(No Model.) 2 Sheets—Sheet 1.

G. H. REYNOLDS & T. J. RIDER.

DIRECT ACTING ENGINE.

No. 318,656. Patented May 26, 1885.

Fig 2.

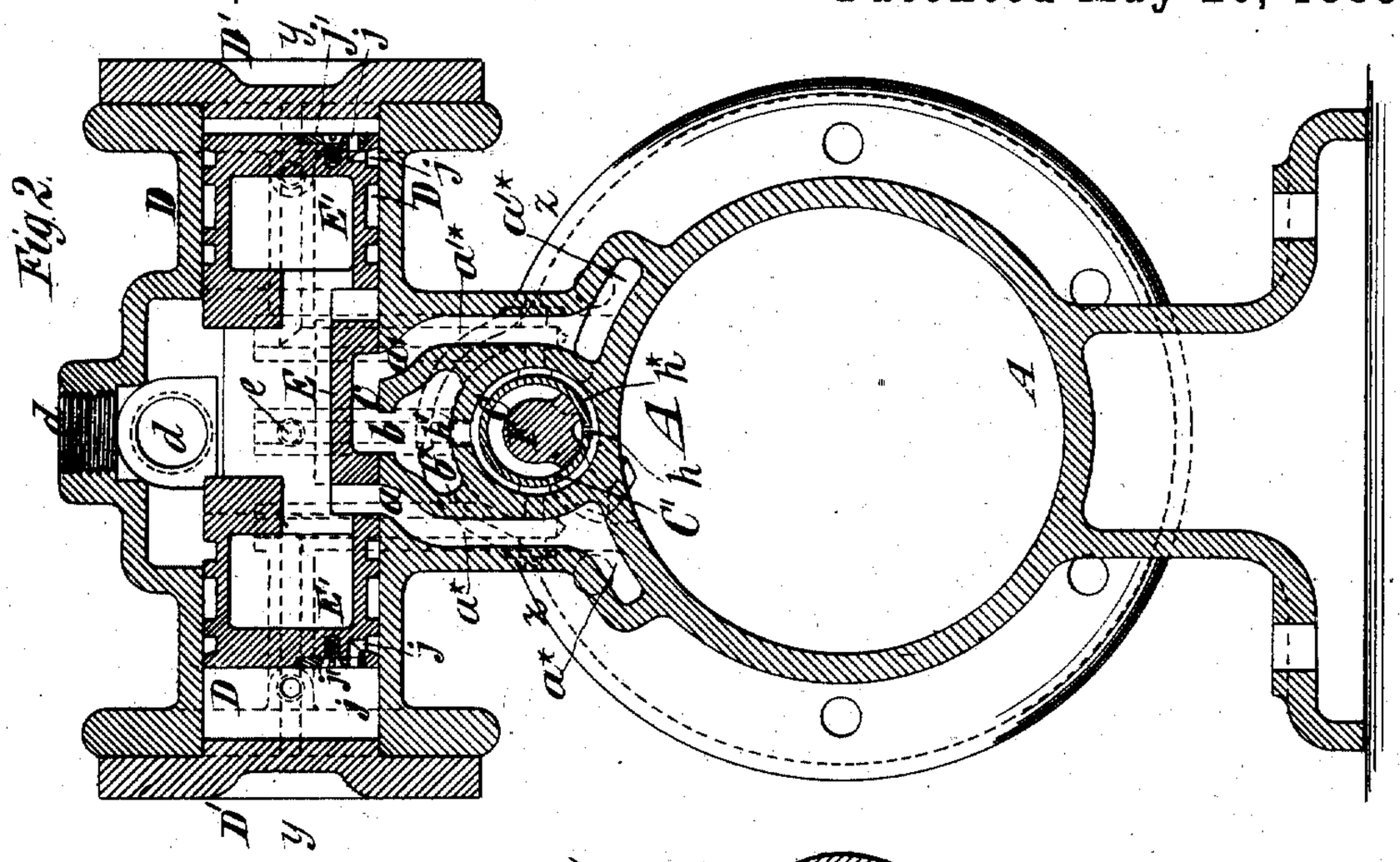


Fig 1.

