July 21, 1925. 1,546,526

R. B. WASSON

METHOD OF ROLLING PISTON RINGS

Filed Dec. 3, 1924 2 Sheets-Sheet 1

Fig. 1.

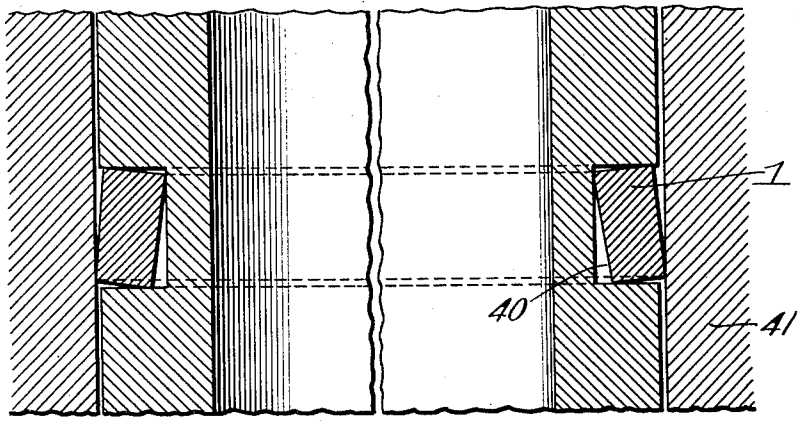


Fig. 6.

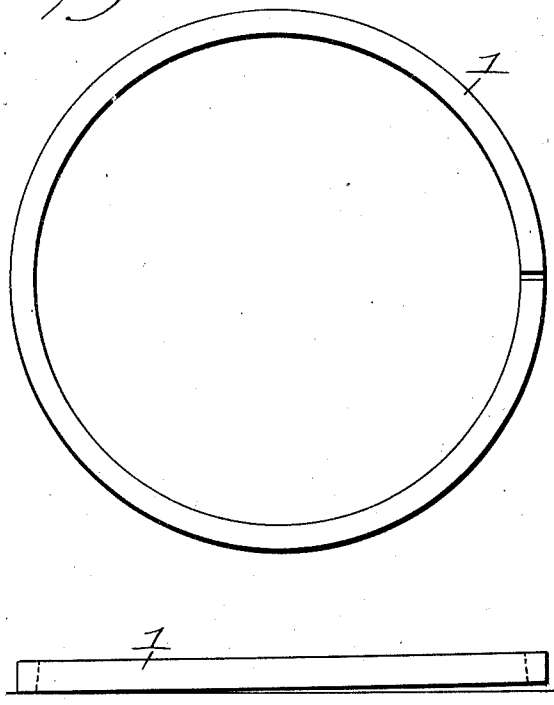


Fig. 5.

Fig. 2.

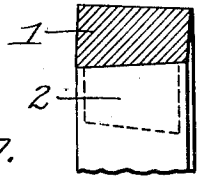


Fig. 7.

Fig. 3.

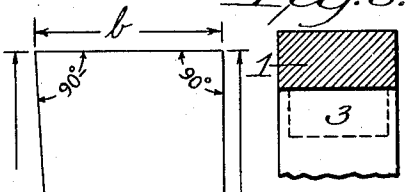
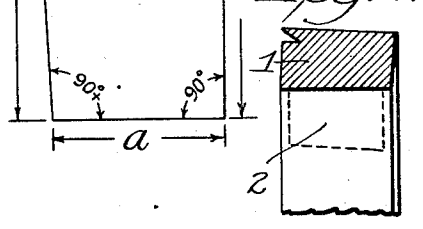


Fig. 4.



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Filed Dec. 3, 1924 2 Sheets-Sheet 2

Fig. 8.

