United States Patent Office 3,438,229
Patented Apr. 15, 1969

3,438,229

STRESS PEENING STEEL ARTICLES

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Filed Apr. 25, 1966, Ser. No. 544,863
Int. Cl. B21j 13/00; B21d 31/06
U.S. Cl. 72—53 12 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus and process for stress peening steel articles such as automobile leaf springs wherein a spring is deflected from a free configuration to a contour corresponding to that condition of the spring when installed for use, and then peened to work the tensioned surface.

This invention relates to machinery and a method for stress peening steel articles on a continuous basis. More specifically, the present invention relates to machines and a method for utilization in a process for stress peening steel articles of the leaf spring type such as are currently employed in automotive vehicle suspension systems.

Shot peening is an operation whereby hardened steel shot are caused to impinge upon the surface of the steel article being treated. In well-known devices, the shot are thrown from the periphery of a wheel which is running at high speed, or they may be directed by a high velocity air stream against the surface of the article. In either case, the shot are caused to travel at such a high velocity that when they impinge upon the surface of the article, they will effect a cold working of the surface.

Stress peening refers to the operation of shot peening a part while it is statically stressed in the same direction as the stress which is to be sustained when the part is in service.

It has been known that shot peening of steel springs effects a cold working of the surface, introducing compressive stresses and so altering the crystalline structure of the skin portion of the spring so as to beneficially increase the endurance limit or fatigue characteristics against failures resulting from surface defects such as notches or scores which may result from prior operation. Such scores, notches, grooves and the like provide points of incipient premature fatigue or failure. It has been found that the endurance characteristics of single leaf springs can be improved by shot peening the tension surface while the spring is reverse stressed near to its yield point. When peening is done under these conditions, the spring takes a considerable set during peening which must be allowed for when designing the quench form. The features and advantages of stress peening a single leaf spring are fully set forth and explained in U.S. Patent No. 2,608,752. Because of the demand for stress peened springs, the spring industry is continually striving to devise better production methods and machinery for stress peening springs. Such production machines were the subject of U.S. Patents 3,094,768 and 3,131,457. This invention is another step in the continued improvement of design of better production methods and machinery for stress peening springs.

Accordingly, the primary object of the present invention is to stress steel articles, specifically leaf springs, by machinery which provides support for the stressed spring throughout its entire length and which peens the entire spring surface.

Another object of this invention is to provide uniform peening of a leaf spring under tension on a continuous basis.

It is another object of this invention to peen the tension surface of a leaf spring uniformly by deforming said spring to the shape of a wheel so that the entire spring is the same distance from the peening means which projects peening particles against the spring.

It is a further object of this invention to provide a process for stress peening steel articles, specifically leaf springs, on a continuous basis in which a spring is: securely mounted to a rotating wheel; deflected by cooperating roller means to conform to the circular contour of the wheel; secured at is other end to the rotating wheel; shot peened throughout its entire surface; and subsequently released, all in automatically controlled manner.

It is still a further object of this invention to provide a method of improving the endurance characteristics of steel articles which comprises deflecting the article to conform to a circular wheel, securing said articles on the wheel, and shot peening the entire tension side of the deflected article continuously.

These, as well as other objects of the present invention, will be more clearly understood from the following description of the invention and the accompanying drawings, wherein:

FIGURE 1 is a side elevation view of the machinery assembly of the present invention for stress peening steel articles on a continuous basis.

FIGURE 2 is an end elevational view of FIGURE 1.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to stress peening leaf springs as illustrated in the accompanying drawings, since the invention is capable of application in stress peening other steel articles and other embodiments. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

This invention utilizes a conventional centrifugal machine together with the necessary shot handling and dust removal equipment. The rotating wheel of the centrifugal machine is arranged to accommodate manual loading thereon of leaf springs to be stress peened. After being secured on the wheel, the springs are subjected to stressing or deflecting actions which bow them out of their relaxed attitudes and in the directions of their stressed conditions when in use. The springs are then rotatably transported into the range of the shot peening equipment wherein they are subjected to peening action for a predetermined period requisite to provide the desired strengthening effect. The speed of the wheel and the intensity of the shot must be predetermined in order to attain the desired strengthening of the springs by the stress peening process. After the peening operation the springs are continually rotated away from the peening area where they are released and are conveyed either by hand or automatic machinery to the next operation in the manufacturing process.

