No. 717,136. Patented Dec. 30, 1902.

E. E. THOMAS.

ENGINE.

(Application filed May 31, 1902.)

(No Model.) 4 Sheets—Sheet 1.

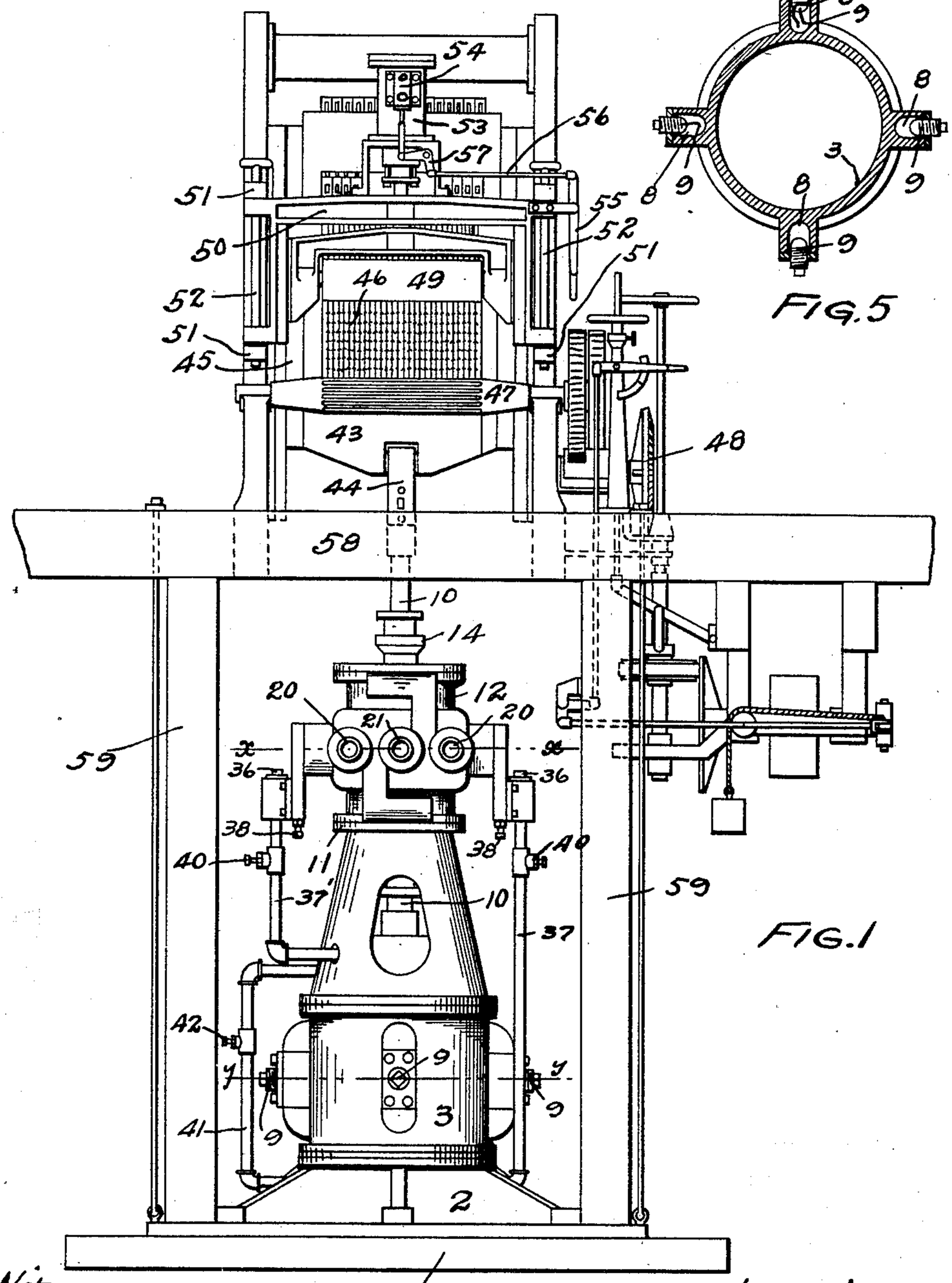

FIG. 1

FIG. 5

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(No Model.) 4 Sheets—Sheet 2.