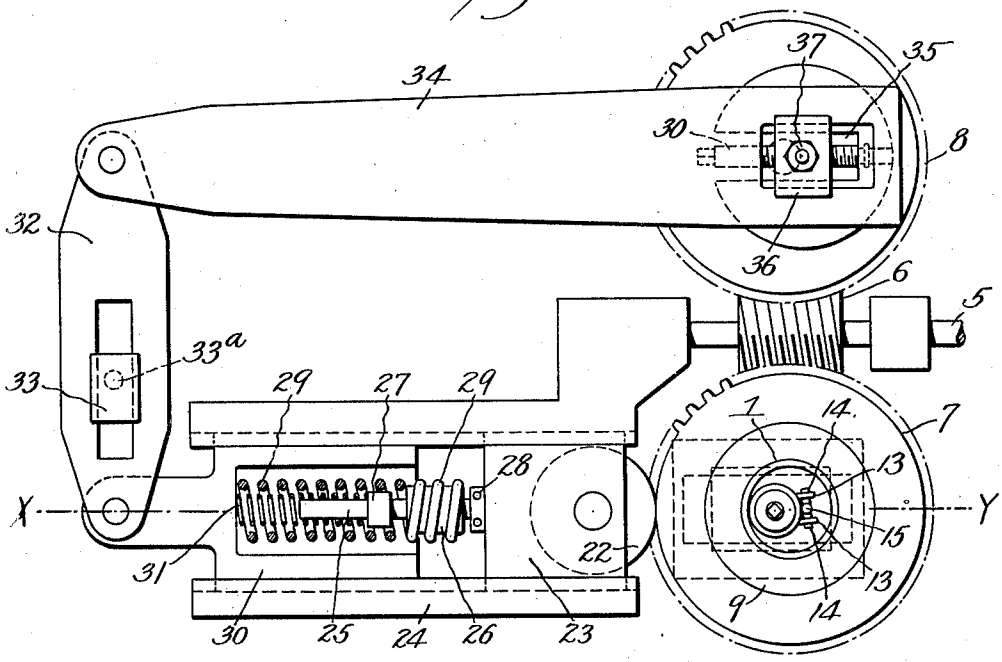


Fig. 9.

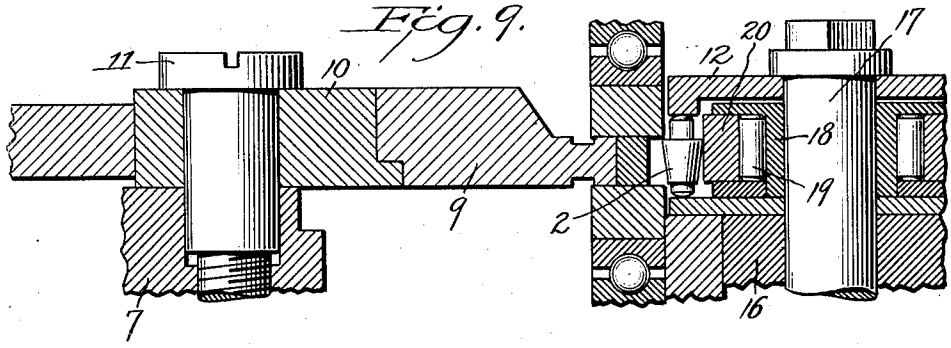
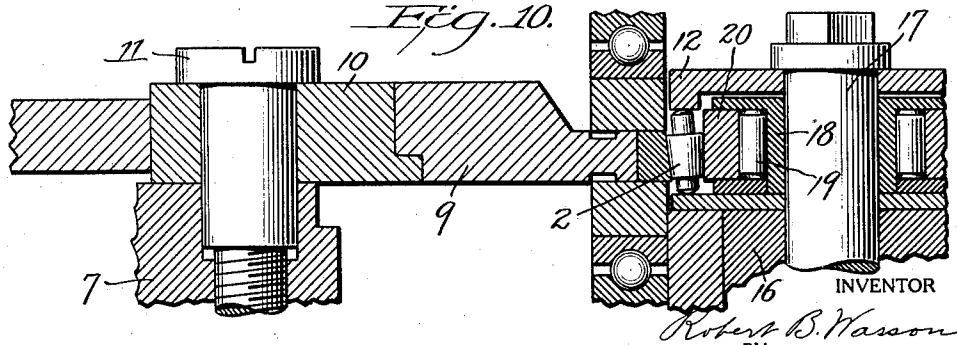


Fig. 10.



