No. 801,651. PATENTED OCT. 10, 1905.

C. S. DAVIS & J. ZILLIOX.

STEAM ENGINE.

APPLICATION FILED FEB. 9, 1903.

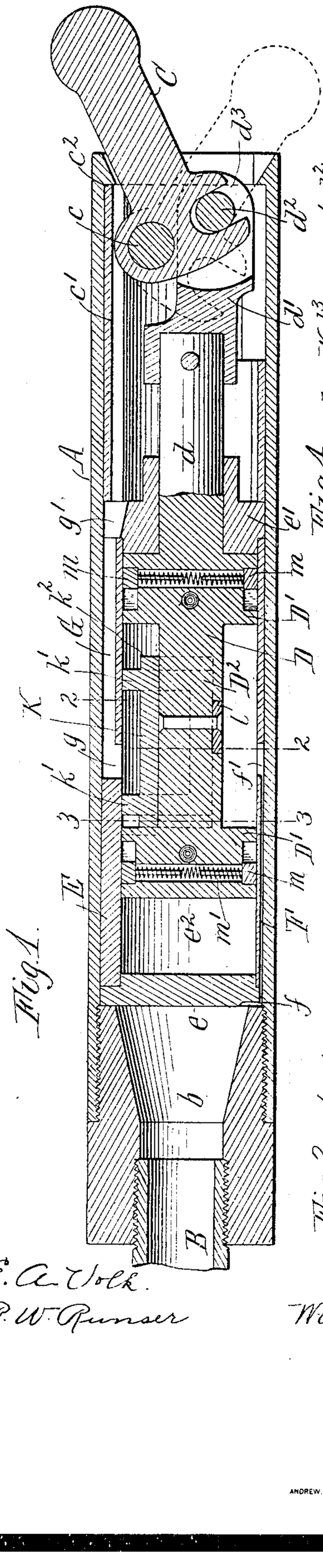

Fig. 1.

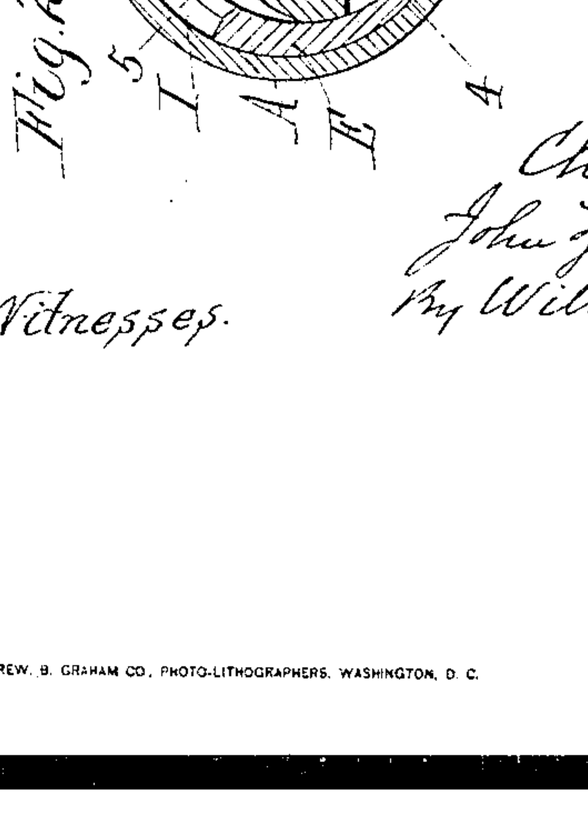

Fig. 2.

