

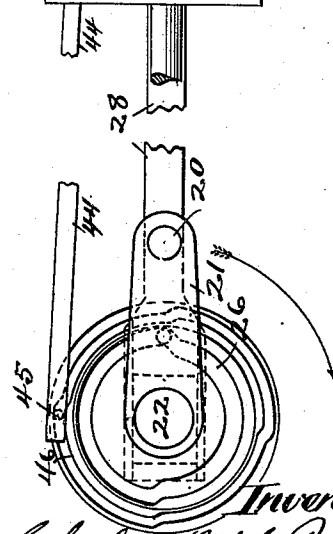
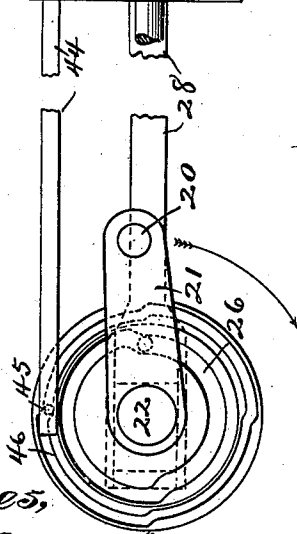
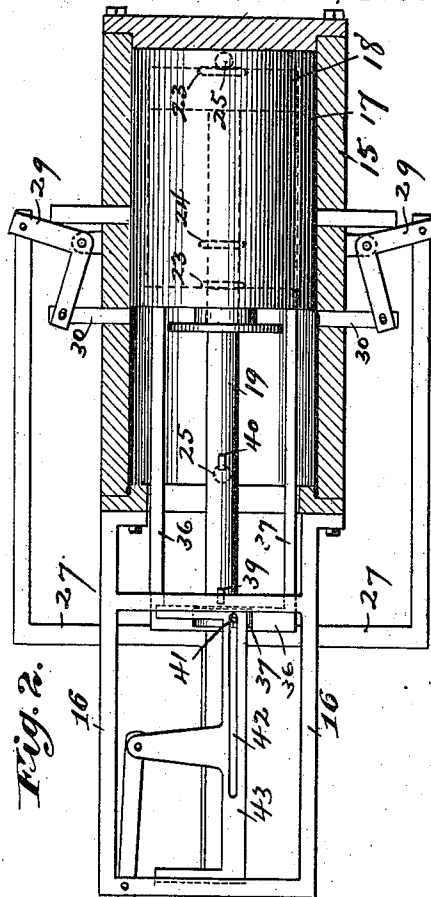
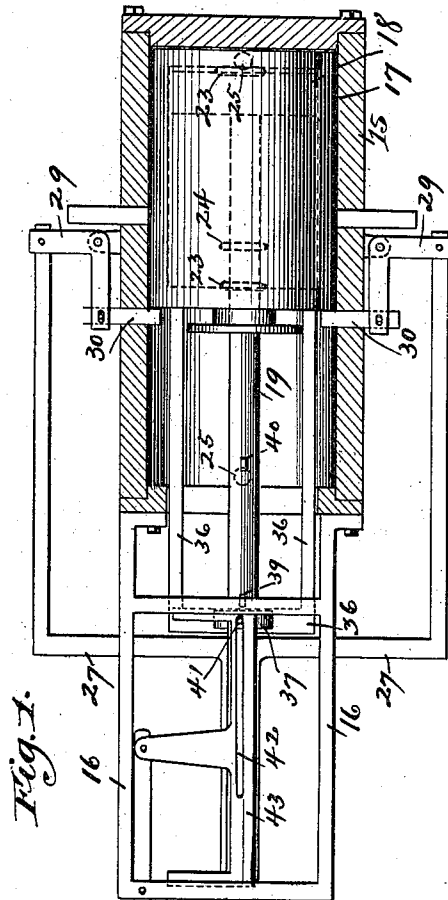
(No Model.)

4 Sheets—Sheet 1.

C. M. C. PRENTICE.
ENGINE.

No. 577,518.

Patented Feb. 23, 1897.



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(No Model.)

C. M. C. PRENTICE.
ENGINE.

4 Sheets—Sheet 2.

No. 577,518.

Patented Feb. 23, 1897.

