

(No Model.)

2 Sheets—Sheet 1.

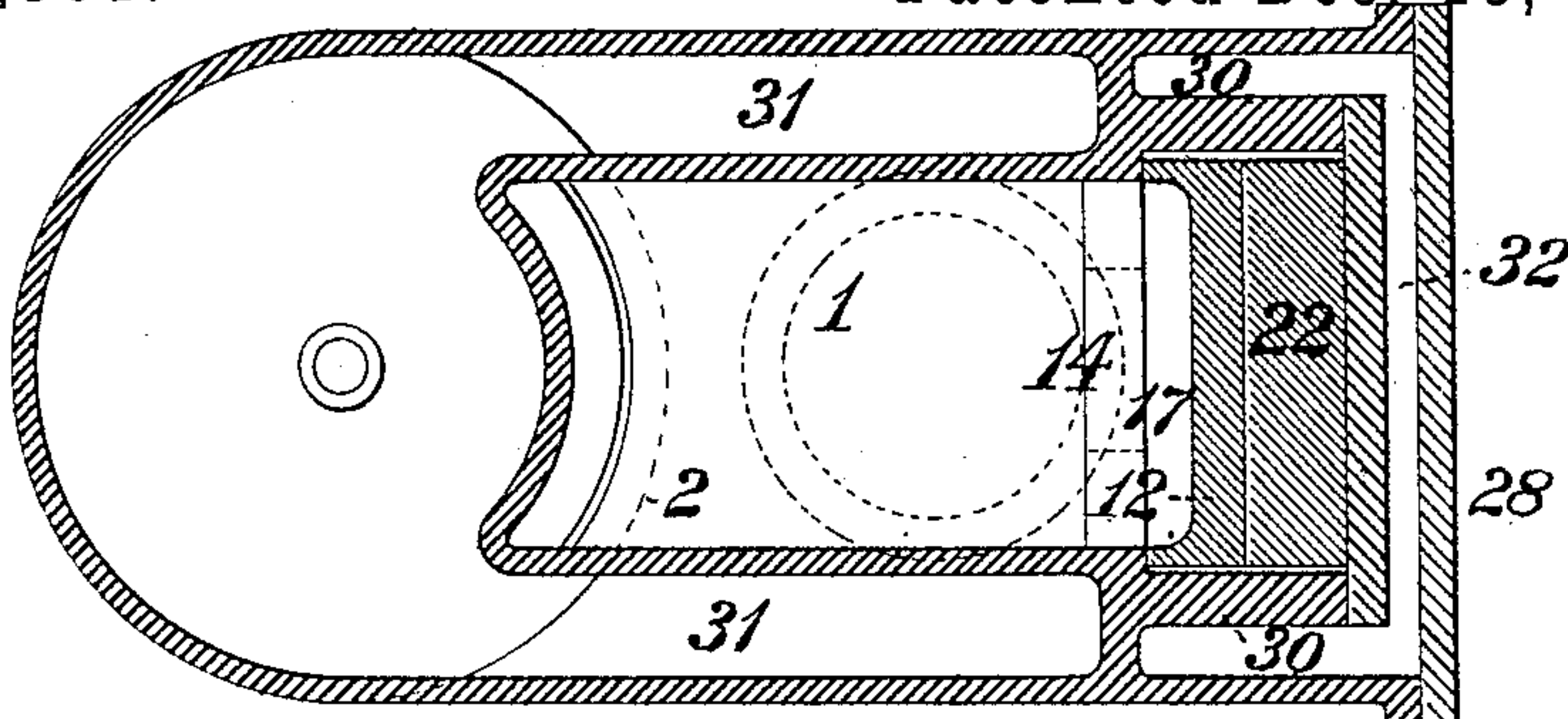
R. CREUZBAUR.

STEAM ENGINE.