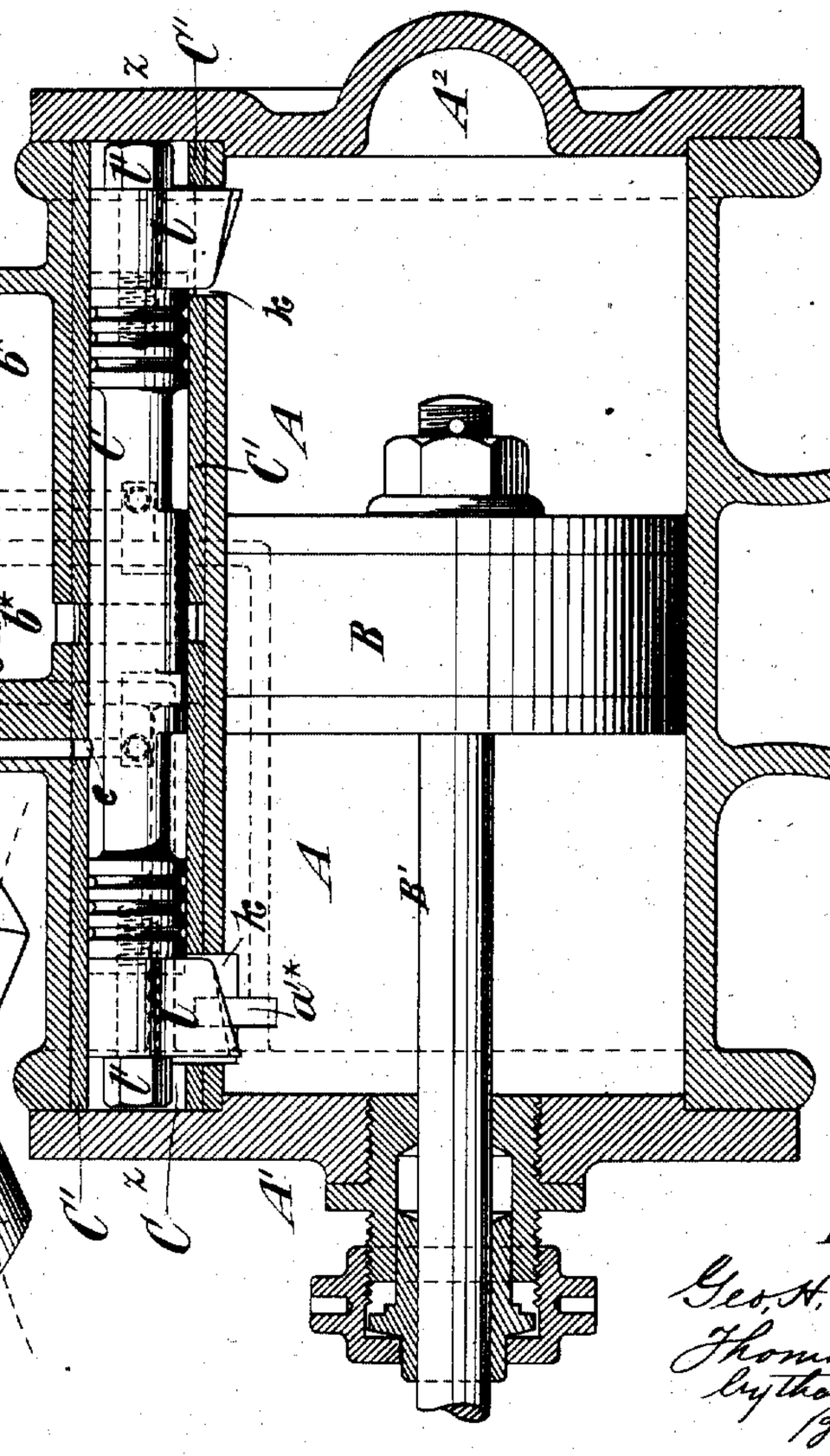
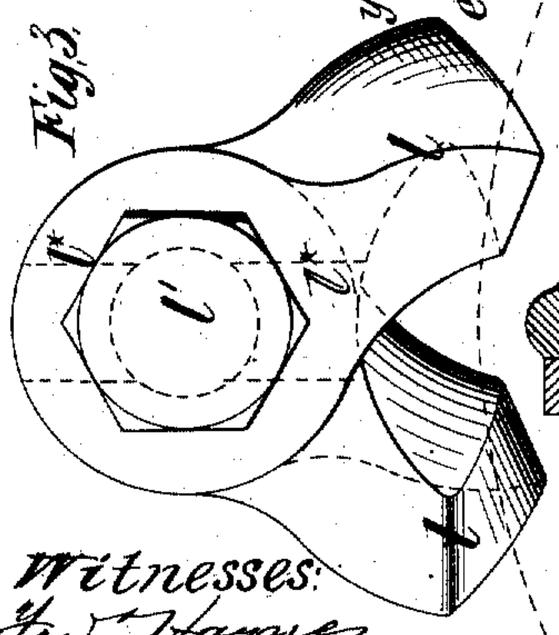