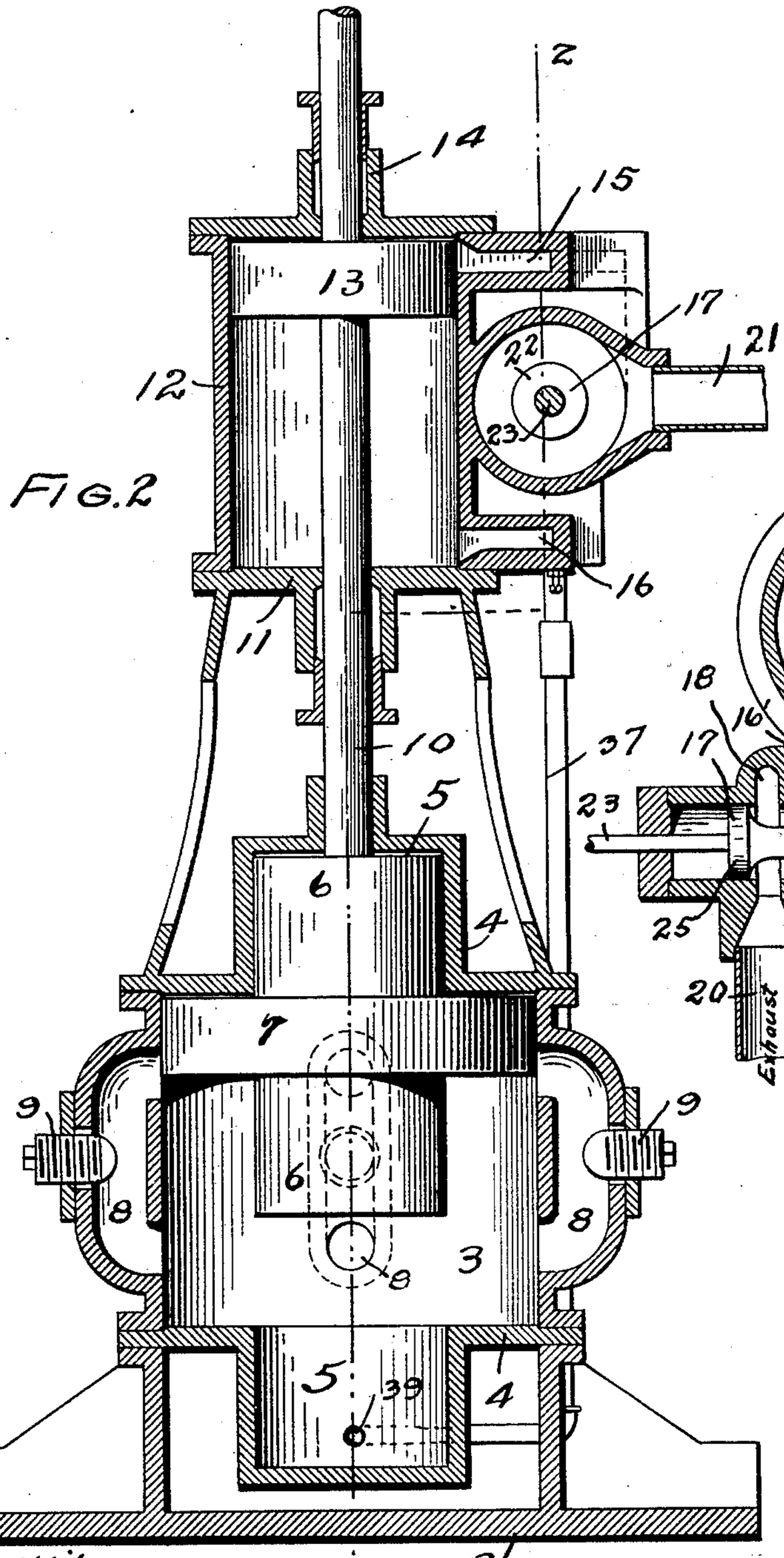

FIG. 2

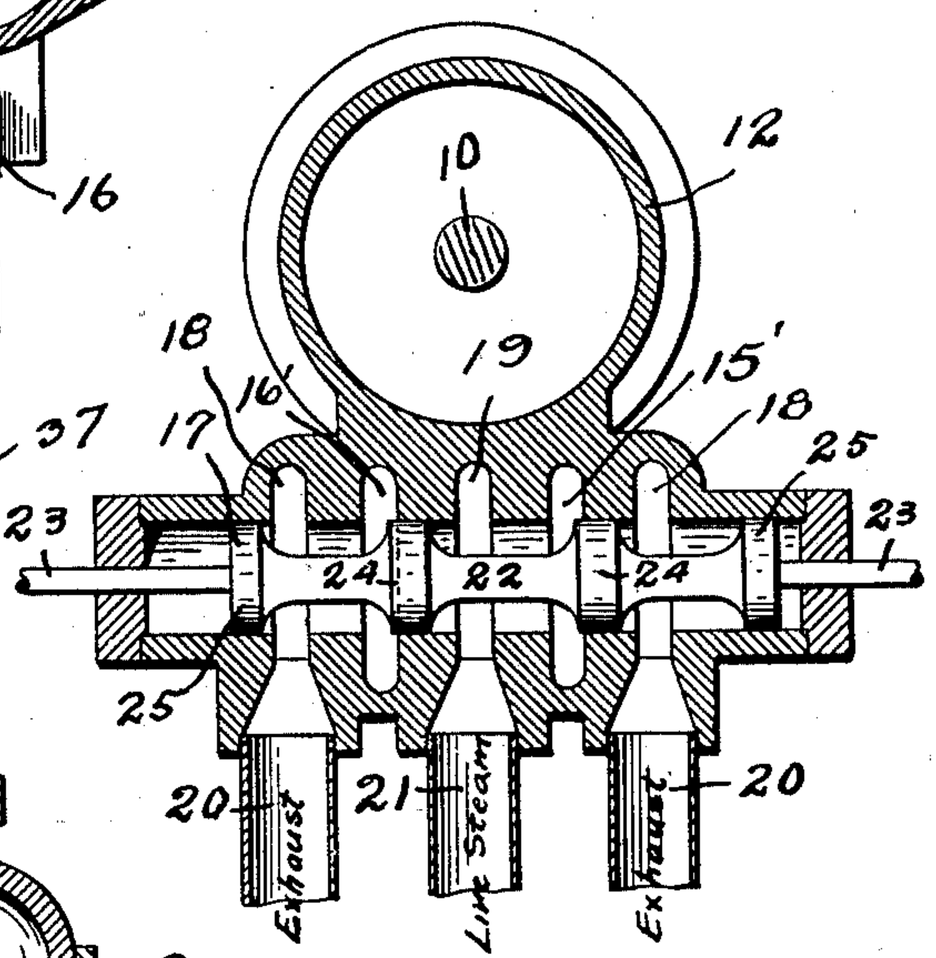

FIG. 4.

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(No Model.) 4 Sheets—Sheet 3.

