Dec. 1, 1931. A. PFLÜGER ET AL 1,834,729

INTERNAL COMBUSTION ENGINE

Filed March 12, 1930

Fig. 2.

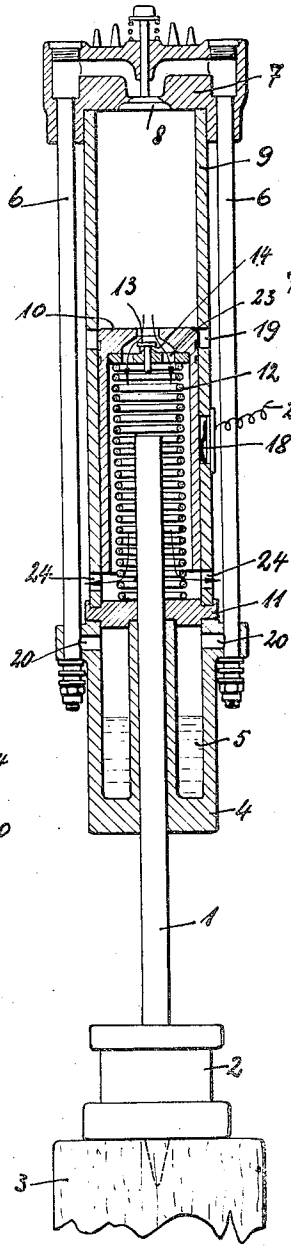


Fig. 1.

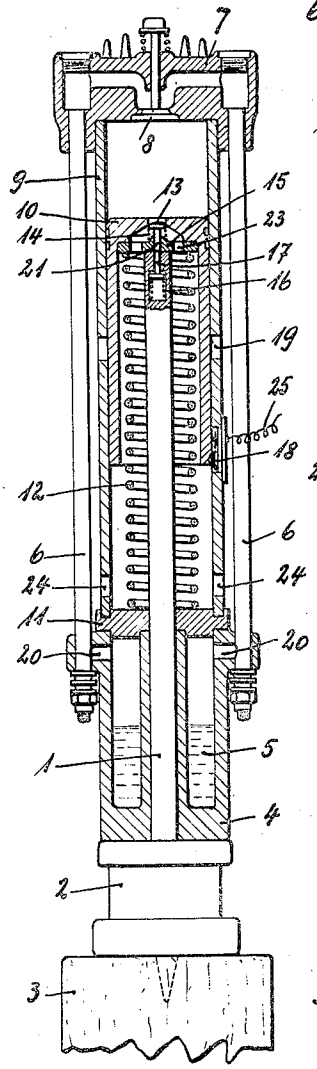
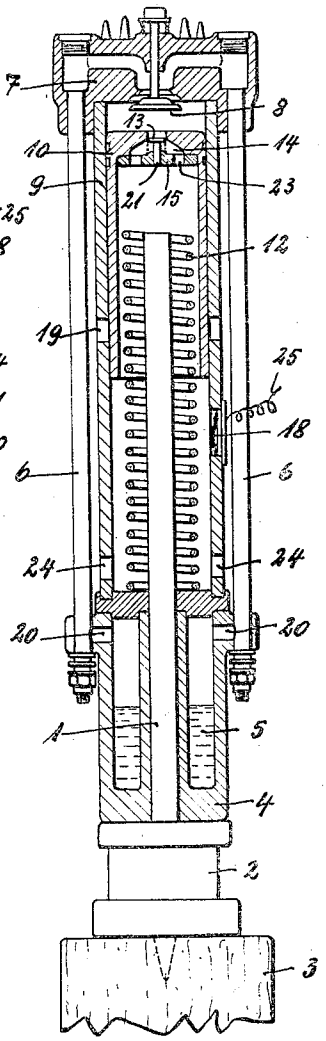


Fig. 3.



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UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

Application filed March 12, 1930, Serial No. 435,133, and in Germany February 3, 1930.

Our invention relates to internal combustion engines particularly for use in connection with mechanical percussive tools, for instance hand rams. In a tool of this type, as described in our copending application for patent in the United States, Serial No. 221,726, the cylinder of the internal combustion engine is fitted to slide on a piston and constitutes the tup.