Fig 3.



Witnesses:
Geo Hamer
Emil Schwartz

Inventors:
Geo. H. Reynolds
Thomas J. Rider
by their Attys.
Brown & Hall

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

G. H. REYNOLDS & T. J. RIDER.

DIRECT ACTING ENGINE.

No. 318,656. Patented May 26, 1885.

Fig. 4.

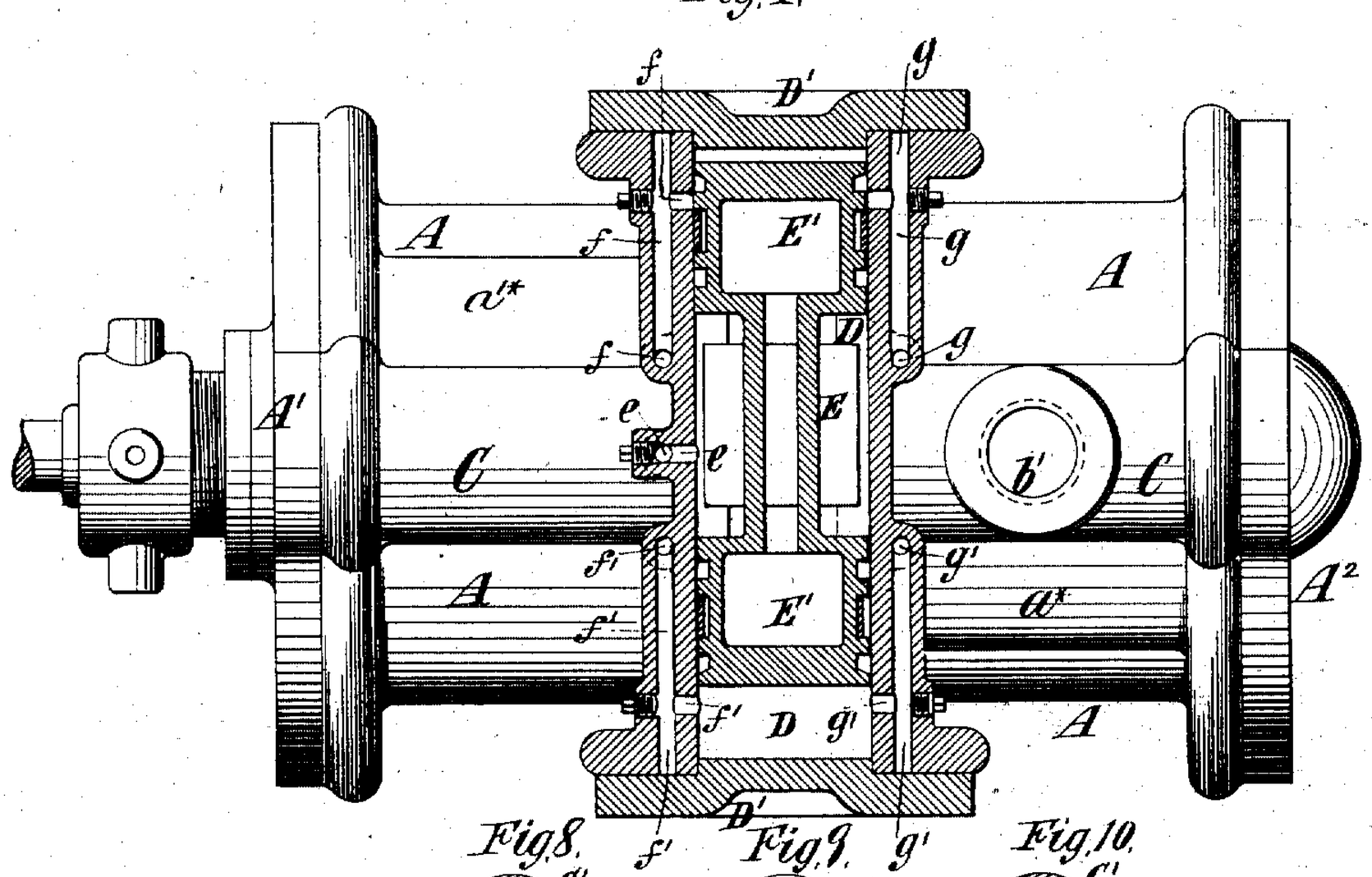


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 5.