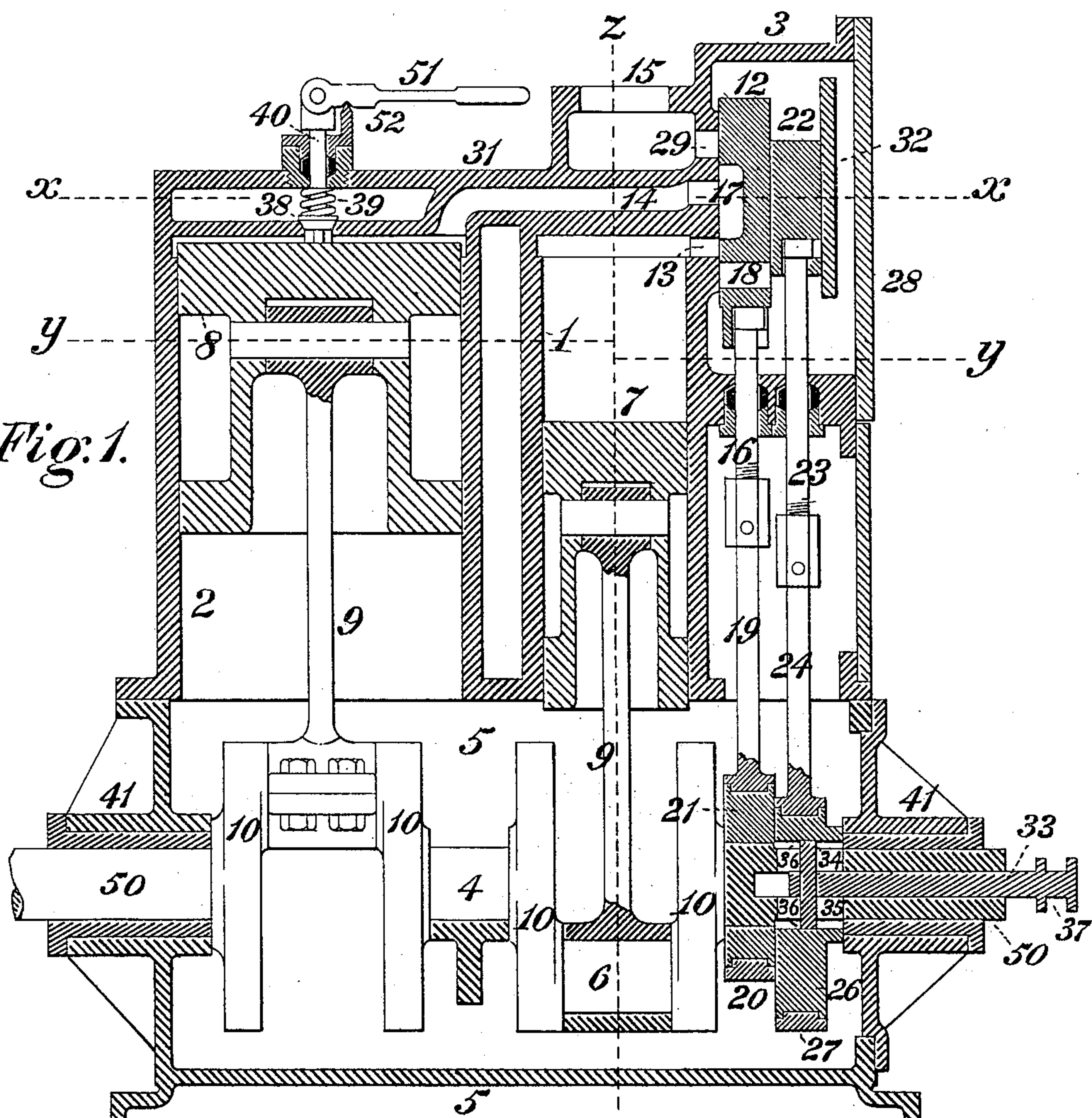
No. 332,501.

Patented Dec. 15, 1885.

