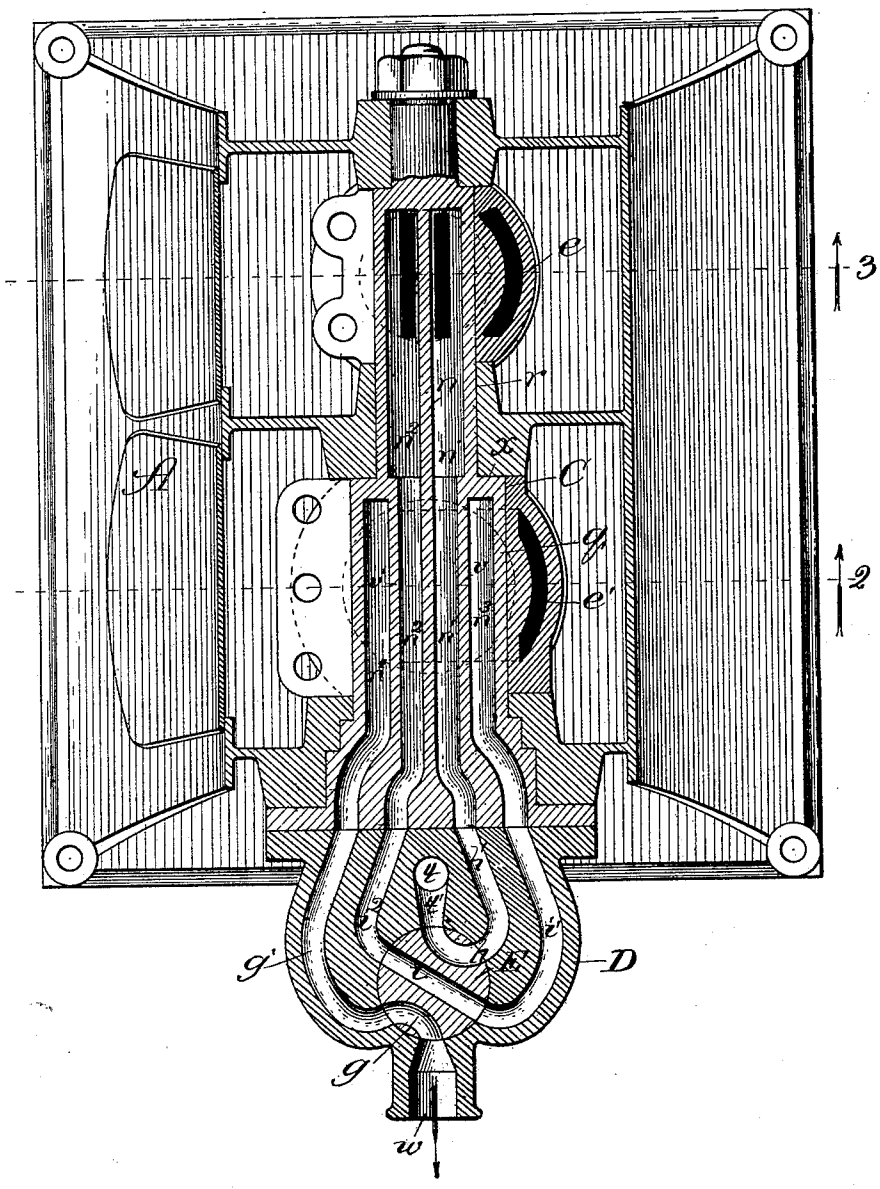
(No Model.) 3 Sheets—Sheet 1.

W. THOMAS.

OSCILLATING STEAM ENGINE.

