No. 672,340.

Patented Apr. 16, 1901.

J. E. SWEET.

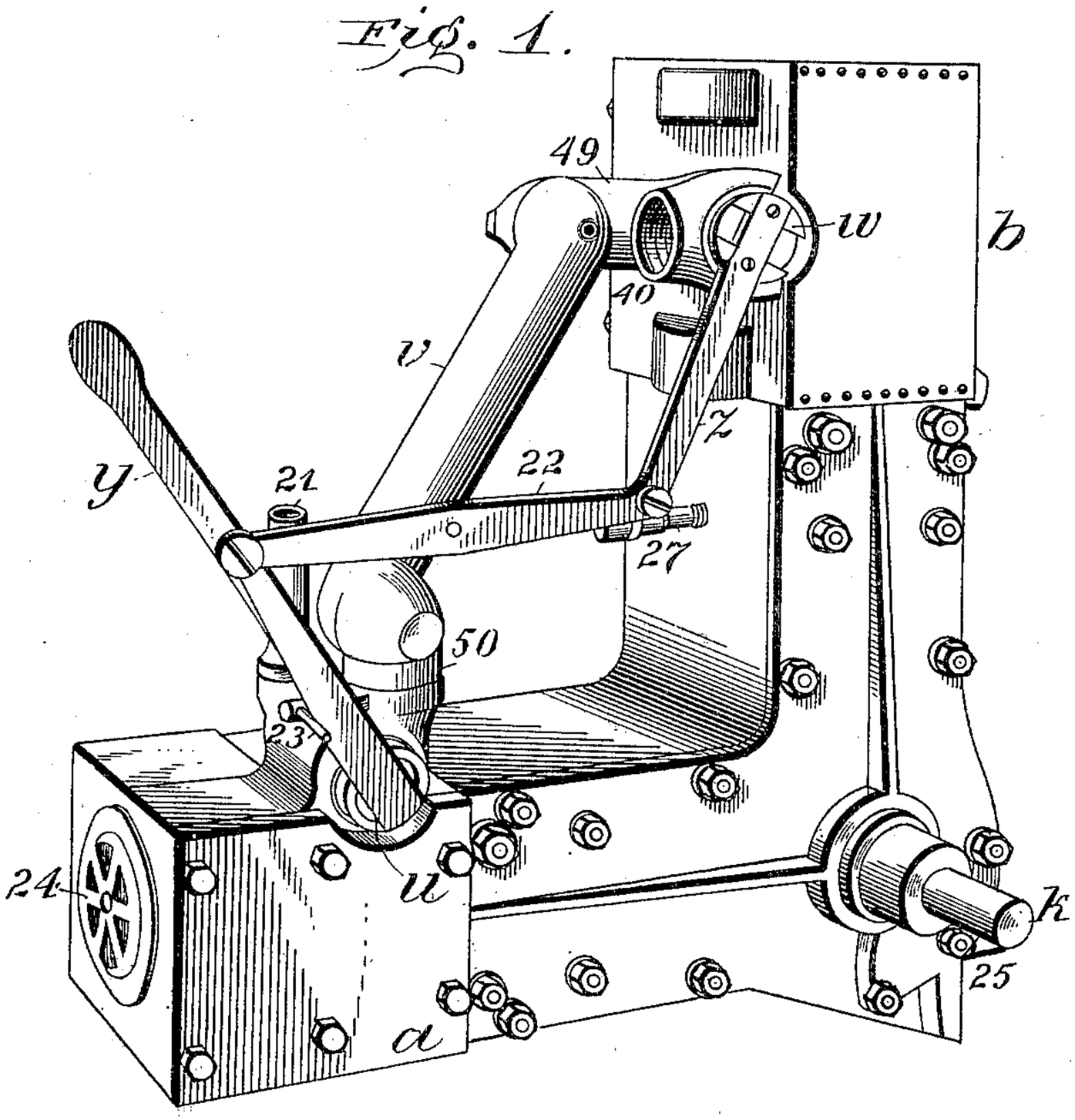
STEAM ENGINE.

(Application filed Aug. 9, 1900.)

(No Model.)

6 Sheets—Sheet 1.

Fig. 1.



Witnesses:

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H. G. Wilson.

Inventor:

John E. Sweet:

By Henry A. Bates,

Atty

No. 672,340. Patented Apr. 16, 1901.

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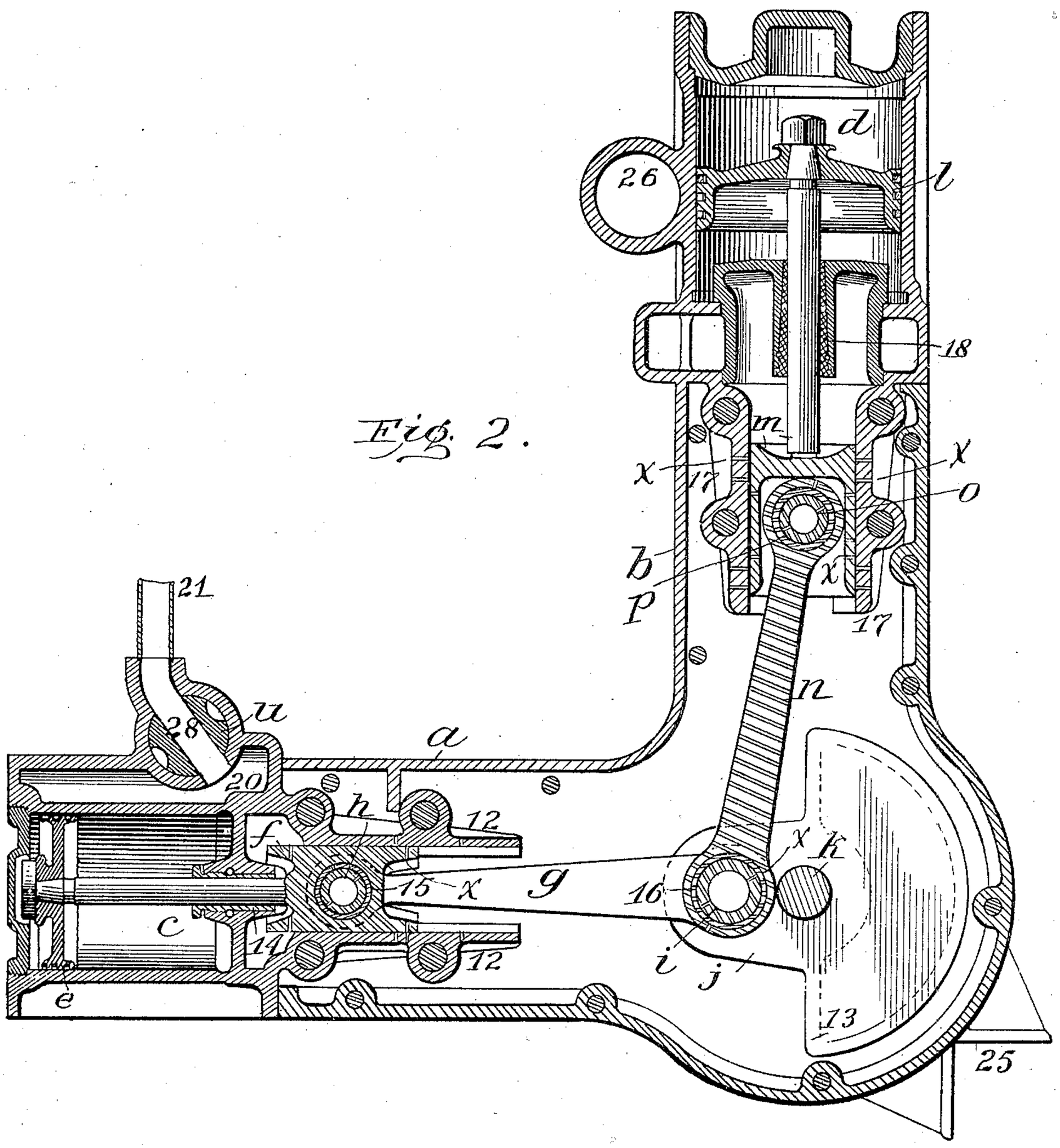
(No Model.) 6 Sheets—Sheet 2.