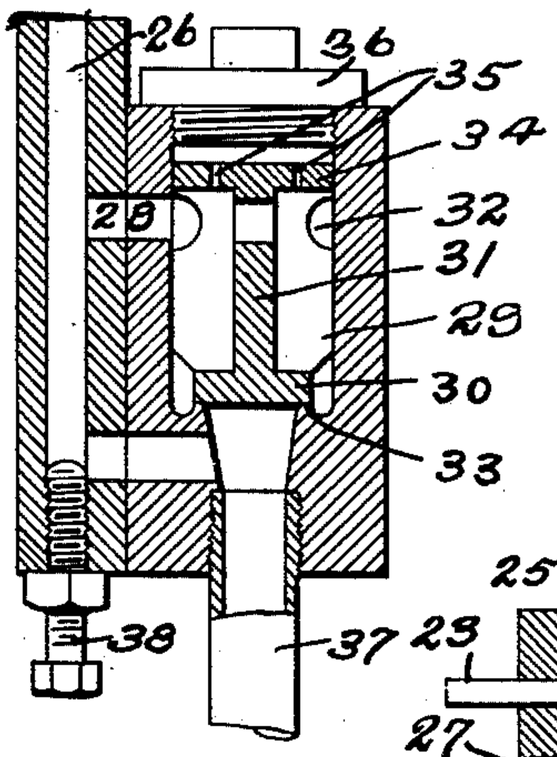

FIG. 6

FIG. 3.

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ENGINE.

(Application filed May 31, 1902.)

(No Model.)

