(No Model.)

J. E. SWEET.
PISTON FOR HIGH SPEED ENGINES.

No. 551,913. Patented Dec. 24, 1895.

Fig. 1

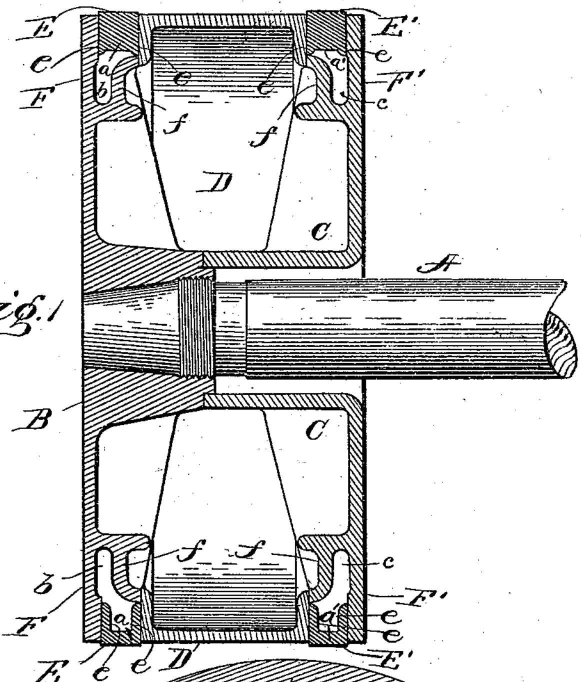
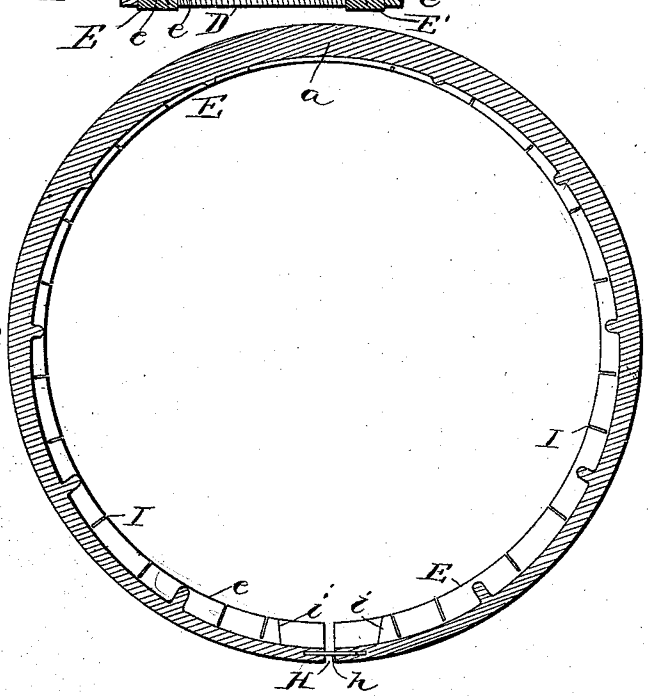


Fig. 2



Witnesses:
J. M. Fowler Jr.
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Fig. 3

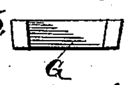
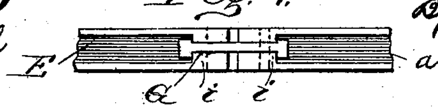


Fig. 4



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UNITED STATES PATENT OFFICE.

JOHN E. SWEET, OF SYRACUSE, NEW YORK.

PISTON FOR HIGH-SPEED ENGINES.

SPECIFICATION forming part of Letters Patent No. 551,913, dated December 24, 1895.

Application filed August 1, 1895. Serial No. 557,852. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. SWEET, a citizen of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Pistons for High-Speed Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in the construction of pistons for high-speed engines, particularly those designed for a double stroke; and it consists primarily in so constructing the piston and the co-operating rings that wear between the two will be practically prevented, thus obviating the leakage which is prone to occur at these points; also, in a construction of the rings and piston-heads whereby a minimum of wear is occasioned on the inner surface of the cylinder, and, finally, in the specific details of construction and arrangement by which I have been able to accomplish the above results in the best and most practical manner, which will be circumstantially described below, reference being had to the accompanying drawings, forming a part of this specification.

