Dec. 9, 1941. R. M. ULRICH 2,265,616

METHOD OF EXPANDING PISTON SKIRTS

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Fig. 1.

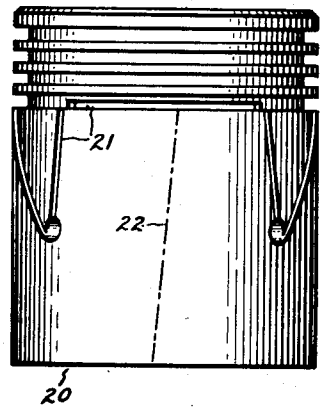


Fig. 2.

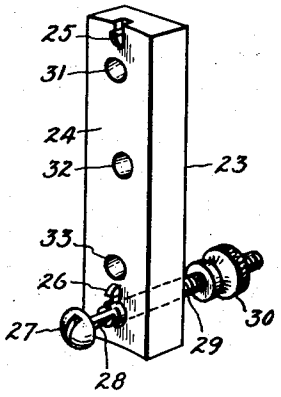


Fig. 3.

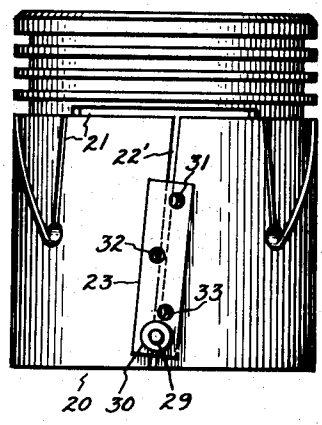


Fig. 4.

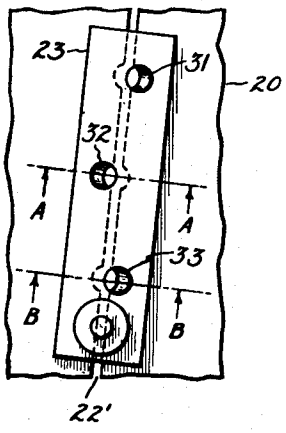


Fig. 5.

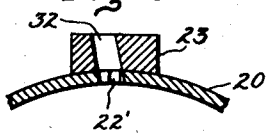


Fig. 7.

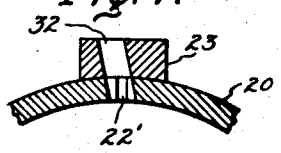


Fig. 6.

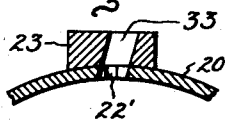


Fig. 8.

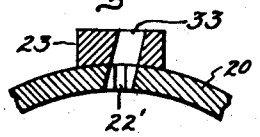


Fig. 9.

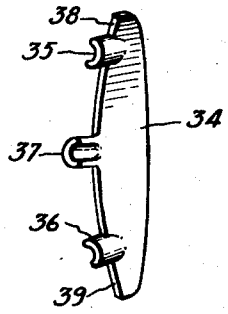
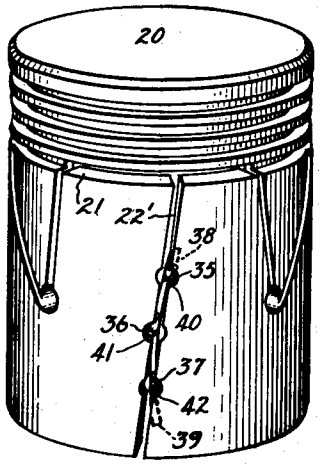


Fig. 10.



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Fig. 11.

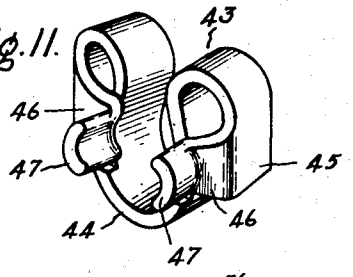


Fig. 12.

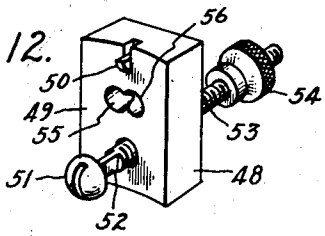


Fig. 13.