4 Sheets—Sheet 4.

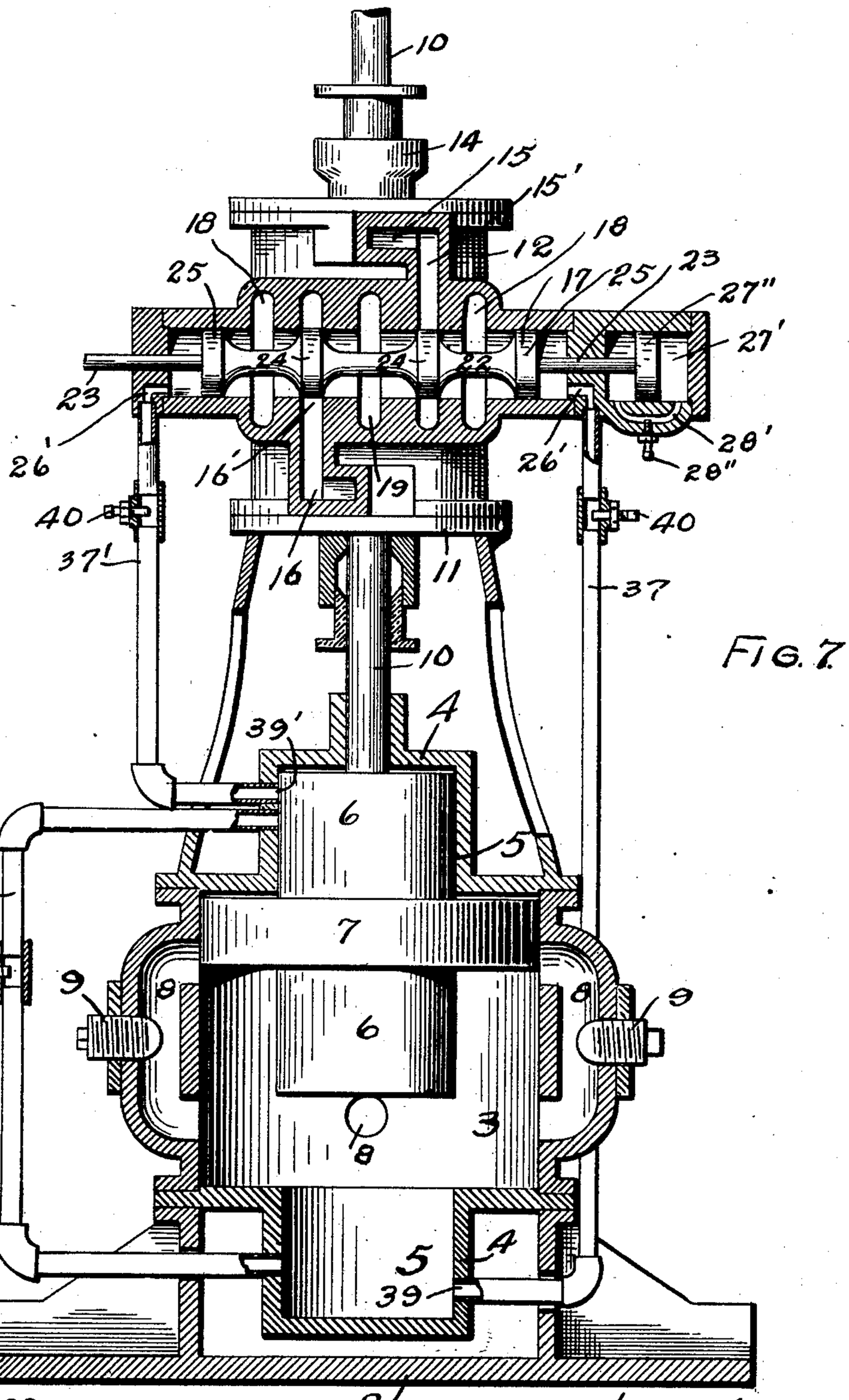

FIG. 7.

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Inventor
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UNITED STATES PATENT OFFICE.

EDWIN E. THOMAS, OF ST. PAUL, MINNESOTA, ASSIGNOR OF ONE-HALF TO UNION IRON WORKS, OF MINNEAPOLIS, MINNESOTA, A CORPORATION OF MINNESOTA.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 717,136, dated December 30, 1902.

Application filed May 31, 1902. Serial No. 109,629. (No model.)

To all whom it may concern:

Be it known that I, EDWIN E. THOMAS, of St. Paul, Ramsey county, Minnesota, have invented certain new and useful Improvements in Engines, of which the following is a specification.

My invention relates to engines that are capable of use wherever it is desired to impart a reciprocating movement to mechanism, though designed particularly for operating a gang-saw. This type of saw is usually driven from a crank-shaft, and the speed of the gang is comparatively slow, making only about three hundred strokes per minute, a high speed with the usual driving means or with an ordinary reciprocating-piston engine being practically impossible, owing to the danger of breakage arising from too-rapid motion and the consequent vibration, momentum, and shock of the reciprocating parts.

The primary object, therefore, of my invention is to greatly increase the capacity and efficiency of the gang-saw by providing means for driving the same at more than double the speed that can possibly be attained with any degree of safety by the ordinary driving mechanism now employed.

Other objects will appear from the following detailed description.

The invention consists generally in providing an engine of such construction that a direct driving connection may with perfect safety be made with the saw-gate.

