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A. FLOWER

1,978,045

METHOD FOR MAKING MULTIPIECE PISTONS FOR FLUID PRESSURE ENGINES

Original Filed March 7, 1933

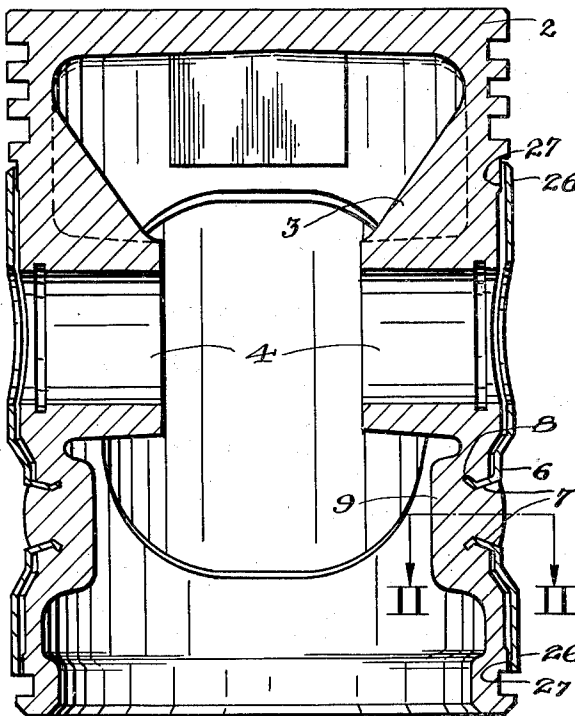


Fig. 1.

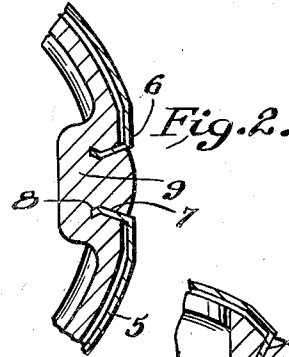


Fig. 2.

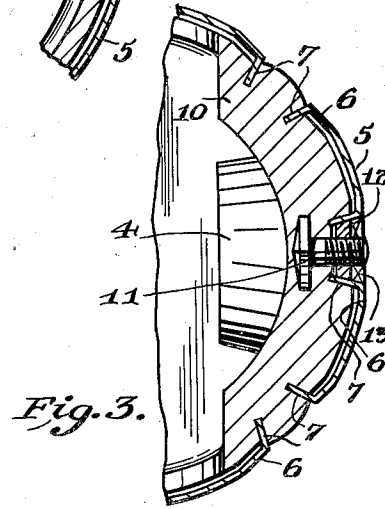


Fig. 3.

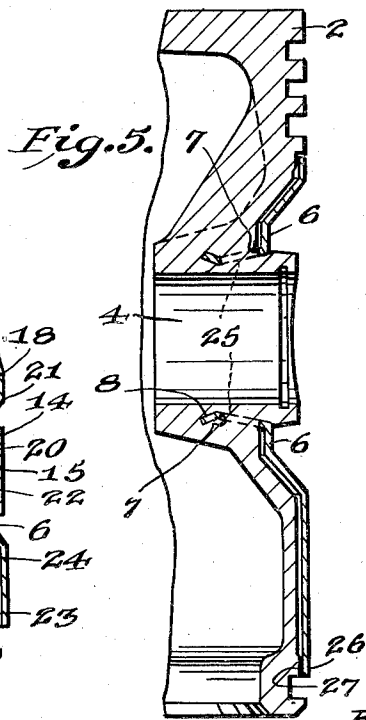


Fig. 4.

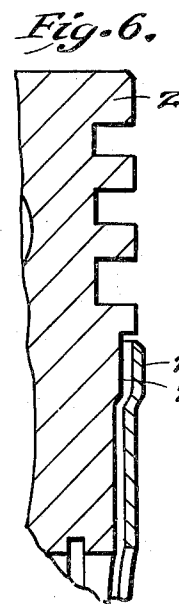


Fig. 5.

