June 13, 1939. M. G. KURTH 2,162,555

COMPOUND HELICAL PACKING

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Fig. 1.

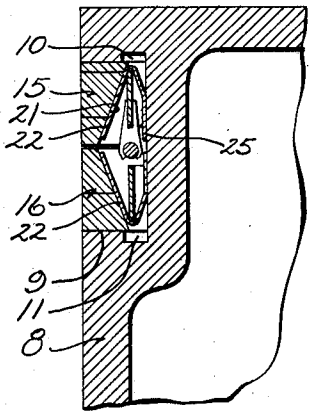


Fig. 2.

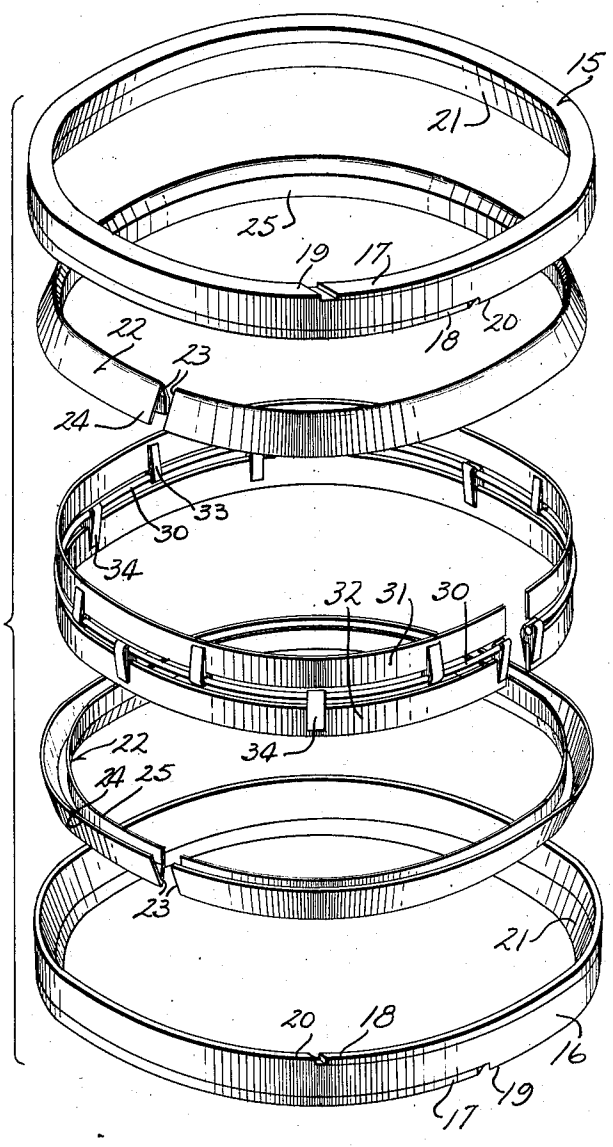
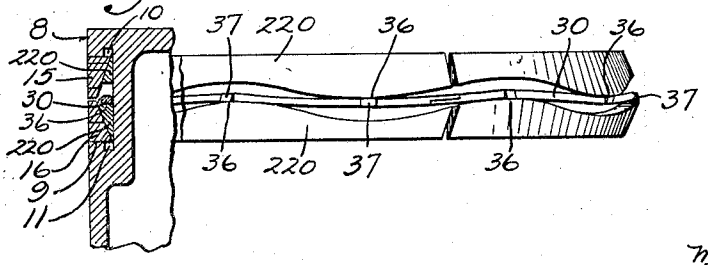


Fig. 3.



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Fig. 4.

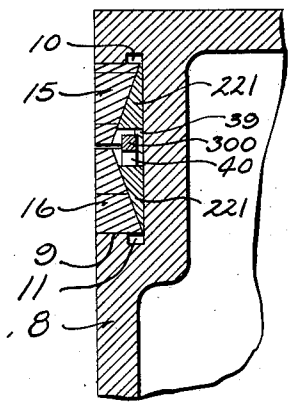


Fig. 5.

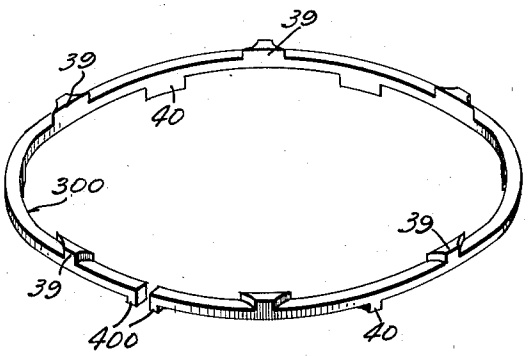


Fig. 6.

