No. 703,013. Patented June 24, 1902.

L. S. STILES.

ENGINE FOR MOLDING MACHINES.

(Application filed May 14, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

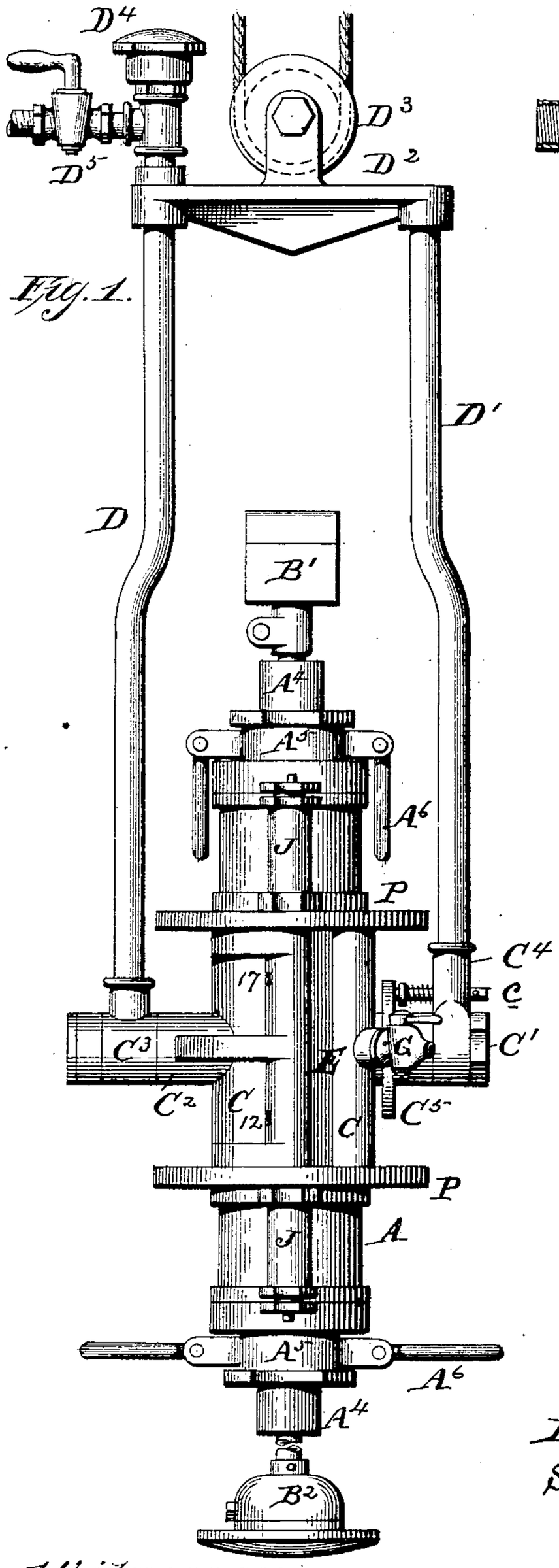


Fig. 2.

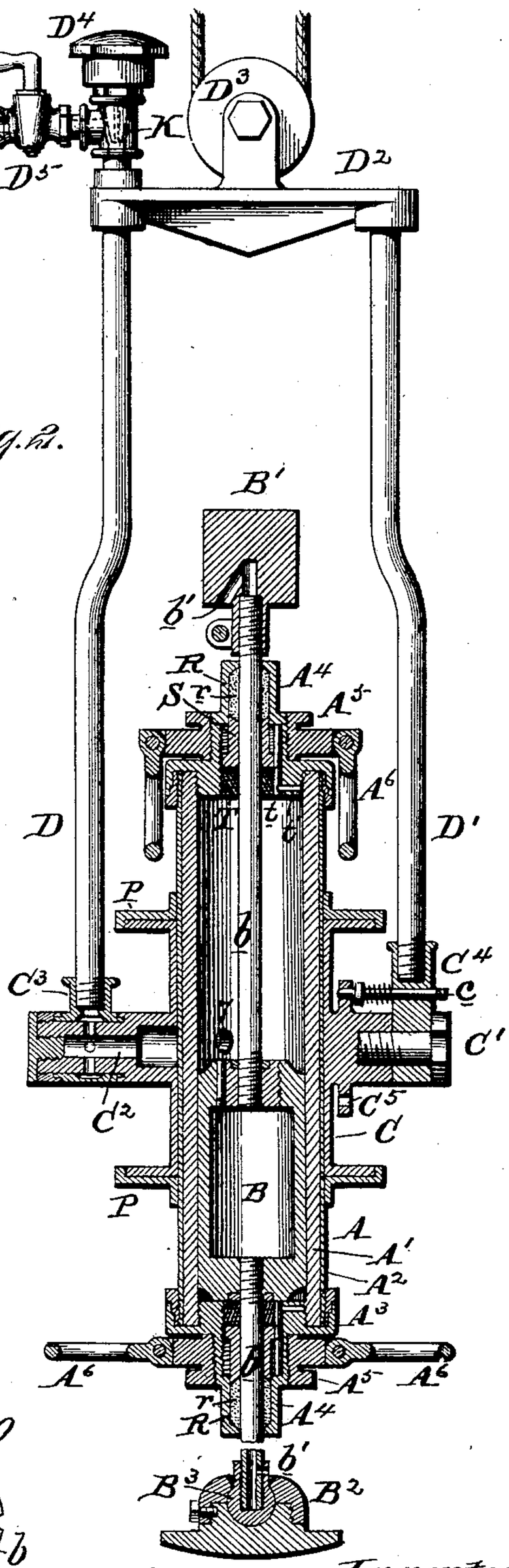
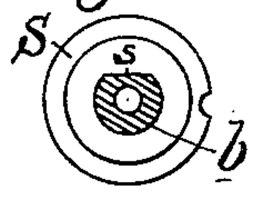


Fig. 10



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(No Model.) 3 Sheets—Sheet 2.

