Dec. 12, 1933. H. S. FRANK 1,938,826

PISTON

Filed April 6, 1932 2 Sheets-Sheet 1

Fig. 1.

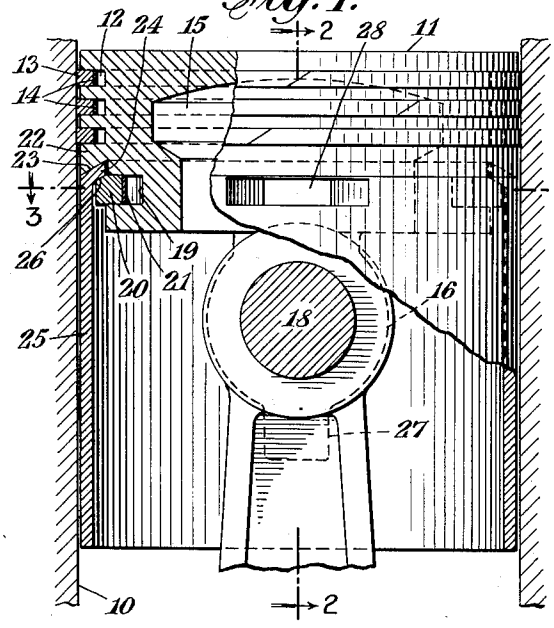


Fig. 2.

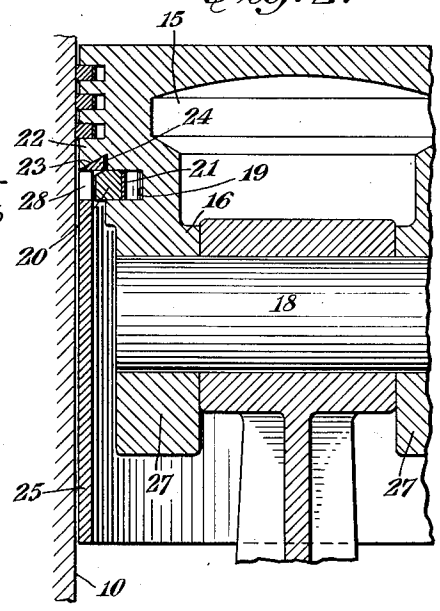


Fig. 3.

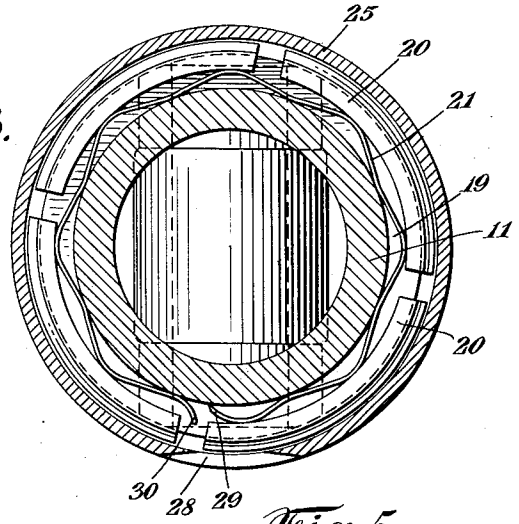


Fig. 4.

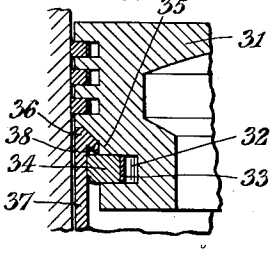
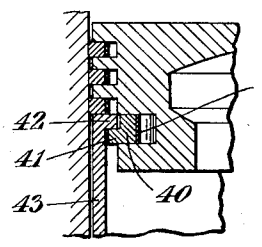


Fig. 5.



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Fig. 6.

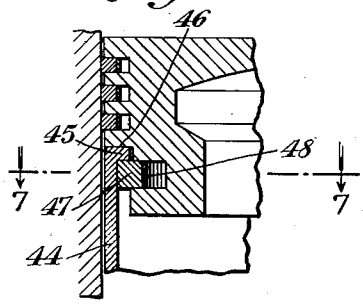


Fig. 8.

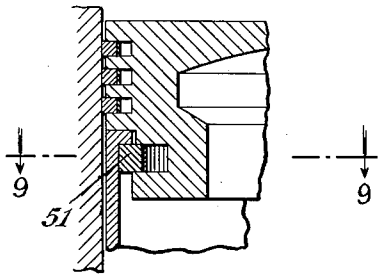


Fig. 7.

