2 Sheets—Sheet 1.

F. DOUGLAS

VALVE-GEAR FOR STEAM-ENGINES.

No. 179,846. Patented July 18, 1876.

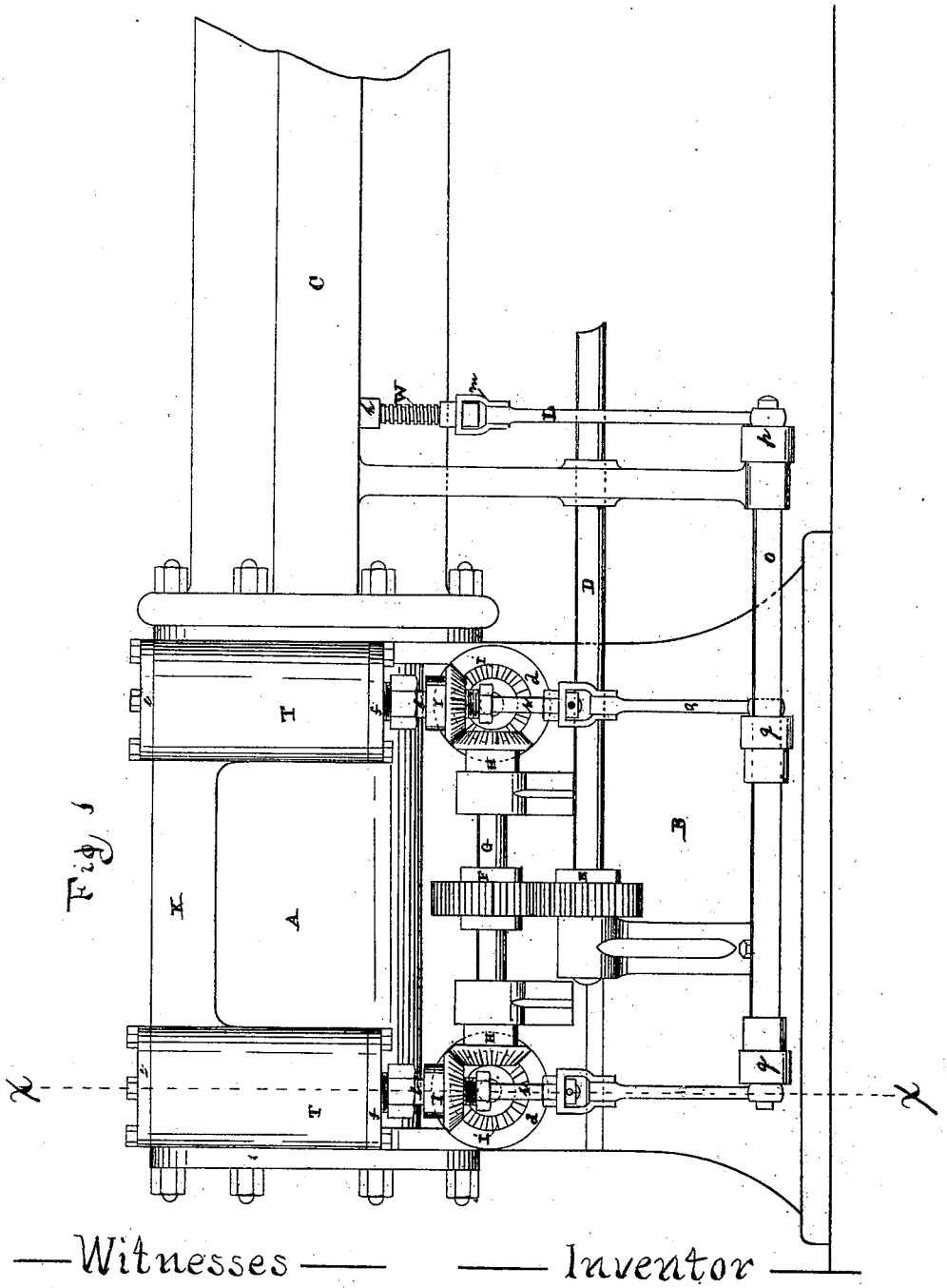

Fig. 1

—Witnesses— —Inventor—

J. E. Griffing
Thomas B. Connolly.

Frank Douglas.

2 Sheets—Sheet 2.

F. DOUGLAS

VALVE-GEAR FOR STEAM-ENGINES.