Fig. 2.



Witnesses:
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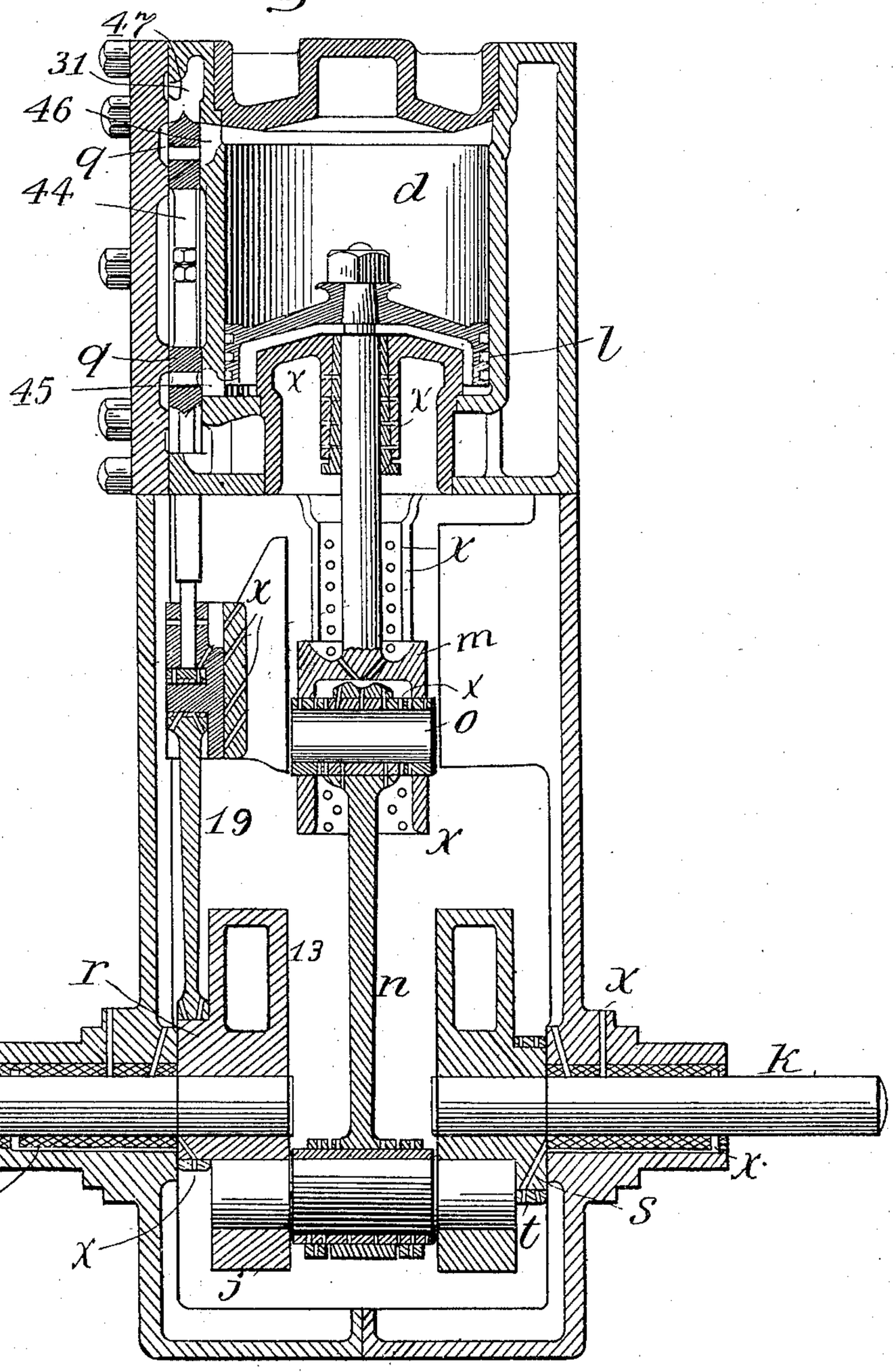
(No Model.) 6 Sheets—Sheet 3.

Fig. 3.



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(No Model.) 6 Sheets—Sheet 4.