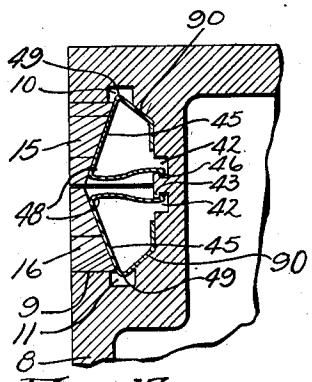


Fig. 7.

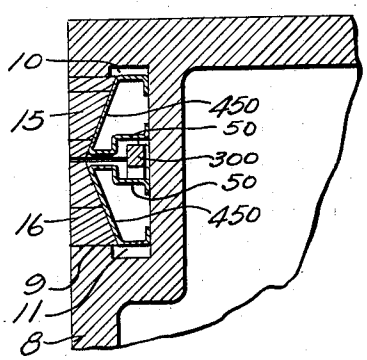


Fig. 13.

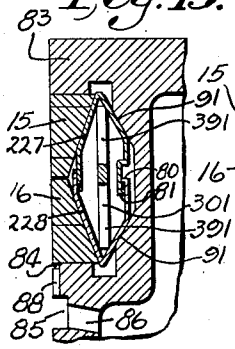
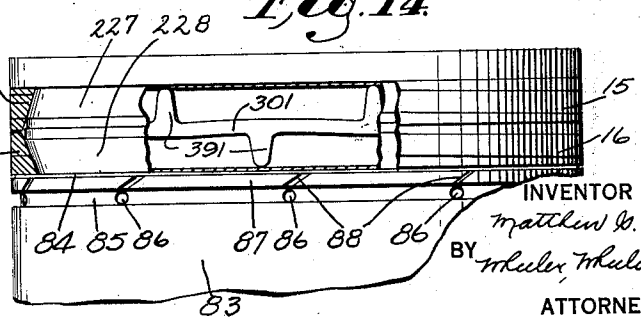


Fig. 14.



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Fig. 8.

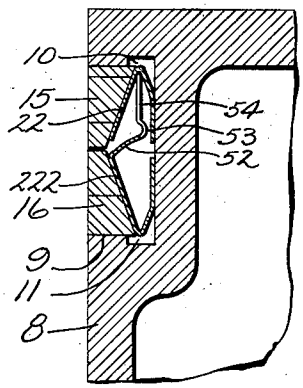


Fig. 9.

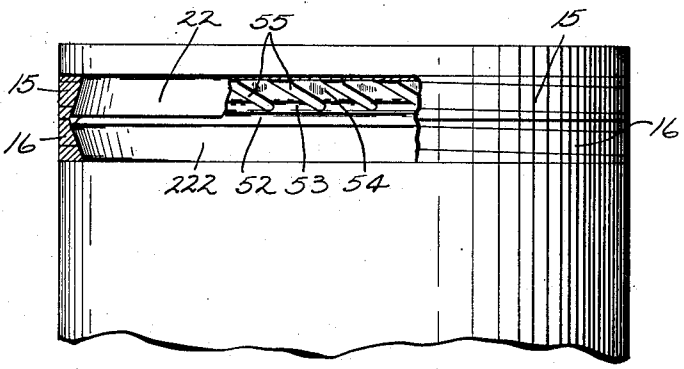


Fig. 10.

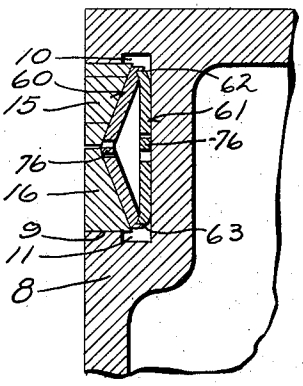


Fig. 11.

