

Jan. 30, 1951

F. A. GRUETJEN
PISTON FABRICATION

2,539,903

Filed Dec. 5, 1946

3 Sheets-Sheet 1

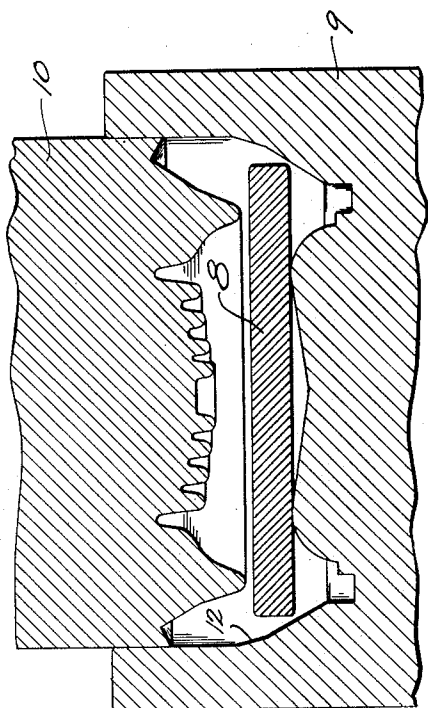


Fig. 1

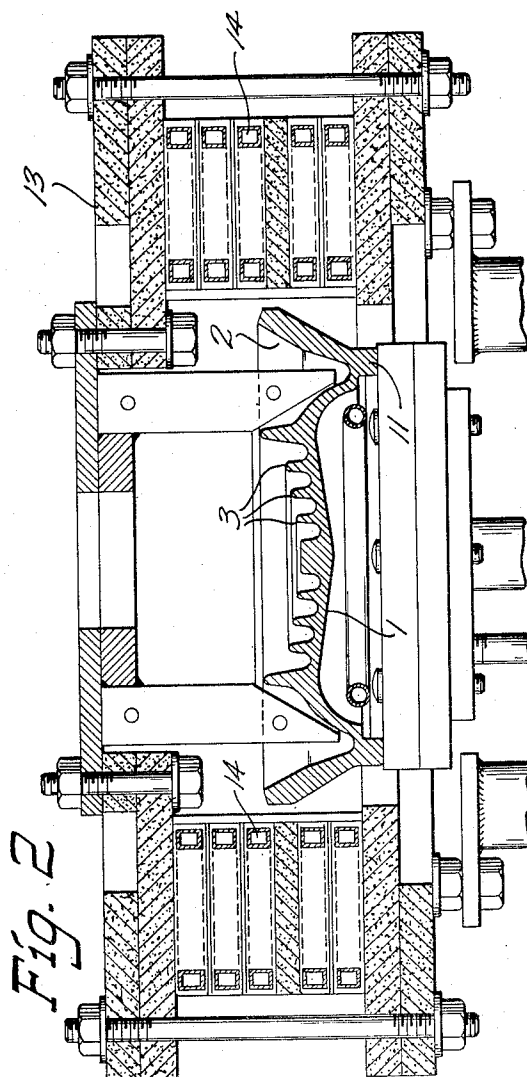


Fig. 2