No. 462,826. Patented Nov. 10, 1891.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

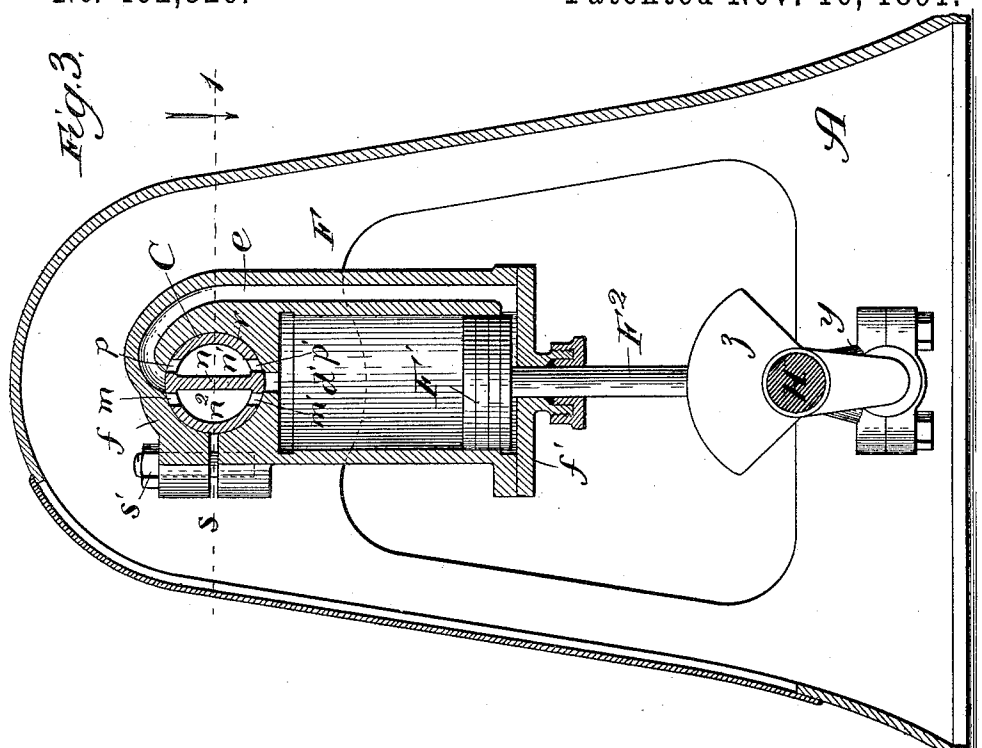
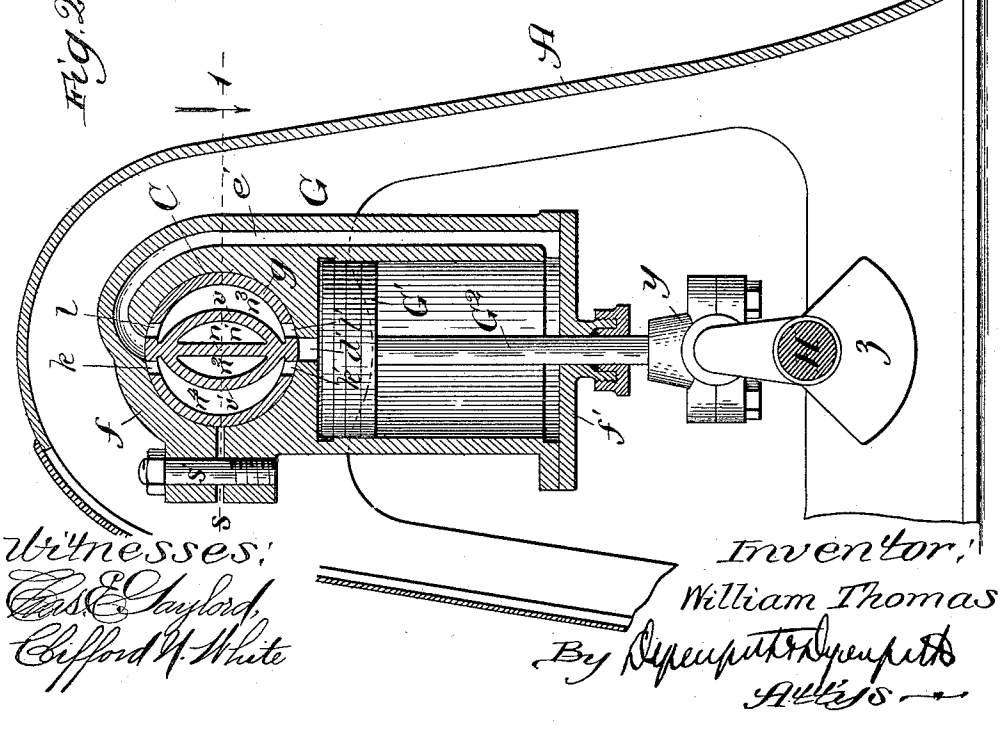


Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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OSCILLATING STEAM ENGINE.

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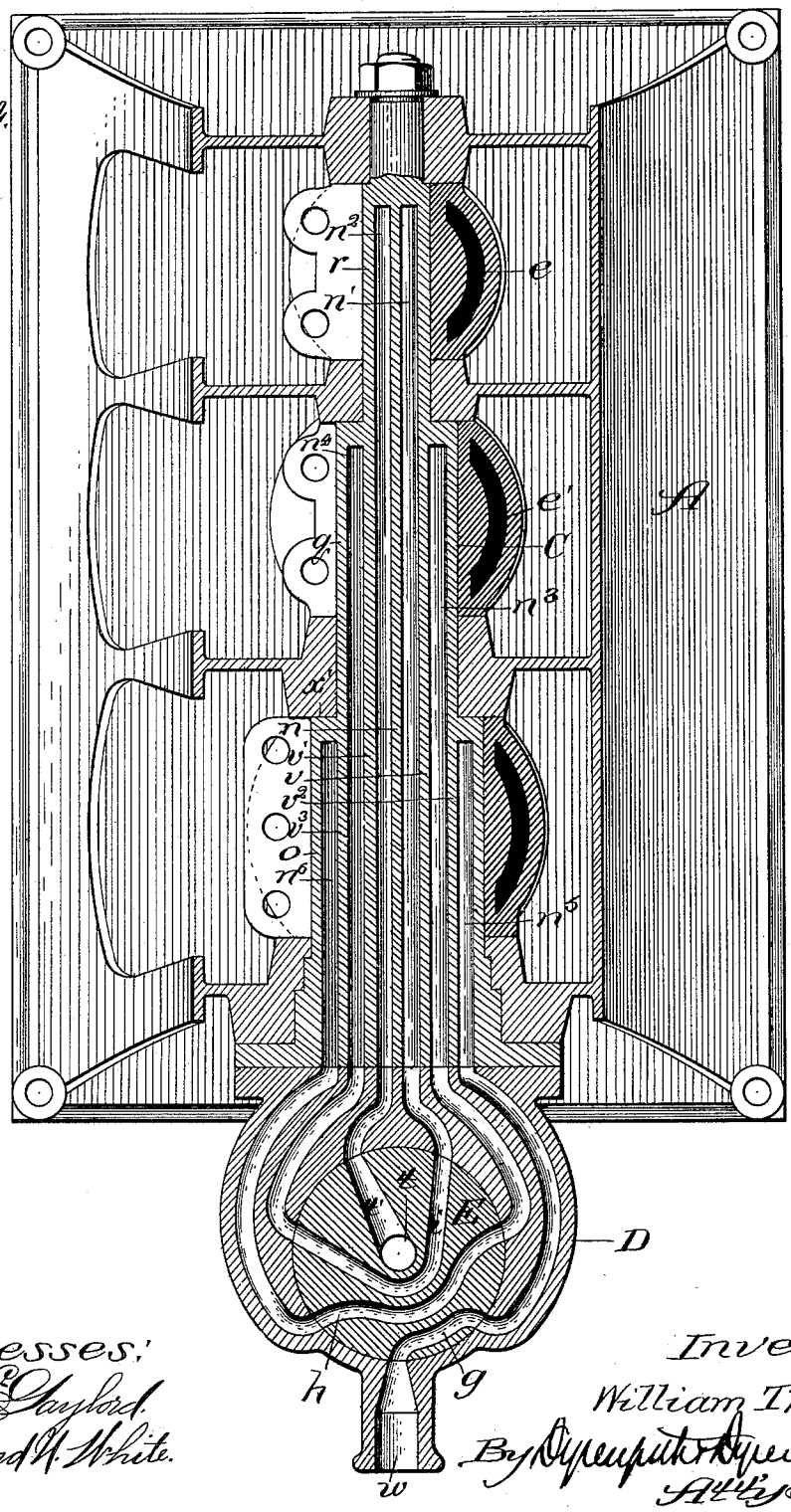
Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM THOMAS, OF OVINGTON, ILLINOIS.