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UNITED STATES PATENT OFFICE.

ROBERT B. WASSON, OF CRANFORD, NEW JERSEY.

METHOD OF ROLLING PISTON RINGS.

Application filed December 3, 1924. Serial No. 753,666.

To all whom it may concern:

Be it known that I, ROBERT B. WASSON, a citizen of the United States, residing at 306 Elizabeth Avenue, Cranford, New Jersey, have invented certain new and useful Improvements in the Method of Rolling Piston Rings, of which the following is a specification.

My invention relates to the method of rolling metal packing or piston rings and more particularly to the method of rolling a piston ring so as to impart permanent stresses in the ring according to a predetermined law, around the ring; the ring, further, being condensed more to one side of the central diametrical zone than the other, thereby causing the ring to twist in accordance with a definite law.

One of the objects of the invention is to so distribute the stresses in the ring by rolling that not only will the ring, when confined to circular form, exert a uniform radial outward pressure, but the twist will multiply the pressure without altering its uniformity and will localize the pressure at the edge of the ring. Attempts have been made to achieve this result by hammering but it is not easily possible to control the hammering of the ring off center; an irregular twist often resulting therefrom.

These difficulties and defects are avoided in my method. Although I shall particularly describe the invention as applied to rolling an expanding ring, it will be understood that it may be applied to rolling a contracting packing ring by rolling the ring on its outer circumference instead of on its inner.

The stresses are localized toward the inner face of the expansible ring, and at one side of the central diametrical zone thereof, the result being that with the ring in its free state, these stresses expand and twist it, setting up temporary opposing stresses in the outer portion until the ring has expanded into non-circular form and has twisted so that the resisting stresses are equal to the expanding stresses and the ring is in equilibrium. When the ring so rolled is confined within a circular cylinder, it will translate the stresses into substantially uniform pressure per unit of contact line or area, thus securing uniform sealing pressure between ring and cylinder. In rolling the ring a small area of contact between the roller and the ring is preserved which is of considerable lesser extent than the area of contact between the outer face of the ring and the holder. This enables the roller to condense the inner face of the ring locally without objectionable distortion of the metal.

It is found by experience in peening or hammering rings, that once established, any variation in the area of the hammer point as by dulling due to wear will result in a variable product with an irregular expanding force for the ring. My invention overcomes these difficulties.

Again, the compacting effect at the points of the ring is very small but increases variably to a point opposite the split. Nevertheless, the force applied at the points must cause the metal to flow and permanently compact the inner region near the inner face. This flow must not expand the metal laterally and any substantial change in the inner face of the ring must be prevented for this would require a correcting operation and introduce other variables. The hammer is not able to repeat its results nor to overcome the above objections. My rolling method with its definitely applied radial force at every point of the ring and the restriction of the flow of the metal laterally, overcomes these difficulties. As the radial dimension of the ring is quite small and since only a portion of this section should be compacted, small commercial variations in the radial dimension will cause large variations in the regularity of the force applied and will vary the resultant law of expansion of the ring. My invention overcomes this difficulty, applies the force regularly and produces a uniform piston ring.

All metals require time in which to flow. If the time element is too short to permit the full amount of flow in the metal, the result will vary as the metal is harder or softer. In some cases it is necessary to subject the inner surface of the ring to the condensing pressure two or more times. This I accomplish by treating the ring to a succession of rolling steps.

With the above and other objects in view, my invention consists in the parts, improvements and combinations more fully pointed out hereinafter.

