

Aug. 12, 1924.

1,504,448

C. C. HANCH

PISTON

Filed May 31, 1922

Fig. 1.

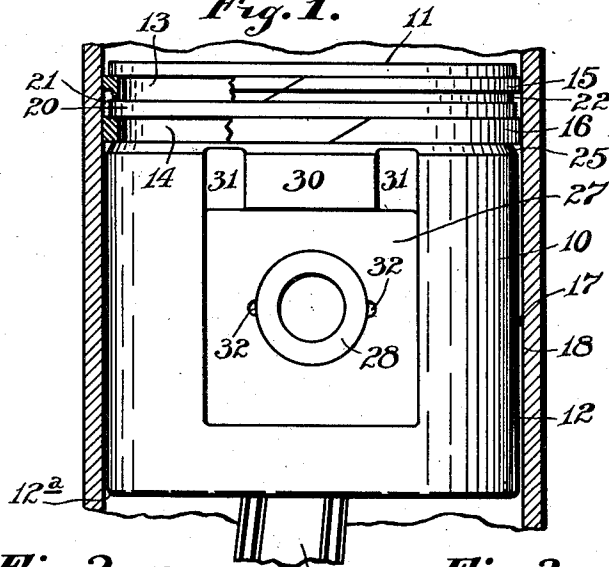


Fig. 2.

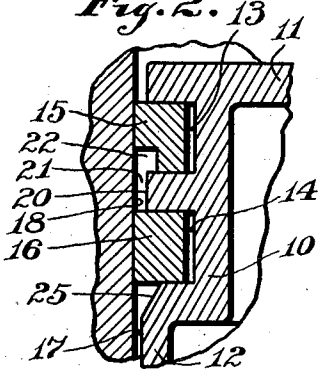


Fig. 3.

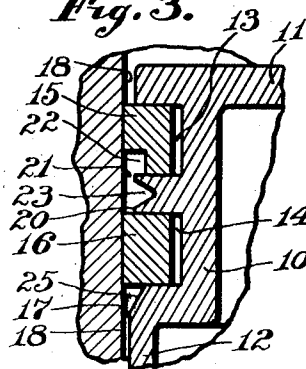


Fig. 4.

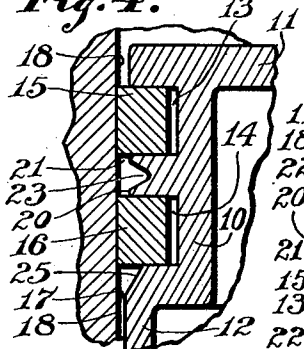


Fig. 6.

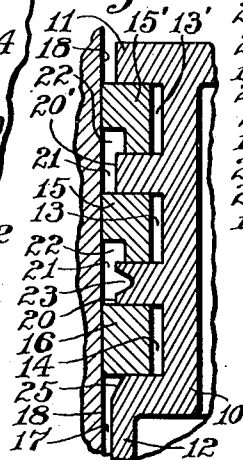
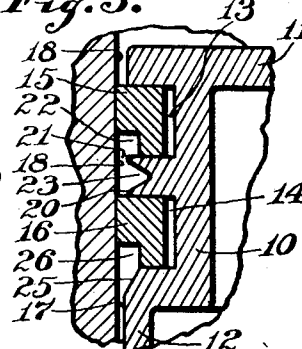


Fig. 5.



INVENTOR

Charles C. Hanch,

BY

E. J. Schley,
ATTORNEY

UNITED STATES PATENT OFFICE.

CHARLES C. HANCH, OF CONNERSVILLE, INDIANA.

PISTON.

Application filed May 31, 1922. Serial No. 564,767.

To all whom it may concern:

Be it known that I, CHARLES C. HANCH, a citizen of the United States, residing at Connerville, in the county of Fayette and State of Indiana, have invented a new and useful Piston, of which the following is a specification.