Figure 1 of the drawings represents a median longitudinal section of my improved piston, in which A is the piston-rod. B is the spider, showing the chambered cavities *b b*. C is the follower, showing cavities *c c*. D is the "bull-ring," shown flanged like the piston-rings. E E′ are the piston-rings, showing the different thicknesses of the eccentric web *a a′* at the different points of the section. *e e* are the flanges of the piston-ring, showing wearing-surface of equal width at all points. F F′ are the resilient flanges of the piston-heads, made with equal wearing-faces all around within the groove, and designed to yield slightly under the impact of steam and grip the rings E E′ between their wearing-faces and those of the bull-ring, and *f f* are the members or portions of the piston-heads which extend to and support the flanged edges of the bull-ring.

Fig. 2 represents a plane section of one of the piston-rings E through the middle of the web *a*, showing the eccentric form and construction of the web. The ring is shown cut at the thin part of the web at *h*. At H is shown a stop-gate formed of a thin piece of sheet metal inserted across the cut to stop steam from penetrating back of the ring through the cut. The flanges of equal width all around are shown at E E. I I are saw-cuts made in the inner circumference of the flanges of the rings at intervals to facilitate free differential expansion and contraction of the rings.

Fig. 3 illustrates the T-headed link or shackle G employed to connect the cut ends of the piston-ring and limit their expansion. Fig. 4 illustrates the plan of the joint in the piston-ring, showing the T-headed link in place.

The packing-rings which I employ are spring-rings made on what I have designated the "limited-expansion" principle—that is, they do not bear with pressure against the interior wall of the cylinder either by their own resiliency, as is customary with spring-rings, or by the force of steam behind them, as is the case in some forms of high-speed engines. I make my rings in the first place much too large for the cylinder, then cut them and spring them in with considerable force to a true circular curve, then pin or shackle them in that position as the maximum position of expansion, then turn the outside circumference accurately to a true and perfect fit to the interior surface of the cylinder, the latter being first made as truly circular and parallel as possible. The shackles thus permit the rings to yield inwardly, while the maximum limit of expansion of the latter only gives them the perfect fit and contact designed for them without pressure. Steam cannot pass these rings, and at the same time they do not and cannot cut the cylinder, which if made a truly geometrical cylinder-surface at the outset has a tendency to remain so. The pistons also run much easier than those whose rings are forced against the cylinder-surface, either by their own resiliency or by extraneous pressure applied from within.

One method of locking the ends of the cut rings so as to limit their expansion while permitting them to yield inwardly is shown in Figs. 2, 3 and 4. The rings which I employ are of the eccentric form, with the modification detailed below, and are made so as to expand exclusively by the force of their own resiliency. It is well known that a piston-ring eccentric in thickness is better than one concentric or parallel all around as to its inner and outer faces, since when the concentric ring is turned truly around upon its outer face and then cut and sprung into the smaller circumference which it must assume in performing its functions it does not fit a cylinder of such smaller diameter as truly and with as equal a radial bearing at all points as one made eccentric and cut through the thin part and then sprung in, since the latter springs at all points to a truly circular curve, while the former tends to be elliptical in outline on account of the leverage of compression being exerted more powerfully the greater the distance from the cut ends. On the other hand, an eccentric ring as ordinarily made is not as good as a concentric one on account of the greater wear occasioned in the groove of the piston, where the thin part or the point of greatest play is located.

My improved ring is designed to retain the advantages of both constructions by providing for equal resiliency while I retain at the wearing-faces a uniform and equal wearing-surface. This I accomplish by constructing the ring with an eccentric web in its middle and main portion—that is, thickest at the point opposite to the cut place and gradually diminishing in thickness to a minimum at the cut ends. To secure equal wear I provide at the edges flanges of parallel or concentric form giving equal area and consequently equal wearing-surface all around where the ring encounters the wearing-surfaces of the piston-groove in frictional contact. These flanges I cut at intervals, as shown at I I, Fig. 2, to permit the resilient web to have its due proportional play. The ring by this mode of construction is thus made lighter and with equal spring quality all around, while at the same time the equal wearing-surfaces are retained.