Turning now to the drawings:

Fig. 1 is a section showing a rolled twist-

ed ring in place in its groove in the piston, the twist being greatly exaggerated; the upper portion of the figure extends towards the explosion chamber.

Fig. 2 is a detail transverse section thru a rolled twisted ring, illustrating the condensing action of a tapered roller.

Fig. 3 is a detail transverse section, illustrating the condensing action of a cylindrical roller.

Fig. 4 is a detail transverse section thru a portion of a rolled twisted ring, the ring being provided with a notch on its lower flat face.

Fig. 5 is a side elevation of a rolled twisted ring in its free state, showing how the twist raises the ring from a plane surface.

Fig. 6 is a plan view of the ring.

Fig. 7 is a diagrammatic view illustrating the outline of a cross-section of the ring.

Fig. 8 is a plan view illustrating a step in the process of rolling the ring.

Fig. 9 is a section on line X Y of Fig. 8, but with the ring and tapered roller separated, the parts being in the position just before the rolling action begins.

Fig. 10 is a section on line X Y of Fig. 8 showing the parts while the ring is being rolled.

The process of rolling the ring so as to give it a twist, will first be described.

The ring 1 is condensed by rolling one of its sides or faces by means of a condensing roller 2. As illustrated the rolling action takes place against the inner face of the ring. The condensing roller may be tapered as shown in the drawings so that a greater pressure is applied on one half of the ring than on the other, that is to say, the pressure is increased toward the bearing half of the ring, i. e. the portion which bears against the cylinder wall under the twist that has been imparted to the ring by the rolling action. As shown in Fig. 3, the condensing roller 3 may be cylindrical in form, in which case the roller is positioned slightly to one side of the central diametrical plane passing thru the middle of the ring, parallel to the flat faces of the ring and perpendicular of the axis of the ring. In all these cases the condensations of the metal due to rolling lie more to one side of the central diametrical portion of the ring.

In Fig. 8, the drive shaft 5, carrying worm 6, gears with worm wheels 7, 8, the former driving a rotating holder 9, which receives the ring and the latter 8, driving a train of mechanism which applies the rolling pressure in accordance with a predetermined law. It will be understood that the mechanism for producing the rolling pressure may be widely varied. The mechanism illustrated is the same as that illustrated in my copending case, Serial No. 611,273, filed January 8th, 1923, for ring tensioning machines.

The holder 9, is secured to worm wheel 7, thru the intermediate carrier 10, which is shouldered to receive the holder, the carrier and holder being locked together by a dowel pin. Bolts 11 secure the carrier 10 to worm wheel 7.

A housing 12 is provided, having a pair of lugs 13, each having an adjusting screw 14, which contact with stud 15, carried by block 16. The condensing roller 2, is located in a cut-out notch in the housing. It has axial extensions which keep the roller substantially upright by contact with the top and bottom portions of the housing at the notch. The block 16, engages the sides of the cut-out portion of the plate—and allows the plate and its associated parts to move slightly but only in the direction in which the pressure is applied and prevents movement of the plate transverse to the line of pressure. Secured to the block 16, is the stud 17, upon which is mounted roller bearing 18, having a series of rollers 19, surrounded by ring 20.

The condensing roller 2, is of a comparatively small diameter. The greatest practical difference in magnitude of the area of contact between the roller and ring and holder and ring is desirable. It is known from experience in peening or hammering rings, that once established any variation in the relation of these areas, one to the other, such as the wear of the striking point, etc., results in a variable product which will not meet the requirements. My condensing rolling method overcomes these difficulties. By rolling one half of the ring more than the other and by applying the condensing pressure in accordance with a predetermined law, either by making use of a tapered roller, or by utilizing a cylindrical roller shifted toward one side of the central plane of the ring or otherwise, the rolling action will compress and condense half of the ring more than the other and throw the forces produced in the metal, out of balance, in accordance with the desired law giving uniform pressure and a twist to the ring when the ring is in the cylinder, the twist increasing the pressure at the contacting edge of the ring when it is in the cylinder. The ring in its free state is rolled and the metal condensed in such a way that when in its confined state within the cylinder it will exert a uniform pressure per unit of contact area. The roller is positioned slightly off the center line X Y of the pressure applying means, as shown in Figure 8 and is freely movable or floating. It is located off the center line of pressure X Y and at the near side of the line which a point of the ring approaches before it is condensed. This

enables a heavy pressure to be applied to the roller and ring.