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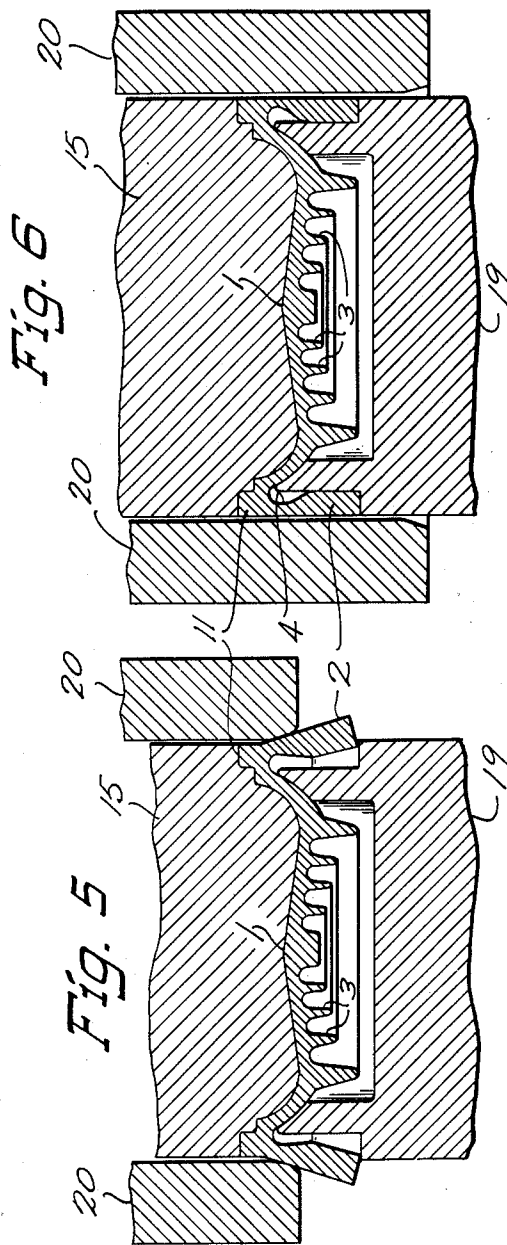
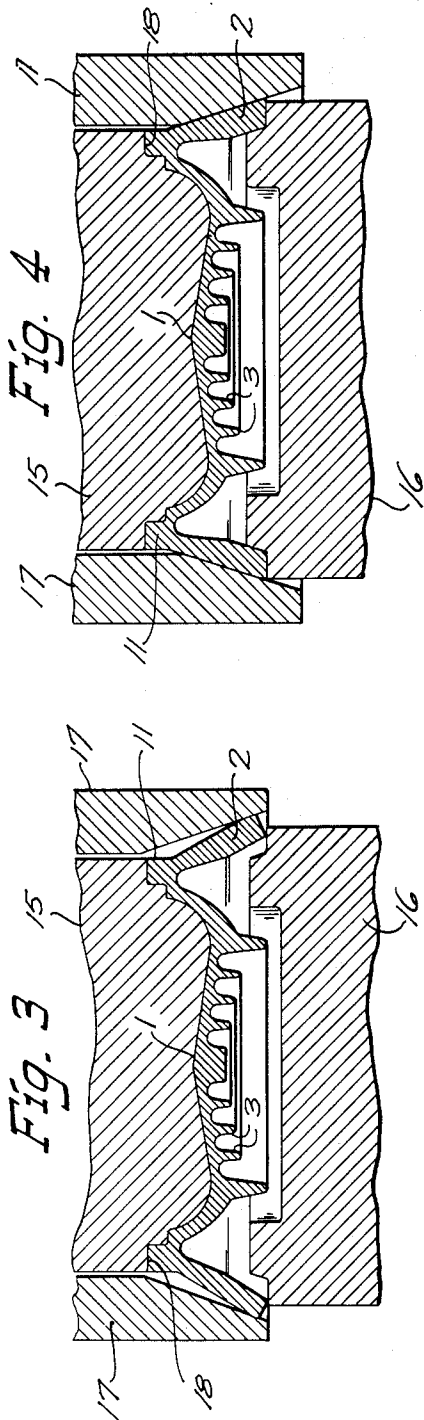
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Fig. 9

