

Aug. 26, 1947.

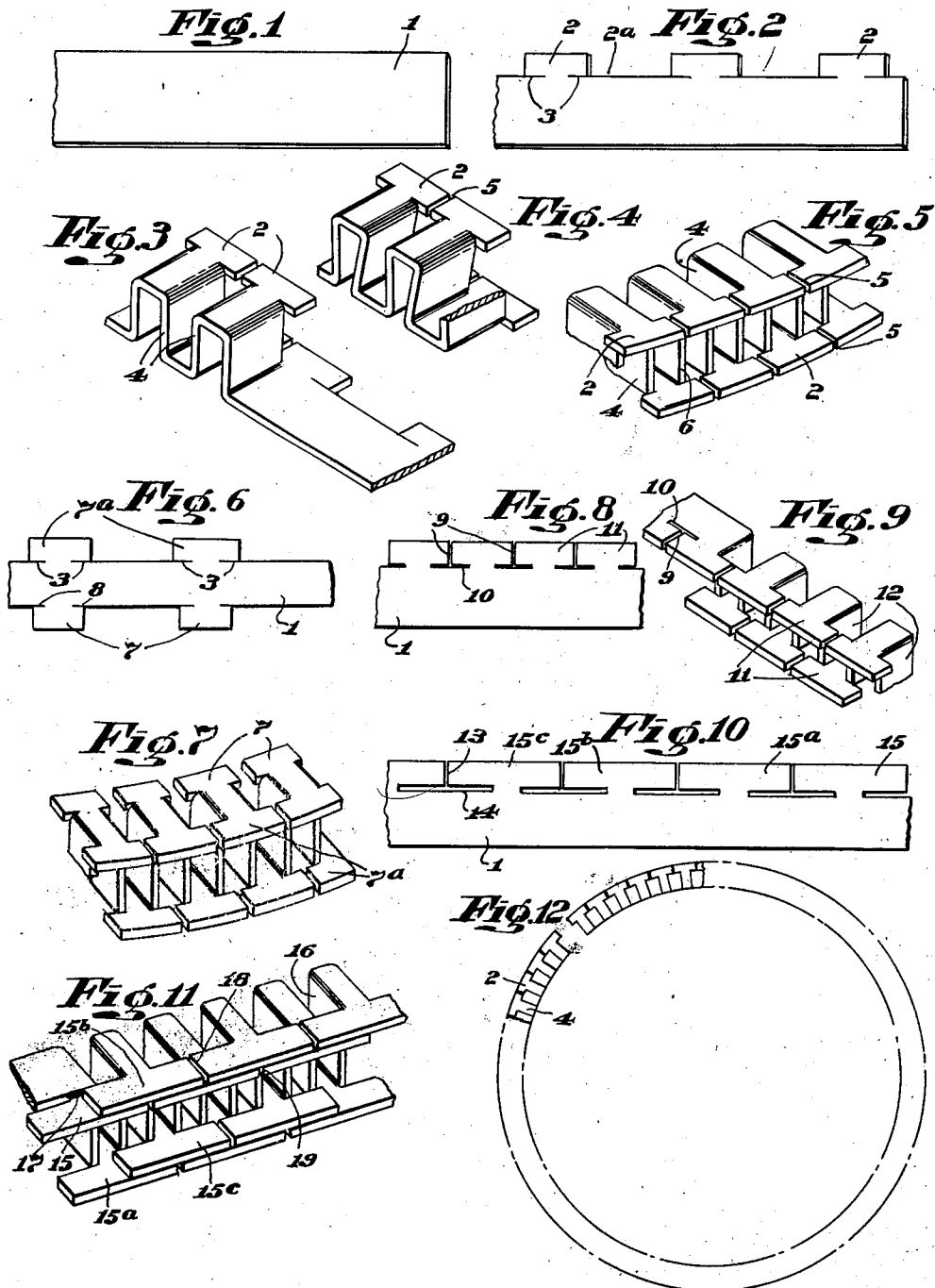
T. A. BOWERS

2,426,385

FABRICATED PISTON RING

Filed March 28, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 13

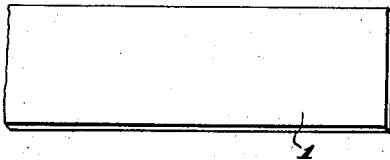


Fig. 14

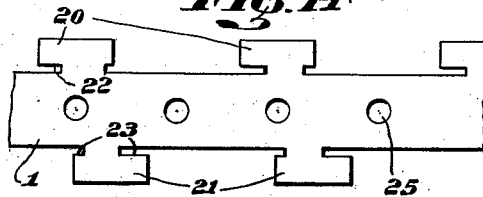


Fig. 15

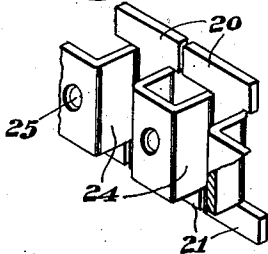


Fig. 18

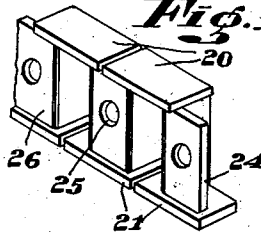
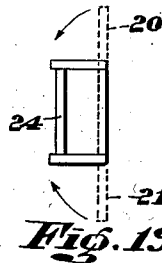


Fig. 16

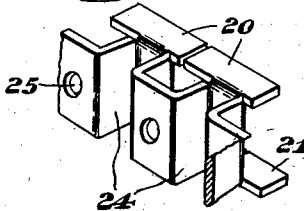
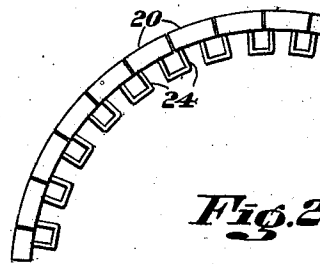


Fig. 20

Fig. 17

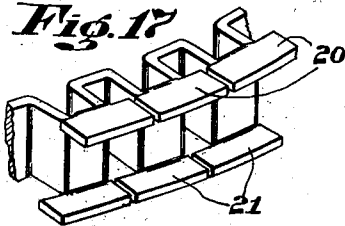


Fig. 21

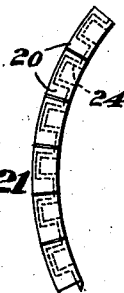
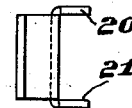


Fig. 22



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FABRICATED PISTON RING

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8 Claims. (Cl. 309-44)

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This invention relates to piston rings and more especially to flexible piston rings formed of resilient materials and is a continuation in part of my co-pending applications Ser. No. 268,721, filed April 19, 1939, and Ser. No. 276,503, filed May 31, 1939; and an improvement on my earlier patents 1,796,882, March 17, 1931; 1,796,883, March 17, 1931; and 2,076,554, April 13, 1937, and 2,076,539, April 13, 1937.

In the manufacture of piston rings of the oil control type, it is customary to provide, among other features, extended circumferential edges for more efficiently scraping oil from the wall of a cylinder. Such edges are attained by various methods, as by recessing solid rings, or by utilizing a plurality of thin steel rings supported on a spacing ring, or in other ways. The solid rings fail when their recessed portions become filled up and clogged with carbon. The steel ring assembly referred to is subject to formation of carbon to a lesser extent and further objectionable in that the assembly necessarily includes a steel expander which greatly raises the cost of the ring assembly, develops excess wear on a cylinder wall, and is hard to assemble about a piston.