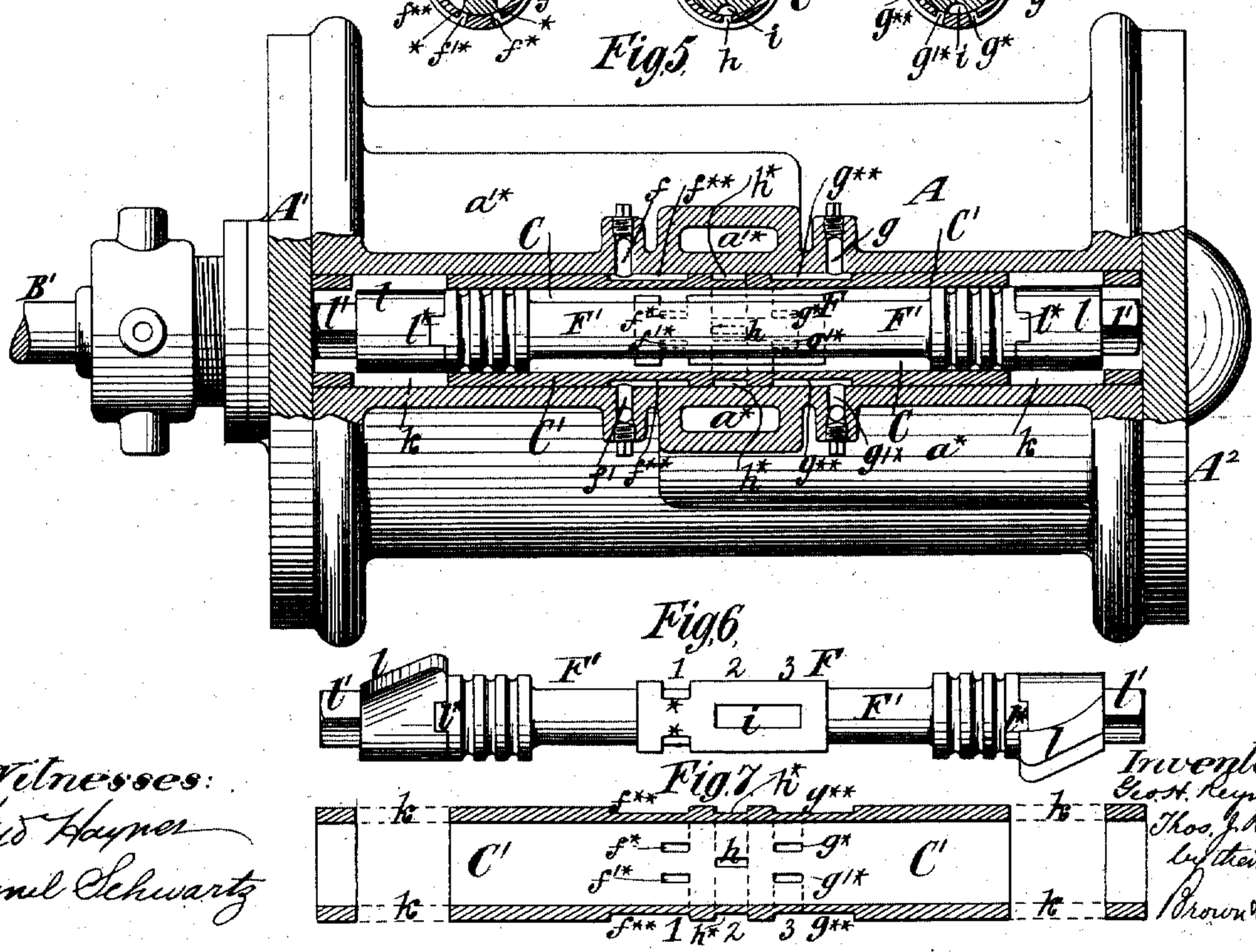


Fig. 6.

Fig. 7.

Witnesses:
Fred Haynes
Emil Schwartz

Inventors:
Geo. H. Reynolds
Thos. J. Rider.
by their Attys
Brown & Hall

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

GEORGE H. REYNOLDS AND THOMAS J. RIDER, OF NEW YORK, N. Y., ASSIGNORS OF THREE-FOURTHS TO CORNELIUS H. DE LAMATER, GEORGE H. ROBINSON, AND WILLIAM DE LAMATER, ALL OF SAME PLACE.

DIRECT-ACTING ENGINE.

SPECIFICATION forming part of Letters Patent No. 318,656, dated May 26, 1885.

Application filed December 4, 1884. (No model.)

To all whom it may concern:

Be it known that we, GEORGE H. REYNOLDS and THOMAS J. RIDER, both of the city and county of New York, in the State of New York, have invented a new and useful Improvement in Direct-Acting Engines, of which the following is a specification.

Our invention is applicable to direct-acting engines in which the supply and exhaust of steam or other motive agent to and from the main cylinder is controlled by a main valve operated by an auxiliary piston, and in which the supply and exhaust of the motive agent to and from the cylinder containing the auxiliary piston is controlled by an auxiliary valve operated by the movement of the main piston. Direct-acting engines of this class are commonly used for operating direct-acting steam-pumps, but may be employed for other purposes.

Our invention relates to that class of direct-acting engines in which the auxiliary valve has connected with it cams or toes which project into the main cylinder and into the path of travel of the main piston, such engines being advantageous, because