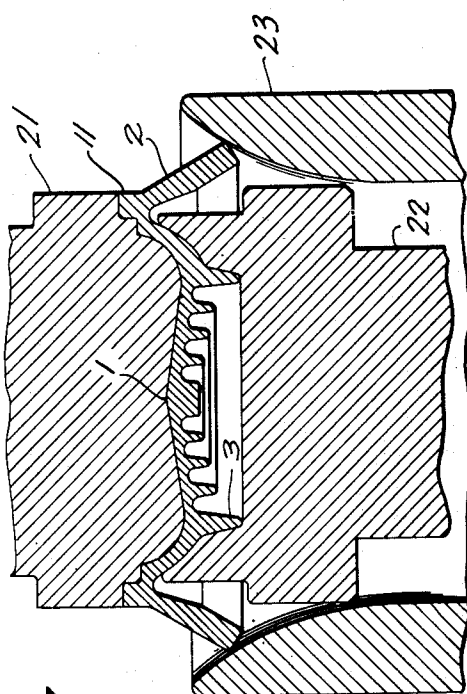
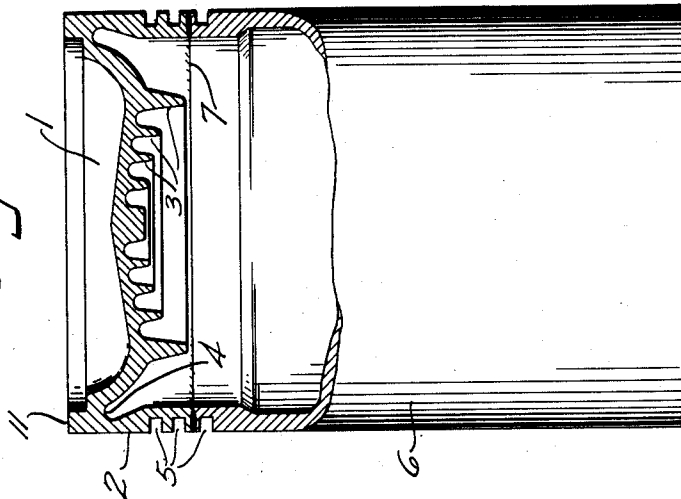


Fig. 7

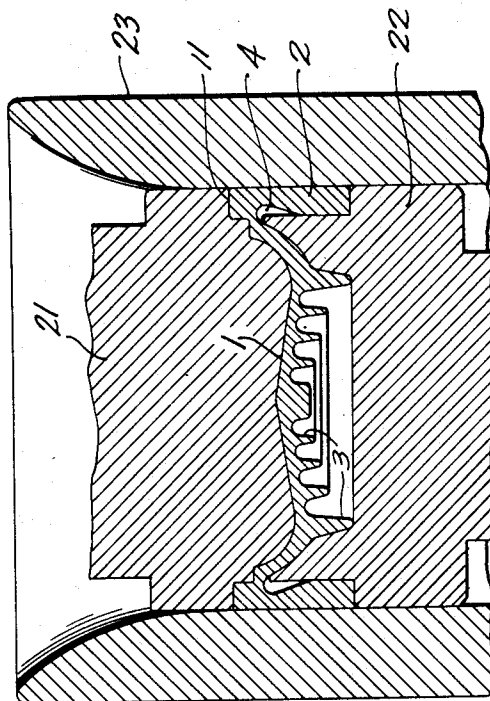


Fig. 8

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PISTON FABRICATION

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2 Claims. (Cl. 29—156.5)

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This invention relates to piston fabrication and particularly is directed to the fabrication of a piston crown to be welded to a skirt to provide the piston.

The principal object of the invention is to provide a method of fabricating a piston with a heat dam without substantial machining operations.

Another object is to provide a method of forging and folding a piston crown to shape which will provide a crown substantially free of internal stresses and other flaws.

Another object is to provide a method of forming the crown in which the folding of its sides does not take place at the corner of the head of the piston.

Another object is to eliminate internal stresses in the corner areas of the crown which normally are created in folding operations.

A further object is to provide a piston crown by forging and folding operations which will decrease costs of fabrication.

The invention in general is directed to forging the piston crown to conical shape with a heat dam therein, folding the longitudinal wall of the crown inwardly on a line through the heat dam to a line parallel with the central longitudinal axis of the piston, and then electric welding the same to the ring provided as the skirt of the piston.

These and other objects of the invention will appear hereinafter in connection with the following description of several embodiments of the invention illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a longitudinal sectional view of the blank from which the piston crown is forged with the blank confined in dies in position preparatory to forging;

Fig. 2 is a longitudinal sectional view of a piston crown blank, after forging, and disposed in an induction furnace for taper heating preparatory to forming;

Fig. 3 is a sectional view of the forged blank assembled within a die preparatory to forming;

Fig. 4 is a longitudinal sectional view of the die, knock-out and piston crown blank showing the forged blank of Fig. 2 after the first forming or folding operation;

Fig. 5 is a section showing the blank disposed in a second set of dies just prior to the second and final folding step;

Fig. 6 is a section similar to Fig. 5 showing the piston crown after final folding;

Fig. 7 is a longitudinal sectional view of an-

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other embodiment of the invention with the forged piston crown blank in position preparatory to forming in a single operation;

Fig. 8 is a view similar to Fig. 7 after forming; and

Fig. 9 is an elevational view with parts broken away and sectioned of a finished piston with the crown and skirt welded together.

