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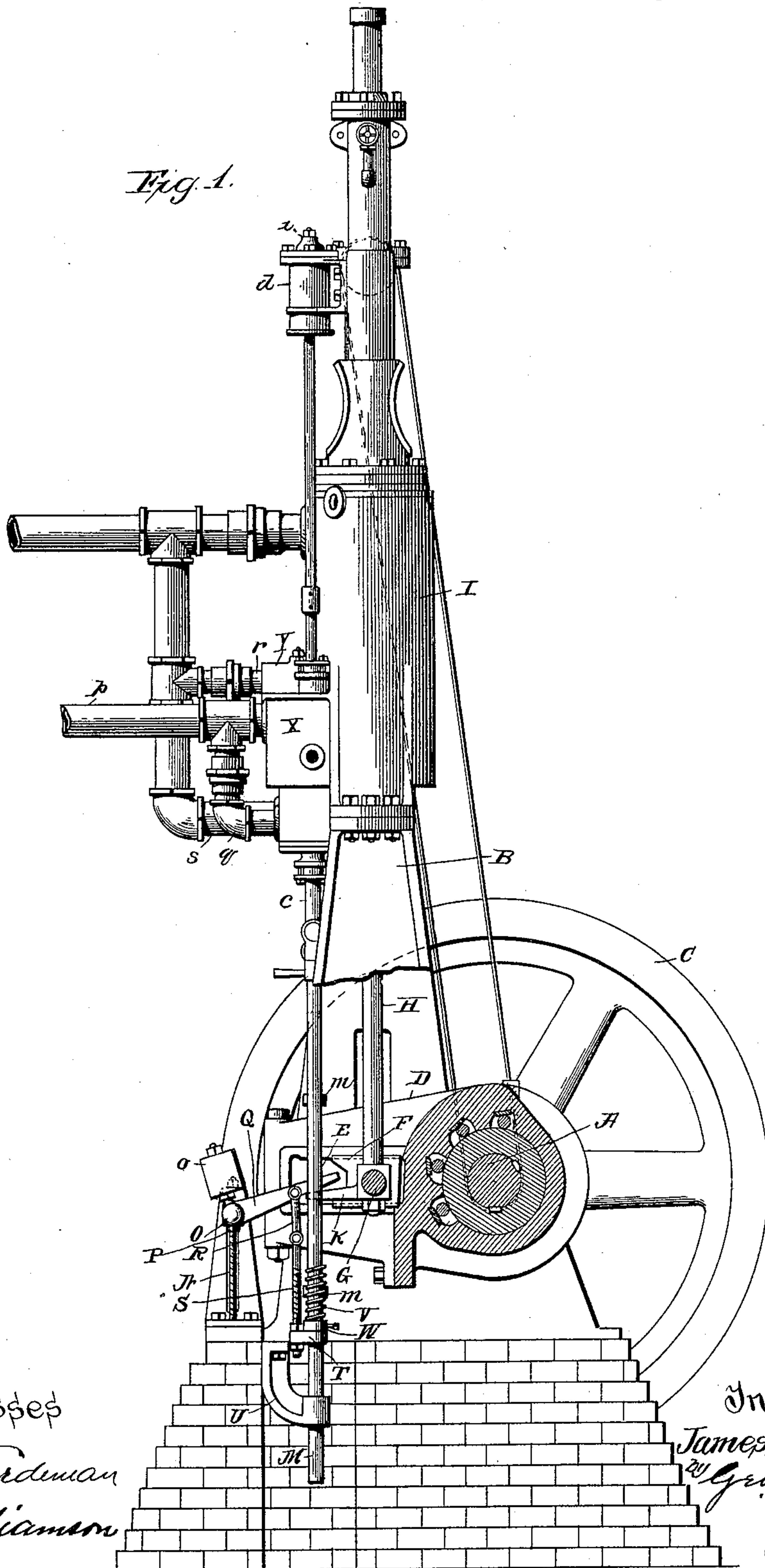
3 Sheets—Sheet 1.

J. D. GRAY.  
CUT-OFF MECHANISM FOR ENGINES.

No. 583,432.

Patented May 25, 1897.

