May 31, 1927. 1,630,759

W. S. PIERCE, JR

BREAKING DEVICE FOR HOLLOW CYLINDERS

Filed April 23, 1926

Fig. 1.

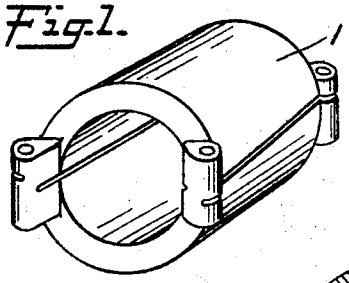


Fig. 3.

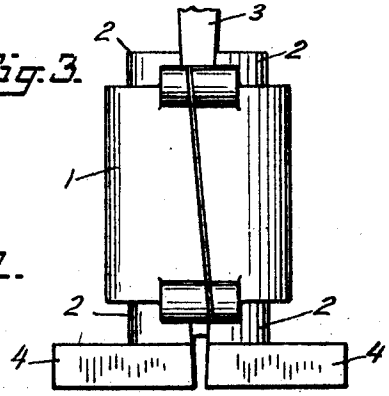


Fig. 2.

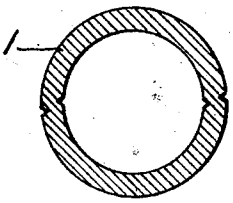


Fig. 4.

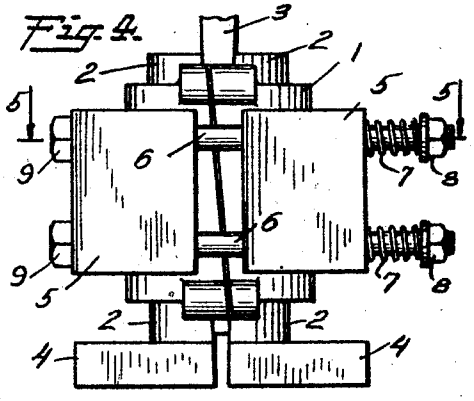


Fig. 5.

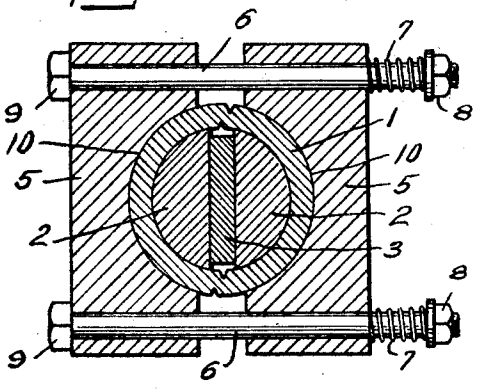


Fig. 8.

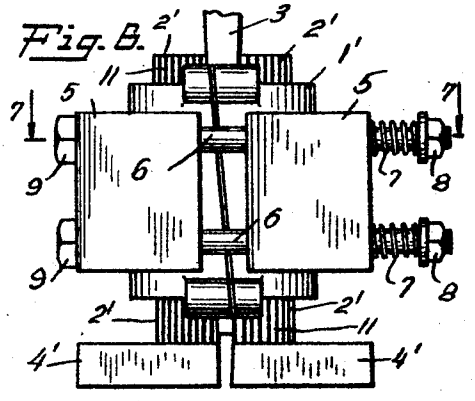
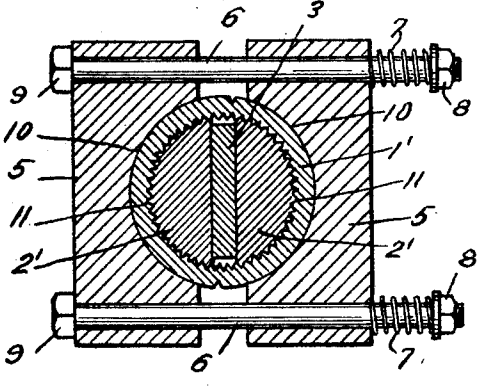


Fig. 7.



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UNITED STATES PATENT OFFICE.

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BREAKING DEVICE FOR HOLLOW CYLINDERS.

Application filed April 23, 1926. Serial No. 104,110.

This invention relates to the breaking of hollow cylinders into axial sections. In general, it includes a method of breaking cylinders of such type, and an improved breaking device for accomplishing such a result. In particular, this invention is useful in the manufacture of split bearing races such as are described and claimed in my application Serial No. 76,006, filed December 17, 1925, and in my Patent No. 1,498,748.