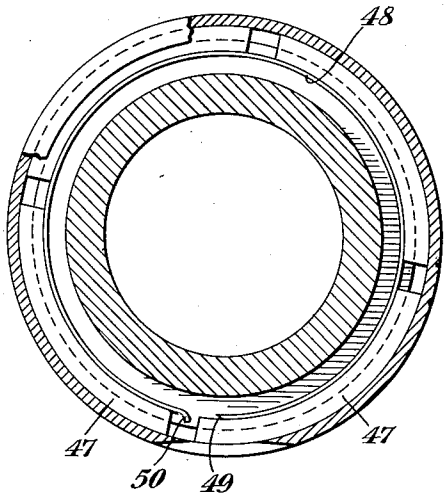


Fig. 10.

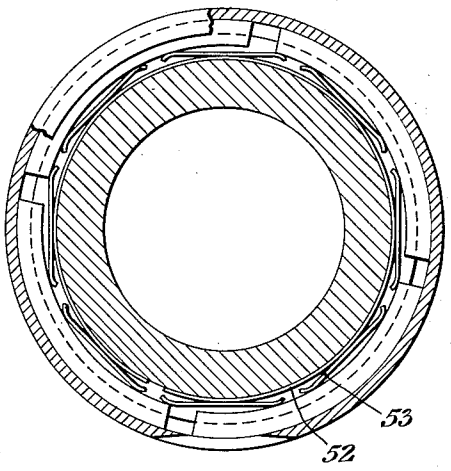
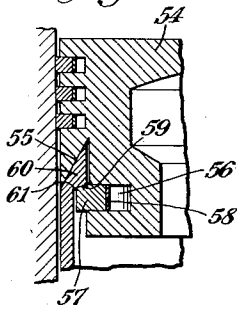


Fig. 11.



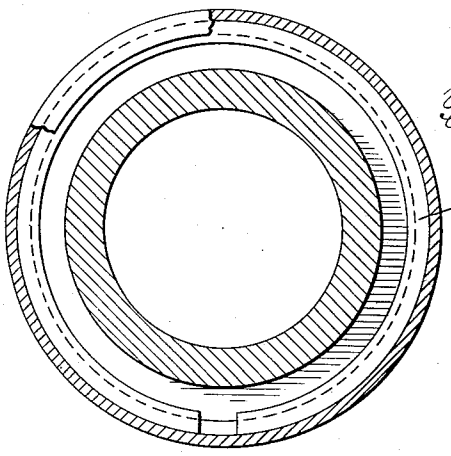


Fig. 9.

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1,938,826

UNITED STATES PATENT OFFICE

1,938,826

PISTON

Harry S. Frank, New York, N. Y.

Application April 6, 1932. Serial No. 603,510

14 Claims. (Cl. 309—15)

This invention relates to pistons for internal combustion engines in general, and particularly to what may be termed duo- or bi-metal pistons.

It is generally conceded that a light piston is instrumental in substantially increasing the flexibility and acceleration of internal combustion engines, for which reason the present-day high speed engines are equipped with aluminum or aluminum alloy pistons of very light weight. Also pistons of other light material, not aluminum alloys, have been produced.

Another great advantage of aluminum pistons resides in the peculiarity of aluminum absorbing heat much faster than other metals, whereby the temperature within the combustion chamber is materially reduced, which effects a beneficial cooling of the engine.

In order to explain the advantages and disadvantages of aluminum, it may be well to state that through the higher coefficiency of expansion, the head of the piston spreads by heat, more than iron. This expansion of material becomes distinctly undesirable at the sleeve portion of the piston, in that the latter's expansion causes excessive friction between piston and cylinder wall. On the other hand, when the piston is cool, its dimension is considerably reduced, so that during the initial period of operation, the engine efficiency is appreciably lowered, since the aluminum piston in its normal, cool state will have too great a clearance.

At the present time the disadvantages encountered, due to the expansion of the aluminum sleeve, are partly overcome by splitting or slotting the sleeve portion in various places, so as to allow for excessive expansion and contraction, thereby minimizing the variations in pressure against the cylinder wall when the piston is either cold or hot.

I have outlined in the foregoing paragraphs the essential advantages and disadvantages of alloy or aluminum pistons, so that the present invention will be more clearly understood and its purpose and objects better appreciated.

