

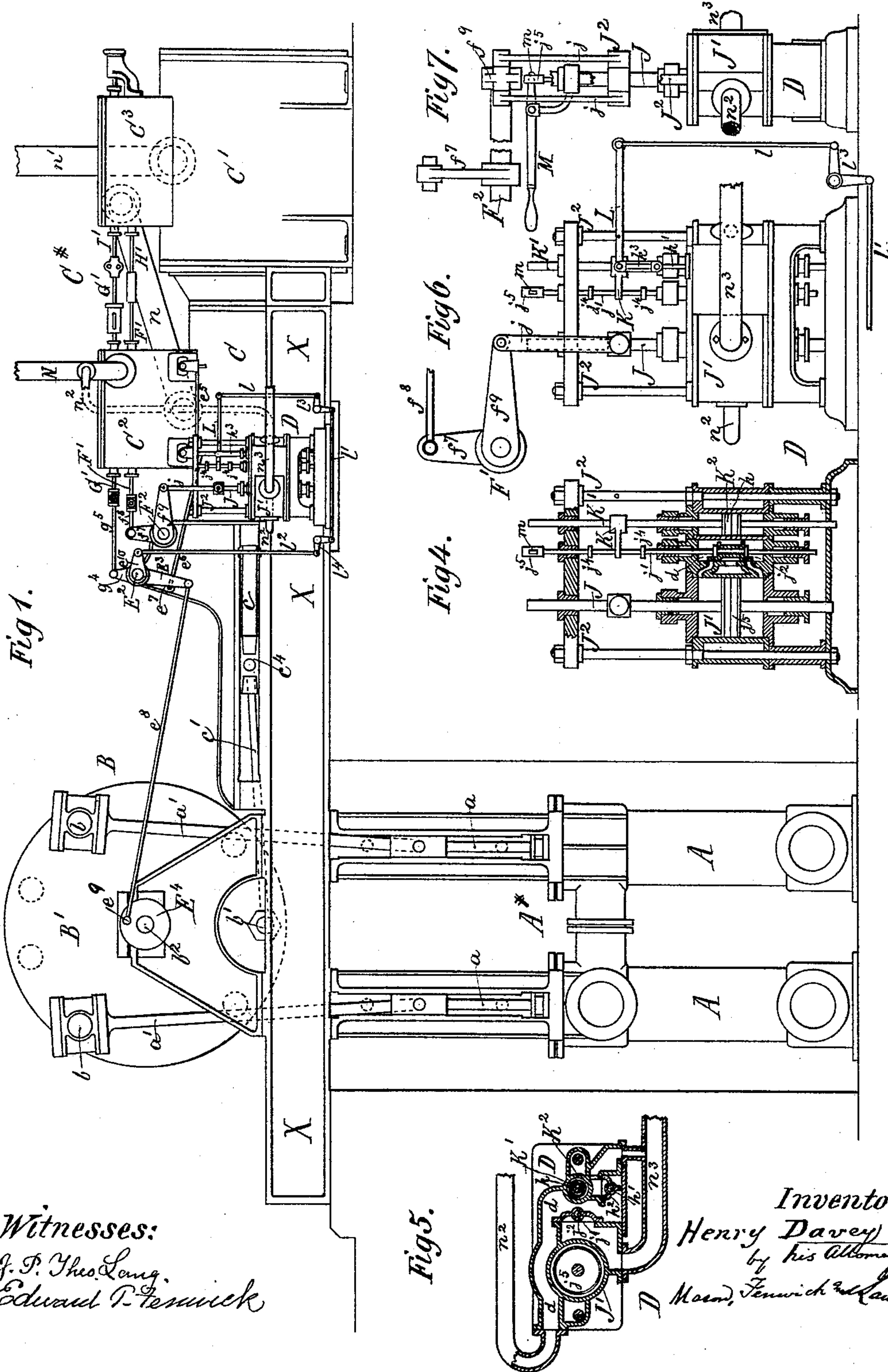
(No Model.)

2 Sheets—Sheet 1.

H. DAVEY.  
PUMPING ENGINE.

No. 434,704.