OSCILLATING STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 462,826, dated November 10, 1891.

Application filed July 6, 1891. Serial No. 398,487. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM THOMAS, a citizen of the United States, residing at Ovington, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Oscillating Steam-Engines, of which the following is a specification.

My invention relates to an improvement in the class of oscillating steam-engines comprising a cylinder supported to oscillate on a pin forming the steam-chest and containing ports caused to open by the oscillations of the cylinder into the latter to introduce the steam therein alternately at opposite sides of the piston, the rod of which is connected with a crank-shaft.

The object of my invention is to provide with the general construction thus outlined a compound reversible valveless oscillating steam-engine by employing the exhaust-steam from one cylinder to actuate the piston in another cylinder or in several other cylinders successively, all the cylinders being supported on the one hollow pin, divided into steam-chambers to receive primarily the initial steam-supply to and exhaust from the first cylinder and direct the exhaust into the other or others in succession, alternately at opposite sides of the piston of each, having its rod connected with the common crank-shaft or a different crank-shaft.

It is further my object to provide a construction of throttle for permitting at will ready, immediately-responsive, and easy or smooth reversal of the compound engine to be effected.

In the accompanying drawings, Figure 1 is a sectional plan view of my improved single-compound or double-expansion oscillating steam-engine, the section being taken at the lines 1 1 on Figs. 2 and 3 and regarded as indicated by the arrows. Figs. 2 and 3 are vertical sectional views taken, respectively, at the lines 2 and 3 on Fig. 1 and regarded as indicated by the arrows. Fig. 4 is a view like that presented in Fig. 1; but showing the double-compound or triple-expansion form of the engine.

A is the frame, carrying the rotary crank-shaft H in its lower portion. In the upper portion of the frame, extending parallel with the shaft H, is a hollow pin C, formed in connected sections r and q, varying in diameter and defined by an offset x. The hollow pin C is rigidly supported in place and is permanently closed at the end of the section r and open at its opposite wider end. Internally the pin C is divided longitudinally by a central diaphragm n into two chambers n' and n^2, either of which affords the steam-chamber, while the other is for exhaust. At the opposite upper sides of the diaphragm n in the section r are the ports p and m, extending lengthwise of the section and leading, respectively, into the chambers n' and n^2, and at its opposite lower side are corresponding ports p' and m'. The chambers n' and n^2 in the section q are divided lengthwise by diaphragms v and v' at opposite sides of the diaphragm n into chambers n^3 and n^4. At the opposite upper sides of the diaphragm n in the section q are the ports l and k, extending lengthwise of the section and leading, respectively, into the chambers n^3 and n^4, and at its opposite lower sides in said section are corresponding ports l' and k'. At its outer end the section q is expanded, and the several chambers extend therein somewhat flaringly, as shown, to coincide with passages in a head D, firmly fastened to the end of the pin C and containing the steam-inlet t, from which the passage t' branches.

E is a rotary throttle-valve in the head D, containing a central transverse passage i. (Shown in Fig. 1 as communicating at its opposite ends with the passages i' and i^2 in the head and leading, respectively, into the chambers n^3 and n^2 in the pin C.) The valve also contains passages h and g, the former shown as communicating at one end with the branch passage t' from the inlet t, and at its opposite end with the passage h', leading into the chamber n', and the latter shown as connecting the outlet w with a passage g', leading into the chamber n^4.

