Nov. 12, 1940. R. W. PATON 2,220,948

PISTON RING

Filed Jan. 3, 1939 2 Sheets-Sheet 1

Fig. 1

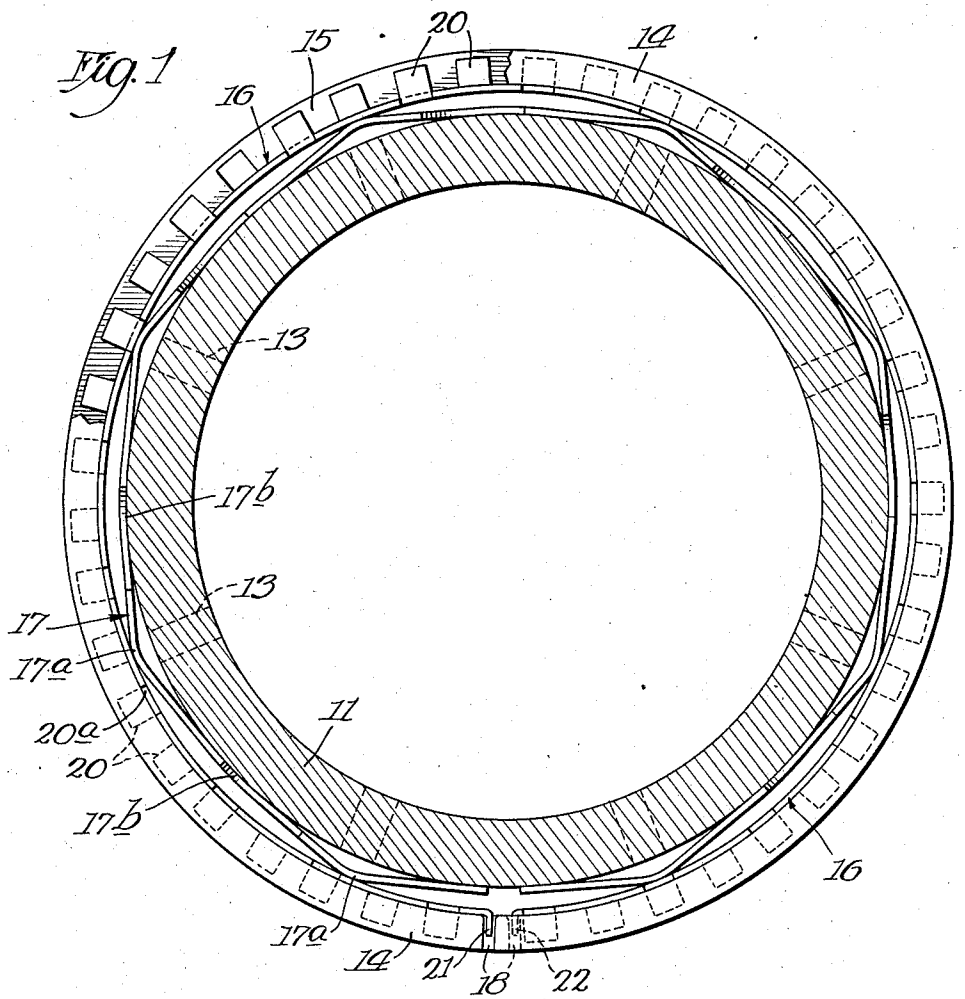
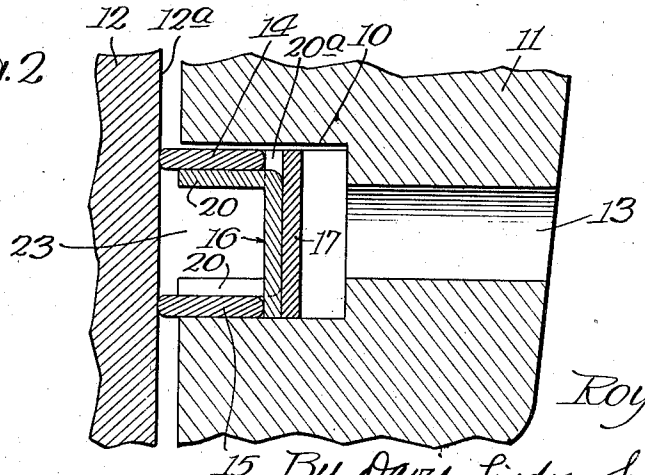