*Fig. 2.*



*Fig. 1.*



WITNESSES:

*Sheldon Bell.*  
*R. M. Clarke.*

INVENTOR,

*Robert Kreuzbaur.*  
BY *George H. Christy.*  
ATTORNEY.



(No Model.)

2 Sheets—Sheet 2.

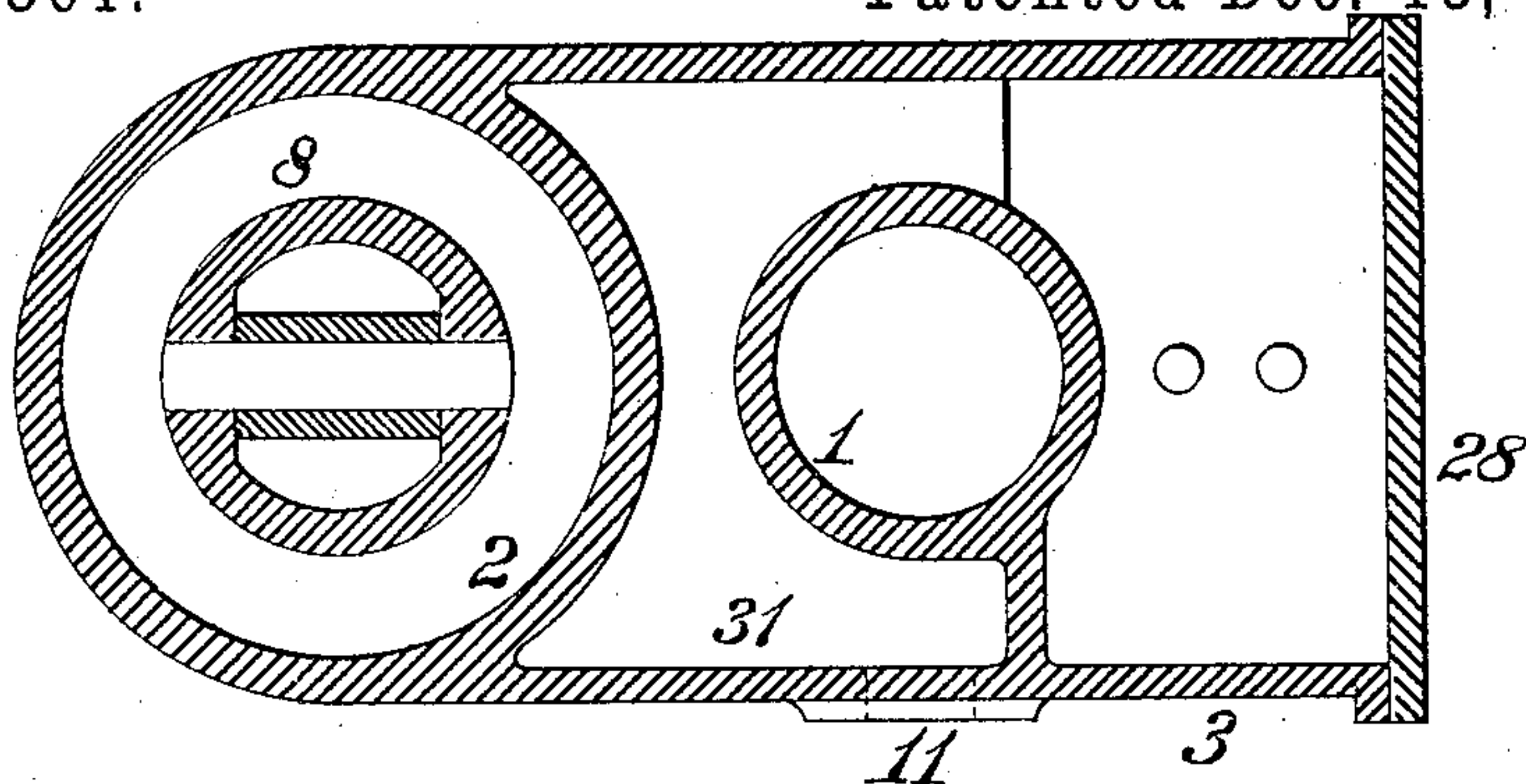
R. CREUZBAUR.