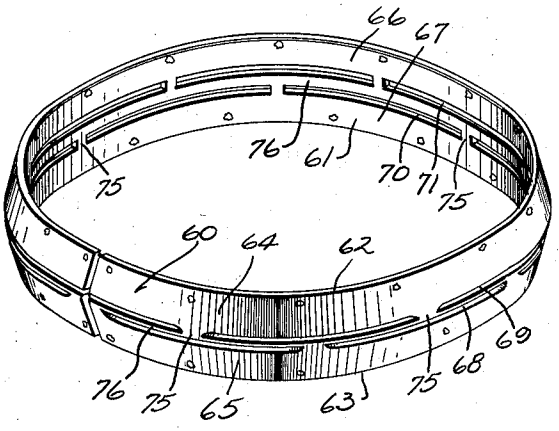
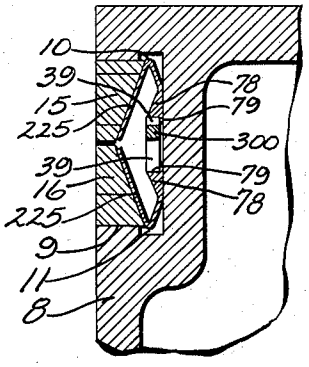


Fig. 12.



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COMPOUND HELICAL PACKING

Matthew G. Kurth, Madison, Wis.

Application October 7, 1935, Serial No. 43,934

8 Claims. (Cl. 309—27)

This invention relates to improvements in compound helical packing.

It is the primary object of the invention to provide an improved packing which will accomplish its packing function with a maximum of effectiveness and a minimum of cylinder pressure and friction.

In the particular device herein disclosed I accomplish this purpose through the provision of a pair of opposed helical packing elements arranged end to end in a single groove in the member to be packed and having oppositely beveled interior surfaces with which an improved expander co-acts in an axial direction to produce radial expansion of the packing elements.

More specifically, it is one of the objects of the invention to provide improved helical packing elements and a variety of improved expanding means capable of maintaining a substantially uniform thrust under the most severe conditions of use. With reference to this last objective, it is my purpose to provide a type of spring which is manufactured without material distortion in a direction in which its force is exerted in the assembled structure, substantially its entire deflection in such direction being produced in the assembly of the parts.

In the drawings:

Figure 1 is a fragmentary detail view in axial section showing improved packing embodying the present invention.

Figure 2 is a view in perspective on a reduced scale as compared with Figure 1, showing in "exploded" relation the component parts of my compound packing.

Figure 3 is a view showing the fragment of a piston in cross section, and showing partially in cross section and partially in side elevation a modified packing including a slightly different form of expander.

Figure 4 is a view similar to Figure 1 showing a further modified embodiment of the invention.

Figure 5 is a view in perspective showing the type of expanding spring used in Figure 4.

Figure 6 is a view similar to Figure 1 showing a further modified embodiment of the invention, in which the expanding and wedging functions for separate parts in Figures 1 to 4 inclusive are consolidated in single members.

Figure 7 is a view similar to Figure 1 showing a further modified embodiment of the invention, in which sheet metal wedge rings are employed, but in which the expanding function is performed by a spring as in the construction disclosed in Figures 1, 2, 4 and 5.

Figure 8 is a view similar to Figure 1, illustrating a further modified embodiment of the invention.

Figure 9 is a view showing on a reduced scale partially in cross section and partially in side elevation the installation of packing of Figure 8 in a piston.

Figure 10 is a view similar to Figure 1 showing a further modified embodiment of the invention.

Figure 11 is a view on a reduced scale showing in perspective the spring expander used in Figure 10.

Figure 12 is a view similar to Figure 1 showing a further modified embodiment of the invention.

Figure 13 is a view similar to Fig. 1 showing a further modified embodiment of the invention.

Figure 14 is a view on a reduced scale partially in side elevation and partially in section showing the packing construction of Fig. 13, and also showing a special oil groove with which I prefer to equip the member which is packed.

Like parts are indentified by the same reference characters throughout the several views.

The piston shown at 8 in Figs. 1, 3, 4, 6, 7, 8, 9, 10, and 12 will be understood to be typical of any member requiring packing, whether provided with a groove in its internal or external periphery. It will be obvious to those skilled in the art that by simply reversing the curvature of the parts they may be adapted for use in a converse situation as internal packing.

The piston 8 has a packing groove 9 under-cut at 10 and 11 at both of its ends to provide clearance for the wedge rings hereinafter to be described.

Two packing rings 15 and 16 are used, each of these comprising preferably a helix with end portions 17 and 18 oppositely tapered and an intervening coil thickened at 19 and 20 to provide shoulders leveling up the ends of the rings so that the terminal surfaces of each of the helical packing rings are parallel. Thus two rings 15 and 16 substantially fill the outer porton of groove 9, as clearly shown in Figs. 1, 3, 4, 6 and 7.