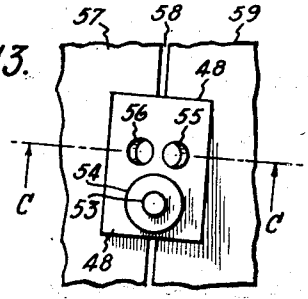


Fig. 14.

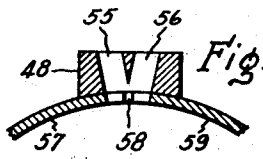


Fig. 15.

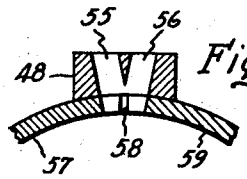
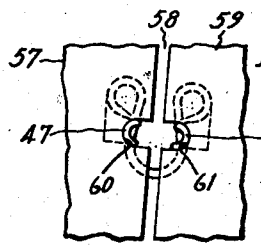


Fig. 16.



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UNITED STATES PATENT OFFICE

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METHOD OF EXPANDING PISTON SKIRTS

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Application December 21, 1938, Serial No. 247,089

4 Claims. (Cl. 29—156.5)

My invention relates to the method of expanding piston skirts and more particularly to a method of expanding pistons of the aluminum alloy type.

This application is a continuation-in-part of my copending application Serial No. 204,272, filed April 26, 1938, entitled Piston expanders and method of installation.

It is an object of my invention to provide an improved piston expander and method of installation which will produce the same degree of expansion fit within the piston cylinder in the case of thick-walled pistons as is the case in thin-walled pistons.

It is still another object of my invention to provide an improved method of and means for the preparation of expansible pistons for the reception of the piston expander cooperating with the piston slot of the expansible skirt.

A still further object of my invention is to provide an improved method of expanding the skirt of a U-slot piston.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will be understood better by reference to the following description taken in connection with the accompanying drawings in which Fig. 1 shows a U-slot piston; Fig. 2 shows a perspective view of my piston drill guide block; Fig. 3 shows the application of my drill guide block to the skirt of the U-slot piston; Fig. 4 is a detailed view of the application of the drill guide block to the skirt of a piston; Figs. 5, 6, 7 and 8 are cross-sectional views which illustrate the manner in which the drill guide block cooperates with thin-walled pistons and with thick-walled pistons; Fig. 9 shows a perspective view of one type of expander utilized in expanding the skirts of pistons; Fig. 10 shows a U-slot piston in which an expander has been installed; Fig. 11 shows a perspective view of another type of piston expander; Fig. 12 shows a perspective view of another type of piston drill guide block; Fig. 13 shows the application of this modified form of drill guide block to the slot of a piston skirt; Fig. 14 explains the operation of the drill guide block in connection with thin-walled pistons; Fig. 15 explains the operation of the drill guide block in connection with thick-walled pistons, and Fig. 16 shows the expander of Fig. 11 inserted in a piston.

Referring to Fig. 1 of the drawings, I have illustrated therein a piston 20 of the U-slot type which is provided with a U-slot 21 which permits the skirt to expand to a certain degree. In order to prepare the piston 20 for reception of a piston skirt expander, a substantially perpendicular line 22 is drawn from a point approximately midway between the two sides of the U-slot 21 to the bottom of the skirt. It is preferable to incline the line 22 slightly so as to distribute the edge of the slot formed by sawing along the line 22 with a hack saw over an extended area of the cylinder wall. After a slot has been formed by sawing with a hack saw along the line 22 a piston drill guide block of the form shown in Fig. 2 is placed in position on this slot.

The piston drill guide block which is used is shown in Fig. 2 and it comprises an elongated body portion 23 having a concave face 24, the radius of curvature of which corresponds approximately to the radius of curvature of the more common pistons in use. This concave surface 24 is provided with a pair of projections 25 and 26 located adjacent opposite ends of the elongated body portion 23 so as to engage the slot formed along the line 22 of the piston 20 shown in Fig. 1. At one extremity suitable fastening means are provided comprising a head member 27, a flat portion 28, a threaded portion 29 and a nut 30 which serves to maintain the block 23 in proper operative position on the piston skirt. The head member 27 bears against the inside surface of the piston skirt while the flat portion 28 is located between the faces of the piston slot. The body portion 23 is furthermore provided with a plurality of drill bit guides 31, 32 and 33, respectively, which are spaced apart and extend from the concave surface 24 through the block 23, the axis of each guide forming an acute angle with the perpendicular to the tangent of the curvature of the concave face 24 at the center line extending between the projections 25 and 26. The alternate axes of the members 31, 32 and 33 are so placed to the right and left of the center line so that the drill bit cooperating within the guide will produce concave indentations in the faces of the slot which are oblique sections of a cylindrical surface. Thus irrespective of the skirt wall thickness, each piston skirt is drilled at the slot in a plurality of places spaced at fixed distances, from each other and from the slot, along the outer circumference of the piston skirt. Fig. 3 shows the drill guide block 23 in operative relation with respect to the piston skirt of the piston 20. The drill bit guide 32 is placed so as to be just slightly below a line drawn from one end of