Fig. 2



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Nov. 12, 1940. R. W. PATON 2,220,948

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Filed Jan. 3, 1939 2 Sheets-Sheet 2

Fig. 3

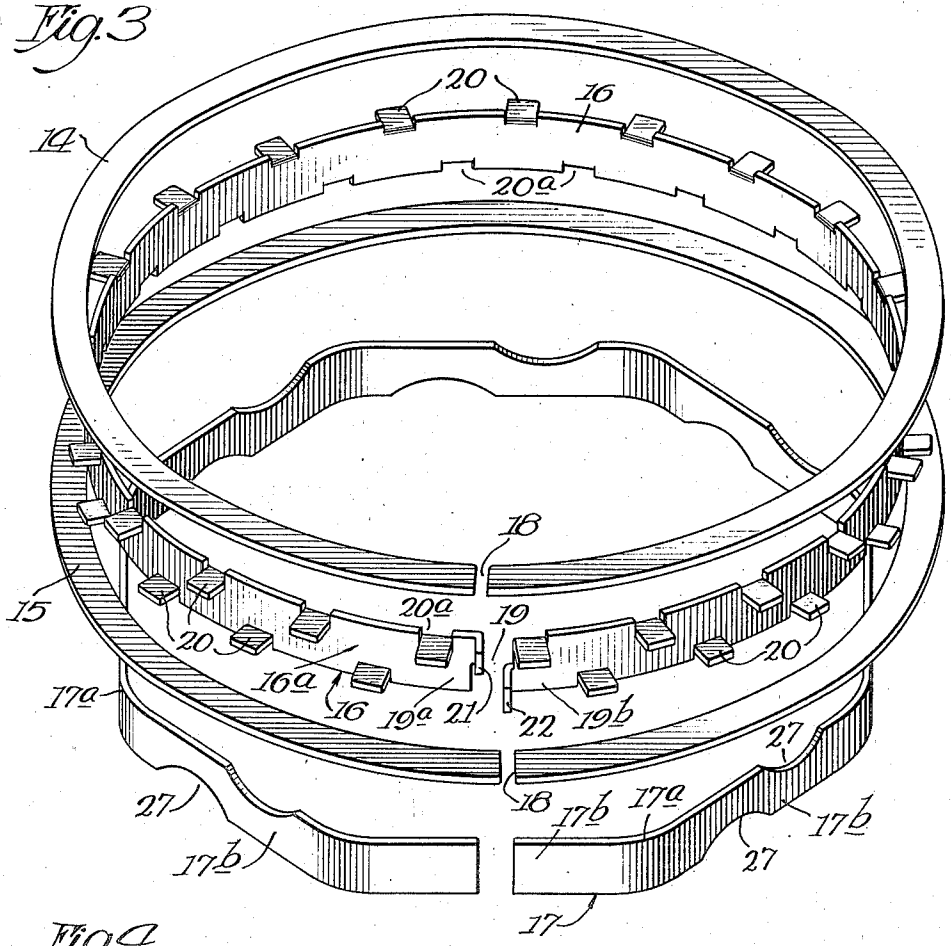
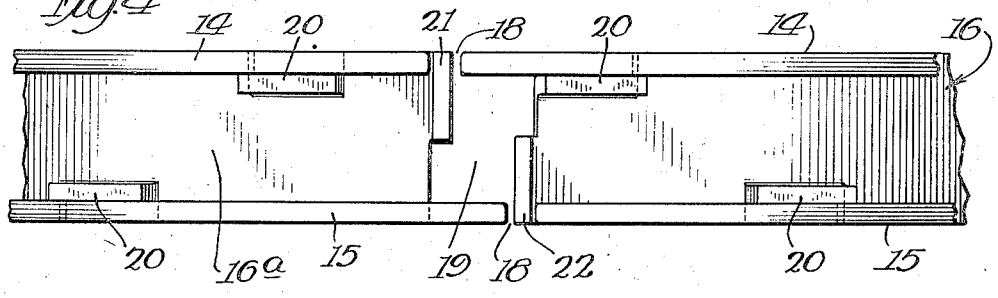


