

(No Model.)

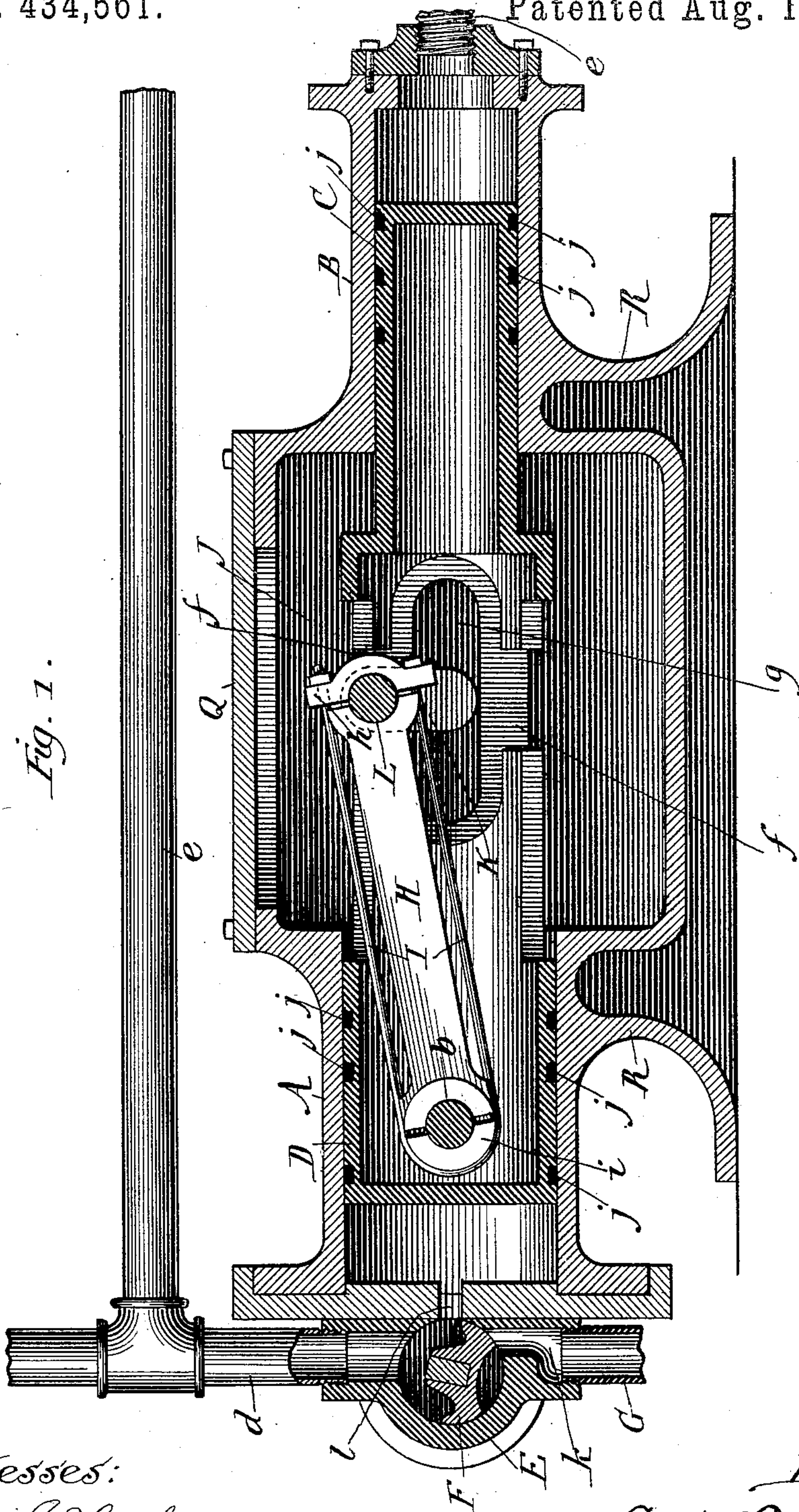
2 Sheets—Sheet 1.

D. D. HARDY.

# STEAM ENGINE.

No. 434,561.

