No. 617,762.

Patented Jan. 17, 1899.

A. E. McCOLLUM.

ENGINE.

(Application filed June 26, 1897.)

(No Model.)

4 Sheets—Sheet 1.

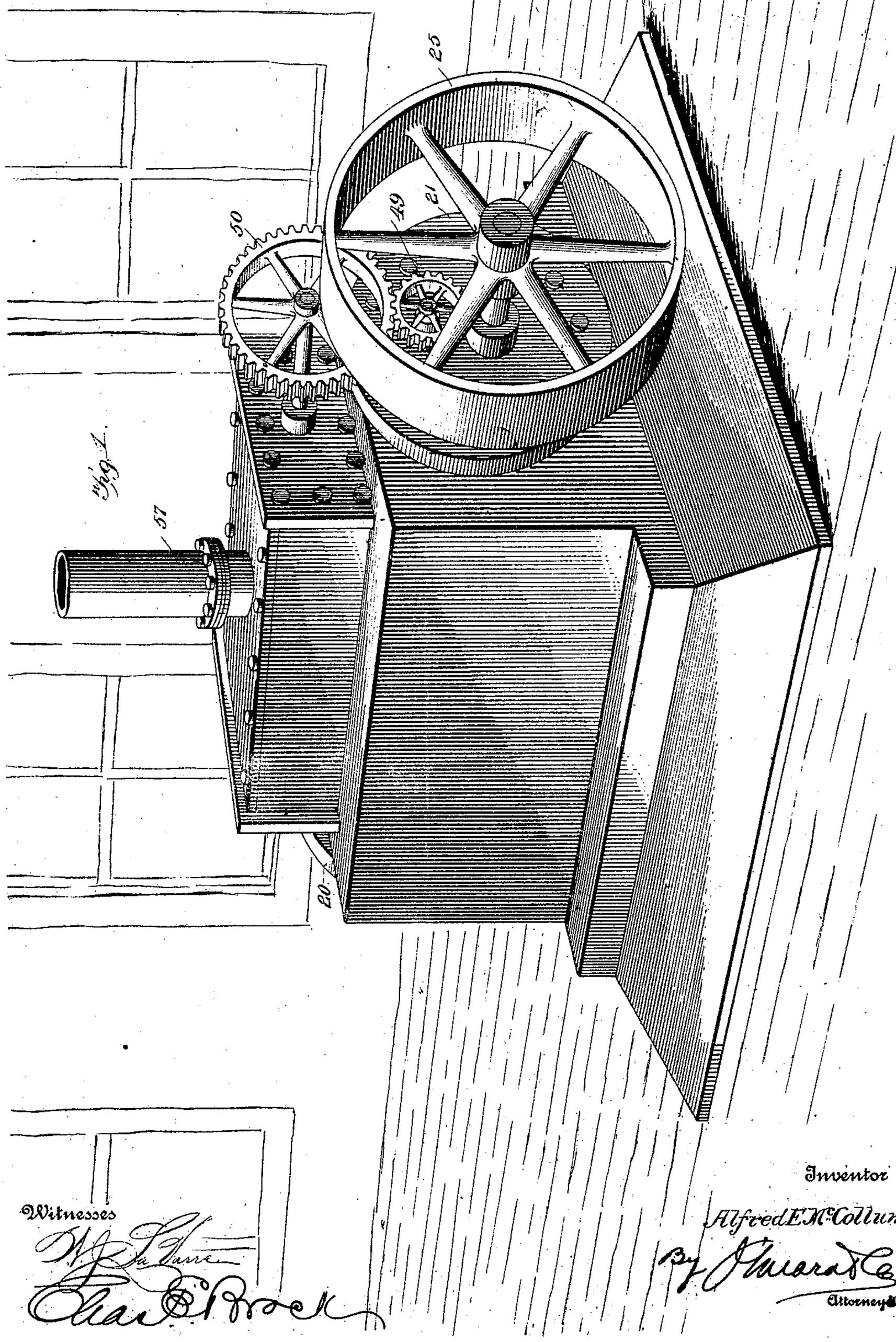

Fig. 1.

Witnesses

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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