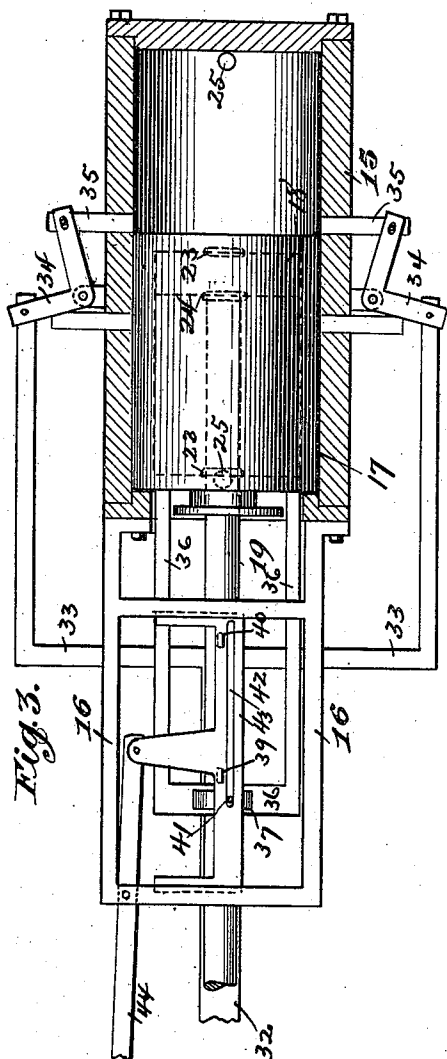


Fig. 3.

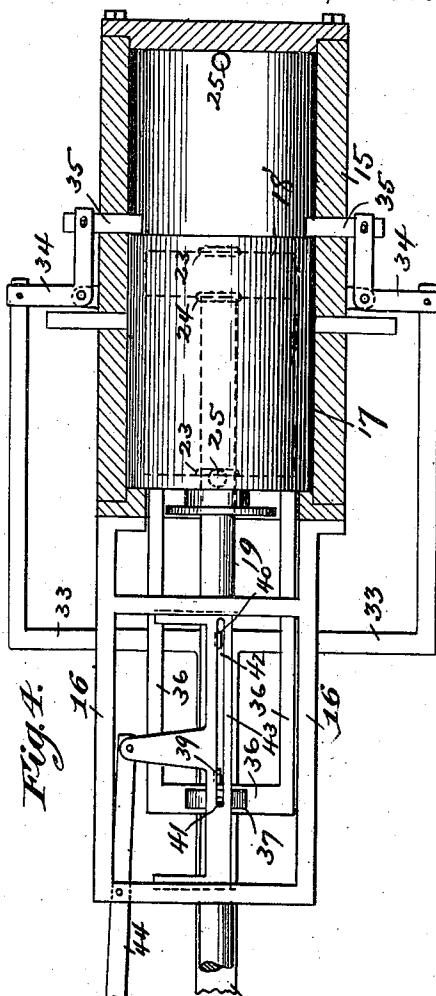
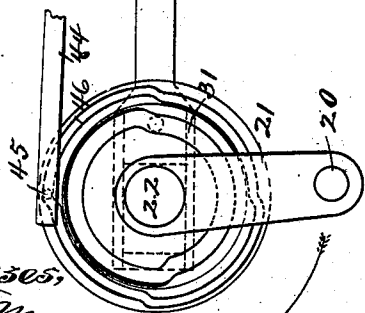
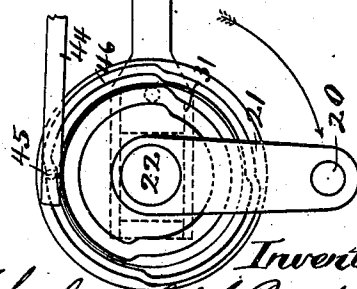


Fig. 4.