*Fig. 1.*



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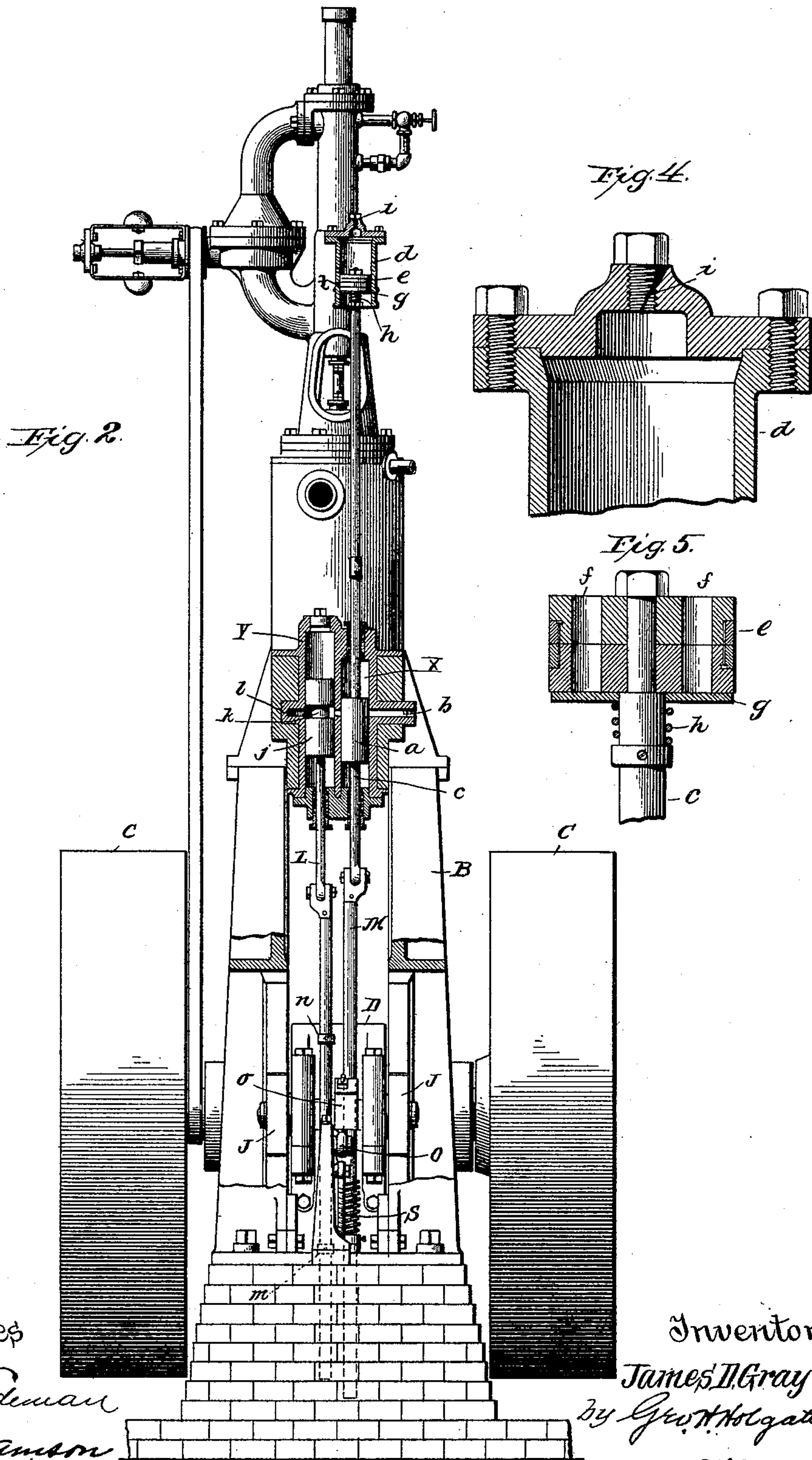
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