Jan. 2, 1923.

F. A. PARKHURST.

PISTON.

ORIGINAL FILED DEC. 19, 1917.

1,440,549.

3 SHEETS—SHEET 1.

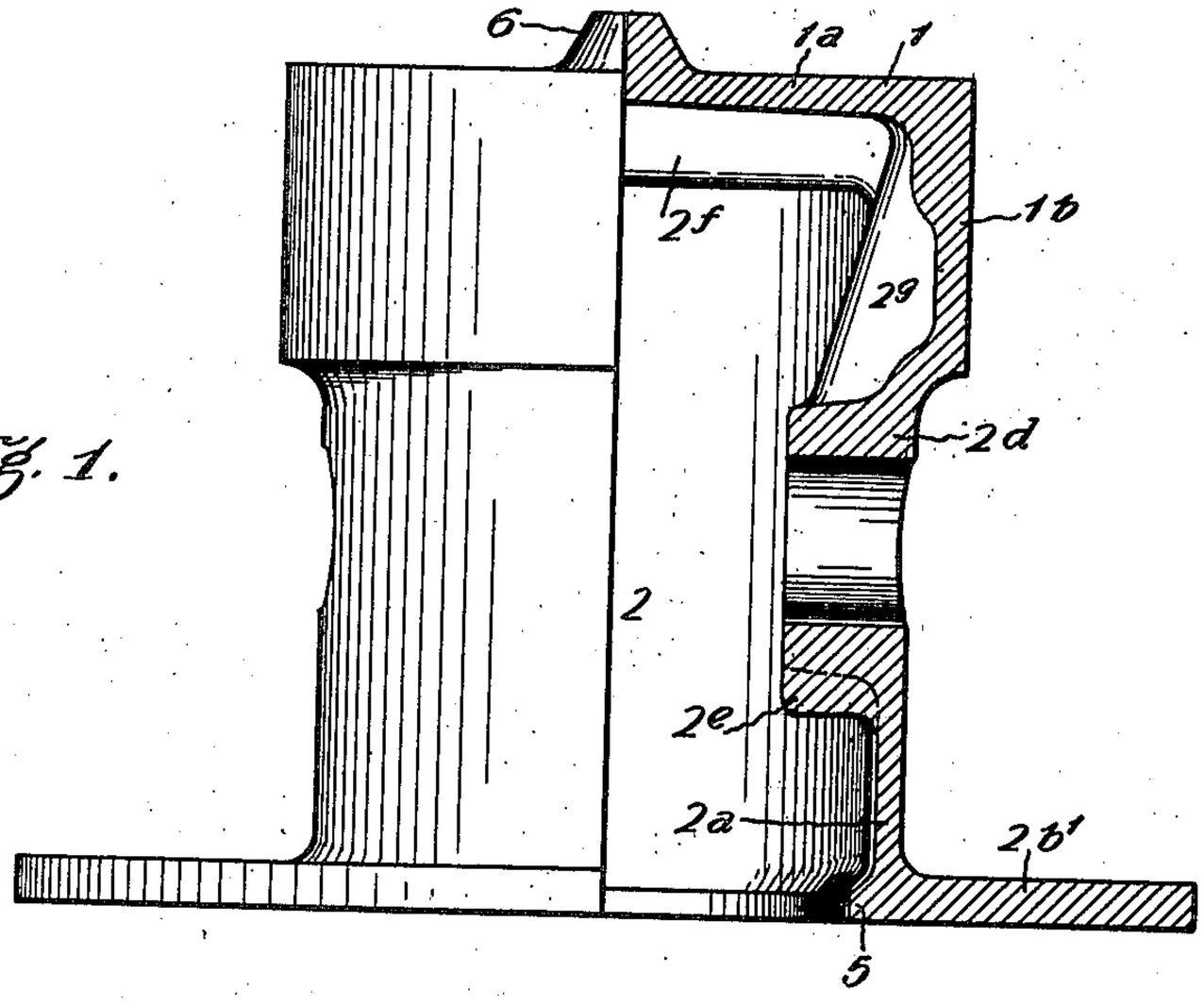

Fig. 1.