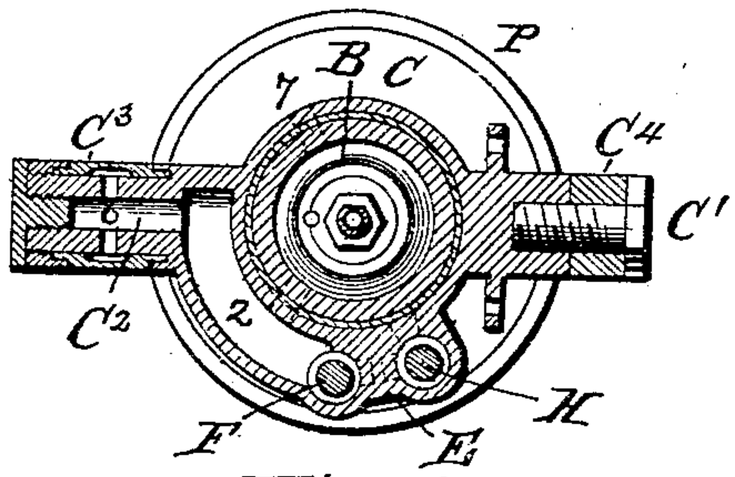

Fig. 3

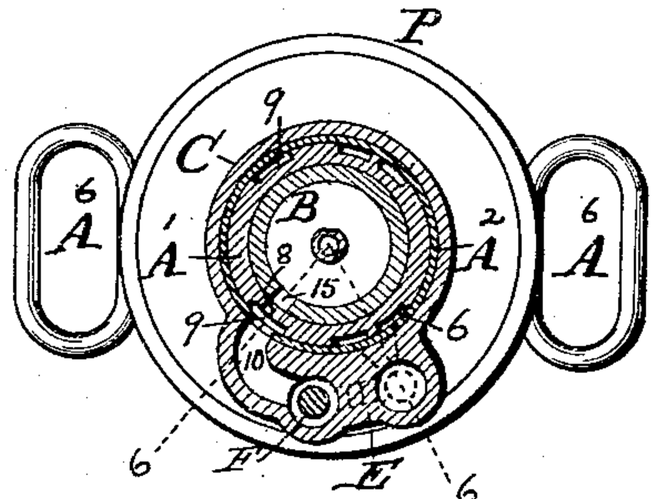

Fig. 4

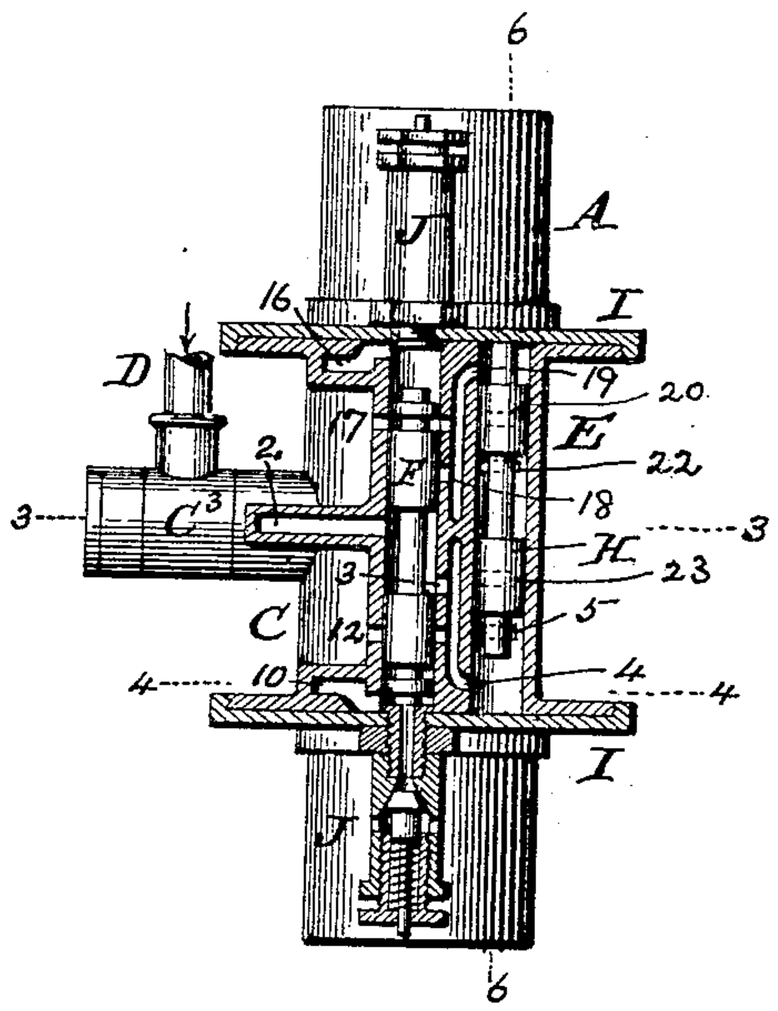

Fig. 5

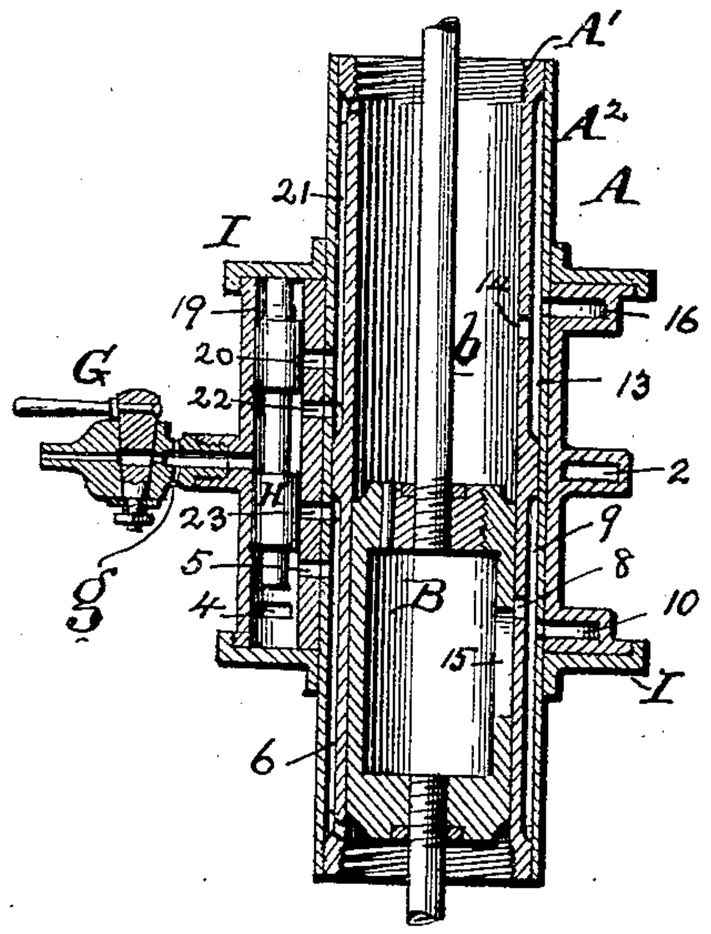

Fig 6

Fig. 7

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ENGINE FOR MOLDING MACHINES.

(Application filed May 14, 1901.)

(No Model.) 3 Sheets—Sheet 3.