There has always been more or less trouble, and frequently great trouble, with pistons of internal combustion engines, resulting in "oil pumping," "piston slaps," and chafing or galling with the resultant scoring of the cylinder wall. It has been difficult and frequently impossible to avoid one or more of these troubles, especially upon even the slightest variation in the clearance between the piston and cylinder; so that it was necessary to do exceedingly careful machine work to get an accurate compromise clearance which would reduce these evils as low as possible, without reducing any of them at the expense of raising another to an excessive degree. This compromise clearance was frequently impossible to obtain, was at best only a compromise, and was never a cure, as it merely lessened one evil at the expense of increasing another.

It is the object of my present invention to provide a piston and piston-ring construction which will largely or wholly eliminate all these evils and at the same time will permit a wide variation in the clearance between the piston and the cylinder, so that the great accuracy formerly necessary to produce even approximate results will no longer be required.

I do this, fundamentally, by permitting the oil to pass freely in a film between the piston and cylinder to a point near the piston head, and by providing between two piston rings near the piston head both an ample clearance and an oil reservoir or pocket, which latter may be either in the piston itself or in the piston ring, or in both; and I preferably combine with this oil reservoir between the piston rings an oil-reservoir construction below the lowermost piston ring, of the same general character as that set forth in my co-pending application, Serial No. 535,115, filed February 7, 1922.

My present invention is to some extent a development and improvement on that shown in the aforesaid co-pending application.

The accompanying drawing illustrates my invention: Fig. 1 is an elevation of a piston embodying my invention, looking at the end of the wrist-pin, with a fragment of the associated cylinder wall in section and with the piston rings partially in section; Figs. 2, 3, 4, and 5 are enlarged fragmental sections showing various constructions of the piston rings and the adjacent parts of the piston head, all embodying the broad features of my invention, and Fig. 2 being a detail enlargement of the structure shown in Fig. 1; and Fig. 6 is a detail showing my invention in a piston using more than two piston rings.

The piston 10 is fundamentally a conventional piston, with a head 11 and a skirt 12; and it is provided at or near the head 11 with a plurality of piston-ring grooves 13 and 14, shown as two in number as I find two to be sufficient in most cases, with piston rings 15 and 16 in such piston-ring grooves. There are no piston rings along the skirt 12, save at the top thereof where such skirt merges into the head 11, so that there is an unrestricted passageway 17 for oil between the skirt 12 and the adjacent cylinder wall 18. This passageway 17 is the clearance space between the piston skirt and the cylinder wall, and is the clearance which it has heretofore been necessary to maintain within exceedingly close limits as a compromise to prevent one or more of the evils mentioned above from becoming unduly large. Preferably the lower corner 12^a of the piston skirt 12 is rounded off, as indicated in Fig. 1, to prevent such corner from scraping the oil from the cylinder wall, and to permit the oil splashed from the crank-case onto the cylinder wall to enter freely into the clearance space 17 and to flow along such clearance space as far as the lower surface of the lower piston ring 16.

The piston-ring grooves 13 and 14 are separated by a "land" 20, which should have an ample clearance 21 from the cylinder wall 18 to get proper results, as if this land has insufficient clearance I find that under some circumstances it produces oil pumping, inconsistent as that may at first blush appear. The clearance 21 is considerably greater than the slight clearance which always exists between the cylinder wall and the piston rings, and is preferably greater than the clearance 17.

Between the two piston rings 15 and 16 I provide a circumferential oil reservoir or pocket in addition to the ample clearance 21, which reservoir or pocket is relatively much larger than is indicated in the drawing in comparison with the clearance space, as the clearance space is shown greatly exaggerated in the drawing at the land 20, as well as at the piston head and along the piston skirt. This reservoir is preferably provided by making the upper piston ring with a circumferential rabbet 22 in its lower outer corner, as is indicated in Figs. 1, 2, 3, and 5; which has the additional effect of making such ring 15 of less external area, so that it presses with greater force and therefore more closely against the cylinder wall 18 and acts more efficiently to scrape off a greater part of the oil film on the downward stroke of the piston. The reservoir may be provided, however, by a circumferentially extending groove 23 in the land 20, as is indicated in Figs. 3, 4, and 5; and this groove 23 in the land 20 may be used either in conjunction with the rabbet groove 22 in the upper piston ring, as is indicated in Figs. 3 and 5, or either the groove 22 or the groove 23 may be used without the other, as indicated in Figs. 2 and 4 respectively.