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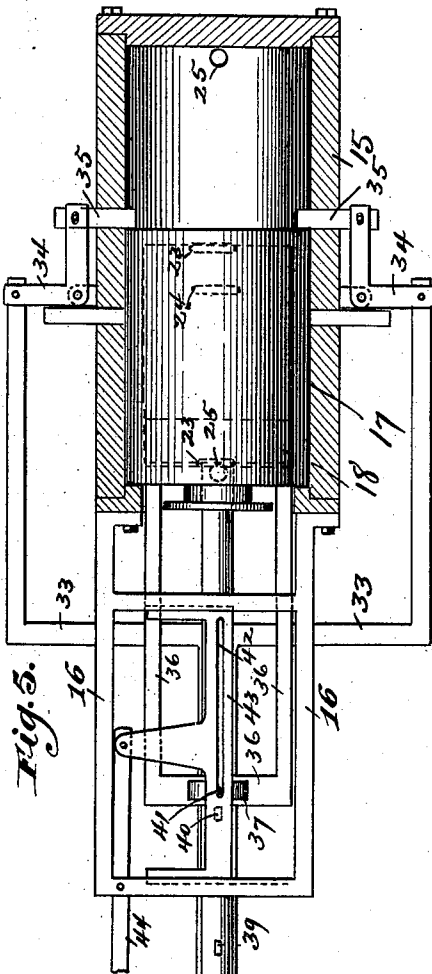


Fig. 5.

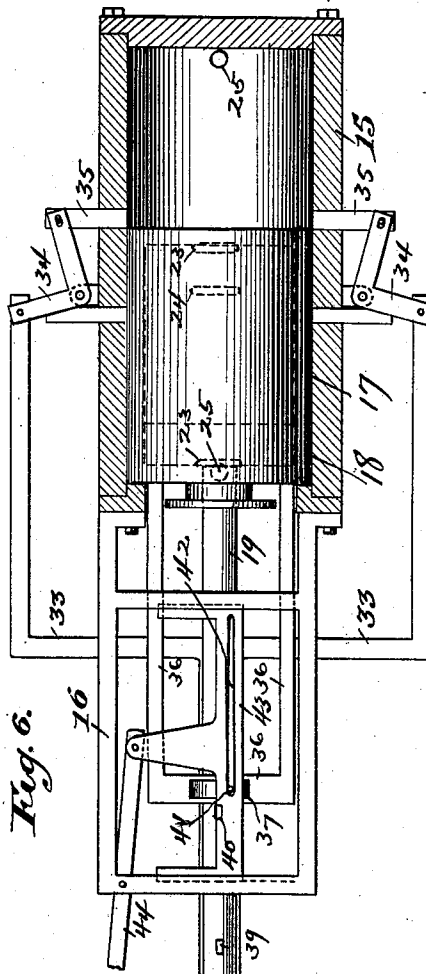
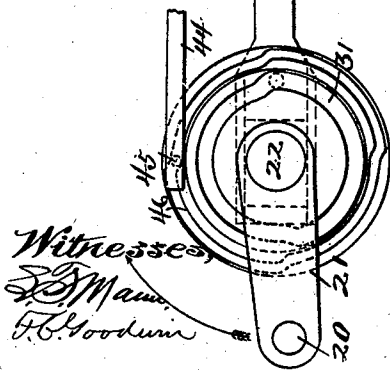
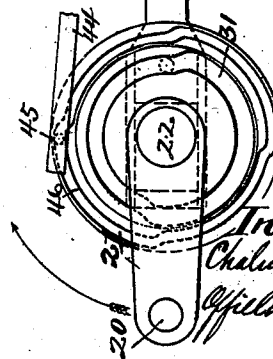


Fig. 6.



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4 Sheets—Sheet 4.

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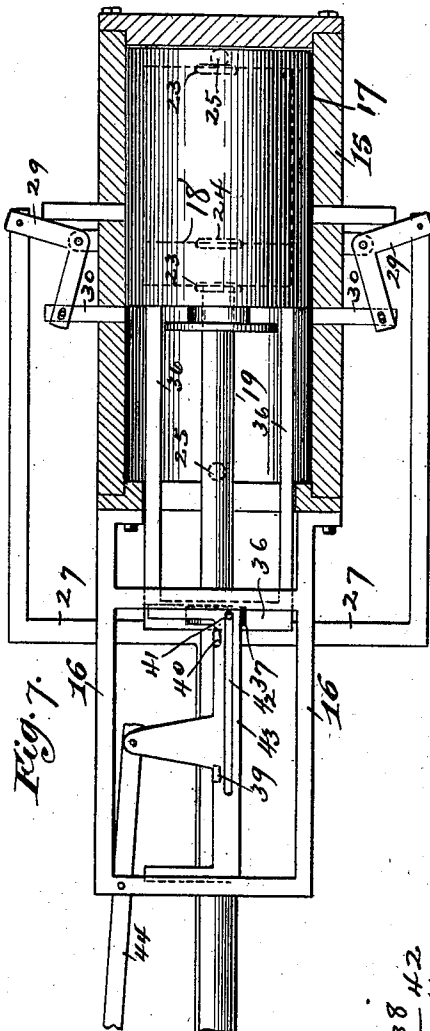


Fig. 7.