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Fig 3

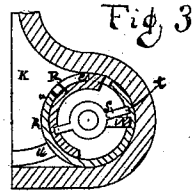


Fig 2

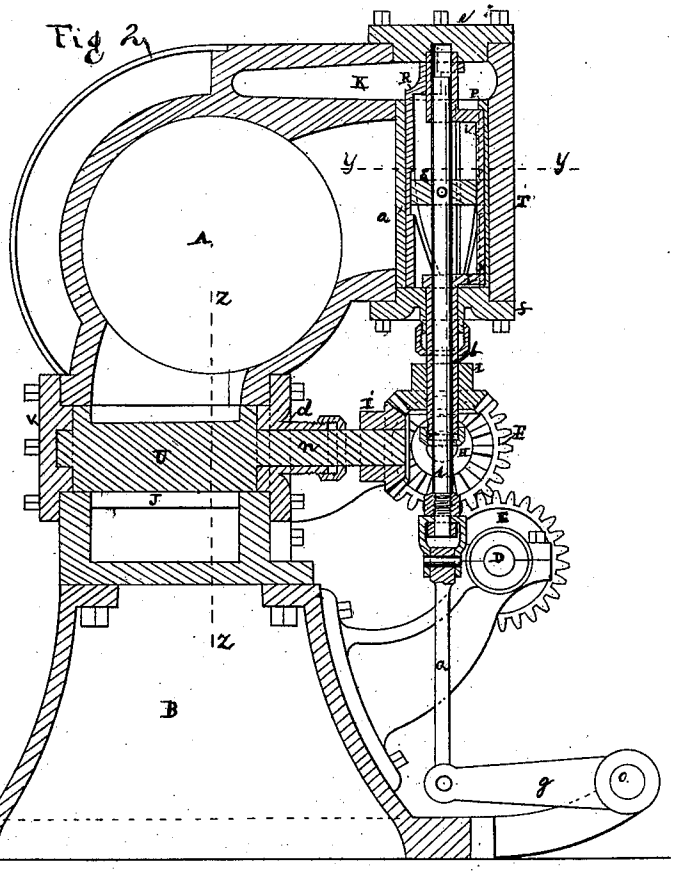
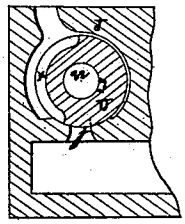


Fig 4



Witnesses

J. E. Griffing

Thomas E. Connolly.

Inventor

Frank Douglas.

UNITED STATES PATENT OFFICE.

FRANK DOUGLAS, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN VALVE-GEAR FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **179,846**, dated July 18, 1876; application filed February 2, 1876.

To all whom it may concern:

Be it known that I, FRANK DOUGLAS, of Chicago, Illinois, have invented certain Improvements in Steam-Engines, of which the following is a specification:

This invention relates to an improvement in the class of engines known as the automatic cut-off engines, in which the cut-off valves are actuated by the governor in such a manner as to promptly cut off the steam at any point of the stroke, the cut-off taking place earlier or later in the stroke, to accommodate the varied loads on the engine, and the varied pressure in the boiler.

The object of my invention is to produce a steam-engine in which the valves are made to rotate continuously by direct connection to main shaft with gearing, dispensing with all eccentrics and reciprocating valve movements. With my improved rotating valves the engine can be run at a very high rate of speed, if desired, without any disarrangement of the valve-gearing.

Figure 1, on Sheet 1, is a vertical side view of the cylinder and valve-gearing, with part of bed-plate attached. Fig. 2, on Sheet 2, is a vertical cross-sectional view of the cylinder and valves. Fig. 3 is a cross-section of induction and cut-off valves and chest. Fig. 4 is a vertical cross-section of exhaust-valve and chest.