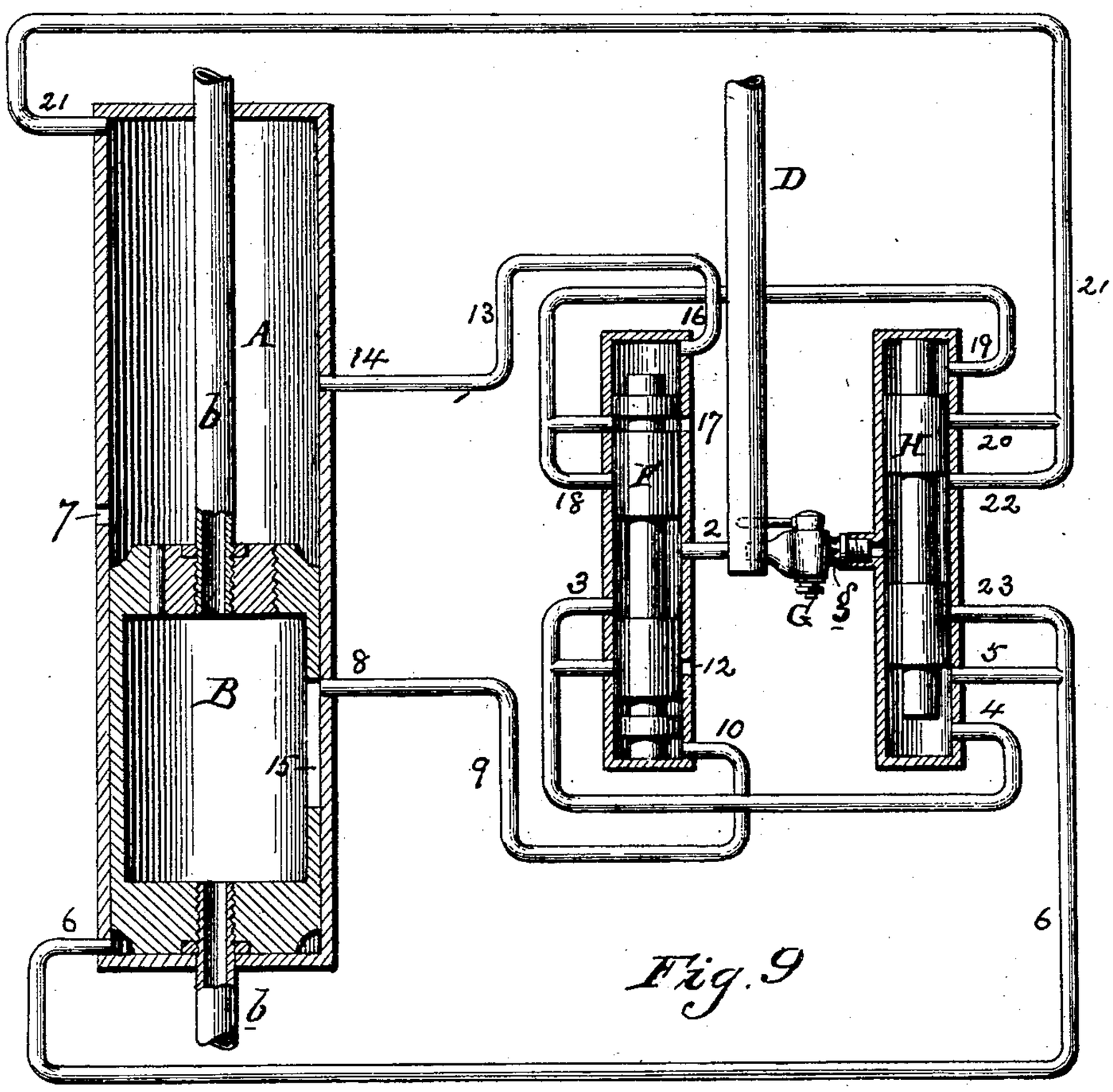

Fig. 9

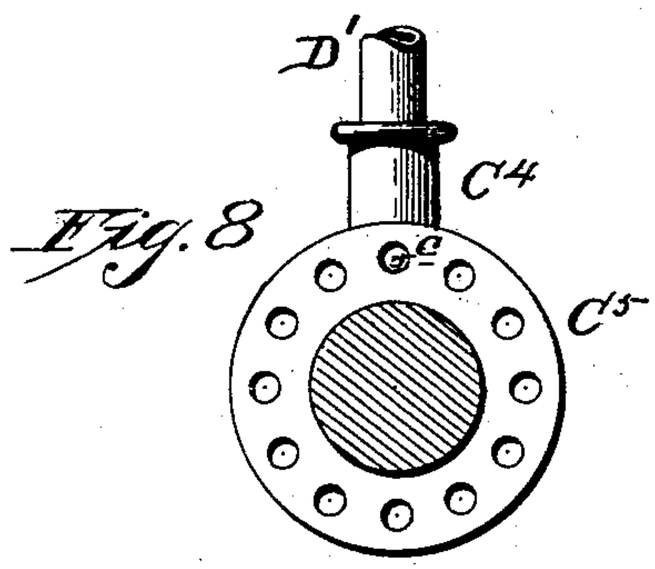

Fig. 8

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UNITED STATES PATENT OFFICE.

LINFORD S. STILES, OF PHILADELPHIA, PENNSYLVANIA.

ENGINE FOR MOLDING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 703,013, dated June 24, 1902.

Application filed May 14, 1901. Serial No. 60,146. (No model.)

To all whom it may concern:

Be it known that I, LINFORD S. STILES, of the city and county of Philadelphia, State of Pennsylvania, have invented an Improvement in Reciprocating Engines for Molding-Machines, of which the following is a specification.

My invention has reference to reciprocating engines for molding-machines, &c.; and it consists of certain improvements, all of which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

The object of my invention is to provide a suitable construction of reciprocating engine combined with molding devices adapted for large work, the machine being adapted to operate by compressed air, gas, or steam, as desired.

The machine is adapted for use as set out in Letters Patent No. 659,712, granted to me on October 16, 1900, combining all of the advantages of said machine as an organized apparatus, together with numerous improvements in construction comprehending the simplifying of the parts, greater reliability of action, smoother operation, less jarring, lighter in weight, better regulation, and great facility in handling.

My invention will be better understood by reference to the drawings, in which—

Figure 1 is an elevation of a molding-machine embodying my improvements. Fig. 2 is a sectional elevation of same. Fig. 3 is a cross-section of same on line 3 3. Fig. 4 is a cross-section of same on line 4 4. Fig. 5 is an elevation of the middle portion of the cylinder with the valve-chambers in section. Fig. 6 is a sectional elevation of Fig. 5 on line 6 6 of Fig. 4. Fig. 7 is an elevation of the molding-iron upon one end of the piston-rod. Fig. 8 is a cross-section on line 8 8 of Fig. 1. Fig. 9 is a sectional diagrammatic elevation showing the various parts and the port connections arranged in one plane for more clearly disclosing the principles of construction of the machine, and Fig. 10 is a cross-section of piston-rod and plan view of stuffing-box gland.