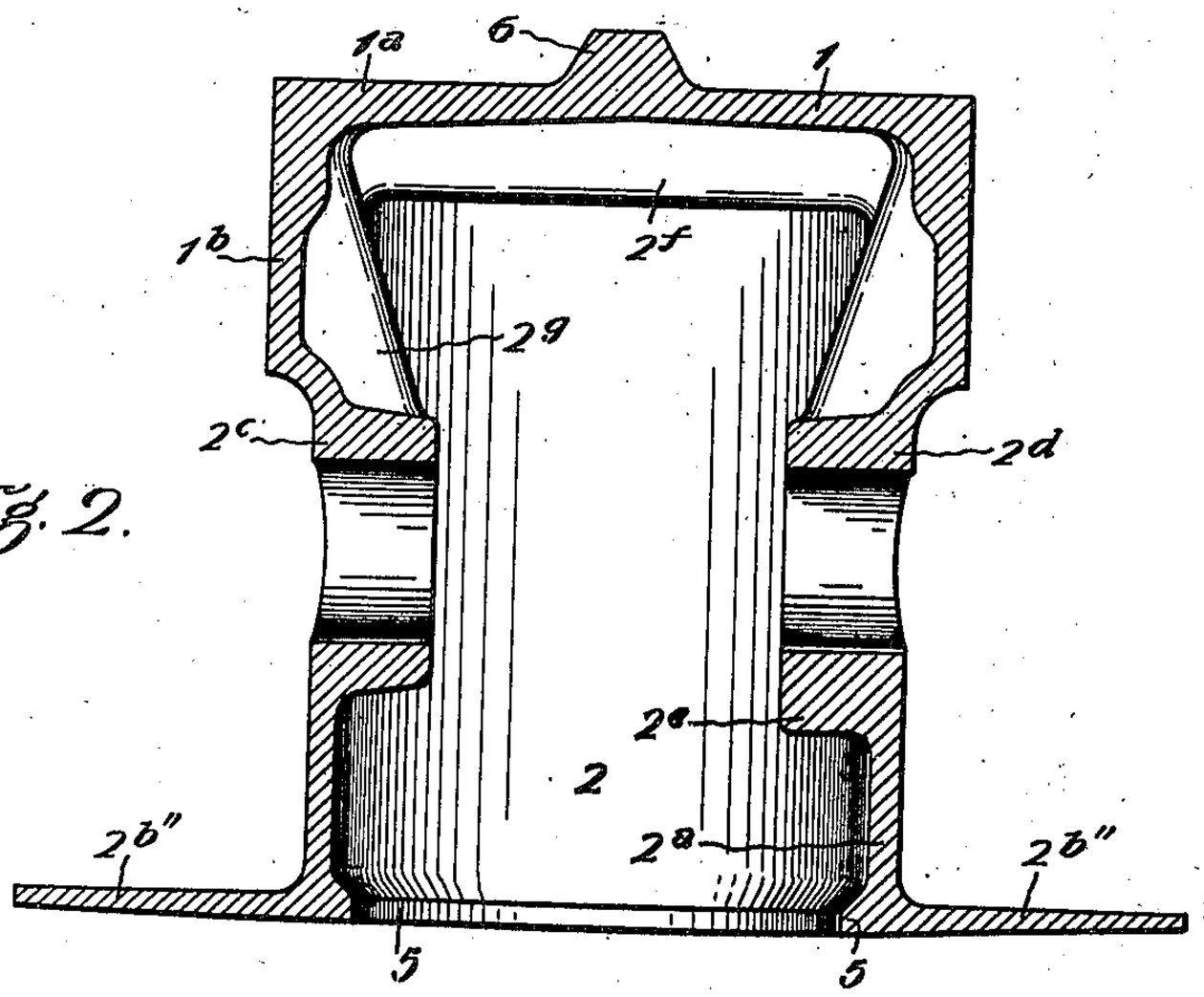

Fig. 2.

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3 SHEETS—SHEET 2.

