A. J. MUMMERT & J. T. WOODBRIDGE.

PACKING RING.

APPLICATION FILED JULY 21, 1917.

1,298,548. Patented Mar. 25, 1919.

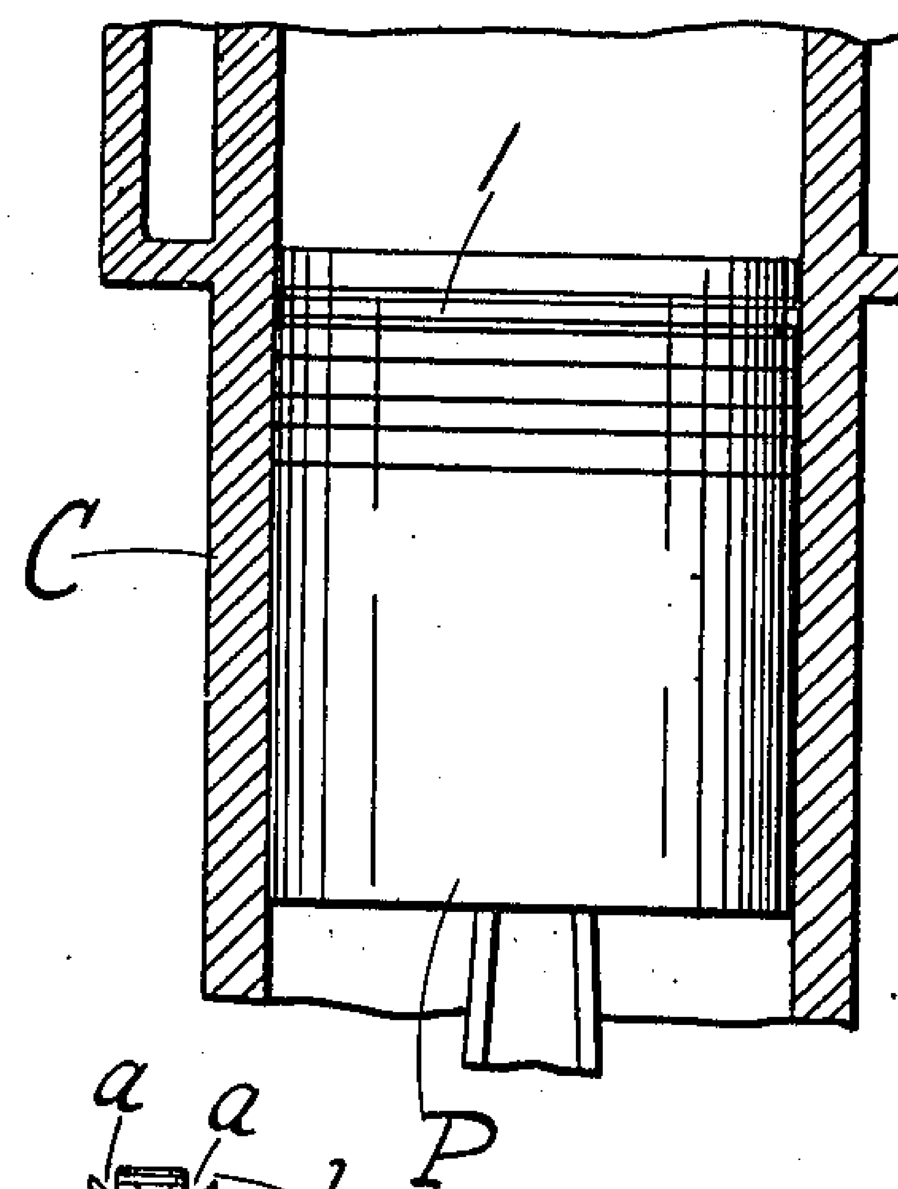

FIG. 1.