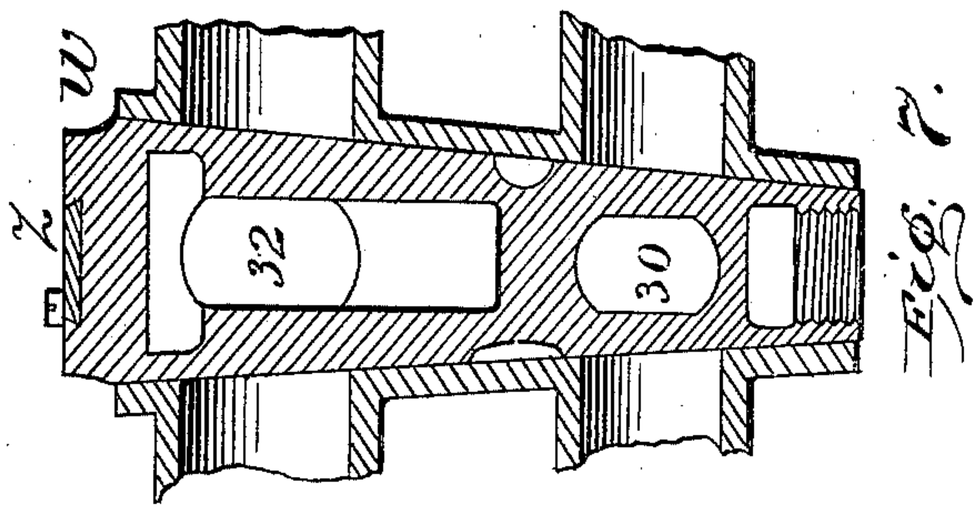

Fig. 7.

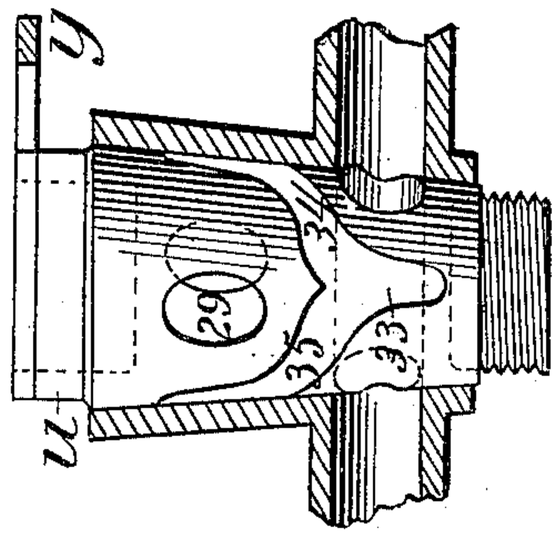

Fig. 11.

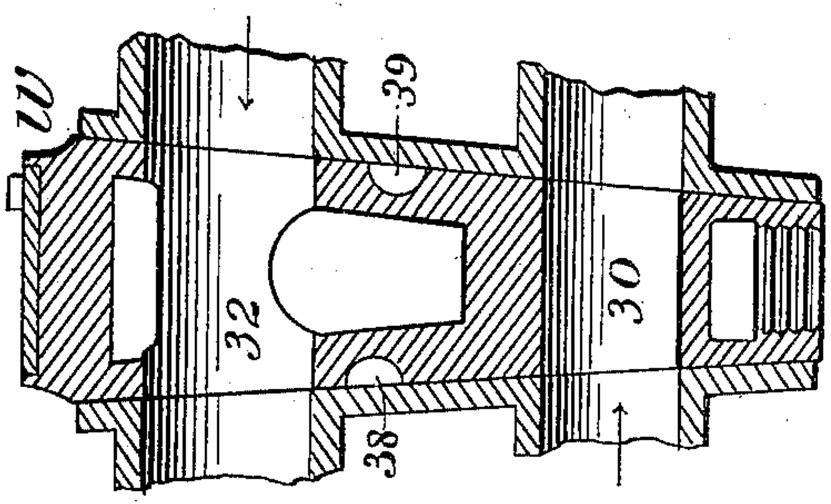

Fig. 6.

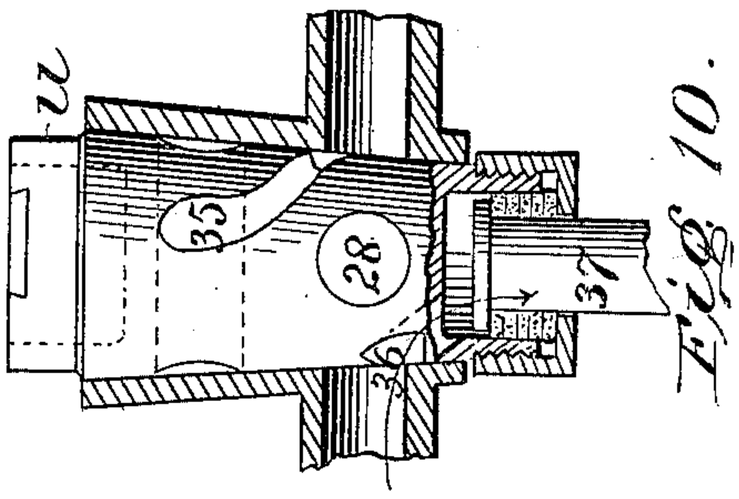

Fig. 10.

Fig. 5.

Fig. 9.

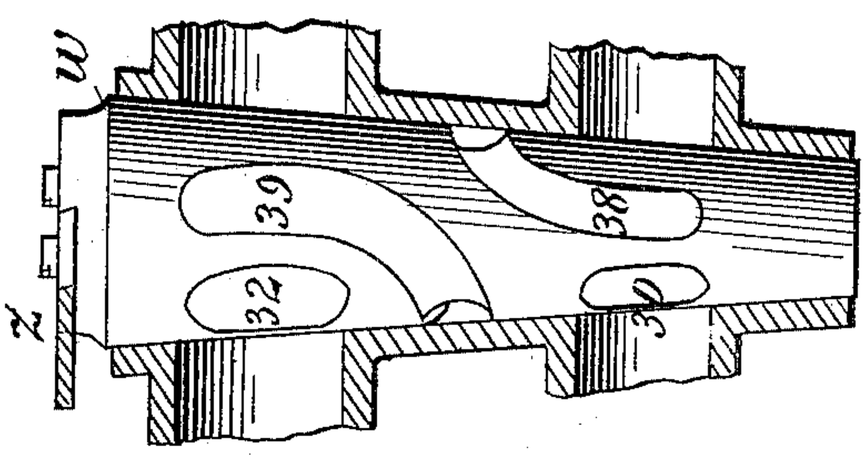

Fig. 4.

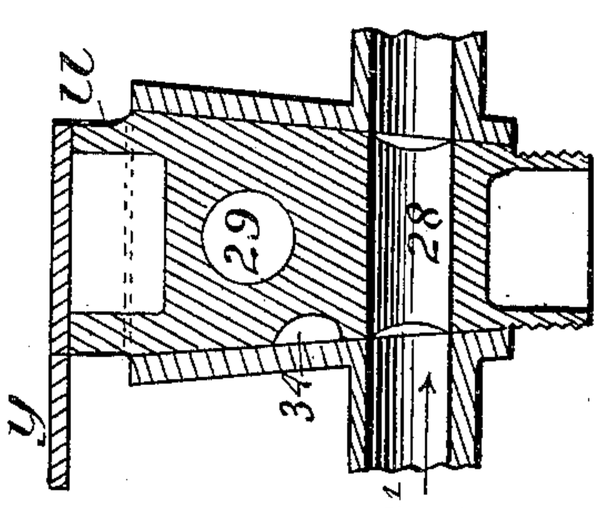

Fig. 8.