the U-slot 21 to the other end of the U-slot 21 so that the center of the biasing force exerted by the expander comes slightly below the ends of the U-slot. Fig. 4 shows an enlarged view of the block 23 upon the skirt of the piston 20 and from this view it will become apparent that the axes of the drill bit guides 31 and 33 are in the same plane which is at an acute angle to the right of a plane perpendicular to a plane tangent to the curvature of the piston skirt at the slot, whereas the axis of the drill bit guide 32 is in a plane which is at an acute angle to the left of the plane perpendicular to a plane tangent to the curvature of the piston skirt at the slot 22'. The vertices of the angles formed by these planes are at a point within the area bounded by the piston skirt.

From Figs. 5 and 6 which are respectively sectional views along the lines A—A and B—B of Fig. 4, it will be seen that in a thin-walled piston skirt the inside view of the arcuate indentations in the faces of the slot would represent indentations in staggered relation so that if tangents to the indentations were drawn on the inside of the skirt parallel to the faces of the piston slot 22', they would be spaced apart an appreciable amount. Thus in a thin-walled piston the fixed skirt expander such as shown in Fig. 9 will not exert as great a tension on the piston skirt as would be the case in thick-walled piston skirts. Figs. 7 and 8 are sectional views respectively along the lines A—A and B—B of Fig. 4 in the instance where thick-walled pistons are utilized. In this instance it will be apparent from the figures that when viewed from the inside of a piston skirt the arcuate indentations will appear to be more nearly in line and hence the tangents to the indentations are drawn parallel to the piston slot on the inside of the piston skirt. These indentations will be closer together than was the case in a thin-walled piston. Thus an expander of a fixed or a non-adjustable type such as shown in Fig. 9 when inserted in the indentations thus made will exert a greater force on a thick-walled piston than on a thin-walled piston. The angles at which the drill bit guides 31, 32 and 33 have been arranged are so chosen that an expander of the type shown in Fig. 9 will always produce the proper biasing effect against the slot faces at the indentations to produce the proper expansion fit of a piston within a piston cylinder. From this it is apparent that the single type of piston expander produces the proper expansion in both thin-walled and thick-walled piston skirts. Thus no compensation or adjustment is required on the part of the person installing these expanders to provide for the variations in the thicknesses of piston walls.

Referring to Fig. 9 of the drawings, I have illustrated therein one embodiment of my piston expander comprising an arcuate-shaped body member 34 preferably of spring steel, provided with a plurality of projections or lugs 35 and 36 in the proximity of the ends of the body member 34 and a projection or lug 37 at an intermediate portion thereof. The projections 35 and 36 near the ends of the body 34 are set back a short distance from the extremities thereof so as to leave flat portions 38 and 39, the purpose of which will subsequently become apparent. The projecting members 35, 36 and 37 are arranged substantially perpendicular to the plane of the arc of the body of the expander, but preferably at slight angles to the perpendicular of the plane so that the curved outer portions of the projections 35, 36 and 37 form slight angles to the right and left of the line perpendicular to the plane of the arc of the body 34.