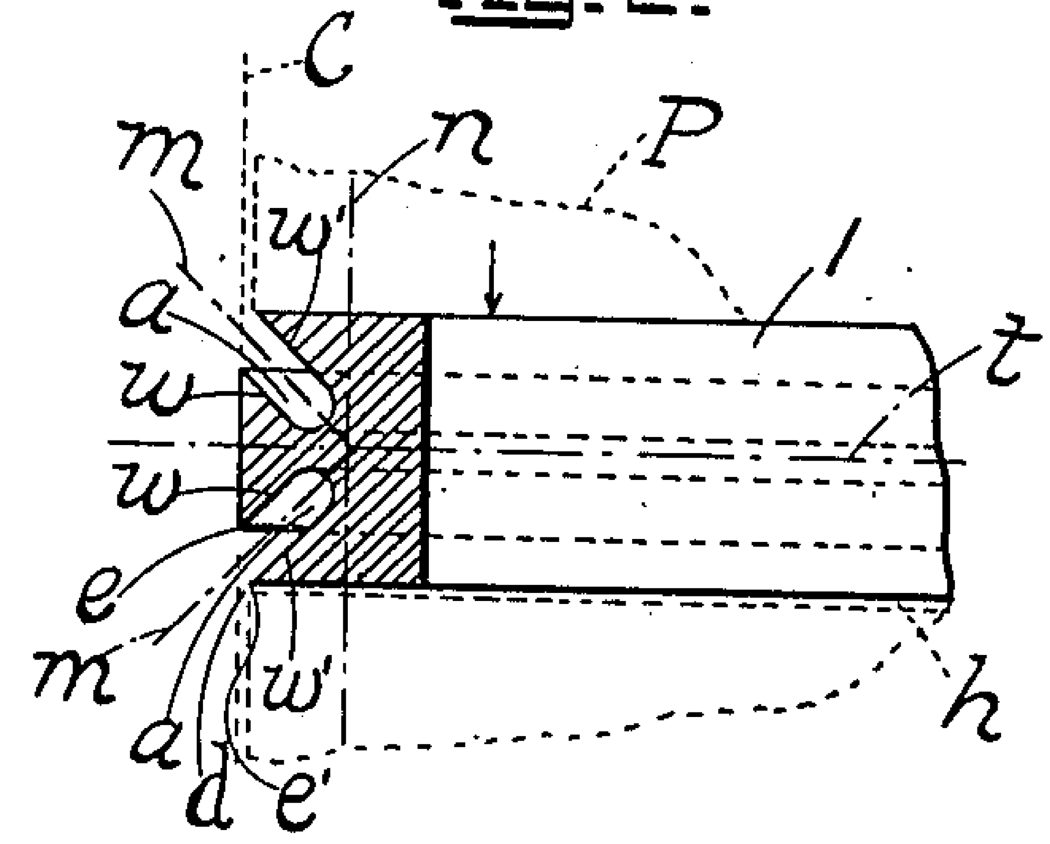

FIG. 2.

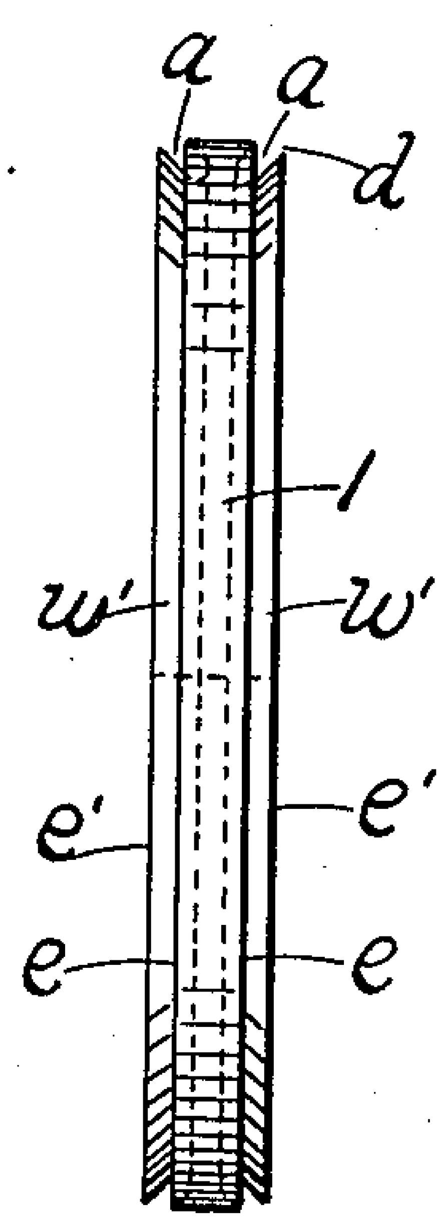

FIG. 3.