F is a cylinder for the high pressure and G is a larger cylinder for the low pressure, each having a thick upper head f, provided with a cylindrical transverse opening, that of the former fitting snugly around the section r of the pin C and that of the latter similarly fitting around the section q thereof, the head of each cylinder being divided at one side, as shown at s, Figs. 1 and 2, and there flanged

to receive screws s' for tightening the head around its pin-section, and thus affording means for adjusting the heads on their seats in case of wear. The cylinders F and G contain pistons F′ and G′, the rods F^2 and G^2 of which pass through the cylinder-heads f', where they are surrounded by suitable stuffing-boxes and are connected by yokes y with cranks on the shaft H, the cranks carrying counter-weights z for the cylinders. Steam-ducts e and e' lead from the cylindrical openings in the head of the cylinders F and G, respectively, and from a point above the diaphragm r down through the sides of the cylinders into the latter below the limit of play of the downstrokes of the pistons, and vertically-short ducts d and d' lead from below the pin into the cylinders above the pistons therein.

Referring to Figs. 1 to 3, inclusive, the operation of the single-compound engine is as follows: With the throttle-valve E turned to the position represented in Fig. 1, high-pressure steam from the inlet t enters the steam-chest chamber n', the duct e then eventually (when the crank with which the piston-rod F^2 is connected is moved beyond the center) coinciding with the port p, the ports p' and m being closed by the respective head f and the duct d coinciding with the port m'. Then the steam from the chamber n will enter the cylinder F through the duct e against the under side of the piston therein, driving the shaft H, and the upward stroke of the piston will force any steam previously admitted above it out of the cylinder through the duct d into the exhaust-chamber n^2. From the latter the exhaust-steam passes through the head-passage i^2, valve-passage i, and head-passage i' into the steam-chamber n^3 in the low-pressure section q. There the duct d' will have meantime been brought coincident with the port l' of the chamber n^3, admitting the low-pressure steam therein against the upper side of the piston G′ in the cylinder G, and the duct e', with the port k (the ports l and k' being then closed) allowing the low-pressure steam previously introduced against the lower side of the piston to be forced by its downstroke through the duct e' into the chamber n^4, whence it escapes through the passage g' and valve-passage g to the outlet w. The movements thus described throw the crank-shaft half-way around beyond a dead-center and the completion of its throw oscillates the cylinders F and G back, bringing the ducts d and d', respectively, to the ports p' and k', leading into the chambers n' and n^4, the ports e and e', respectively, to the ports m and l, the other ports being closed by the heads, whereby steam from the chamber n' enters the cylinder F above its piston to lower it and drive the steam below it through the duct e, port m, chamber n^2, and valve-passage i into the chamber n^3, thence into the cylinder G, through the duct e', raising the piston G′ and driving out the spent low-pressure steam previously introduced above it through port k' into the chamber n^4, and thence through the passages g' and g and outlet w. Thus the oscillations of the cylinders F and G continue to rotate the crank-shaft. Obviously to reverse the direction of rotation of the crank-shaft at either end of the stroke of a piston or at any intermediate point between the ends of its stroke, it is only necessary to turn the throttle E to lead the high-pressure steam into the passage i^2 through the valve-passage h and produce communication of the passages h' and g' through the valve-passage i and of the passage i' through the valve-passage g with the exhaust w. The reversal thus produced at any point of the stroke is instantaneous, smooth, and without jarring or injury to the engine, or danger from it. The course of the high-pressure steam is then through the branch t', valve-passage h, passage i^2, chamber n^2 into cylinder F′; of the low-pressure steam from chamber n', through valve-passage i, passage g', and chamber n^4 into cylinder G, and of the exhausted steam from cylinder G into chamber n^3, and thence through passage i' and valve-passage g to the outlet w. In the same manner that the high-pressure cylinder F and low-pressure cylinder G are constructed to compound the pressure of the former into the latter, one or more additional cylinders like the cylinder G, but larger, may be added, all on a common steam-chest pin C, thereby to double, triple, quadruple, &c., the compounding or expansion of the initial high-pressure steam, the cranks on the shaft or shafts being of course set accordingly. The manner of thus compounding any number of times within the capacity of the steam will be readily understood from Fig. 4 of the drawings, showing means for twice compounding it. In that figure a third section o is added to the hollow pin C on which to suspend a third cylinder. (Not fully shown, but like the cylinder G, except that it is larger.) The section o, which joins the section q at an offset x', has ports like and operating in the manner of those in the other sections and contains chambers n^5 and n^6, formed by diaphragms v^2 and v^3. The rotary throttle-valve E in the head D contains the high-pressure inlet t and branch t', and also passages i, h, and g, to produce the desired connections with the several passages in the head D and with the outlet w.