A is the engine-cylinder, and consists of an inner casting A′, incased in a steel sheet A^2, the latter being forced on by hydraulic pressure, so as to make a tight fit all over except where the ports are cut in the casting A′. These ports are shown in Figs. 4 and 6 and marked 6, 9, 13, and 21. To prevent the outer steel sheet A^2 from bending inward, the port-grooves 6 and 21 may be made with a central rib extending almost their full length. By making the cylinder in this manner great strength, lightness, and cheapness of construction are secured. The heads A^3 of the cylinder are screwed upon the ends and are provided with packing-boxes A^4, through which the piston-rods *b* pass. The packing-boxes A^4 consist of an internally-recessed head R, through which the piston-rod *b* passes. Suitable packing *r* is placed in the recessed head by a screw-plug T. This plug is prevented from turning, and thereby working out, by a pin *t*, which is itself held against backing out by the pin *t*′, held under it by the cylinder A′. In this way the parts are firmly held against working loose in the operation of the engine. The gland S is held against turning by the pin *t*, and as its hole is flattened, as at *s*, and fits the flattened side of the piston-rod *b*, Fig. 10, it is evident that the piston and the ram are prevented from turning in the cylinder. This keeps the ram in proper position to its work and also insures the ports in the piston moving in proper relation to the ports in the cylinder, as more fully described later on. These piston-rods extend through each end of the cylinder and are connected on their adjacent ends with the ends of the hollow piston B. The piston-rods *b* are hollow and carry upon their ends the peen-ram B′ and butt-ram B^2, either of which may be brought into action by turning the cylinder upon its pinions C′ C^2 to bring the end desired into operating position relatively to the work. As shown, the peen-head B′ is formed with a vent-aperture *b*′, communicating with the aperture of the piston-rod *b*, to permit the escape of the air from the piston into the atmosphere, for purposes to be explained hereinafter. The butt-ram B^2 is connected upon the end of the other piston-rod by a ball-and-socket joint B^3, whereby it is self-adjusting to the work and the effect of the blow is always transmitted directly upon the piston-rod. A vent *b*′ may also be formed from the interior of the hollow piston-rod, as in the case above

described; but it is evident that, if desired, one of these piston-rods may be solid.

Surrounding the middle portion of the cylinder A^2 is a cast-metal jacket carrying the valve-chambers E and the trunnions C' C^2, by which the cylinder is journaled upon the suspending-frame. This frame consists of a top frame D^2, carrying a sheave D^3 about which the sespending-table passes by which the engine is hung from a crane or other suitable support, and two depending tubular rods D, D′, the former also acting as the supply-pipe for the air to operate the engine. The lower end of the rod D′ is provided with a box C^4, in which the journal C' is journaled. The lower end of the tubular rod D is provided with a box C^3, in which is journaled the hollow journal C^2 of the engine, the compressed air passing through the parts D, C^3, and C^2 into the port 2, communicating with the main valve F of the engine. P represents caps which are screwed upon the flanges of the jacket C and encircle the cylinder-casing A^2. They close the ends of the valve-relief valves J when employed. The upper end of the tubular rod D connects with the controlling-valve D^5 and receives the compressed air through a strainer *d* of suitable construction. D^4 is an oil-cup adapted to supply oil to the upper end of the tubular rod D, to be thence carried into the engine.

A^5 represents castings screwed upon the cylinder-heads A^4 and provided with the loose handles A^6, so pivoted that they may be either turned outward or made to assume a horizontal position, so as to be easily grasped for guiding the engine to secure the proper directive movement to the ramming or molding head. They may be hinged in any suitable manner.

To adjust the engine in any position upon the supporting-frame, I provide a spring locking-pin in the box C^4 and a circular row of holes in flange C^5 on the trunnion-casting of the engine.

Having now explained the general construction of the engine and its mode of support, I will proceed to set out the valve mechanism for producing the automatic reciprocation of the piston.

There are two valves—namely, a main valve F and an auxiliary valve H, the former directly controlling the supply of compressed air from the source of supply and the latter controlling the supply and exhaust to and from the ends of the cylinder. The functions of these valves will be better understood by following the course of the air through the engine, and this will be more easily done by following Fig. 9, which is lettered similarly with the other figures. The compressed air passes by port 2 into the main-valve chamber at the middle and thence passes by port 3 and port 4 into the bottom of the auxiliary-valve chamber, raising the valve H to the position shown. This opens port 5, and the compressed air passes through port 5 into port 6 on the cylinder and into the bottom of the cylinder A below the piston. The compressed air which was above the auxiliary valve H escaped by port 19 and through ports 17 of the main-valve chamber to the atmosphere, the main valve being so shaped as to offer no obstruction when in position shown. The main piston B is now raised, and when sufficiently elevated it uncovers port 8 in the interior of the cylinder, permitting a small quantity of compressed air to pass through said port 8, port 9, and port 10 into the bottom of the main-valve chamber; but at this time the piston B has closed the port 14 in the upper half of the cylinder, thereby preventing the air above the main valve from escaping by ports 16, 13, and 14. The main valve does not shift, therefore, at this time, and the piston B continues its movement until the slot 15 through the piston-wall opens into the port 14, at which time the air above the main valve is discharged into the piston and the said main valve under the action of the air below it quickly rises. The air discharged into the piston escapes through the hollow piston-rod *b* to the atmosphere; but as the piston rises it closes the port 7 to the atmosphere and forces the air in the cylinder out by ports 21 and 22 through the auxiliary-valve chamber and through the cushioning-valve G, which is provided with a series of normally open small exhaust-apertures *g* and an adjustable valve-plug to modify the area of the discharge-apertures, so as to vary the degree of cushioning action of the piston upon the air in the cylinder. During the upward rise of the piston B it is moved past the exhaust-aperture 7 through the cylinder, and at that moment the compressed air is largely discharged to the atmosphere, thereby removing the initial force of the operative charge of compressed air just at the time that the proper cushioning effect is taking place at the top of the cylinder. The parts being in the positions last described, we will have the piston B raised and the main valve F raised. The compressed air will then pass through port 18 and 19 and force the auxiliary valve H down, the air below it discharging through ports 4 and 12 to the atmosphere through the main valve. The compressed air then passes from port 19 to port 20, thence through port 21 into the top of the cylinder A, forcing the piston down. As it descends it uncovers port 14 and air passes to top of main valve, but cannot move the valve until the port 15 of the piston opens port 8. At the same time the air in the lower part of the cylinder is exhausted by ports 6 and 23 through the auxiliary valve and cushioning-valve G, as before. Upon the piston B fully descending port 7 is uncovered and discharge takes place into the atmosphere and the operations are repeated.