the means whereby the auxiliary valve is operated are wholly concealed within the main cylinder and valve-chest, and do not extend beyond the ends of the main cylinder, whereby simplicity of construction is secured and the space between the steam and water cylinders of a direct-acting steam-pump may be reduced.

To enable our invention to be better understood, we will briefly describe a direct-acting engine which embraces all the features of our invention.

Immediately over the main cylinder is an auxiliary valve-chest, which is circular and of small diameter and extends the whole length of the main cylinder and parallel therewith. Over the auxiliary valve-chest, and preferably transverse to or crosswise of the main cylinder, is an auxiliary cylinder, wherein is the main valve and auxiliary piston, which may consist of a simple slide-valve and piston-heads on opposite ends thereof. The auxiliary piston and main valve are operated by the supply of steam or motive fluid to and its exhaust from opposite ends of the auxiliary cylinder, and the main valve controls ports or passages leading to opposite ends of the main cylinder and an intermediate main exhaust-port. The auxiliary valve-chest is supplied with steam by a port or passage from the main valve-chest, and in said auxiliary chest is an auxiliary valve arranged parallel with the cylinder and serving by a slight rocking or reciprocating rotary movement to control suitable ports, whereby steam or other motive fluid used is alternately admitted to and exhausted from the ends of the auxiliary cylinder in a manner hereinafter described.