In breaking hollow cylinders for use as bearing races of the type disclosed in the above mentioned application and patent, I prefer to apply force to the inner surface of the cylinder until sufficient tensile stress is developed in the cylinder walls to break the cylinder along axial lines previously scored or grooved. This force is applied to the inner surface of the cylinder throughout substantially the entire area of the surface. It may be done by subjecting the cylinder to the action of fluid pressure, or by filling the cylinder with a soft metal, such as lead, and applying sufficient pressure to this metal to break the cylinder. Furthermore, an expansion device comprising two members, each having one plane surface and one semi-cylindrical surface closely fitting the inside of the cylinder, may be employed. A third member, wedge-shaped, engages with the plane surface of each of the other members to force them apart until the cylinder is broken.

I have found when using such a device in practice that at times there is a tendency for one side of the cylinder to break before the other with the result that a hinging action takes place about the side last to break. This leads to a distortion of the line of fracture and sometimes a damaging of the broken surface itself. The importance of such a condition is particularly emphasized for such cases where the cylinder or bearing is completely machined before fracturing. Any slight distortion or feathering of the fracture then becomes extremely undesirable.

In order to avoid the various above mentioned difficulties, I have constructed a breaking device having an external yoke, partially surrounding the cylinder, to produce straight line separation of the broken sections thereof. Any tendency for a hinging action is thus eliminated. In general, this may be accomplished by a pair of spring loaded, parallelopipedal shoes placed one on each side of the intended plane of fracture and so shaped as to contact with the outside surface of the cylinder along substantially a semi-cylindrical surface.

To still further assure smooth fracture, I have devised as a particular form of my invention an internal expansion member providing an even distribution of the expansion force of the wedge. I obtain this result by longitudinally machining the inner surface of the cylinder and the two semi-cylindrical surfaces of the members contacting therewith, to form ribs and grooves. I thereby produce a positive non-rotative contact between the internal expansion member and the inner surface of the cylinder that gives an even distribution of the expansion force of the wedge throughout the cylinder walls.

My invention can be best understood by considering the following detailed description, which is to be taken in conjunction with the accompanying drawings wherein:

Figure 1 is a perspective view of a bearing cylinder in the manufacture of which this invention may be used;

Figure 2 is a cross section of the bearing cylinder of Figure 1 showing the internal and external scorings or grooves along which the cylinder fractures upon breaking;

Figure 3 is an elevation showing a bearing cylinder placed over an internal expansion member;

Figure 4 is an elevation showing one form of a complete breaking device;

Figure 5 is a section through Figure 4 on the line 5—5;

Figure 6 is an elevation of another form of a complete breaking device;

Figure 7 is a section through Figure 6 on the line 7—7.

In describing the invention more in detail in connection with the accompanying drawings, and the embodiment of the invention illustrated therein, it will be understood that the drawings as well as the description are intended to be illustrative of the invention, and not to be limited to use in the manufacture of the particular type of bearing I have illustrated therein.

Figures 1 and 2 illustrate the type of bearing cylinders described in my previously mentioned application and patent. The scorings along which the cylinder breaks are clearly shown in Figure 2. It is this type of bearing cylinder that is shown in the

drawings and that is described in the description as constituting one use for the breaking device of this application.

Figure 3 shows a form of the internal expansion member with a bearing cylinder in position for breaking without the use of the external compression shoes. The bearing cylinder is indicated at 1, and the two members having external, semi-cylindrical surfaces contacting with the inner surface of the cylinder are shown at 2—2. Each of these members may be provided with a base portion 4 forming a support for holding the member in an upright position. The inner surfaces of the members are inclined to the axis of the cylinder, and a wedge 3 inserted between them as shown. The grooves along which the cylinder is to be broken should preferably be as nearly as possible in line with the longitudinal plane of the wedge. Such a position leads to a more even distribution of the expansion force of the wedge, with the result that a more uniform tensile stress is developed across both lines of fracture.

If the cylinder were broken with the device as shown in Figure 3, all of the troubles and difficulties in obtaining a smooth clean fracture as outlined in the earlier discussion would be present. The illustration makes clear the hinging action that can take place if one side should break before the other, and also the lack of any means to prevent it should it occur.