Further, the invention consists in providing a steam-cylinder and an air-cylinder having pistons mounted on a common rod, and a piston-valve for said steam-cylinder connected with the ends of the air-cylinder and adapted to be operated by the compression of the air therein to alternately admit steam to the ends of the steam-cylinder.

Further, the invention consists in providing an air-cushion for the piston-valve.

Further, the invention consists in an improved form of check-valve.

Further, the invention consists in various constructions and combinations, all as hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a front elevation of a gang-saw frame, the feed-rolls and means for driving the same, and my improved saw-driving apparatus. Fig. 2 is a vertical transverse section of the engine or motor. Fig. 3 is a similar view on a line substantially at right angles to the section-line of Fig. 2. Fig. 4 is a section on the line $x\,x$ of Fig. 1. Fig. 5 is a section on the line $y\,y$ of Fig. 1. Fig. 6 is a detail of the check-valve. Fig. 7 illustrates a modified and preferred form of valve and connection.

In the drawings, 2 represents a suitable base, upon which I arrange an air-cylinder 3, having heads 4, provided with chambers or recesses 5 to receive the reduced ends 6 of the cylinder-piston 7. These ends or auxiliary pistons moving in advance of the air-cylinder piston proper allow the latter to approach close to the cylinder-heads and complete its stroke in each direction, and at the completion of such stroke the air is compressed by said reduced ends sufficiently to operate the steam-cylinder piston-valve. I prefer to employ these auxiliary pistons in connection with the air-cylinder piston; otherwise if the air-passages led directly into the main portion of the cylinder the air might be sufficiently compressed to operate the valve before the air-cylinder piston had completed its stroke.