STEAM ENGINE.

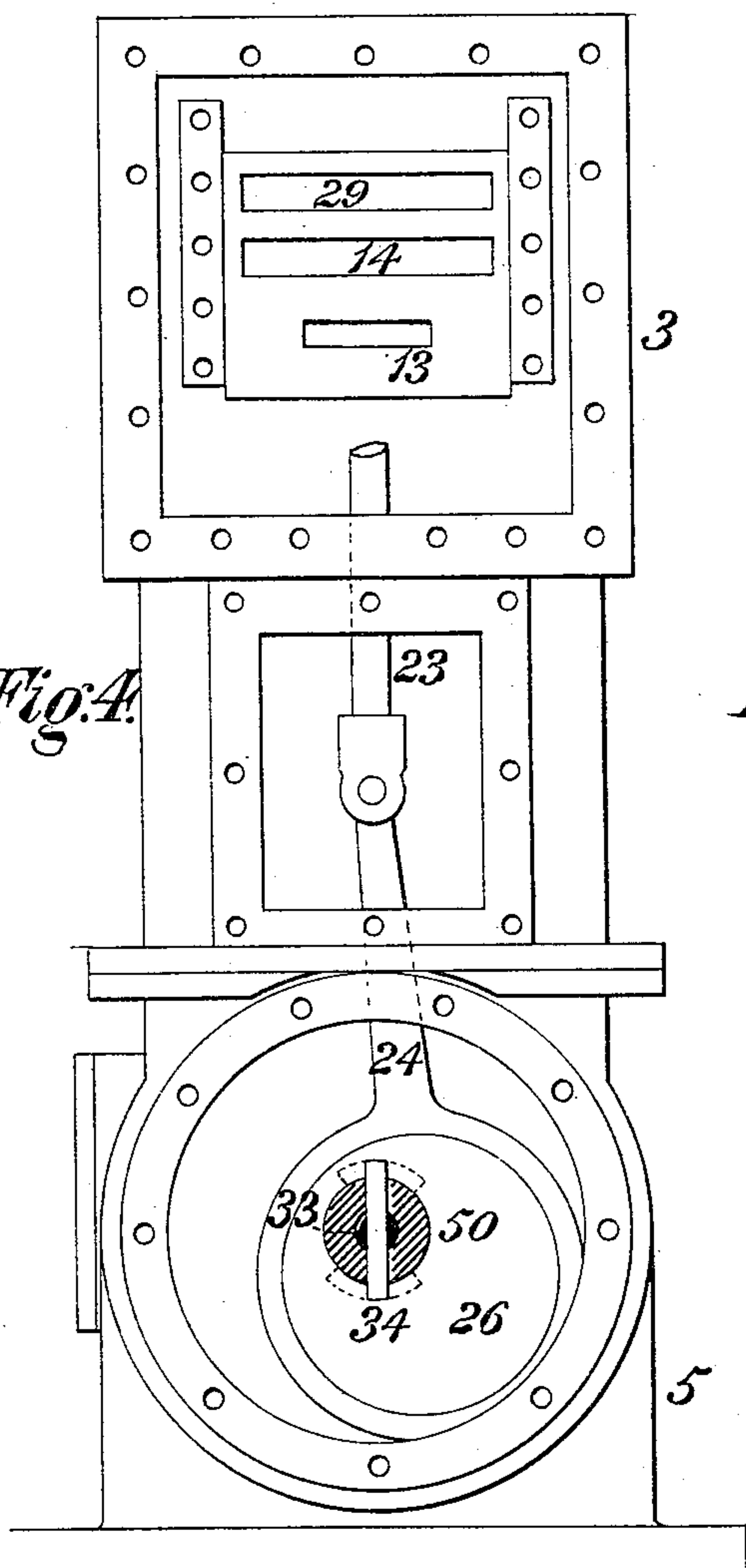
No. 332,501.