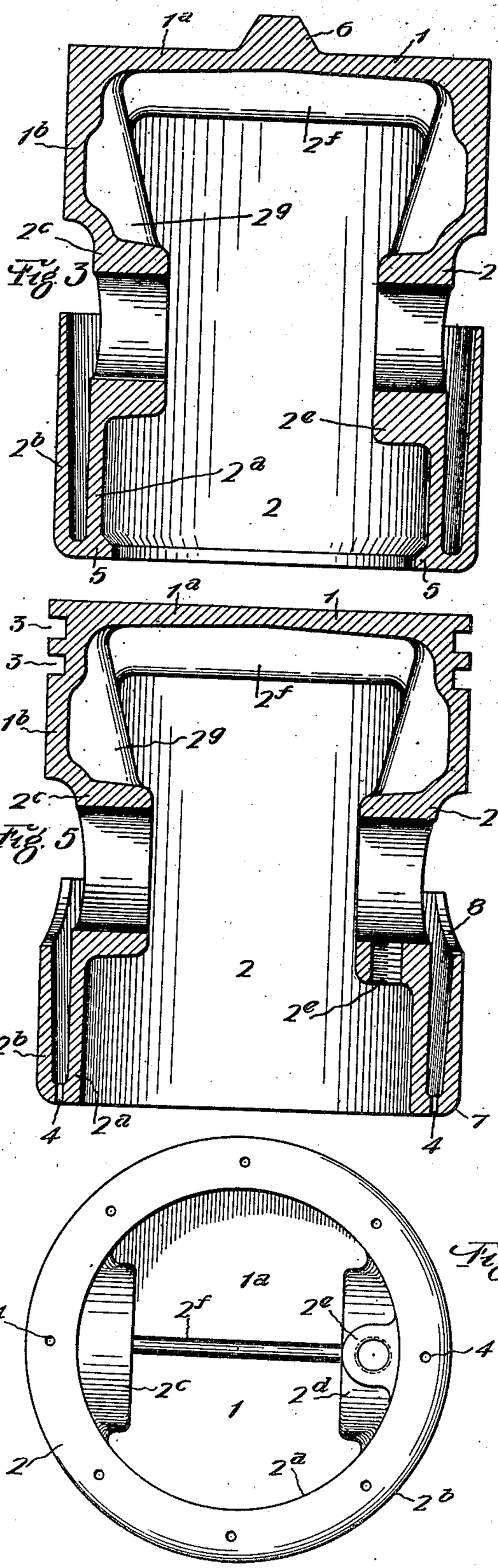

Fig. 3

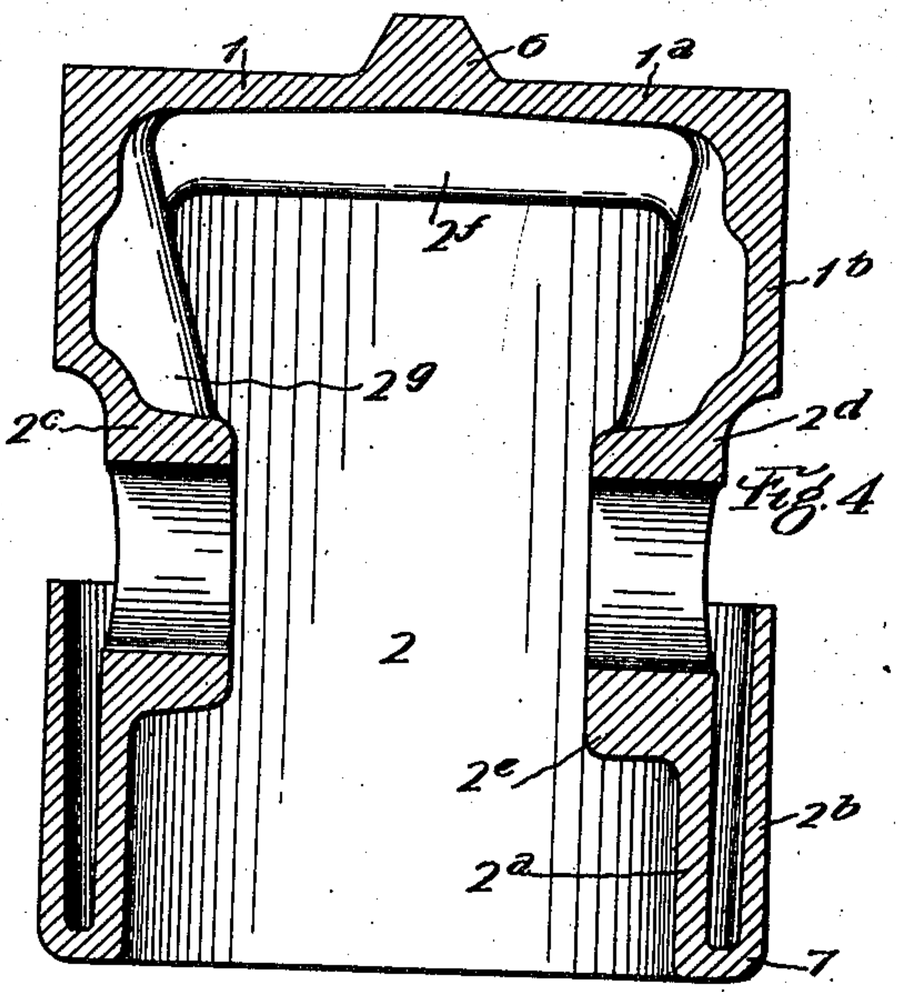

Fig. 4

Fig. 5

Fig. 6

Fig. 7

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3 SHEETS—SHEET 3.