The cylinder is provided in its side walls with air-passages 8, leading from one end to the other and having plugs 9, by means of which the passages may be enlarged or contracted to regulate the volume of air passing therethrough. The openings leading to the passages are a sufficient distance from the cylinder-heads to insure the requisite space for an air-cushion between the piston 7 and the heads and prevent contact between them. This distance may be varied, according to the diameter of piston and its probable momentum. The air-cylinder piston is provided with a rod 10, that extends up through a casting 11 and through a steam-cylinder 12, mounted on said casting and preferably of less diameter than said air-cylinder and having a piston 13 also mounted on the rod 10. Suitable stuffing-boxes 14, inclosing the piston-rod, are provided in the heads of the steam-

cylinder. In the ends of the steam-cylinder are ports 15 and 16, communicating with a valve-casing 17, preferably provided on the side of the cylinder between the ports. This valve-casing has annular passages 15′ and 16′, communicating, respectively, with the steam-cylinder ports and with corresponding passages 18 and 19, that lead, respectively, to the exhaust-pipes 20 and the live-steam pipe 21. A sliding piston-valve 22 is provided within said casing, having stems 23 projecting through the ends thereof to permit the operation of the valve by hand, if desired, and said valve corresponds, substantially, to the valves of this type in general use in that it has a series of annular grooves in its surface between which bridges 24 and 25 are provided that form substantially steam-tight joints with the wall of the casing and are adapted to alternately close the passages between the steam-cylinder ports and the live-steam and exhaust pipes as the valve is reciprocated. Near the ends of the valve-casing I provide air-ducts 26 and 27, which communicate with the interior of the casing at a point near the ends thereof, but a sufficient distance therefrom to afford space for an air-cushion to prevent the bridges 25 from coming in contact with the ends of the casing.

The air-ducts are each provided with branch ducts 28, that lead into valve-chambers 29, wherein I prefer to provide check-valves 30, having wings 31, provided with notches 32 to allow the air to pass around them and normally resting upon a seat 33. At the upper end of these valves is a disk 34, that forms a substantially close joint with the wall of the chamber and is provided with small holes 35 between the wings. The upper end of the chamber of each valve is closed by a screw-cap 36, and between said cap and the disk 34 an air-cushion is formed to prevent the pounding or hammering of the valve in the chamber, the holes 35 allowing the air to slowly escape and permitting the valve to rise from its seat and allow air to enter the chamber and pass through the branch duct 28 into the duct 26. The duct 26 communicates with a pipe 37 below the valve-seat 33, and I prefer to provide a plug 38 in each duct 26 to regulate the size of the opening therein and the volume of the air passing therethrough. These plugs may be adjusted to entirely close the lower end of the duct 26 and compel the air to pass through the check-valve, which closing thereafter will prevent premature escape of the air-cushion. The pipe 37 extends down beside the air-cylinder and communicates with a port 39, provided in the wall of the chamber 5 thereof, and the duct at the opposite end of the valve-casing 17 is provided with a pipe 37′, which communicates with the port 39′ in the chamber of the upper head of the air-cylinder. To control the volume of air passing through the pipes 37 and 37′, I prefer to provide plugs 40, acting as throttles to regulate the size of the openings through the pipe, and hence the volume of air passing therethrough to the valve. By means of these plugs or throttles I am able to regulate the volume of air delivered to the valve, according to the size of the valve and its ease of movement, the desired resistance of the air-cushions, and the speed of the engine.

It is desirable to prevent all pounding or hammering of the piston-valve, and hence an excess of air-pressure in the valve-casing should be avoided; but at the same time there should be sufficient pressure to insure the perfect working of the valve under adverse conditions, such as grinding or sticking. I therefore provide an air-cylinder piston of sufficient area to insure the compression of a volume of air which will operate the valve under all circumstances, and to regulate the air so compressed and prevent an excess of pressure in the valve-casing I prefer to provide a pipe 41, connecting the chambers 5 in the air-chamber between the ports 39 and 39′, so that the air ahead of the auxiliary piston as it enters its chamber may be conducted around the piston to the opposite chamber, and the air so led around the piston may be regulated or shut off altogether by means of the plug 42 and the desired air-pressure on the valve easily obtained.

