July 12, 1927. 1,635,530

E. N. BRODERICK

PISTON RING

Filed Nov. 5, 1920

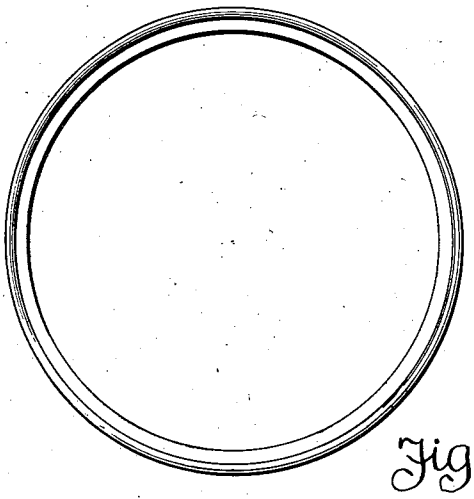


Fig. 1.

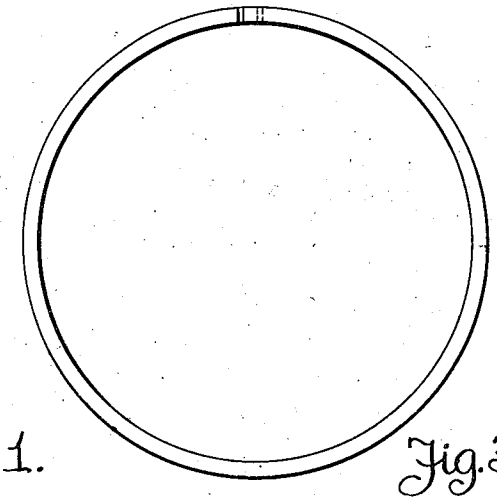


Fig. 3.

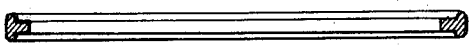


Fig. 2.

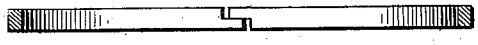


Fig. 4.

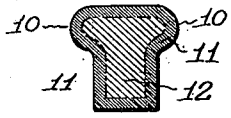


Fig. 5.

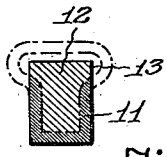


Fig. 6.

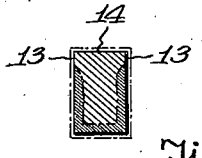


Fig. 7.

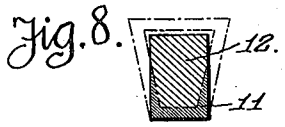


Fig. 8.

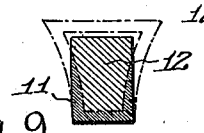


Fig. 9.

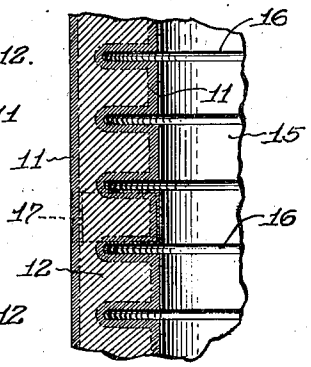


Fig. 10.

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UNITED STATES PATENT OFFICE.

ERNEST N. BRODERICK, OF DETROIT, MICHIGAN.

PISTON RING.

Application filed November 5, 1920. Serial No. 421,893.

This invention relates to piston rings and to methods of casting piston rings for internal combustion engines and has for its object the production of a highly elastic ring with a wearing surface free from portions of such hardness as to cause uneven or excessive wear of the cylinder.

It has been a common practice to manufacture piston rings by making a tubular casting of iron slightly softer than the metal of which the cylinders are cast, and after boring out the interior and turning off the exterior surface, cutting the tube into narrow sections which are then ground, severed at one side to permit expansion and contraction, and shaped to fit the cylinder when in position. Such rings are so readily distorted by careless or unskilled workmen while being set into the piston grooves that it has become the practice in the manufacture of higher grade rings to cast each ring separately in the endeavor to secure better castings and more highly resilient rings.