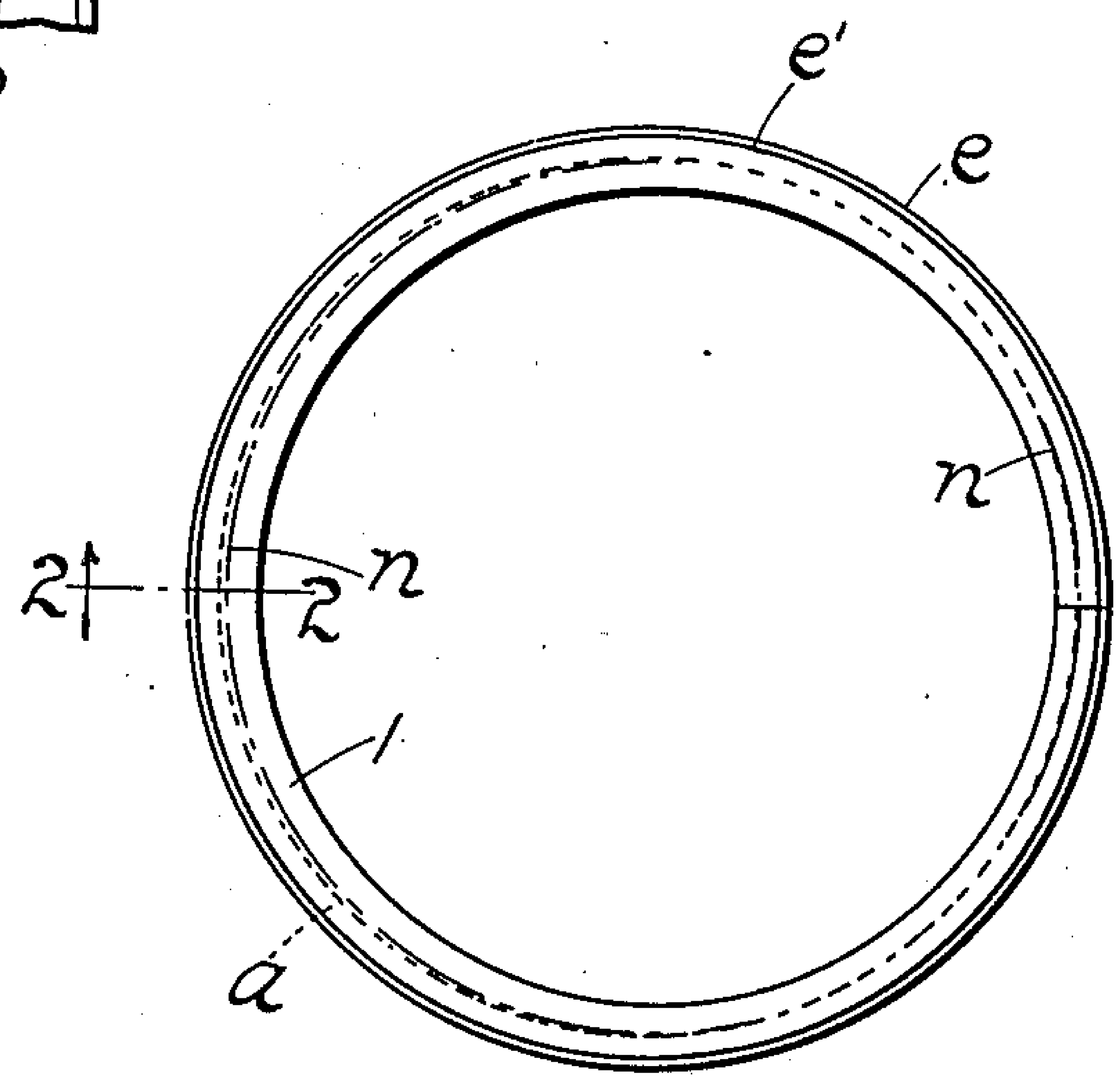

FIG. 4.

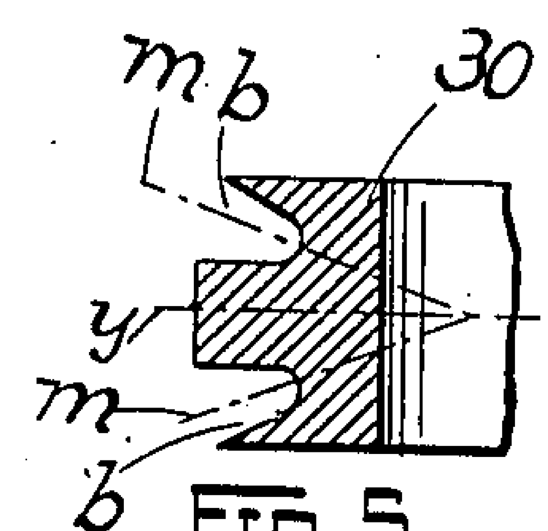

FIG. 5.

