudinal dimensions.

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Aug. 19, 1941.

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APPARATUS FOR SHOT BLASTING LEAF SPRINGS

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2 Sheets-Sheet 2

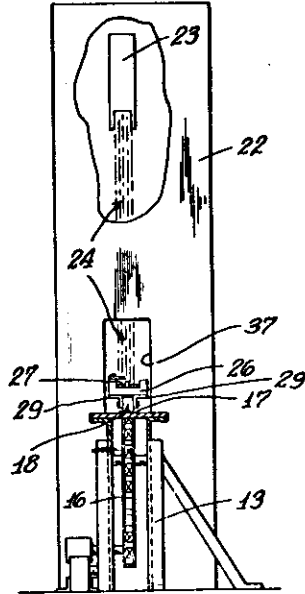


Fig. 2.

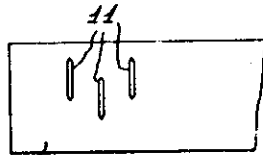


Fig. 4.

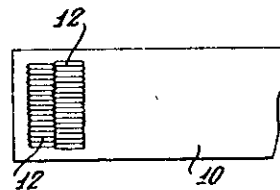


Fig. 5.

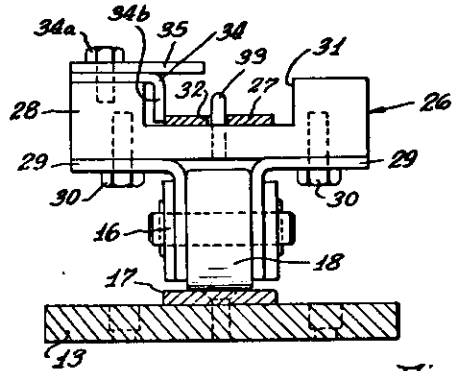


Fig. 3.

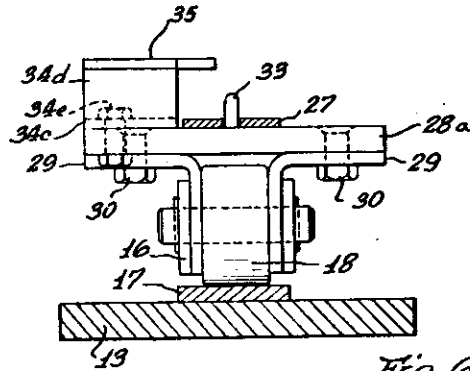


Fig. 6.

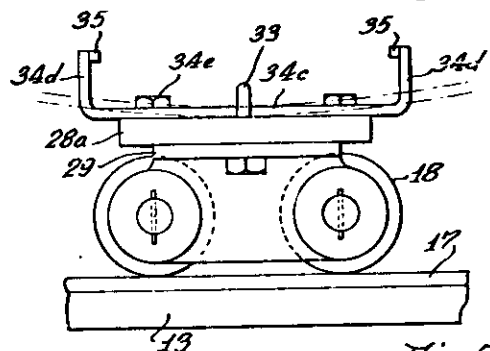


Fig. 7.

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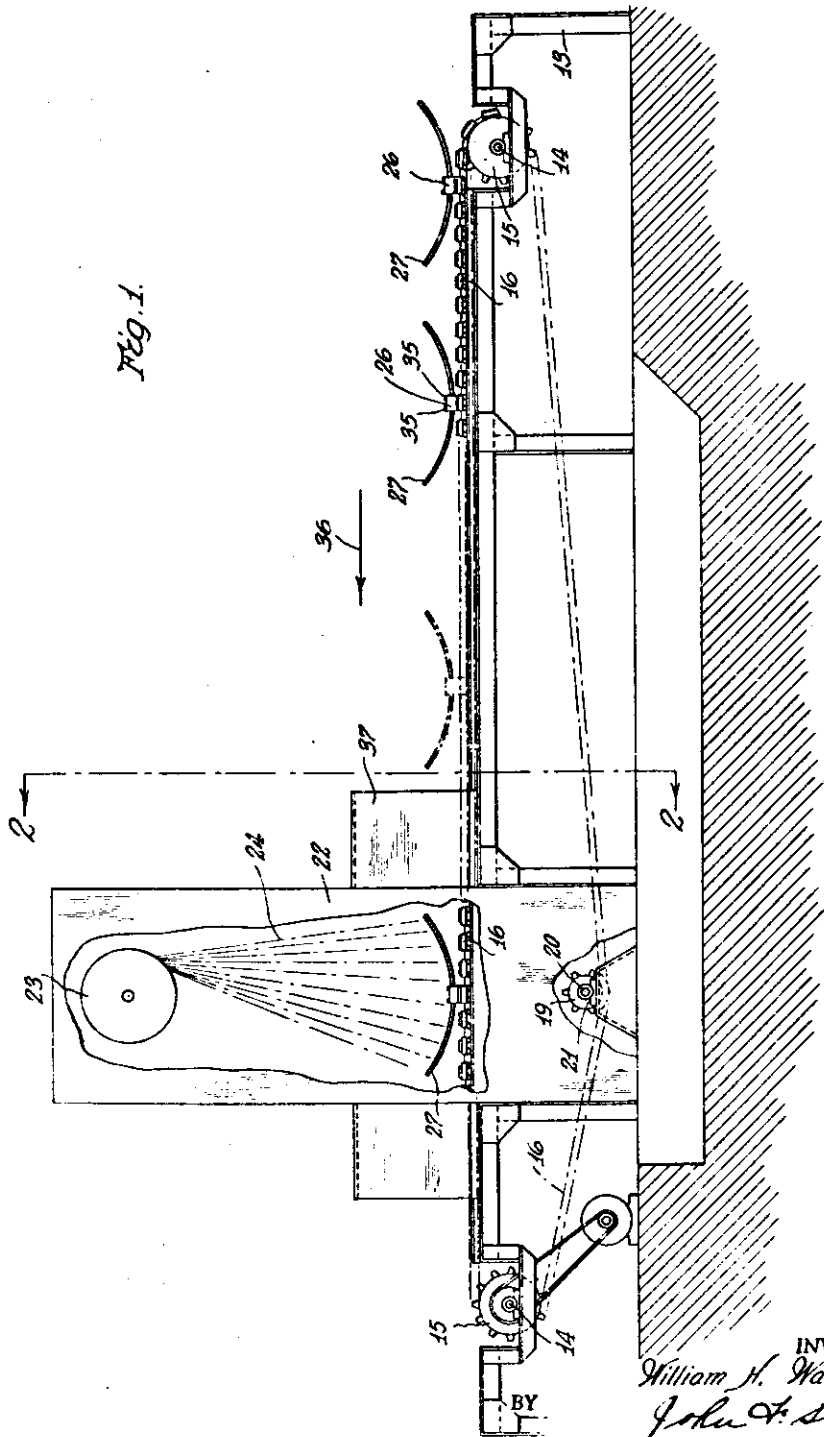
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APPARATUS FOR SHOT BLASTING LEAF SPRINGS

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2 Sheets-Sheet 1

Fig. 1.



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