In the above-described way the engine has its piston rapidly reciprocated and properly cushioned, and the valves are so timed in their movement that they shift only at the proper moment irrespective of whether the

engine is operated fast or slow. The cushioning action is easily adjusted, and hence very smooth operation may be obtained.

In cases where the supply of compressed air or other motive fluid is very irregular as to pressure it is advisable to provide the main valve with relief-valves J, so that in case of an excessive pressure the excess is exhausted through said valves to insure that the main valve shall not operate to shift its position until the pressure at the other end is positively relieved by the piston B, as above described. These relief-valves J are similar to safety-valves, being spring-actuated conical valves, closing an exhaust-aperture to the atmosphere except when the internal pressure becomes abnormally great from any cause. There is one of these valves at each end of the main-valve chamber, as shown in Fig. 5. Ordinarily these valves J would not be necessary and may be dispensed with. If desired, a regulator-valve K may be used between the source of supply and the engine and may be conveniently located at the top of the tubular rod D, as indicated in dotted lines. This valve is simply a conical valve adapted to a conical seat and adapted to be screwed down to the proper adjustment to insure a regulated supply of compressed air or motive fluid to operate the engine uniformly at the required speed. By the use of such a valve it requires no special care in handling valve D^5 in stopping and starting the engine.

The valve G is the direct means of regulating the exhaust from both sides of the piston B. By opening the valve fully the exhaust is most free, and the engine gives a full and powerful stroke. When the valve is fully closed, then the exhaust is throttled to the greatest extent, exhausting through the small holes *g* of the valve-body, and the result of this is to cause the engine to make short and light strokes, because the piston is cushioned against the air trapped in the cylinder. By simply adjusting the valve G between its open and closed positions a variety of blows as to stroke and effect may be secured at will and as the work may require. This renders quicker service and obviates any necessity of altering or adjusting the position of the engine relative to the work to be done.

I would further point out that in my improved machine it may be reversed end for end to present either the peen or butt ram to the work, and in doing so the valves automatically set themselves so as to correspond to the proper position of the piston B when the compressed air is turned on. When not operating, both the piston B and the valves F and H will descend to the bottom, and hence the valve F will be in proper position to supply air to bottom of cylinder A and below piston B to raise the same. When it is down, the ram will be down also, and the proper position of the engine to the work may be readily determined and the performance of the work commenced without loss of time.

The aperture or port 7 while useful is not essential, as the exhaust may all pass out of the ports in the ends of the cylinder and ultimately through the valve G. However, the port 7 performs the function of relieving the engine of some of the expanded air at the completion of each stroke. It further gives provision for properly oiling the engine in starting and also for so relieving the piston of too great a pressure at completion of its stroke as to prevent it striking the cylinder-head, especially should any disarrangement of the controlling-valves of the engine occur from any cause.

While I have described my invention as being especially adapted for a molding-engine, it is to be understood that the reciprocating engine may be employed to operate any suitable tool on the end of its piston-rod irrespective of any particular use. Pneumatic tools are extensively employed in the arts for drilling and dressing stone, and it is evident that my improved engine may be used for those purposes. It is also to be understood that while I make special reference to the use of compressed air as the motive force any other source of power may be employed, such as steam or compressed gas or vapor.

I do not limit myself to the details of construction herein set out, as they may be modified in various ways without departing from the spirit of my invention.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a reciprocating power mechanism adapted for molding or other work, the combination of a suspended supporting-frame, an engine pivoted in said frame and carried upon horizontal journals so as to be completely reversible, and a locking mechanism for supporting the engine in its reversed and different positions consisting of a circular frame having holes arranged above and below the horizontal journals and a locking-pin adapted to said holes one of said parts being secured to the engine and the other to the suspended supporting-frame.