It is a chief object of the invention to improve piston rings and to devise a novel ring structure of the reversely folded flexible type indicated in my earlier patents in which are provided substantially continuous circumferential edges for scraping oil and for constituting a substitute for the oil scraping edges comprised by the thin C-type rings above described. The invention also aims to provide a flexible and circumferentially extensible and contractible piston ring which is cheap, efficient, and durable, which presents openings for facilitating passage of oil through the ring in two dimensions, and which reduces carbon formation and oil extruding between the rings and its piston groove.

Attainment of these and other objects of the invention will appear in the following description of the drawings and discussion relating thereto.

In the accompanying drawings:

Fig. 1 is a perspective view of a trip of piston ring material employed in making the ring of the invention.

Fig. 2 is a perspective view illustrating a step in the formation of a piston ring.

Fig. 3 is a perspective view illustrating a further step in the formation of a ring.

Fig. 4 is a perspective view illustrating a still further step.

Fig. 5 is a perspective view fragmentarily illustrating the ring in its finished state.

Figs. 6 and 7 illustrate a modified ring construction and its method of manufacture.

Figs. 8 and 9 illustrate another modified ring construction and its method of manufacture.

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Figs. 10 and 11 illustrate still another modified ring construction and its method of manufacture.

Fig. 12 is a plan view of a finished ring of the type indicated in Figs. 1-5 inclusive.