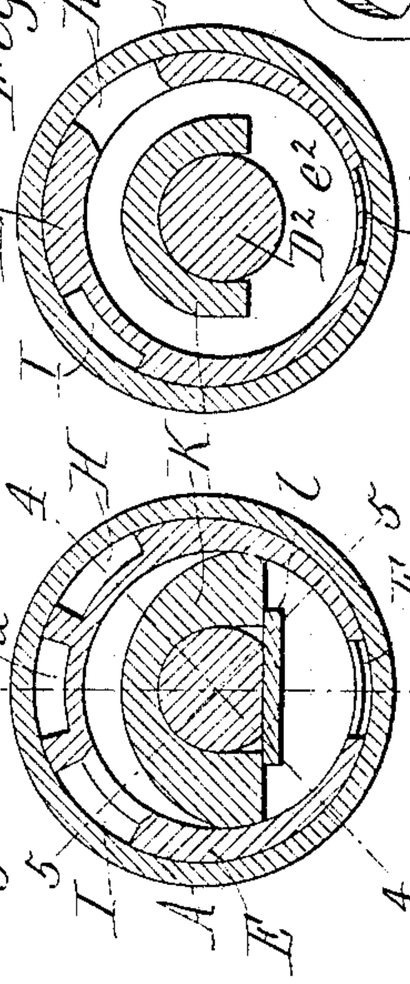

Fig. 3.

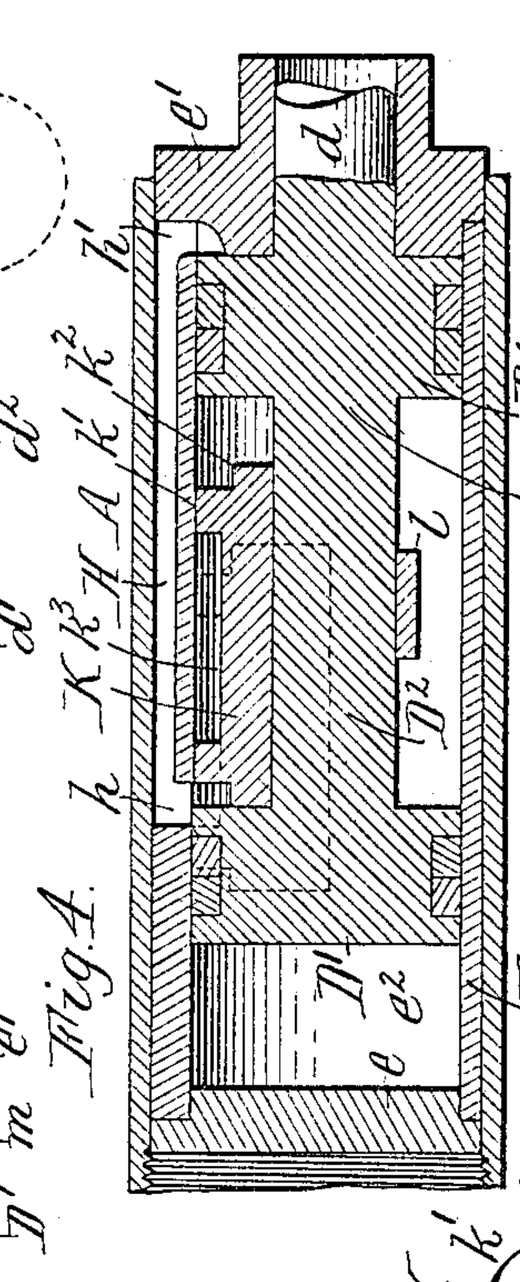

Fig. 4.