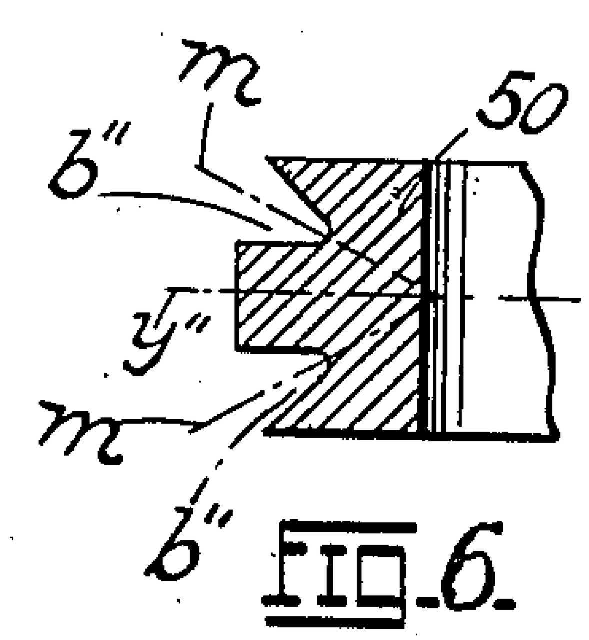

FIG. 6.

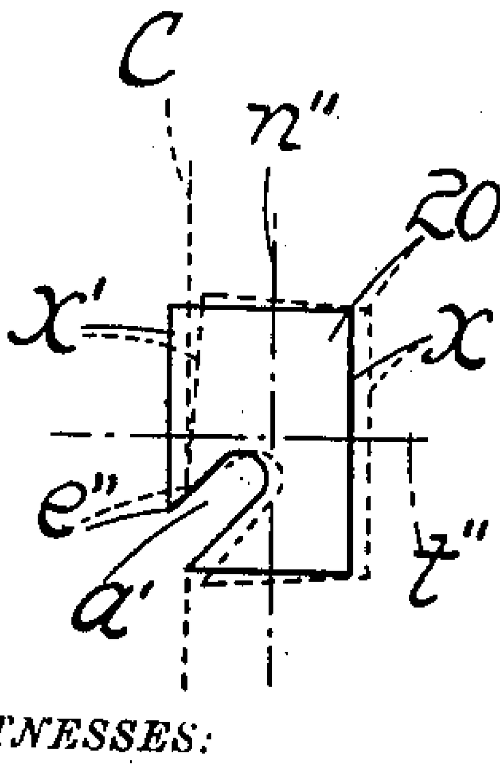

FIG. 8.

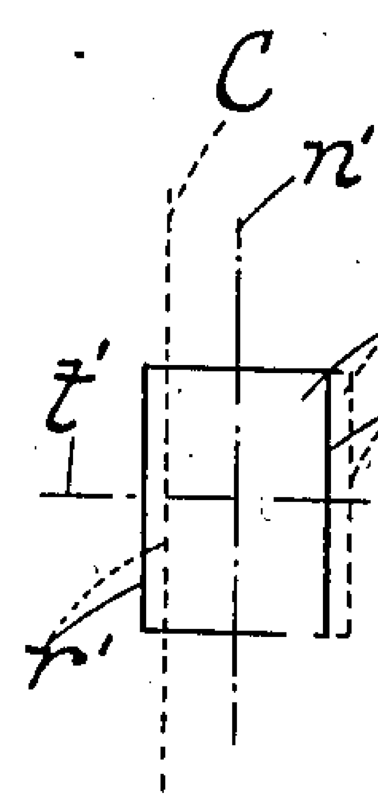

FIG. 7.

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PACKING-RING.

1,298,548. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed July 21, 1917. Serial No. 181,999.

To all whom it may concern:

Be it known that we, ARDEN J. MUMMERT and JESSE T. WOODBRIDGE, citizens of the United States, residing at St. Louis, State of Missouri, have invented certain new and useful Improvements in Packing-Rings, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

Our invention has relation to improvements in piston-head packing rings; and it consists in the novel features of construction more fully set forth in the specification and pointed out in the claims.