Fig. 4



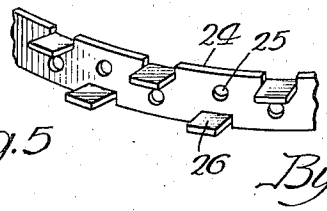


Fig. 5

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UNITED STATES PATENT OFFICE

2,220,948

PISTON RING

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Application January 3, 1939, Serial No. 249,035

15 Claims. (Cl. 309—45)

My invention relates to piston rings adapted to be mounted in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring, and it has to do particularly with segmental rings of the foregoing character adapted for reducing oil consumption.

One of the objects of my invention is to provide an improved ring of the foregoing character which is of simple construction, and which is adapted to perform its intended functions in a highly efficient manner, and particularly when applied to pistons used in worn cylinders.

Another object is to provide a segmental ring including a pair of thin, split, ring-like steel rail sections supported both radially and in axially spaced relation by a split steel ring-like carrier section that is engaged and radially expanded to expand the rail sections by a spring steel expander section adapted to be mounted in the ring groove behind the carrier section, the sections being so constructed and arranged that the carrier section extends substantially throughout the inner edges of the rail sections and engages such edges over the greater portion thereof, the expander section engages only the carrier section and in such a way that the spring contact area effective on the rail sections is increased, and the expanding pressure exerted on the rail sections is substantially equalized throughout the circumference thereof.

A further object is to provide ring structure of the foregoing character wherein the rail and carrier sections form an oil channel extending substantially throughout the width of the rail sections and opening outwardly toward the cylinder wall, the rail sections being supported by the carrier section in such a way that drainage of oil from the ring channel through the ring structure takes place along (over and under) the opposite sides of each of the rail sections.

Still another object is to provide a segmental ring including a pair of split, thin, steel rail sections spaced apart axially and supported radially by a split steel carrier section which is interlocked with the rail sections in such a way that the rail and carrier sections expand and contract, or breathe, so to speak, as a unit.

A more specific object is to provide a segmental ring structure including split, ring-like, thin rail sections, a carrier section and an expander section, the carrier section including a split, band-like steel body portion disposed behind the rail sections with its side edges engaging the inner edges of the rail sections and having projections struck therefrom outwardly of the ring structure and upon which the rail sections are seated to support the same in axially spaced relation, and the expander section having spring portions adapted to engage the body portion of the carrier section through a substantial contact area for applying expanding pressure to the rail sections.

Other objects and advantages will become apparent as this description progresses and by reference to the drawings wherein,—

Figure 1 is a horizontal sectional view taken through the ring groove of a piston having ring structure embodying my invention mounted therein;

Fig. 2 is an enlarged sectional view of the structure shown in Fig. 1, the same being illustrated in position in a cylinder;

Fig. 3 is an assembly view of the ring structure shown in Figs. 1 and 2;

Fig. 4 is a fragmental side elevational view of the ring structure shown in the previous figures, and further illustrating the manner of interlocking certain of the ring sections; and

Fig. 5 is a fragmental, perspective view of a modified form of carrier section that may be employed in carrying out my invention.

The ring structure shown in the drawings is adapted to be mounted in the groove 10 (Figs. 1 and 2) in the piston 11, of an internal combustion engine having a cylinder 12 in which the piston operates. The piston 11 may take any suitable form and it is provided with an annular series of oil holes 13 leading through the piston wall from the bottom of the ring groove 10 for drainage of oil from the latter back to the engine crank case (not shown). The ring structure that I have chosen to illustrate my invention is of segmental form and it includes a pair of rail sections 14, 15 (Figs. 1–3), a carrier section 16 and an expander section 17.