Some of the prime objects of my invention are to provide a piston for internal combustion engines, or other motors, which will have all the advantages of aluminum or alloy pistons, as to its light weight, the expansible properties of the head, for assuring perfect compression, while at the same time possessing a sleeve which will be, so to speak, unaffected by the heat changes within the engine and which will form an effective, easily working-in guide for the piston, and a connection between the head and the sleeve which will permit unrestricted expansion and contraction of the alloy or aluminum head, without causing a disalignment between the head and the sleeve, so that both of the parts remain always concentric with one another, irrespective of the temperature changes to which they are constantly subjected.

Another object of this invention is to provide a connection between a head and sleeve of a piston, by means of which the two members may be readily locked in position, while at the same time affording simple ways for disconnecting the two members, when desired.

The foregoing and still further objects of my invention will be more fully apparent from the following description and the accompanying drawings, forming part of my disclosure, but by no means intended to limit the same to the actual showing, and in which

Fig. 1 is an elevation, partially in cross-section, of one of my piston constructions.

Fig. 2 is a partial vertical cross-sectional view thereof, taken on line 2—2 of Figure 1.

Fig. 3 is a horizontal cross-sectional view through the locking arrangement between the head and sleeve of the device, taken on line 3—3 of Figure 1, showing the employment of a corrugated spring member behind four locking ring sections.

Fig. 4 illustrates a modified detail locking construction shown in cross-section.

Fig. 5 is another modified form of a locking arrangement between the head and sleeve.

Fig. 6 is a cross-sectional view through another locking arrangement between the head and piston sleeve.

Fig. 7 is a cross-sectional view taken on line 7 of Figure 6, and showing the employment of a plain spring band behind four locking ring sections.

Fig. 8 illustrates another modified form of my locking arrangement employing a one-piece resilient locking ring.

Fig. 9 is a cross-sectional view taken on line 9—9 of Figure 8, and

Fig. 10 is another horizontal cross-sectional view through a modified form of my locking arrangement, employing a multiple-leaf-spring expander behind the locking ring sections.

Fig. 11 is a partial detail cross-sectional view of a sleeve and head locking arrangement, similar to that employed in Figures 1 and 2, but of a modified construction.

Referring now to the drawings, and particularly to Figures 1, 2 and 3, numeral 10 denotes

the cylinder wall of an engine, in which is mounted a piston composed of a piston head 11, preferably made of aluminum or of an aluminum alloy, but capable of being made from other suitable material having properties similar to that of aluminum or aluminum alloys. The piston head is provided with a plurality of piston ring grooves, indicated at 12, in which are lodged piston packings 13, preferably of sectional construction equipped with an expander, indicated at 14. The head is preferably hollow, as indicated at 15, and is provided at its lower end with bearing extensions 16 for receiving wrist pin 18.

In the lower head portion there is provided an annual recess 19, adapted to receive a plurality of locking ring sections 20, preferably urged radially outwards by an expander indicated at 21. Below the lowest piston ring groove of the head there is formed a lip 22 which is undercut on a taper, as shown at 23, to receive the conical upper end 24 of sleeve 25, which is preferably made of cast iron or any other metal or alloy, as for instance bronze. The lower face of upper end 24 of the sleeve is also beveled, as indicatd at 26. This lower tapered face registers with the outer beveled face of locking ring sections 20. Particular attention is called to the space or clearance provided between upper sleeve end 24 and the piston head body.

From Figure 2, it will be observed that wrist pin 18 does not extend through sleeve 25, but that it is secured within the sleeve and cannot possibly leave its bearings, which is one of the important advantages resulting from my construction. The lower end of bearings 16 terminate in lugs 27 for the purpose of giving all pistons a uniform weight, in that parts of the lugs may be milled off, when the weight of one or the other piston should be greater than the rest of the pistons used in one engine.

The expander behind locking ring sections 20 is in this case in the form of a corrugated spring strip, as clearly seen in Figure 3. In order to permit the insertion of the spring behind the ring sections, sleeve 25 is provided with an aperture 28, through which the spring may be either inserted or removed.

In assembling my piston, the wrist pin is passed into its bearings, through the piston rod head, and ring sections 20 are placed into their groove and forced against the inner wall thereof, so as to allow the unrestricted passage of the upper end of sleeve 25 into abutting position with its beveled seat 23. Then the sleeve is turned until its opening 28 registers with a space between two ring sections, and spring 21 is inserted between the inner face of the latter and the wall of groove 19.