As shown in the accompanying drawings, the wheel of the centrifugal machine is generally indicated as 2. The rotational drive system for the wheel 2 is an electric motor 3 which through a system of a conventional speed reducer 4 and gears, generally indicated as 5, drives the shaft 6 which effects rotation of the wheel 2. Mounted adjacent the wheel 2 are similar deflecting and releasing rollers 11 and 12 respectively. The deflecting roller 11 cooperates with the wheel 2 to deflect or stress a spring which is loaded therebetween. The rollers are biased to their illustrated position by spring means generally indicated as 13, or an air-over hydraulic system including an air actuated hydraulic cylinder with an accumulator. A spring as 20 is manually loaded onto the wheel 2 by securing one end of the spring to a mounting pin 24 integral with the wheel. The spring 20 has been conventionally fabricated by hot rolling

or otherwise shaping spring steel or other spring material into the required shape. The ends of the blanks were then curled to form eyelets. The springs were then heat treated to hardening temperature, quenched and tempered. The stress peening of the present invention will improve the strength and life characteristics of the conventionally made springs. The operator who is manually loading the spring onto the wheel 2 would put the forward eyelet of the spring in position for the pin 24 to secure the spring. The deflecting roller 11 and the wheel 2 effect a deflection of the spring 20 to conform with the contour of the wheel 2. When the spring is conformed to the wheel so that the rear eyelet of the spring is on the wheel circumference, the rear eyelet would be pinned like the front eyelet to a pin as 24. In its deflected form, the entire spring has been deformed to a reverse shape which substantially duplicates the spring when at a specified stress level of operative service. The amount of reverse stress of the springs in the instant invention is dependent on the diameter of the wheel 2. The diameter may be varied or segments of circles may be mounted on the periphery of the wheel to provide the stress reversal of the desired magnitude to adequately stress peen the springs. For most stress peening of leaf springs a twelve foot diameter of the wheeel 2 is adequate as it gives a stress reversal of enough magnitude to adequately stress peen most leaf springs. Furthermore, it has been found that with a twelve foot wheel a rotational speed of the wheel of one-half to 2 r.p.m.'s is adequate for production needs. The speed of the wheel is determined by the required working or penetration of the springs by the peening, the specified coverage of the peening and also the weight of the spring itself.

The deformed spring, carried by the wheel 2, is then rotated into the path of the stream of shot generally indicated by the lines 25. A shot throwing wheel 26 of well-known construction is supported within the housing 27 and adapted to throw the stream of shot 25. A suitable feed chamber or hopper 28 which is loaded by means of the bucket elevator, generally indicated as 30, provides the throwing wheel with the necessary shot. The size shot, the delivery speed, and volume of shot, as well as the wheel speed may be varied to suit the particular operation and material condition of the article being peened. Furthermore, the placement of the shot throwing equipment, that is, either above the wheel 2 or below it, may be varied to suit the needs of production.

When the rotating wheel and the deformed spring is rotated past the area of peening, the spring then comes into contact with the roller 12. At this point the forward pin means 25 would be removed releasing the forward end of the spring while the remainder of the spring, which is under great tension, would be slowly unloaded because of the engagement with the roller 12. When the spring has rotated past the roller 12, the rear pin 24 may be released and the spring is then free of the peening system and conveyed to the next operation of manufacture.

The spring peened in accordance with the present invention has superior properties because of the uniform peening of the spring. The entire spring surface has been peened continuously at the same distance from the shot throwing wheel throwing the shot against the spring. Thus, the spring has been peened while deflected to a contour corresponding to that condition of the spring when it is installed in an automobile or the like for operative service on a true radius from the throwing wheel. The process and machinery of this invention produce a leaf spring having superior life and endurance characteristics.

While I have shown what I consider to be the preferred embodiment of my invention, it will be understood that various modifications and rearrangements may be made therein without departing from the spirit and scope of the invention.

Having described my invention, I claim:

1. An apparatus for stress peening steel articles comprising:
   - a wheel mounted for variable rotation,
   - securing means on the wheel for receiving opposite ends of an article,
   - deflecting means adjacent the rotational path of said wheel for deforming the entire article elastically to conform to the wheel contour,
   - shot blasting means adjacent said wheel for blasting the entire surface of said deformed article continuously as it travels thereby, and
   - means for releasing said securing means to permit said article to resume its normal undeformed shape.

2. A mechanical arrangement for stress peening steel articles comprising:
   - a centrifugal machine having a wheel adapted to be driven at variable rotational speeds,
   - securing means on said wheel for receiving one end of the article,
   - deflecting means adjacent the rotational path of said wheel for stressing said article for its entire length to conform to the shape of said wheel,
   - means for securing the other end of the stressed article,
   - peening means adjacent said deflecting means and said rotational path of said wheel for projecting particles against the entire surface of said deflected article continuously, and
   - means for releasing said article.

3. The mechanical arrangement for stress peening steel articles as set forth in claim 2 wherein the steel articles are leaf springs.