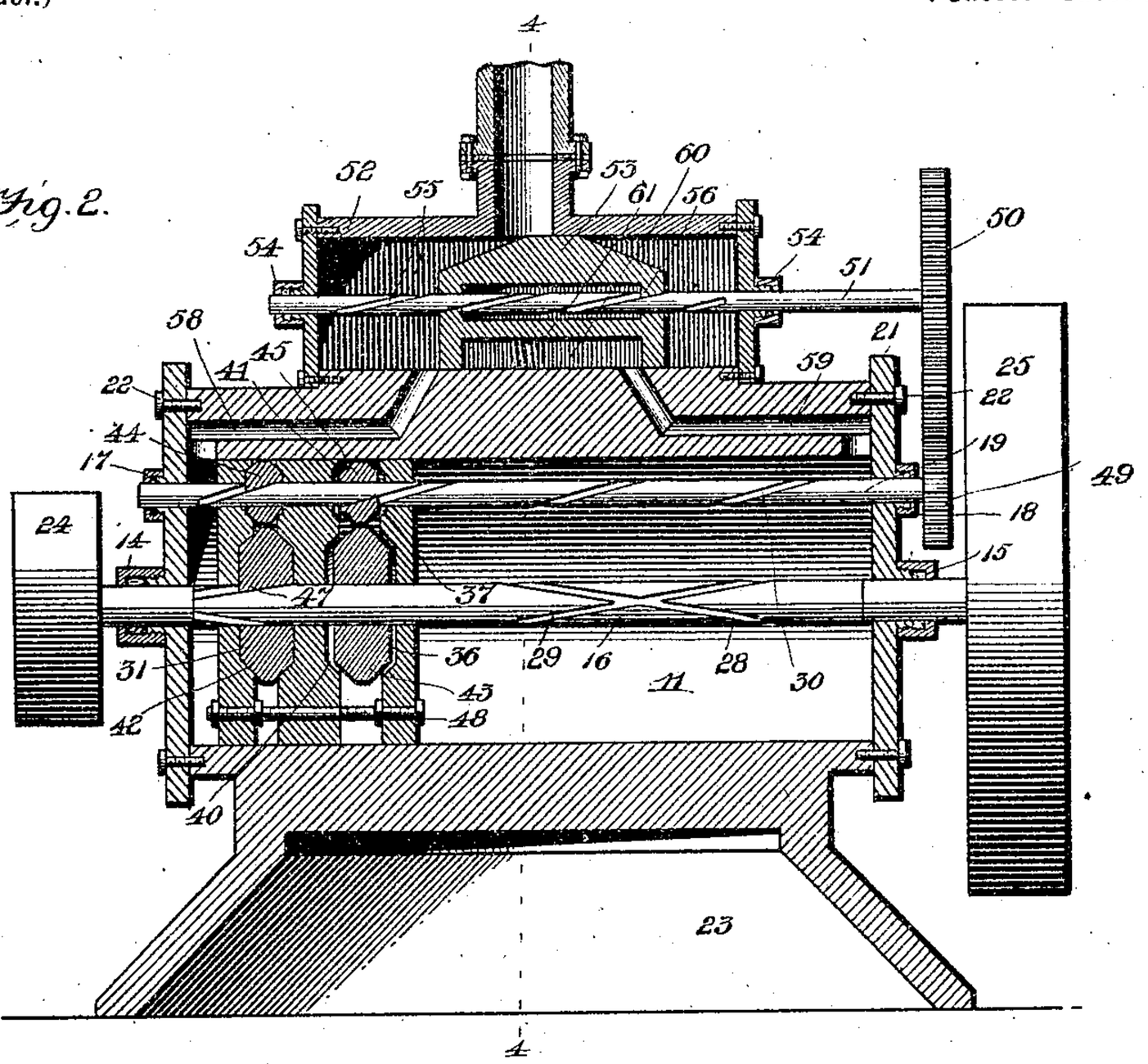
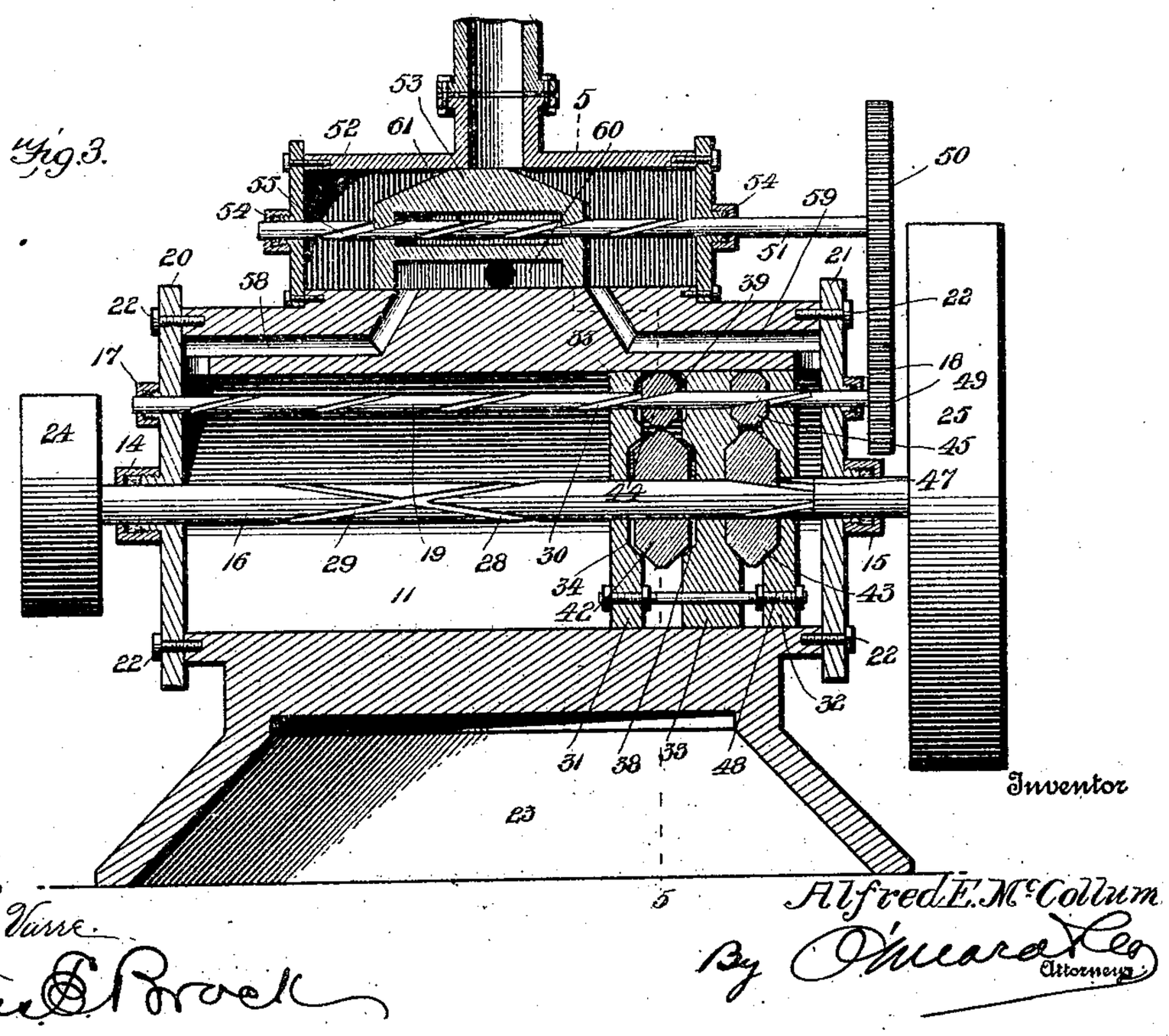


Fig. 3.