The drawings illustrate the construction of a piston having a piston crown which has been fabricated by the method of the invention and in general comprises the head or crown 1 and the cylindrical wall or skirt flange 2. The head 1 is provided internally with a plurality of ribs 3 for dissipation of heat and the circumferential heat dam 4 is provided at the base of flange 2 to prevent excessive heat from flowing to the flange from the head when the piston is in operation. The annular grooves 5 are provided in skirt flange 2 for piston rings, not shown, and the crown is joined to skirt cylinder 6 by a circumferential weld 7 to provide the completed piston.

In carrying out the method of fabricating a piston under the invention the blank 8 from which the crown is forged is confined within the die opening of die 9 beneath the forging die 10.

The lower die 9 is shaped to provide crown 1 with the circumferential flange or hook 11 which extends opposite skirt 2. The function of the flange 11 in the succeeding folding operation will be described hereinafter. The inner surface 12 of die 9 at the lower end of the die opening is cylindrical to form the outer periphery of flange 11 and the upper portion of the crown 1 in the area of the juncture of the skirt flange 2 with the crown 1, and then the die surface upwardly of the opening assumes a conical shape to receive the lower part of the skirt 2 which is formed outwardly in blank 8 by dies 9 and 10.

Forging die 10 is shaped to forge skirt 2 outwardly in die 9 to conical shape and to form an annular constriction in the skirt 2 adjacent crown 1 of lesser cross section than the remainder of the skirt to constitute the heat dam 4. The body of the skirt 2 is also initially forged narrower and longer than the desired finished dimensions to allow for the upsetting or thickening of the walls which takes place during the later folding operations. In addition die 10 is shaped to form the ribs 3 internally of head 1. The blank after forging is illustrated in Fig. 2.

As shown in Fig. 2, after forging, blank 8 is placed in the induction furnace 13 for induction heating of skirt 2 to accomplish the folding op-

erations to which the crown blank is subjected.

Skirt 2 of crown blank 8 is taper heated in furnace 13. The furnace is constructed so that skirt 2 is subjected to taper heating forging temperatures from the coils 14 of the furnace under which the temperatures to which the skirt is subjected gradually decrease from a temperature such as 2000° F. at the outer end of the skirt to less than 700° F. at the base or heat dam 4. The taper heating of skirt 2 leaves the metal in and above the heat dam portion of the blank strong to serve as a mandrel or die to support the blank in the folding of the same into the crown.

After heating, as described, blank 8 is next confined in the die 15 and operated on by the punch 16 and folding die 17 to fold skirt flange 2 inwardly. The blank is centered between die 15 and punch 16 by the annular flange or hook 11 which fits in the annular recess 18 of die 15.

The punch 16 supports the blank 8 along the bottom edge portion of the skirt 2 and is slightly lesser in diameter than skirt 2 to allow for the first folding step.

The folding die 17 encompasses die 15 and the blank 8 and the lower end thereof is conical on the inside and engages skirt 2. In the first folding operation, as shown in Figs. 3 and 4, the blank 8 which is seated on die 15 is pushed into the die 17 by the punch 16 until the skirt 2 is given the same conical dimensions as die 17.

In the second folding operation blank 8 is reheated as described previously, and then reentered on die 15. A second punch 19 similar to punch 16, supports the bottom edge portion of skirt 2, but is sufficiently smaller than skirt 2 to allow for the second folding step. Punch 19 also extends within the head 1 to support the head in the area around the ribs 3.

The folding die 20 which is similar to die 17 encompasses the die 15 and the lower conical shaped end engages skirt 2. In folding, blank 8 seated on die 15 is pushed into die 20 by the punch 19 and the blank obtains a substantially cylindrical shape as shown in Fig. 6.

The number of folding steps employed may vary in practice and is determined by the width of skirt 2 and the extent of the folding required to bring skirt 2 from conical forged shape to the desired cylindrical dimensions.

A second method of carrying out the invention contemplates the use of a hollow-tapered die in a single folding operation for folding skirt 2.