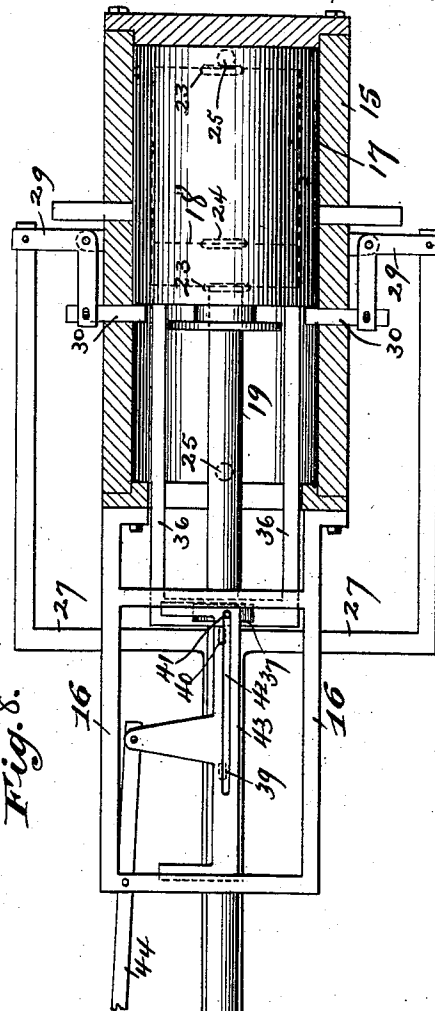


Fig. 8.

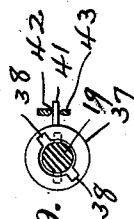
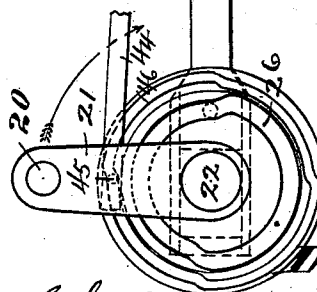


Fig. 9.



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UNITED STATES PATENT OFFICE.

CHALMER M. C. PRENTICE, OF CHICAGO, ILLINOIS.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 577,518, dated February 23, 1897.

Application filed February 18, 1896. Serial No. 579,736. (No model.)

To all whom it may concern:

Be it known that I, CHALMER M. C. PRENTICE, of Chicago, Illinois, have invented certain new and useful Improvements in Engines, of which the following is a specification.

My invention relates to engines of the class having a reciprocating piston and a piston-rod operatively connected with a crank or eccentric; and my invention is applicable to steam, gas, and other types of engines in which a piston is made to reciprocate within a cylinder by the expansive force of a vapor, a gas, or gases, and may be applied also to explosive-engines in which the piston is moved by the impact of the explosion.

The general object of my invention is to secure a higher efficiency in proportion to the cost than has heretofore been obtained. I attain this object by a construction which permits of the utilization of the moving force at such times as render it effective, and my construction involves in its broadest scope the application of the motive power within a restricted area and at such point in the working cycle of the engine as will give the piston great leverage upon the driven crank. To accomplish this, I so construct the cylinder that it is caused to move with the piston during the initial movement of the latter from either or both of its limits. After the cylinder and piston have moved either separately or simultaneously together through a portion of the stroke the cylinder is then locked by appropriate mechanism against a return movement due to recoil, and the motor fluid is admitted behind the piston and permitted to expand within a chamber of comparatively small area. The admission of the motor fluid is timed so that it exerts its force upon the piston to drive it forward at a point when the crank is in an effective position for the application of power thereto; that is to say, at a point between its dead-centers and preferably when it is midway or substantially midway between its dead-centers. The motor fluid being thus limited to a chamber of small area exerts its initial force upon the piston at the time when the crank is in an advantageous position for the application of power. When the piston has completed its travel, the cylinder is unlocked, and the momentum carries

the crank over its dead-center and toward a second effective position attained by it during its revolution. During this action the cylinder is again caused to travel in the direction of the stroke of the piston during the initial part of the return stroke of the latter, and as the crank approaches its second position of high efficiency the cylinder is again locked against recoil and the motor fluid admitted, operating, as before, by its initial pressure at the effective point of the revolution to complete the return stroke of the piston. In this method of operation the motor fluid being confined within a small area exerts its initial force, as before stated, at the time when the crank is in the best position for the application of the effective force, and the motor fluid also works expansively until the piston completes its stroke.