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4 Sheets—Sheet 3.

Fig. 4.

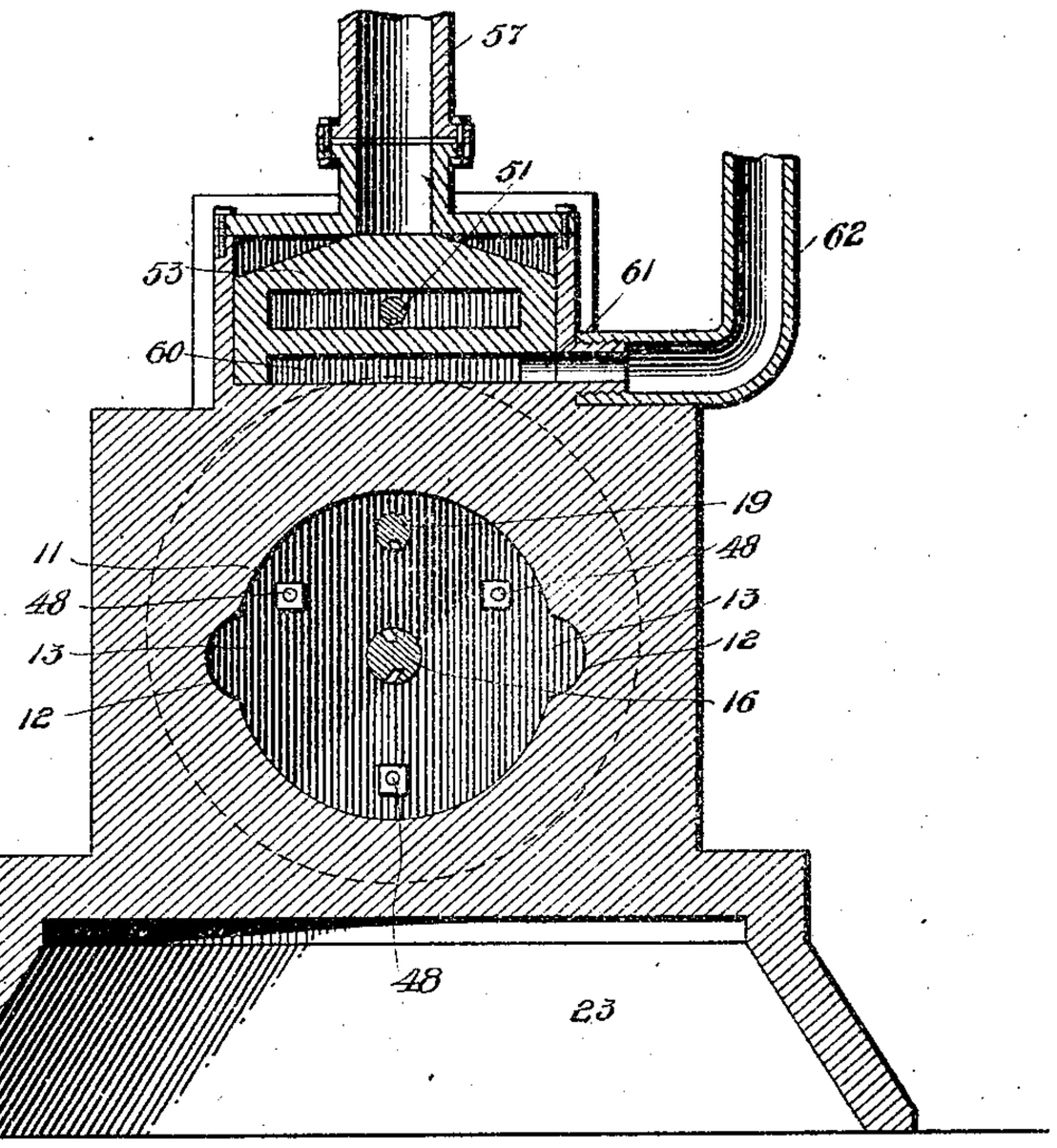
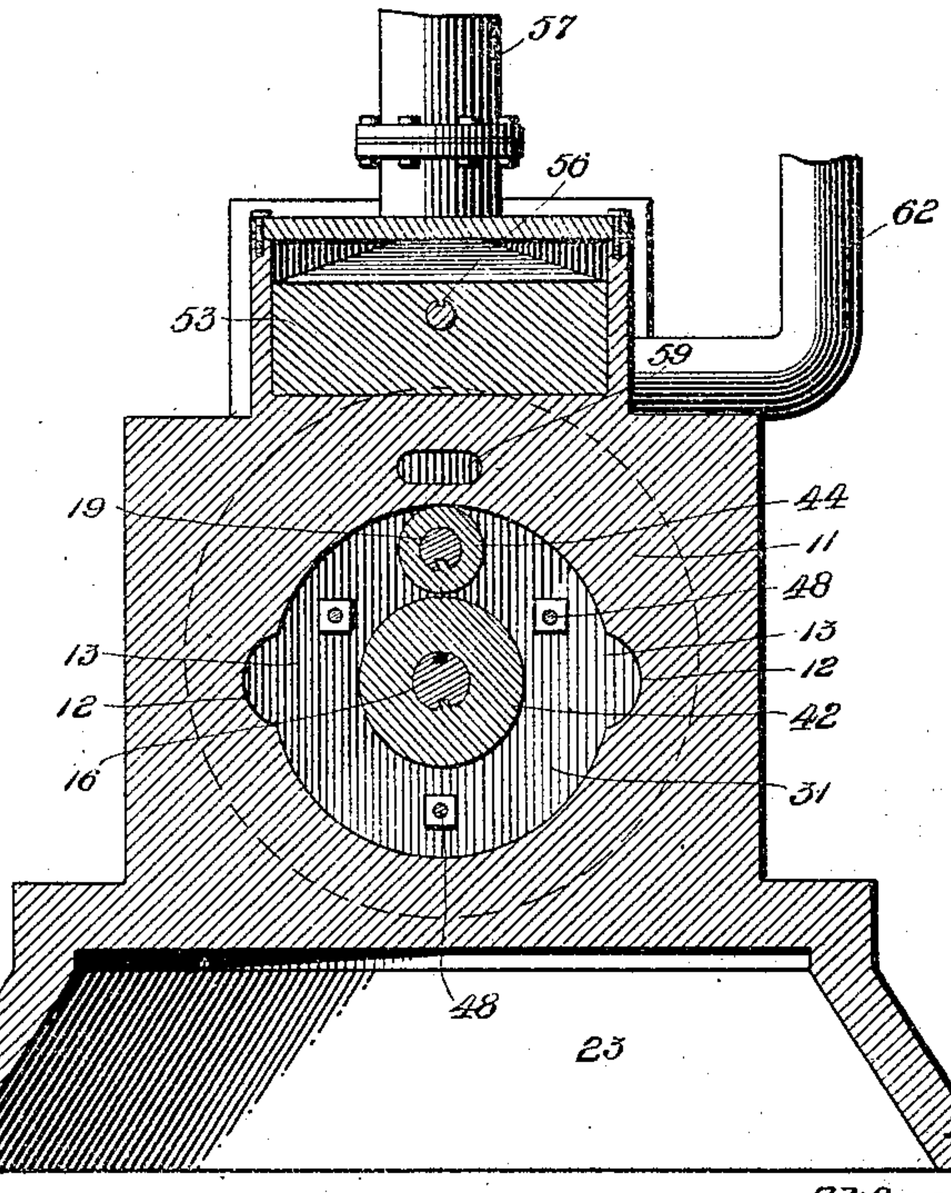