The rail sections 14 and 15 (Fig. 3), which are of similar construction, are each formed from a thin steel material to a ring-like shape split at 18 for purposes that will be well understood. These sections are adapted to be disposed along the opposite side walls of the ring groove 10 and they are of such width that, when a piston embodying the same is inserted in the cylinder 12, they engage the cylinder wall 12a (Fig. 2) under some tension. The rail sections 14, 15 are supported in axially spaced position, as well as radially, by the carrier section 16, which will now be described.

The carrier section 16, which is located behind the rail sections 14, 15, takes the form of an annular band having a body portion 16a that is split

at 19. This section is formed from a relatively thin steel material and it is of such width that it extends substantially throughout the width of the ring groove 10 so that its opposite side edges engage the inner edges of the rail sections 14, 15, and thereby support the rail sections 14, 15 in radial direction. The carrier section 16 is further provided with an annular row of circumferentially spaced supporting lugs 20 struck therefrom along the opposite or upper and lower edges thereof, the lugs 20 being so formed that those of the upper row are staggered relative to the adjacent lugs of the lower row. The lugs 20, which are of less length than the width of the rail sections 14, 15 and which extend outwardly of the ring groove 10 in a plane substantially parallel with the opposite side walls of the ring groove and the sides of the rail sections 14 and 15, engage the inner sides of the rail sections 14 and 15 to support the latter in axially spaced-apart position. The lugs 20 are, preferably, located inwardly of the side edges of the carrier body 16a a distance substantially equal to the thickness of the rail sections so that the rail sections are supported adjacent the sides of the ring groove 10 with a slight clearance. Also, the lugs 20 are comparatively narrow and they are so spaced apart that a substantial and major portion of the carrier body 16a extends behind and engages the inner edges of the rail sections 14, 15 providing an increased and quite substantial radial support therefor.

As is well known, a piston ring tends to expand and contract, or breathe, so to speak, as the piston supporting it reciprocates in a cylinder, and particularly a worn cylinder where the diameter of the cylinder varies because of wear. This breathing action tends to cause a piston ring to creep or shift circumferentially in its groove and, in the use of a segmental ring, it causes the several segments or sections thereof to tend to creep relative to each other. It is desirable that, for best performance, the ring sections, or certain of them, be prevented from creeping; and, in carrying out my invention, I so construct and arrange the rail and carrier sections that they will expand and contract, or breathe, as a unit. To that end, the carrier body ends 19a and 19b formed by the carrier slit 19 are provided with outturned right-angular lugs 21, 22 so located that the lug 21 is at the end of the upper row of rail supporting lugs 20 and the other lug 22 is at the other end of the lower row of lugs 20. One end of the upper rail section 14 abuts the lug 21 and the opposite end of the lower rail section abuts the lug 22. With this arrangement, when the piston 11 is mounted in the cylinder 12 and the rail and carrier sections are contracted to working diameter, the ends of the rail section are disposed in such close proximity to the respective lugs 22, 21 that no material relative displacement of the rail and carrier sections can take place in a circumferential direction. It will be noted that the rail sections 14, 15 of somewhat greater diameter than the carrier section 16 so that, when the rail sections are properly assembled with the carrier section and such sections are contracted to working diameter, the joint 18 of one rail is slightly offset circumferentially from the joint 18 of the other rail. This arrangement not only facilitates the sealing action of the ring but also aids the interlock feature above referred to.