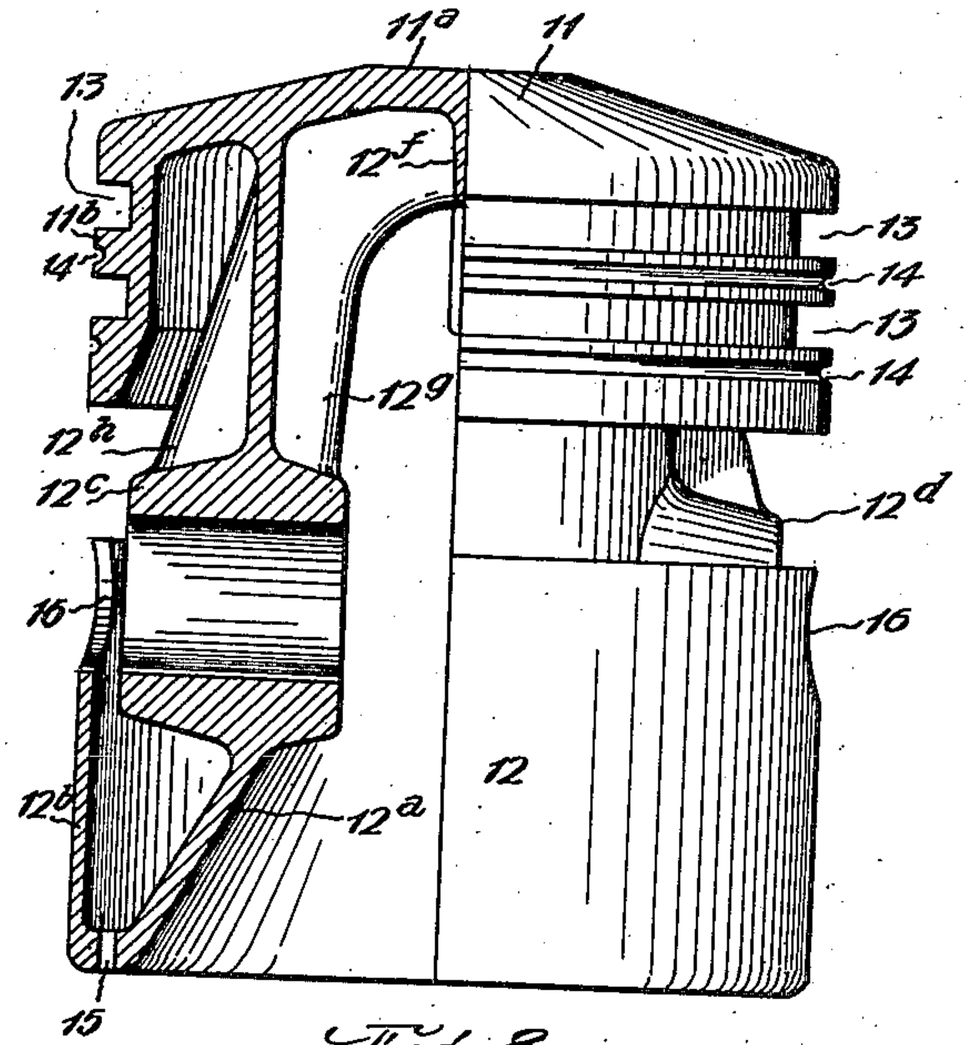

Fig. 8.