Patented Dec. 15, 1885.

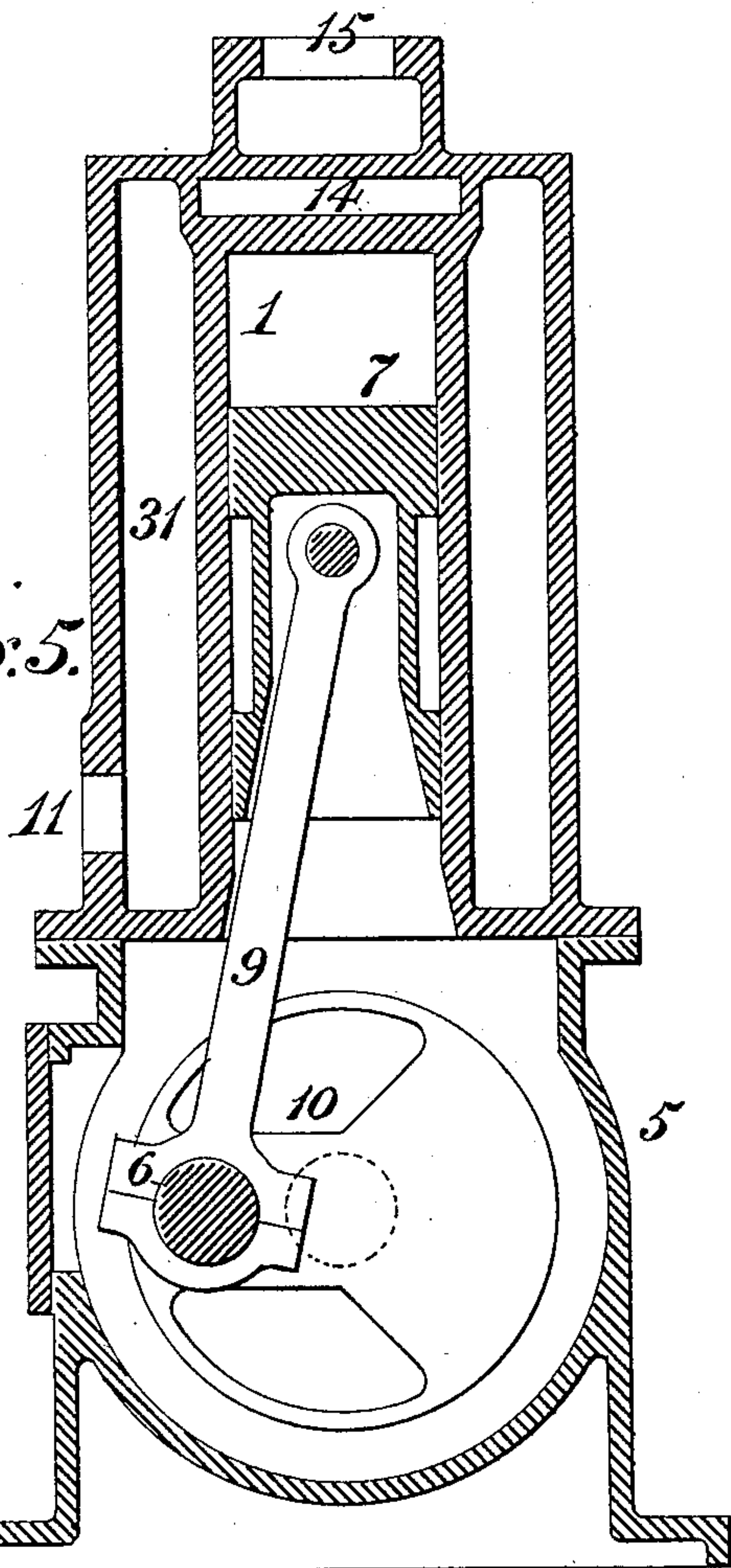
*Fig. 3.*



*Fig. 4.*



*Fig. 5.*



WITNESSES:

*J. Snowden Bell.*  
*L. M. Clarke.*

INVENTOR,

*Robert Kreuzbaur,*  
BY *George H. Christy*  
ATTORNEY.