Near opposite ends of the auxiliary valve-chest are apertures, which open into the main cylinder near opposite ends, and on the ends of the auxiliary valve piece or rod are cams, which project through these apertures and into the main cylinder beyond or inward of the bore thereof. These cams are located on opposite sides of a vertical plane intersecting the axes of the main cylinder and auxiliary valve-chest, and as the main piston approaches the ends of its stroke it acts upon these cams and turns the auxiliary valve alternately in opposite directions.

The auxiliary valve-chest is fitted with a lining in which the ports controlled by said valve are formed, and the lining is recessed or cut away on its exterior, so that when inserted in place there will be formed between it and the bore in which it is fitted passages for steam or motive fluid to and from the auxiliary ports.

The invention consists in novel features of construction and combinations of parts hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a central longitudinal section of an engine embodying our invention. Fig. 2 is a transverse vertical section on the plane of the dotted line *x x*, Fig. 1, the main piston being omitted. Fig. 3 is an end view, on a much larger scale, of the auxiliary valve and the cams on which the main piston acts. Fig. 4 is a section in a horizontal plane indicated by the dotted line *y y* in Figs. 1 and 2. Fig. 5 is a similar section on the plane of the dotted line *z z*, Figs.

1 and 2, the auxiliary valve being shown in plan view. Fig. 6 is an inverted plan of the auxiliary valve and its cams. Fig. 7 is a horizontal section, on the same plane as Fig. 5, illustrating the lining of the auxiliary valve-chest detached from other parts; and Figs. 8, 9, and 10 are transverse sections of the auxiliary valve and lining, taken, respectively, in the plane of the dotted lines 1 1, 2 2, and 3 3, Figs. 6 and 7.

Similar letters of reference designate corresponding parts in all the figures.

A designates the main cylinder, and B the piston thereof, fast on the piston-rod B′. A′ A² designate the usual cylinder-heads, in the former of which is the stuffing-box, through which the rod works.

Extending parallel with and from end to end of the main cylinder A is the auxiliary valve-chest C, which is formed by a cylindric bore of small diameter, to which is fitted a lining, C′, which may be of brass. The lining C′ is held in place by the cylinder-heads A′ A², bearing against the opposite ends.

Above the cylinder A, and, as here shown, arranged transversely thereto, is an auxiliary cylinder, D, closed at the ends by heads D′, and having a portion intermediate between its ends, which constitutes a main valve-chest. In the auxiliary cylinder and main valve-chest D are arranged a main valve, E, (here shown as consisting of a simple slide-valve, and this valve is operated by an auxiliary piston, E′, which, as here shown, consists of two piston-heads formed integral with the valve and fitting the auxiliary cylinder. The piston-heads may be fitted with packing-rings. (Not here shown.)

The main valve E controls the ports *a a′ b*, which are best shown in Fig. 2. The ports *a a′* communicate with passages *a* a′**, which lead downward on opposite sides of the auxiliary valve-chest C, and thence in opposite directions along the main cylinder A to or near to opposite ends thereof, as shown in Fig. 5. The intermediate port, *b*, communicates with the main exhaust-cavity *b**, having a screw-threaded socket, *b′*, in which an exhaust-pipe may be inserted. The main valve E has an exhaust-cove *c*, and when moved to one or other end of its stroke it places a port, *a* or *a′*, in communication through its cove *c* with the exhaust-port, *b*, and simultaneously admits steam through the other port, *a′* or *a*, to the main cylinder at one or other end thereof.

As here shown, the auxiliary cylinder and main valve-chest D are furnished with two screw-threaded apertures or sockets, *d*, into one of which may be inserted a pipe for supplying steam or other motive fluid thereto.

The auxiliary valve-chest C is supplied with a motive fluid from the main chest and auxiliary cylinder D by a passage, *e*, (best shown in Figs. 1 and 4,) and this, as well as other passages hereinafter described, are or may be formed by drilling holes at right angles to each other and plugging up their outer or exposed ends. The supply-passage *e* extends directly through the top of the lining C′, as best shown in Fig. 1, and the pressure of the motive agent in the auxiliary valve-chest C is constant.