Patented Aug. 19, 1890.



Witnesses:  
Frank Blanchard  
Fred Gerlach

Inventor:  
Dexter D. Hardy



(No Model.)

2 Sheets—Sheet 2.

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Fig. 2.

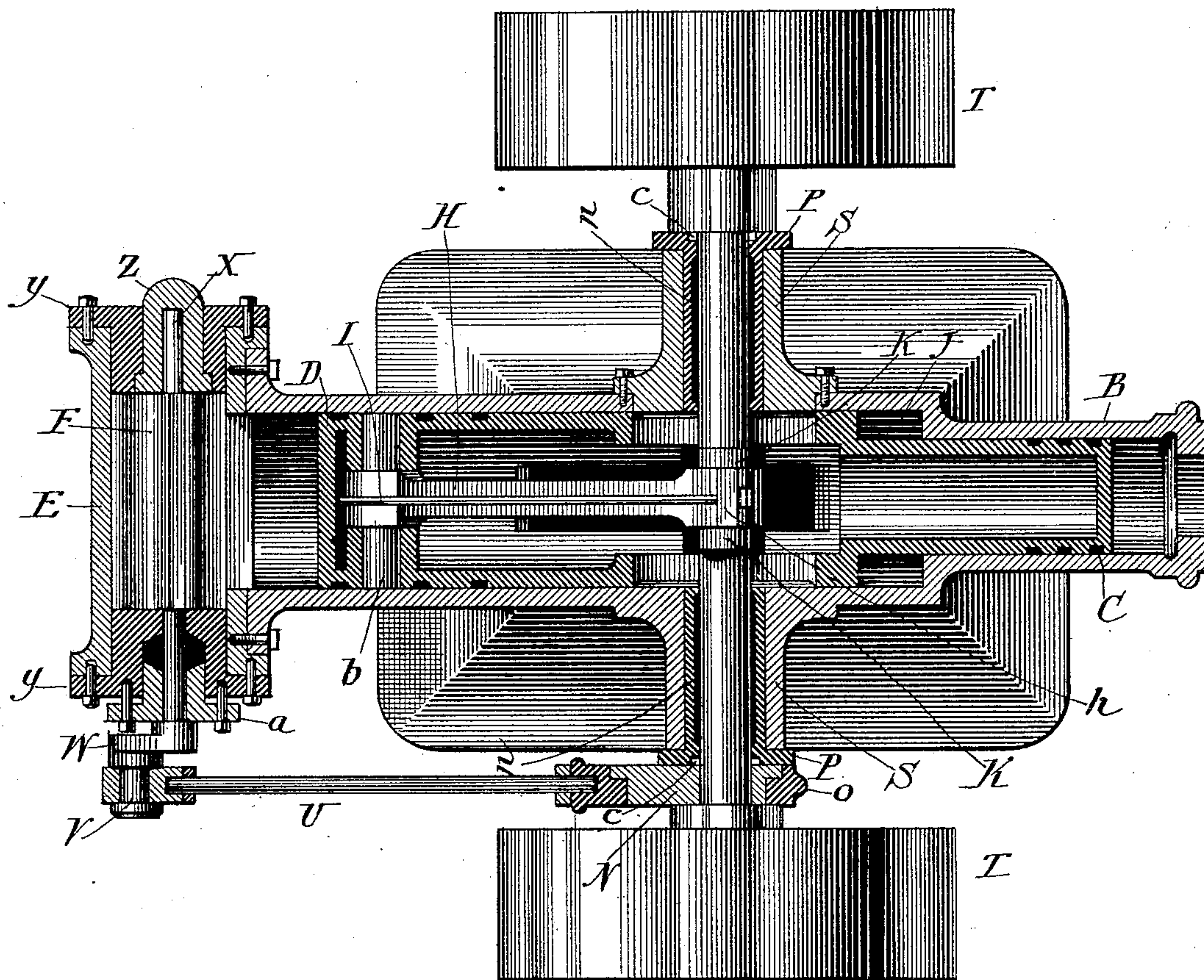
