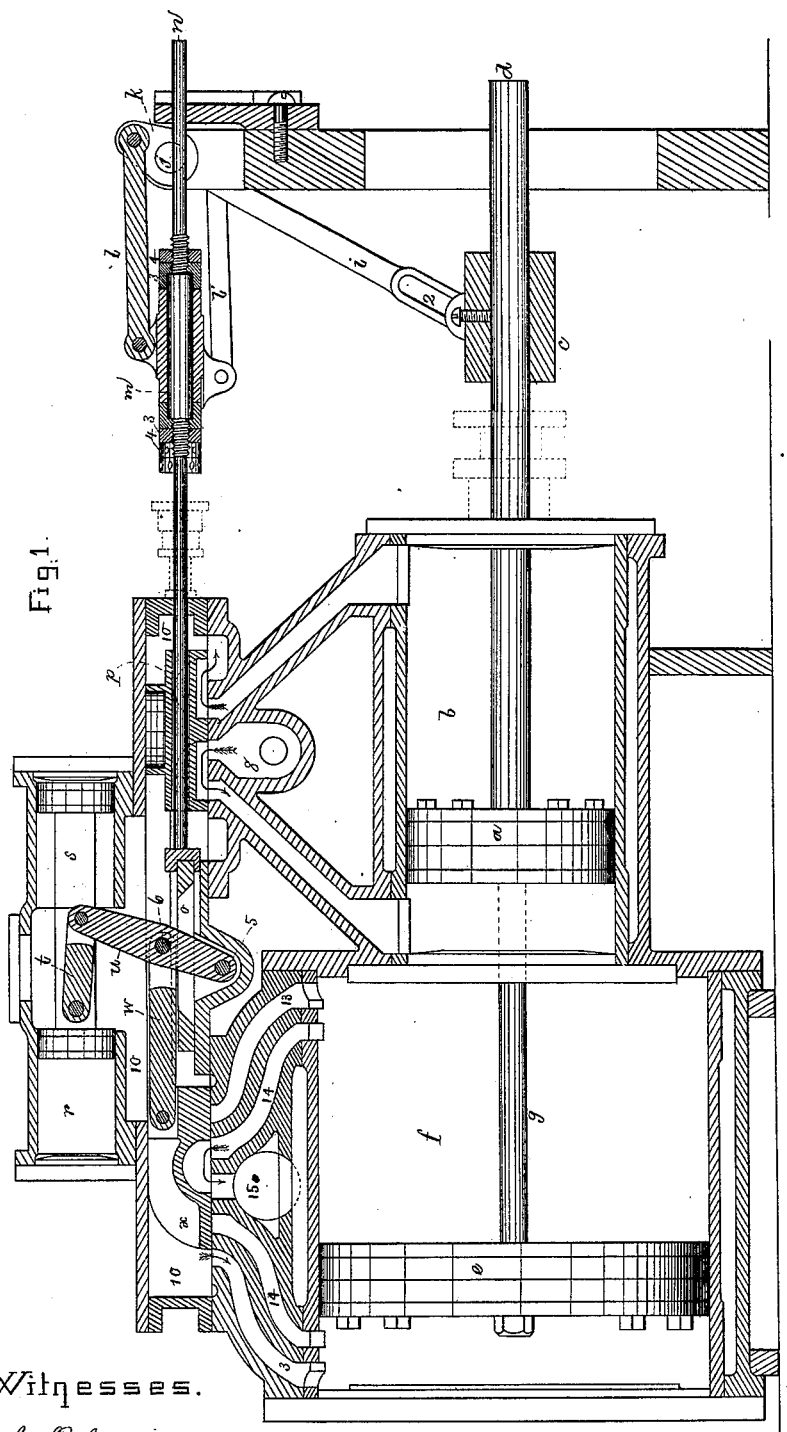
2 Sheets—Sheet 1.

G. F. BLAKE.

Compound Steam Pumping Engine.

No. 213,615. **Patented Mar. 25, 1879.**

Fig. 1.



Witnesses.

L. F. Connor.

N. E. Whitney.

Inventor.