The foregoing description sets forth the details affording what I believe to be the best construction of my improved compound oscillating engine. These may, however, be variously changed without thereby departing from the principle of my invention. Hence I do not wish to be understood as limiting it to the details and combinations of parts exactly as shown and described.

What I claim as new, and desire to secure by Letters Patent, is—

1. A compound oscillating steam-engine having a hollow pin forming the steam and

exhaust chest supported on the engine-frame and divided into sections having chambers provided with ports, two or more steam-cylinders supported to oscillate on said pin and having their pistons connected with the crank-shaft, one of said cylinders being actuated by high-pressure steam and the other or others successively compounding the steam-pressure from the first, a head at the end of the said hollow pin containing passages communicating with the chambers in the hollow pin, and a throttle-valve seated in the said head and common to all the said chambers for reversing at will the action of the engine, substantially as described.

2. In a compound oscillating steam-engine, the combination, with the frame and crank-shaft, of a hollow pin C, formed with longitudinal sections r and q, a diaphragm n, dividing the pin lengthwise into chambers n' and n^2, ports p and p' in the section r for the chamber n, and ports m and m' therein for the chamber n^2, diaphragms v and v', forming chambers n^3 and n^4 in the section q, ports l and l' in the section q for the chamber n^3, and ports k and k' therein for the chamber n^4, and steam-cylinders F and G, supported to oscillate on the pin and having their pistons connected with the crank-shaft, each cylinder containing two ducts for the four ports in its section of the hollow pin, one of said ducts in each cylinder leading at one end below the piston therein and coinciding at its opposite end in the oscillations of the cylinder alternately with two of the ports and the other of said ducts in each cylinder leading at one end above the piston therein and coinciding at its opposite end in the oscillations of the cylinder alternately with the other two of said ports, substantially as described.

3. In a compound oscillating steam-engine, the combination, with the frame and crank-shaft, of a hollow pin C, formed in longitudinal sections r and q, a diaphragm n, dividing the pin lengthwise into chambers n' and n^2, ports p and p' in the section r for the chamber n', and ports m and m' therein for the chamber n^2, diaphragms v and v', forming chambers n^3 and n^4 in the section q, ports l and l' in the section q for the chamber n^3, and ports k and k' therein for the chamber n^4, steam-cylinders F and G, supported to oscillate on the pin and having their pistons connected with the crank-shaft, each cylinder containing two ducts for the four ports in its section of the hollow pin, one of said ducts in each cylinder leading at one end below the piston therein and coinciding at its opposite end in the oscillations of the cylinder alternately with two of the ports and the other of said ducts in each cylinder leading at one end above the piston therein and coinciding at its opposite ends in the oscillations of the cylinder alternately with the other two of said ports, a head D at the end of the pin C, having a steam inlet and exhaust and containing passages for connecting therewith the chambers in the hollow pin, and a throttle-valve E in the said head, the whole being constructed and arranged to operate substantially as described.

WILLIAM THOMAS.

In presence of—
J. N. HANSON,
M. J. FROST.