It is an object of our invention to improve the control of the exhaust valve in engines of this kind.

To this end we arrange the exhaust valve in the piston and provide a rod extending into the cylinder on which the piston is normally supported and which rod is adapted to close the exhaust valve.

In the tool described in our said copending application the rod referred to is the piston rod and is connected with the piston in the usual manner while the inlet and exhaust valves are combined into a single member which is operated manually and is under the control of springs. In our present invention the piston and the piston rod are separate elements, and so are the inlet and exhaust valves. Both valves are automatic and are operated by the pressures in the cylinder. Besides, the exhaust valve, as mentioned, is closed in the normal or initial position of the parts by the aforesaid rod.

In the drawings affixed to this specification and forming part thereof a rammer embodying our invention is illustrated in axial section and in three stages of operation.

In the drawings

Fig. 1 illustrates the normal or initial position of the parts of the tool when ready for ignition,

Fig. 2 illustrates the position at the beginning of the exhaust stroke, and

Fig. 3 illustrates a position during the suction stroke.

Referring now to the drawings, 1 is the rod for controlling the exhaust valve 13 in the piston 10, 2 is a base plate at the end of the rod 1, and 3 is a pile or the like which is to be rammed.

The tup comprises a lower compartment 4 and an upper compartment 9 which are separated by a partition 11. A supply of fuel 5 is stored in the lower compartment which is guided on the rod 1 by a central sleeve. The upper compartment 9 is the combustion chamber or cylinder of the engine and is closed by the head 7 at the top. 10 is a piston of the plunger type, which is fitted to slide in the upper compartment or cylinder 9 against the action of a spring 12 abutted on the partition 11. 8 is the automatic inlet valve in the cylinder head 7, 6, 6 are pipes or tubular stays extending from the cylinder head 7 to a flange at the upper end of the fuel compartment 5, and 20, 20 are passages extending from the fuel compartment to openings in the tubes or stays 6, 6. A carbureter, not shown, is provided for preparing a combustible mixture.

The exhaust valve 13 is seated in the bottom of the plunger 10 and is under the action of a spring 14 which tends to seat the valve. The spring may be dispensed with. 15 is a plate in the plunger in which the spindle 21 of the valve is guided. The lower end of the spindle is flush with the lower face 15 when the exhaust valve is seated or projects slightly therefrom so that the valve will be kept seated when the piston 10 bears on the central rod 1 as shown in Fig. 1.

In order to make up for any irregularities in the length of the spindle 21 we may provide a buffer 17 in the upper end of the rod 1 which is guided in a central bore of the rod and is pushed forward by a spring 16.

23 are exhaust ports in the plate 15, 19 are upper exhaust slots in the cylinder 9, and 24 are lower exhaust slots, also in the cylinder 19, the upper and lower slots being pitched apart for the length of the skirt of the piston 10.

18 is a contact spring in a recess of the cylinder 9 which is in contact with the piston skirt, and 25 is a cable for supplying current to the spring. The current flows through the piston skirt to a suitable ignition device, sparking plug or the like, not shown, in the cylinder 9.

Suppose that the parts are in the position

illustrated in Fig. 1 and that the combustion chamber above the piston 10 is charged with combustible mixture from the fuel supply 5. The exhaust valve 13 is closed by the rod 1. When the mixture is ignited the expanding products of combustion move the cylinder 9 upwards while the piston 10 remains in contact with the rod 1. The inlet valve 8 and the exhaust valve 13 remain closed. The spring 12 is compressed as the partition 11 rises while the piston is held down on the rod 1 by the pressure of the expanding products of combustion. When the cylinder or tup moves beyond the position illustrated in Fig. 2, the upper exhaust slots 19 move beyond the piston 10 and the pressure is rapidly relieved. The spring 12 raises the piston 10 against the reduced pressure and the spindle 21 of the exhaust valve 13 is moved away from the upper end of the rod 1 or the buffer 17. The exhaust valve now opens under the pressure which still obtains in the cylinder and overcomes the reaction of the spring 14. The residual exhaust escapes through the ports 23 in the plate 15, the cavity of the piston and the lower slots 24, the piston rising in the cylinder until it strikes, or nearly strikes, the base of the head 7, so that the products of combustion are completely expelled.