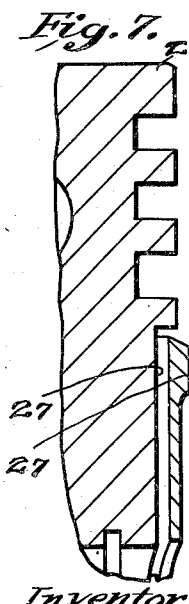


Fig. 6.

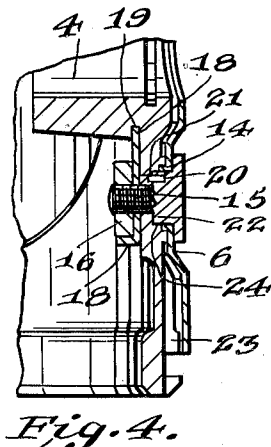


Fig. 7.

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UNITED STATES PATENT OFFICE

1,978,045

METHOD FOR MAKING MULTIPIECE PISTONS FOR FLUID PRESSURE ENGINES

Alpheus Flower, London, England

Original application March 7, 1933, Serial No. 659,970. Divided and this application September 18, 1933, Serial No. 689,977. In Great Britain March 9, 1932

6 Claims. (Cl. 29—156.5)

The present invention relates to improvements in Method for making multi-piece pistons for fluid pressure engines, and is a division of my co-pending application entitled *Pistons* filed March 7, 1933, Serial No. 659,970.

The invention has particular relation to pistons of the bi-metallic kind comprising a crown or head formed of aluminium or other light alloy, preferably as a casting, with integral wrist-pin or gudgeon-pin bosses or other body parts to which is attached a tubular skirt of cast iron, steel, or some other good wear-resisting material.

The main object of the present invention is the provision of an improved method of attaching the skirt to the head or some other piece of the piston whereby said means constitute a device for compensating for the varying expansion and contraction of the different metals. A further object is to provide an improved arrangement with which the cost of production will be reduced, particularly inasmuch as it allows of the head being cast independently of the tubular skirt and subsequently securely united to it in an inexpensive and simple manner.

Furthermore, in the usual type of "cast-in" bi-metallic pistons the contraction of the aluminium from its hot state, after the casting operation, provides a clearance between the two metals; that is, between the steel skirt and the bosses for the wrist-pins, etc., inside the skirt; and where the skirt meets the head or lower portion of the ring belt of the piston, or at the lower end of the skirt, the initial contraction clearance is too great and allows the head or other parts to move relatively to the steel skirt. A further object of this invention is to obviate this disadvantage.

A piston, according to the main feature of the invention, has a tubular skirt provided peripherally with a substantially flat disc or annular portion through which the skirt is attached to another piece of the piston.

According to a further feature of the invention, the inner periphery of the annular portion is surrounded by a flange which extends inwardly of the skirt and engages the other piece of the piston for attachment purposes. This flange may be frustum-shaped, with or without an outwardly-flared edge, or with or without a keying hole.

According to a still further feature, the steel skirt has a portion, preferably at the top or bottom thereof, originally enlarged in diameter externally, and after the metal of the head or

other part of the piston has been cast and has cooled off the skirt is drawn through a ring of the desired final dimension of the skirt, or treated in an equivalent manner, thereby bringing the enlarged portion back to the proper diameter. By this means the clearance between the exterior wall of the head or other part of the cast metal and the inner wall of the steel skirt can be reduced, thereby preventing any independent rocking of one part relatively to the other.

In the accompanying drawing:—

Figure 1 is a vertical section through the wrist-pin or gudgeon-pin axis of one form of bi-metallic piston according to the invention;

Figure 2 is a cross-section on the line II—II of Figure 1;

Figure 3 is a corresponding cross-section showing a modification;

Figure 4 is a vertical section through part of another form of bi-metallic piston according to the invention;

Figure 5 is a fragmentary vertical section indicating another embodiment of the invention;

Figure 6 is a fragmentary vertical section, to a somewhat larger scale, indicating a step in the manufacture of the pistons shown in any of the foregoing figures; and

Figure 7 is a similar view to that of Figure 6, but it shows a modified arrangement.