Figs. 13-17 inclusive and Figs. 20 and 22 illustrate another general type of ring construction and its method of manufacture; and

Figs. 18, 19 and 21 illustrate a modification of ring construction of the type indicated in Figs. 13-17 inclusive.

Referring in detail to the drawings, Figs. 1-5 inclusive and Fig. 12 relate to one type of reversely folded piston ring construction and its method of manufacture; Figs. 6-11 inclusive relate to modifications thereof; and Figs. 13-21 inclusive indicate another general type of reversely folded ring construction.

Having reference to the construction included in Figs. 1-5 inclusive and Fig. 12, numeral 1 indicates a length of sheet material employed in making the rings of the invention. The sheet is of a resilient character and may be spring steel, alloy, or other metal or suitable material. A development in piston ring construction is to reversely fold sheet material, of the character noted, into ring bodies in some suitable manner as has, for example, been described in the above referred to patents and applications. These reversely folded rings are characterized by great flexibility and extensibility constituting a definite advance in the art.

According to the present invention, a strip or sheet of the resilient material is formed in some suitable manner to provide a ring of the reversely folded character described in which is incorporated, as an integral part thereof, extending portions designed to function as oil scraping edges. As illustrated in Fig. 2, the strip 1 is punched along one edge thereof to form segments 2 and spaces 2a occurring therebetween. Cutting is also carried out to effect slits 3 which extend inwardly of the segments to partly relieve these portions. The formed strip is reversely folded transversely of itself along lines of bending, the positions of which are determined by the ends of the slits 3, whereby the folds are bent away from the segments 2, as illustrated in Fig. 3. The folded material is arranged in some suitable position such as that illustrated in Figs. 4 and 5 and thereafter a length of the formed material of a size suitable for comprising a desired piston ring diameter is formed into an annular body and treated if desired with various finishing operations such as grinding, hardening and the like, to present a completed ring as illustrated in Fig. 12.

The operations described in connection with forming the sheet may be effected by apparatus commonly referred to as "tool machinery." For example, the punching of openings 2a may be

readily effected with conventional punch press mechanism. Similarly, the cutting of slits 3 can be effected by cutting or shearing dies, and folding of the material is achieved with forming dies or press mechanism. Forming a straight length of folded material into a circular body can be effected in several ways, one example of which is to force a length of the material through an annular rack or die.

In the ring construction shown there is provided an annular supporting structure made up of the folds or web portions 4 extending between top and bottom sides, or "land surfaces" of the ring, which in turn are comprised by the crowns or segments 2 arranged in contiguous relation to one another. The disposition of the webs 4 relative to the said sides may vary. In the preferred form shown in Fig. 3, the webs occur substantially at right angles to the land surfaces or sides. In the form shown in Fig. 4, the webs occur angularly between the sides. As customary with reversely folded rings, the annular supporting structure is characterized by an extensible and compressible character obtained from arranging resilient folds of metal in spaced relation whereby the folds may be compressed upon one another and thereafter tend to revert to a more open position.

A feature of the invention consists in the arrangement of the segments 2 in adjacent relation to one another to constitute a substantially continuous circumferential edge in a ring formed from a transversely folded strip of piston ring material. It has been found that such an edge for oil scraping purposes is the equivalent of, and an improvement upon, a fully continuous edge as comprised by a solid ring. By the alternate disposition of the segments or crowns 2 on the supporting structure as shown, there are further provided spaced-apart upper and lower circumferential edges which are embodied in the supporting structure and integral therewith and yet extend beyond it so that the outer edges 6 of the webs 4 are maintained from contact with the walls of a cylinder. In each of the circumferential edges thus formed, there occurs interstices 5, the interstices of one edge occurring in staggered relation with respect to the interstices of the other edge, and the interstices in both edges cooperating to maintain the compressibility of the ring. Either one as well as both of the edges may be utilized for oil scraping if desired.

Another feature of the ring, also obtained from the segments or crowns 2, consists in novel "land surfaces" or "sealing surfaces" which provide for satisfactory seating or sealing of the ring in its groove. It has been found that the segments taken collectively may form circumferential sealing surfaces for the ring which are suitable for sealing purposes in connection with preventing passage of oil by the ring, and which are therefore well adapted to act as a substitute for unbroken ring surface heretofore used. It has also been found that the segments may be of such size that they constitute only a part of the radial width of the ring in which they occur, thus allowing the sealing surfaces to occur at one side of a supporting structure or at other points. This makes possible the construction of a light, efficient ring, having a supporting structure made up of web portions of highly open character well suited to passage of oil radially or vertically through the ring.