It will be seen from the foregoing that my invention, so far as relates to the structural features, covers in its broadest scope a reciprocating piston coöperating with a movable cylinder and suitable mechanisms for moving, locking, and unlocking the cylinder.

The accompanying drawings are diagrammatic views illustrating an embodiment of my invention without an attempt to illustrate all of the details, which latter could readily be supplied by persons skilled in the art to which my invention appertains.

The several views, Figures 1 to 8, inclusive, are broken elevations, partly in section, each showing a frame in which the cylinder reciprocates, the piston being indicated by dotted lines and the piston-rod broken away, the crank-shaft showing in section and a crank and cams for operating the locking and unlocking mechanisms in elevation. The parts shown in the several views will be more particularly referred to in connection with said views, respectively. Fig. 9 is a detail in section through the piston-rod and showing certain mechanisms mounted thereon and associated therewith.

In the drawings, let 15 represent a framework, shown in section in the several views, (1 to 8 inclusive,) and 16 a framework attached thereto and shown in full lines. The framework 15 is hollow and of such interior configuration as to adapt it to inclose the cylinder 17 and the valve-chest or valve-con-

taining mechanism for controlling the admission and exhaust of the motor fluid. Said framework will also be adapted to provide ways in which the cylinder 17 may slide, the travel of the cylinder being in the illustration shown somewhat less than the length of the cylinder itself.

18 indicates the piston, and 19 the piston-rod.

20 represents the crank-pin, 21 the crank, and 22 the crank-shaft.

In general construction the cylinder, piston, and piston connection may be as usual. The means for controlling the admission and exhaust of the motor fluid are not shown, but the admission-ports in the cylinder are indicated at 23, and one of the corresponding ports in the casing or frame 15 is indicated at 24, it being understood that a second similar port is provided in the casing, but which is in register with one of the ports 23 in the several views, and hence not shown.

The exhaust-ports are indicated at 25.

The locking, unlocking, and holding mechanisms for the cylinder may be of any desired construction, and the mechanisms shown are intended as suggestive or indicative merely. These several mechanisms may be operated from cams on the crank-shaft 22, and I have shown upon said crank-shaft a cam having three grooves.

In Figs. 1, 2, 7, and 8, 26 is a cam-groove which is made to operate a sliding frame 27 through the intervention of the pitman or bar 28, having a stud working in the groove. Said sliding frame is made to operate bell-cranks 29, pivoted on the stationary frame 15 and pivotally connected with locking-dogs 30, said locking-dogs working in apertures in the frame 15 and being adapted to project into the hollow or chamber thereof and in position to form an abutment or stop to prevent the recoil of the cylinder when in the position shown in Figs. 1 and 8, while in Figs. 2 and 7 said locking-dogs are shown as withdrawn, so as to permit of the travel of the cylinder with the piston. It will be observed that these locking-dogs are effective when the cylinder is at the limit of its outward movement or at the conclusion of its movement away from the crank-shaft. Now in order to lock the cylinder when it is at the opposite limit of its travel or at the inner end of the frame a second set of locking-dogs are employed connected to a second frame and operated by a second cam-groove, marked 31, Figs. 3, 4, 5, and 6, the pitman coöperating therewith being marked 32 and the frame 33, the bell-cranks 34, and sliding dogs 35. These mechanisms operate in due order and sequence to lock and unlock the cylinder and are so timed as to effect this locking and unlocking with due relation to the admission of the motor fluid to the interior of the cylinder, as will be hereinafter described.