Like numerals indicate like parts throughout the drawing.

In the constructions illustrated in Figures 1 to 4, showing a bi-metallic piston having a head 2 of aluminium alloy, formed integrally with body webs 3, 3 from which the wrist-pin or gudgeon-pin bosses 4, 4 are supported, and a tubular skirt 5 of steel, the latter is provided peripherally, below where the wrist-pin will be, with a depression forming a substantially flat annular portion 6 the centre of which is in the longitudinal plane of the skirt through the wrist-pin axis.

In the arrangement of Figures 1 and 2, where there is a single flat annular portion 6 on each side, each of these has at its centre an aperture surrounded by a frustum-shaped flange 7, the end of which, in the interior of the skirt, is outwardly-flared, as at 8, to provide an increased keying effect with the circular metal boss 9, beneath the wrist-pin bosses 4, which is cast on to the flange 7.

Obviously the metal bosses 9 may be in the form of a belt 10 extending wholly, or partly, as shown in Figure 3, around the piston, and there may be two or more keying flanges 7 on each side of the piston, as is also indicated by Figure 3. The cast

metal inside the flanges may be hammered into contact therewith after cooling.

This latter figure also shows a further method of securing the skirt through the annular portion 6 which may be used as an alternative to or in conjunction with the arrangement of Figures 1 and 2. In Figure 3 the non-circular head of a bolt 11 is embedded in the belt 10 co-axial with the flange 7, and the latter contains a nut 12 of similar outline and adapted, as by the provision of serrations 13, to be screwed tightly on to the bolt after the cast metal has cooled and shrunk. Tightening the nut forces the flange into contact with the surrounding metal. The nut can be locked by punching part of the bolt into the serrations 13.

In the arrangement of Figure 4 the head, as illustrated, is pre-cast and then bolted to the skirt at the flat annular portions 6 of the latter. Thus, the metal of the body of the head is also formed with a more or less similar depression 14 that will engage the inner face of the flat annular portion 6 but be elsewhere spaced from the skirt, to allow of expansion of the head body.

A bolt 15 with a flat narrow head resting in the depression and not extending as far outwardly as the main portion of the skirt is passed through the skirt and through a corresponding hole in the body portion of the head. At its inner end there is a nut 16 which can be tightened to lock the skirt and body portion securely together.

It is desirable to prevent relative rotation of the nut on the bolt, and for this purpose a disc washer 17 may be interposed between the nut and the adjacent inner face of the body portion, the washer being formed with outwardly-extending tangs 18, 18 of which one enters a hole 19 provided in the under-surface of the wrist-pin boss 4 to prevent rotation of the washer, whilst another tang can be bent up as shown to lock the nut after it has been tightened. In like manner suitable holes 20, 20 may be provided in the bolt and in the body portion to receive a short stem or key 21 by which the bolt when the nut is tightened will be locked against rotation.

In a preferred arrangement the bolt is formed with an enlarged shoulder 22 beneath its head (which is conveniently the portion of the bolt drilled to receive the bolt locking member 21) and this enlarged shoulder fits the hole in the skirt and extends into a corresponding recess provided in the body portion, acting to take the shear load.

As stated, in practice at least two such attachment means would be provided for a piston, these being arranged diametrically opposite one another. To facilitate assembly, a longitudinal groove 23 is provided to receive the flat annular portion 6 and its internal flange 24, which springs into the hole in the head body.

In the modification of Figure 5, where the head is cast on to the skirt, the flat annular portion 6 and the flange 7 are co-axial with the wrist-pin bosses 4. This construction is somewhat lighter and cheaper to produce than that of Figures 1 and 2. The keying effect is increased by the provision of the holes 25.

With a view to preventing relative movement between the head of the piston and the upper end of the skirt, these are preferably adapted in the manner illustrated in Figure 6 or Figure 7, where the clearances between the skirt and the cast metal are shown much exaggerated for the sake of clearness. There the skirt, prior to the cast-

ing operation, is not of uniform bore; but at its upper and lower ends 26, 26 it is enlarged slightly, as indicated in Figures 6 or 7.