# UNITED STATES PATENT OFFICE.

ROBERT CREUZBAUR, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE WEST-  
INGHOUSE MACHINE COMPANY, OF PITTSBURG, PENNSYLVANIA.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 332,501, dated December 15, 1885.

Application filed August 31, 1885. Serial No. 175,719. (No model.)

*To all whom it may concern:*

Be it known that I, ROBERT CREUZBAUR, residing at Brooklyn, in the county of Kings and State of New York, a citizen of the United States, have invented or discovered certain new and useful Improvements in Steam-Engines, of which improvements the following is a specification.

In the accompanying drawings, which make part of this specification, Figure 1 is a vertical longitudinal central section through a steam-engine embodying my invention; Figs. 2 and 3, horizontal sections through the same at the lines *x x* and *y y*, respectively, of Fig. 1; Fig. 4, an end view in elevation as seen from the right, and Fig. 5 a vertical transverse section at the line *z z* of Fig. 1.

My invention relates to single-acting engines having two cylinders located side and side with their pistons connected to independent cranks upon a common crank-shaft; and its objects are (a) to effect the compounding of an engine of such character by the employment of a single distribution-valve; (b) to provide for the jacketing of the cylinders by steam in its passage from the boiler to the valve-chest in such manner as to maintain the steam in the high-pressure cylinder and the exhaust therefrom at temperature proper to enable it to be expanded effectually in the low-pressure cylinder, the steam from the jacket being thereby reduced to the temperature and saturation desirably admissible to the working parts; (c) to further restore to the exhaust-steam from the high-pressure cylinder heat to insure its due expansion in the low-pressure cylinder; (d) to maintain the constant direction of unbalanced strains relatively to the operation of the distribution-valve; (e) to enable the power of the engine to be increased at starting or when otherwise necessary by the admission of live steam to the low-pressure cylinder; (f) to effect variation of the degree of expansion or point of cut-off by simple mechanism, and (g) to attain a symmetrical contour in an engine having cylinders differing materially in diameter.

The improvements claimed are hereinafter fully set forth.

My invention is herein illustrated as ap-

plied in a single-acting engine having a high-pressure cylinder, 1, and a low-pressure cylinder, 2, of larger diameter, each open at its lower end, located side and side, being preferably cast together, and secured upon the top of a crank-case or crank-shaft chamber, 5, having end bearings, 41, for the journals of a crank-shaft, 4. The high and low pressure cylinders 1 2 are fitted, respectively, with pistons 7 8, which are coupled by connecting-rods 9 9 with crank-pins 6 6, which are set opposite one to the other upon a pair of double cranks, 10, formed upon the crank-shaft 4. A valve chest or chamber, 3, is cast integral with or secured to the high-pressure cylinder 1, upon the side thereof farthest from the low-pressure cylinder, and the cylinders are inclosed at their upper ends above the outer surfaces of their heads and on the major portion of their perimeter by a steam-jacket, 31, corresponding in width with the diameter of the low-pressure cylinder and in height with the length of the cylinders, and extending from the shell of the low-pressure cylinder to the base of the valve-chamber, and to an end wall extending therefrom to the top of the crank-case, so as to inclose the space intervening between the cylinders. Steam from the boiler is supplied to the interior of the jacket 31 by a steam-pipe connected to a lateral flange or supply-nozzle, 11, thereon, and passes between and partially around the cylinders into the valve-chest 3, from which its distribution to and from the high and low pressure cylinders is effected by a main or distribution valve, 12, which is preferably supplemented by an independent cut-off valve, 22. Steam is admitted through a supply-port, 18, in the main valve 12 to a port, 13, leading into the upper end of the high-pressure cylinder 1, and after effecting the stroke of its piston 7 is exhausted through the exhaust cavity or recess 17 of the valve into a port, 14, leading into the upper end of the low-pressure cylinder 2. The exhaust-steam of the low-pressure cylinder passes through the port 14 and the exhaust-cavity 17 into a port, 29, leading to a flange or nozzle, 15, to which the exhaust-pipe is connected. The main valve 12 is reciprocated by an eccentric,