Rings 15 and 16 are identical with each other but are used in relatively inverted positions. Each ring is internally beveled at 21 to provide a frusto-conical surface with which the wedge members hereinafter to be described are arranged to co-act. While various modifications of the packing rings 15 and 16 may be made within the scope of this invention they have, for convenience, been illustrated uniformly throughout the several views, the present invention being related particularly to the expanding devices and their co-action with the rings 15 and 16.

In the construction shown in Figs. 1 and 2 the wedge rings 22 are made of sheet metal folded approximately to a V-shape in cross section and rolled into the form of a split ring, the ends 23 of which are in close proximity as shown in Fig. 2. The outer flange 24 of each wedge member is fitted to and co-acts with the interior of beveled surface 21 of the adjacent packing helix 15 or 16. The inner flange 25 flares for only a portion of

its length from the outer flange 21, the major portion of its area being shaped to a cylindrical form to fit the inner wall of the groove 9 as clearly appears in Figs. 1 and 2.

Co-operating with the wedge members 22 to expand the packing helices 15 and 16, is a spring unit which comprises a split ring 30 of spring wire, a pair of short split tubes 31 and 32, and brackets 33 and 34 alternately engaging the spring wire 30 and connected to the respective split tubes 31 and 32. The brackets are bifurcated pieces of metal welded to respective split rings and having their terminal legs formed to engage the spring wire 30, as shown in Figs. 1 and 2, to provide for a permanent connection between the parts to enable the spring assembly to be handled as a unit. It will be noted that the ends of the split tubes 31 and 32 and spring wire 30 are aligned so that the entire assembly may be regarded as a split ring resiliently yieldable in an axial direction as the thrust of the ends of the split tubes 31 and 32 is transmitted through the brackets 33 and 34 to arcuately spaced points on the spring ring 30. The resulting resilient deflection of spring ring 30 will subject the ends of the split tubes 31 and 32 to axial pressure.

In the arrangement shown in Fig. 1 and Fig. 2 the ends of the split tubes 31 and 32 are engaged in the apices of the folded wedge rings 22. The dimensions of the parts are so chosen that with the various elements assembled in the position shown in Fig. 1 the spacing between the apices of the wedge members 22 will be insufficient to receive the spring assembly except when the spring wire 30 is resiliently distorted. Consequently, in the Fig. 1 relation of the parts the tubes 31 and 32 are exerting axial pressure on the channeled wedge members 22 tending to separate such wedge members and thereby to expand the packing helices 15 and 16. The under-cutting at 10 and 11 of groove 9 provides clearance for the expanding movement of the wedge members 22 in a direction to take up all wear between the packing and the cylinder with which it is associated.

In the construction shown in Fig. 3 the wedge members 220 are not made of sheet metal but are solid rings of brass or the like, having complementary marginal convolutions with alternating crest portions 36 engaging the spring ring 30 at arcuately spaced points as clearly shown in the drawing. At each crest portion 36 each of the split rings 22 will peripherally be provided with fingers 37 for the engagement of the ring to keep the parts in line. In the Fig. 3 assembly of the parts it will be observed that the split wedge rings 220 have been forced together in an axial direction, thereby distorting the spring ring 30. The compression of the spring ring acts through the wedge members 220 to force the wedge members apart in an axial direction and thereby to expand the beveled helical packing elements 15 and 16.

The construction shown in Fig. 4 is identical with that of Fig. 3 so far as the wedge members are concerned, except that the wedge members 221 shown in Fig. 4 need not have the convoluted or undulating surfaces illustrated in Fig. 3. The opposed surfaces of wedge members 221 are planiform and the spring ring 300 is provided at intervals with integral bosses 39 and 40 projecting alternately from its opposite faces to be engaged by the opposing surfaces of the wedge members 221, thereby to distort the spring ring 300 exactly as the ring 30 is distorted by the pressure of brackets 33 and 34 carried by the split rings 31 and 32 as shown in Fig. 1 and Fig. 2. The difference is that the means which spans the gap between the spring ring and the wedge member is here carried by the ring itself instead of by the co-acting split rings shown in Figs. 1 2 and 3. At the ends of the spring 300 I may divide the boss 40 to comprise two lugs 400. The ring 300 and the integral bosses thereon may be machined from any suitable material such as cast iron or steel. The spring 30 will usually be made of spring steel wire such as piano wire.