When a small, light casting is made in the usual way, there is an outer surface which, because is has chilled so rapidly in the mold, is very hard, and unless this hardened portion is removed completely, there will be a place in the ring casting harder than the cylinder and this will act to score the cylinder wall. It the chilled surface is completely removed, the ring is no more elastic, or but very little more elastic than one made by cutting sections from a tube as described above.

I propose to gain all the advantages of the individually cast ring while obviating its disadvantages by making the shape of the rough casting such that when the ring is finished the wearing surface will be free from hard portions while the remainder of the ring will have a hard and highly elastic surface making it much more resilient than a ring as ordinarily made.

To accomplish this result, I make the outer periphery of the casting considerably wider than the inner portion, and the diameter of the casting greater than that of the finished ring so that when the side faces are made parallel and the outer circumference turned down to the proper size, all of the hard, chilled exterior portion of the casting will be removed from the wearing surface of the ring while part of both side faces and the inner circumference will retain a surface layer of chilled, hard, and elastic metal which will act as a spring to render the ring more resilient and less readily deformed than those not having such a surface.

In the drawing,

Figures 1 and 2 are respectively a plan view and a diametral section of the casting;

Figs. 3 and 4 are respectively a plan and a diametral section of the finished ring;

Fig. 5 is an enlarged section of the preferred form of casting;

Fig. 6 is a section indicating the contour after the removal of the first portion of the surplus material;

Fig. 7 is a section showing the distribution of material in the finished ring;

Figs. 8 and 9 are sections of modified structures showing other embodiments of the same invention; and

Fig. 10 is a section of a fragment of another form of blank.

In the form illustrated in Figs. 5, 6, and 7, representing successive stages of manufacture, the casting for the ring is made with the outer circumference enlarged in width by the addition of laterally projecting annular portions 10, 10, which extend far enough to each side to carry the outer layer of chilled metal, indicated at 11, by heavier shading, beyond the plane of the sides of the finished ring. The casting is also sufficiently greater in diameter than the finished ring so that the removal of the outer circumference in reducing the casting to the diameter of the ring will result in the removal of all of the chilled portion from the wearing surface. After removing the excess of metal from the outer circumference and from the sides of the outer edges, only a small portion of the chilled metal will be taken from the inner circumference and from the inner portion of the side faces in the finishing grinding as is indicated by the small space between the dot-and-dash line and the section in Fig. 7. It will be understood that the dimensions shown are greatly exaggerated.

The inner portion 12 of the casting is free from the hardened metal formed upon the outer surfaces of the casting, and by making the contour as shown in Fig. 5, the removal of the projecting portions 10 beyond the planes of the sides of the ring will leave the soft interior exposed at each side for a short distance in from the outer circumference, as indicated at 13, while the cutting off of the outer circumference to reduce the

blank to the diameter of the ring will leave a soft wearing surface 14. Thus as the ring wears, it may be reduced to a diameter such as to necessitate its replacement before the hard portions 11 left on the sides will be reached.

The U-shaped hardened portion, left as the surface of the inner circumference and the inner portion of the sides, acts as a spring member to provide sufficient resiliency to hold the ring in proper contact with the cylinder and to cause it to resume its circular contour after distortion.

The dot-and-dash outlines in Figs. 8 and 9 indicate other sections that may be used to give different distributions of the hardened portions left in the finished ring. With the straight sides shown in Fig. 8, it will be noted that there will be less of the chilled metal left than when the sides are curved as in Fig. 9. Other similar cross sections may obviously be employed, the essential features in each case being the excess of metal at each side, and the greater diameter of the casting as compared with the finished ring to insure that all of the metal of undesirable hardness may be removed from the outer periphery and inward from the edges while leaving the U-shaped, chilled, spring portion extending outward from the inner circumference.

In the form of blank indicated in Fig. 10, a cylinder 15 is cast with a series of internal channels 16, the internal surface of the cylinder and the channels being chilled in casting. The cylinder is cut into sections, the cuts being in the plane of the bottom of the channels, and the ring blanks are then finished as in the cases where the blanks are separately cast, by the removal of the outer circumference to a point beneath the hardened portion, and by the removal of a relatively small amount from the sides and inner circumference as indicated at 17 in dashed lines. The hard surface layer is indicated by the numeral 11 in this figure and by the darker section lining.