The present is an improvement on the packing ring forming the subject-matter of U. S. patent issued to Arden J. Mummert, numbered 1,210,674, and bearing date of January 2, 1917; and has for its object to overcome the objection of uneven wear inherent not only in the patented structure but in all rings of similar character which are provided with oil-collecting grooves or basins on one side only. As fully indicated in the patent aforesaid, the ring comprises an imperforate resilient split band, such a band, as well understood in the art, being subjected to stresses operating in a plane or planes transverse or at right angles to the axis of the ring and of the piston carrying the same, the said stresses tending to expand the ring, and causing the outer face thereof to hug the inner walls of the cylinder in which the piston operates. It is of course desirable that a ring subjected to the stresses in question should expand, contract, or otherwise yield in planes parallel to the planes in which the force is exerted, so that the outer rubbing face or periphery of the ring shall bear evenly against the cylinder walls throughout the width of the ring. A ring with a single oil-collecting groove or basin (or its equivalent) disposed adjacent to one side of the ring, as in the patent aforesaid does not in practice wear uniformly, the ring having a tendency to bear more heavily against the cylinder walls at points in the region of the groove than at any other portion of the ring periphery, the result being that the rear cutting or oil scraping edge of the basin shows the first signs of wear and the outer face of the ring wears unevenly and loses its effectiveness. The uneven pressure referred to results from a distortion or strain imparted to the ring by the stresses to which it is subjected, said distortion being due to the uneven distribution of the molecules of the ring about a medial plane perpendicular to the axis of the ring, in which plane the stresses are supposed to operate. The ring may be compared to a beam subjected to flexure under a load. As well understood in mechanics and in the science of stresses, the bending moment of a force acting on a beam causes the beam to bend with its concave side in the direction toward which the moment acts, and with its convex side in the opposite direction, it being understood that the layers subjected to the stress are disposed perpendicular to the plane in which the moment of the force acts. As further understood in the art, the layers near and at the concave side are shortened or subjected to compression while the layers near the convex side are lengthened or subjected to tension, there being an intermediate surface termed the "neutral surface" which is neither lengthened nor shortened. At any cross-section of the beam the neutral surface intersects said cross-section on a line known as the "neutral axis," said axis traversing the center of magnitude of the cross-section. Where the surface represented by the cross-section has a center of figure (as would be the case for example with a square, parallelogram, circle, ellipse, hexagon and the like) the center of magnitude would be coincident with the center of figure. In compound figures and polygons having no center of figure, the center of magnitude is ascertained by fixed mathematical rules not necessary herein to discuss. For our immediate purpose we need only to concern ourselves with the neutral axis and with the bending moment of the force operating in a central plane across said axis or at right angles to the neutral surface in which said axis is disposed. The present improvement is the outcome of the technical application of the principles of moments to the ring in question, the result being a perfectly balanced ring, expanding and contracting throughout its width in planes parallel to the plane in which the stresses are exerted, that is to say, in planes perpendicular to the neutral axis of the cross-section of the ring, the ring bearing with even pressure against the inner walls of the cylinder, throughout its entire width whereby an even wear results and a maximum life for the ring is assured. The advantages of the improved ring will be fully apparent from the following detailed description in connection with the accompanying drawings in which—

Figure 1 represents a longitudinal section of a gas engine cylinder, with the piston in elevation, showing the improved ring applied thereto; Fig. 2 is an enlarged cross-section on the line 2—2 of Fig. 4; Fig. 3 is an outer face or edge view of the ring; Fig. 4 is a plan of the ring; Figs. 5 and 6 are cross-sections of modifications of the invention; Fig. 7 is an outline cross-section of a ring with perfectly balanced stresses and in which the center of figure and center of magnitude are coincident; and Fig. 8 is an outline cross-section of a ring formed with a single oil basin adjacent to one side of the ring showing the strain or distortion produced therein by the stresses to which the same is subjected.