Patented Aug. 19, 1890.



Witnesses:  
J. P. Theo. Lang.  
Edward T. Fenwick

Inventor:  
Henry Davey  
by his Attorneys  
Maen, Fenwick & Lawrence

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Fig 2.

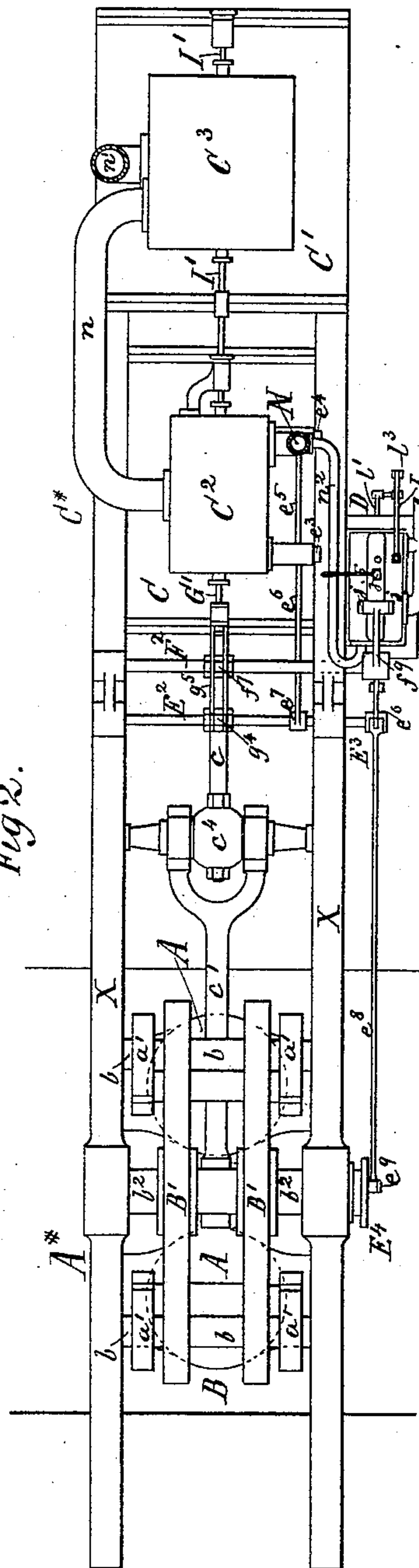


Fig 3.