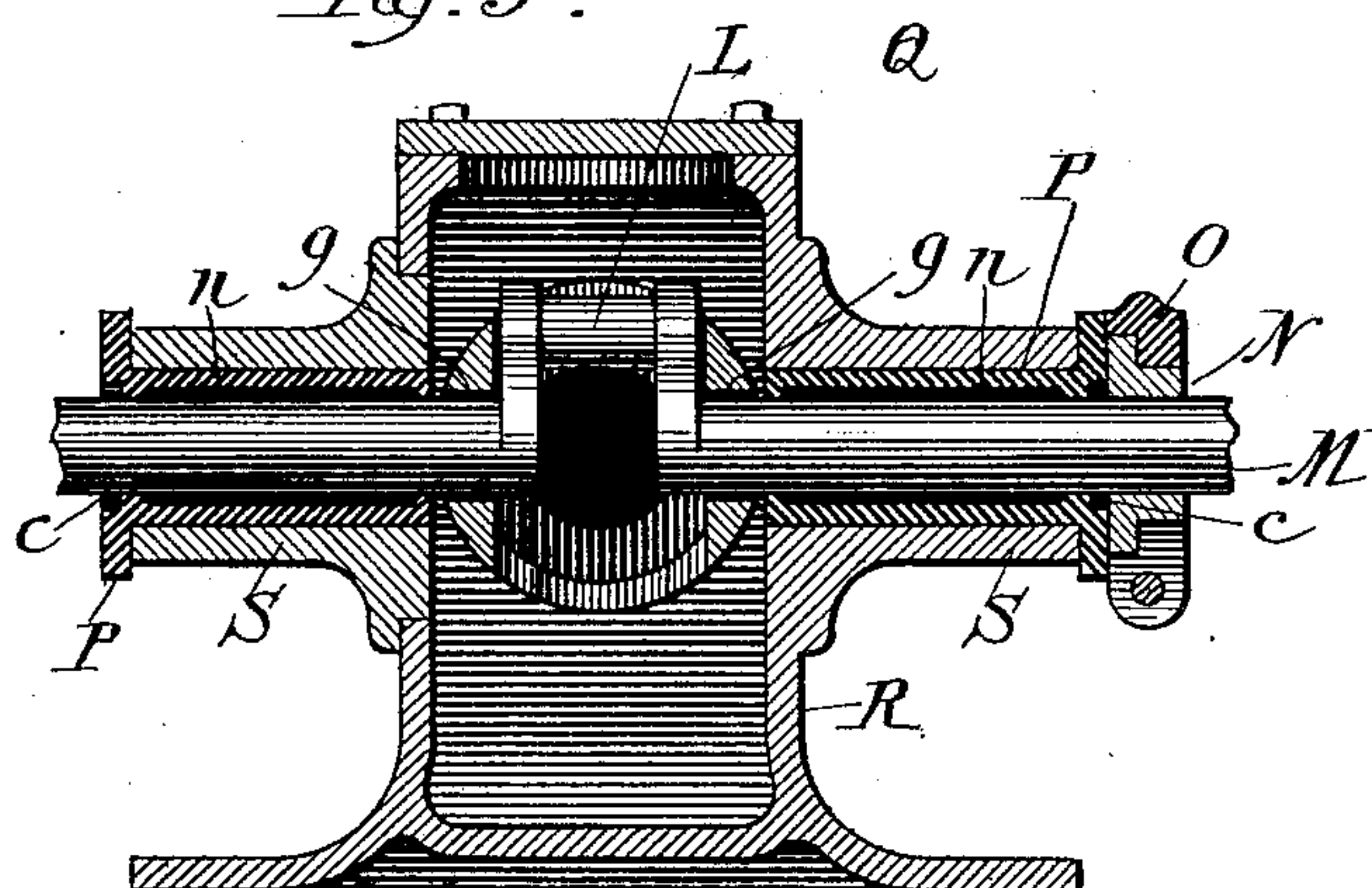


Fig. 3.



Witnesses:

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Inventor:

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# UNITED STATES PATENT OFFICE.