On one side of the auxiliary cylinder D are passages *f f′*, which communicate therewith near opposite ends, and thence extend downward to about the horizontal plane of the axis of the auxiliary valve-chest C, where they communicate with said chest outside the lining C′, as is shown in Fig. 5. In the bottom of the lining C′, and in the plane of the dotted line 1 1, Figs. 6 and 7, are two ports, *f* f′**, and the exterior of the lining C′ is recessed at *f***, as shown in Figs. 7 and 8, so as to place the ports *f* f′** in direct communication with the ports or passages *f f′*, and through them with the ends of the auxiliary cylinder D.

On the other side of the auxiliary cylinder D are passages *g g′*, communicating with the cylinder near the ends thereof, and thence extending downward and to the auxiliary valve-chest C on the exterior of the lining, as shown in Fig. 5. In the bottom of the lining C′ are two posts, *g* g′**, in the plane of the dotted line 3 3, Figs. 6 and 7, and the lining is recessed on the exterior at *g***, as shown in Figs. 7 and 10, so as to place the ports *g* g′** in direct communication with the passages *g g′*, and through them with the ends of the auxiliary cylinder D.

In the plane of the dotted line 2 2, Figs. 6 and 7, is a single port, *h*, in the bottom of the lining C′, and at that point there is an annular recess or groove, *h**, in the exterior of the lining, and at the top of the lining is a passage or opening, *h′*, directly into the main exhaust cavity *b′*, as shown in Fig. 2.

F designates the auxiliary valve, which consists of a segmental face formed upon a shaft or spindle, F′, and fitted to the curvature of the lining C′. The inlet edges * * of the valve are in the plane of the dotted line 1 1, Figs. 6 and 7, and the face of the valve is of sufficient width at that point to cover the ports *f* f′**, as shown in Fig. 8, when turned to a central position. From Fig. 8 it will be clearly understood that if the valve F is turned in either direction from the position shown, it will uncover the port *f** or *f′**, and so admit steam through the passage *f* or *f′* to one or other end of the auxiliary cylinder D. In the valve F is a cove or cavity, *i*, which is of such width that when the valve is turned to open the port *f** it will place the port *g′** in communication with the exhaust-port *h*, and when the valve is turned to open the port *f′** it will place the port *g** in communication with the said exhaust-port *h*. Consequently it will be understood that whenever steam is admitted to one end of the auxiliary cylinder D the exhaust is open from the other end thereof, and hence the main valve and auxiliary piston E E′ will be moved by the pressure of steam or other motive agent thus admitted to the auxiliary cylinder.

It will be observed that as soon as the auxiliary piston in approaching the end of its cylinder passes the opening or mouth of the passage *g* or *g'*, the remaining steam is trapped in the end of the cylinder, and there serves to effect the cushioning of the auxilary piston and main valve. In order to regulate the cushioning action of the exhaust, we form in the auxiliary piston-heads E' small ports *j*, which are controlled by washers *j'*, capable of being turned to more or less close the ports, and constituting throttling devices for the ports. These throttling devices for the cushioning-ports form the subject of our United States Letters Patent No. 237,323, dated February 1, 1881, and form no part of our present invention.

Near the ends of the main cylinder A are apertures *k*, which form communication with the auxiliary valve-chest C, and on the ends of the shaft or spindle F' of the auxiliary valve F are secured cams *l*, which project through the apertures or openings *k* and inward of the bore of the main cylinder. These cams are on opposite sides of a vertical plane coincident with the piston-rod, the cam at one end being at one side of said plane, and the cam at the other end being on the other side of the plane.

As the main piston approaches the ends of its stroke, it strikes one or other of the cams *l*, and so operates the valve and admits steam to one or other end of the auxiliary cylinder D. As here shown, the cams *l* are secured by bolts *l'* to the ends of the valve shaft or spindle F'; and to hold the cams against turning relatively to the valve we form them with tongues *l**, which enter grooves in the end of the valve shaft or spindle, as shown in Figs. 5 and 6, and so hold the cams against turning. In assembling these parts the lining C' is first placed in position, the auxiliary valve F is then slipped thereinto, and the cams *l* being pushed upward through the apertures *k*, the bolts *l'* are inserted in place to hold them securely in place on the ends of the valve shaft or spindle F'.