In addition to the reservoir between the two piston rings 15 and 16, I preferably also provide a relief and reservoir below the lower piston ring 16, of the general character shown in my aforesaid co-pending application Serial No. 535,115. A very brief description of that in the present case will be sufficient.

At the lower edge of the lowermost piston ring 16, there is a circumferential relief groove or passageway into which the clearance space 17 opens. This passageway most conveniently takes the form of an oblique-bottom circumferential groove 25 in the piston skirt just below but communicating with the lowermost piston-ring groove 14, as indicated in all the figures of the drawing; but it may take any of the other forms described in my aforesaid co-pending application, and may include a circumferential rabbet groove 26 in the lower outer corner of the lowermost piston ring 16, as is indicated in Fig. 5. This relief groove, in whichever form it may be, extends circumferentially around the piston, and communicates with an oil reservoir 27, which is conveniently provided by a shallow depression in the outer face of the piston skirt opposite or around or in the vicinity of the end of the wrist-pin 28 by which the piston is connected to the usual connecting rod 29, and/or by the hole through the wrist pin itself if such wrist pin be hollow. The wrist-pin 28 may be of any suitable form, as explained in my aforesaid co-pending application, though in the present case only the form is shown with the

wrist pin turning in the piston. As there is a reservoir 27 around each end of the wrist pin, with this arrangement the two reservoirs are at substantially diametrically opposite points on the piston, and substantially at right angles to the plane of swing of the connecting rod and to the component of lateral thrust which is exerted on the piston by the oblique reaction from the connecting rod. Preferably there is an un-cut-away boss or land 30 directly above the wrist pin, to assist in alining the piston, with a cut-away passage 31 on each side of such boss or land 30 leading from the reservoir 27 to the circumferential grooves 25 and/or 26. The passages 31 are restraining ones, to limit the oil flow from the relief grooves; and to this end they may conveniently be made merely as shallow flat places on the piston surface.

The reservoir 27 preferably extends well below the wrist-pin; and it has a restraining relief outlet, preferably at an intermediate point in its height, provided by oil grooves 32 which extend along the bearing surfaces of the wrist pin as explained in my aforesaid co-pending application. This reservoir relief by the oil grooves 32 serves the additional function of lubricating the wrist pin by oil under forced-feed pressure.

In operation: When the circumferential relief grooves and reservoir below the lowermost piston ring 16 are used, they act substantially as described in my aforesaid co-pending application. When the piston descends, the oil enters freely into and fills the clearance space 17, and to a great extent is scraped off the cylinder wall 18 by the lowermost piston ring 16, and forced around the cylinder through the relief grooves and through the restraining passages 31 into the oil reservoir 27, and to some extent onto the bearing surfaces of the wrist-pin. When the piston rises, the oil which has been accumulated in the reservoir 27 and in the circumferential relief grooves 25 and/or 26 is to a large extent spread back on to the cylinder wall.

While this construction operates most efficiently under many circumstances, it is apparently not of itself always wholly sufficient to take care of as wide variations in the clearance space 17 as may be desired in some cases. When the reservoir construction between two piston rings is used, however, especially in conjunction with the reservoir construction below the lowermost piston ring, I find that it is possible to get exceedingly wide variations in the clearance space 17, without producing any of the aforesaid evils which have so long troubled engine manufacturers.

When the piston descends, some of the oil film is not scraped off by the lowermost piston ring 16, regardless of whether or not

the reservoir construction below such lowermost piston ring is used. This un-scraped-off part of the oil film therefore presses by the lowermost piston ring into the space
 5 between the two piston rings, and there a further part of this oil film is scraped off by the upper piston ring 16 as the piston descends. This upper piston ring probably removes the greater part of the remaining
 10 oil film, so that only an exceedingly thin film exists between the upper piston ring and the cylinder wall and reaches the combustion chamber. The oil which the upper ring 15 scrapes off is caught in the circumferentially extending reservoir formed by the grooves 22 and/or 23 and ample clear-
 15 ance 21 between the two piston rings, and probably a considerable oil pressure is built up there to float the piston fairly centrally in the cylinder. When the piston ascends again, some of this oil may be spread back onto the cylinder wall 18; but on account of the sharp upper outer corner of the piston ring 16, I believe this oil pressure is only
 20 partially relieved, and sufficient oil is retained to continue to float the piston even at the top of the stroke.