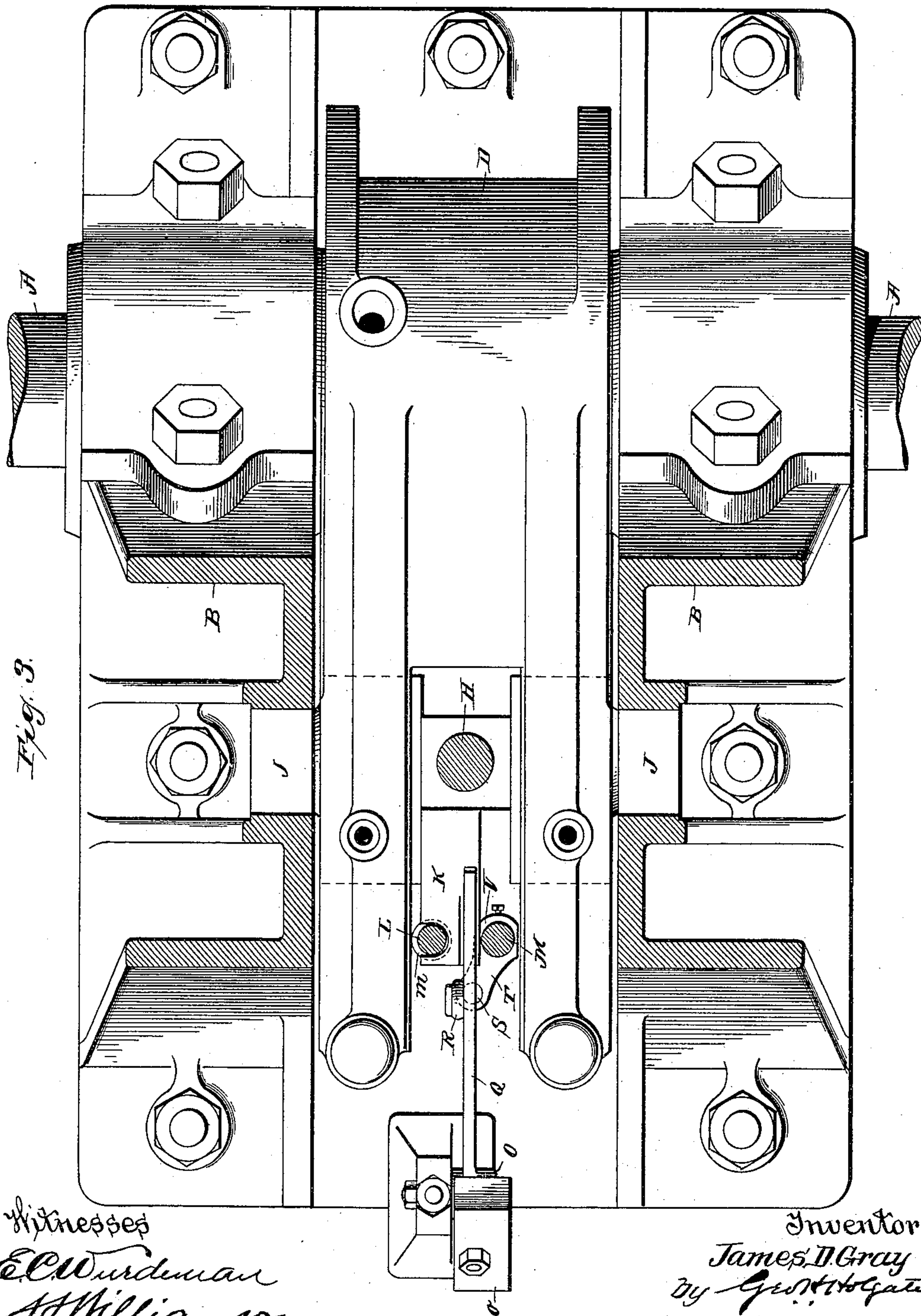
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# UNITED STATES PATENT OFFICE.