Referring to the drawings, and for the present to Figs. 1 to 4 inclusive, C represents the engine cylinder and P, the piston, the latter being herein shown with one of the improved oil sealing and packing rings in conjunction with ordinary lubricating and packing rings common in the art. The improved ring comprises a resilient imperforate annular split band 1 which is deposited (as well understood in the art) in the annular peripheral groove *h* of the piston, the band normally tending to expand or dilate and hence to hug the walls of the cylinder when the piston with its band are inserted thereinto. The stresses which cause the band to expand or contract act in planes transverse or at right angles to the axis of the band; and when a resilient band of the character here indicated is confined by the inner walls of the cylinder and thereby held contracted, or restrained against further expansion, the bending moment of the restraining force tends to impose tension on the outer layers of the ring and compression on the inner layers the same as would a load acting on a beam supported or fixed at one end, or the opposite to the action of a load acting on a beam supported at both ends. In a ring subjected to stresses of the character referred to, there will necessarily be present a "neutral surface" *n* (Figs. 2, 4,) between the inner and outer faces of the ring, said neutral surface intersecting the cross-section of the ring along the neutral axis of said cross-section as shown in Fig. 2, said axis being supposed to traverse the center of magnitude of the area represented by said cross-section. The bending moment of the stresses may be assumed to operate in the plane indicated by the line *t* in Fig. 2, said plane being perpendicular to the neutral surface *n* of the ring and bisecting the neutral axis of the cross-section taken at any point along the ring, and corresponding to a medial plane through the ring and transverse to the axis thereof. Disposed on opposite sides of said medial plane *t* along the outer cylindrical face of the ring or band, and contiguous to the sides thereof, or at what correspond to the outer corners of the band are (preferably) annular oil-collecting basins, grooves or equivalent chambers or receptacles *a* the opposite walls *w*, *w'*, whereof terminate respectively in cutting or shearing edges *e* which scrape the oil or lubricant from the inner walls of the cylinder, and with edges *e'* which clear said walls, leaving a passage-way or clearance *d* through which the oil is free to pass to and from the basin. The basins *a*, *a*, are disposed symmetrically about and at equal distances from the medial plane *t* of the moments involved in the stresses to which the ring is subjected, the result being that in the cross-section of the ring (Fig. 2) the molecules of the mass are evenly distributed relatively to said medial plane *t*. It follows therefore that the stresses through the ring will be perfectly balanced, the molecules yielding or responding to the bending moment uniformly and evenly throughout the entire cross-section of the ring, whereby the outer face of the ring will bear evenly at all points against the inner walls of the cylinder and hence wear evenly, thereby prolonging the life of the ring. Both sides of the ring being alike (or substantially alike, an absolute correspondence not necessarily being required to bring the ring within the scope and spirit of our invention), it follows that the ring is reversible and it makes no difference in mounting the ring which side is caused to face the crank-case and which the explosion chamber of the engine. Of course when the ring is in service, the active basin *a* is the one facing the crank-case, it being the scraping or cutting edge *e* of the rear or inner wall *w* of this basin which is depended on to scrape the oil from the walls of the cylinder with the "down" or forward stroke of the piston, the oil being released from the basin and spread over said walls on the up or backward stroke, the same as, and as fully described in the patent aforesaid. Preferably, the basins *a*, *a*, should be so formed and disposed that the cone elements *m* which bisect the respective basins (or which bisect the angle between the basin walls where such walls are not opposite or parallel) shall intersect in the medial moment plane *t* as indicated in Fig. 2. Where kerosene or hydrocarbons of high igniting or flashing temperature are employed in admixture with gasolene as the motor fluid, the unconsumed liquid portions of the kerosene or hydroor that facing the combustion chamber are prevented by the inner inclined wall of such basin from coming in contact with the comparatively cool walls of the cylinder and accordingly prevented from cooling to the point where they will give rise to engine trouble by the carbonization of particles not completely or sufficiently consumed. The object sought of course is to prevent an undue cooling of these heavy hydrocarbons, such cooling being inevitable were the liquid particles accumulating in the upper basin *a* permitted to come in direct contact with the cool cylinder walls. Another advantage of the upper basin *a* is, that the heavy hydrocarbons accumulating therein are prevented from working their way into the crank-case of the engine, being thus permanently confined in the combustion chamber where they will eventually vaporize and subserve the function intended therefor.

