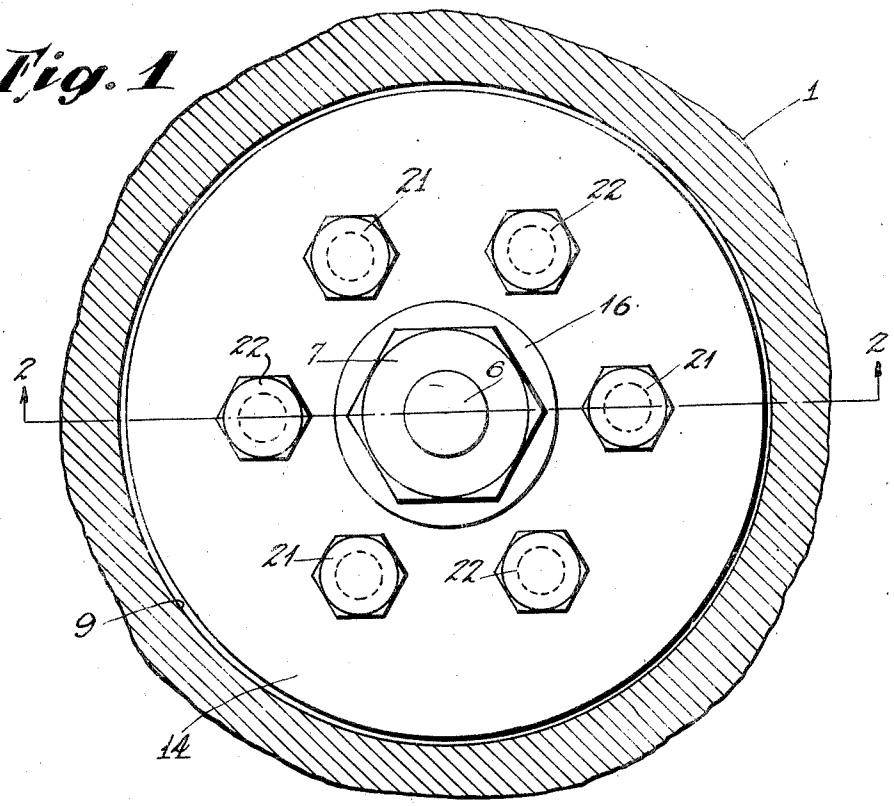
July 16, 1929. W. G. WILSON 1,721,325

PISTON PACKING

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Fig. 1



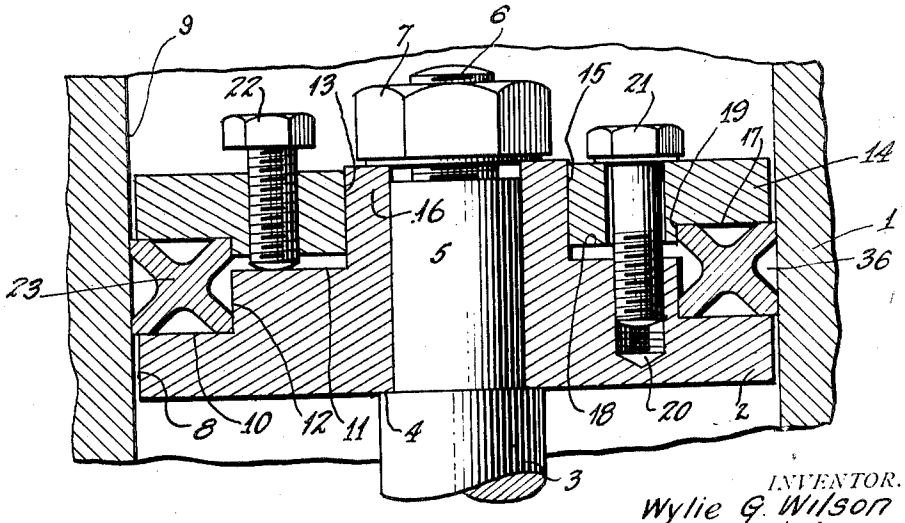


Fig. 2

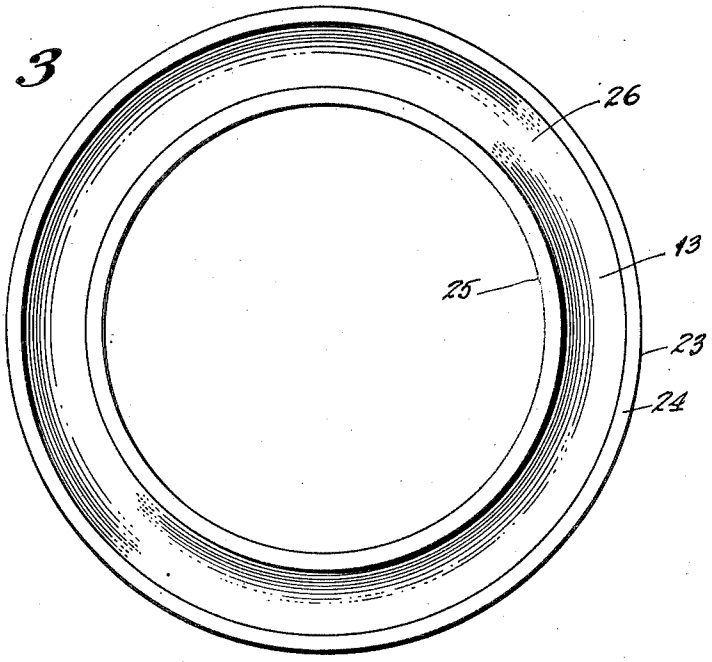
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July 16, 1929. W. G. WILSON 1,721,325

PISTON PACKING

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Fig. 3