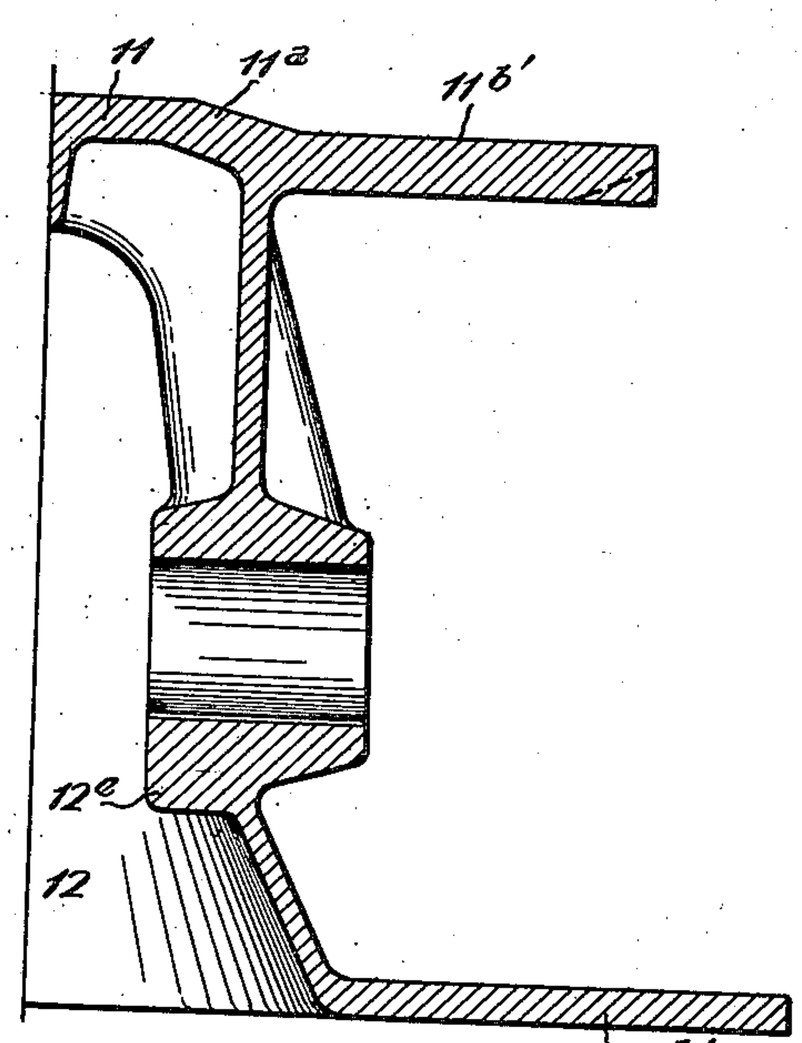

Fig. 9.

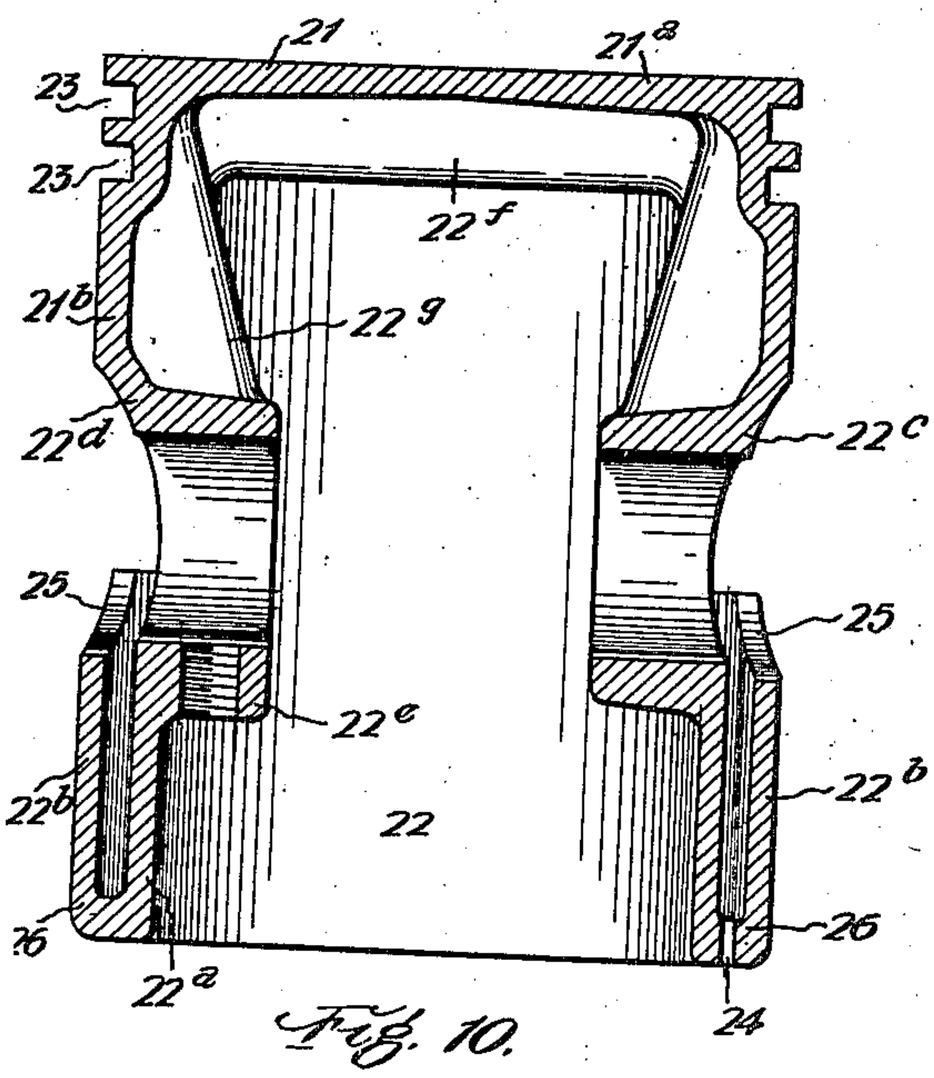

Fig. 10.