When the rail and spacer sections 14, 15 and 16 are assembled, they provide a continuous, annular oil channel 23 of a depth substantially equal to the depth of the ring and opening outwardly through the outer face of the ring structure. Oil scraped from the cylinder wall 12a into the channel 23 is drained radially through the ring structure and back to the engine crank case through the piston holes 13 by passing over and under the rail sections and, in part, through the openings 20a provided in forming the lugs 20 and, in part, past the side edges of the carrier body 16a. As a piston embodying my ring structure reciprocates in a cylinder, a hydraulic action takes place in which oil tends to be thrown, forced or pumped, so to speak, toward the opposite side walls of the ring groove, and it is at these points that oil drainage is afforded by my ring structure. In other words, in carrying out my invention, there is sufficient clearance between the rails 14, 15 and the adjacent side walls of the ring groove 10 to permit oil collected in the oil channel 23 to readily pass the ring structure under the influence of the hydraulic action above referred to, even though the carrier 16 may not be provided with drain openings for that purpose. However, if desired, a perforated carrier section, as shown in Fig. 5, may be employed. In that case, the carrier section 24 may be provided with small openings 25 formed therein opposite each rail supporting lug 26 thereof.

The expander section 17 takes the form of a thin, split, polygonally shaped band of spring steel, the corners 17a of which form spring humps. The expander portions 17b between the humps 17a are adapted to seat against the inner wall of the ring groove 10, while the humps 17a engage the inner side of the carrier section body 16a at substantially equally spaced points around the circumference thereof. When the expander is assembled in the ring groove along with the other ring sections, it tends constantly to urge the carrier section outwardly, in turn, simultaneously and uniformly expanding the rail sections 14 and 15 supported by the carrier section 16. With this arrangement, the expanding action transmitted from the expander section 17 through the carrier section 16 to the rail sections 14, 15 is equalized and uniformly distributed throughout the circumference of the rail sections without concentration of the same at points opposite the humps 17a. Also, the expander contact area is increased tending to minimize wear, and the entire arrangement is such that the structure may expand and contract freely and tendency of the expander to collapse during high-speed operation is reduced to the minimum.

The expander section 17 is further provided with oil drainage recesses 27 disposed along the opposite side edges thereof. The recesses 27 in one edge of the expander section are staggered relative to the recess 27 in the opposite expander edge, but such recesses are of such length that the ends of adjacent recesses overlap. The recesses 27 are located substantially in alignment with the rail sections 14, 15 adjacent the sides of the ring groove 10, thereby facilitating oil drainage past the expander section 17 under the influence of the hydraulic action above referred to.

I believe that the operation and advantage of my invention will be well understood from the foregoing description; and, while I have illustrated only two forms of my invention, other changes in details and arrangements of parts may be resorted to without departing from my invention as defined by the claims that follow.

I claim:

1. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split, ring-like rail sections adapted to be mounted in spaced relation adjacent the sides of the ring groove, a split carrier section having a band-like body portion disposed in a plane behind said rail sections with its opposite edge portions seated against and radially supporting the inner edges of said rail sections, said carrier body portion having axially spaced portions extending therefrom between and axially supporting said rail sections, and an expander section disposed behind said carrier section and having spring portions engaging only the body portion of said carrier section to expand said rail sections.

2. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split, ring-like rail sections adapted to be mounted in spaced relation adjacent the sides of the ring groove, a split carrier section having a band-like body portion disposed in a plane behind said rail sections with its opposite edge portions seated against and radially supporting the inner edges of said rail sections, and forming with said rail sections a continuous oil channel opening outwardly toward the cylinder wall to be engaged and of a depth substantially equal to the width of said rail sections, said carrier body portion having portions extending therefrom between and axially supporting said rail sections, and an expander section disposed behind said carrier section and having spring portions engaging only said carrier section to expand said rail sections.

3. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split, ring-like rail sections, a carrier section disposed behind said rail sections with its opposite side edges engaging the inner edges of the latter for radial support thereof, said carrier section having spaced upper and lower rows of lugs between its opposite side edges and extending inwardly between and supporting said rail sections in axially spaced relation adjacent the sides of the ring groove, and means located behind and engaging said carrier section for applying radial expanding pressure thereto to, in turn, radially expand said rail sections.

4. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split, ring-like rail sections, a carrier section of band-like form disposed behind said rail sections with its opposite side edges engaging the inner edges of the latter for radial support thereof, said carrier section having spaced upper and lower annular rows of circumferentially spaced lugs between its side edges and extending inwardly between and supporting said rail sections in axially spaced relation adjacent the sides of the ring groove, said lugs being of a length less than the width of said rail sections with the lugs of one row staggered relative to the lugs of the other row, and means located behind and engaging said carrier section for applying radial expanding pressure thereto to, in turn, radially expand said rail sections.

5. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split, ring-like rail sections, a carrier section of band-like form disposed in a plane behind said rail sections with its opposite side edges engaging the inner edges of said rail sections, said carrier section having portions of its opposite edges displaced inwardly between said rail sections and engaging the adjacent faces of the latter to support them in axially spaced relation adjacent the sides of the ring groove, and an expander section engaging only said carrier sections to apply radial expanding pressure thereto and, in turn, to said rail sections.

6. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split, ring-like rail sections, a carrier section of band-like form and of a width only slightly less than the width of the ring groove and disposed in a plane behind said rail sections with its opposite side edges engaging the inner edges of said rail sections, said carrier section having portions of its opposite edges displaced inwardly between said rail sections and engaging the adjacent faces of the latter to support them in axially spaced relation adjacent the sides of the ring groove, said portions being disposed in annular rows axially inward of the side edges of said carrier section a distance substantially equal to the thickness of said rail sections, and an expander section engaging only said carrier section substantially throughout the width thereof to apply radial expanding pressure thereto and, in turn, to said rail sections.

7. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of split, ring-like rail sections having outer edges adapted to engage the cylinder wall, a band-like carrier section disposed in a plane behind said rail sections with its opposite side edges engaging the inner edges of said rail sections to radially support the latter and to form with said rail sections a continuous, annular oil channel, said carrier section having portions adjacent the opposite edges thereof extending inwardly and between said rail sections to support the same in axially spaced relation, said carrier section being of such width that it has substantially a working clearance with respect to the opposite sides of the ring groove, and said rail supporting portions being so disposed and said rail sections being of such thickness that said rails are supported with substantially the same working clearance as said carrier section, the arrangement being such that oil passes from said channel to the back of the ring groove only along the opposite sides of each of said rail sections, and an expander section engaging only said carrier section to apply expanding pressure thereto and to said rail sections.

8. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split rail sections adapted to be disposed along the opposite sides of said ring groove with a slight working clearance, a split, band-like carrier section disposed in a plane behind said rail sections with its opposite side edges engaging the inner

edges of said rail sections to radially support the latter, portions extending from the opposite side edge portions of said carrier section between said rail sections for axially supporting and spacing them apart relative to the sides of the ring groove, said rail sections and that portion of the carrier section between said rail sections providing an imperforate-walled annular oil channel opening outwardly toward the cylinder wall, the arrangement being such that oil can pass from said channel to the back of the ring groove only along the opposite sides of each of said rail sections, and an expander section adapted to be mounted in the ring groove behind said carrier section to engage and expand the latter and, in turn, said rail sections.

9. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split rail sections adapted to be mounted adjacent the sides of the ring groove, a split carrier section having portions disposed behind and engaging the inner edges of said rail section to support the latter radially, said carrier section having other portions extending between said rail sections and supporting the same in axially spaced relation, an interlock element on said carrier section and engaged by one of said rail sections, another interlock element on said carrier section and engaged by the other of said rail sections independently of the first-mentioned interlock element, said elements preventing any substantial relative circumferential movement between said carrier and rail sections in circumferential direction only, whereby all said sections expand and contract as a unit.

10. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine having a cylinder wall to be engaged by the ring structure, which comprises a pair of thin, split rail sections adapted to be mounted adjacent the sides of the ring groove, a split carrier section having portions disposed behind and engaging the inner edges of said rail section to support the latter radially, said carrier section having other portions extending between said rail sections and supporting the same in axially spaced relation, an interlock element on one of the split ends of said carrier section circumferentially aligned with the upper of said rail sections and adapted to be abutted by the split ends of such rail section, another interlock element on the other split end of said carrier section circumferentially aligned with the lower of said rail sections and adapted to be abutted by the split ends of such rail section, the arrangement being such that all said sections are interlocked together to expand and contract as a unit, and an expander section for applying expanding pressure to said unit.

11. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine, which comprises a pair of thin rail sections adapted to be mounted adjacent the sides of the ring groove, each of said rail sections being split providing free ends, a split carrier section having portions disposed behind and engaging the inner edges of said rail sections to support the latter radially, said carrier section having other portions extending between said rail sections and supporting the same in axially spaced relation, an interlock element on said carrier section and disposed between the free ends of one of said rail sections, another and axially offset interlock element on said carrier section and disposed between the free ends of the other of said rail sections, said interlock elements preventing any substantial relative movement between said carrier and rail sections in circumferential direction only, whereby all said sections expand and contract as a unit.

12. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine, which comprises a pair of thin, split rail sections adapted to be mounted adjacent the sides of the ring groove, a split carrier section having portions disposed behind and engaging the inner edges of said rail section to support the latter radially, said carrier section having other portions extending between said rail sections and supporting the same in axially spaced relation, an interlock element on one of the split ends of said carrier section circumferentially aligned with the upper of said rail sections and adapted to be disposed between the split ends of such rail section, another interlock element on the other split end of said carrier section circumferentially aligned with the lower of said rail sections and adapted to be disposed between the split ends of such rail section, the arrangement being such that all said sections are interlocked together to expand and contract as a unit.

13. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine, which comprises a pair of thin, split rail sections adapted to be mounted adjacent the sides of the ring groove, a split carrier section having portions disposed behind and engaging the inner edges of said rail sections to support the latter radially, said carrier section having other portions extending between said rail sections and supporting the same in axially spaced relation, and means providing an interlock between said rail and carrier sections for preventing relative circumferential movement therebetween which comprises a portion extending at substantially right angles from each of the split ends of said carrier section, one of said right-angular portions extending between the split ends of one of said rail sections and the other of said right-angular portions extending between the split ends of the other of said rail sections.

14. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine, which comprises a pair of thin, split rail sections adapted to be mounted adjacent the sides of the ring groove, a split carrier section having portions disposed behind and engaging the inner edges of said rail sections to support the latter radially, said carrier section having other portions extending between said rail sections and supporting the same in axially spaced relation, and means providing an interlock between said rail and carrier sections for preventing relative circumferential movement therebetween which comprises a portion extending at substantially right angles from each of the split ends of said carrier section, one of said right-angular portions extending from one edge of said carrier section and terminating short of the other edge of said carrier section so that it is disposed between and in circumferential alignment with the split ends of one of said rail sections and the other of said right-angular portions extending from the opposite edge of said carrier section and terminating short of the other edge thereof so that it is disposed between and in circumferential alignment with the split ends of the other of said rail sections.

15. Piston ring structure adapted for use in the ring groove in a piston of an internal combustion engine, which comprises a pair of thin, split rail sections adapted to be mounted adjacent the sides of the ring groove, a split, band-like carrier section having portions disposed behind and engaging the inner edges of said rail sections to support the latter radially, said carrier section having other portions with surfaces disposed axially inward of the side edges of the section which are disposed between said rail sections for supporting them in axially spaced relation, and another edgewise portion extending outwardly at substantially right angles at each of the split ends of said carrier section, one of said edgewise portions extending from the upper edge of said carrier section and terminating short of the lower edge thereof a distance sufficient to permit the lower rail section to pass the same, and the other of said edgewise portions extending from the lower edge of said carrier section and terminating short of the upper edge thereof sufficiently to permit the upper rail section to pass the same, said edgewise portions being disposed, respectively, between the split ends of the upper and lower of said rail sections.

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