Fig. 5.



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4 Sheets—Sheet 4.

Fig. 6.

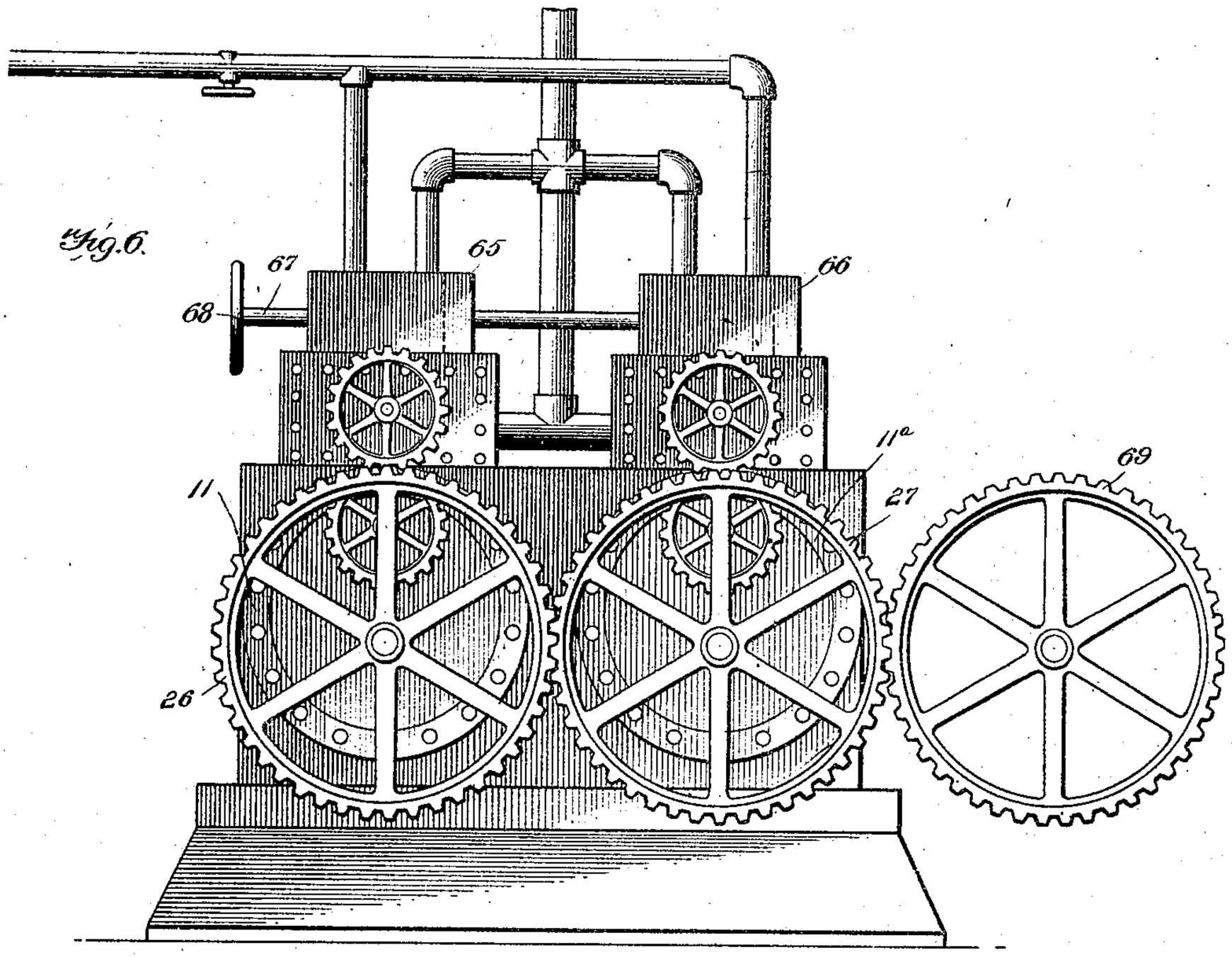

Fig. 7.