JAMES D. GRAY, OF BALTIMORE, MARYLAND, ASSIGNOR OF TWO-THIRDS  
TO WILLIAM B. PRICE AND ABRAHAM SHARP, OF SAME PLACE.

## CUT-OFF MECHANISM FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 583,432, dated May 25, 1897.

Application filed June 30, 1896. Serial No. 597,522. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES D. GRAY, a citizen of the United States, residing in the city of Baltimore and State of Maryland, have invented certain new and useful Improvements in Cut-off Mechanism for Direct-Acting Engines, of which the following is a specification.

My invention relates to a new and useful improvement in direct-acting engines designed to utilize fluid under pressure for the development of mechanical power, and has for its object to provide a cut-off mechanism for such an engine by means of which the steam or other fluid may be admitted to the cylinder through a given portion of the stroke of the piston and then automatically cut off said fluid, so as to utilize the same to the greatest advantage in imparting motion to the piston, the special object of my present invention being to improve upon the construction shown and described in Letters Patent No. 533,290, granted to me upon the 29th day of January, 1895.

With these ends in view my present invention consists in the details of construction and combination of elements hereinafter set forth, and then specifically designated by the claims.

In order that those skilled in the art to which this invention appertains may understand how to make and use the same, I will describe its construction and operation in detail, referring to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a side elevation of an engine applied in accordance with my improvement, the lower portion of one of the uprights being broken away to clearly illustrate the connection between the cross-head and the cut-off mechanism; Fig. 2, a section through the valve-chambers and auxiliary dash-pot, the remainder of the engine being in elevation; Fig. 3, an enlarged section of the clutch-arm, showing the cross-head in plan and illustrating the relative position between said head and the cut-off lever; Fig. 4, an enlarged detail of the vent-valve, and Fig. 5 a detail section of the plunger.

In describing my present invention I will refer only to so much of the engine herein shown as is necessary to give a full and clear

understanding of the bearing which the several parts may have upon the cut-off mechanism, the other features of the engine being shown and described in other applications filed by me.

A represents the main shaft, mounted in suitable bearings in the frame B, and this shaft carries a balance-wheel C of sufficient heft to perpetuate the momentum imparted thereto by the operations of the engine. A clutch-arm D is suitably mounted upon the main shaft and provided with means for imparting motion to said shaft in one direction, but to permit the latter to revolve freely when the clutch-arm is at rest or moving in the opposite direction, and this arm is bifurcated and has formed therein the slots E, in which are fitted to slide the slippers F. Journaled within these slippers is the cross-head G, carried by the piston-rod H, which in turn is connected with a suitable piston adapted to slide within the cylinder I. Slippers J are carried by the outer ends of the cross-head and arranged to slide within suitable guide-ways formed in the uprights of the engine, so as to cause said cross-head to move in a vertical line while imparting an oscillatory movement to the clutch-arm, as will be readily understood.

The center portion of the cross-head has a striker K formed therewith, which projects outward between the bifurcated members of the arm and so cut away upon one side as to partially embrace the exhaust-valve rod L for the purpose hereinafter set forth, and this striker also travels in close proximity to the admission-valve rod M. A threaded rod N is secured to the bed-plate of the engine and extends upward and has secured thereon the block O, in which runs a swiveled nut P, by means of which said block may be adjusted vertically upon the rod, and to this block is pivoted a lever Q, projecting inward within the field of travel of the striker K. Thus when said striker is moved upward in unison with the cross-head this arm will be operated upon thereby to bring about the cut-off movements, as hereinafter set forth.

Pivoted to the lever Q is a link R, the lower end of which is pivoted to the connecting-rod



S, the latter in turn being secured to the yoke T, and this yoke is connected loosely to the admission-valve rod M. The lower end of the valve-rod M is fitted within the bracket U, so as to be held in vertical alinement when being operated, and its operations are brought about first by the striker coming in contact with the lever Q, which will move said rod upward, and then by said rod coming in contact with the spring V, which is coiled about said rod above the collar W, which latter operation will compress this spring until sufficient force has been stored therein to overcome the opposing force upon the valve-rod, when the latter will shoot downward for the purpose hereinafter set forth.

The valve-chests X and Y, the former serving as the admission-chest and the latter as the exhaust-chest, are formed with or secured to the lower portion of the cylinder I, upon one side thereof, as clearly shown in Fig. 1, and within the chest X is located the cylindrical valve *a*, of such length as to properly control the admission of live steam through the inlet *b* to the cylinder. This valve has secured thereto the valve-stem *c*, which is connected with the valve-rod M at its lower end and passes upward within the auxiliary dash-pot *d* and is there provided with a plunger *e*. The plunger *e* is adapted to fit snugly within the dash-pot and has a number of holes *f* formed therethrough, which are closed upon the under side by the disk *g*, held in place by the coil-spring *h*, from which it will be seen that when the plunger is moved upward the air within the dash-pot will escape through the holes *f* by forcing the disk *g* from off its seat, but this plunger will be sustained within the upper portion of the dash-pot by the tendency to form a vacuum therein should said plunger be moved downward.