In the construction shown in Fig. 6, a single element furnishes both the spring pressure and the required wedging action. The piston is provided with a pair of inward extensions 42 of the groove 9, each such extension being preferably under-cut to provide a rib 43. The annuli 45 are made of spring sheet metal in tubular cross section of the peculiar outline shown in Fig. 6. The margin of each is flanged at 46 for engagement behind the appropriate rib 43. The outer periphery of each is frusto-conical in form and substantially rectilinear in cross section as shown in Fig. 6, whereby to be adapted to co-act with the beveled inner surface of the helical packing member 15 or 16. The proportions of the parts are such that the angle at 48 has been subjected to material distortion in the assembly of the elements of the compound ring, whereby the stress in the sheet metal tends to force the apex 49 into the undercut portion 10 or 11 of the groove to produce the desired wedging action for the expansion of the packing helix 15 or 16, as the case may be.

In the construction shown in Fig. 7 the sheet metal rings 450 instead of being made of resiliently yieldable material as are the rings 45 in Fig. 6, are made of comparatively rigid material to comprise blunt annular wedges of hollow cross section. Their inner flanges are preferably offset to be spaced apart at 50 to receive between them the split spring ring 300 illustrated in Fig. 5, such ring being subject to stress in the assembled relation of the parts to force the wedge members 450 asunder in an axial direction whereby to expand the helices 15 and 16 in the manner already described.

In the construction shown in Figs. 8 and 9 the packing elements 15 and 16 and one of the sheet metal wedges 22 are identical with the parts already described, but the other wedge member 222 is made to provide integrally the resiliently expansible spring. It is rolled inwardly to provide the annular flange 52 which is reversely curved at 53 to increase its resilient yielding qualities and is extended axially upwardly at 54 in the form of teeth or fingers as shown in Fig. 9, these teeth or fingers 54 being formed by helical notches 55. The helical inclination of the teeth 54 gives them a certain degree of resilience axially of the cylindrical surface in which they are disposed, and additional resilience is provided by the reverse curve at 53, across which the notches 55 extend. The annular flange portion 52 is likewise resilient, the result being that when the parts are assembled the spring portions 52, 53 and 54 are subjected to distortion and their reaction pressure forces the wedge device 22 in one direction and the wedge device 222 in the opposite direction to act on the packing elements 15 and 16 as above described.

In the construction shown in Figs. 10 and 11 I have illustrated another device in which the spring action and the wedge action are provided

integrally in the same members. The construction now being described has the advantage that it may be handled as a unit, the parts being in permanent connection.

To make up this combination spring and wedge expander unit I provide two axially yieldable spring split rings 60 and 61 which are spaced apart intermediate their ends and are peripherally joined at their end margins 62 and 63 by spot welding or the like.

The separation of the middle portions of these rings is preferably accomplished by forming the outer ring 60 in the form of a shallow channel having a frusto-conically finished bearing surface at 64 and a similar surface of opposite taper at 65. The surfaces 64 and 65 are complementary to the inner surfaces of the packing elements 15 and 16 and consequently they serve the functions of the wedges 22.

The resilient axial yielding between the portions 64 and 65 of the outer ring 60, and the corresponding portions 66 and 67 of the inner ring 61 is provided for by peripherally slotting each of the two rings 60 and 61 to provide overlapping kerfs 68, 69, 70 and 71. Between the ends of the kerfs of each series are integral tongues 75, the integral tongues of one series being staggered equi-distant between the tongues of the other series. Between the two series of kerfs remains an unslotted band 76 integral with the upper and lower annular areas but connected therewith solely through the staggered tongues. Thus the resilient yielding of this band corresponds to the yielding of the spring 30 in Fig. 2 or Fig. 3, or the ring 3 as shown in Fig. 5, with the result that both the inner rings 61 and the outer ring 60 are axially yieldable in the same manner.

In the construction shown in Fig. 12 the spring 300 may be identical with that shown in Fig. 5, but the wedge members 225 which act upon the packing elements 15 and 16 have been so rolled as to provide a thickened portion at 78 having a shoulder machined at 79 to receive the thrust of the bosses 39 on the spring ring 300.