2. In a reciprocating power mechanism adapted to molding or other work, the combination of a supporting-frame, a reversible engine pivoted in said frame upon horizontal journals, intermediate of its ends, and handles for guiding the engine hinged to each end of the engine-cylinder so as to fold close up to the cylinder or held projecting therefrom under the action of gravity whereby when the cylinder is adjusted to an upright position the upper handles extend laterally therefrom into position to be grasped.

3. In a machine for molding or operating a reciprocating tool, the combination of a suspended supporting-frame, a reversible cylinder journaled at its middle to said frame so

as to be reversible and having stuffing-boxes at each end, a piston in said cylinder, piston-rods from said piston extending respectively through the stuffing-boxes to the outside of each end of the cylinder, locking means for locking the cylinder in its reversed positions upon the suspended supporting-frame, differently-shaped rams attached to each end of the projecting piston-rods, and suitable valve mechanism for causing the motive fluid to be alternately supplied to each end of the cylinder to reciprocate the piston.

4. In a reciprocating power mechanism adapted to molding or other work, the combination of a supporting-frame, a reversible cylinder journaled at its middle to said frame and having stuffing-boxes at each end, a piston in said cylinder, piston-rods from said piston extending respectively through the stuffing-boxes to the outside of each end of the cylinder, differently-shaped rams attached to each end of the projecting piston-rods, and suitable valve mechanism for causing the motive fluid to be alternately supplied to each end of the cylinder to reciprocate the piston consisting of normally gravity-actuated valve-pistons and ports communicating between a source of supply of motive fluid and the valve mechanism and cylinder whereby the valve-pistons normally assume positions adapted to direct the motive fluid to the bottom of the cylinder and under the ram-piston upon starting the machine.

5. In a reciprocating power mechanism adapted to molding or other work, the combination of a supporting-frame, an engine hinged at its middle in said frame and having a projecting piston-rod, and a locking device between the support and engine for locking the engine in various adjusted positions upon the support.

6. In a reciprocating power mechanism adapted to molding or other work, the combination of a supporting-frame, an engine hinged at its middle in said frame so as to be completely reversible and having a projecting piston-rod, and a locking device between the support and engine for locking the engine in its reversed and various adjusted positions upon the support, and an adjustable passage-way for motive fluid from the support to the engine in all of its adjusted positions.

7. In a reciprocating power mechanism adapted to molding or other work, the combination of the engine proper having a reciprocating piston and piston-rod, automatic valve devices for controlling the supply and exhaust of the motive fluid to and from said engine, and a controlling-valve in the exhaust-port of the valve devices for adjustably throttling the exhaust for changing the length, speed and power of the stroke of the reciprocating piston said valve consisting of a valve-body having small exhaust vents or apertures and a throttling-valve for the body for opening an additional exhaust-vent through the body of adjustable size.

8. In a machine for molding, the combination of a universally-adjustable suspended engine having a reciprocating piston-rod, a butt-ram having a circular body and convex under or operating face, and a ball-and-socket connection between the ram and piston-rod whereby the ram is made to automatically adjust itself to the work when the position of the piston-rod is not at right angles to the surface of the mold.

9. In a machine for molding, the combination of a universally-adjustable suspended engine having a reciprocating piston-rod, a butt-ram, and a ball-and-socket connection between the ram and piston-rod whereby the ram is made to automatically adjust itself to the work when the position of the piston-rod is not at right angles to the surface of the mold.

10. The engine-cylinder formed of the inner tubular cylinder having grooves or channels cut longitudinally in its outer surface, combined with an outer case or sleeve tightly driven over the inner tubular cylinder whereby the grooves or channels form ports or passage-ways for the motive fluid and a strong light construction of cylinder is secured.

11. In a reciprocating power mechanism adapted to molding or other work, the cylinder having a reciprocating piston, combined with a removable internally-recessed head, a piston-rod extending through the recessed head, packing about the piston-rod in the recess, a gland encircling the piston-rod and fitting into the recess of the head from the inside of the cylinder, and an annular screw-plug screwed into the head to hold the gland in place.

12. In a reciprocating power mechanism adapted to molding or other work, the cylinder having a reciprocating piston, combined with a removable internally-recessed head, a piston-rod extending through the recessed head, packing about the piston-rod in the recess, a gland encircling the piston-rod and fitting into the recess of the head from the inside of the cylinder, an annular screw-plug screwed into the head to hold the gland in place, and locking devices for preventing the gland and screw-plug from turning.

13. In a reciprocating power mechanism adapted to molding or other work, the cylinder having a reciprocating piston, combined with a removable internally-recessed head, a piston-rod extending through the recessed head and having a flattened side, packing about the piston-rod in the recess, a gland encircling the piston-rod and fitting into the recess of the head from the inside of the cylinder and also having a flattened portion fitting to the piston-rod to prevent it from turning, an annular screw-plug screwed into the head to hold the gland in place, and a locking device for holding the gland against turning.

14. In a reciprocating power mechanism adapted to molding or other work, the combination of a cylinder having ports leading from

the middle part to the ends, a piston for the cylinder, a valve casing or jacket forced upon the cylinder intermediate of its ends and having ports corresponding with the ports in the cylinder, and valves in valve-chambers of the jacket to control the supply of motive fluid to and from the cylinder.