The tup now descends freely until its lower end with the compartment 4 strikes the block 2 which in turn drives the pile 3. The tup is now stationary but the piston 10 moves on by its inertia until the exhaust valve 13 is closed by the contact of its spindle with the upper end of the rod 1, or the buffer 17. If the spring 14 is provided—it may be dispensed with, as mentioned—it will close the exhaust valve 13 as soon as the pressure of the spring 14 is able to overcome the pressure on the valve. During the descent of the piston the inlet valve 8 opens automatically and fresh mixture is drawn into the cylinder as shown in Fig. 3 until finally the parts return into the position illustrated in Fig. 1, and the mixture is again ignited.

The valve gear combines simplicity with exact operation. Clearances in the cylinder are practically eliminated and the cylinder volume is utilized throughout.

While the example illustrated is a preferred embodiment of our invention which has the advantage of particular simplicity we wish it to be understood that we do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

We claim:—

1. An internal combustion engine comprising a cylinder, a rod on which said cylinder is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said cylinder, a piston in said cylinder adapted to engage said rod, means for supplying combustible mixture to said cylinder, and an exhaust valve in said piston adapted to be closed by said rod when said piston engages said rod.

2. An internal combustion engine comprising a cylinder, a rod on which said cylinder is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said cylinder, a piston in said cylinder adapted to engage said rod, an abutment in said cylinder, a spring inserted between said abutment and said piston, means for supplying combustible mixture to said cylinder, and an exhaust valve in said piston adapted to be closed by said rod when said piston engages said rod.

3. An internal combustion engine comprising a cylinder, a rod on which said cylinder is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said cylinder, a piston in said cylinder adapted to engage said rod, a fuel-supply tank at one end of said cylinder, a partition between said tank and the piston-swept portion of said cylinder, a spring inserted between said piston and said partition, a suction-controlled inlet valve at the other end of said cylinder, a suction pipe extending from said inlet valve to said tank, and an exhaust valve in said piston adapted to be closed by said rod when said piston engages said rod.

4. An internal combustion engine comprising a cylinder, a rod on which said cylinder is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said cylinder, a piston in said cylinder adapted to engage said rod, means for supplying combustible mixture to said cylinder, an exhaust valve in said piston and a spring buffer on said rod adapted to close said exhaust valve when said piston moves into engagement with said rod.

5. A percussive tool comprising a hollow tup, a rod on which said tup is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said tup, a piston in said tup adapted to engage said rod, means for supplying combustible mixture to said tup, an exhaust valve in said piston adapted to be closed by said rod when said piston engages said rod, and a block at the free end of said rod which is adapted to be struck by said tup.

6. A percussive tool comprising a hollow tup, a rod on which said tup is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said tup, a piston in said tup adapted to engage said rod, an abutment in said tup, a spring inserted between said abutment and said piston, means for supplying combustible mixture to said tup, an exhaust valve in said

piston adapted to be closed by said rod when said piston engages said rod, and a block at the free end of said rod which is adapted to be struck by said tup.

7. A percussive tool comprising a hollow tup, a rod on which said tup is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said tup, a piston in said tup adapted to engage said rod, a fuel-supply tank formed integral with the striking end of said tup, a partition between said tank and the piston-swept portion of said tup, a spring inserted between said piston and said partition, a suction-controlled inlet valve at the other end of said tup, a suction pipe extending from said inlet valve to said tank, an exhaust valve in said piston adapted to be closed by said rod when said piston engages said rod, and a block at the free end of said rod which is adapted to be struck by said tup.

8. A percussive tool comprising a hollow tup, a rod on which said tup is fitted to slide and which is adapted to be held in a fixed position and adapted to penetrate into said tup, a piston in said tup adapted to engage said rod, means for supplying combustible mixture to said tup, an exhaust valve in said piston, a spring buffer on said rod adapted to close said exhaust valve when said piston moves into engagement with said rod, and a block at the free end of said rod which is adapted to be struck by said tup.

In testimony whereof we affix our signatures.

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KONRAD HAAGE.