George F. Blake,

by Crosby & Gregory

Attys

2 Sheets—Sheet 2.

G. F. BLAKE.

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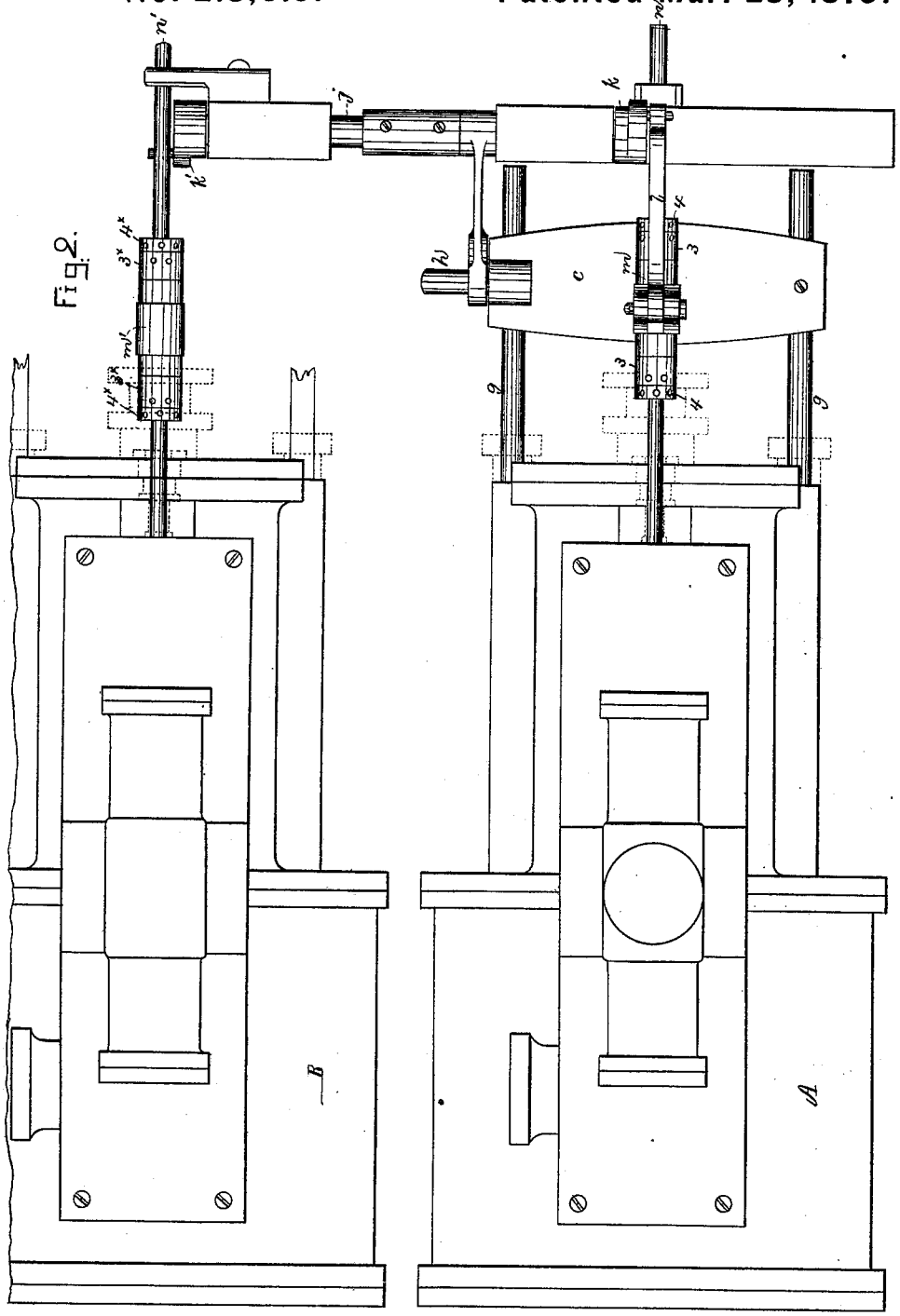
Fig. 2.



Witnesses.
L. F. Connor
N. E. Whitney

Inventor.
George F. Blake
by Crosby & Gregory Attys

UNITED STATES PATENT OFFICE.

GEORGE F. BLAKE, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN COMPOUND STEAM PUMPING-ENGINES.

Specification forming part of Letters Patent No. **213,615**, dated March 25, 1879; application filed December 20, 1878.

To all whom it may concern:

Be it known that I, GEORGE F. BLAKE, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Compound Steam Pumping-Engines, of which the following description, in connection with the accompanying drawings, is a specification:

This invention relates to a compound steam pumping-engine in which the steam after being used in the smaller cylinder is exhausted into the larger cylinder, from which, after performing work, it is exhausted into the atmosphere or into a suitable condenser.

In this my improved pumping-engine the valves for the large or low-pressure cylinder, for the small or high-pressure cylinder, and for the auxiliary engine are shown all as located in the same steam-chest, and the exhaust-steam from the small cylinder enters directly into the steam-chest, and from it into the large cylinder, whereas in other pumping-engines heretofore commonly made each cylinder has had its own steam-chest and stuffing-boxes, and the steam has passed from the small cylinder to the chest of the large cylinder through an independent pipe.

To prevent shocks in the pipes I have so arranged the steam-valves and their shifting mechanism that the said valves are gradually reversed at the ends of their strokes, thereby causing the pump-piston to pause at each end of its stroke, and permit the pump-valves to open and close gradually. This I accomplish by a system of links and levers located in the steam-chest, and connecting the auxiliary piston with the valves of the small and large cylinders. The time of reversal of the valve for the auxiliary engine is adjusted or regulated by means of a valve-controller, which derives its motion from arms and links actuated by the steam-piston.

Figure 1 represents, in longitudinal vertical section, one of my improved compound pumping-engines; and Fig. 2, a top view thereof, showing, also, connecting mechanism for a similar engine to be used on the duplex system.