Whatever may be the explanation, I find that with this reservoir formed by the
 30 grooves 22 and/or 23 and ample clearance 21 it is possible to vary the clearance space 17 within very wide limits. Even with relatively very wide clearance, the piston can be operated without slapping or oil pump-
 35 ing or galling, and the extremely careful fitting of the piston in the cylinder heretofore believed to be necessary is no longer required.

Although I have described my invention
 40 primarily with relation to a piston with only two piston rings, my invention is by no means limited to the use of only two piston rings. It may be used with any desired number of piston rings, and in Fig. 6 I have
 45 illustrated a construction using three piston rings. My invention is embodied by the provision of the reservoir referred to between any two of these piston rings, or between each set of two if desired; and any
 50 of the variations described above and shown in Figs. 2, 3, 4, and 5 for the two-ring construction may be used in the piston having more than two rings. For illustration, I have shown in Fig. 6 a plain piston ring 16
 55 in the bottom groove 14, and rabbetted piston rings 15 and 15' in both of the upper grooves 13 and 13', though it is not essential that both the rings 15 and 15' be rabbetted rings; I have shown both the lands
 60 20 and 20' between each two piston rings as having an ample clearance 21; and I have shown the lower land 20 with a circumferential groove 23. I believe it is not necessary to go into detail on the various mod-
 65 ifications which may be provided when there

are more than two piston rings, as they will be clear from what has already been said.

I claim as my invention:

1. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plu-
 70 rality of piston rings in the respective grooves, the nearer to the head of two such rings being provided with a circumferential groove in its outer corner remote from
 75 the head, the piston-part between adjacent piston-ring grooves having a greater clearance than has the skirt portion of the piston to provide a relatively large reservoir hav-
 80 ing a reservoir capacity greater than that provided for expansion clearance.

2. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plu-
 85 rality of piston rings in the respective grooves, said piston between two piston-ring grooves forming a land which has greater than expansion clearance through-
 90 out and which is provided with a circumferential groove to form a relatively large reservoir having a reservoir capacity greater than that provided for expansion clear-
 95 ance.

3. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plu-
 95 rality of piston rings in the respective grooves, the nearer to the head of two such rings being provided with a circumferential groove in its outer corner remote from the
 100 head, said piston between two piston-ring grooves forming a land provided with a circumferential groove to form a relatively large reservoir having a reservoir capacity greater than that provided for expansion
 105 clearance.

4. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plu-
 110 rality of piston rings in the respective grooves, the aforesaid parts being provided with an otherwise substantially closed reservoir communicating freely with two adja-
 115 cent piston ring grooves by a clearance greater than that of the skirt portion and greater than that provided for expansion clearance.

5. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plu-
 120 rality of piston rings in the respective grooves, the piston rings having substantially square cylinder-engaging corners toward the piston head, and the aforesaid parts being provided between the adjacent
 125 cylinder-engaging corners of adjacent piston rings with a superficial circumferentially extending reservoir communicating with adjacent piston-ring grooves by greater than expansion clearance and having a
 130

reservoir capacity greater than that provided for expansion clearance.

6. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, the aforesaid parts being provided with a superficial reservoir between the adjacent cylinder-engaging corners of adjacent piston rings, said superficial reservoir having a greater reservoir capacity than would be provided for expansion clearance, said piston being also provided with an external circumferential passage on the side remote from the piston head of the piston ring remote from the piston head, and being also provided with a reservoir into which said last-named circumferential passage leads.

7. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, the piston having between adjacent piston-ring grooves a land which has a clearance from the cylinder wall which is greater than expansion clearance, the aforesaid parts being provided with a superficial reservoir between the adjacent cylinder-engaging corners of adjacent piston rings, said piston being also provided with an external circumferential passage on the side remote from the piston head of the piston ring remote from the piston head.