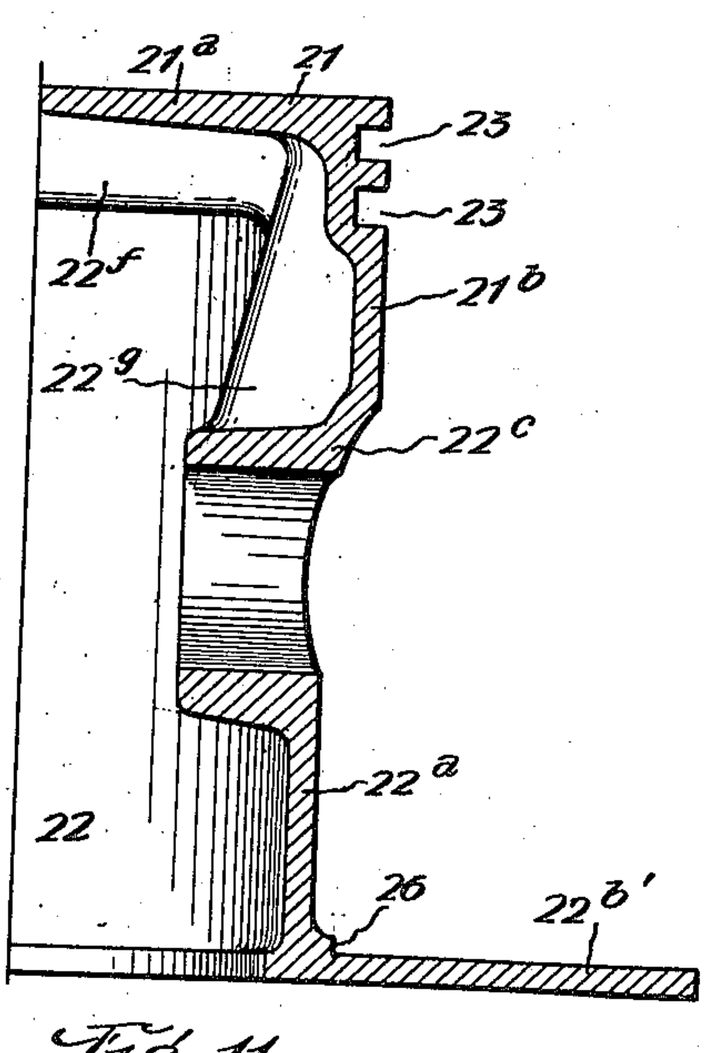

Fig. 11.

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by B. D. Watts
his attorney.

Patented Jan. 2, 1923. 1,440,549

UNITED STATES PATENT OFFICE.

FREDERIC A. PARKHURST, OF CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ALUMINUM MANUFACTURES, INCORPORATED, OF CLEVELAND, OHIO, A CORPORATION OF DELAWARE.

PISTON.

Original application filed December 19, 1917, Serial No. 207,836. Divided and this application filed September 10, 1920. Serial No. 409,304.

To all whom it may concern:

Be it known that I, FREDERIC A. PARKHURST, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Pistons, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to pistons for internal combustion engines, the invention having to do more especially with pistons of the type shown in the patent to Spillman and Mooers, No. 1,092,870.

One object of the invention is the production of a piston of the type last referred to formed of metal of low specific gravity, such as a suitable aluminum alloy, and having an internal structure and other physical characteristics which mark such alloys when cast in permanent molds.

Another object of the invention is the production of an improved piston of the type referred to of such character that complicated core work is obviated.

A further object of the invention is the production of an improved piston of the type in question having a form and constituent material such that it can be formed either in whole or in part by (1) casting and (2) further shaping the cast structure by drawing, spinning, rolling or other form of swaging operation.

Pistons of the type in question comprises a head part with an end wall and a cylindrical side wall; and a guide part or trunk having an inner wall, which is preferably formed with wrist pin bosses, and an outer cylindrical, cylinder-engaging wall. While pistons of this type may be made by various processes, an improved process has been described and claimed in my copending application, No. 207,836, filed December 19, 1917, of which this application is a division. Briefly stated, my improved process consists of making a piston casting of metal capable of being swaged, with the metal of either or both the side wall of the head and the outer wall of the trunk in the form of an outwardly extending flange, and thereafter by spinning or other swaging operation, turning such flange or flanges to cylindrical conformation. By such a method, the original casting is simplified to such an extent that it is possible to produce it in a permanent mold and thus give the metal of the finished piston physical characteristics which are peculiar to the rapid chilling of the permanent mold.

For the purpose of explaining the character of my improved piston and the process of producing it, I have illustrated in the accompanying drawings several forms of construction and have indicated the successive steps in carrying out the process.