DEXTER D. HARDY, OF LAKE VIEW, ASSIGNOR TO THE HARDY HIGH SPEED ENGINE COMPANY, OF CHICAGO, ILLINOIS.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 434,561, dated August 19, 1890.

Application filed January 12, 1889. Serial No. 296,174. (No model.)

*To all whom it may concern:*

Be it known that I, DEXTER D. HARDY, a citizen of the United States, residing at Lake View, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My invention relates to improvements in reciprocating steam-engines in which two cylinders of different diameters are used between which the shaft passes at right angles to their bore, and operating in conjunction with two pistons rigidly connected together and having steam constantly applied to one of said pistons and alternately applied to and exhausted from the other; and the objects of my improvements are, first, to simplify the construction of such engine; second, to make it more compact; third, to reduce the liability of getting out of repair, and, fourth, to make it more accessible to repairs. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section through the cylinders and pistons, showing the connecting-rod and crank in elevation; Fig. 2 is a horizontal section through the entire engine, showing the shaft-connecting rod and pulleys in elevation. Fig. 3 is a vertical cross-section showing the crank and shaft in elevation.

Similar letters refer to similar parts throughout the several views.

A indicates the large cylinder; B, small cylinder; C, small piston; D, large piston; E, steam-chest; F, valve; G, exhaust-pipe; H, connecting-rod; I, loop-rod; J, crank-chamber; K, crank; L, crank-pin; M, crank-shaft; N, eccentric; O, eccentric-strap; P P, shells for main bearings; Q, cover to crank-chamber; R, main frame; S S, main bearings containing the shells P P; T T, fly-wheel pulleys; U, eccentric-rod; V, wrist-pin by which the valve is operated; W, rocker-arm; X, rock-shaft, to which the rocker-arm W is attached; Y Y, heads to steam-chest; Z, bushing for valve-rod X; a, gland for stuffing-box; b, pin in large piston, to which one end of the connecting-rod H is connected; c c, receptacles for receiving collars when rebabbiting shells; d, live-steam pipe; e, branch of live-steam

pipe d, leading to small cylinder B; f f, openings in the piston D to allow the cranks K to pass; g g, are elongated openings through which the shaft N passes; h, cap forming one end of connecting-rod; i, cap forming a portion of the box that works upon the pin b; j j j j j, packing-rings in the pistons D and C; k, exhaust-port; l, admission-port.

The cylinders A and B and main frame R are preferably formed of one piece, but may be made otherwise—as, for example, the cylinders A and B may be bolted to the main frame R or the entire engine may be bisected vertically through the shaft between the cylinders. The two pistons D and C are also shown formed of one piece, having the elongated openings g g to admit of the reciprocation of the pistons freely over the shaft, and the openings f f, to enable the cranks K K to pass freely through the walls of the piston; but I do not confine myself to the integral construction indicated.

Located in and near one end of the large piston D is the pin b, to which one end of the connecting-rod H is pivotally fixed, the other end of the connecting-rod being connected to the crank-pin L of the main shaft M. The loop-rod I, passing around the cap i, forming one of the ends of the connecting-rod H, that works on the pin b, has its two ends pass through the cap h, with suitable nuts placed thereon to enable the collar on the pin b and pin L to be taken up at the same time and by the same operation. The pistons D and C are provided with suitable packing-rings j, and preferably connected together, as shown.

The frame R is provided with bearings S for the crank-shaft M, one of said bearings being preferably cast on the frame and the other bolted or otherwise fastened thereto. Both bearings may, however, be bolted or otherwise detachably secured to the frame. The bearings S are provided with shells P P, having chambers n n, in which Babbitt or other suitable bearing metal may be poured. Said shells are also provided with annular recesses c to receive collars for the purpose of keeping the shaft M in line when the chambers n n in the shells are being refilled.