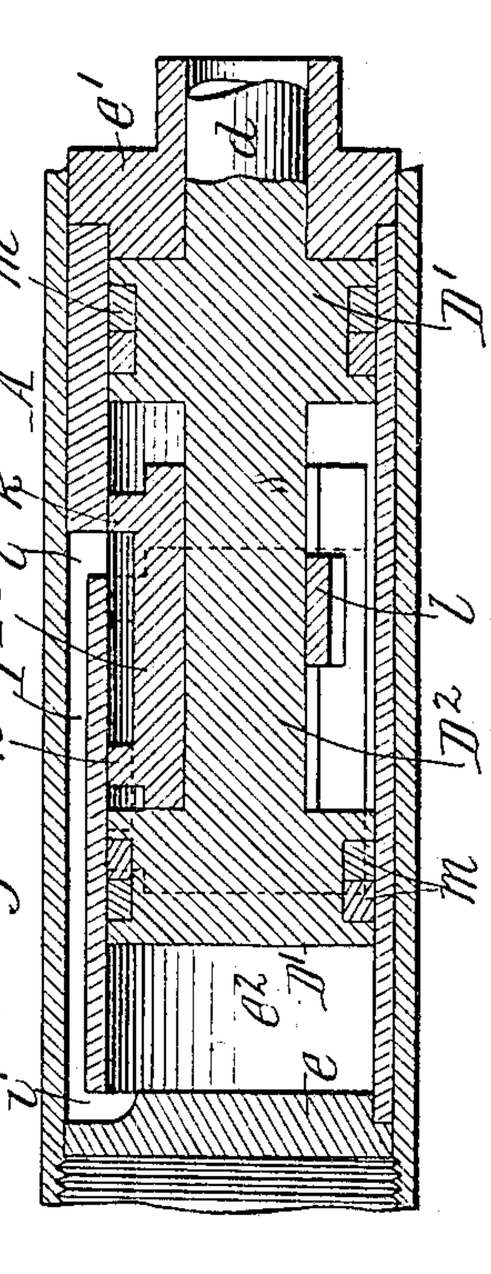

Fig. 5.

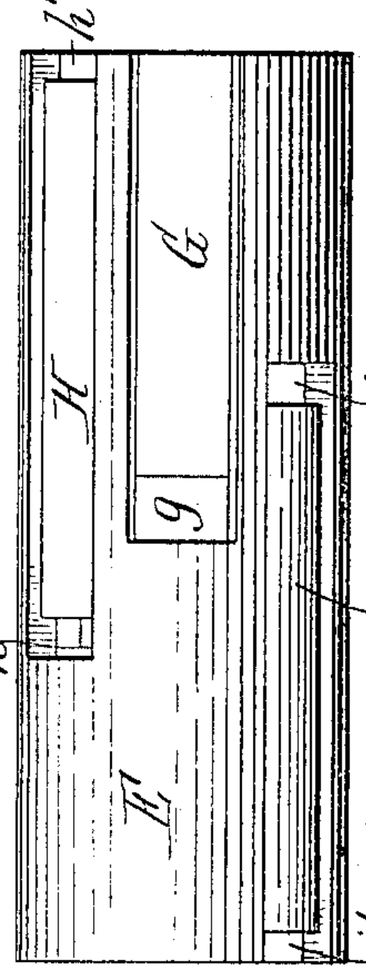

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

CHARLES S. DAVIS AND JOHN ZILLIOX, OF BUFFALO, NEW YORK, ASSIGNORS TO WILLIAM B. PIERCE COMPANY, OF BUFFALO, NEW YORK.

STEAM-ENGINE.

No. 801,651. Specification of Letters Patent. Patented Oct. 10, 1905.

Application filed February 9, 1903. Serial No. 142,511.

To all whom it may concern:

Be it known that we, CHARLES S. DAVIS and JOHN ZILLIOX, citizens of the United States, and residents of Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Steam-Engines, of which the following is a specification.

This invention relates to that class of cylinder and piston engines in which the valve which controls the admission of the actuating fluid to the cylinder and the exhaust is operated from the reciprocating piston.

One object of the invention is to produce an engine of this general character which is very simple and compact and which for that reason is particularly desirable for use in structures in which the available room is very small—as, for instance, in cleaners for boiler flues and tubes, in which cleaners the engine is combined with a vibrating hammer or rapper which is actuated by its piston.

Another object of the invention is to so construct the valve and piston that the valve is not liable to leak or to rebound when being shifted by the piston and does not interfere with the proper operation of the piston.

The accompanying drawings represent the improved engine as forming part of a flue-cleaner; but it is obvious that the engine may be used for various other purposes—for instance, for driving automobiles.

In the accompanying drawings, Figure 1 is a longitudinal section through a flue-cleaner embodying the invention in line 1 1, Fig. 2. Fig. 2 is a transverse section thereof in line 2 2, Fig. 1. Fig. 3 is a transverse section thereof in line 3 3, Fig. 1. Fig. 4 is a transverse section through the hammer-operating piston, cylinder, and valve in line 4 4, Fig. 2. Fig. 5 is a similar view in line 5 5, Fig. 2. Fig. 6 is a plan view of the cylinder removed from the inclosing casing. Fig. 7 is a perspective view of the valve detached.

Like letters of reference refer to like parts in the several figures.