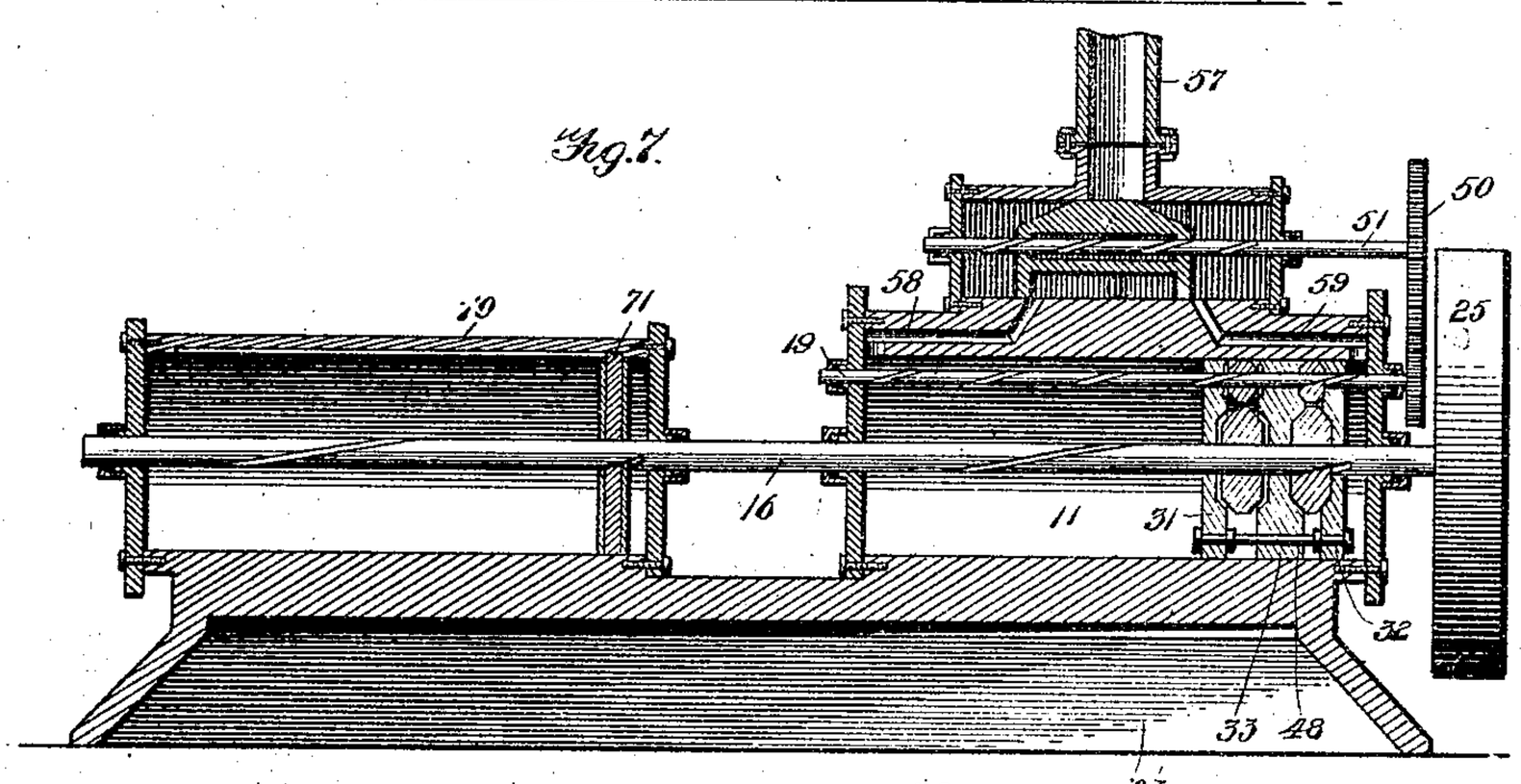

Fig. 8.

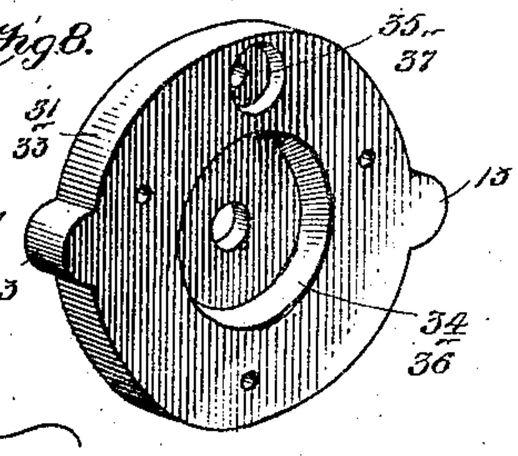

Fig. 9.

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Fig. 10.

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UNITED STATES PATENT OFFICE.

ALFRED E. McCOLLUM, OF WEST LEISENRING, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO JAMES H. STINER, OF SAME PLACE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 617,762, dated January 17, 1899.

Application filed June 26, 1897. Serial No. 642,454. (No model.)

To all whom it may concern:

Be it known that I, ALFRED E. McCOLLUM, residing at West Leisenring, in the county of Fayette and State of Pennsylvania, have invented a new and useful Engine, of which the following is a specification.