The mechanisms for effecting the movement of the cylinder may also be of any de-

sired or appropriate construction. The means which I have selected for illustration operate to lock the cylinder to the piston-rod, so that the movement of the cylinder is effected by the piston-rod, and the movement of the latter is due to momentum. Said locking means comprise a yoke 36, which has mounted so as to rock therein a collar 37, (shown in the detail Fig. 9,) surrounding the piston-rod. Said collar has two notches in its perimeter located opposite each other and marked 38. The piston-rod carries two sets of pins 39 40, said pins being of such size and length as to pass through the notches or slots 38 when the collar 37 is turned so that the positions of the slots and pins register. The collar 37 has an offstanding lug 41 on its periphery, which slides in a slot 42 in a sliding frame 43, the latter being reciprocally mounted in the frame 16. Said frame 43 is reciprocated by means of a walking-beam 44, having a pin 45 at its outer end working in a cam-groove 46 in the cam-wheel carried by the crank-shaft. Any other suitable mechanism may be employed for locking the cylinder and piston-rod. Now by referring to the drawings it will be seen that said cam is of such configuration that the walking-beam 44 will be vibrated four times during each complete revolution of the crank-shaft, thereby locking and unlocking the cylinder and piston-rod in its two extreme positions during each rotation of the cam.

In the position shown in Fig. 1 the cylinder is disconnected from the piston-rod, and in Fig. 2 the high side of the cam having tilted or vibrated the walking-beam and depressed the frame 43 the collar has been turned into the position shown in Fig. 9, thus bringing the pins 39 into position to engage the collar, so that as the piston is carried by momentum over the dead-center in the direction of the arrow in Fig. 2 it will cause the cylinder to travel with it toward one end of the frame, and as the cylinder reaches the inner limit of its travel the configuration of the cam permits or causes the return of the sliding frame and the unlocking of the cylinder from the piston-rod, which position is about to be attained in Fig. 3 and is shown attained in Fig. 4. During the next quarter of the stroke the two sets of lugs or pins on the piston-rod both pass through the collar, as shown in Fig. 5, and as the crank reaches the outer dead-center point the inner set of pins are in position to engage with the collar, so as to again lock the frame connected with the cylinder to the piston-rod. As the crank proceeds through the third quarter of the revolution to the positions indicated in Figs. 7 and 8 the cylinder is moved to the outer limit or returned to the position shown in Fig. 1, and at the completion of the revolution of the crank the collar is in such position that the lugs on the piston-rod have passed through as the piston is driven by the expansive force of the motor charge to the limit of its stroke.

It only remains to state the order of the ad-

mission of the motor fluid, the locking and unlocking of the cylinder, and the relative positions of the crank during the working cycle of the engine.

5 Starting again with the position shown in Fig. 1 it will be seen that the crank is approaching its dead-center nearest to the cylinder and that the latter is locked while the piston is nearing the outer limit of its stroke, 10 working under the expansive force of the motor fluid or under the effect of impact. In Fig. 2 the locking-dogs 30 are withdrawn, leaving the cylinder free to be moved with the piston when the latter begins its return 15 stroke, the pins 39 being in position to lock the cylinder to the piston-rod, as shown in Fig. 2. From the position shown in Fig. 2 toward the position shown in Fig. 3 the cylinder and piston are moved simultaneously 20 by momentum. In Fig. 3 the cylinder is about to be unlocked from the piston-rod and is in position to be locked against recoil. In Fig. 4 the cylinder is locked against recoil, and the piston is free to travel independently 25 of the cylinder. Further, the ports are in such position as to admit steam behind the piston, which is near the end of the cylinder-head, leaving a working chamber of small area. The initial pressure of the motor fluid 30 is exerted upon the piston, and by reference to Fig. 4 it will be seen that the crank is in an effective position for utilizing this initial pressure—that is to say, it is at a point between the dead-centers, and the leverage is 35 great.

I have demonstrated, approximately, that a body of steam of, say, a half-inch to an inch following the piston will exert in this position of the crank as great a pressure as eight 40 to sixteen times that body would give in the ordinary cylinder having, say, a sixteen-inch stroke, and this results from the fact that in an engine of the ordinary construction, having a stationary cylinder and a reciprocating 45 piston, it will require a body of steam, where the piston has a sixteen-inch stroke, of, say, eight inches, linear measurement, to drive the piston from the dead-center to the point of greatest efficiency of the crank, or, in other 50 words, to the point where the initial pressure of the steam is most efficiently exerted upon said crank. In the position shown in Fig. 5 the piston has nearly completed its instroke, and in Fig. 6 the stroke is completed and the 55 cylinder is unlocked. From the position shown in Fig. 5 to that shown in Fig. 7 the piston and cylinder are driven together by momentum toward the original position, being in the position to be locked in Fig. 7 and 60 shown locked in Fig. 8 and again ready to receive the motive fluid.