A represents an inclosing casing or shell having the form of a cylindrical open-ended tube, which is connected at its rear end to the front end of a pipe B by a hollow screw-threaded coupling or union *b*. This pipe serves as the handle for manipulating the cleaner and as the supply-conduit for the steam or other actuating fluid.

C represents the oscillating hammer or rapper, arranged at the front end of the shell and mounted in any suitable manner—for instance, as shown, on a pivot-pin *c*, carried by a hollow cylindrical bearing-block *c'*, which fits snugly in the casing and is held against endwise movement therein between the forward end of the cylinder and an internal shoulder c^2 at the forward end of the casing.

D represents the piston, composed of end heads D' and a connecting reduced body D^2.

d represents the piston-rod, which connects the piston with the hammer or other part to be actuated. As shown, this rod is provided at its front end with a yoke *d'*, having a pin d^2, which engages in a slot d^3 in the hammer.

E represents the cylinder, which comprises a cylindrical body fitted in the shell A, a rear head *e*, and a front head *e'*. The latter for convenience in assembling the parts is preferably detachably fitted in the end of the cylinder-body. The rear head *e* of the cylinder abuts against the front end of the coupling *b*, and the front head *e'* abuts against the rear end of the bearing-block *c'* for the hammer, so that by screwing the coupling tightly into the casing the cylinder-body, front head, and bearing-block are held tightly in the casing between the coupling and the shoulder at the forward end of the casing. The piston chamber or bore e^2 of the cylinder is formed eccentrically therein, so that the wall of the cylinder-body at one side is thick enough for the formation of ports or passages of ample size. The cylinder fits snugly in the tubular casing, and the ports or passages are formed by longitudinal channels or grooves in the external cylindrical face of the cylinder, the casing forming the outer wall of each port or passage.

F, Figs. 1, 2, and 3, represents the supply port or passage, through which the actuating fluid passes from the supply-pipe B to the valve-chamber formed in the cylinder between the piston-heads and around the reduced piston-body. This port opens at its outer end *f* in the rear cylinder-head *e* to receive the fluid and opens at its inner end *f'* through the wall of the cylinder, midway between the ends thereof, into the valve-chamber formed around the reduced body of the piston between the piston-heads. This inlet-port is formed in the thin portion of the cylinder-wall.

G, Figs. 1, 2, and 6, represents the exhaust-port, which is formed in the thick portion of

the cylinder-wall diametrically opposite the inlet-port F. This exhaust-port opens at its inner end *g* into the valve-chamber midway between the heads of the cylinder and opens at its front end *g'* into the cavity of the bearing-block *c'*, from which the exhaust escapes forwardly.

H and I represent the front and rear ports, through which the actuating fluid passes from the valve-chamber to the ends of the cylinder and from the latter to the exhaust-port. These ports are formed in the thick portion of the cylinder-wall on opposite sides of the exhaust-port. The ports H and I open into the valve-chamber at their inner ends *h i* and into the cylinder at their outer ends *h' i'*, respectively.

K represents the slide-valve, which is arranged in the annular chamber between the piston-heads and mounted on the reduced body of the piston, so as to be capable of sliding thereon from one piston-head to the other. The valve is saddle or U shaped, having approximately the form of a half-cylinder, and straddles the body of the piston, having its open side arranged toward the supply-port F, so that the valve is seated against the opposite part of the cylinder in which the front and rear ports and the exhaust-port are arranged, against which part of the cylinder the valve is snugly held by the fluid-pressure.

The valve is held from turning on the body of the piston by suitable means, such as a transverse bearing-piece *l*, which is secured to the piston-body and extends beneath the opposite legs of the valve. The latter is provided with longitudinal side faces *k* and transverse raised semicircular ribs *k'*, arranged near the ends of the valve. These faces and ribs bear throughout their length on the inner face of the cylinder. The ends k^2 of the valve, outside of the ribs *k'*, are reduced in diameter, so that when the valve is in contact with either piston-head a space is left between the piston-head and valve which establishes communication between the supply-port and valve-chamber and the front and rear port H or I, according to the position of the valve. The body of the valve between the ribs *k'* and the longitudinal faces *k* is reduced to provide an exhaust-cavity k^3, which establishes communication between the exhaust-port G and one or the other of the front and rear ports H I, according to the position of the valve. By reason of this construction the valve is held by the fluid-pressure against that side of the cylinder which is provided with the exhaust-port and the front and rear ports, so that no packing-rings for the valve are required. The frictional contact of the valve with the cylinder also prevents the valve from rebounding when struck by the piston-heads, so that leakage of the valve is prevented and its proper action maintained at all times.