Another principal feature of my invention consists in chambering the piston-heads, as shown at *b b c c*, so as to leave a wide thin margin or flange all around the edge, so that as the impact of the steam-pressure comes upon the piston-face it will spring a trifle at the margin and thus pinch the ring in the groove and lock it fast. The ring expands outwardly to its limit to fit the cylinder during the exhaust on its approach to the end of its travel, and then when truly adjusted the steam-pressure strikes the piston-surface on the return stroke, pinching the ring, as before said, and locking it fast. This also has a tendency to keep the cylinder-surface parallel, if truly made so in the beginning, and a minimum of wear is occasioned, not only between the piston-rings and their grooves, but also between the piston-ring circumferences and the cylinder, since a minimum of pressure is exerted by the fully-expanded and locked ring against the inner surface of the cylinder, and at the same time a steam-tight fit is insured. These chambers may be cored out in casting, or made in any other workmanlike manner.

The cut in the ring I make at the thin part of the web, as beforesaid, and it may be made either straight across, as shown in the drawings, or diagonally in the usual manner. I place a thin plate of steel across the gap, with provision for expansion and contraction, as shown at H, Fig. 2. This is designed to prevent access of steam behind the rings, which is essential to their perfect operation.

In Figs. 3 and 4 I have shown a very convenient form of shackle which I employ. This is provided with a double T-head, the heads playing freely in recesses in the ring at the cut ends, as shown, but limited by the shoulders *i i*, so that the ring cannot attain to an expansion as to its circumference greater than the interior circumference of the cylinder. Any other form of link limiting the outward play of the cut ends of the ring in the same manner I would consider to be the equivalent of the link or shackle shown. Pins affixed to exterior parts, playing in slots in the ring at the cut ends, may also serve the same purpose and constitute a mechanical equivalent.

The mode of operation is as follows: The piston shown in Fig. 1 being designed for a double-stroke engine, we will suppose the pisson to be at the limit of its travel in the cylinder at the end farthest from the cross-head. The piston-ring E in the "spider" has expanded during the exhaust to its utmost limit, exactly fitting the cylinder at that point. The valves being opened, the impact of the incoming steam on the piston-face slightly springs the flanges F F, which find their abutment on the face of the piston-ring E beneath, and pinch the said ring tightly between the posterior face of the flange F and the annular face of the bull-ring. The ring being thus set to a perfect fit is carried the length of its travel on parallel lines, which fit the cylinder at all points, the latter having been made truly parallel to begin with. A readjustment takes place at each return-stroke, at the occurrence of the exhaust, to compensate for any displacement. During this stroke the ring E′, being free from any constriction by the flange F′ while the exhaust was in operation, has freely adjusted itself by its own elasticity within the limit of expansion to the cylindrical surface and is ready at the end of the stroke to be gripped by the flange F′ on the impact of the incoming steam on that side. In my system the readjustment of the rings is effected by their resiliency alone, no steam being permitted to enter the cored piston-cavity in the rear of the rings. In this respect my construction differs from that of prior devices where the rings have been incidentally pinched by the impact of the steam against the piston-faces, the rings being forced out in such construction by the pressure of the steam behind them, admitted for that purpose through perforations in the piston-face. In my piston the resilient flanges F F′ are integral with the piston-heads and are imperforate with the resultant advantage that there are no attached parts to shake loose under the powerful alternating blows of the steam in the cylinder, and also that the steam is prevented from getting back of the rings into the chambered cavities, which could add injuriously to the clearance-space and the condensing-surface, and, besides, by omitting steam-pressure into the said cavities just so much pinching power would be lost to the piston-flanges F F′, thus nullifying in proportional measure the very function for which the cavities were provided.

It is obvious that my plan of construction may be applied also to single-acting engines, or pistons of single stroke.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A piston for double acting high speed engines, having spring packing rings and heads formed respectively with annular chambered cavities *b c*, leaving supporting members *f f* and integral flanges F F′, the latter being of sufficient thinness to spring slightly under the impact of steam pressure upon them, whereby the said packing rings are pinched and held between the contacting surfaces while the steam pressure is upon the piston face, substantially as specified.