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(Application filed Aug. 9, 1900.)

(No Model.)

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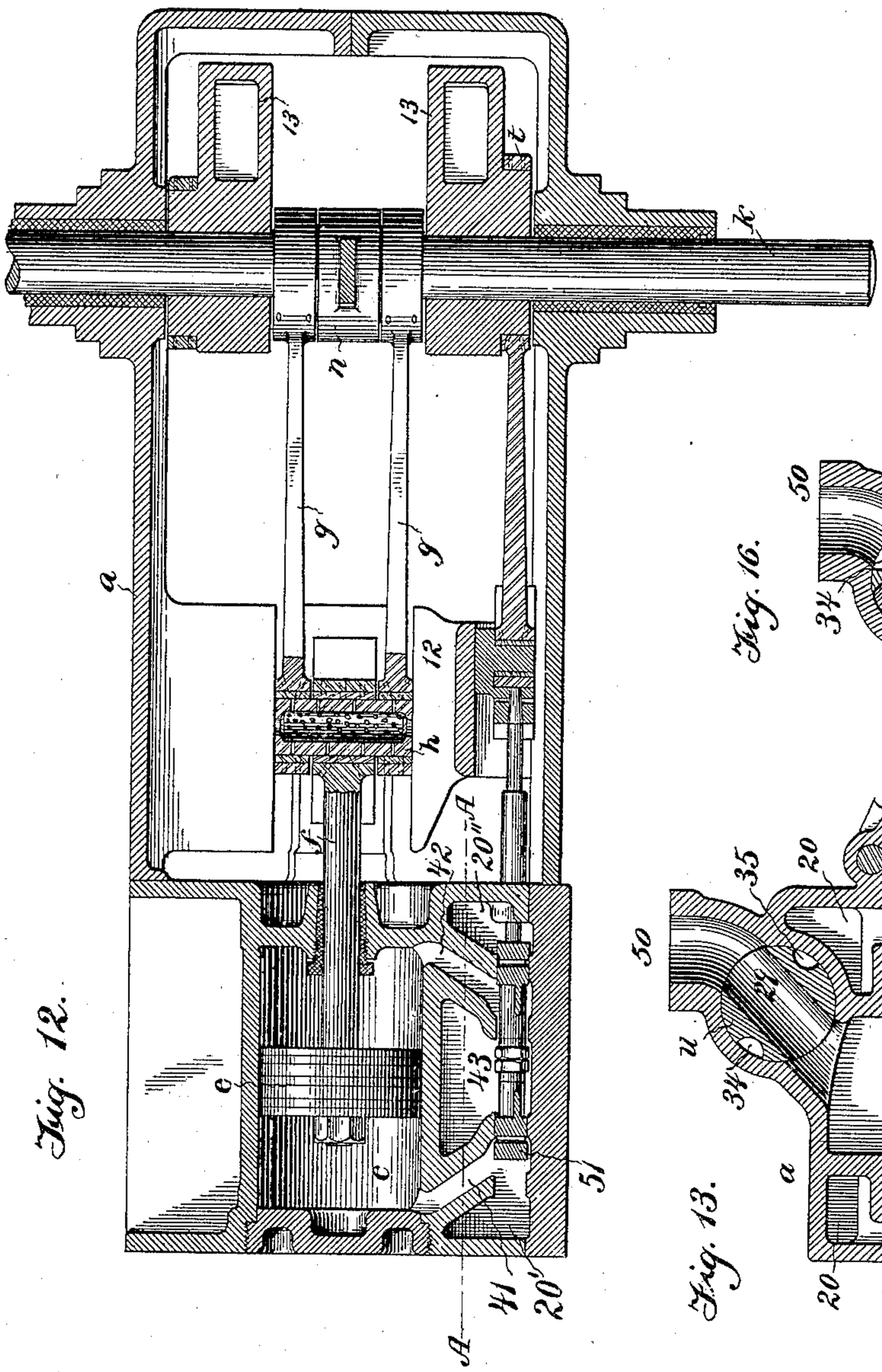

Fig. 12.

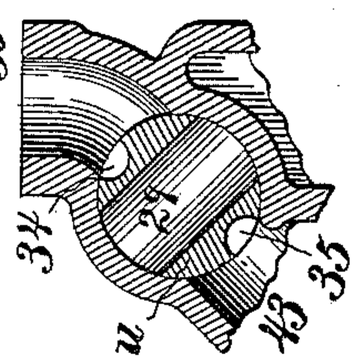

Fig. 16.

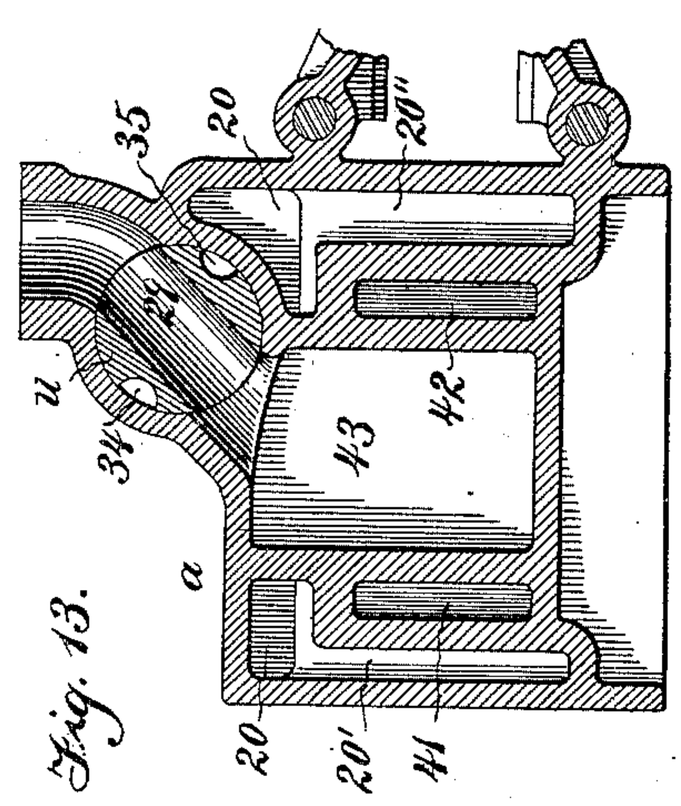

Fig. 13.