By placing a set of external restricting or compression shoes partially surrounding the cylinder, as shown in Figure 4, the possibility of such hinging action is eliminated. The external member can be slipped over the assembly of Figure 3, and adjusted to the position shown. The two parallelopipedal shoes 5, 5 are interconnected by bolts 6 and compressed together under the action of coil springs 7. The bolts have fixed heads 9 and adjustable nuts 8 to permit regulation of the degree of spring compression. I have illustrated four bolts, each having a coil spring, but it is conceivable that 6 and perhaps more could be used and that some other form of spring loading could be adapted. In practice, however, I have found four bolts with a coil spring on each bolt to be very satisfactory. Alignment splines might also be provided.

The advantage of such a set of shoes depends upon the restraining action they offer to any force other than that which is parallel to the line of the bolts. Figure 5 perhaps makes such condition a little clearer and also illustrates to better advantage the contact between the cylinder and the various members of the breaking device. In this figure the wedge is indicated at 3 and the internal expansion members contacting with the inner surface of the cylinder at 2, 2. The cylinder to be broken is shown at 1 and the two external diametrically opposite shoes partially surrounding it at 5, 5. The substantially semi-cylindrical inner surface 10 of the shoes contacts with the outer surface of the cylinder. The bolts and springs are as previously described.

With the cylinder in the position shown, which brings the scored sections midway between the two shoes and substantially in line with the wedge, the wedge 3 is gradually forced between the members 2, 2 and a tensile stress developed across the scored section of the cylinder. If this stress becomes great enough the cylinder wall will break at that point. As the expansion gradually increases the shoes 5, 5 will slide laterally along the bolts 6 against the action of the springs 7, the amount depending upon the material of which the cylinder is made. At all times there is a constant compression force being exerted upon the outer surface of the cylinder tending to restrain any great outward movement. Since the shoes fit snugly over the bolts they are free to move in but one direction—that along the line of the bolts. Even if one side breaks before the other no hinging action about the line to break can result because such a rotative force applied to one side of the shoe would immediately produce a binding action that would lock the shoes against further movement. The closer the shoes fit the bolts the more instantaneous will such action be, and the more effective the restraining action of the shoes. From this it is evident that the shoes hold the two halves of the cylinders together in their original relation until both scorings have broken and the force of expansion has once more become a straight line force parallel to the line of the bolts. If both sides break simultaneously no binding action will occur, and the shoes will separate under the straight line force of expansion. If the mass of the shoes is made very large compared with the cylinder the restrictive force becomes still greater due to the added force needed to set such large masses in motion.

To make a clean even break doubly sure I may combine the same external shoes with a somewhat different form of internal expansion member, as shown in Figure 6 and Figure 7. The tendency for one side to break before the other, which may occur with a smooth internal expansion member may be due to uneven distribution of the expansion force of the wedge through the cylinder walls. A slight change in the position of the grooves away from the line of the wedge would be sufficient to produce different tensile stress across the two scored sections, granting, of course, that the cylinder is of uniform density throughout. Another cause might be the lack of a positive non-rotative

contact between the expansion member and the inner surface of the cylinder. As the cylinder expands under the force of the wedge the force distribution across the contact surface might change considerably in location if the expansion member is free to move relatively to the cylinder.

By machining the semi-cylindrical surfaces of the internal expansion member and also the inner surface of the cylinder to form longitudinal ribs and grooves, as shown at 11, Figure 7, a positive interlocking contact between the two is obtained. If the cylinder 1′ is now placed over the internal expansion member 2′, with the scoring in correct alignment with the wedge, it will be locked in that position until removed. Rotative movement or slipping of one about the other, is impossible. The result is that when the wedge is driven down the expansion force will be transmitted through the interlocking ribs and grooves to every part of the cylinder wall. As the cylinder expands the internal member expands with it, always maintaining the same force distribution across the contact surface because of the positive engagement of the ribs and grooves. The tensile stress then developed across each scored section will be of substantially the same magnitude, and both sides will break at the same time.

I have found such a breaking device as set forth in the foregoing description and drawings to be very satisfactory in use. By driving the wedge between the two parts of the internal expansion member force is applied to the inner surface of the cylinder in such a manner that there is no tendency to distort the two sections of the cylinder during the breaking operation. The semi-cylindrical surfaces of the members 2, 2 or 2′, 2′ fit exactly the inner surface of the cylinder, and the concave portions of the two external shoes 5. 5 fit exactly the outer surface of the cylinder; the result is that the only stress of any great magnitude developed in the cylinder walls is a tensile stress across the scored sections.