In Fig. 7 I have shown a modification in the manner of conducting the air into the piston-valve casing and for cushioning the valve itself. This construction has advantages over that heretofore described, and I may prefer to use it in practice. It consists in dispensing with the check-valve and providing air-ducts 26′ in the ends of the valve-casing, through which the air is admitted from the pipes 37 and 37′, and in one end of the casing I provide a dash-pot appliance, consisting of a cylinder 27′, provided with a piston 27″, that is secured on the valve-stem. An air-passage 28′ is provided in the wall of the cylinder 27′, leading around the piston, and a plug 28″ permits the regulation of the volume of air passing through said passage. Where the air enters the valve-casing through its wall, there is a possibility of the valve when arrested by the air-cushion stopping over the port and preventing the intake of air to drive the valve in the opposite direction. With the ports in the ends of the casing this danger is entirely eliminated, and by providing the cylinder and piston on the end of the valve it is not necessary to regulate the admission of air to the valve-casing to obtain the desired resistance of the cushion. The piston 27″ will positively control the movement of the valve, making its travel uniform and regular, and by means of the plug 28″ the resistance to the movement of said piston can be accurately gaged, according to the size of the valve and the speed of the engine.

In Fig. 1 I have shown the apparatus connected to the gate of a gang-saw, 43 representing the lower end of the gate, and 44 the

coupling connecting the upper end of the piston-rod 10 thereto. This gate is vertically movable in the frame 45 and carries a series of saws 46, that are secured therein in the usual manner. 47 represents the feed-rolls operated by the usual mechanism 48, that is common to machines of this character, and hence requires no detailed description herein, the same forming no part of my invention.

Upon each side of the saws are the pressure-rolls 49, carried in frames 50, that are hinged on the framework 45 by means of lugs 51 and rods 52 passing therethrough. The removal of one of these rods allows the frame 50 on that side of the saw to be swung out to permit access to the saws. Upon the frame 50, on each side of the saws, are steam-cylinders 53, having sliding piston-valves 54, controlled by a lever 55, that is connected with said valve by a link 56 and a bell-crank 57. This pressure-roll-operating mechanism and the manner of supporting the same on the framework of the gang forms the subject-matter of a companion application herewith filed June 2, 1902, Serial No. 109,628, and I make no claim to the invention in this application. Any suitable means may be provided for supporting the gang above the operating-engine; but I have shown horizontal timbers 58, supported upon posts 59, that rest upon a base 60.

The operation of my improved engine or gang-operating mechanism is as follows: Steam being admitted through the port 16 beneath the steam-cylinder piston, both pistons will be raised to the upper ends of their cylinders. As the piston 7 opens the passages 8 behind it in its upward movement the air in front will be allowed to pass around to the rear of the piston, and no compression will take place until the piston 7 has closed the upper inlet-openings to the air-passages. From this point on toward the cylinder-head the air will be compressed and will act as a cushion to take up the momentum of the rapidly-moving parts and prevent shock and damage to the machinery arising from the contact of the pistons with the cylinder-heads. As the piston 7 approaches the point where it will close the air-passages leading around to it the reduced end 6 will enter the chamber or recess in the cylinder-head and compressing the air therein will force it up through the pipe 37 and the air-duct 27 into the valve-casing and move the valve toward the opposite end until its motion is arrested by the air-cushion or by the piston and cylinder device heretofore referred to. The travel of the valve, however, before being stopped will be sufficient to close the passage leading from the live-steam pipe to the port 16 and open the passage from said pipe to the port 15. Steam will then enter the steam-cylinder above its piston, and both pistons will immediately begin to descend. The piston 7, approaching the lower head 4, will, as before described with reference to its opposite movement, allow the air to escape until the piston passes the open mouths of the air-passages and approaches the cylinder-head, when the cushion will be formed as before and the momentum and shock taken up. The air will be driven through the pipe 37 into the right-hand end of the valve chamber or casing behind the valve, which will be moved toward the left, closing the upper steam-port to the live steam and opening it to the exhaust. It may be necessary in starting to set the valve by hand; but after that the valve and engine will continue to operate until steam is shut off from the steam-cylinder. The valve will automatically adjust itself to its different positions, and should it for any reason during the operation of the engine get out of stroke and not move in unison with the reciprocating pistons it can be readily set by hand.