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No. 672,340. Patented Apr. 16, 1901.

J. E. SWEET.

STEAM ENGINE.

(Application filed Aug. 9, 1900.)

(No Model.) 6 Sheets—Sheet 6.

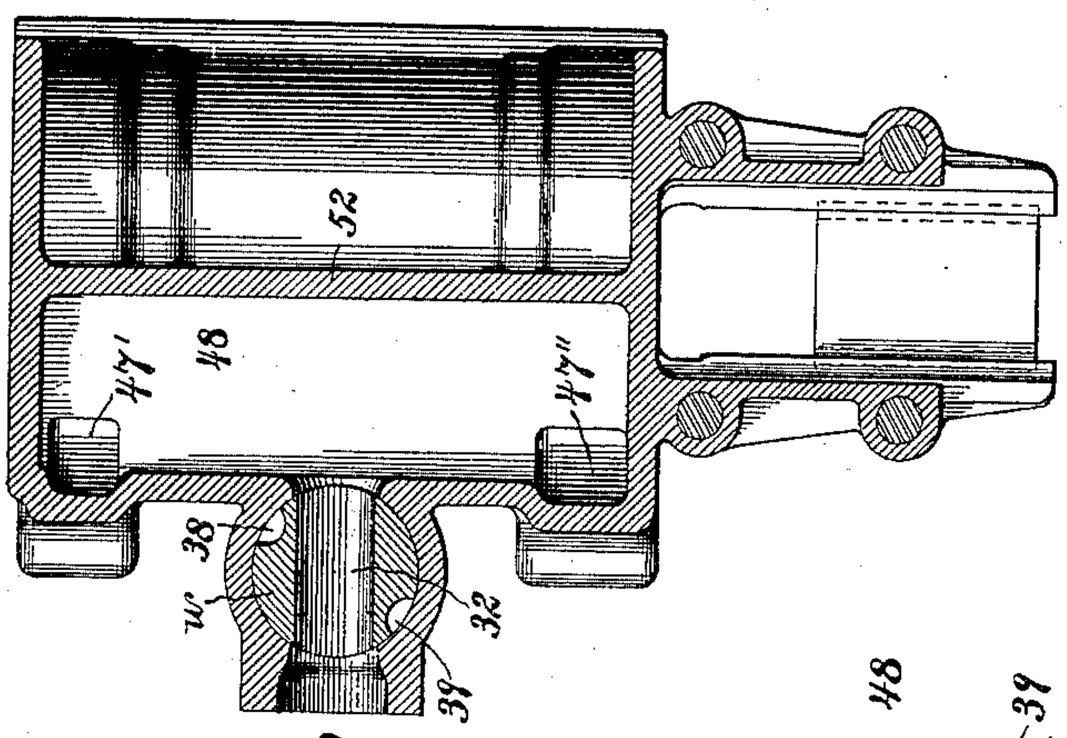

Fig. 15.

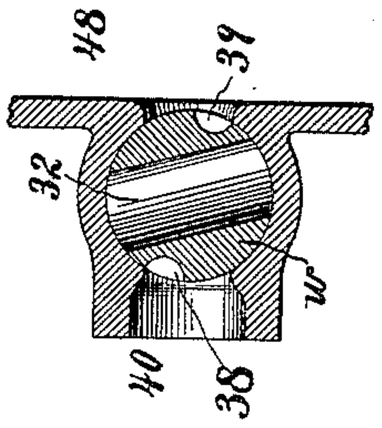

Fig. 18.

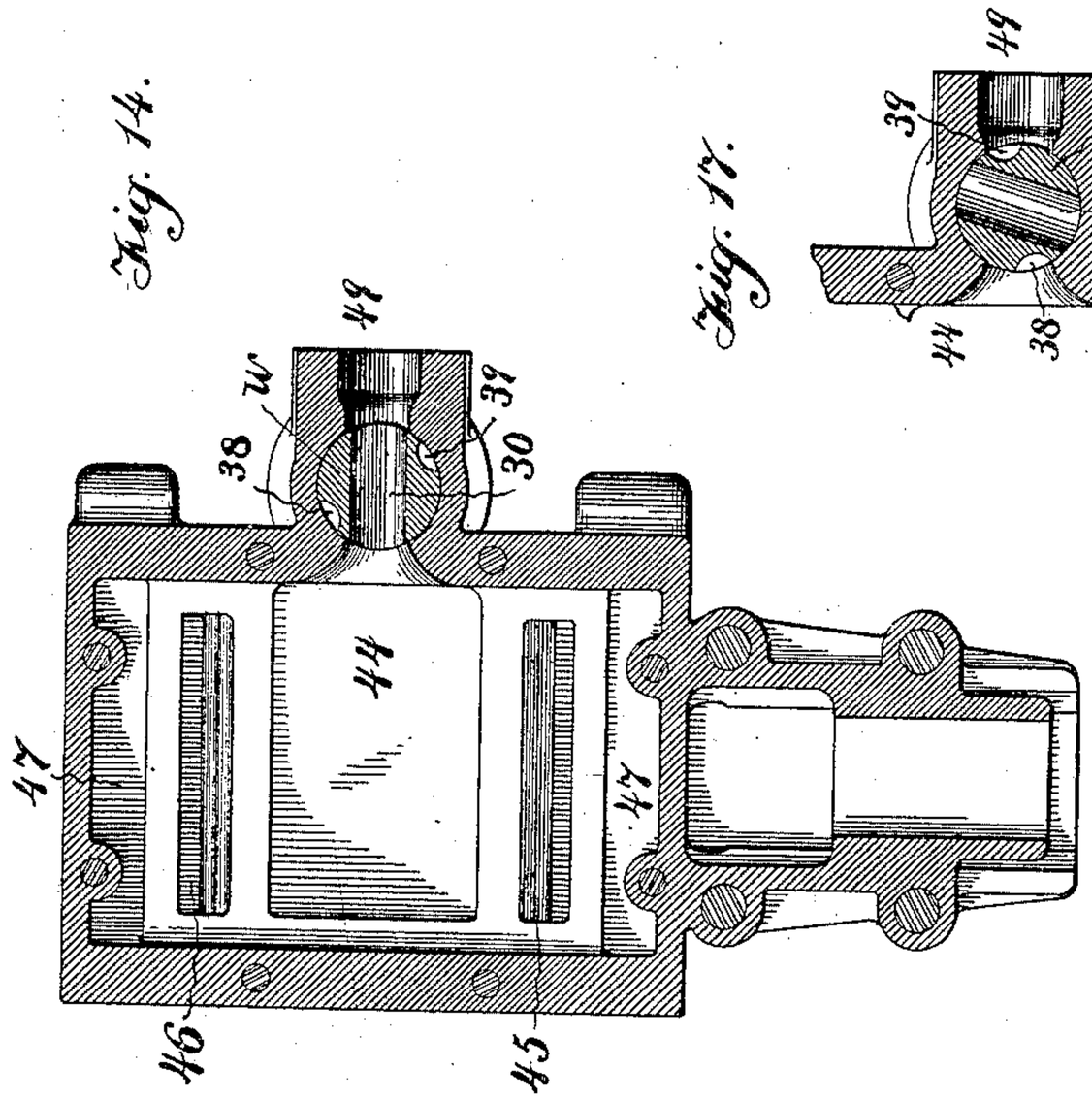

Fig. 14.