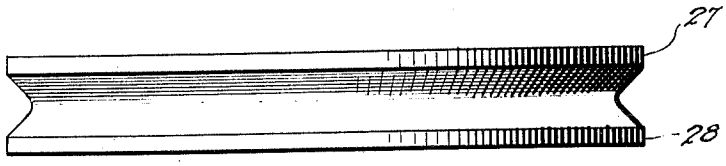


Fig. 4

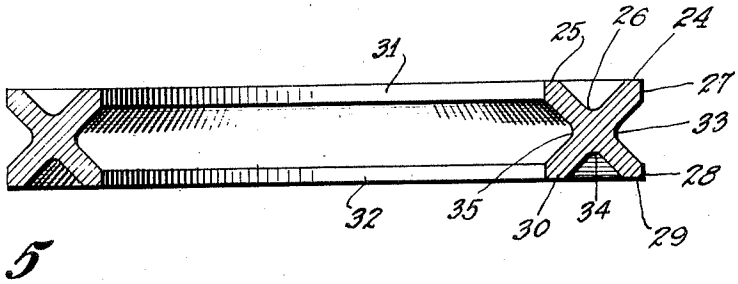


Fig. 5

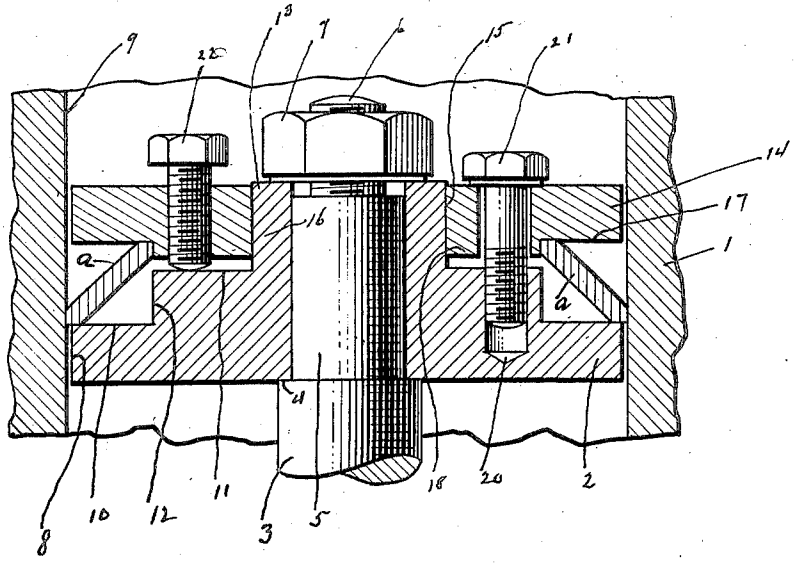
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PISTON PACKING

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Fig. 6



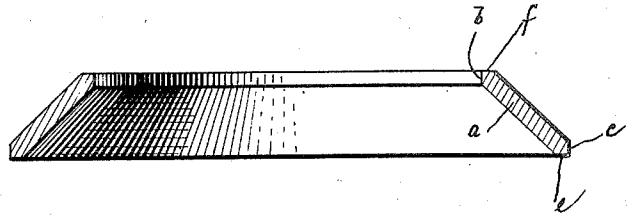


Fig. 7

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UNITED STATES PATENT OFFICE.