21, fixed upon the crank 4 for invariable stroke and lead, except for reversing, when so arranged, its stem 16 being coupled to an eccentric-rod, 19, secured to the strap 20 of the eccentric 21. The cut-off valve 22, which controls the supply-port 18 of the main valve, works upon the back of said valve and between the same and a pressure-relieving plate, 32, secured to posts 30 in the valve-chest, the plate and posts being surrounded by steam, so that their expansion corresponds with that of the valves and a pressure-balancing fit is preserved at all temperatures of the parts. The cut-off-valve stem 23 is connected by an eccentric-rod, 24, with the strap 27 of a cut-off eccentric, 26, which is adjustable upon the crank-shaft, as presently to be described, and the main and cut-off-valve stems 16 23 are made of sufficiently larger diameter than that due to the strains which they are called upon to sustain in the operation of the valves to enable a constant bearing of the valves upon their eccentrics to be maintained by the unbalanced steam-pressure acting upon the transverse areas of the valve-stems, the pressure and friction upon the valve-seat being reduced by the pressure-relieving plate.

The lead of the cut-off eccentric 26 is varied to effect desired variations of the point of cut-off or degree of expansion by adjusting mechanism of the following construction: The crank-shaft 4, together with the journal 50, adjacent to the eccentric, is centrally counterbored to admit a spindle, 33, having the capacity of free end motion in the bore of the shaft. A traverse-key, 34, is secured in the inner end of the spindle 33, and slides therewith without turning in the crank-shaft, in which are formed lateral slots 35 to admit of the required end play of the key. The ends of said key project through the slots 35 into opposite helical grooves 36 in the hub of the cut-off eccentric 26, and are so formed as to fill said grooves transversely. It will therefore be seen that endwise movement of the spindle 33 and key 34 in one or the other direction will by the action of the key upon the helical slots of the eccentric correspondingly vary the position of the latter relatively to the crank, and thereby effect a longer or shorter cut-off, as the case may be. The movement of the spindle 33 is effected and controlled through a grooved head, 37, on its outer end, either by hand or by a suitable connection with a governor or regulator.

As a modification of the above construction, the grooves 36 may be made parallel with the shaft, and the slots 35 be formed helically, or both the grooves 36 and slots 35 may be made helical with lead in opposite directions respectively. The steam-jacket 31 may be further utilized in the admission of steam from the boiler directly to the low-pressure cylinder at starting or at other times when increase of power is required by means of a direct-steam-admission valve, 38, governing an opening leading from the jacket into the upper

end of the low-pressure cylinder, said valve being held to its seat by a spring, 39, and being operated by a hand-lever, 51, coupled to the stem 40 of the valve and having a fulcrum, 52, on the gland of its stuffing-box. The form of the jacket 31 gives parallel sides to the engine, thereby attaining symmetry and a minimum and unbroken perimeter to be protected by suitable lagging.