15. In a reciprocating power mechanism adapted to molding or other work, the combination of a cylinder having ports leading from the middle part to the ends, a piston for the cylinder, a valve casing or jacket forced upon the cylinder intermediate of its ends and having ports corresponding with the ports in the cylinder, and flat flanged ends through which the valve-chambers open, annular caps or heads secured upon the flat flanged ends to make tight joints and inclose the valve-chambers, and valves in the valve-chambers of the jacket to control the supply of motive fluid to and from the cylinder.

16. In a reciprocating power mechanism adapted to molding or other work, the combination of the cylinder, a reciprocating piston therefor, a main valve for controlling the supply of the motive fluid to the ends of the cylinder alternately, and an auxiliary valve operated by the motive fluid delivered by the main valve to control the exhaust of the motive fluid from the end of the cylinder opposite to that being supplied by the main valve.

17. In a reciprocating power mechanism adapted to molding or other work, the combination of the cylinder, a reciprocating piston therefor, a main valve for controlling the supply of the motive fluid to the ends of the cylinder alternately, ports connecting the cylinder respectively with the ends of the main-valve chamber to supply motive fluid to operate the valve when alternately exposed by the piston but otherwise adapted to be sealed by the piston or alternately opened to the atmosphere by the piston, and an auxiliary valve operated by the motive fluid delivered by the main valve to control the exhaust of the motive fluid from the end of the cylinder opposite to that being supplied by the main valve.

18. In a reciprocating engine for molding-machines, &c., the combination of the cylinder, a reciprocating piston therefor, a main valve for controlling the supply of the motive fluid to the ends of the cylinder alternately, ports controlled by the reciprocating piston for controlling the supply and exhaust of motive fluid to the main valve to move it, and an auxiliary valve operated by the motive fluid delivered by the main valve to control the exhaust of the motive fluid from the end of the cylinder opposite to that being supplied by the main valve.

19. In a reciprocating power mechanism adapted to molding or other work, the combination of the cylinder, a reciprocating piston therefor, a main valve for controlling the supply of the motive fluid to the ends of the cylinder alternately, ports controlled by the reciprocating piston for controlling the supply and exhaust of motive fluid to the main valve to move it, an auxiliary valve operated by the motive fluid delivered by the main valve to control the exhaust of the motive fluid from the end of the cylinder opposite to that being supplied by the main valve, and an adjustable throttling-valve to control the freedom of the exhaust from the auxiliary valve to control the speed, stroke and character of the reciprocation of the piston.

20. In a reciprocating power mechanism adapted to molding or other work, the combination of the cylinder, a reciprocating piston therefor, a main valve for controlling the supply of the motive fluid to the ends of the cylinder alternately, an auxiliary valve operated by the motive fluid delivered by the main valve to control the exhaust of the motive fluid from the end of the cylinder opposite to that being supplied by the main valve, and exhausting-ports controlled by the main valve for exhausting the motive fluid from the end of the auxiliary valve to secure its quick reciprocation in timed relation to the movements of the main valve.

21. In a reciprocating power mechanism adapted to molding or other work, the combination of the cylinder, a reciprocating piston therefor, a main valve for controlling the supply of the motive fluid to the ends of the cylinder alternately, ports connecting the cylinder respectively with the end of the main-valve chamber to supply motive fluid to operate the valve when alternately exposed by the piston but otherwise adapted to be sealed by the piston or alternately opened to the atmosphere by the piston, and an auxiliary valve operated by the motive fluid delivered by the main valve to control the exhaust of the motive fluid from the end of the cylinder opposite to that being supplied by the main valve, and exhausting-ports controlled by the main valve for exhausting the motive fluid from the end of the auxiliary valve to secure its quick reciprocation in timed relation to the movements of the main valve.

22. In a reciprocating power mechanism adapted to molding or other work, the combination of the cylinder, a main valve to control the supply of motive fluid to each end of the cylinder, ports for supplying motive fluid from the cylinder to the valve-chamber to operate the valve, and a hollow piston having a port and acting to control the escape of motive fluid from the ends of the valve-chamber alternately by permitting said ends of the valve-chamber to exhaust into the piston.

23. In a reciprocating engine the combination of the cylinder, a main valve to control the supply of motive fluid to each end of the cylinder, ports for supplying motive fluid from the cylinder to the valve-chamber to operate the valve, and a piston-rod and piston having a port and acting to control the escape of motive fluid from the ends of the valve-chamber alternately by permitting said ends

of the valve-chamber to exhaust into the piston and through the piston-rod into the atmosphere.

24. In a reciprocating engine the combination of the cylinder, a main valve to control the supply of motive fluid to each end of the cylinder, ports for supplying motive fluid from the cylinder to the valve-chamber to operate the valve, and a piston-rod and piston having a port and acting to control the escape of motive fluid from the ends of the valve-chamber alternately by permitting said ends of the valve-chamber to exhaust into the piston and through the piston-rod into the atmosphere, and an auxiliary valve actuated by the motive fluid being supplied to the cylinder and controlled by the main valve to alternately exhaust from the two ends of the cylinder.

In testimony of which invention I have hereunto set my hand.

LINFORD S. STILES.

Witnesses:
R. M. HUNTER,
R. M. KELLY.