In operation the ring functions as a gapless

ring with its ends adapted to abut one another. By its circumferential extensibility, the ring completely engages the wall of a cylinder, conforming to any non-uniformity or worn areas in the cylinder and exerting a substantially uniform pressure at all points therealong. It should be noted that the ring attains its extensible character without the use of any expanding means disposed between the back of the ring and its ring groove. As a result there is less transfer of piston slap and reduction of wear ordinarily developing therefrom.

As above described, the interstices 5 of one circumferential edge are disposed in staggered relation with the interstices of the other circumferential edge so that there is a continual wiping of oil on a cylinder wall at all points therealong during reciprocation of the ring. Also, since the edges 6 of the webs 4 are disposed in a recessed position with respect to the circumferential edges of the ring formed by the segments 2, they do not contact the cylinder wall and pick up carbon particles which reduces carbon formation at these points. At the same time, the extending portions of the segments 2 relative to the webs provide for great efficiency in the wall pressure exerted by the ring on a cylinder wall since for any given pressure available from the reversely folded structure described, more efficient application of it is achieved through reduced surface areas comprised by the circumferential edges described.

The ring structure is further characterized by novel functioning at the time when it slaps in its groove with change of the piston stroke. In oil rings, it is customary to provide relatively large surfaces at the top and bottom sides of the ring to effect sealing with the piston groove as described above. This has objections due to the fact that at the time when the ring slaps in its groove, there is collected on one of the surfaces a relatively large body of oil which is extruded in two directions: inwardly around the groove in a desired manner, and outwardly on to the cylinder wall above the ring in an undesired manner.

The ring of the invention provides for reduced sealing surfaces as above described, which are satisfactory for sealing the ring in its groove and yet provide reduced surfaces upon which oil may collect and be extruded. Attention is directed to Figs. 5 and 12 in which it may be seen that oil collected by the circumferential edges may rapidly pass thereover into the spaces between the web portions 4, thereby providing for a large part of the oil metered by the top circumferential edge not being subject to extrusion at all.

A number of advantages are obtained from the structure described. There is presented a unitary oil ring of circumferential extensibility and compressibility, having incorporated therein substantially continuous circumferential portions which are well adapted to take the place of the conventional multi-piece oil rings referred to. Considering the structure in detail, it is pointed out that the circumferential edges constitute a highly satisfactory equivalent for the two steel rings heretofore used in the art. The connecting web portions perform the double function of acting as a supporting structure which is circumferentially extensible and contractible, and constituting a spacing member which maintains the circumferential edges in spaced relation one above another, thereby taking the place of both expander and spacer structures. Also, it will be

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seen that these desirable effects are achieved while also providing desirable means for allowing oil collected by the ring to be passed to the back of the piston ring groove.

Another advantage of the invention is in the cheapness of the method and materials employed in forming a ring such as that shown. The forming operations described in connection with making the ring are adapted to being carried out with conventional "tool" machinery of the type described which provides cheap and efficient production methods. The resilient sheet metal is also of a cheapness which allows a ring, together with the methods described, to be made in production at costs substantially below those of cast iron rings or steel and cast iron ring assemblies. An immediate result of providing a cheap ring of this type is the use of such structures in original installations, a procedure which is not now resorted to, owing to the relatively greater cost of steel ring assemblies compared with cast iron rings.

The forming steps illustrated in Figs. 1-5 inclusive have been shown in connection with a length or strip of material. However, it is intended that such operations may be effected upon materials occurring in varying forms as in sheet form or in a web or roll. The strip or sheet material may further be formed with a variable cross section to effect greater strength at some points in a ring as compared with others, and a plurality of strips or sheets may be desired to be formed in combination with one another. The cutting or forming operations may be modified to occur angularly of the material or in other ways as hereinafter described. Also, the cutting or forming operations may be desired to be effected at other stages in the method of making the ring as for instance after a sheet or strip of material has been folded or formed into either an intermediate or permanent position or at some other point. The advantages obtained by the operations described may be resorted to in different ways and for other purposes as for instance in the manufacture of expander rings, or other types of sealing members in reciprocating bodies.