WYLIE G. WILSON, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO WILSON RINGS COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

PISTON PACKING.

Application filed January 25, 1926. Serial No. 83,424.

This invention relates to a piston and ring assembly adapted to preclude leakage of pressure behind the ring and between the ring and the wall of the associated cylinder.

It is the general practice to provide pistons with one or more metal rings, each of which is split at one point of its circumference to allow of the positioning of the ring on the piston and to permit of radial expansion of the ring into relatively close conformity with the cylinder wall. Such rings are generally made with a normal exterior diameter, somewhat larger than the cylinder bore and upon introduction into the cylinder are contracted and slipped into place, so that their inherent resiliency will cause them to press against said wall.

In a ring of this character, it is absolutely essential in order to compensate for expansion and contraction of the ring under varying changes in temperature, to provide more or less clearance at the gap and it has long been recognized that no matter how well the ring is fitted some leakage must occur at this point, as well as through the ring groove of the piston behind the ring. Furthermore, when a ring is split in the manner described and held against the cylinder wall by its own inherent resiliency, it manifestly follows that such a ring will not uniformly engage the cylinder wall, but, in contradistinction, it will generally engage at different points with greater pressure than at other points, thereby causing unequal wear on both the ring and the cylinder wall. It is largely because of the leakage to which I have referred that a plurality of such rings are generally employed, so that the pressure which may leak past the first ring will be partially retained by the next and so on. Thus, in a piston having three rings, all three are in practice essential to hold compression and if these rings are not properly fitted or are unduly worn, even three of them will not properly hold such compression.

The foregoing practice is common in internal combustion engines. In some of the other arts where pistons and cylinders cooperate, as in pumps, pliable packing of leather, rubber and analogous materials has been extensively used. These materials are, however, permanently deformable and they soon become so permanently distorted as a result of wear, physical deterioration or other causes that they can no longer perform their intended functions. In all prior art structures employing either metal piston rings or a flexible packing, frequent inspection and repairs, at very considerable annoyance and expense, are necessary in order to maintain the assembly in a condition to preclude serious leakage of compression.

With these considerations in mind, the primary object of the present invention is to provide a piston and ring assembly capable of functioning throughout long periods of use or inactivity in the promotion of a tight seal between the piston and the cylinder wall, so as to hold pressure or compression and without that detrimental leakage which so quickly develops in spite of the best prior practice.

Speaking generally, the assembly of this invention embodies as one element of the construction, a piston ring of unbroken, i. e., unsplit, hollow frusto conical form, and in the preferred embodiment of the invention, the ring is of composite frusto conical section. That is to say, it preferably embodies two frusto conical sections which intersect one another at substantially midway of their height, so as to form a ring section which is substantially cruciform or X shape.

I have discovered that a ring thus formed will function with remarkable efficiency in the formation of a tight seal against leakage of pressure between the ring and the cylinder wall and the base of the ring groove, when such ring is constructed from materials which, for the purpose of this invention are termed "obdurate materials". By this term is meant materials which are bendable, but not easily bent, compressible, but not easily compressed, elastic, but not easily deformed. As examples of obdurate materials, I may mention, with excluding others, iron, steel, hard alloys (such as bronze), glass, ceramic materials, hard rubber and wood. These materials are in pronounced contradistinction to those, which may be termed "non-obdurate," such as leather, asbestos, soft rubber, soft metals, etc.

I have discovered that when an unbroken hollow frusto conical section of obdurate material is placed under axial compression which tends to flatten it, that the outer periphery of the frusto conical section will tend to expand cross axially and its inner periph-

ery will tend to cross axially contract to bring both of said peripheries into engagement with suitable cooperating seats or abutments.

By "hollow frusto conical section", I mean a frusto conical section which is hollowed out to provide a frusto conical shell and by "axial compression", I mean pressure exerted upon the element in a direction coaxial with or parallel to its axis, whereby its altitude is diminished and the peripheral diameter of the base increased.

What has been said with reference to the peripheral expansion and contraction of a simple frusto conical section is also found to be present in composite sections and this is particularly true in sections wherein two hollow frusto conical sections are formed into a unitary structure in such manner that the sections intersect one another and produce a substantially cruciform cross section. When a ring thus formed is axially compressed, each frusto conical section will be expanded at its outer periphery, while each inner periphery will be simultaneously contracted.