In the arrangement of Figure 6, where the skirt ends are enlarged both internally and externally, it follows that ridges 27, 27 are formed on the cast metal in the vicinity of the skirt enlargements during the casting operation. When, however, the metal has cooled, the skirt is drawn through a die, or treated in other ways, such that the enlarged portions 26, 26 at its upper and lower ends are brought into line with the remainder of its surface, as indicated in Figure 1, where the upper end of the skirt is shown in very close proximity to the ridge 27.

Consequently, in spite of the fact that the cast metal of the head may shrink from the skirt, leaving an initial clearance, when finally treated the clearance between the upper or lower end of the skirt and the cast metal can be reduced to any requisite amount, and by this means movement between the ends of the skirt and the cast metal can be entirely prevented.

The most inexpensive method of producing the skirt probably consists in the use of a skirt of uniform bore and thickness, of which the ends can then be enlarged to the necessary diameter, as described above, in connection with Figure 6. But an alternative method would consist in the use of a skirt of uniform bore and greater thickness at the two ends 26, 26 as shown in Figure 7, these thickened portions constituting the skirt enlargements referred to above and being flattened, as by being drawn through a die, after the cast metal has cooled.

In all cases, after the enlargements have been flattened, the clearances there should be such as to allow of contact being made internally of the enlargements when the parts have expanded under the normal working temperatures.

It will be seen that by means of the invention a very firm and lasting attachment is evolved which compensates for the varying expansions of the two metals. The arrangement of Figure 4 lends itself to quick production; and furthermore this piston may be economically manufactured.

In all cases the disc or annular portion 6 of the depression in the skirt is sufficiently flexibly connected to the rest of the skirt to move as the adjacent body portion of the head, which is secured to it, expands.

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

1. A method of making a bi-metallic piston consisting in casting a light-alloy head on an internal projection of a tubular steel skirt having one end of enlarged diameter and reducing said enlarged diameter to the diameter of the remainder of the skirt in a manner such that there will be substantially no clearance between the cast metal and the ends of the skirt when the parts have expanded under normal working temperatures.

2. The method of making a bi-metallic piston including a light-alloy head and a separate tubular steel skirt, which consists in forming the end portions of the skirt externally of enlarged diameter, uniting the skirt with the head by casting the latter on to the skirt, and subsequently reducing the enlarged diameter of the skirt ends to the normal diameter of the skirt body whereby there will be substantially no clearance between the cast metal head and the ends of the

skirt when the parts have expanded under normal working temperatures.

lar metal skirt, which consists of forming an end portion of the skirt externally of enlarged diameter, forming an internally extending portion at some other part of the skirt, casting the light alloy body on to said internally extending portion to unite the body and skirt and to engage the inner periphery of said enlarged end, and subsequently reducing the diameter of said enlarged end such that there will be substantially no internal clearance at said enlarged end when all the parts have expanded under normal working temperatures.

3. The method of making a bi-metallic piston including a cast metal head and a tubular steel skirt, which consists in forming the skirt initially with end portions of enlarged diameter both internally and externally, uniting the steel skirt with the head by casting the latter on to the skirt, and subsequently drawing the skirt through a die to reduce the end portions both externally and internally whereby there will be substantially no clearance between the cast metal and the ends of the skirt when the parts have expanded under normal working temperatures.

4. A method of making a bi-metallic piston consisting of casting an internally extending portion of a tubular skirt with a head of aluminium or other light alloy, the head having a smaller diameter than the skirt, and in reducing the diameter of the skirt such that there will be no internal clearance between the ends of the skirt and the head under normal working conditions.

5. The method of making a bi-metallic piston including a light alloy body and a separate tubu-

6. The method of making a bi-metallic piston including a light alloy head and a separate tubular metal skirt, which consists in forming one end of the skirt externally of enlarged diameter, forming an internal projection elsewhere on the skirt, casting the light alloy head to embrace said internal projection and to engage the inner periphery of said enlarged end, and subsequently reducing said enlarged end externally to the external diameter of the remainder of the skirt.

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55	130
60	135
65	140
70	145
75	150