The skirt 2 of blank 8 is first taper heated as previously described and illustrated in Fig. 2 and then the blank is secured beneath the punch 21 on the knockout 22 shown in Fig. 7. The blank 8 is centered in the punch 21 by the annular flange 11 as described above. The knockout 22 extends up into the core of the blank 8 and contacts the blank 8 in the area between the heat dam 4 and the ribs 3.

A hollow die 23 surrounds knockout 22 and at its upper end engages the outer circumferential edge of skirt 2. The inner surface of die 23 tapers downwardly from the top and narrows at the lower end portion to a cylindrical surface to provide the desired final cylindrical dimensions of skirt 2.

In the folding operation the punch 21 pushes the blank 8 down into the described die opening of die 23 and in a single movement of the blank, as shown completed in Fig. 7, the blank is folded to cylindrical shape.

In each method of carrying out the invention the higher temperature metal at the outer end portions of the skirt is supported by the lower temperature metal between the same and the crown 1 so that the skirt is folded without distortion and retains in the final cylindrical skirt the constriction or heat dam initially forged in the conical blank.

The skirt in folding to narrower dimensions thickens and upsets to larger cross-sectional dimensions, the skirt body being formed as described above to narrower than final dimensions in the initial forging of the blank.

The radius of the folding is always in the heat dam or the narrowest portion of the skirt and no part of the folding takes place at the corner of the head of the piston where injurious internal stresses and other flaws might impair the corner structure of the head. Internal stresses at the corner of the crown are precluded by the circumferential flange 11 of substantial dimensions formed integrally with the blank in the initial forging operation and which, as described, also serves to center the blank in the folding dies.

The flange adds strength and rigidity to the corner structure of the head so that in the folding operations, that part of the crown above the heat dam will not fold or collapse under the pressure of the dies. In addition the added body of the flange protects the corner structure against heat back from the body of the skirt which passing through the heat dam might cause a softening or weakening of the upper part of the crown.

In both methods of carrying out the invention the tapering dies engage first the outer or lower areas of the skirt 2 heated to the higher temperatures. As these areas are compressed inwardly the upper less plastic portions of the skirt and especially the narrow portion constituting the heat dam will not collapse under the pressure of the dies. The entire skirt body remains intact until its surface is completely engaged by the dies. In this way a true conical and final cylindrical shape is assured with each folding operation so that the heat dam and the desired cross section is carried into the final structure.

In the second method of carrying out the invention the inner portions of the skirt including the heat dam additionally support the entire thrust of the die in the direction of the die movement. The entire skirt is folded easily into a cylindrical shape assuring adequate external machining dimensions and the desired cross-sectional form without distortion or internal stress and without endangering the corner area of the skirt and face of the crown.

Various embodiments of the invention may be employed within the scope of the accompanying claims.

I claim:

1. The method of fabricating a piston having a crown and a short skirt section of cylindrical outer contour separated from the crown by a thin wall constituting a heat dam, comprising initially forging a blank in which the shape of the outer corner of the crown is substantially final and with the short skirt section flared outwardly at the thin wall intermediate the skirt and the crown to provide for forming the skirt of varying wall thickness with a straight line movement of a forging die, then taper heating the flared skirt section with the outer edge of the skirt section heated the most and corresponding to the metal flow required in the subsequent contraction of the same to final cylindrical outer dimensions.

and thereafter pressing the skirt section longitudinally and forcing the same thereby into the tapered entrance of a cylindrical die to form the skirt to cylindrical outer dimensions corresponding substantially to the outer dimension of the crown while confining the relatively colder outer corner of the crown to prevent distortion of the same.

2. The method of fabricating a piston having a crown and a short skirt section of cylindrical outer contour separated from the crown by a thin wall constituting a heat dam, comprising initially forging a plate into a blank in which the crown is formed with an upstanding circumferential flange having inner and outer cylindrical surfaces for providing a fixed corner for the crown and the short skirt section is flared outwardly at the intermediate thin wall joining the skirt and crown, then taper heating the skirt section to temperatures substantially corresponding to the metal flow required to contract the same radially to the outer dimension of the crown and with the outer edge of the skirt section heated the most, and thereafter pressing the

skirt section endwise into a cylindrical die to form the same with an outer cylindrical dimension corresponding to that of the crown while holding said flange on the crown to prevent distortion of the crown.

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