It will be observed from Figure 3, that the spring member 21 is provided with a sharp end 29, bent so as to engage the inner wall of the groove when first inserted, and as it is pushed into the groove, it successively moves one ring section after the other from the groove wall against the sleeve. The other end of the expander indicated at 30, is permitted to somewhat protrude into the space between two ring sections, so that it may be always picked up and removed, if that becomes necessary. Through the insertion of the spring, all sections are uniformly forced in outward direction, and their beveled edges engage the lower beveled edge of end 24 of the sleeve, thereby holding the latter under uniform tension, while the beveled edge 23 of the head and the corresponding beveled edge of the sleeve keep the two members in uniform alignment throughout subsequent operations of the piston. This arrangement permits the head portion of the piston to expand uniformly outwards, while its expansion does not in the least affect the sleeve, because of the clearances allowed between sleeve and head, as plainly seen from Figures 1 and 2. Similarly, the eventual contraction of the piston head, when cooled off, is readily facilitated by this construction without in any way affecting the sleeve material.

From the foregoing it becomes clearly evident, that through this construction all the advantages of lightness and tightness of the head are accomplished, while none of the disadvantages due to sleeve expansion, drag, and cylinder wear are present. Thus, a perfect light piston with a perfect guiding sleeve is produced.

Referring now to Figure 4, there is again shown a piston head 31, provided with a groove 32, in which is lodged an expander 33 pressing against locking ring sections 34, which in this case have rectangular cross sections. The portion of the head just above groove 32 is beveled, as indicated at 35, and registers with a similar bevel of upper end 36 of sleeve 37. Also in this construction the head and sleeve are centered against one another through their beveled interengagement, and the sleeve is held uniformly under pressure by ring section 34, through the expander 33.

The connection between the head and sleeve is accomplished in this modification in the following manner:

The expander and the ring sections are pressed into the groove and the sleeve with its beveled end 36 is forced against ring sections 34, which recede into the groove, due to the pressure exerted by the beveled end of the sleeve, and immediately move out, the moment the sleeve end has passed the ring sections. Their upper faces then engage and support the inverted tip 38 of the sleeve end.

In the construction shown in Figure 5, the alignment of the head and sleeve is assured purely by the function of expander 39 pressing against locking ring section 40, the shelf 41 of which engages a rim 42 formed at the end of sleeve 43. In this case, the flat upper surface of the sleeve end serves as a support for a piston packing and constitutes the lower surface of the piston ring groove, formed in the head.

A somewhat similar construction is shown in Figure 6, where, however, the head is equipped with three fully developed piston ring grooves, while sleeve 44 rests with its L-shaped end 45 against a ledge 46, provided below the ring grooves. The sleeve end is held in position by ring sections 47, while an expander 48 is employed for forcing the sections outwards. In this case, a plain spring strip is used, as can be clearly observed from Figure 7, one end of which is preferably beveled, as indicated at 49, so as to facilitate its slipping between the groove wall and the ring sections. Its other end 50 is somewhat curved outwards and is intended to remain in the space between two adjacent ring sections, so as to facilitate its removal when desired.

In Figures 8 and 9 a construction similar to that shown in Figures 6 and 7 is provided, but instead of employing several ring sections and an expander as locking means between cylinder head and sleeve, I have shown a one-piece resilient ring 51, which by its own elasticity locks

the two members against one another, and keeps them in alignment.

Figure 10 shows that various types of expanders can be employed behind the locking ring sections, and in this figure a spring expander is illustrated, consisting of a carrier 52 equipped with a plurality of individual spring leaves 53, which latter have the advantage of producing a more uniform outward pressure against the individual locking ring sections.

Referring to Figure 11, numeral 54 denotes a portion of a piston head, provided with an acutely recessed sleeve bearing or centralizing surface 55, and the usual locking ring groove 56, in which operate ring section 57, urged outwardly by expander 58. The outer upper edge of ring section 57 is provided with a tapered surface indicated at 59, beveled at an acute angle, so as to form a wedge.