I have shown my improved form of engine adapted for use with a gang-saw; but it will be understood that it is equally applicable wherever it is desired to drive a reciprocating mechanism at a higher speed than would be practicable for the appliances that have heretofore been used for this purpose.

I claim as my invention—

1. An engine, comprising a steam and an air cylinder provided with pistons on a common rod, the air-cylinder piston having reduced extensions forming auxiliary pistons on each end, said air-cylinder having chambers in its ends corresponding in form and adapted to receive said reduced extensions, a floating piston-valve open to the steam supply and exhaust and having passages communicating respectively with the ends of said steam-cylinder and with the chambers in the ends of said air-cylinder.

2. An engine, comprising a steam and an air cylinder provided with pistons on a common rod, said air-cylinder being provided in its wall with air-passages leading past the middle thereof and opening into the ends near the cylinder-heads and having means for regulating the volume of air passing therethrough, a sliding piston-valve having ports in its casing communicating with the steam supply and the exhaust, ducts or passages leading from said valve and communicating respectively with the ends of said cylinders and a cushion stop device connected with said valve.

3. An engine, comprising a steam and an air cylinder provided with pistons on a common rod, the air-cylinder piston having reduced extensions on each end and said air-cylinder having air-passages in its walls leading around its piston from one end to the other, and means for regulating the flow of air therethrough, the ends of said air-cylinder having chambers corresponding in form and adapted to receive said reduced extensions, and the openings leading to said air-passages being a sufficient distance from the

heads of the main portion of said air-cylinder to allow for the formation of air-cushions between said heads and the middle portion of said piston, a sliding valve having its casing provided with ports communicating with the exhaust and the live steam, and suitable passages or ducts leading from said valve to said steam-cylinder and to said chambers.

4. An engine, comprising a steam and an air cylinder having their pistons on a common rod, a floating piston-valve open to the steam and exhaust pipes and having passages communicating respectively with the ends of said cylinders and adapted when reciprocated to alternately shut off the admission of steam to the steam-cylinder passages and open them to the exhaust, and a cushion stop device connected with said valve.

5. An engine, comprising a steam and an air cylinder provided with pistons on a common rod, said air-cylinder having chambers in its ends to receive correspondingly-shaped extensions on the opposite sides of its piston, a sliding piston-valve open to the steam supply and exhaust and communicating respectively with said steam-cylinder and with said chambers.

6. An engine, comprising a steam and an air cylinder having their pistons connected, a sliding piston-valve having passages communicating respectively with the ends of said cylinders and adapted when reciprocated by the compression of the air in the ends of said air-cylinder to alternately shut off the admission of steam to the steam-cylinder passages and open them to the exhaust, and an air-cushion stop device connected with said valve.

7. An engine, comprising a steam and an air cylinder having their pistons on a common rod, a sliding piston-valve open to the steam and exhaust pipes and having passages communicating respectively with the ends of said cylinders and adapted when reciprocated by the pressure of the air generated by the movement of said air-cylinder piston to alternately shut off the admission of steam to the steam-cylinder passages and open them to the exhaust, and a cylinder provided at one end of said valve and having its piston connected with said valve-stem.

8. An engine, comprising a steam and an air cylinder having their pistons connected, a sliding piston-valve having passages communicating respectively with the ends of said cylinders, a cushion stop device comprising a cylinder provided at the end of said valve and having its piston connected with the stem thereof, and an air-duct in the wall of said cushion stop-cylinder leading around its piston and having a suitable throttle whereby the resistance of the cushion to the movement of the valve may be controlled.

In witness whereof I have hereunto set my hand this 27th day of May, 1902.

EDWIN E. THOMAS.

In presence of—
RICHARD PAUL,
M. C. NOONAN.