The condensations in the metal are confined to a radial and circumferential direction, so as to prevent a lateral flow of metal across the width of the ring. Under the law of pressure applied to the ring by the condensing roller the condensing effect at the points of the ring or at zero degrees, is very small, but increases variably to 180°. Very near the zero degree the force applied must be sufficient to cause the metal to flow and permanently condense thru a portion of the annular section of the ring. In accordance with the invention, this flow is limited to a circumferential flow and any substantial change in the width of the face of the ring is prevented which would require correcting operations and introduce further variables.

Preferably, the top and bottom rollers 21 and 21ª, overlap the flat face of the ring and the condensing roller is shorter than the axial width of the ring. Thus when the ring is revolved, when it is condensed by the condensing roller 2, the metal is confined and the condensations are confined to a radial and circumferential direction. The lines of pressure between the top and bottom roller and the ring should be substantially in the same plane with the line of pressure between the condensing roller and the ring so as to prevent unequal condensations of the metal of the top and bottom faces of the ring.

Pressure is applied to the ring under a predetermined law. The roller 22 is pivoted on a stud mounted in the slide block 23, which slides in guides 24, in the bed plate. A yielding spring pressure is applied to the block. The block carries a stud 25 in the side opposite the roller which has threaded on it two nuts 26 and 27. A flange 28, butts up against the block and has a series of holes in which a suitable tool may be used to rotate the stud 25 and thus move the nuts 26 and 27.

A heavy spring 29 is confined between the larger nut 26 and the sliding head 30. A lighter spring 31, is confined between the smaller nut 27 and the head 30. One or all of the springs are so set as to exert an initial pressure on the roller 22 which thru the mechanism heretofore described forces the piston ring 1, against the condensing roller 2.

It is desirable when tensioning the ring with one revolution of the holder to start with an initial pressure and **under** a predetermined law to increase the **pressure** until the pressure has been applied half-way around the ring, at which point maximum pressure is being applied. Then the pressure is decreased under the same predetermined law until we come back to our starting point, having made one complete revolution of the ring, and again have our initial pressure. The law which gives the pressure applied to the pressure applying roller is the law of the crank with a long connecting rod or equivalent mechanism; this pressure is in turn transferred to the metal of the ring depending on the particular kind of metal or cast iron of which the ring is composed. By adjusting the parts of the pressure applying mechanism, the amount of pressure can be regulated and the ring condensed so as to give equal radial outward pressure. The result may be checked by a suitable testing gage.

The head 30, is mounted to slide in the aforementioned guides 24, and have pivoted thereto, the link 32, which is fulcrumed on the block 33. Pivoted to the opposite end of the link 32, is the connecting rod 34. The other end of the connecting rod carries a slot 35, in which is located the block 36. Thru block 36, passes pivot pin 37, thru the lower portion of which passes the adjusting screw 38.

Means are thus provided for adjusting the throw of the block 36, which serves as a crank pin.

The fulcrum block 33, may be shifted at each revolution of the ring when it is desired to treat the ring to a succession of rolling steps as explained in my copending application above referred to.