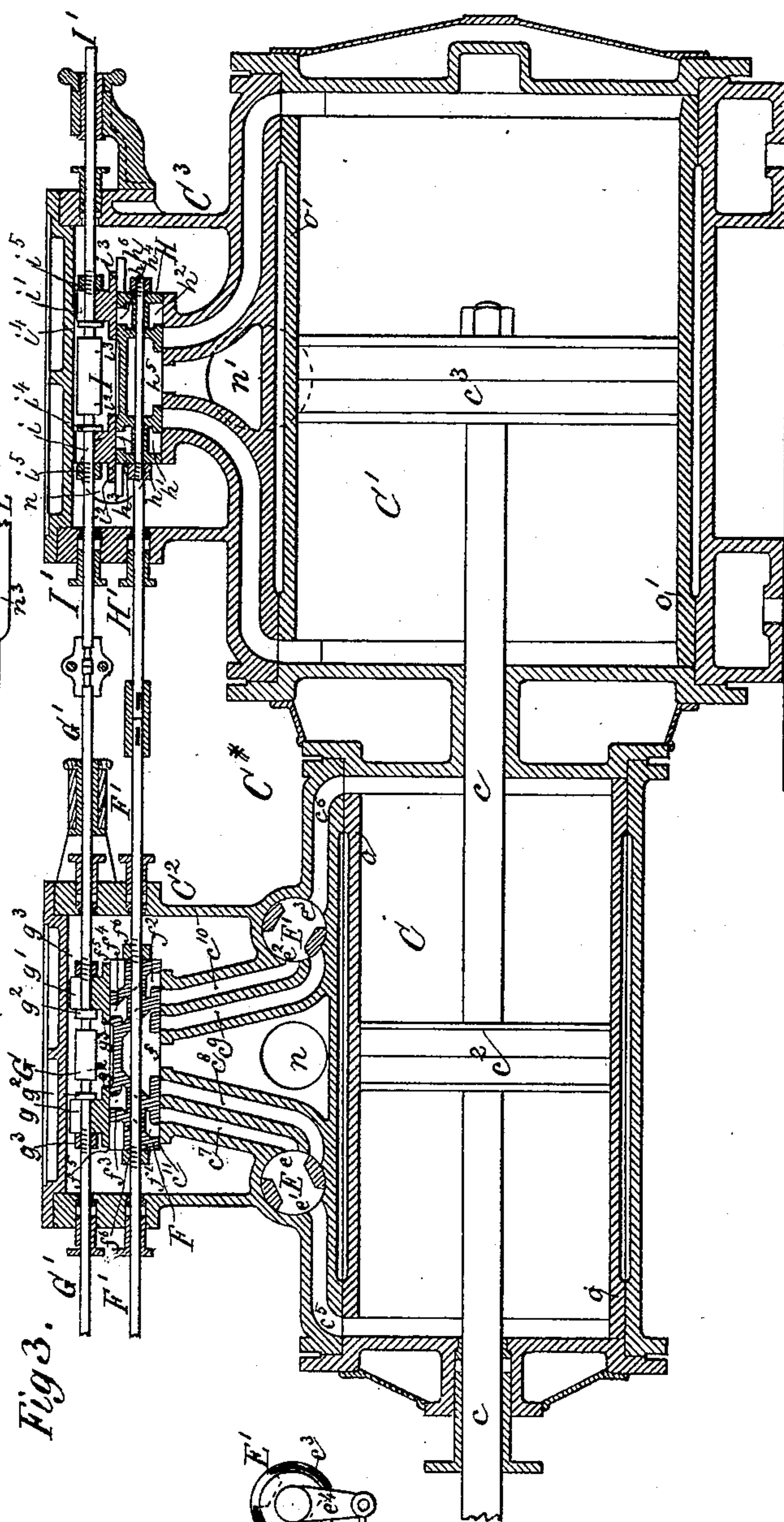
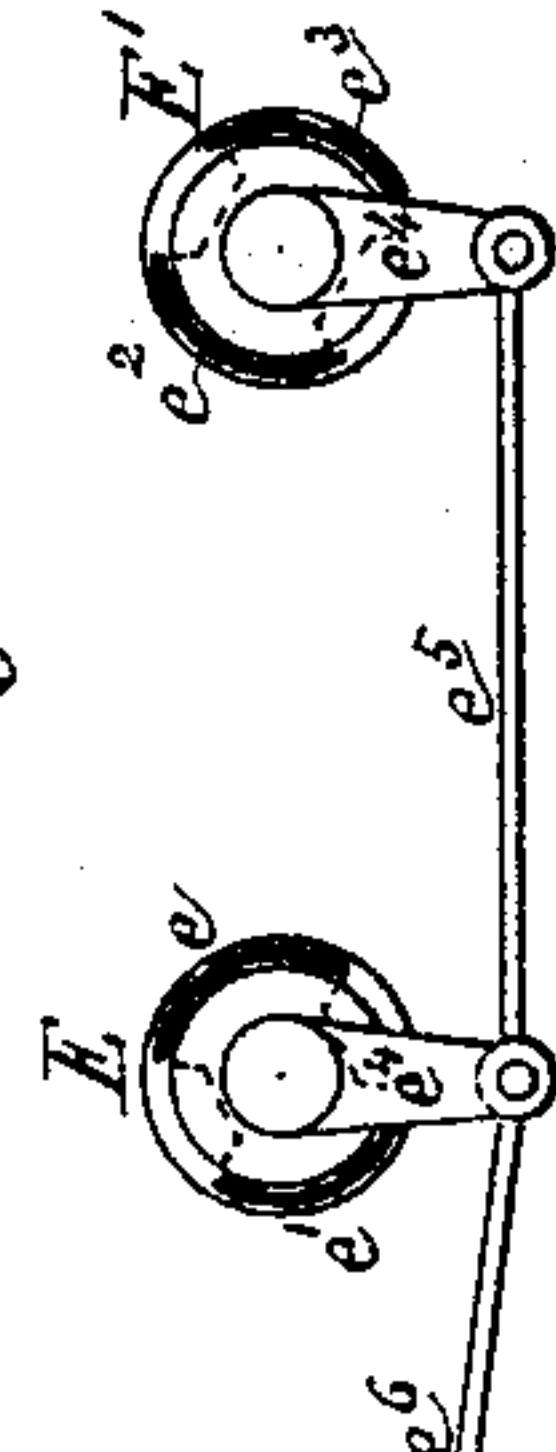