My invention relates to steam or other engines wherein the rectilinear reciprocating motion of a piston-head is converted into rotary motion of a shaft, and has for its object to provide a new and improved engine of this class which will occupy less space and in which the number of parts are decreased, the construction simplified, the cost reduced, and the engine rendered more economical and effective in operation and better adapted to all classes of work.

With this object in view my invention consists in an engine provided with a reciprocating piston-head and a piston-rod on which said head is mounted, said piston-rod acting as the main shaft of the engine.

My invention further consists in an engine having a reciprocating piston-head and a piston-rod on which said head reciprocates, said head and rod being so constructed that the reciprocation of the head on the rod causes the rod to rotate and become the main shaft of the engine.

My invention further consists in an engine provided with a reciprocating piston-head and non-reciprocating piston-rod and a valve-rod located in the cylinder parallel to the piston-rod and passing through the head, the reciprocatory movement of the head on the rods causing them to rotate.

My invention further consists in an engine provided with a reciprocating piston-head and non-reciprocating piston-rod and a valve-rod located in the cylinder parallel to the piston-rod and passing through the head, a slide-valve, and a rod passing through the valve and geared to the valve-shaft, the reciprocating movement of the head on the rods causing them to rotate and the valve to be reciprocated.

My invention further consists in means whereby an engine of the class described may be made single-acting or double-acting, as may be desired.

My invention further consists in means whereby an engine of the class described may be made to act as a pump.

My invention further consists in the improved construction, arrangement, and combination of parts hereinafter fully described, and afterward specifically pointed out in the claims.

In order to enable others skilled in the art to which my invention most nearly appertains to make and use the same, I will now proceed to describe its construction and operation, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective view of a single-acting engine constructed in accordance with my invention in position for practical operation. Fig. 2 is a longitudinal section through my improved engine, the piston-head and valve being at one end of the cylinder ready for a stroke. Fig. 3 is a similar view of the same parts, the piston-head and valve being at the opposite end of the cylinder and ready for the return stroke. Fig. 4 is a transverse sectional view taken on the plane indicated by the dotted line 4 4 of Fig. 2. Fig. 5 is a similar view on the plane indicated by the dotted line 5 5 of Fig. 3. Fig. 6 is a view in elevation of a double-acting engine constructed in accordance with my invention. Fig. 7 is a vertical longitudinal sectional view of a combined engine and pump constructed in accordance with my invention. Fig. 8 is a perspective view of one of the plates entering into the construction of the piston-head of my improved engine. Fig. 9 is a similar view of one of the cone-blocks used to connect the said piston-head plates together by frictional contact when desired. Fig. 10 is a similar view of one of the cones for operating the valve-governor screw-shaft.

Like figures of reference mark the same parts wherever they occur in the various figures of the drawings.

Referring to the drawings by numerals, 11 is the cylinder of my improved engine, which may be made in substantially the same form and manner as the cylinders now in use, except that it is to be provided with means to prevent the piston-head from turning therein. In this instance I have shown such means as consisting of longitudinal grooves 12 to re-

ceive projections 13 on either side of the plates comprised in the piston-head; but the same object might be attained by making the cylinder of some other shape in cross-section, as square or otherwise angular. In any case the cylinder 11 will be provided with suitable bearings 14 and 15 for the screw piston-rod 16 and 17 and 18 for the valve-governor screw-rod 19, said bearings being located in the cylinder-heads 20 21, secured steam-tight in position on the ends of the cylinder by suitable bolts or machine-screws 22. This cylinder is suitably supported upon any approved construction of base, as shown at 23.

The piston-rod 16 is a rotating screw-shaft which extends entirely through the cylinder and has suitable driving-wheels upon its outer ends, said driving-wheels being, as may be desired, either belt-pulleys 24 and 25, as in Figs. 2, 3, and 7, or gear-wheels 26 and 27, as in Fig. 6.

Two spiral grooves 28 29 of any desired sectional form are provided in that portion of the piston screw-shaft within the cylinder, said grooves extending from one cylinder-head to the other, each groove making a complete turn around the shaft and one turned in a right-hand and the other in a left-hand direction.

The valve-governor rod is provided with a single spiral groove 30, which may be of any approved shape in section and may be extended as many times around the rod as may be necessary.

31, 32, and 33 are the disks or plates which form my piston-head, each having projections 13 on opposite sides, as before set forth, to engage in the grooves 12 in the cylinder to prevent the piston-head from turning in the cylinder and openings through which the rods 16 and 19 pass. The plates 31 and 32 have concave recesses 34 and 35 and 36 and 37 in their inner faces, and the plate 33 has similar conical recesses 38, 39, 40, and 41 in both its faces.

42, 43, 44, and 45 are blocks of metal, each shaped like two conic frustums joined together at their bases. These blocks are each provided with a central bore or opening 46 to embrace the rods 16 or 19, and in said opening a feather or inward-projecting tongue or tenon 47 to engage with one of the spiral grooves in said rods.

The disks or plates 31, 32, and 33 are secured together at a fixed distance apart by bolts 48, which are long enough to hold the disks 31 and 32 a sufficient distance apart to form of the opposite concave recesses chambers of sufficient length to loosely accommodate the conic blocks 42, 43, 44, and 45 and to permit the disk 33 to slide a short distance on the rods 16 and 19.

The valve-governor shaft 19 passes through the cylinder-head 21 far enough to permit of the securing thereto of a pinion 49, which meshes with a gear-wheel 50, secured to the projecting end of the valve-rod 51, said rod passing longitudinally through the steam-chest 52, slide-valve 53, and bearings 54 on the ends of the steam-chest. The valve-rod 51 has also one spiral groove 55 in its periphery, and in the openings in the slide-valve 53, through which the valve-rod passes, are provided tongues or feathers, as at 56 in Fig. 5, to engage in said groove.