An ideal piston ring construction thereby results from this arrangement for the reason that if the ring is positioned in an adjustable ring groove and axially compressed, by contraction, of the wall of said groove, the inner peripheries of the two sections will firmly engage with the base of the ring groove, while the outer peripheral edges of said sections may be brought into very nice sliding adjustment with respect to the cylinder wall. In this manner leakage back of the ring is absolutely precluded and the sliding engagement with the cylinder wall can be so nicely adjusted as to produce, in practice, a leak proof ring without undue friction.

Attention is particularly directed to the fact that the stressing of the ring must be within its elastic limit otherwise that nice adjustment to which I have referred would be impossible. For the best results, the ring, when in sealing condition, must be under internal stresses and thus in substantially balanced condition with respect to the compression forces acting upon it, so as to properly conform with the coacting surfaces of the piston and cylinder to form the efficient seal to which I have referred. If the material used in the manufacture of the ring is not obdurate or if the ring is compressed beyond its elastic limit, the efficient functioning of the ring cannot be obtained. In practice, the ring should tend to resume (i. e. tend to spring back to) its normal unsealing form when the sealing stresses are relieved.

The term "elastic limit", as employed in the specification and claims, is so employed to designate that quality or characteristic of the frusto conical form of obdurate material employed, which, when compressed within predetermined limits, and then relieved from such compression, will cause the section to return to approximately its original form and size. In accordance with this invention, it is intended that such compression shall be within and not beyond the tendency of said frusto conical section to return to its original form and size. That is to say, it is intended that the degree of axial pressure employed shall not be sufficient to break down and destroy the resilient or reactive quality of the frusto conical form herein described. On the contrary, it is the purpose in practising this invention that the degree of compression employed shall be limited to a degree where such reactive characteristic of the frusto conical form will not be seriously affected. For a better understanding of the operation of the frusto conical form of this invention, it is suggested that it functions like a toggle. This analogy is, of course, not absolute, but when considered in that light, it may be helpful to a clearer conception of the operation of the invention. When force is applied to the elbow of a toggle, a greater force is exerted at the ends of the toggle links, and this force increases in proportion as the axial dimension of the toggle, relative to the distance between the ends of the links, becomes less and less.

The ring of the present invention may be considered as functioning like a multiplicity of toggles; that is to say, there is a toggle-like action in each diametric plane of each frusto conical element of the construction, and, obviously, there is an infinite number of toggles. When the sealing element is compressed axially, the dimensions of each element and the proportion of the obdurate material of which it is composed, bring about, within the element, the steadily increasing functional characteristics incident to toggle action. This action results in a cross axial or radial movement of the ring until its outer and inner peripheries are forced into the desired tight sealing engagement with the coöperating seats.

The ring is so dimensioned and proportioned, and the seal is effected in the manner described before the elastic limit of the ring is reached. Accordingly, upon release of the stresses incident to producing the seal, the element tends to autogenously, i. e., automatically, return to its unstressed, unsealing form. To utilize the ring of the character described, it is of course essential that the piston be constructed to embody means for placing the ring under axial compression requisite to produce the seal and while the specific structural details of the piston may vary within wide limits without departing from the invention, I find it practical to provide a piston having a ring groove, the axial dimension of which is adjustable, so that after the ring is positioned in the groove in an unstressed condition, the axial dimension of said groove may

be decreased to place the ring under axial compression to effect the seal in the manner described.

It therefore follows that in an assembly embodying this invention, the seal between the ring and the piston and between the ring and the cylinder wall is effected by stressing a sealing member of hollow frusto conical form (preferably composite hollow frusto conical form) of obdurate material, within its elastic limit, by adjustment of the dimension of the ring groove, and that the seal is maintained as long as the ring is thus stressed.

It has been found in practice that in the operation of this device the grinding of the ring to a perfectly true fit may be dispensed with, thus accomplishing material economy in the operation of devices of this nature. It has been found that the structures here presented are such that even though in their primary manufacture they may not be axially coincident with relation each to the other, or of true complementary shape, yet in their conjoint operation they will adjust themselves to such irregularities and compensate for the same by reason of the material from which they are manufactured, together with the particular form employed in their construction.

Features of the invention, other than those specified, will be apparent from the hereinafter detailed description and claims, when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate one practical embodiment of the invention, but the construction therein shown is to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is an end view of a piston and piston ring assembly embodying the present invention.

Figure 2 is a section on the line 2—2 of Figure 1; and,

Figures 3, 4 and 5, respectively, show a piston ring of the character illustrated in Figure 2 in radial cross section; these views show said ring in plan, elevation and radial cross section.