2. In a piston for high speed engines, the piston heads having cavities *b c*, integral flanges F F′, and supporting members *f f*, in combination with the piston rings E E′ and bull ring D, substantially as and for the purpose specified.

3. In a piston for high speed engines, a piston ring formed eccentrically as to its main or body portion, tapering gradually in thickness from its thickest part each way toward the cut portion opposite, and provided with flanges at its outer edges of concentric form or equal width throughout, whereby equal wearing surfaces all around are presented on each edge of the piston ring, substantially as specified.

4. A spring piston ring formed eccentrically as to its web or middle portion and concentrically as to its flanges or edge portions, whereby equal spring quality is insured, and equal wearing surfaces are presented on the edges, substantially as specified.

5. In a piston ring, formed eccentrically as to its web or middle portion and concentrically as to its flanges or edge portions, the plate H, placed across the gap at the cut portion, inserted in recesses formed in the cut edges respectively, with lateral play to allow of the expansion and contraction of the ring, substantially as specified.

6. In a spring piston ring formed eccentrically as to the web or middle portion and concentrically as to its flanges or edge portions, a link or shackle, as G, in combination with limiting shoulders *i i* formed in the cut ends respectively, whereby the expansion of the elastic ring is limited to fixed predetermined dimensions, while free contraction and expansion are provided for within the said limit substantially as specified.

7. A piston ring of true circular outline formed of resilient material, having a web or middle portion eccentrically formed, and flanges or edge portions concentrically formed, confined within its natural limit of expansion by means substantially as described, which permit its contraction to a smaller diameter when sufficient external pressure is applied, but prevent its expansion beyond the limit of a predetermined circumference, substantially as specified.

8. A piston ring formed of resilient material, having a web or middle portion eccentrically formed and flanges or edge portions concentrically formed, the inner edges of the said flanges or edge portions being cut as at I I, to admit of the free expansion and contraction of the eccentric or web portion on true circular lines, substantially as specified.

9. A piston ring formed of resilient material, having the eccentric web portion *a*, concentric flanges *e e*, cut as at I I, link or shackle as G for confining the natural expansion within the limits of elasticity to a predetermined circumference, and stop gate H, for cutting off the entrance of steam to the piston cavity, substantially as specified.

10. A piston for high speed engines, comprising piston heads B C, having cavities *b c*, resilient flanges F F′, bull ring D, resilient piston rings E E′, formed eccentrically as to their webs or middle portions, and concentrically as to their flanges or edge portions, linked against undue expansion beyond a predetermined limit, and having stop gates, as H for preventing access of steam through the cut portion of the rings to the interior of the piston, substantially as specified.

11. In combination with the piston heads B C, formed integrally with the cavities *b c*, and resilient flanges F F′, piston rings as E E′ having eccentrically formed webs or middle portions *a a′* and concentrically formed flanges or edge portions *e e* cut at intervals as at I I, and a bull ring as D, substantially as specified.

12. A piston for high speed engines, comprising integral heads B C formed with the cavities *b c*, resilient flanges F F′, bull ring supports *f f*, bull ring D, spring piston rings E E′, eccentric as to their body portions and concentric as to their edge portions, cut at the thinnest part as at *h* and slit upon the inner flange edges as at I I and provided with shackle G, limiting shoulders *i i* and stop gate H, all substantially as specified.

13. In a piston for high speed engines, a spider B, formed integrally and chambered as at *b* all around its circumference, leaving the resilient integral imperforate flange F, in

combination with a spring ring, substantially as specified.

14. A piston for double acting high speed engines having a piston rod, a bull ring, a follower, a spider formed integrally and chambered all around its circumference leaving a resilient imperforate flange and a supporting member for the bull ring, in combination with a spring ring lying in the channel formed between the said flange and the bull ring, substantially as specified.

15. In a piston for high speed engines, the combination of a piston rod, a bull ring, a follower, a spider formed integrally and chambered all around its circumference leaving a resilient flange, and a spring ring, formed eccentrically as to its web or middle portion, and concentrically as to its flanges or edge portions, said flanges being cut or slit at intervals on the inner edge thereof to allow of free differential expansion and contraction of the eccentric web, substantially as and for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN E. SWEET.

Witnesses:
W. T. POWERS,
WM. F. KACER.