In the one form characterized by the device shown in Figure 4 any hinging action of the cylinder halves due to one side breaking before the other is entirely neutralized by the binding action of the external shoes, and a perfect break is assured. In the other form, illustrated in Figure 6, the ribbed and grooved contact surface of the internal member so distributes the expansion force that the possibility of one side breaking first is eliminated, and the compressing action of the external shoes assures a quick, sharp and simu'taneous break at both scored sections.

It is to be understood that various changes and modifications can be made in the embodiment of my invention as illustrated and described without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A breaking device for hollow cylinders comprising an internal, expanding member for applying force to the inner surface of the cylinder to break it into sections and an external restricting member for restricting the movement of said sections.

2. A breaking device for hollow cylinders comprising an internal expanding member of a plurality of parts for applying force to the inner surface of the cylinder to break it into sections, and an external restricting member of a plurality of parts for restricting the movement of said sections.

3. A breaking device for hollow cylinders comprising an external restricting member, and an internal expanding member having two semi-cylindrical portions with radii substantially equal to the bore of the short cylinder to be broken, the said semi-cylindrical surfaces being adapted to contact with the inner surface of said cylinder.

4. A breaking device for hollow cylinders comprising an external restricting member, and an internal expanding member composed of three portions, two of which have one plane surface and one semi-cylindrical surface, the semi-cylindrical surface having substantially the same radius as that of the bore of the cylinder to be broken, and the plane surface being adapted to be inclined to the axis of said cylinder, the said third portion being wedge shaped and adapted to engage said plane surface so as to urge the said semi-cylindrical surfaces into contact with the bore of the cylinder to be broken.

5. A breaking device for hollow cylinders comprising an internal expanding member for applying force to the inner surface of the cylinder to break it into sections, and an external restricting member composed of two parallelopipedal shoes adapted to partly surround the cylinder to be broken for restricting the movement of said sections.

6. A breaking device for hollow cylinders comprising an internal expanding member for applying force to the inner surface of the cylinder to break it into sections, and an external restricting member composed of two parallelopipedal shoes transversely yieldable for restricting the movement of said sections.

7. A breaking device for hollow cylinders comprising an internal expanding member for applying force to the inner surface of said cylinder to break it into sections, an external restricting member composed of two parallelopipedal shoes for restricting the movement of said sections and springs controlling said external member to produce transverse movement in a straight line.

8. A breaking device for hollow cylinders comprising an internal expanding member

for applying force to the inner surface of the cylinder to break it into sections, and an external, transversely yieldable, restricting member adapted to partially surround the cylinder to be broken for restricting the movement of said sections.

9. A breaking device for hollow cylinders comprising an internal expanding member, and an external, transversely yieldable, restricting member adapted to prevent rotation of at least a portion of the cylinder to be broken along any of its lines of fracture.

10. A breaking device for hollow cylinders comprising an internal expanding member for applying force to the inner surface of the cylinder to break it into sections, and an external restricting member composed of two spring-loaded parallelopipedal shoes each with a concave inner surface of substantially the same radius as that of the outside surface of the cylinder to be broken for restricting the movement of said sections.

11. A breaking device for hollow cylinders comprising an internal expanding member for applying force to the inner surface of the cylinder to break it into sections, and an external restricting member composed of two spring-loaded parallelopipedal shoes having concave inner surfaces adapted to diametrically contact with the outside surface of the cylinder to be broken for restricting the movement of said sections.

12. A breaking device for hollow cylinders comprising an internal expanding member, and an external, transversely yieldable, restricting member composed of two parallelopipedal shoes having concave inner surfaces adapted to diametrically contact with the outside surface of the cylinder to be broken, and adapted to prevent rotation of at least a portion of said cylinder about any of its lines of fracture.

13. A breaking device for hollow cylinders comprising an internal expanding member, and an external, transversely yieldable, restricting member composed of two parallelopipedal shoes having inner faces adapted to be diametrically opposed across the cylinder to be broken, and parallel to both a plane containing the longitudinal axis of the wedge of said internal expanding member and any diameter containing the lines of fracture of said cylinder.