Figure 6 is a vertical section of a modified construction, in that a frusto-conical element is shown, instead of a cruciform construction.

Figure 7 is a vertical section, partly in elevation, of said frusto-conical form.

Referring to the drawings, the several parts are indicated by numerals and letters, like numerals and letters referring to like parts.

1 is a cylinder diagrammatically illustrated. 2 is a piston and 3 a piston rod. These elements may cooperate as part of any kind of an engine assemblage or in any form of valve or pump in which such devices may be appropriately used, and in this sense they are employed in the description and claims of this application.

The details of construction are as follows: A piston rod 3 is reduced in diameter at 4 to form a shoulder, and hub as 5 and again reduced as at 6 to provide a screw threaded section on which is run the conventional nut 7. 8 is the periphery of the cylindrical piston 2. 9 is the internal surface of the cylinder.

The piston 2 is formed in steps forming annular surfaces. The surfaces 10 and 11 are in planes perpendicular to the axis of the said piston, while 12 and 13 are cylindrical surfaces having each an axis common with the axis of the piston. 14 is a disk having a central aperture 15. 16 is a hub adapted to fit loosely into the aperture 15 of the disk 14. Said disk 14 is stepped forming the surfaces 17 and 18, which are in planes perpendicular to the axis of the piston, while 19 is a cylindrical surface. 20 represents a plurality of screw-threaded depressions in one section of the piston 2, while 21 represents a plurality of screws adapted to pass through suitable apertures in the disk 14 and enter said screw holes. 22 are set screws adapted to be mounted in suitable screw threaded apertures in the disk 14 and bear upon the surface 11 to lock the disk in final adjustment when the screws 21 have accomplished their purpose.

The ring exhibited in Figures 3, 4 and 5, and particularly designated by the numeral 23, has the characteristics heretofore more fully described under the title "piston ring"—that is to say, it is integral and formed of what has previously been described as obdurate material, and it has the form of a hollow frusto-cone; i. e., it is of composite frusto-conical section and embodies two frusto-conical sections intersecting at a point substantially midway between the external and internal peripheries of said ring, thus presenting in radial cross section a cruciform or X-shape. The characteristics and qualities of such a ring have been fully developed in the previous presentation of the case. Its operation will be described later.

The physical construction of such a ring is preferably as follows: It is provided with eight faces, two of which, as 24 and 25, and 29 and 30, are in planes perpendicular to the axis of the ring and hence parallel to each other, one being the top surface and the other the bottom. It is also provided with two peripheral surfaces 27 and 28 which are in the lines of a common cylinder, and two internal faces 31 and 32 which in like manner are in the lines of a common cylinder said cylinders having a common axis. It is also provided with annular grooves or depressions 26, 33, 34 and 35.

The device is assembled as follows: The lower half of the cylinder 2 is run on the shaft 5 resting on the shoulder 4. The nut 7 is then screwed down so as to lock the section 2 to the shaft 5. A ring such as exhibited in Figures 3, 4 and 5, and designated generally

as 23, is then dropped into the peripheral aperture formed between the piston and the cylinder wall. This aperture is designated generally as 36. The disk 14 is then run on to the hub 16 and the bolts 21, of which there are preferably three, are screwed down. It is desirable that the pressure exercised by these screws be uniformly applied between the sections of the piston 2 and 14, and as such pressure is applied it will cause the ring 23 to expand radially to the axis of the ring,—thus causing the internal surfaces of the ring 31 and 32 to bear on the internal cylindrical surfaces 12 and 19, whereas the peripheral surfaces 27 and 28 will be forced radially into engagement with the cylinder wall 9.

In other words there will be a simultaneous expansion of the outer periphery of said ring and a contraction of the inner periphery resulting in cross-axial movement of the inner periphery in engagement with the inner face of said peripheral aperture of the piston, and a corresponding axial movement of the outer periphery into engagement with the cylinder wall.

By this operation the inner peripheries of the ring are caused to form an elastic fluid tight joint with the inner periphery of said peripheral aperture of the piston, while the outer peripheries of the ring are expanded to bear with an elastic sliding engagement but fluid tight fit upon the cylinder wall. In the form of the invention shown there are eight sealing surfaces presented by the ring to the walls of the peripheral aperture of the piston and the wall of the cylinder; hence an efficient seal is accomplished.

Inasmuch as the ring, when axially compressed to form a seal, is stressed within its elastic limit, its structure is such as to permit it to yield to slight irregularities in the cylinder wall, so that at all times said sealing relation is maintained.