The large cylinder A is provided with a



head which supports the steam-chest E. Said steam-chest has a port *l*, leading through the head of the large cylinder for the passage of steam to and from the latter, and it also has an exhaust-port *k*, and within said steam-chest is located a valve F for opening and closing these ports. This valve is shown as of the oscillating order, and it is rocked by means of the eccentric-rod U, connected with the eccentric N on the crank-shaft M, and the crank or rocker arm W on the protruding end of the valve-shaft X. The live-steam pipe *d* leading from the steam-generator communicates with the steam-chest E, and has a branch *e* communicating with the small cylinder B.

Q is a cover removably secured over a large opening in the frame R, through which access may be had to the central chamber within the frame for the purpose of adjusting the connecting-rod.

The operation of the engine is as follows: Steam is admitted through the pipe *d* into the steam-chest E, and by the action of the valve F it is also admitted through the port *l* into the large cylinder A, causing the piston D to move its entire stroke. It will be seen, of course, that, while moving its entire stroke, the small piston C, having steam constantly acting upon it, offers a resistance to the movement of the piston D in proportion as the area of the small piston C is to the area of the large piston D. The large piston D having reached the end of its stroke and the large cylinder A being full of steam and the valve F having in the meantime during the inward stroke of the piston D moved into a position that gives communication between the ports *k* and *l* through the cavity in the valve, the steam in the cylinder A is exhausted through the ports *l* and *k*. While the steam is being exhausted from the cylinder A the steam constantly acting on the small piston C causes the piston to move back, thereby completing the revolution.

I am aware that engines having different diameters of cylinders and differential areas of pistons working therein have been made. Therefore I do not claim such broadly; but What I do claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, in an engine, of a crank-shaft, two cylinders of unequal diameter located axially in line with each other on opposite sides of the crank-shaft radially thereto and having their outer ends closed, two connected pistons in said cylinders, a steam-pipe for constantly supplying steam to the smaller cylinder, a steam-pipe communicating with the larger cylinder, and a valve mechanism for alternately admitting steam to and exhausting steam from the larger cylinder.

2. In an engine, substantially as described, cylinders of unequal diameter placed axially in line with each other and having their outer ends closed, a frame connecting said cylinders and forming a crank-chamber be-

tween them adapted to retain oil and provided with an opening in its top, a cover for said opening, shaft-bearings on the frame at right angles to the line of the cylinders, a crank-shaft mounted in said bearings and having its crank within the chamber, connected pistons working in the cylinders, a rod connecting the pistons with the crank of the shaft, a pipe admitting steam constantly to the outer end of the smaller cylinder, a steam-chest communicating with the larger cylinder, and a valve mechanism for admitting steam to and discharging steam from said larger cylinder.

3. In a steam-engine wherein the steam is exhausted from but one end of the piston only, connected pistons of unequal diameter axially in line with each other and placed on opposite sides of the crank-shaft and connected to said crank by a suitable connecting-rod and working within oppositely-arranged cylinders of unequal diameter, the larger cylinder being provided with a steam-chest, and suitable valve mechanism for admitting steam to and exhausting steam from said larger cylinder only, the smaller cylinder being in direct communication with the steam in the boiler by means of a steam-pipe connected in its head.

4. The combination of a centrally-chambered frame cylinder of unequal diameter arranged axially in line with each other on opposite sides of the chamber, the crank-shaft transverse to the axis of the cylinders, connected pistons of unequal area, the connecting part of which is provided with an elongated opening through which the shaft passes, and also being provided with openings to permit of the free rotation of the crank and its connection, a head on the outer end of the smaller cylinder provided with a steam-pipe for constantly supplying steam to the smaller cylinder, the steam being caused to circulate back and forth in said steam-pipe from said smaller cylinder, a head on the outer end of the larger cylinder provided with a steam-chest, and a valve for admitting steam to and exhausting steam from the larger cylinder only.

5. The combination of a centrally-chambered frame supporting oppositely-arranged cylinders of unequal diameter, which stand axially in line with each other, a crank-shaft at right angles to the line of said cylinder, connected pistons working in said cylinders and actuating the crank-shaft, a steam-chest communicating with the larger cylinder only by means of a valve and suitable arrangement of ports, said valve being operated by suitable mechanism connected to the eccentric secured to the crank-shaft, substantially as and for the purpose set forth.

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Witnesses:

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