Figs. 6-11 inclusive relate to modifications of rings of the same general type indicated in Figs. 1-5 inclusive. With reference to the modification included by Figs. 6 and 7, it will be noted that the forming operations have been extended to both sides of the strip to form segments or crown portions 7 and 7a, relieved as before by longitudinal slits 3 and 8, as shown in Fig. 6. The formed strip is reversely folded as before to comprise an annular body having extending circumferential edges at both the inner and outer sides of the ring as has been shown in Fig. 7, in which the inner circumferential edge of the ring is comprised by the segments 7. It should be noted that with this type of structure, the segments 7 preferably are formed smaller and of tapered formation with respect to the portions 2 so that they will readily adapt themselves to constituting the relatively smaller circumference occurring at the inner periphery of a ring. The crown portions 7 may constitute an increased bearing surface for the ring and better maintain the ring in a horizontally supported position.

A further specific modification of piston ring construction has been illustrated in Figs. 8 and 9 in which a strip of material is formed with slits or cuts 9 extending inwardly transversely of the strip and additional cuts or slits 10 extending

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longitudinally along the strip and intersecting the slits 9. This procedure is illustrative of a forming operation of the shearing type or slitting, in which substantially no material is removed from the strip and yet crown portions 11 are provided which may be folded into a ring body having a supporting structure made up of web portions 12, as illustrated in Fig. 9. The ring presents a relatively smaller spacing occurring between the upper and lower circumferential edges formed by the crowns 11, is characterized by the webs occurring substantially at right angles with respect to the circumferential surfaces and may be formed with some saving of material. In other respects, the ring corresponds to the rings already described and is possessed of substantially the same advantages with respect to sealing efficiency, circumferential extensibility and compressibility, oil handling, durability, and cheapness.

Still another modification of piston ring construction is illustrated in Figs. 10 and 11 in which a strip of material is formed with transverse slits or cuts 13, and longitudinally extending cuts 14 intersecting the slits 13, to provide extended segments 15, 15a, 15b, and 15c. By forming the segments 15 of increased length, and then reversely folding the strip transversely of itself into a ring body, there is effected an overlapping relation of the circumferential edges as shown in Fig. 11. Fig. 11 discloses the arrangement of the segments 15, 15a, 15b, and 15c in abutting relation to one another to provide circumferential edges of double thickness supported by an annular structure made up of webs 16, with the points of abutment of the segments in either of the occurring edges in staggered relation with respect to one another.

In addition to the double circumferential edge construction described, cuts 14 may be made with an increased width so that the strip material may be folded at points, as 17, to alternately position the segments 15 in a relatively depressed position with respect to an overlying segment 15b, so that there result circumferential edges in each of which a series of the segments occur in contiguous relation, and in the same plane. This maintains substantially uniformly flat sealing surface throughout the top and bottom sides of the ring for seating it in a piston groove.

It should be noted that by the overlapping construction of the segments 15 as described, there is obtained a novel sealing effect with respect to the interstices 18 of the top row of segments, and the interstices 19 of the underlying row of segments, all of which are covered by adjacent segments. No oil can pass vertically of the ring through these interstices and with the sealing effect thus achieved the interstices may be increased in width if desired. In addition, the wall pressure of the ring per unit area of contacting surface may be varied by increasing the surface area of circumferential edges of the ring which are adapted to bear on the cylinder wall, and similarly a substantially stronger edge construction is arrived at. These modifications are intended to further illustrate modification of formed sheet metal piston rings.

Figs. 13-17 inclusive relate to another general type of ring in which a strip 1 is formed along one side thereof with segments 20, and along an opposite side with segments 21. Also formed in the strip are slits 22 and 23. The segments 21 are further arranged to occur in staggered relation with respect to the segments 20. The formed ma-

material is then reversely folded upon itself as has been illustrated in Fig. 15, to form a ring body in which the lines of folding of the strip extend vertically of the ring instead of radially as was the case with previously described ring forms. Thereafter the segments 20 and 21 are bent away from the supporting web structure in the manner illustrated in Fig. 16 to take a position at the outside of the folded supporting structure. There is thus achieved an annular body, as shown in Figs. 17 and 20, in which the segments 20 comprise an upper circumferential edge, and the segments 21 comprise a lower circumferential edge. At the same time a circumferentially extensible and contractible supporting structure made up of the folded webs 24 is provided for supporting the circumferential edges at the outer side thereof.

If desired, the strip may be formed with openings 25 of any suitable shape, as for instance that illustrated in Figs. 14, 15, and 16. These openings are adapted to facilitate passage of oil radially through the ring when collected by the circumferential edges described. The advantages previously noted are present with the radially folded ring, and there is a further reduction in the top and bottom surfaces of the ring against which oil may be extruded when the ring slaps in its groove.