Fig 8.



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# UNITED STATES PATENT OFFICE.

HENRY DAVEY, OF WESTMINSTER, ENGLAND.

## PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 434,704, dated August 19, 1890.

Application filed January 31, 1890. Serial No. 338,715. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY DAVEY, a subject of the Queen of Great Britain, residing at No. 3 Princes Street, Westminster, in the  
5 county of Middlesex, England, have invented certain new and useful Improvements in Pumping-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable  
10 others skilled in the art to which it appertains to make and use the same.

My invention relates to compound pumping-engines; and it consists of an improved construction, hereinafter fully described, and  
15 specifically claimed, in which a pump, an intermediate compensating frame and mechanism, and a compound expansion steam-engine and valve-gear and motor thereof, of novel construction, for operating the main valves  
20 are combined, whereby the motion of the engine is so regulated as to produce improved and more beneficial results under like circumstances during the operation.

In the accompanying drawings, Figure 1 is  
25 an elevation of my invention; Fig. 2, a plan view of the same; Fig. 3, a longitudinal vertical central section of the steam-engine proper; Fig. 4, a vertical central section through the cylinders of an auxiliary valve-operating en-  
30 gine; Fig. 5, a horizontal section of the same in the line of its pistons; Fig. 6, a side elevation; Fig. 7, an end elevation of the same; and Fig. 8 is an enlarged detail view of two coupled cut-off valves of the main steam-cyl-  
35 inder.

The letters A A in the drawings represent the pump-barrels; *aa*, their piston-rods; *a' a'*, their connecting-rods; B, an oscillating intermediate compensating frame; C C', steam-  
40 cylinders; *c*, their common piston-rod; *c'*, connecting-rod, and D valve-gear-operating engine.

The compensating frame B consists of two parallel disks B', fastened to a shaft *b*<sup>2</sup>, which  
45 latter is hung to the main frame of the machine. The said disks are provided with crank-pins *b b b'*, of which *b b* operate connecting-rods *a' a'* of two pumps A A, and *b'* is operated by the connecting-rod *c'* of the  
50 steam-engine. When the crank-pin *b'* stands

vertically below the fulcrum-shaft *b*<sup>2</sup>, the pins *b* stand above the said shaft, which arrangement serves to gradually decrease the resistance of the "lift" in the pumps, and thus enable the expanding steam to move the  
55 steam-piston to the end of the stroke.

The wrist-pins *b* of the connecting-rods of the pumps A A and the wrist-pins *b'* of the connecting-rod of the compound steam-en-  
60 gine C\* are so arranged as to increase the lifting-power of the pump A\* toward the end of the lifting-stroke. These pins *b b'* are fastened to two parallel disks B', having a fulcrum-shaft *b*<sup>2</sup>, hung to a suitable frame X.