4. The mechanical arrangement for stress peening steel articles as set forth in claim 2 wherein the rotational speed of the wheel is determined by the desired length of exposure of the article surface to the peening particles.

5. The mechanical arrangement for stress peening steel articles as set forth in claim 4 wherein the wheel is twelve feet in diameter and its rotation rate is ½ to 2 r.p.m.'s.

6. The mechanical arrangement for stress peening steel articles as set forth in claim 2 wherein the deflected article conforming to the contour of the wheel substantially duplicates the condition of the article in operative service.

7. The mechanical arrangement for stress peening steel articles as set forth in claim 6 wherein the entire spring surface is peened at the same distance from the peening means.

8. The mechanical arrangement for stress peening steel articles as set forth in claim 2 wherein the article includes end loops and the securing means includes a pair of spaced pins over which the loops of said article fit.

9. A process for stress peening steel articles comprising:
   - securing one end of an article to a rotating wheel,
   - deflecting said article to conform to the circular contour of said wheel,
   - securing the other end of said article to said rotating wheel,
   - shot peening the entire surface of said deflected article continuously, and
   - releasing the stress peened article.

10. A process for stress peening steel articles as set forth in claim 9 wherein the rotational speed of the roller is determined by the desired length of exposure of the article surface to the shot peening.

11. A process for stress peening steel articles as set forth in claim 9 wherein the steel articles are leaf springs.

12. In a process for stress peening an elongated steel article, the steps of
   - deflecting said article across a solid arcuate surface to conform to the contour of a wheel,

shot peening the entire tension surface of said deflected article, and

releasing the stress peened article.

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U.S. Cl. X.R.

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April 15, 1969 C. W. BARTLETT 3,438,229