The operations of my improvement as thus far described will be obviously as follows: When the cross-head and consequently the piston are moved downward by gravity, the striker K will come in contact with the spring V, and, compressing the same, store sufficient force therein to move the valve-rod M downward against the opposing force of the suction within the dash-pot until the plunger *e* passes the vent-hole *t*, when the atmosphere will be admitted above the plunger, thus permitting the valve *a* to shoot below the inlet *b*, thereby admitting steam to the lower end of the cylinder, which will so act upon the piston as to force the latter upward, causing the clutch-arm to impart rotation to the main shaft; and this upward movement of the cross-head will bring the striker into contact with the lever Q, moving the latter upward, which, through the link R and yoke T, will carry the valve-rod M upward until the valve *a* again closes the inlet *b*, thereby shutting off the inflowing steam from the cylinder and permitting the latter to continue the upward movement of the piston by expansion. The up-

ward movement of the valve *a* also carries the plunger *e* upward in the dash-pot, and, as before described, the air above said plunger will escape therethrough, after which the valve *a* and parts connected thereto will be held in their elevated position until a force sufficient to overcome the tendency to form a vacuum within the dash-pot shall move these parts downward, and this force is the energy which is stored in the spring V by the striker compressing the same upon the downward movement of the cross-head. A vent-valve *i* is located in the top of the dash-pot and so arranged as to permit of the variance of the capacity of the vent, and this vent serves to permit the downward movement of the plunger until passing below the vent-hole *t*, so as to bring about the sudden downward movement of the valve *a* and parts carried thereby when sufficient energy has been stored within the spring V, since a certain amount of air may pass through the vent to occupy the space above the plunger, thereby regulating the partial vacuum formed within the dash-pot.

A sudden downward movement of the valve *a* is necessary to the proper working of the engine, in that it prevents the wiring of the admission-steam and permits this valve to be opened only upon the last end of the downward movement of the piston, thus preventing a back pressure from the boiler which would otherwise be created within the cylinder. *j* is the exhaust-valve adapted to slide within the chest Y, and this valve is cylindrical and has a portion thereof reduced at *k*, which, when brought into alinement with the exhaust-port *l*, will permit the outflow of the dead steam from the cylinder, and this valve is operated by the striker K coming in contact with the collar *m* when moving downward and in contact with the collar *n* when moving upward. These collars may be adjusted upon the valve-rod L, so as to regulate the distance through which said rod and its valve will be moved by the striker. When the piston moves upward, carrying therewith the cross-head and striker, said striker will move the valve *j* upward at the last end of the stroke of the piston, so as to bring the reduced portion *k* into alinement with the exhaust-port *l*, thereby releasing the pressure upon the piston and permitting it to return upon its downward stroke, when the striker, coming in contact with the collar *m*, will force said valve downward, closing the exhaust-port just prior to the opening of the admission-port by the operation of the valve *a*, and as the valve-rod M is moved downward, as before described, the lever Q will be drawn therewith, which will bring said lever into the proper relative position to the travel of the striker to permit said striker to again operate said lever upon its upward movement.

A counterbalancing-weight *o* may be secured upon the extension of the lever Q, so as to assist in holding said lever in its ele-



vated position. It is to be noted that the point at which the admission-steam is cut off will be determined by the location of the block O upon the rod N, since should this  
 5 block be lowered by the proper manipulation of the nut P the lever Q would be caused to stand at a greater angle to the horizontal and its inner end therefore in a higher plane, thus necessitating a further upward movement of  
 10 the striker to lift the valve *a* to a predetermined height. This arrangement will increase or decrease the extent to which the expansion of the admission-steam is carried, and in an engine of this description this is of  
 15 great importance, since economy of operation therein depends upon the utilization of the steam under the most effective pressure, and it is therefore essential that the expansion be not carried to an extent which will so decrease  
 20 the pressure upon the piston as to permit its effective operation upon the main shaft to fall below the minimum.

It is obvious that a number of designs of admission and exhaust valve might be used  
 25 in connection with this improvement; but I prefer to use those shown and to balance the same by the admission-pipe *p*, leading to the upper end of the admission-chest, and a branch *q* thereof, leading to the lower end of  
 30 said chest, and the exhaust-valve is likewise balanced by the branch *r*, leading to the upper end of its chest, and the branch *s* thereof, leading to the lower end of said chest, as will be readily understood.