It was pointed out above that a symmetrical distribution of the molecules about the medial plane *t*, or a medial plane through the ring perpendicular to the axis of the ring, resulted in an even and uniform distribution of the stresses through the ring and in an even and uniform pressure of the outer face of the ring against the inner walls of the cylinder. A typical example of an evenly and uniformly stressed ring is shown in Fig. 7 wherein the cross-section of the ring 10 is a parallelogram, the "neutral axis" *n′* of which passes through the center of figure and through the center of magnitude coincident therewith, the central plane of moments being indicated by *t′*. It is perfectly obvious that a ring (or beam) having at all points a symmetrical and uniform cross-section as shown in this figure, will flex or yield to the bending moment evenly and uniformly and in planes parallel to the medial plane *t′* in which the bending moment or force is supposed to act, and the inner and outer faces *r*, *r′*, of the ring (or the corresponding faces of a beam) will remain parallel and permanently at right angles to said plane *t′*. In other words the ring (or beam) will suffer no distortion or strain under the stresses to which the same is subjected. The moment however that we excise or remove from one corner of a ring of the cross-section shown in Fig. 7, sufficient material so as to form a ring 20 with a basin *a′* as shown by the outline cross-section in Fig. 8 (corresponding in cross-section to the ring forming the subject-matter of the patent aforesaid), the inner and outer faces *x*, *x′*, of such ring, when the ring is under stress will no longer remain perpendicular to the plane *t″* along which the force or bending moment acts, but the ring will suffer a strain or distortion as shown by the dotted position of the parts in said figure, the outer face of the ring being brought to an incline to its original position due to a spreading of the walls of the basin *a′*, and causing most of the wear to center on the oil-scraping edge *e″*, the major portion of the outer face of the ring operating clear of the inner walls of the cylinder C. The distortion suffered by the ring thus causes the ring to wear unevenly and in a comparatively short time the ring is useless. This distortion or tilting is due to the unevenness of the stresses through the cross-section of the ring resulting from the uneven distribution of the molecules of the ring about the medial moment plane *t″*, the thicker portions of the cross-section of the ring on one side of such plane offering more resistance than the reduced portions disposed on the opposite side of said plane. In this ring the neutral axis *n″* no longer passes through the center of figure.

We need not of course adhere to the cross-section of ring shown in Figs. 1 to 4. For example, in Fig. 5 is shown a ring 30 with oil collecting basins *b* where the opposing walls of the basin are not strictly parallel. In Fig. 6 we show a ring 50 with corner oil basins *b″* substantially V-shaped in cross-section. Other modifications are possible. Like in the main form described, the bisectrices *m* of the basins incline toward and meet in the central moment plane of the ring. Thus, in Fig. 5, the bisectrices *m* meet in the moment plane *y*; and in Fig. 6 they meet in the moment plane *y″*. In Figs. 1 to 4, the basin walls *w*, *w′*, are parallel and inclined to the axis of the ring and to the medial moment plane *t*.

It is to be understood that we may depart from the details and structures shown, in many particulars without departing from the nature or spirit of our invention. For example the peripheral basins or grooves *a* need not be continuous but may extend only partially around the ring; they may have various depths; their walls may assume various inclinations to each other and to the medial moment plane. Whatever be the form of the oil collecting basin however, the cutting and clearing edges of its walls should be disposed in different transverse planes through the axis of the ring.

Having described our invention what we claim is:

1. A piston packing ring comprising a resilient split band provided with peripheral oil-collecting basins at the outer corners of the band, the outer wall of each basin or that adjacent the side of the band being inclined to the plane of moments by which the band is stressed when in service and terminating in an edge clearing the walls of the cylinder in which the piston is to operate, the inner wall of the basin terminating in a cutting edge operating to scrape the oil from the walls of the cylinder with a given stroke of

the piston, the edges of the respective walls of each basin being disposed in different transverse planes through the axis of the band.

2. A piston packing ring for engine cylinders comprising a resilient split band provided with peripheral oil collecting basins at the outer corners of the band, said basins having opposing walls inclined to the plane of moments by which the band is stressed when in service, the outer of said walls terminating in an edge clearing the walls of the cylinder in which the piston is to operate, and the inner of said walls terminating in a cutting edge for scraping the oil from the cylinder walls with a given stroke of the piston.

3. A piston packing ring for engine cylinders comprising a resilient imperforate split band provided on opposite sides of a medial circumferential line with an annular basin bounded on one side by an outer wall inclined to the plane of moments by which the band is stressed when in service, and terminating in an edge clearing the walls of the cylinder in which the piston is to operate, and bounded on the opposite side by an inner wall terminating in a cutting edge operating to scrape the oil from the walls of the cylinder into the basin with a given stroke of the piston, the oil being free to flow into the basin past the clearing edge aforesaid.

In testimony whereof we affix our signatures, in presence of two witnesses.

ARDEN J. MUMMERT.
JESSE T. WOODBRIDGE.

Witnesses:

EMIL STAREK,
JOS. A. MICHEL.