I am aware that the structure shown in the drawings may be modified as will be apparent to those skilled in the art in adapting the invention to use in the different arts, wherein pistons and cylinders cooperate and in some cases it may be desirable to provide the piston with more than one ring. For these reasons the invention is to be understood as not limited to the specific showing of the drawings, but is rather to be considered as broadly novel as is commensurate with the appended claims.

The degree of pressure exercised by said screws 21 will determine the nature of the fit of the piston within the cylinder walls, and such fit may be made to conform to the particular usage to which the apparatus is to be applied. In the event of wear incident to the operation of the piston within the cylinder, this can be taken up by tightening the screws 21, or if for any reason it becomes desirable to remove the piston, it is only necessary to release said screws 21 and the resilient or elastic quality of said obdurate ring will cause the same to retract, thus releasing the ring from contact with the wall of the cylinder.

It is desirable that when the appropriate relation is established between the cylinder and said ring by the screws 21, such relation should be permanently fixed. Provision is made for such fixing or locking by the operation of the set screws 22 bearing upon the surface 11. With the operation of these screws the relation of the sections of the cylinder 2 and 14 will be permanently established and, vice versa, when it is desired to release said setting.

It will be understood from what has previously been stated in this specification that it is desirable in the operation of this device that, in the exercise of axial compression on the ring 23, such pressure should be limited so that it will not exceed the elastic limit of the ring. So long as said compression is within such elastic limit the ring will retract from its compressed condition when relieved of such axial pressure, and thus release the compression of the ring against the walls of the cylinder for the purpose of accomplishing a suitable packing or seal.

In this application the packing ring is illustrated as a composite frusto-conical section embodying two frusto-conical sections intersecting one another substantially midway of their height so as to form a ring section which is substantially cruciform or of X-shape in radial section. This is regarded as the preferred form of construction but it is not intended to limit the case to that particular form of construction, as satisfactory results can be obtained by the employment of one frusto-conical ring of obdurate material, as distinguished from the compound structure wherein two frusto-hollow cones are combined to form the radial section of X or cruciform shape.

a is a frusto-conical element having faces *b* and *c* parallel with its axis and faces *e* and *f* perpendicular to such axis. In other respects said frusto-cone is similar to the cruciform construction herein described as regards the material of which it is constructed, and the operation thereof.

Claims:

1. In a cylinder and piston assembly, a cylinder and a piston, said piston being provided with a peripheral aperture adapted to receive a piston ring, a piston ring mounted within said aperture, such ring being made of obdurate material and integral, the form thereof corresponding to two hollow frusto-cones intersecting to produce a cruciform or X radial cross section, with means to exercise axial pressure on said ring to expand the same within its elastic limit between the wall of said aperture adjacent the axis of the piston and the cylinder wall.

2. In a cylinder and piston assembly, a cylinder and piston, said piston being divided in a plane perpendicular to its axis, into two relatively movable sections to form a peripheral aperture between such sections, such aperture being adapted to receive a piston ring, and means to move such sections axially of said piston with relation each to the other to decrease or increase the axial diameter of said aperture, a piston ring mounted within said radial aperture, the same being made of obdurate material and integral, the form thereof corresponding to two hollow frusto cones intersecting to produce a cruciform or X radial cross section so that with the axial contraction of said aperture, said ring will be expanded within its elastic limit with relation to its seat within said aperture and the cylinder wall and, vice versa, when relieved of such compression said ring will contract.

3. In a cylinder and piston assembly, a cylinder and piston, said piston being divided in a plane perpendicular to its axis into two relatively movable sections to form a peripheral aperture between such sections, such aperture having parallel walls in planes perpendicular to the axis of the piston and cylindrical wall adjacent the axis of the piston, said aperture adapted to receive a piston ring, and means to move such sections axially of said piston with relation each to the other, to decrease or increase the axial dimension of said aperture, a piston ring mounted within said radial aperture, the same being of obdurate material and integral, the form thereof corresponding to two hollow frusto cones intersecting to produce a cruciform or X radial cross section, the external and internal faces of said ring corresponding to parallel cylinders, whereas the remaining faces are in planes perpendicular to the axis of said ring, so that with the axial contraction of said aperture said ring will be expanded within its elastic limit between the cylindrical wall of said aperture adjacent the axis of the piston and the cylinder wall and, vice versa, when relieved of such compression, said ring will contract.

Signed by me at Jersey City, N. J., this 20th day of January, 1926.

WYLIE G. WILSON.