The usual steam-inlet pipe 57 leads from the boiler (not shown) into the steam-chest and, according to the position of the slide-valve 53, the steam passes into the opposite ends of the cylinder 11 through steam-channels 58 and 59. The slide-valve is made hollow to lighten its construction and has a recess 60 in its lower face, which alternately communicates with said steam-channels 58 and 59, so that when channel 58 is used as an inlet channel 59 is an exhaust, the exhaust-steam passing from it into the recess 60 and thence through exhaust-port 61 and exhaust-pipe 62. This order of things is reversed on the return stroke, channel 59 becoming the inlet and channel 58 the exhaust.

From the foregoing persons skilled in the art of steam-engineering will understand the construction of my invention in the form of a single-acting engine, and its operation may be described as follows: The several parts of the engine being in the position illustrated in Fig. 2 and suitable steam connections having been made, the steam is turned on and passes through the steam-chest 52 and the channel 58 into the end of the cylinder. Pressure is thus brought to bear directly upon the disk or plate 31 of the piston-head, causing it to advance sufficiently to tightly inclose the conical blocks 42 and 44 in the chambers formed by the opposite recesses 34 and 35 in disks or plates 31 and 33, so that said blocks 42 and 44 are held from turning. By this movement of the disk or plate 31 the disk 32 is pushed by the rods or bolts 48 sufficiently far away from disk 33 to enlarge the chambers formed by the recesses 36 and 37 in disk 32 and recesses 40 and 41 in disk 32 enough to permit of the blocks 43 and 45 turning freely therein. From an inspection of Fig. 2 it will be found that the feather or tenon 47 in block 42 engages in the left-hand groove 29 of the piston-rod 16, and when the block 42, locked by pressure between disks 31 and 33, and thus prevented from turning, is carried along with the piston-head the feather 47, riding along in the groove 29, will cause the shaft to rotate in the direction of the pitch of the groove, and such rotation of the shaft will continue as long as the piston-head moves toward the right as illustrated in Figs. 2 and 3, which will be until it reaches the position shown in Fig. 3. During this movement the block 43, being loose and free to rotate with the shaft 16 and its feather riding in right-hand groove 28 of said shaft, will be carried along with the piston-head and rotated on the piston-rod by the action of the walls of the groove 28 on its tenon or feather.

Having reached the end of this stroke, the piston-head will receive the pressure of steam on disk 32 to perform its return stroke, during which all the operations just described will be reversed. As soon as the pressure is exerted on disk 32 it will move toward disk 33 and clamp block 43 between itself and said disk 33, securing it against rotation on the shaft and at the same time forcing disk 31 away from disk 33 and leaving block 42 free to rotate with the piston-rod 16. The continued movement of the piston-head to the left, with tenon or feather 47 of block 43 in groove 28, will cause the continuation of the rotation of the shaft begun by the passage of the tenon or feather of block 42 through the groove 29 during the opposite stroke of the piston-rod 16. During the right-hand stroke of the piston-head, as hereinbefore described, the same action which locked block 42 between disks 31 and 33 also locked block 44 between the same plates, and the action of the feather in the central opening of block 44 in the single groove 30 of the valve-governor shaft 19 caused that shaft to be rotated. This carried pinion 49 with it, and the rotation of said pinion was communicated to gear-wheel 50 and valve-rod 51, causing said rod to rotate. The action of the walls of groove 55 in the valve-rod upon the tenon or feather 56 in the opening through the slide-valve 53 caused said slide-valve to be carried to the left, thus closing steam-channel 58 and opening channel 59 and admitting steam to the right-hand end of the cylinder to perform the return stroke, as before described.

The feathers of the two blocks 44 and 45 traverse the single groove in the valve-governor screw-shaft 19; but as one is loose in each stroke alternately the shaft is made to turn in opposite directions, the result of which is that the valve-rod 51 also turns in opposite directions. The groove in the valve-governor shaft, as well as that in the valve-rod, need not be made on regular spiral lines, but either or both may be so shaped, as may be desired, to give a regular or irregular movement to the slide-valve or to move it during part of the stroke and permit it to remain stationary part of the time.

The feathers of the larger cone-blocks 42 and 43 in the cylinder traverse different grooves, which traverse the piston-rod in different or opposite directions. Designating the block 42 as the "advancing" block and the block 43 as the "returning" block, when the advancing block is caused to act on the shaft the returning block is rendered idle or inactive in relation to the shaft, and the advancing block causes the shaft to move toward the left one complete revolution, when the advancing block immediately becomes the idler or inactive block and the returning block and will cause the rotation of the shaft to be continued in the same direction one more complete revolution while completing its return stroke. Thus the blocks 42 and 44 act alternately on the shaft and a continuous rotation is maintained in the same direction as long as the steam-supply is kept up.

The possible advantages which this engine may possess over those propelled by the direct action of the piston may be partially enumerated as follows: It will occupy less space on the floor, no room being needed to accommodate the extended piston. It consists of fewer parts and is less complicated, being less liable to get out of order and more easily adjusted. It has fewer bearings, will require less oil, and presents fewer surfaces to clean. It has no crank or dead-center. The power is continuous. One expansion of steam completes an entire revolution of the shaft instead of two expansions, as required in the piston-engine. It has no eccentrics to slip, and the adjustment of the slide-valve is exceedingly simple. It will require less material in its construction and will cost comparatively less. As to comparative power and speed the advantage is greatly in its favor, as it affords additional steam-pressure area within the same diameter of cylinder, caused by the side projections of the piston-head equaling the area of space occupied by the piston-rod. The principal points of wear will be the friction concavities or chambers and the cone-blocks, tenons or feathers, and the walls of the grooves. If the screw-shaft and the disks or plates of the piston-head be made of harder material than the cone-blocks and their feathers, the wear may be confined almost entirely to the last-named parts, thereby necessitating the removal and renewal of only these parts.