In many respects the construction shown in Figs. 13 and 14 is similar to that of Fig. 1. The wedge elements 227 and 228, however, are extended axially of the piston 8 into mutually overlapping and telescopically expansible relation to each other. Thus they completely enclose the annular spring 301 which, like spring 300 shown in Fig. 5, is distorted by the engagement of its lug portions 391 (Figs. 13 and 14) with the inner apices of the wedge members 227 and 228.

The two wedge members are preferably interlocked with each other against axial separation so that the wedge and spring parts 227, 228 and 301 may be handled unitarily and applied and removed unitarily. For this purpose at least one flange of each member has a hook 80 or 81, the said hooks 80 and 81 of the respective members being interlockingly engaged as clearly illustrated in Fig. 13. It will be noted that there is mutual clearance between the hooks to permit of all necessary expansion of the wedge members 227 and 228 telescopically in response to the pressure of spring 301, but the range of possible movement is not such that the wedge members may accidentally become separated.

In the construction shown in Figs. 6, 13 and 14, I have provided a beveled surface in the packing groove with which the tapered inner portions of the wedge elements coact in the course of their expansion to increase the radial thrust upon the packing members 15 or 16 per unit advance axially of the wedges. The tapered surfaces in Fig. 6 are designated by reference character 90, and in Fig. 13 they are designated by reference character 91.

With any of the packing elements herein disclosed I may use, and I prefer to use, oil grooves as shown in Figs. 13 and 14, which are preferably formed integrally in the member to be packed. By way of example I have shown the piston 83 with a narrow shallow groove 84 immediately adjacent the packing, and a deeper groove at 85 from which the holes 86 open to the interior of the piston. The intervening ungrooved rib portion 87 will be noted to be provided at intervals with diagonal or helical channels 88 leading from the small groove 84 to the deeper groove 85. These channels are preferably so located as to terminate immediately adjacent the respective ports 86. This particular arangement of wiping edges and communicating grooves and channels has proved especially effective in preventing all loss of oil. The lower margin of the packing is one of the principal oil collecting edges, and it is important that the oil thus collected is not drained through any portion of the packing groove but is led to another groove from which the drain holes open.

The various constructions in which the spring and wedge assemblies are hollow as shown in Figs. 1, 6, 7, 8, 9, 10, 11, 12, 13 and 14, have an important advantage in that they operate at low temperature as compared with the solid wedge construction such as those illustrated, for example, in Fig. 3 or Fig. 4. In actual practice with a heavy duty engine developing horse power far in excess of that developed by the same engine with other packing, it was found that my improved packing using sheet metal wedge elements remained at a temperature not to exceed 300° F. The importance of this low temperature operation lies in the fact that metals do not lose their resilience at such low temperatures.

Exhaustive tests have indicated that the compound packing herein disclosed is highly efficient as a packing, although its radial pressure is much reduced as compared with other packing for the purpose. In a gasoline engine equipped with these rings greatly increased power has been developed as compared with packing rings of conventional design previously used in such engines. The increase was almost entirely traceable to the reduced pressure of the packing on the wall of the cylinder and the correspondingly reduced frictional resistance to piston movement. The result was not merely increased power but greatly prolonged packing life.

One of the advantages of the several constructions herein disclosed lies in the fact that radial pressures are entirely within the control of the design. In other words, the helical packing has very little spring per se and the pressure between the packing and the surface contacted thereby is almost entirely the result of the axially exerted spring pressure and the angularity of the surface with which the wedge reacts. By changing the spring pressure or the angularity of the wedge surface, or by lengthening or shortening the helix to vary the total area over which the pressure is exerted, I am able to control with accuracy the pressure contact between the packing and the wall of the cylinder in which it may be operated.

Another advantage of the constructions herein disclosed consists in their relative freedom from slap. In any construction where the entire contact pressure is developed by a spring ring such

ring will naturally yield resiliently to allow the piston to become laterally displaced upon each occasion when the piston is subject to high compression with the connecting rod at an angle. The resulting displacement of the piston is known to the art as side slap. In the present construction the fact that the pressure is developed by a force acting at right angles through a wedge upon the packing, results in a certain amount of friction which resists any sudden changes of position of the packing with respect to the piston, so that any tendency for the piston to slap laterally against the wall of the cylinder is resisted not only by the spring pressure but by the friction and inertia of the parts which prevent any sudden displacement. As a result, slap is substantially eliminated and wear is greatly reduced.