The steam-cylinders C C' are coupled, and  
65 their pistons *c*<sup>2</sup> *c*<sup>3</sup> are fastened to the piston-rod *c*, which is provided with a cross-head *c*<sup>4</sup> and the connecting-rod *c'*. The steamways *c*<sup>5</sup> *c*<sup>6</sup> of cylinder C are provided with conical plug-valves E E', which cut off or open  
70 communication with steamways *c*<sup>5</sup> *c*<sup>6</sup> *c*<sup>7</sup> *c*<sup>8</sup> *c*<sup>9</sup> *c*<sup>10</sup>, leading to and ending in the valve-seat *c*<sup>11</sup> inside of the steam-chest C<sup>2</sup>. The valves E E' are ground into their seats in the steam-cylinder C, and are provided with ports *e e'*  
75 *e*<sup>2</sup> *e*<sup>3</sup>, respectively. At their small ends they are provided with levers *e*<sup>4</sup> *e*<sup>4</sup>, respectively, which are coupled to a rod *e*<sup>5</sup> and a connecting-rod *e*<sup>6</sup>. The connecting-rod *e*<sup>6</sup> is pivoted  
80 to a lever *c*<sup>7</sup> on a rock-shaft E<sup>2</sup> suitably hung to the frame X. This rock-shaft E<sup>2</sup> receives its motion by means of a lever E<sup>3</sup> and connecting-rod *e*<sup>8</sup> from an eccentric-pin *e*<sup>9</sup> on a disk E<sup>4</sup>, fastened to the main rock-shaft *b*<sup>2</sup>. Thus the motions of the valves E E' coincide  
85 with the motions of the steam-engine. Thus by the operation of these valves the stroke of the steam-piston is positively determined by cutting off whatever steam may be admitted through either one of the passages *c*<sup>7</sup> or *c*<sup>10</sup> at  
90 the end of the backward or forward stroke. Such steam is thereby confined in said steamways and economized for the next stroke, and so confined it also serves as an elastic cushion, partly balancing the main valve of the  
95 engine.

Upon the valve-seat *c*<sup>11</sup> the main valve F is placed, which is an ordinary slide-valve with lower and upper ports *f' f*<sup>2</sup> and *f*<sup>3</sup> *f*<sup>4</sup> and an exhaust port *f*. The top surface of the main  
100



valve serves as a valve-seat  $f^5$  for an expansion or cut-off valve G of ordinary construction. The valve G consists of two forked heads  $g g'$ , having cut-off flanges  $g^2 g^3$ , which latter slide upon the valve-seat  $f^5$  of the valve F, and are held at a proper distance apart upon the valve-rod G' by means of the forked-heads  $g g'$ , through which the valve-rod passes, and also by collars  $g^2$  on the valve-rod and nuts  $g^3$ , screwed to the valve-rod. The main valve F is fastened by means of clamp-nuts  $f^6$  to its valve-stem F', which is passed through said valve.

The cylinder C' is provided with a steam-chest C<sup>3</sup>, containing a main valve H, having steam-ports  $h' h^2 h^3 h^4$ , exhaust-port  $h^5$ , an upper valve-seat  $h^6$ , and a cut-off valve I, consisting of two forked heads  $i i'$  with cut-off flanges  $i^2 i^3$ . The fastening of said two valves to their respective valve-stems H' and I' is effected in a manner similar to that of cylinder C, viz: The valve H is fastened by means of two clamp-nuts  $h$  and the valve I by means of collars  $i^4$  and nuts  $i^5$ . The valve-stems F' and H' and those G' and I' are coupled between the valve-chests C<sup>2</sup> C<sup>3</sup> by the well-known device or devices, as shown, or by some other suitable device or devices, and while the cut-off valves G and I are operated from the rock-shaft E<sup>2</sup> by means of a lever-arm  $g^4$  and connecting-rod  $g^5$ , as seen in Figs. 1 and 2, the valves F and G are operated by a rock-shaft F<sup>2</sup> by means of a lever-arm  $f^7$  and connecting-rod  $f^8$ .