35 Having thus fully described my invention, what I claim as new and useful is—

1. In combination with an engine of the character described, a striker carried by the piston-rod of the engine, a cut-off lever in the  
 40 path of said striker, a valve-rod connected with the cut-off, an admission-valve operated by the valve-rod, a dash-pot, a piston therein connected to the valve-rod, and means on the valve-rod to be engaged by the striker, as  
 45 and for the purpose described.

2. In combination with an engine of the character described, a cross-head adapted to be reciprocated upon the axial line of the cylinder, a striker carried by said cross-head, a  
 50 cut-off lever pivoted to an adjustable block so that its free end may extend within the field of travel of said striker, a valve-rod M, means for connecting said valve-rod to the cut-off lever, a spring arranged upon the  
 55 valve-rod so as to be compressed by the downward movement of the striker, an admission-valve, a valve-stem for connecting said valve with the valve-rod, and an exhaust-valve also adapted to be operated by the movements of  
 60 the striker, substantially as and for the purpose set forth.

3. In combination with an engine of the character described, a cross-head carried by the piston-rod of said engine, a striker carried  
 65 by said head, a cut-off lever, the free end of which extends within the field of travel of said

striker, an adjustable block to which said lever is pivoted, a valve-rod vertically guided in a suitable bearing, a connecting rod and  
 70 link for transmitting to and from the lever and valve-rod, a spring coiled about said rod, an admission-valve arranged within a suitable chest, a stem carried by said valve and by means of which said valve is connected with  
 75 the valve-rod, an auxiliary dash-pot, a plunger fitted therein, said plunger being carried by the upper end of the valve-stem, means for permitting the escape of the air within the dash-pot above said plunger, and a vent for regulating the downward movement of the  
 80 plunger and admission-valve, substantially as shown and described.

4. In combination with an engine of the character described, a cross-head carried by the piston-rod of said engine, a striker carried  
 85 by said head, a cut-off lever, the free end of which extends within the field of travel of said striker, an adjustable block to which said lever is pivoted, a valve-rod vertically guided in a suitable bearing, a connecting rod and  
 90 link for transmitting motion to and from the lever and valve-rod, a spring coiled about said rod, an admission-valve arranged within a suitable chest, a stem carried by said valve and by means of which said valve is connected  
 95 with the valve-rod, an auxiliary dash-pot, a plunger fitted therein, said plunger being carried by the upper end of the valve-stem, means for permitting the escape of the air within the dash-pot above said plunger, a vent for regu-  
 100 lating the downward movement of the plunger and admission-valve, an exhaust-valve fitted within a suitable chest, a stem carried by said valve, a valve-rod connected to said stem, and collars carried upon said rod and  
 105 so located as to bring about the proper movement of the exhaust-valve by contact with the striker, substantially as shown and for the purpose set forth.

5. In an engine of the character described, 110  
 a frame, a shaft journaled therein, a fly-wheel secured on the shaft, a clutch engaging the shaft, a cross-head slidable in a horizontal guideway in the clutch and a vertical guide-  
 115 way in the frame, a striker carried by said cross-head, a cut-off lever, the free end of which extends within the field of travel of said striker, an adjustable block to which said lever is pivoted, a valve-rod vertically guided in a suitable bearing, a connecting rod and  
 120 link for transmitting motion to and from the lever and valve-rod, a spring coiled about said rod, an admission-rod arranged within a suitable chest, a stem carried by said valve and by means of which said valve is connected  
 125 with the valve-rod, an auxiliary dash-pot, a plunger fitting therein, said plunger being carried by the upper end of the valve-stem, means for permitting the escape of the air in the dash-pot above said plunger, a vent for regulating  
 130 the downward movement of the plunger and admission-valve, an exhaust-valve fitted with-

in a suitable chest, a stem carried by said valve, a valve-rod connected to said stem and collars carried on said rod and so located as to bring about the proper movement of the  
5 exhaust-valve by contact with the striker, as and for the purpose described.

In testimony whereof I have hereunto af-

fixed my signature in the presence of two subscribing witnesses.

JAMES D. GRAY.

Witnesses:

S. S. WILLIAMSON,  
R. BRENT WALLING.