Fig. 17.

Witnesses
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M. J. Dixon

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UNITED STATES PATENT OFFICE.

JOHN E. SWEET, OF SYRACUSE, NEW YORK, ASSIGNOR OF TWO-THIRDS TO WILLIAM B. COGSWELL AND FRANK M. BONTA, OF SAME PLACE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 672,340, dated April 16, 1901.

Application filed August 9, 1900. Serial No. 26,390. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. SWEET, a citizen of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to steam-engines adapted for self-moving vehicles known as "automobiles," the object being to produce an engine of great compactness, as noiseless as possible, economical in working, perfectly balanced, safe in unskilled hands, proof against derangement except by actual breakage, inclosed so as to be protected from dust and dirt and from tampering, and self-oiled from a single source; also to obtain simple and easy reversal and regulation of speed with great backing power, safely applied, all by means of a single lever, which controls the starting, stopping, backing, and rate of travel by a simple and natural transition movement.

The nature of the invention consists in the novel combination of well-known mechanical elements and means adapted to secure the above-enumerated results, as set forth in the following specification and illustrated by the drawings accompanying the same and forming a part thereof, in which—

Figure 1 is a perspective view of the engine. Fig. 2 is a vertical section thereof central and at right angles to the main shaft. Fig. 3 is a vertical section central through the main shaft (shaft not in section) looking from the front. Figs. 4 to 11, inclusive, are diagrammatic views showing the plug-valves *u* and *w* in various positions. Fig. 4 shows the turn-valve *w* of the low-pressure cylinder (casing in section) at that angle where direct inlet and exhaust passages 30 32 are partially cut off and showing winding recessed passages 38 39 fully cut off. Fig. 5 is a view of the valve *w* (casing in section) in the position which it assumes on reversal when direct passages 30 32 are cut off and the winding passages 38 39 are coming into operation, as in Figs. 17 and 18. Fig. 6 is a sectional view of valve *w*, showing steam-ports 30 32 in position to connect with the intermediate receiver and the exit-passage, respectively, as in Figs. 14 and 15. Fig. 7 is a sectional view of valve *w* in the same position as in Fig. 5. Fig. 8 is a sectional view of the turn-valve *u* of the high-pressure cylinder (casing also in section) in the position which it occupies in Figs. 1 and 2 with live-steam inlet-aperture 28 fully turned on and exhaust-aperture 29 turned so as to supply receiver *v* and the low-pressure cylinder. Fig. 9 is a view of valve *u* in same position as in the sectional Fig. 8, the outlet-passage 36 appearing and also a portion of the branch 34 of the branched recess, hereinafter described. Fig. 10 shows valve *u* in a position at right angles to that shown in Figs. 8 and 9, the branch recess being in the position for reversing and backing and the exhaust being through aperture 36 and pipe 37. Fig. 11 shows valve *u* in an intermediate position advanced beyond that of Fig. 10, so as to show branched recess 33, with its branched passages 34 35. Fig. 12 is a horizontal section central through the main shaft and high-pressure cylinder, showing the steam-chest, steam-ports, and working valves of the high-pressure cylinder in section. Fig. 13 is a vertical section through the steam-chest and steam-ports of the high-pressure cylinder on line A A of Fig. 12, showing the exhaust-port of the hand-operated plug-valve *u* in operative position. Fig. 14 is a vertical longitudinal section through the steam-chest of the upper or low-pressure cylinder in the plane of rotation of the inlet-port 30 of plug-valve *w*, showing the steam ports and passages. Fig. 15 is a vertical longitudinal section through the steam-chamber 48 of member *b*, taken in the plane of rotation of exit-port 32 of plug-valve *w*, showing the passages connecting said chamber with the steam-chest of the upper or low-pressure cylinder. Fig. 16 is a vertical section through plug-valve *u* in the same plane as Fig. 13, showing the position of said valve and its branched passages when reversed for backing. Fig. 17 is a vertical section through plug-valve *w* in the same plane as Fig. 14,

showing the position of passage 30 and its winding passages 38 39 when reversed for backing. Fig. 18 is a vertical section through plug-valve *w* in the same plane as Fig. 15, showing the position of passage 32 and winding passages 38 39 when reversed for backing.

Like letters and numerals indicate like parts in the several figures.

a is the horizontal branch of the casing of the engine, in which is located the high-pressure cylinder *c*.

b is the vertical branch of the casing, at right angles to *a*, in which is located the low-pressure cylinder *d*, taking steam from the high-pressure cylinder in the direct or forward movement in the manner of compound engines, with the object of economy and also to reduce the exhaust-pressure and consequent noise arising therefrom. These two cylinders are set at right angles to each other, so as to admit of a perfect balance and coöperate with maximum effect at each quarter-revolution, being connected by suitable connecting-rods to the single main crank and shaft.

e is the piston of the high-pressure cylinder. *f* is the piston-rod and cross-head, all in one piece, the latter moving in the parallel ways 12 12.

g is one of the connecting-rods or pitmen linking the cross-head to the main crank-pin. These connecting-rods are in a pair for constructive reasons.

h is the cross-head pin.

i is the engine crank-pin.

The cross-head pins, as well as the crank-pin, are not only bushed, but are fitted so as to revolve relatively either in the cross-heads or in the connecting-rod, thus furnishing a choice of wearing-surfaces in favor of the one of least resistance.

j is the main crank, and *k* the main crank-shaft.

13 is the counterbalance of the main crank.

