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FREE PISTON ENGINE HAVING HOLLOW PISTONS

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Fig. 1.

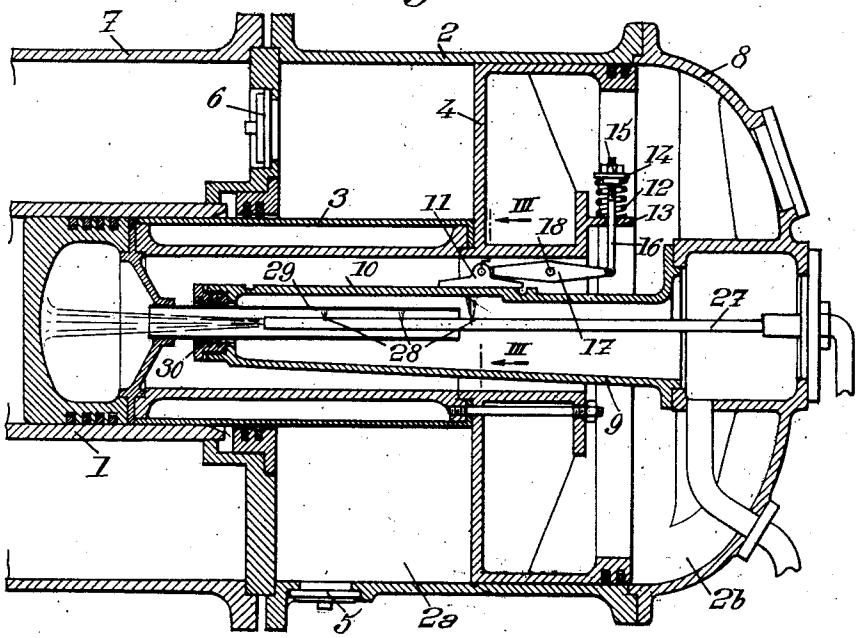


Fig. 2.

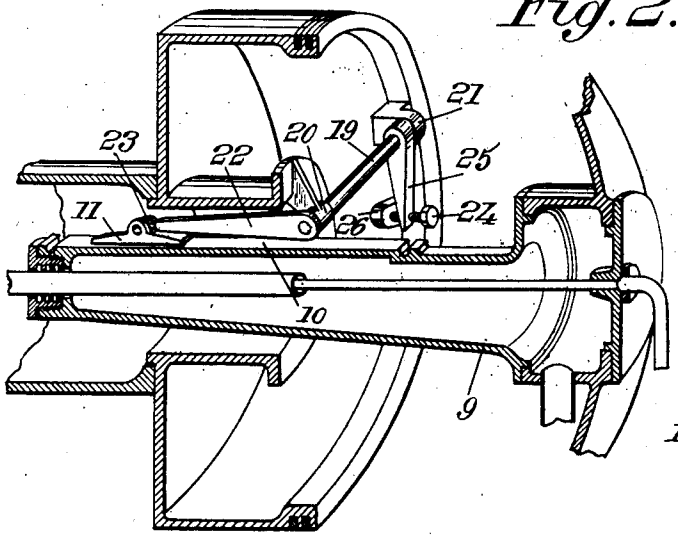
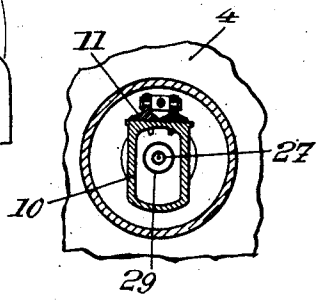


Fig. 3.



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7 Claims. (Cl. 123—41.31)

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The present invention relates to machines having hollow horizontal pistons and it is more particularly but not exclusively concerned with machines of this type in which these pistons are freely movable.

Its chief object is to provide a machine of this kind which is better adapted to meet the requirements of practice than the machines existing at the present time.

My invention consists essentially in having at least a portion of the weight of the hollow piston supported by a track rigid with a fixed portion of the machine and extending into said piston, a sliding shoe connected with the piston through elastic means having a given initial tensioning transmitting the piston weight to this track. Preferably, the track and the shoe are arranged to have no guiding action in a horizontal direction transverse to the axis of the piston.