In actual comparative tests a piston having an ordinary commercial packing was operated in an engine pulling 65 H. P. for a period equivalent to fifteen thousand miles of truck operation, and it was found that the eccentric wear in the cylinder amounted to .015''. The pistons equipped with packing as herein disclosed were all capable of operating under greater load and for longer periods without producing any appreciable wear. In a specific test one such piston in an engine having packing in accordance with this invention was operated for the equivalent of about fifteen thousand miles of truck operation pulling 122 H. P. and showed a wear of less than .002''.

Not only does my improved packing greatly reduce the wear between the surfaces packed but, in addition, it also greatly reduces the amount of pressure required between the packing and its coacting surface. Since the yielding of the packing with respect to the surface is resisted not merely by spring pressure but also by friction in the wedge and the beveled surfaces with which the wedge coacts, I am able to reduce greatly the amount of spring pressure which would otherwise be used, and this fact not only reduces cylinder wear but also greatly reduces the drag, so that an engine equipped with packing of this invention has its power very materially increased as compared with an engine having conventional packing.

I claim:

1. A compound packing comprising a pair of expansible packing elements having opposed beveled peripheral surfaces, of annular hollow sheet metal wedges co-acting with the beveled surfaces of said members and movable axially with respect thereto for the expansion of said elements, and spring means housed within and confined under stress between said wedges and re-acting oppositely thereon, whereby to tend to separate said wedges for the expansion of said elements, said spring means comprising a normally planiform ring, and spacers angularly offset about said ring and alternately interposed between said ring and said wedge means, whereby said ring is undulatory in form when subject to stress, said hollow wedges thermally insulating said ring to maintain the tension thereof.

2. A packing comprising the combination with annular packing elements having beveled peripheral surfaces, of wedge members bodily axially movable with respect to each other, a spring housed between said wedge members and reacting thereon to move said wedge members oppositely, and means interconnecting said wedge members against axial separation, whereby said wedge members and spring comprise a unit for handling.

3. An expander for internally beveled packing comprising a sheet metal annulus formed axially between its margins to comprise a wedge having an axially projecting apex and a pressure member housed within said annulus between the margins thereof and comprising peripherally separated spacers internally engaged with the apex of said wedge and otherwise free of said annulus and packing, whereby to be thermally insulated.

4. In a compound packing, the combination with hollow sheet metal wedge means of annular form providing oppositely directed apices, of a resilient spreader housed within said wedge means and including spaced members internally engaging at least one of said apices and spaced from adjacent portions of said wedge means, whereby to be thermally insulated.

5. In a device of the character described, a resilient support for radially expansible packing having opposed beveled interior portions, said support comprising sheet metal annuli having adjacent lateral margins and oppositely formed beyond their respective margins to provide axially directed apices, a spring ring housed between said annuli and having staggered oppositely projecting spacers in pressure engagement with the interior portions of the respectve annuli adjacent the apices thereof, said ring and spacers being otherwise substantially free of said annuli, whereby to be thermally insulated for the protection of the tension of said ring.

6. In a device of the character described, the combination with a pair of annular wedges comprising sheet metal annuli having radially spaced margins and oppositely directed annular apices, corresponding margins of the respective annuli being close together to enclose a space within said annuli, of resilient reactance means housed within said space for forcing said annuli in opposite directions and comprising an undulatory element extending peripherally within said annuli under stress with its various undulations in pressure transmitting relation to the opposing annuli.

7. In a device of the character described, the combination with a pair of annular wedges comprising sheet metal annuli having radially spaced margins and oppositely directed annular apices, corresponding margins of the respective annuli being close together to enclose a space within said annuli, of resilient reactance means housed within said space for forcing said annuli in opposite directions, said reactance means comprising a distorted ring interposed between said annuli and having staggered spacing elements supporting said rings solely from the internal surfaces of the respective apices of said annuli.

8. A device of the character described comprising the combination with a packing helix having a cylindrical external face and a beveled internal face, said helix being finished to provide a flat face at its end of larger thickness, an annular wedge acting axially against the beveled internal face of the helix and projecting beyond said thicker helix end, and a packed member providing integrally an abutment for the said end of the helix and having an under-cut groove registering with said wedge and into which said wedge projects, said helix being expansible and contractible to be manipulated over said member and received into said groove and having its convolutions tightened upon each other in said groove under compression of said wedge.

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