In the drawings, Fig. 1 is a side elevation, partly in section, of a piston casting which represents the first step of my improved process.

Fig. 2 is a central vertical section of the same piston casting after a portion of the flange which is to form the outer wall of the trunk has been machined away preparatory to the next step of the process.

Fig. 3 is a view similar to that of Fig. 2 but showing outwardly extending flange spun upward to form the cylindrical outer wall of the trunk.

Fig. 4 is a view similar to that of Fig. 3, but showing the piston after the removal by machining of superfluous metal.

Fig. 5 is a view similar to the last, showing the piston completed by machining operations.

Figs. 6 and 7 are side elevation and bottom plan, respectively, of the finished piston.

Fig. 8 is a side elevation, partly in section, of a piston illustrating a modified form of construction.

Fig. 9 is a fragmentary side elevation, partly in section, illustrating the first step in the process of making the piston shown in Fig. 8.

Fig. 10 is a central vertical section of a piston illustrating still another form of construction.

Fig. 11 is a fragmentary side elevation partly in section illustrating the first step in the process of making the piston shown in Fig. 10.

Referring now in detail to the form of construction illustrated in Figs. 5, 6, and 7, 1 designates the head part of the piston in its entirety and 2 designates the trunk part of the piston in its entirety. The head 1 comprises an end wall 1ª and a side wall

1^b, while the trunk or guide part of the piston has an inner wall or section 2^a and an outer cylinder-engaging wall 2^b. The trunk or guide part of the piston preferably also performs the function of connecting the piston to the connecting rod and to that end is formed with wrist pin bosses 2^c, 2^d, the latter boss being formed with an enlargement 2^e to receive the usual set screw. The head and trunk are also preferably formed with strengthening and heat dissipating ribs 2^f, 2^g.

In its finished form, the lateral wall of the piston head is provided with grooves 3 to receive the usual packing rings (not shown), and said lateral wall has a diameter such that it never closely fits the engine cylinder.

The outer wall 2^b of the trunk is connected with the inner wall thereof only at its lower end, so that heat conducted from the end wall of the piston head must traverse the entire length of the piston before reaching the outer guide wall 2^b, and therefore much of this heat is dissipated by radiation and contact with the air and vapors of the crank case before it reaches said outer wall 2^b, so that said outer wall is maintained at a relatively low temperature and can, therefore, fit relatively closely in the engine cylinder.

Preferably, a series of holes 4, 4 are formed at the bottom of the piston between the inner wall 2^a and the outer wall 2^b to permit lubricant and oil which enters the space between said walls to drain freely back to the crank case.

In the production of the piston illustrated in Figs. 5, 6 and 7, the first step, in accordance with my improved process, is the making of the casting shown in Fig. 1. This casting is preferably formed of a metal of low specific gravity such as the aluminum alloys now extensively employed in the making of pistons and in a suitable permanent mold. I preferably employ a mold and process such as is set forth in Letters Patent 1,296,589, granted to Joseph H. Bamberg and such as is illustrated also in Letters Patent 1,296,596 granted to me, both dated March 4th, 1919. When a suitable aluminum alloy is cast in molds of the character referred to, the metal of the casting as compared with the same metal cast in molds of relatively low conductivity is given a hard, fine grained, ductile structure with excellent swaging, machining and bearing qualities, is capable of taking a high polish, and also has remarkable strength.

To make possible the use of a permanent mold, I cast the outer wall 2^b of the piston trunk in the form of a heavy outwardly extending flange $2^{b'}$, and I preferably also form the casting with an internal rib or flange 5 which extends continuously around the piston directly in line with the flange $2^{b'}$. The end wall of the piston head may be formed with a "work spot" 6 to facilitate subsequent machining operations, said work spot being later removed.

After the production of the casting, as shown in Fig. 1, the next step in my process is the machining away of the lower part of the flange $2^{b'}$ and preferably the slight reduction of its diameter to form the flange $2^{b''}$ shown in Fig. 2.

The third step in my improved process is the spinning of the flange $2^{b''}$ upward to form the cylindrical outer wall 2^b of the piston trunk, as shown in Fig. 3. During the spinning operation, the unturned rib or flange 5 serves to greatly stiffen the piston structure so that the pressure of the spinning tool is adequately resisted.

After the spinning operation, the rib 5 is machined away, the lower outer corner of the piston is rounded as at 7 and the upper edge of the trunk wall 2^b is trimmed away, with the resulting structure shown in Fig. 4.

Finally, the machining of the ring grooves 3, the drilling of the lubricant holes 4 and the recessing of the wall 2^b at 8 to permit the introduction of the wrist pin and the other usual finishing operations, gives the finished piston shown in Figs. 5, 6, and 7.