We are aware that it is not new to provide an auxiliary valve, or two auxiliary valves connected together by devices external to the valve chest or chests, with cams or toes which project into the main cylinder through openings near the ends thereof, and are acted upon alternately by the main piston to shift the auxiliary valve or valves; and we do not claim, broadly, such a combination and arrangement of parts as included in our invention.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a direct-acting engine, the combination, with the main and auxiliary cylinders A D and the main and auxiliary pistons B E' and valve E, of the cylindric auxiliary valve-chest C, arranged parallel with the main cylinder, and communicating therewith by openings *k* near the ends thereof, ports and passages, substantially as herein described, providing for the supply of motive fluid to and its exhaust from the main and auxiliary cylinders, and the oscillating or rocking auxiliary valve F F', arranged in the chest C parallel with the axis of the main cylinder A, and provided with cams *l*, projecting through the openings *k* in the path of the main piston B, and adapted to be operated on alternately by said piston to turn the auxiliary valve in a plane transverse to the axis of the main cylinder, and auxiliary valve-chest C, substantially as and for the purpose herein set forth.

2. In a direct-acting engine, the combination, with the main and auxiliary cylinders A D and the main and auxiliary pistons B E' and valve E, of the cylindric auxiliary valve-chest C, arranged parallel with and extending from end to end of the main cylinder, and communicating therewith by openings *k* near the ends thereof, the heads A' A², closing the ends of the main cylinder A and chest C, ports and passages, substantially as herein described, providing for the supply of motive fluid to and its exhaust from the main and auxiliary cylinders, and the oscillating or rocking auxiliary valve F F', arranged in the chest C parallel with the axis of the main cylinder A, and provided with cams *l*, projecting through the openings *k* in the path of the main piston B, and adapted to be operated on alternately by said piston to turn the auxiliary valve in a plane transverse to the axis of the main cylinder and auxiliary valve-chest C, substantially as and for the purpose herein set forth.

3. The combination, with the main and auxiliary cylinders A D and the auxiliary valve-chest C, constructed with the ports and passages *e f f' f* f'* g g' g* g'**, the auxiliary valve-chest C being parallel with the main cylinder A, of the main and auxiliary pistons B E', and the main valve E, and the auxiliary valve F F', arranged parallel with the axis of the main cylinder and provided at the ends with the cams *l l*, which are acted on alternately by the main piston to rock the auxiliary valve in a plane transverse to the axis of the main cylinder, all substantially as herein described.

4. The combination, with the main and auxiliary cylinders A D, and the auxiliary valve-chest C, and externally-recessed lining C', all constructed with the ports and passages *e f f' f* f'* g g' g* g'**, of the main and auxiliary pistons and the auxiliary valves F F', provided with the cams *l l*, substantially as herein described.

GEO. H. REYNOLDS.
THOMAS J. RIDER.

Witnesses:
FREDK. HAYNES,
MATTHEW POLLOCK.

Letters Patent No. 318,656.

Correction in Letters Patent No. 318,656.

It is hereby certified that Letters Patent No. 318,656, granted May 26, 1885, upon the application of George H. Reynolds and Thomas J. Rider, of New York, N. Y., for an improvement in "Direct-Acting Engines," should have been issued to said Reynolds and Rider, assignors of *one-half* the interest in said invention to Cornelius H. De Lamater, George H. Robinson, and William De Lamater, and said Reynolds assignor of his *remaining interest to said assignees;* that the proper corrections have been made in the files and records pertaining to the case in the Patent Office, and should be read in the Letters Patent that the same may conform thereto.

Signed, countersigned, and sealed this 16th day of June, A. D. 1885.

[SEAL.]

H. L. MULDROW,
Acting Secretary of the Interior.

Countersigned:

M. V. MONTGOMERY,
Commissioner of Patents.