Fig. 10 discloses a U-slot piston having an expansible skirt provided with a slot 22' therein. The faces of the slot 22' have indentations therein which have surfaces corresponding to oblique sections of a cylindrical surface and each surface has an axis which is at an acute angle to the perpendicular to the tangent of the surface of the piston skirt at the slot. The expansible skirt of the piston 20 which is normally provided with a slot 22' in accordance with the method previously set forth has indentations 40, 41 and 42 on the faces thereof which are formed by the drill cooperating with the drill guides 31, 32 and 33 respectively of the piston drill guide block 23. An expander of the type shown at 39 is shown inserted in these indentations so that the projections 35, 37 and 36, respectively, extend into the indentations 40, 41 and 42, respectively. The expander 34 is inserted into these indentations by grasping the lower end of the expander adjacent to the flat portion 39 with a pair of pliers, inserting projections 35 and 37 into the indentations 40 and 41 and by applying a slight pressure to the left causing the projection 36 to engage the indentation 42. The flat end portions 38 and 39 of the body member 34 of the expander now serve as bearing surfaces against the inside wall of the piston skirt thereby preventing any possible change in the position or shape of the expander due to temperature variations which would tend to cause the end projections 35 and 36 to extend through the wall of the piston an undesired amount. The flat portions 38 and 39 and the intermediate portions between the projections are therefore contiguous to the inside wall of the piston skirt. An expander of the type shown in Fig. 10 is particularly adapted to the expansion of U-slot pistons since the expansive force along the piston slot 22' extends over a considerable distance and the center of the force is slightly below the lower extremities of the U-slot 21.

In Fig. 11 I have shown another form of fixed or non-adjustable piston expander 43 which has a body member 44 arranged in a double reverse curve shape or, in other words, a shape having a central U or horseshoe-shaped portion and the ends of the U or horseshoe-shaped portion are bent back in reverse curves. Near the ends 45 of the curved portion of the expander there are small portions 46 substantially at right angles to the material adjacent the end 45 and at right angles to the small portion 46 there are projections 47 which have convex bearing surfaces. The projections 47 are arranged to engage indentations along the faces of the piston slot and the flat portions 46 serve as inside bearing surfaces on the inner face of the piston skirt. If at the center of the convex surfaces of the projections 47 planes are drawn tangent thereto it will be found that the planes of the two projections 47 will form an acute angle. The projections 47, therefore, may be said to be at slight angles to each other and at slight angles to a plane perpendicular to the plane of the body 44 of the expander.

In Fig. 12 I have shown a piston drill guide block having a body portion 48 which has a concave face 49 the radius of curvature of which corresponds approximately to the radius of curvature of the pistons more commonly in use. At the upper end of the concave surface 49 there is provided a projection 50 for the purpose of engaging the slot of the piston skirt. At the other

extremity of the body 48 suitable fastening means are provided comprising a head member 51, a flat portion 52, a threaded portion 53 and a nut 54 which serves to maintain the block 48 in proper operative relation on the piston skirt. The head member 51 bears against the inside surface of the piston skirt while the flat portion 52 is located between the faces of the slot. The body portion 48 is furthermore provided with a plurality of drill bit guides 55 and 56, respectively, which are spaced apart and extend from the concave surface 49 through the block 48, the axis of each guide forming an acute angle with the perpendicular to the tangent of the curvature of the concave face 49 at the center line extending between the projection 50 and the aperture for the fastening means 51 to 54. The axes of the guides 55 and 56 are so placed to the right and left of the center line that the drill bits cooperating within the guides will produce in the faces of the slot indentations which are oblique sections of a cylindrical surface. From this it will be apparent that the method here utilized is the same as that employed with the drill guide block of Fig. 2. Hence, irrespective of the skirt wall thickness, each piston skirt is drilled near the slot in a plurality of places spaced at fixed distances from the slot along the outer circumference of the piston skirt.

In Fig. 13 there is shown a portion 57 of a piston skirt, a piston skirt slot 58 and another portion 59 of the piston skirt. The drill guide block 48 is shown in operative relation with respect to the piston slot 58. From this view it will be apparent that the axes of the drill bit guides 55 and 56 have a common plane which is substantially at right angles to the piston slot 58. If planes along the axes of the drill bit guides 55 and 56 are formed which are perpendicular to the common plane it will be found that these planes will form an acute angle somewhere to the inside of the piston skirt.

Fig. 14 shows a sectional view along the line or plane C—C of Fig. 13 in the instance where a thin-walled piston skirt is used. From this view it will become apparent that the arcuate indentations in the faces of the slot when viewed from the inside of the piston skirt are spaced apart an appreciable amount. If tangents to the indentations were drawn on the inside of the skirt parallel to the faces of the slot 58 they would be spaced apart an appreciable amount. Thus in thin-walled piston skirts the expanders of the type shown in Fig. 11 will not exert as great a tension on the piston skirt as would be the case in thick-walled piston skirts.