The segments 20 and 21 may be bent from the position shown in Fig. 15 in an opposite direction, as illustrated in Fig. 18, in which the segments extend across and are supported by the top and bottom edges of the webs 24, which imparts added stability to the structure. Either side of the ring thus formed may serve as the outer periphery. It should also be noted that if desired, the segments 20 and 21 may be of a size such that they do not extend beyond the outer sides 26 of the webs 24, thereby forming a complete ring face without extending circumferential edges.

It will be seen that there are provided efficient, durable and cheap piston rings, highly adapted to comprising oil metering members. The rings are uniformly extensible, have an adjustable range of wall pressure, and develop oil metering efficiency of greatly improved character as compared with conventional structures employed for this purpose. It is pointed out that oil scraping edges have been incorporated in piston rings of the reversely folded type which take the place of oil ring assemblies, and which are adapted to be much more readily assembled in a piston.

While I have shown a preferred embodiment of the invention, it should be understood that various modifications and changes in the construction and materials may be resorted to, as for example other types of cuttings and foldings may be employed, a varying thickness of material to vary the wall pressure of ring structures, without departing from the spirit of the invention as defined by the appended claims.

Having described my invention, I claim:

1. A packing ring formed from corrugated sheet material in which the lines of folding extend radially of the ring, said ring having upper and lower faces in spaced superimposed relation, each of said faces including a plurality of T-shaped portions with the heads thereof aligned to define wearing edges for the ring and with the legs thereof projecting radially inward in spaced relation to each other, and intermediate wall members extending radially of the ring along and between the legs of the superimposed T-shaped portions to hold the said portions together.

2. A packing ring formed from sheet material bent along lines of folding which extend radially of the ring, said ring having upper and lower faces in spaced superimposed relationship, each of said faces including a plurality of T-shaped portions with the heads thereof aligned to define wearing edges for the ring and with the legs thereof projecting radially inward in spaced relation to each other, the T-shaped portions in one face being staggered with reference to those in the other face, and intermediate wall members extending radially of the ring along and between the legs of the staggered T-shaped portions to hold said portions together.

3. A piston ring comprising a corrugated strip of sheet metal forming a circumferentially and radially extensible and compressible annular body in which the lines of folding of the strip occur radially of the piston ring, said strip having web portions which support alternate upper and lower crown portions, said crown portions arranged in contiguous relationship at the outer periphery of the ring and extending beyond the web portions both circumferentially and radially of the ring to provide oil scraping edges.

4. A piston ring comprising a corrugated strip of sheet metal in which the lines of folding extend radially of the piston ring, the structure comprising crowns and connecting webs, said crowns being arranged adjacent one another to form interrupted surfaces of the ring, said crowns being broken away along their edges for a portion only of their radial length, the gaps between adjacent crowns being of less circumferential width at the outer edges of the ring than at points within the ring.

5. A packing ring formed from corrugated sheet material in which the lines of folding extend radially of the ring, said ring including a plurality of T-shaped portions with the heads thereof aligned to define an oil scraping edge for the ring and with the legs thereof projecting inward radially of the ring, and wall members extending radially of the ring along and between the legs of adjacent T-shaped portions to hold the said portions together.

6. A piston ring comprising a corrugated strip of sheet metal in which the lines of folding of the strip occur radially of the piston ring, said ring having resilient web portions which support crown portions, said crown portions arranged in contiguous relationship at the outer periphery of the ring and extending beyond the web portions to provide at the outer circumference of the ring an edge for scraping oil from a cylinder wall and also to provide a sealing surface for sealing the ring against a side of a piston groove, said sealing surface extending inwardly of the ring for a part only of the radial width of the ring.

7. A packing ring formed from corrugated sheet material in which the lines of folding extend radially of the ring, said ring having upper and lower faces in spaced superimposed relation, each of said faces including a plurality of rows of T-shaped portions with the heads of the T-shaped portions in each row being aligned to define wearing edges for the ring and with the legs thereof projecting radially inward in spaced relation to each other, and intermediate wall members extending radially of the ring along and between the legs of the superimposed T-shaped portions to hold the said portions together.

8. A packing ring formed from sheet material bent along lines of folding which extend radially of the ring, said ring having upper and lower

faces in spaced superimposed relationship, each of said faces including a plurality of rows of T-shaped portions with the heads of the T-shaped portions in each row being aligned to define wearing edges for the ring and with the legs thereof projecting radially inward in spaced relation to each other, the T-shaped portions in one row being staggered with reference to those in an adjacent row, and intermediate well members extending radially of the ring along and between the legs of the staggered T-shaped portions to hold said portions together.

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