In my construction, as in the usual construction, the piston moves with some slight friction within the cylinder, particularly where 65 the motor fluid works expansively, as in the case of steam, and this friction will be used in assisting to cause the travel of the cylin-

der with the piston, and in order to avoid loss of power the cylinder will be so mounted in its ways as to slide with very little friction. 70 Its bearings may be constructed, therefore, in any approved way to avoid excessive friction.

I wish it to be understood that the particular mechanisms which I have herein illustrated and described are intended to represent only one of the many practical embodiments in which the underlying principle of my invention may be used, and that therefore I do not limit my invention to the structural 80 features shown and described, but intend in the claims hereinafter made to cover not only the particular means shown for causing the travel of and holding the cylinder, but all other means operating to attain these results. 85

My invention may be said, broadly, to consist in a system in which the cylinder is movable and in which the piston has a reciprocating movement relative to the cylinder and in the employment of a movable cylinder and 90 reciprocating piston and means for admitting the motor fluid to the cylinder when the piston is in a position for effective work upon the crank-shaft.

As above stated, my invention is applicable 95 to steam, gas, or other motor fluids working by expansive force, and it may also be used in connection with explosive mixtures which work, properly speaking, by impact rather than by expansion. Furthermore, it will be 100 understood that the time of the actions of the various mechanisms may be changed. For example, I have described an arrangement whereby the motor fluid is admitted to the cylinder when the crank is about midway between its dead-centers, and I believe that at 105 substantially this point the crank is in the most effective position for work, but I wish it to be understood that the motor fluid may be admitted advantageously at any point between the dead-centers. All of these variations I consider within the scope of the general principle of my invention above stated. 110

I have shown the mechanism so arranged that the cylinder and piston move simultaneously toward the point of admission of the motor fluid, but obviously the piston might be moved in advance of the movement of the cylinder, the movement of the latter being 120 faster than that of the piston. Further, instead of locking the cylinder and piston together during the movement of the former the cylinder might be moved entirely independent of the piston and its rod, and the relative length of movement of the piston and cylinder, as well as the size or area of the chamber into which the motor fluid is admitted, may be varied at will. 125

I claim—

1. An engine having a movable cylinder 130 with fixed heads, a piston reciprocating within the cylinder, mechanism substantially as described for moving the cylinder in definite relation to the piston movement, and mech-

anism for fixedly securing or locking the cylinder at predetermined limits of travel, substantially as described.

2. An engine having a single bodily-movable cylinder with fixed heads and a reciprocating piston working within the cylinder, mechanism substantially as described for moving the cylinder and piston from dead-center positions, means for admitting the motive fluid to the cylinder and mechanism for locking the cylinder against recoil whereby an added movement may be imparted to the piston by the expansion of the motive fluid behind it, substantially as described.

3. The combination with a stationary frame having suitable ways, a cylinder mounted to slide in said ways, a piston reciprocating within said cylinder, means for locking the cylinder and piston together whereby they are moved simultaneously during the first part of the piston stroke, means for locking the cylinder against recoil and for unlocking the cylinder and piston whereby to permit the piston to continue its travel freed from its connection with the cylinder, substantially as described.

4. The combination with a stationary frame having ways therein, of a cylinder adapted

to slide in said ways, a piston mounted to reciprocate within the cylinder and having a piston-rod, a crank-shaft connection, means for locking the cylinder to the piston-rod whereby the cylinder is caused to move with the piston during the initial part of the stroke of the latter, means for locking the cylinder against recoil and means for unlocking the cylinder from the piston-rod and admission-ports in the cylinder adapted to admit the motor fluid when the crank-shaft is intermediate its dead-centers, substantially as described.

5. The combination with a movable cylinder, of a piston adapted to move therein and also independently thereof, a piston-rod having locking projections thereon, a collar encircling the rod and having grooves through which the locking projections of the rod may pass, and means for rocking said collar whereby to turn the locking projections out of register with the grooves and a connection between the collar and the cylinder whereby the latter may be locked to and moved with the piston-rod, substantially as described.

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