In machining the outer side wall of the piston, as has been indicated, the outer diameter of the wall 2^b is made such that said wall has a relatively close fit in the engine cylinder while the side wall 1^b of the head has a loose fit, the wall 2^b being relied upon to guide the piston in its movement in the cylinder.

By means of my improved process I not only avoid the complicated core work incident to the casting of prior pistons of this type, but also have produced an integrally cast piston having the advantages peculiar to pistons of this type with the added advantages of light weight and the hereinbefore mentioned physical characteristics peculiar to aluminum alloys cast in permanent molds.

Turning to the form of construction illustrated in Fig. 8, the finished piston comprises a head part designated in its entirety by 11 and a trunk part designated in its entirety by 12. The head comprises an end wall 11^a and a cylindrical side wall 11^b. This latter side wall is formed, in the present case, independently of the trunk of the piston which comprises an inner wall 12^a and a cylindrical outer wall 12^b, the said inner wall joining the end wall of the piston head at points radially inside of said side wall 11^b of the head, while the outer wall 12^b is connected with the inner wall

only at the lower end of the piston. The inner wall of the piston trunk is preferably formed with wrist pin bosses 12^c, 12^d, the last named boss being formed with a set screw enlargement 12^e.

The inner wall of the trunk and the end wall of the head are formed with strengthening and heat dissipation ribs 12^f, 12^g, 12^h.

The side wall 11^b is formed in the usual manner with grooves 13 to receive packing rings and preferably also with lubricant grooves 14 also a suitable number of lubricant apertures 15 are provided at the bottom of the piston and the outer wall 12^b of the trunk is recessed at 16 to permit the entry of the wrist pins in the bosses 12^c, 12^d.

In the production of the piston shown in Fig. 8, the first step, in accordance with my process is the formation of the casting shown in Fig. 9, this casting being formed of suitable aluminum alloy or other metal in permanent molds as has been set forth in connection with the first form of construction. In this casting, it will be observed that the metal of the finished side walls 11^b and 12^b are in the form of outwardly extending flanges $11^{b'}$ and $12^{b'}$ respectively. After the machining or trimming of flange $11^{b'}$ to the form indicated by the dotted lines, it and the lower flange $12^{b'}$ are spun or otherwise worked downward and upward respectively, to form the cylindrical side walls 11^b and 12^b, and thereafter trimming and machining operations are carried out similar or analogous to those described in connection with Figs. 1 to 7, resulting in the finished piston shown in Fig. 8.

The construction shown in Fig. 10 is in many respects similar to that shown in Fig. 5 and comprises a head part 21 having an end wall 21^a and a cylindrical side wall 21^b, and a guide or trunk part 22 having an inner wall 22^a and a cylindrical outer wall 22^b. The inner wall of the trunk is formed with wrist pin bosses 22^c, 22^d, the boss 22^d having a set screw enlargement 22^e and internal ribs 22^f and 22^g are provided as in the first form of construction. The side wall 21^b is formed with the usual grooves 23 for packing rings, a series of lubricant apertures 24 are provided at the bottom of the piston and the side wall 22^b is recessed at 25 to permit the introduction of the wrist pin. This last form of construction differs from the first form principally in the manner in which the outer wall 22^b is formed.

As shown in Fig. 11, the outwardly extending flange $22^{b'}$ of the original casting is formed, either by casting or machining with shoulder 26. In the subsequent spinning operation by which the flange $22^{b'}$ is formed into the cylindrical wall 22^b, the shoulder 26 affords a firm abutment for the metal of the flange as it is spun inward and upward, as will readily be understood.

The trimming and machining operations subsequent to the spinning operation are similar in this case to those described in connection with Figs. 1 to 7 and need not be further referred to.

I have herein referred to the use of metals or metallic alloys of low specific gravity and it is to be understood that I mean by these terms metals or alloys whose specific gravities are low in comparison with that of iron, the metal of which pistons have commonly been made in the past.

It will be understood that the foregoing description of certain embodiments of my invention is not intended to define or limit the invention but is presented for purposes of explanation and illustration, the scope of the invention being indicated by the following claim.

What I claim is:

An aluminum alloy piston of the trunk type having a head section comprising an end wall and a cylindrical side wall, and a trunk section comprising an inner wall and a cylindrical cylinder-engaging outer wall, said cylinder-engaging outer wall being formed of metal characterized by having a swaged structure, the said head section and the inner wall of the trunk sections being integral and formed of metal characterized by having a fine grained structure characteristic of aluminum alloys cast in permanent molds.

In testimony whereof I hereunto affix my signature.

FREDERIC A PARKHURST.