Preferred embodiments of my invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example and in which:

Fig. 1 is an axial sectional view of the right hand portion of a horizontal machine made according to my invention and having opposed pistons;

Fig. 2 shows a modification;

Fig. 3 is a section on the line III—III of Fig. 1.

The machine is constituted, with the exception of its pistons and of the means which support the weight thereof, in any suitable manner.

For instance this machine includes a power cylinder 1, only the right-hand part of which is shown by Fig. 1, and two compressor cylinders 2 disposed on either side of power cylinder 1. Fig. 1 shows only one compressor cylinder 2. In this power cylinder 1 work two opposed power pistons 3 each of which is rigid with a compressor piston 4 which works in the corresponding compressor cylinder 2.

Compound piston 3—4 is hollow.

In the embodiment shown by the drawing, the space 2*a* located, in compressor cylinder 2, on the left hand side of compressor piston 4, constitutes the compressor chamber proper, fitted with intake valve 5 and delivery valve 6. The air drawn into space 2*a* through inlet valve 5 during the outward stroke of compound piston 3—4 is discharged, after it has been compressed, during the inward stroke of this piston, through valves 6 into a casing 7 which surrounds power cylinder 1.

The space 2*b* on the outer side of compressor piston 4, between this last mentioned piston and the end wall 8 of compressor cylinder 2, contains an air cushion capable of storing up energy during the outward stroke of compound piston 3—4

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and of giving it back to said piston during its inward stroke.

As shown by the drawing, compound piston 3—4 is hollow and a piece 9, rigid at its outer end with the end wall 8 of the compressor cylinder, extends into said piston.

Up to the present time, in machines such as above described, the same part was used both to guide piston 3—4 and to support its weight. The part which thus performed these two functions was either the inner wall of compressor cylinder 2 or piece 9 extending into the hollow portion of piston 3—4. In both cases, when the machine is of big size, excessive wear and tear is to be feared. This is why, according to my invention, the piston guiding function is at least substantially made distinct from the function of supporting at least a substantial portion of the piston weight.

According to my invention, the inner wall of the compressor cylinder 2 acts as guiding means and piece 9 serves to support the piston weight.

For this purpose, I provide on piece 9 a flat surface 10 acting as a track on which can slide a shoe 11, elastic means being interposed between shoe 11 and piston 3—4. These elastic means have a preliminary tensioning such that they transmit at least a substantial portion of the piston weight, if not the whole thereof, to said shoe 11. On the other hand, these elastic means prevent any wedging of the piston against its guiding surface constituted by the inner wall of cylinder 2.

Such elastic means may of course be made in different ways. They may include springs placed under a given preliminary tensioning, but they may also include pneumatic cushions, in particular of air under pressure.

According to Fig. 1 of the drawing, the elastic means include a helical spring 12 interposed between a bearing surface 13 rigid with piston 3—4 and a washer 14 applied against a nut 15 screwed on a rod 16 connected to shoe 11 through a lever 17 the pivot axis of which 18 is mounted on piston 3—4. The preliminary tensioning of spring 12 can be adjusted by means of nut 15.

In the embodiment shown by Fig. 2, helical spring 12 is replaced by a torsion bar 19 mounted rotatable about its longitudinal axis in bearings 20—21 rigid with hollow piston 3—4 and connected through a lever 22 with shoe 11 on which the end of lever 22 is hinged at 23. The initial twisting of bar 19 can be adjusted by means of a screw 24 which is screwed in a lever 25 rigid with bar 19 and the end of which bears against an abutment 26 rigid with piston 3—4.

Preferably, the means which support the weight of piston 3—4 are arranged in such manner as to exert on said piston no guiding action

in a horizontal direction transverse to the axis of the piston.

For this purpose, it is advantageous to arrange surface 10 and the corresponding surface of shoe 11 in the form of flat horizontal surfaces. If the sliding surfaces of the track and of the shoe were curved in a direction transverse to the axis of the machine, it would be necessary to provide in the connecting means between the shoe and the piston a hinge to prevent any guiding from being exerted transversely to the axis of the machine by such curved surfaces.