14 is the bushing of the piston-rod *f*, 15 the bushing of the cross-head pin *h*, and 16 the bushing of the main crank-pin.

l is the piston of the low-pressure cylinder *d*.

m is the piston-rod and cross-head, all in one piece, 17 17 the parallel ways for said cross-head, *n* the connecting-rod between the cross-head *m* and the main crank-pin *i*, placed centrally and therefore between the two connecting-rods of the high-pressure branch.

o is the cross-head pin, 18 the bushing for the piston-rod *m*, and *p* the bushing for the cross-head pin *o*.

q, Fig. 3, is the slide-valve for low-pressure cylinder *d*, and 19 the connecting-rod therefor.

r is the eccentric for said valve.

s is the eccentric for the slide-valve of the high-pressure cylinder. This valve is shown in Fig. 12 and is similar to the valve of the low-pressure cylinder. *t* is the connecting-rod strap for said valve.

20 is the steam-chest of the high-pressure cylinder.

u is a plug-cock or turn-valve controlling the admission and exit of steam to the engine from the pipe 21.

v is an intermediate receiver forming the communication between the two cylinders.

w is a plug-cock or turn-valve controlling the admission and exit of steam to and from the low-pressure cylinder.

y is a hand-lever controlling the position of turn-valve *u*, and *z* is a lever controlling the position of turn-valve *w*. These two valves are linked together by link 22.

23 is a stop to limit the movement of lever *y*.

24 is the cylinder-head of high-pressure cylinder *c*.

25 is an angular seat or abutment for seating the engine on the cross-tree of the vehicle to which it is applied.

26 is the seat of valve *w*.

27 is a pipe for the introduction of oil into the casing.

x represents holes and passages in various parts of the mechanism for conducting oil for lubricating purposes to the frictional surfaces requiring lubrication.

The plug-valves *u* and *w* are of peculiar construction, which requires specific description. In addition to the direct passages 28 29 through valve *u* at right angles to each other in different rotational planes, Fig. 8, said valve has an indirect branched passage 33 35 36, Fig. 11, incised in its circumference, the object being a provision to convey live steam from inlet-pipe 21 in two directions, one branch leading to the exhaust side of steam-cylinder *c* when the valve is reversed and the other branch leading to the intermediate receiver *v* for a purpose presently to be explained. Obviously the said branched passage might penetrate the valve by direct paths instead of being cut in the surface, so that they reached the same points, this being a matter simply of economy in construction. In the valve *w* also, in addition to the direct passages 30 32 diametrically through it in the same axial plane, but in different rotational planes, there are the sigmoidal passages 38 39, Fig. 4, cut in its periphery, each winding through a semicircumference from one of said planes of rotation to the other from opposite sides without interfering, as from entrance-port 49 of the low-pressure steam-chest to a point opposite exit-port 40, and vice versa. The object will be presently explained.

Referring now to Figs. 12 and 13, 20′ and 20″ are passages in the steam-chamber of the high-pressure cylinder connected with chamber 20 and leading to steam-ports 41 42. 51 is the slide-valve in the steam-chest of cylinder *c*. 43 is the exhaust-chamber connecting with intermediate receiver *v* by passage 50.

In the figures relating to the low-pressure cylinder 44 is the steam-chest thereof. 45 46 are steam-ports; 47, a steam-chamber; 47′ 47″, steam-passages leading from chamber 47 to steam-chamber 48 opposite the exit-port 40 on the other side from steam-chest 44, which

is opposite inlet-port 49. 52 is the diaphragm rear wall of chamber 48, limiting its capacity.

The framing of the engine is an oil-tight casing, and the system of lubrication is that which is known as "splash-oiling," the case being partially filled with oil, which is thrown over the various working parts by the movements thereof, the oil gaining access to the frictional surfaces by means of the numerous holes and passages provided for that purpose, this being a novel feature.

Oil has heretofore been conducted to a wearing-surface by means of oil-passages through the solid portion above the revolving or sliding surface; but in my improvement I lubricate the parts from both sides, making numerous apertures and passages through both the ways and the cross-heads which slide upon said ways, through both the eccentric and the eccentric-strap, through the cross-heads and the cross-head pins, and through the bushings. The oil thus reaches the wearing-surfaces from both sides by perforated surfaces, making an automatic lubrication requiring no attention as long as the oil-case is clean and properly supplied with oil. The cross-heads and crank-pin are hollow, as shown in the drawings, to admit of this double access of lubricant. As above stated, these pins rotate in their bearings as well as in the connecting-rod sockets, which not only increases the wearing-surface and gives a choice of wearing-surfaces, according to frictional resistance, but by permitting such rotation or shifting of position tends to obviate the constant wear on the side of the thrust which in time robs the pin of its cylindrical form, increases friction, and destroys the fit of the contacting parts.

The plug-valves *u w* being in the position shown in Figs. 1 and 2, steam enters direct from the boiler through the pipe 21 to the steam-chest of the high-pressure cylinder *c* through port 28 of valve *u* by way of chamber 20, Figs. 2 and 13. Said chamber is in direct communication with the steam-chest by passages 20′ 20″, forming a portion thereof. From 20′, supposing the slide-valve 51 to be in the position shown in Fig. 12, steam passes through port 41 to the outer side of piston *e*, driving it forward. The steam from the inner or exhaust side of the piston at the same time passes out through port 42 to exhaust-chamber 43, and thence out through port 29 of valve *u* to the intermediate receiver *v*, connected to the steam-chest at 50, Fig. 1. From the intermediate receiver the exhaust-steam passes through port 30 of valve *w*, Fig. 14, to the steam-chest 44 of the low-pressure cylinder *d*, Figs. 3 and 14, whence it passes (valve *q* being supposed to be now in the lower position) through steam-port 45 to the under side of piston *l*. At the same time the exhaust-steam from the upper side of the piston is passing out through steam-port 46 to chamber 47, Figs. 3 and 14, which is in communication by passage 47′ with steam-chamber 48, Fig. 15, whence the steam passes to chamber 48, and thence through steam-port 32 of valve *w* out to the atmosphere through exit-pipe 40, Figs. 1 and 15. So much for the direct working. By operating the hand-lever *y* more or less, so as to vary the amount of steam-inlet, the valve *u* becomes a throttle-valve and controls the speed of the machine. By operating the hand-lever so as to turn both valves a little less than one-fourth of a revolution the direct admission of steam is cut off and the engine stops. By pushing the lever a little farther, so as to turn the valves rather more than one-fourth of a revolution, as shown in Figs. 16 and 17, reversal is effected. In this position the pointed terminal 33 of the branched passage of valve *u*, Figs. 10 and 11, which is in the same plane of rotation as passage 28, but nearly in the same axial plane as passage 29, comes opposite steam-passage 21, the current of live steam from which enters the branch channels 34 and 35 and is divided, one half going to chamber 43, Fig. 13, through passage 35, Fig. 16, and the other half proceeding by branch passage 34 to the intermediate receiver *v* through passage 50, thus filling said receiver with live steam at boiler pressure simultaneously with live steam in the steam-chest of the high-pressure cylinder on the side of the piston fed by port 42. The live steam thus introduced into chamber 43 and port 42, Figs. 12 and 13, forces the piston *e* to reverse the direction of its motion, and the exhaust-steam from the other side of the piston flows through port 41 and passage 20′ to chamber 20 and thence out through port 36, Figs. 9 and 10, and pipe 37 to the atmosphere, the port 36 being so located in valve *u*, nearly in the plane of rotation of passage 28, as to come opposite the inlet 21, where there is a passage from chamber 20 at the same time that the branch passage 35 is forming the connection between steam-pipe 21 and chamber 43. By the reversal of the valve *w* simultaneously with the valve *u* through the link connection 22, Fig. 1, the live steam now in the intermediate receiver *v*, which, as stated above, is at boiler pressure, instead of passing through aperture 30, as in direct action, and thence to the under side of piston *l*, goes through the winding passage 39, Fig. 17, now in position opposite inlet 49, crossing over to a point opposite exit-port 40, Fig. 18, whence it escapes into chamber 48 and thence passes through passage 47′ into chamber 47 and gains access to the upper side of the piston through port 46, thereby reversing the direction of motion of said piston, while at the same time the steam from the under side thereof exhausts out through port 45 to chamber 44, thence entering the winding passage 38 in valve *w*, the terminal of which is now opposite passage 49, Fig. 17, and passing across to exit-aperture 40, Fig. 18, whence it escapes into the atmosphere. The live steam by this route has thus simultaneously entered both cylinders by a divided path and has exhausted out from both