Fig. 15 shows a sectional view along the line C—C of Fig. 13 in the instance where thick-walled pistons are utilized. In this instance it will be apparent from the figure that when viewed from the inside of the piston skirt the arcuate indentations will appear to be closer together than was the case in a thin-walled piston. Thus, an expander such as shown in Fig. 11, when inserted in the indentations will exert a greater force on a thick-walled piston than on a thin-walled piston. The angles at which the drill bit guides 55 and 56 have been arranged are so chosen that any expander of the type shown in Fig. 11 will always produce the proper biasing effect against the slot faces of the indentations to produce the proper expansion fit of the piston within the piston cylinder.

Fig. 16 illustrates the manner in which an expander of the type shown in Fig. 11 is inserted in the indentations 60 and 61 which are formed in the faces of the piston slot 58 by the drill bit guides 55 and 56. It will be seen that the convex surfaces of the expander projection 47 are complementary to the arcuate indentations 60 and 61 which have concave surfaces each comprising oblique sections of a cylindrical surface.

While I have shown and described my invention in connection with certain specific embodiments, it will, of course, be understood that I do not wish to be limited thereto, since it is apparent that modifications may be made in the instrumentalities employed without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of expanding by equal amounts slotted piston skirts of different thicknesses with a single size fixed expander located within said skirt and provided with a plurality of projections engaging indentations formed in said slot without altering the outer circumferential distances between said indentations which comprises controlling the degree of biasing force applied by said expander by forming an indentation on one face of the slot by drilling at a predetermined acute angle to a plane perpendicular to the tangent of the skirt at the slot and forming at a fixed outer circumferential distance from said first indentation an indentation on the other face of the slot by drilling at an acute angle to the opposite side of said plane whereby the circumferential distances between said indentations on the inside of said skirt decreases in proportion to the skirt thickness, said angles having vertices within said skirt, and biasing said skirt to expand it by engaging said indentations with said expander projections.

2. The method of expanding by equal amounts longitudinally slotted piston skirts of different thicknesses with a single size fixed expander which comprises drilling said skirt at said slot in a plurality of places spaced at fixed distances along the outer circumference of said skirt and at acute angles to the right and left of a plane perpendicular to the tangent of a piston at the slot to form in opposite faces thereof concave indentations, each having surfaces which correspond to oblique sections of a cylindrical surface, said surfaces each having an axis at an acute angle to said plane, said angles having vertices on the inside of said piston skirt, and applying biasing forces to said indentations on alternate faces of said slot in directions generally perpendicular to the surfaces of said indentations, said biasing forces being increased in proportion to increased thickness of said skirt.

3. The method of expanding a U-slot piston comprising forming a longitudinal slot in the piston skirt in the general direction of the axis of the piston on the side adjacent to the U-slot, drilling said piston skirt at said slot at a plurality of places at fixed distances relative to the outer circumference of said skirt and at angles to the right and left of a plane perpendicular to the tangent of the piston at the slot thereby forming a plurality of concave indentations on alternate faces of said longitudinal slot, each indentation having a surface corresponding to an oblique section of a cylindrical surface, said angles having vertices on the inside of said piston skirt, and biasing said piston skirt to an expansion fit by applying biasing forces to said indentations on alternate faces of said slot in direc-

tions generally perpendicular to the surfaces of said indentations.

4. The method of expanding by equal amounts slotted piston skirts of different skirt wall thicknesses with a single size fixed expander having projections thereon and which is adapted to be located within said piston skirt which comprises controlling the degree of biasing force exerted by said expander at the projections thereof by drilling said piston skirt in a plurality of places spaced at fixed distances along the outer circumference of said piston skirt to the right and left of said piston skirt slot and at acute angles to the right and left of a plane perpendicular to the tangent to the curvature of said piston skirt at the slot thereof to form surfaces which correspond to oblique sections of a cylindrical surface, said surfaces each having an axis at an acute angle to said plane, said angles having vertices on the inside of said piston skirt whereby the inner circumferential distances between the surfaces formed will decrease in proportion to an increase in the skirt thickness to increase the effective biasing force of said expander, and applying the biasing forces of said expander projections in directions generally perpendicular to said formed surfaces to expand said piston skirt.

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