14. A breaking device for hollow cylinders comprising an internal expanding member, and an external, restricting member composed of two shoes adapted to be diametrically opposed across the cylinder to be broken and limited to a line of motion within or parallel to the plane containing the axis of said cylinder and the longitudinal axes of both shoes.

15. A breaking device for hollow cylinders comprising an external restricting member, and an internal expanding member having a multiplicity of axial ribs and grooves on its outer surface adapted for positive contact with the inner surface of the cylinder to be broken.

16. A breaking device for internally ribbed and grooved hollow cylinders comprising an external restricting member, and an internal expanding member having a multiplicity of axial ribs and grooves on its outer surface adapted to fit into the ribs and grooves on the inner surface of said cylinder, whereby positive and non-rotative contact is obtained between said expanding member and said cylinder.

17. The method of breaking hollow cylinders which comprises scoring one surface of a hollow cylinder with a groove, scoring the other surface of the cylinder, placing around said cylinder a spring-loaded restricting member comprising two shoes diametrically contacting, between the scored grooves, with the outer surface of said cylinder, and applying a force to the inner surface of the cylinder until said cylinder fractures along the scored grooves.

18. The method of breaking hollow cylinders which comprises scoring one surface of a hollow cylinder with a groove; scoring the other surface of the cylinder; placing said cylinder over a device comprising two members each with one semi-cylindrical surface having a radius substantially equal to that of the bore of said cylinder and a plane surface longitudinally inclined to the axis of said cylinder, and a third wedge-shaped member adapted to urge said semi-cylindrical surfaces into contact with the inner surface of said cylinder; placing around the said so mounted cylinder a spring-loaded member comprising two shoes diametrically contacting, between the scored grooves, with the outer surface of the cylinder; and forcing said wedge-shaped member between the adjacent members of said device until the cylinder fractures along the scored grooves.

19. The method of breaking hollow cylinders which comprises scoring one surface of a hollow cylinder with a groove; scoring the other surface of the cylinder; broaching the inner surface of the cylinder to produce a multiplicity of ribs and grooves; placing said cylinder over a device comprising two members similarly ribbed and grooved to fit the inner surface of the cylinder with positive, non-rotative contact, each of said members having one semi-cylindrical surface with a radius substantially equal to that of the bore of said cylinder and a plane surface longitudinally inclined to the axis of said cylinder, and a third wedge-shaped member adapted to urge said semi-cylindrical surfaces into contact with the inner surface of said cylinder; placing around the said so

mounted cylinder a spring-loaded, transversely yieldable member adjusted to prevent rotation of any portion of said cylinder about any of its lines of fracture, and comprising two shoes diametrically contacting with the outer surface of the cylinder between the scored grooves; and forcing said wedge-shaped member between the adjacent members of said device until the cylinder fractures along the scored grooves.

20. The method of breaking hollow cylinders, which consists in scoring one surface of a cylindrical piece of metal with grooves having at least a portion thereof extending at an angle to any plane containing the axis of the cylinder, scoring the other face of the piece of metal, placing the piece of metal over a device comprising two semi-cylindrical pieces having radii substantially equal to that of the bore of the said piece of metal, the said semi-cylindrical surfaces being in contact with the inner surface of the said piece of metal, and forcing the two pieces of said device apart, while constantly maintaining the two portions of said piece of metal on opposite sides of said grooves in parallelism by a laterally yieldable pressure, until the piece of metal breaks along the scored grooves therein.

21. The method of breaking hollow cylinders, which consists in scoring one surface of a cylindrical piece of metal with grooves having at least a portion thereof extending at an angle to any plane containing the axis of the cylinder, scoring the other face of the piece of metal, placing the piece of metal over a device comprising members two of which each have one plane surface and one semi-cylindrical surface, the semi-cylindrical surface having substantially the same radius as that of the bore of the said cylindrical piece of metal, and the plane surfaces being inclined at an angle to the axis of said cylindrical piece, the said third member being wedge-shaped and adapted to engage said plane surfaces so as to hold the semi-cylindrical surfaces in contact with the bore of said cylindrical piece of metal; and forcing said wedge-shaped member between the adjacent members of said device, while constantly maintaining the two portions of said piece of metal on opposite sides of said grooves in parallelism by a laterally yieldable pressure, until the lateral strain transmitted through said semi-cylindrical members to the said piece of metal causes the same to break along the scored grooves therein.

In testimony whereof I affix my signature.

WINSLOW S. PIERCE, JR.