The fulcrum block is provided with a hole 33ª into which enters the pin 33ᵇ, on sliding block 33ᶜ, the latter sliding in guides 33ᵈ. The pin connection between the two blocks provides the fulcrum. By shifting block 33ᶜ, the fulcrum is shifted. This may be done by hand by means of a screw 33ᵉ, threaded to engage the block 33ᶜ. On turning the screw by hand at 33ᶠ, at each revolution of the ring, the fulcrum may be shifted to a new position and the pressure applied to the ring may thus be increased. The crank pin starting at dead center when beginning the rolling operation, the pressure applied to the ring at the points always begins with the same minimum. The fulcrum block can then be brought back to its initial position after the desired number of revolutions of the ring, or this shifting may be done automatically.

The ring which has been rolled by the foregoing method so as to give it uniform outward pressure and a twist, is shown more particularly in Figs. 1 to 7. The ring twists when rolled on its inside face toward one side of its central portion, the outer curved face adjacent to the rolled portion being thus pressed outwardly when the ring 1 is confined in the piston groove 40, and is within the cylinder 41. This is shown considerably exaggerated in Fig. 1;

the upper portion of which figure lies toward the explosion end of the cylinder.

The radial width of the ring which has been rolled, at the compressed portion of a cross-section is less than at the uncompressed portion (see Fig. 7) in which the compressed dimension *a* is less than the uncompressed dimension *b*.

In Fig. 4, a circumferential notch is made in the flat face of the outwardly twisted portion of the ring. The notch will thus act to scrape the oil towards the crank case. It also helps to twist the rolled ring, the removal of the metal by means of the notch, unbalancing the stresses so as to cause the ring to twist in the same direction as that produced by the off-center rolling. The ring when rolled so as to give it a uniform twist and uniform radial pressure when confined in circular form within the cylinder will, when in a free state outside of the cylinder assume a non-circular form. It will have a variable radius of curvature, the shortest at the split, the maximum at a point midway of the ring and opposite the split, and in between according to the law of rolling. The twist, per unit of length when the ring is in a free state, begins at the points and increases toward the midsection opposite the points. The twist is not great, at the points the twist may be very small, a few minutes of arc and at the midsection the twist may be 1 or 2 degrees, but, of course, the amount of twist may vary between wider limits. If the ring is placed on a flat plate and its portion opposite the split is pressed against the plate, the points of the ring will rise, the twist having an accumulative effect from the midsection toward the points (see Fig. 5). The angles between the flat faces of the ring and outer curved face remain substantially right angles but the angles between the inner compressed face and the flat faces vary from this somewhat (see the diagram in Fig. 7), the variation being least at the points and most at the midsection.

What I claim is:

1. The method of twisting a ring which consists in rolling a circumferential face of the ring more at one side of the central diametrical zone of the ring, the condensations of the metal due to rolling lying more to one side of the central portion of the ring.

2. The method of twisting a ring which consists in rolling a circumferential face of the ring more at one side of the central portion of the ring, the condensations of the metal due to rolling lying more to one side of the central zone of the ring, and in varying the rolling pressure in accordance with a predetermined law.

3. The method of twisting a ring which consists in so rolling the inside face of the ring that the condensations of the metal due to rolling, lie more to one side of the central portion of the ring.

4. The method of twisting a ring which consists in rolling the inside face of the ring more at one side of the central portion of the ring, the condensations of the metal due to rolling lying more to one side of the central zone of the ring, and in varying the roller pressure in accordance with a predetermined law.

5. The method of twisting a ring which consists in once rolling the inside face of the ring more at one side of the central zone of the ring, the condensations of the metal due to rolling lying more to one side of the central portion of the ring, varying the roller pressure in accordance with a predetermined law, and then rerolling the ring with increasing pressure during a second revolution.

6. The method of twisting a ring which consists in rolling the inside face of the ring more at one side of the central portion of the ring, the condensations of the metal due to rolling lying more to one side of the central zone of the ring, in varying the roller pressure in accordance with a predetermined law, and in simultaneously applying pressure to the flat faces of the ring so as to prevent a lateral flow of metal across the inside face of the ring.

In witness whereof, I have signed my name to this specification.

ROBT. B. WASSON.