The rock-shaft F<sup>2</sup> is suitably hung in the frame X and provided with a lever-arm  $f^9$ , which latter is connected by means of a couple of links  $j$  to the main piston-rod J of a piston  $j^5$  in a steam-cylinder J' of the subsidiary engine D. This steam-cylinder, which may be operated by water-pressure from the pump-main or by steam from the boiler, is of ordinary construction, and the valve-rod  $j'$  of its slide or main valve  $j^2$  is extended out and beyond the steam space or way  $d$ , and is there provided with two collars  $j^4$ , which serve as abutments of a tappet K on a piston-rod K' of a piston  $k$  in a small steam-cylinder K<sup>2</sup> of ordinary construction. The valve-rod  $k'$  of its slide-valve  $k^2$  is connected by means of a link  $k^3$  to a lever L, suitably hung or fulcrumed to an upper frame J<sup>2</sup> of the subsidiary engine D, and this lever is by means of a number of connecting-rods  $l l' l^2$  and levers  $l^3 l^4$  or other suitable devices connected to a lever-arm  $e^{10}$  upon the rock-shaft E<sup>2</sup>. The main-valve rod  $j'$  is, above the frame J<sup>2</sup>, provided with a mortised head  $j^5$ , into which the end  $m$  of a hand-lever M is passed, so that the valve  $j^2$  can be operated by hand in case of an emergency.

Steam is admitted to the valve-chest C<sup>2</sup> of the cylinder C from a boiler through a pipe N. The exhaust-steam is conveyed from the cylinder C by a pipe  $n$  to the valve-chest C<sup>3</sup> of cylinder C', the exhaust of which is conveyed away by a pipe  $n'$ . A branch pipe  $n^2$

conveys steam from the pipe N to a steam space or loom  $d$  of the subsidiary engine D, in which the valves  $j^2 k^2$  are located. The exhaust-steam from both cylinders J' and K<sup>2</sup> is conveyed away by a pipe  $n^3$ . This device for conveyance of the steam to engine D may, however, be substituted by any other suitable device, and any other motor beside steam may be used for operating the same.

The steam-cylinders C C' are shown provided with linings  $o o'$ ; but they may be safely constructed and operated without these linings.

While the piston-rod  $c$  is finishing its stroke the pin  $e^9$ , with its described connections, reverses the position of the valve  $k^2$ , whereby the position of the piston  $k$  and that of the tappet K are reversed. By means of this operation the tappet K reverses the position of the valve  $j^2$ , whereby the position of the piston  $j^5$  and piston-rod J is reversed, and consequently the main valves F H are also reversed. By this construction the said main valves are always operated with a full-stroke, and the fresh steam from the boiler enters the cylinder C through a fully-opened port. The stroke of the piston-rod  $c$  is now limited to its exact extent by the operation of the valves G I E F, as will be seen. The exact or correct length of the stroke of the piston-rod  $c$  can only be attained by the cut-off valves G I and E F, for the reason that they are directly operated from the rock-shaft  $b^2$ , and thus move simultaneously with the piston-rod  $c$ . Thus when the piston-rod  $c$  has arrived at the terminus of the stroke the valve G has previously cut off the steam-supply from the valve F, and the opposite valve E or E', as the case may be, has cut off the exhaust, so that the piston  $c^2$  is arrested between two elastic cushions of steam, in which position it remains while the subsidiary engine is reversing the main valves.

It is found that steam-pumps provided with independent valve-motion, as herein described and shown, cannot be operated with a uniform stroke, and various provisions have been made to avoid unduly prolonged strokes, but at great expense. I therefore provide the main cylinder with an expansion slide-valve operated by the valve-gear-operating engine D, whereby the end portion of the stroke of the main engine is effected with simply expanding steam, thus retarding its speed and greatly reducing the momentum of the engine, and enabling me by closing the steam-passage of the main cylinder by the valves E E' to stop the motions of the steam-pistons with greater precision than would be the case if the main cylinder were operated by live steam to the end of the stroke.

What I claim as my invention is—

1. The combination of the pump A\*, intermediate compensating beam B, and operating steam-engine C\*, comprising cylinders C C', a subsidiary valve-motor D for operating the main valves of the steam-engine, and the



directly-operated cut-off valves G I E E', substantially as described.

2. The combination of the compound pumping steam-engine C\*, comprising cylinders C  
5 C', piston-rod c, piston c<sup>2</sup> c<sup>3</sup>, valves E E', F G, and H I, with the subsidiary engine D, substantially as described.

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

HENRY DAVEY.

Witnesses:

ALEXR. CECIL RIDGWAY,  
W. N. RIDGWAY.