The piston-heads may be provided with packing-rings of any suitable construction—for instance, rings *m*, located in annular grooves in the piston-heads and each composed of halves, which are held yieldingly against the cylinder-wall by springs *m'*, arranged in diametrical pockets in the piston-head. The ring-sections may be provided with guide-stems which project into pockets and serve also as retainers for the springs, as shown.

Assuming the piston and valve to be in the position indicated in the drawings, the operation of the engine is as follows: Steam or other fluid under pressure from the pipe B enters the valve-chamber between the piston-heads, through the supply-port F, and passes through the space between the rear end of the valve and adjacent piston-head and the front port H to the front end of the cylinder in front of the piston, which it drives rearwardly. The front head of the piston engages the valve near the end of the stroke and moves the valve rearwardly to the position in which communication between the valve-chamber and the front port H is cut off, and the exhaust-port G is placed in communication with the port H. This movement of the valve also places the rear port I in communication with the valve-chamber, so that the steam from the supply-port passes through the port I to the cylinder in rear of the rear piston-head and drives the piston forward. Near the end of this stroke the valve is returned by the piston to the position indicated in the drawings. The piston is thus rapidly reciprocated, and this movement is transmitted to the hammer or other part with which the piston is connected.

We do not wish to claim in this application any subject-matter relating to the cleaner mechanism herein shown and described, because such subject-matter is claimed in our pending application, filed August 9, 1902, Serial No. 118,985.

We claim as our invention—

1. The combination of a cylinder having an exhaust-port and fluid-ports at the same side, a reciprocating piston comprising heads and a reduced connecting-body, and a slide-valve which is mounted on said reduced body between said heads to move longitudinally of the piston and is free to move transversely of the cylinder to compensate for wear and is seated by the fluid-pressure against the port face of the cylinder, said valve being shifted by the piston, substantially as set forth.

2. The combination of a cylinder having an exhaust-port and fluid-ports at the same side, a reciprocating piston having heads and a reduced connecting-body, and a saddle-shaped slide-valve which straddles said reduced body and is seated by the fluid-pressure against the port face of the cylinder, substantially as set forth.

3. The combination of a cylinder having an

exhaust-port and adjacent fluid-ports at the same side, a reciprocating solid piston having heads and a reduced connecting-body, an approximately semicylindrical slide-valve which straddles said body and is seated by the fluid-pressure against the port face of the cylinder and provided in its convex face with an exhaust-cavity, substantially as set forth.

4. The combination of a cylinder having an exhaust-port and adjacent fluid-ports at the same side, a reciprocating solid piston having heads and a reduced connecting-body, an approximately semicylindrical solid slide-valve which straddles said body and is provided with longitudinal side faces and transverse semicylindrical ribs, seated against the port face of the cylinder and forming an exhaust-cavity in the valve, substantially as set forth.

5. The combination of a cylinder having an exhaust-port and adjacent fluid-ports at one side, a reciprocating piston having heads and a reduced connecting-body, an approximately semicylindrical slide-valve which straddles said body and is provided with longitudinal side faces and transverse semicylindrical ribs, seated against the port face of the cylinder and forming an exhaust-cavity in the valve, said ribs being arranged at a distance from the ends of the valve, leaving a steam-space between the end of the valve and the piston-head against which the valve bears, substantially as set forth.

6. The combination of a cylinder having an eccentrically-arranged bore whereby its wall is thicker at one side than at the opposite side, a shell surrounding said cylinder, exhaust and fluid passages both formed in the external surface of the thick portion of the wall of the cylinder, a reciprocating piston having heads and a connecting-body, and a slide-valve mounted on said body, substantially as set forth.

Witness our hands this 17th day of January, 1903.

CHAS. S. DAVIS.
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Witnesses:
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