STRESS PEENING STEEL ARTICLES

Filed April 25, 1966 Sheet 1 of 2

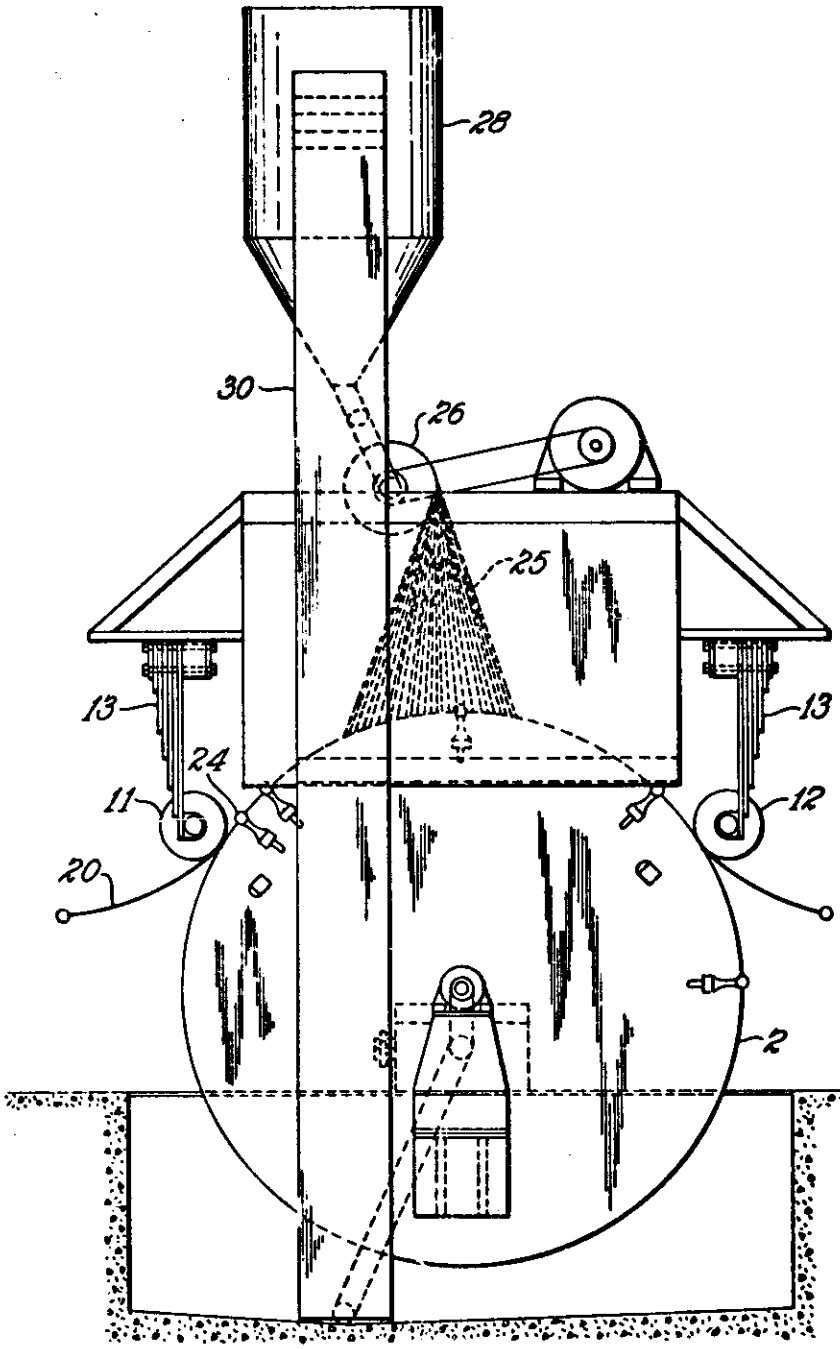

Fig. 1

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April 15, 1969 C. W. BARTLETT 3,438,229

STRESS PEENING STEEL ARTICLES

Filed April 25, 1966 Sheet 2 of 2

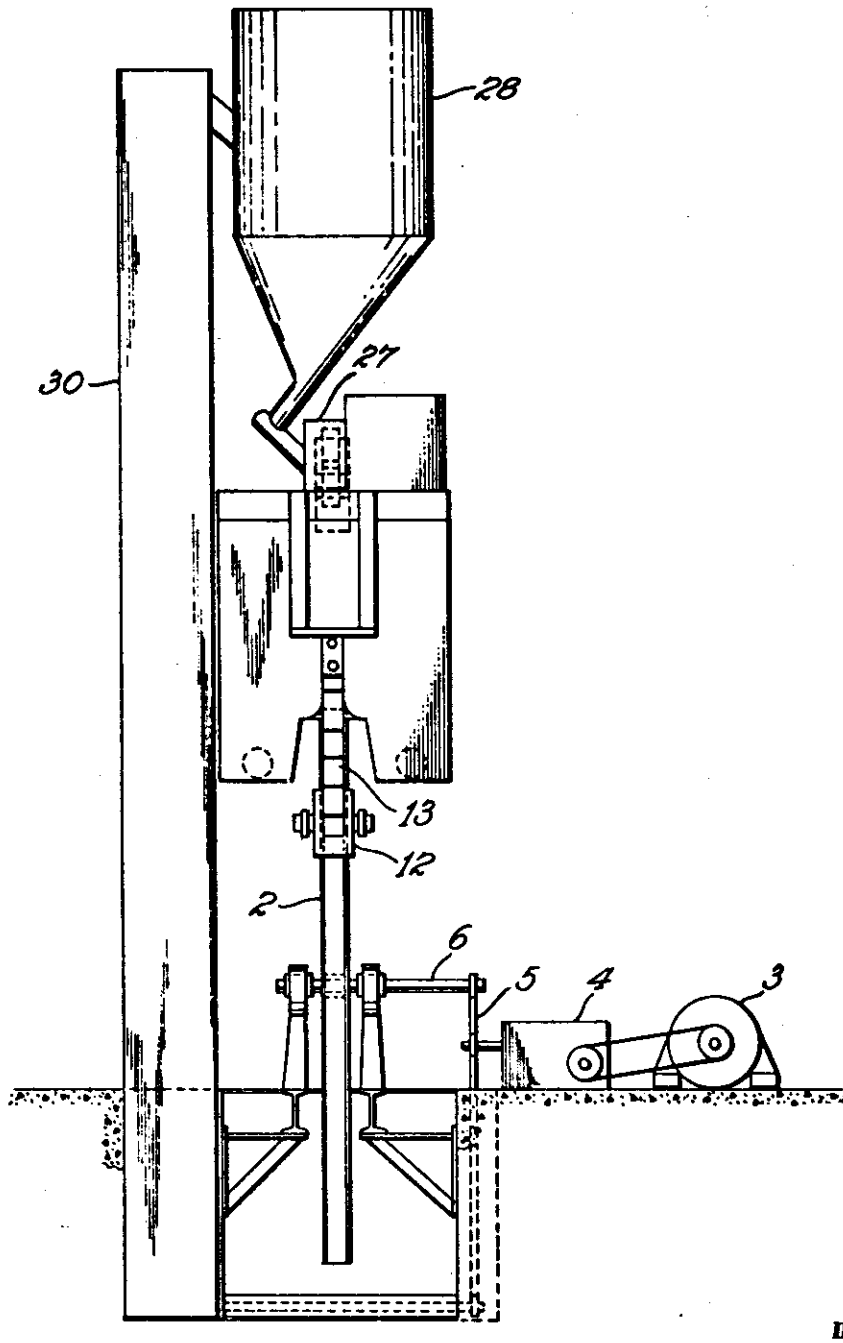

Fig. 2

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