Seating against conical surface 55 of the head, a similarly shaped surface of the sleeve end 60 is provided, which latter is undercut at 61 on a taper corresponding to surface 59 of ring section 57. The acute abutting surfaces between head and sleeve tend to hold the two members in concentric relation to one another, while the beveled surface of ring section 57 and the corresponding inner seating surface of the sleeve function in the manner of a wedge lock, whereby the outward movement of ring section 57 not only supports the sleeve, but also urges it against abutting surface 55 of the head, and holds it in permanent relation thereto.

From the foregoing it is clearly evident that in order to assure a very rigid connection between the head and sleeve, the abutting surfaces between the two members must be provided at a rather acute angle, so as to make the two members self-centering, or concentric with one another, and that the supporting edge of the ring sections and the inner seating surface of the sleeve must be constructed at a more acute angle, so as to form a wedge engagement. The dimensional changes caused by the contraction and expansion of the head are facilitated by the spaces left between head and sleeve, and between sleeve and ring section 57.

While I have shown and explained a few specific constructions of my device, be it understood, however, that changes and improvements may be developed in meeting various conditions of existing combustion engines, and I therefore reserve for myself the right to make improvements and changes therein without departing from the broad scope of my invention, as set forth in the annexed claims.

I claim:

1. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means interposed between the members, and comprising a combination of relatively non-resilient and resilient elements, the former being held under tension produced by the latter.

2. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means comprising an expansible locking element interposed between said members, and consisting of relatively non-resilient sections and a resilient band, the latter adapted to bear against these sections.

3. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means comprising a plurality of spring induced ring sections.

4. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means comprising a plurality of ring sections and an expander interposed between the head member and said sections.

5. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means comprising a plurality of ring sections and an expander interposed between the head member and said sections, said sections adapted to bear against the upper end of said sleeve member.

6. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means comprising a spring induced, non-resilient ring adapted to uniformly bear against said sleeve member, while being held against lateral movement by said head member.

7. A two-piece piston, comprising head and sleeve members, both provided with concentric abutting surfaces, relatively non-resilient locking means interposed between said members a resilient element bearing against said locking means said locking means, induced by said element, adapted to hold said members concentrically relative to one another and under uniform pressure.

8. A two-piece piston, comprising head and sleeve members, both provided with beveled, concentric abutting surfaces, locking means also provided with a beveled, concentric abutting surface interposed between said members and adapted to keep them concentrically united so that the abutting surfaces of the two members remain under tensional contact with one another, and said locking means comprising relatively non-resilient and resilient elements, the latter adapted to bear against the former.

9. A two-piece piston, comprising head and sleeve members, both provided with beveled, concentric abutting surfaces, locking means interposed between said members and adapted to keep them concentrically united so that their abutting surfaces remain under tensional contact with one another, said locking means composed of a plurality of ring sections and an expander interposed between said sections and said head member.

10. A two-piece piston, comprising head and sleeve members, both provided with beveled, con-

centric abutting surfaces, locking means interposed between said members and adapted to keep them concentrically united so that their abutting surfaces remain under tensional contact with one another, said locking means composed of a plurality of ring sections and an expander interposed between said sections and said head member, said sleeve member having provisions for the insertion or removal of said expander.

11. A multiple-piece piston, comprising head and sleeve members provided with relatively acute, self-centering abutting surfaces, and resilient member connecting means, substantially in wedge-engagement with said sleeve member, adapted to hold the members under tension in concentric alignment and in substantially permanent abutment with one another, said connecting means comprising a combination of relatively non-resilient and resilient elements, the latter adapted to exert pressure against the former.

12. A two-piece piston, comprising head and sleeve members, connecting means for said members adapted to hold them concentrically relative to one another and to permit uniform expansion of said head member without affecting the relative concentric arrangement between the members, said means comprising a plurality of ring sections and an expander interposed between the head member and said sections, said sections adapted to bear against the lower face of the upper end of said sleeve member.

13. A substantially two-piece piston, comprising a piston head member, made of relatively light material of a relatively high coefficient of expansion, a sleeve member made of material having a lower coefficient of expansion than that of the head member, tapered self-centering connecting means provided between the two members, and a clearance arranged between the members for permitting the unrestricted expansion of the head member without affecting the alignment of and the connection between said members, said connecting means comprising relatively non-resilient and resilient elements, the latter adapted to hold the former under tension.

14. In a piston, as set forth in claim 13, said head member having wrist pin bearings provided with weight extensions, the latter adapted to be reduced in weight for the purpose of equalizing the weights of several pistons of one set, so as to facilitate their balancing within an engine.

HARRY S. FRANK.