8. In combination with a cylinder, a piston within and having a clearance space from said cylinder, said piston being provided with means including a plurality of piston rings for preserving the film of oil in this clearance space under pressure on the downward stroke, and having on both sides of one of said piston rings reservoirs of greater reservoir capacity than that which would be provided for expansion clearance, both of which reservoirs communicate with a piston-ring groove through clearances greater than that necessary for expansion.

9. In combination with a cylinder, a piston within and having a clearance space from said cylinder, said piston being provided with means including a plurality of piston rings for preserving the film of oil in this clearance space under pressure on the downward stroke, and having on both sides of one of said piston rings reservoirs of greater reservoir capacity than that which would be provided for expansion clearance, one of said reservoirs being between two piston-ring grooves and communicating with both of them by greater than expansion clearance.

10. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and

means connecting two adjacent piston-ring grooves by greater than expansion clearance and having greater reservoir capacity than has ordinary expansion clearance for accumulating and holding lubricant between such piston-ring grooves.

11. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, said piston and piston rings being arranged to accumulate and hold between and in interconnection by greater than expansion clearance with two adjacent piston rings a greater volume of lubricant than could be contained in ordinary expansion clearance.

12. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head and with a plurality of lands between grooves, and a plurality of piston rings in the respective grooves, the aforesaid parts being provided between the adjacent cylinder-engaging corners of adjacent piston rings with a superficial reservoir having a greater reservoir capacity than would be provided by ordinary expansion clearance of a land between such two rings, a land also being provided with greater than expansion clearance throughout from the cylinder wall.

13. A piston, comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, said piston between two piston-ring grooves forming a land which co-operates with the adjacent piston rings and the cylinder wall to form a circumferential reservoir of greater reservoir capacity than is provided by ordinary expansion clearance and in communication with both adjacent piston-ring grooves by greater than expansion clearance.

14. A piston, comprising a head portion and a skirt portion and a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, the aforesaid parts being provided with a superficial reservoir between the adjacent cylinder engaging corners of adjacent piston rings, said piston being also provided with an external circumferential passage on the side remote from the piston head of the piston ring remote from the piston head, and being also provided with a reservoir into which said last named circumferential passage leads and with a restraining outlet for relieving excessive pressure.

15. A piston, comprising a head portion and a skirt portion and a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, the piston having between adjacent piston-ring grooves a land which has greater clear-

ance from the cylinder wall than has the piston skirt, the aforesaid parts being provided with a superficial reservoir between the adjacent cylinder-engaging corners of adjacent piston-rings, said piston being also provided with an external circumferential passage on the side remote from the piston head of the piston ring remote from the piston head and with a restraining outlet for relieving excessive pressure.

16. In combination with a cylinder, a piston within and having a clearance space from said cylinder, said piston being provided with means including a plurality of piston rings for preserving the film of oil in this clearance space under pressure on the downward stroke, and having on both sides of one of said piston rings reservoirs of greater reservoir capacity than that which would be provided for expansion clearance, one of said reservoirs being provided with means for relieving excessive pressure therein.

17. In combination, a piston having a plurality of piston-ring grooves near its head end, and a plurality of piston rings in said grooves, including a plain ring, said structure having a plurality of circumfer-

ential oil channels co-acting with piston rings, and one of said channels communicating along the external surface of the piston by greater than expansion clearance with two adjacent piston-ring grooves.

18. In combination with a cylinder, a piston within it and comprising a head portion and a skirt portion with a plurality of piston-ring grooves near the head, and a plurality of piston rings in the respective grooves, said piston having between adjacent piston rings a land having greater than expansion clearance, and a superficial reservoir or pocket bounded by surfaces including said land, a piston ring, and the cylinder wall.

19. An internal-combustion engine piston having a head portion and a skirt portion, with a plurality of piston-ring grooves near the head, and a land between two adjacent piston-ring grooves having greater than expansion clearance throughout its width.

In witness whereof, I have hereunto set my hand at Connersville, Indiana, this 27th day of May, A. D. one thousand nine hundred and twenty-two.

CHARLES C. HANCH.