cylinders by separate paths all by means of the extra or provisional passages in the valves *u* and *w*, whose functions are independent of and superadded to those of the ordinary or direct passages 28 29 30 32. By this device a powerful means of suddenly arresting and reversing motion is provided in case of emergency or whenever backing is required and all under control of the single hand-lever by which the entire operation of the engine is directed and regulated. Owing to the narrowness of the passages in the valves *u* and *w* the powerful backing action is designedly slow, which affords the needed element of safety.

I claim and desire to secure by Letters Patent—

1. In a steam-engine, two cylinders of different sizes, having pistons connected to a common crank at right angles, said cylinders and working parts inclosed in an oil-tight case, a connecting passage to place the cylinders in compound relation, valves at the extremities of said connecting-passage, with means for causing the valves to move together, and passages in said valves leading live steam to one cylinder and exhaust-steam to the other cylinder in one position, and sending live steam to both cylinders in the reversed position, substantially as specified.

2. In a steam-engine, two cylinders of different sizes, a connecting-passage placing them in compound relation, plug-valves controlling the admission of steam to both cylinders, a mechanical connection to cause said valves to move together, direct passages through said valves whereby steam enters both cylinders and exhausts simultaneously but in compound relation, and indirect passages in said valves whereby on reversal live steam enters both cylinders simultaneously and reversely, and exhaust-steam escapes by two separate paths to the atmosphere, substantially as specified.

3. In a steam-engine, two cylinders of different sizes, with connecting-passage to place them in compound relation, a plug-valve controlling the entrance and exit of steam to and from the smaller cylinder, said valve having direct passages through it in different axial planes and in different planes of rotation, and an indirect branched passage unconnected with said direct passages, the direct passages coöperating with the inlet and exhaust passages of the cylinder when in position for direct operation, the branched passage coöperating with the inlet and exhaust passages when in position for reversed operation, and an independent exhaust-passage in said valve communicating with the atmosphere when in reversed position, substantially as specified.

4. In a steam-engine, two cylinders of different sizes, with connecting-passage to place them in compound relation, a plug-valve controlling the entrance and exit of steam to and from the larger cylinder, said valve having direct passages through it in the same axial plane but in different planes of rotation, and having two indirect winding passages therein, unconnected with said direct passages, the direct passages coöperating with the inlet and exhaust passages of the cylinder respectively when working directly, and the winding passages coöperating with the inlet and exhaust passages respectively when working reversely, substantially as specified.

5. In a steam-engine, two cylinders of different sizes having pistons connected to a common crank, a connecting-passage to place the cylinders in compound relation, a single hand-lever to control starting, rate of speed, stopping, and backing, and valves connected to each cylinder and to said hand-lever, provided with passages for working the cylinders compound when working directly and other passages for working both cylinders with live steam when working reversely, substantially as specified.

6. In a steam-engine, two cylinders of different sizes having pistons connected to a common crank, a connecting-passage to place the cylinders in compound relation, hand-operated valves for admitting and releasing steam to and from said cylinders, a mechanical connection between said valves to cause them to move together, four passages in each valve, two of which in each valve coöperate in direct working, in compound relation, two of which in each valve coöperate in reverse working in independent relation, and a fifth passage affording an independent exhaust-outlet for the smaller cylinder when working reversely, substantially as specified.

7. In a motive engine, having a crank, a cross-head, and a connecting-rod between said members, pins for making the connections at each end of said connecting-rod, said pins being free to turn both in the connecting-rod and in the part to which it is connected, whereby the number of wearing-surfaces is increased and the cylindrical form of the pin maintained, substantially as specified.

8. In a motive engine whereof the working parts are inclosed in an oil-tight case, apertures or passages in each of the opposed members of said working parts which are in sliding contact, leading to the surfaces which move on each other from both sides, whereby each surface, whether moving or fixed, receives lubricant from and through the opposed member, substantially as specified.

9. In a motive engine having reciprocating cross-heads, a crank, and connecting-rods connecting said cross-heads and crank, pins forming the connections between the connecting-rods, cross-heads, and crank-arms, said pins being hollow, open at the ends, perforated in the walls, and free to turn in either of the members of which it forms the connection, substantially as specified.

10. In a motive engine, two cylinders having pistons connected to a common crank at right angles, said cylinders and working parts

inclosed in an oil-tight case, plug-valves controlling the admission and exit of steam to and from both cylinders, a mechanical connection to cause said valves to move together, an intermediate passage between said valves connecting said cylinders, and four passages in each valve, two of which in each valve cooperate in direct working, and two of which in each valve coöperate in reverse working, when said valves are turned through substantially a right angle, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN E. SWEET.

Witnesses:
W. H. THOMAS,
JESSIE L. DAVIS.