My engine is intended for use as a single-acting engine, and for this use it will be constructed and operated as hereinbefore described. It is, however, capable of use as a double-acting or reversible engine, as a pumping or compressing engine, as a compound engine, as a marine engine, as a street-car motor, and as a locomotive.

As a double-acting or reversible engine it may be constructed as hereinbefore described and furnished with a suitable train of reversing-gearing; but, preferably, I would construct it with two cylinders 11 and 11^a, as shown in Fig. 6. These cylinders will be of equal capacity and each of the required horse-power to alone perform the work for the reason that only one operates at any given time, they alternating in operation in opposite directions. These two cylinders are placed side by side or one above the other, the former arrangement being shown in the drawings. They are exactly alike in all respects and when set in motion the shafts are rotated in the same manner as hereinbefore described. These two cylinders are, however, provided with supplementary steam or throttle chests 65 and 66, in which are throttle-valves mounted on a stem or rod 67, having a hand-wheel 68 on one end for convenience in manipulating the valves. When the valve in chest 65

is opened, admitting steam to cylinder 11, that in chest 66 will be closed, cutting off steam from cylinder 66, and vice versa.

In the illustration Fig. 6 the throttle-valve stem is in its forward position and is in position to admit steam to cylinder 11. Steam will now enter said cylinder and rotate the shaft therein, upon which cog-wheel 26 is mounted—say to the left. All the cog-wheels 26, 27, and 69 being connected, all must rotate together. Consequently wheel 26 turning to the left will cause 27 to move to the right and 69 to the left. While 26 is the active or driving wheel there will be no steam in cylinder 11^a, and as a consequence the cone-blocks on its piston-rod will be free to turn with it. The cog 27 may therefore turn freely as an idler, only transmitting the motion of 26 to 69. If the throttle-valves are reversed in position, cutting off steam from cylinder 11 and admitting it to cylinder 11^a, then the shaft of cylinder 11^a will be rotated to the left, carrying cog-wheel 27 with it, said cog-wheel 27 becoming the driver and cog-wheel 26 the idler, causing the cog-wheel 69 to be turned to the right or in the reverse direction. The engine may be stopped at any time by moving the throttles to a position in which an equal amount of steam will be admitted to each cylinder at the same time, thus establishing a state of equilibrium or rest therein.

The adaptation of my invention as a pumping-engine or air-compressor is illustrated in Fig. 7, in which the piston-rod 16 is continued into a cylinder 70, set up in line with cylinder 11, the two parts of the rod in both cylinders being provided with a spiral groove pitched to the right or left, as desired. A plunger-head 71 on the rod in said cylinder 70 is caused to reciprocate therein by the oscillatory rotation of the piston-rod, the walls of the groove acting upon feathers located therein, the action being the converse of the action of the piston-head on the piston-rod in the main cylinder 11.

As a compound engine the engine may be constructed along the general lines of ordinary piston-pattern compound engines.

As a marine engine it would economize valuable space, being equally effective in any position, horizontal, vertical, or otherwise.

The necessary modifications to adapt my engine for use as a car-motor or locomotive will be obvious to ordinary machinists and engineers and need not be described here.

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

1. In an engine, the combination with a cylinder, of a piston rod or shaft journaled therein, having right and left pitched spiral grooves in its surface extending from end to end thereof, a head or piston, consisting of three movable plates, loosely mounted upon said rod and held against turning, rods connecting the outer plates and passing loosely through the middle plate, two blocks mounted upon said shaft between said plates one between each outer plate and the middle plate, and having feathers to engage said grooves respectively, and means for alternately locking said blocks against turning, between said plates, substantially as described.

2. In an engine, the combination with a cylinder of a piston rod or shaft centrally journaled therein and having right and left pitched, spiral grooves in its surface, two blocks mounted upon said head or piston and having feathers to engage in said grooves respectively, a second rod or shaft journaled in said cylinder and provided with a spiral groove in its periphery, two blocks mounted upon the last-mentioned shaft, each having a feather to engage in said groove, and means for alternately locking one of each pair of blocks against turning upon its shaft while being longitudinally moved through the cylinder, substantially as described.

3. In an engine, the combination with a cylinder of a piston rod or shaft, consisting of movable plates, locked against turning therein, a valve-governor shaft journaled therein, a slide-valve having openings with interior feathers, a valve-rod passing through said opening and having a spiral groove in which said feathers engage, means for rotating the valve-governor shaft, and gearing to communicate its rotation to the valve-rod, substantially as described.

4. In an engine, the combination with the cylinder and the steam-chest of a valve-governor shaft, journaled in the cylinder and held against longitudinal movement, a piston-head, longitudinally movable in said cylinder but held against turning, a valve-rod journaled in the steam-chest, a slide-valve, mounted on the valve-rod within the steam-chest, means whereby the longitudinal movement of the piston-head is caused to rotate the valve-governor shaft, gearing connecting the valve-governor shaft with the valve-rod, and means for causing the rotation of the valve-rod to reciprocate the sliding valve, substantially as described.

5. In an engine, the combination with a piston-head consisting of three plates, longitudinally movable but locked against turning in the cylinder, of rods or bolts, passing through said plates and connecting the two outer plates at a fixed distance apart, the central plate being movable upon said rod, a piston rod or shaft, centrally journaled in the cylinder and having oppositely-pitched, spiral grooves, and two blocks located in recesses between the plates with room for longitudinal play, mounted upon said rod or shaft and having feathers to engage said grooves respectively, substantially as described.

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