In the operation of the engine the advantageous results of the compound system are made available with an extremely simple mechanism involving a comparatively small number of parts, and an important function is performed by the steam-jacket in attaining high expansion and economy in the use of highly-superheated steam without injury to the working parts. The hot and dry steam passing into the steam-jacket from the boiler first strikes and almost entirely surrounds the high-pressure cylinder, maintaining its walls at a high temperature and transmitting heat through the same to the steam, which parts with heat in doing work therein. The steam of the jacket in like manner transmits heat to the steam in the low-pressure cylinder, returning to it heat lost in the high-pressure cylinder, and which it requires to perform work at the close of its high expansion. With the large surfaces so applied for extracting heat from superheated steam and for transmitting it to the working steam to prevent the exhaustion of its energy before it has completed its intended duty the steam in the jacket is reduced to a temperature and saturation safely admissible to the working parts and an economy is attained with safety to the working parts not otherwise practicable. Where superheated steam is admitted from the jacket directly to the low-pressure cylinder, its effect will be to quickly heat said cylinder to the requisite temperature and largely diminish the danger from water of condensation, the presence of which is, with proper lagging, almost entirely prevented by the superheated steam in the jacket, so that cylinder-cocks are scarcely necessary, a drain-cock being applied at the bottom of the steam-jacket.

I claim herein as my invention—

1. The combination of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side, and a single main or distribution valve governing ports in said cylinders, through which steam from the boiler is first admitted to the space above the piston of the high-pressure cylinder, then exhausted therefrom into the space above the piston of the low-pressure cylinder, and finally exhausted from the low-pressure cylinder, substantially as set forth.

2. The combination of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter, said cylinders having their pistons connected to opposite crank-pins on a common crank-shaft, and a single main or distribution valve effecting



the distribution of steam to and from both of said cylinders, substantially as set forth.

3. The combination of a high pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter, said cylinders having their pistons connected to opposite crank-pins on a common crank-shaft, a single main or distribution valve effecting the distribution of steam to and from both of said cylinders, and a variable cut-off valve governing the admission of steam to said main valve, substantially as set forth.

4. The combination, in a compound engine, of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a main or distribution valve located in a chest or chamber on the side of one of the cylinders in a plane passing longitudinally through the crank-shaft, and ports governed by said valve and leading from its chest to the high-pressure cylinder, the low-pressure cylinder, and an exhaust-pipe, respectively, substantially as set forth.

5. The combination, in a compound engine, of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side, a valve-chest on the side of one of said cylinders, a main steam-jacket surrounding the major portion of the outside of and inclosing a space intervening between said cylinders, passages for the admission of boiler-steam to the jacket and of steam from the jacket to the valve-chest, and a steam-jacket covering the cylinder-heads and communicating with the main steam-jacket, substantially as set forth.

6. The combination, in a compound engine, of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side, a main or distribution valve working in a chest on the side of one of said cylinders and performing the distribution functions of both cylinders, a pressure-relieving plate by which the steam-pressure in the chest is relieved from the back

of the valve, and a valve-stem of diameter greater than that due to its working strength, these members being combined for joint operation to maintain a constant pressure in one direction on the eccentric which operates the valve, substantially as set forth.

7. The combination, in a compound engine, of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side, a valve-chest on the side of one of said cylinders, a steam-jacket inclosing the major portion of said cylinders and communicating with a steam-supply pipe and with the valve-chest, and a hand-operated valve by which steam from the jacket may be admitted directly to the low-pressure cylinder, substantially as set forth.

8. The combination, in a compound engine, of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side, a main or distribution valve working in a valve-chest on the side of one of said cylinders and performing the distribution functions of both cylinders, and a variable cut-off valve governing the admission of steam from the chest to said main valve, substantially as set forth.

9. The combination, in a compound engine, of a high-pressure single-acting cylinder and a low-pressure single-acting cylinder of larger diameter located side and side, a main or distribution valve performing the distribution function of both cylinders, a cut-off valve governing the admission of steam to said main valve, an eccentric mounted adjustably upon a crank-shaft and coupled to the stem of the cut-off valve, and a spindle fitted with the capacity of end movement in a central bore in the crank-shaft, and carrying a key which passes through longitudinal slots in said shaft and fits in helical grooves in the hub of the cut-off eccentric, substantially as set forth.

In testimony whereof I have hereunto set my hand.

ROBERT CREUZBAUR.

Witnesses:

CHAS. S. PEASE,  
W. L. McCULLAGH.