It has previously been proposed to form piston rings having upon the periphery a facing of anti-friction material of a different composition from that constituting the body of the ring, but rings made by the process disclosed herein have all portions of the ring produced concurrently to provide a permanent molecular arrangement of the ring with one of the zones having less hardness than that of the cylinder with which it is to be used, and another zone integral therewith and composed of the same materials, but having the quality of greater resiliency because of a difference in molecular arrangement due to the more rapid cooling of this portion because of its direct contact with the walls of the mold.

Substantially all commercial metallic castings consist of a mixture of various ingredients capable of varying molecular arrangements, and the quality of the finished product is dependent upon the manner in which these various arrangements occur during the process of manufacture. The resilient outer skin which forms the U-shape hardened portion left as the surface of the inner circumference and the inner portion of the sides is composed of substantially the same chemical ingredients as is the material forming the softer outer periphery, the difference in hardness being due principally to the variation in the molecular arrangement of the constituent material, while the molten alloy is hardening in the mold.

What I claim is:—

1. An integral piston ring having its outer circumference and a portion of each side face extending inward from the circumference formed of a metal of less hardness than that of the cylinder with which it is to be used and having the surface of the inner circumference and the remaining portion of each side face composed of the same metal having its constituent elements provided with a molecular arrangement of greater hardness than that of the outer circumference.

2. An integral piston ring comprising two portions composed of the same elements, one relatively soft and the other relatively hard, the soft portion forming the surface of the outer circumference and extending inward from the outer edges, and the hard portion arranged as the U-shaped exterior of the inner circumference and the adjacent surfaces of the side faces.

3. A piston ring having the inner circumference and the inner portion of each side face formed of chilled cast iron, and the outer circumference and the outer portion of each side face formed of cast iron devoid of chilled portions.

4. The method of producing piston rings which includes casting an annular blank having a greater diameter than the finished ring and an outer edge thicker than the inner edge, the entire surface having a hard, chilled portion, then removing the chilled portion from the outer circumference and reducing the diameter to that desired for the finished ring, and removing the chilled portion from both sides of the outer edge.

5. The method of producing piston rings which includes casting an annular blank having a hard chilled surface layer and removing the entire hard layer from the outer circumference and from the portion of the sides adjacent thereto while retaining the major part of the hard layer on the remaining portion of the sides and on the inner circumference.

6. The method of producing a piston ring which comprises casting a blank of greater

dimensions than desired for the ring and reducing the blank to the desired dimensions of the finished ring by removing the outer surfaces, the inner circumference and the portions of the side faces adjacent thereto being cast with a chilled, hard surface of approximately the dimensions of that portion of the finished ring, so that little is removed, the hardened portion being left substantially as cast, and the outer circumference of the blank and the portion of the side faces adjacent thereto having a configuration such that enough material must be removed in reducing that portion to the dimensions of the finished ring to ensure the removal of any hardened portions that may be formed near the surface.

7. The method of producing a piston ring which comprises casting a blank which has a part, having approximately the dimensions desired for the inner circumference and the portions of the side faces adjacent thereto in the finished ring, cast with a chill, the portion of the blank from which the outer circumference and the side faces adjacent thereto are formed having dimensions sufficiently greater than those of the finished ring to ensure the removal of the surface hardening produced when the blank is cast.

8. A piston ring having portions differing as to resiliency characteristics, one of said portions being of less hardness than that of the cylinder with which it is to be used, said portion forming the wearing face and a portion of each side face of the ring, another of said portions being of greater resiliency than that forming the wearing surface, said portions being concurrently cast.

9. A piston ring blank comprising a body of greater width in cross-section at its outer than at its inner periphery, said blank being cast with a chilled surface, a portion of which surface is removed in finishing the blank to bring it to proper cross-sectional configuration.

In testimony whereof I affix my signature.

ERNEST N. BRODERICK.