The piston *a* of the small cylinder *b* is connected with the cross-head *c*, to which is attached the pump-piston rod *d*, of usual construction. The piston *e* of the large cylinder *f* is connected, by means of two rods, *g*, with the same cross-head *c*. This cross-head has a pin, *h*, to enter a slot, 2, in the arm *i*, connected at its upper end with the rock-shaft *j*, provided with an arm or arms, *k k'*, according to whether one or two pumps are being used. The arm *k* is, by link *l*, joined with a sleeve, *m*, which forms part of the valve controller, its other parts being the nuts 3 4 at each end thereof, the said nuts and sleeve being placed about the valve-rod of the auxiliary valve *o*, the said rod being herein shown as extended through the valve *p* of the small engine.

The auxiliary valve *o* is opened and closed at the proper time to control the passage of steam from the steam-boiler into the cylinder *r*, containing the auxiliary piston *s*.

The time at which the valve *o* is shifted depends upon the amount of lost motion between the sleeve *m* and nuts 3 on the rod *n*. The greater the space the later the said valve will be shifted after the arm *i* reaches the center of its movement.

The auxiliary piston, controlled by the movement of the auxiliary valve, is connected, by a link, *t*, with a lever, *u*, pivoted at its lower end, 5, and said lever, at a point between its ends, is attached, by means of a pin, 6, with a link, *w*, which is jointed to the valve *x* of the large cylinder. The movement of the auxiliary piston, through its connections, just described, with the valve *x*, operates the valve *x* and its connected valve *p* in unison.

These valves *x p* may be cast together, or be joined by any suitable connection.

The top of valve *p* contains a piston of usual construction, under which live steam is admitted to retain valve *p* on its seat.

Live steam to operate the pumping-engine is admitted in the opening 8, under the valve *p*, into the cylinder *b* at one side of its piston *a*, the steam from the other side of the said piston passing out under the valve *p* into the chest 10, as shown by the arrows, from which it passes into the large cylinder, and acts in the same direction against the large piston that the live steam acts against the small piston.

The large cylinder has at each end a live and exhaust steam port, 13 14, the live-steam-ports opening into the extreme ends of the cylinder, and the exhaust-ports entering at a

certain distance from the ends. These ports permit the piston to be cushioned on vapor, the quantity of which is regulated by a valve (not shown) on the outside, which opens communication between ports 13 14, regulated by the attendant.

The steam, after doing its work in cylinder *f*, passes out through ports 14, under valve *x*, and out of the engine.

To produce a compound duplex pumping-engine, a second set of cylinders, *f b*, pistons, and valves, as described, is placed alongside of the parts already described, and to the same rock-shaft *j*, or a continuation of it, is attached a valve-rod, *n'*, in the same manner as the rock-shaft is attached to rod *n*, but it will be noticed that the cranks *k k'* are set on the rock-shaft at about one hundred and eighty degrees apart.

The valve-controller of the second compound engine is marked *m'* and $3^{\times}$ $4^{\times}$.

From the foregoing description it will be observed that any movement imparted to the arm *i* will cause the rock-shaft *j*, and consequently the arms *k* and *k'* and valve-rods *n n'*, to be actuated by their controlling devices.

By this means each engine may actuate its own valves and that of its neighbor; but by disconnecting the rock-shaft from the link *l'* the opposite compound engine may be thrown out of action. The arm *i* may be so placed on the rock-shaft as to be operated from either compound engine and actuate the other one.

In Fig. 2 I have designated one of the compound engines by the letter A, and have shown in Fig. 1 a vertical section of it. The compound engine B (shown in Fig. 2) will be constructed as represented by the section Fig. 1.

I have not, in the drawings, shown the ports for the auxiliary valve, as they will be as usual, and will be operated in the usual manner.

To insure the positive action of the auxiliary valve by steam at full pressure, I prefer to actuate it by steam directly from the boiler, without passing through the chest. By placing all the valves in one chest the usual stuffing-boxes are dispensed with.

I claim—

1. In a compound pumping-engine, the combination, with a steam-chest common to both of its cylinders, of the valves for both cylinders, and the valve for operating the auxiliary piston or engine, all to operate substantially as described.

2. In a compound engine, an auxiliary piston and the valves of the high and low pressure cylinders, combined with a pivoted lever connected with the said auxiliary piston, and the valves to operate them in unison, substantially as described.

3. The piston-rod, rocker-shaft, connected valve-controller, and an arm to operate the rock-shaft, combined with the valve-rod for actuating the valve of the auxiliary piston at the proper time, substantially as described.

4. The connected valves *p x*, the lever *u*, links *w t*, and auxiliary piston, all connected together as shown and described, and located in the same steam-chest, substantially as described.

5. In a pumping-engine, a rock-shaft and valve-rod to operate the valve for the auxiliary engine, combined with a second valve-rod connected with the same rock-shaft or a prolongation thereof, to operate the valve for the auxiliary engine of a second pumping-engine, thereby producing a compound duplex engine, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GEO. F. BLAKE.

Witnesses:
G. W. GREGORY,
N. E. WHITNEY.