In order to avoid heating of slideway 9—10, cooling means should be provided. Preferably, these means are combined with the means which serve to cool the piston and in particular the head of power piston 3. For this purpose, I provide in the wall of a fixed tube 27 which feeds the cooling liquid, in particular cooling oil, into hollow piston 3—4, orifices 28 which are located opposite the sliding surface 10. A portion of the cooling liquid which flows out through these orifices is thus caused to impinge upon the inner wall of the portion of piece 9 which constitutes track 10.

It should be noted that, as shown by Fig. 1, the apertures 28 which are in the vicinity of the inner end of tube 27 exert a cooling action upon track 10 only at intervals, that is to say during periods for which piston 3—4 is close to the end of its inward stroke. Only during these periods are said orifices cleared by a sleeve 29 rigid with piston 3 and which passes through a packing box 30 to achieve a fluidtight communication between the inside of fixed piece 9 and the inside of piston head 3.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. In a machine including a frame, a horizontal cylinder carried by said frame and a hollow piston in said cylinder, the combination of a piece rigid with said frame and extending into said piston out of contact therewith, said piece forming a track extending into said piston and parallel to the cylinder axis, a shoe movable vertically with respect to said piston resting slidably on said track, and elastic means interposed between said piston and said shoe for transmitting a portion of the weight of said piston to said shoe to apply it against said track.

2. In a machine including a frame, a horizontal cylinder carried by said frame and a hollow piston in said cylinder, the combination of a piece rigid with said frame and extending into said piston out of contact therewith, said piece forming a track extending into said piston and parallel to the cylinder axis, a shoe slidable on said track, elastic means interposed between said piston and said shoe for transmitting a portion of the weight of said piston to said shoe to apply it against said track, said shoe being freely movable in a direction transverse to the axis of said cylinder with respect to at least one of the parts, constituted by said track and said elastic transmitting means, between which it is interposed, and means distinct from said shoe and said track for guiding said piston with respect to said frame against horizontal relative displacements transverse to the cylinder axis.

3. A combination according to claim 2, in which said piece is of cylindrical shape, further including means for projecting a cooling fluid against the inner wall of said cylindrical piece opposite the portion thereof which constitutes said track.

4. In a machine including a frame, a horizontal cylinder carried by said frame and a hollow piston in said cylinder, the combination of a piece rigid with said frame and extending into said piston out of contact therewith, said piece forming at its upper part an at least substantially horizontal track extending into said piston and parallel to said cylinder axis, a shoe resting on said track, a lever pivoted to said shoe and to said piston about respective horizontal axes both at right angles to said cylinder axis, and elastic means operatively connected to said lever and to said piston and arranged yieldingly to oppose rotation of said lever under the effect of the weight of said piston.

5. In a combination according to claim 4 in which said lever is pivoted at an intermediate point thereof to said piston, and at one end thereof to said shoe, a vertical rod pivoted to the other end of said lever about an axis parallel to the two first mentioned axes, a disc rigid with said rod at the top end thereof, and a part of said piston extending horizontally between said disc and said lever, said elastic means including a compression spring interposed between said disc and said part of the piston.

6. In a combination according to claim 4, a torsion rod rigid at one end with said lever and extending at right angles thereto journalled in said piston, a bar rigid with the other end of said rod, and an abutment carried by said piston adapted to cooperate with said bar, said torsion bar forming the elastic means arranged yieldingly to oppose rotation of said lever.

7. A machine including a frame, a horizontal power cylinder, a horizontal compressor cylinder in line with said power cylinder, a hollow power piston slidable in said power cylinder, a hollow compressor piston slidable in said compressor cylinder and fixed to said power piston coaxially therewith, a piece rigid with said frame and extending into said pistons out of contact therewith, said piece forming a track extending into said piston and parallel to the axis of said cylinders, a shoe movable vertically with respect to said pistons resting slidably on said track, said shoe being located substantially in the plane of the face of said compressor piston which is nearer to said power piston, and elastic means interposed between said pistons and said piece for transmitting a portion of the weight of said pistons to said shoe to apply it against said track.

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