The cylinder A rests upon foundation B, and is connected to main pillow-block by bed-plate C. Shaft D is driven by gearing from the main shaft, and rotates at the same speed, in the direction indicated by the arrow. Gear E is attached to shaft D by an adjustable fastening, for the purpose of adjusting the lead of the valves. Gear F on shaft G is driven by gear E, and transmits motion through bevel-gears H H to valve-gears I I I′ I′. There is the same relative difference in size between gears E and F that there is between H and I, which makes the valves P P and U U turn the same number of revolutions as the main shaft of engine, and therefore will always maintain the same relation to the ports at any given point of stroke. The cylinder A is provided with two circular steam or valve chests, T T, for the induction of steam, and are placed vertically near the ends of one side of cylinder. These induction-chests are connected to steam-pipe from boiler by chest K. The exhaust-chests J J are placed under the cylinder at right angles to induction-chests. The driving-stems *b b* of the induction-valves are made with an offset, *i i*, to fit into grooves of induction-valves, for the purpose of allowing the valves to lie freely up to the induction-ports *a a* while in motion. Stem *b b* extends up into cover *e e*, to guide their upper ends, and sleeve end extends down through lower covers with stuffing-box *f f*, to receive driving-gears I I. Cut-off valve-stems *r r′* extend down through the sleeve or lower end of driver *b b′*, and are driven by induction-valves. The exhaust-valves U U′ are made to fill the circular exhaust-chests, except the depression in valves *x*, little less than one-half its circumference. Exhaust-chest has a slight depression around inside of chest, except a small bearing on either side of exhaust-port for seat of valve. The exhaust-valves are also driven by loose stems *n n*, which pass through valves and into covers *v v*, to hold them in a central position. A projection on stem *n* fits freely in corresponding groove in valve U, by which it is driven. This allows the exhaust-valves to find their own seats directly over the exhaust-ports. The other end of stem passes through stuffing-box in cover *d d*, and receives the driving-gear I. The induction-valves P P are made in the form of tubes the proper length and thickness, with little more than one-fourth cut away, through which steam is admitted to the cylinder. These valves are driven by the offset on stems *b b*, which fit freely into grooves to receive them. Valves P P also have spiral grooves to receive dogs *s*, for driving cut-off valves. The cut-off valves fit the inside of induction-valves, and have lips or projections *c c* extending through the cut-away portion of induction-valves even with the outside surface. W represents the screw of my patent governor, patented September 8, 1863, which is bolted to bed C. The nut *h*, through which the governor-screw passes, is also a part of the governor. Connection L connects the governor-screw through spade-handle joint *m* to arm *p* on rock-shaft *o*. Arms *g g* connect by connections Q Q′ to spade-handle joint of cut-off

valve stems *r r*. The driving-dogs *s* for each cut-off valve is firmly fastened to stem *r*, and one end fits freely in spiral groove *t* of induction-valve P, and the other end fits freely in spiral groove cut spirally in the opposite direction in cut-off valve R.

The operation is as follows: When steam is admitted to the induction-chests it enters the induction-valve at the top, and when the valve has turned around so as to bring the cut-away portion of valve over the port, the steam passes freely into the cylinder, and when the lip *c* of the cut-off valve R reaches the port it cuts off the steam, and the port remains covered until the opening edge of the induction-valve reaches the port again. After the piston has made the stroke the exhaust-valve has turned around, so as to bring depression *x* over the exhaust-opening *j*, which allows the steam to pass out freely until it completes the stroke, when the outer portion of the valve covers the opening or port *j*, and it remains covered the remainder of the revolution. When the governor-screw is down, the dog in the spiral groove throws the cut-off valve back, so as to allow steam to follow more than one-half stroke, and when the governor runs the screw up it pushes stem *r* up, and dog *s*, sliding in spiral grooves of induction and cut-off valves, leads the cut-off valve lip *c* ahead, so as to nearly close the opening, and cuts the steam off directly after it is admitted, thereby cutting off the steam, at any point indicated by the governor, from zero to more than one-half stroke. Cut-off valve R may be driven by a dog from stem *r*, and be acted upon by the governor, through a spiral connection to driving-arm *b* outside of valve-chest, and between gear I and arm *g*.

I claim as my invention—

1. The combination of the cylindrical valve P, having longitudinal groove, and the driving-yoke *i* of stem *b*, for the purpose of operating the valve, substantially as herein specified.

2. The combination of the valve P, having longitudinal driving-groove, the driving-stem *b*, stem *r*, with dog *s*, for the purpose of driving cut-off valve R, and the rock-shaft *o*, with connections to governor-screw W, substantially as herein specified.

3. The gears H, I, I′, F, and E, in combination with shaft D and the valves P, R, and U, said valves being placed at right angles to each other, as herein specified.

4. The circular chests for valves P, R, and U, placed at right angles with each other, when used in combination with cylinder A and driving-gears I I′, substantially as herein specified.

FRANK DOUGLAS.

Witnesses:
THOMAS C. CONNOLLY,
ULYSSES G. WHITE.