No. 652,544. Patented June 26, 1900.

C. A. MILLER.

GAS ENGINE.

(Application filed Feb. 13, 1897.)

(No Model.) 3 Sheets—Sheet 1.

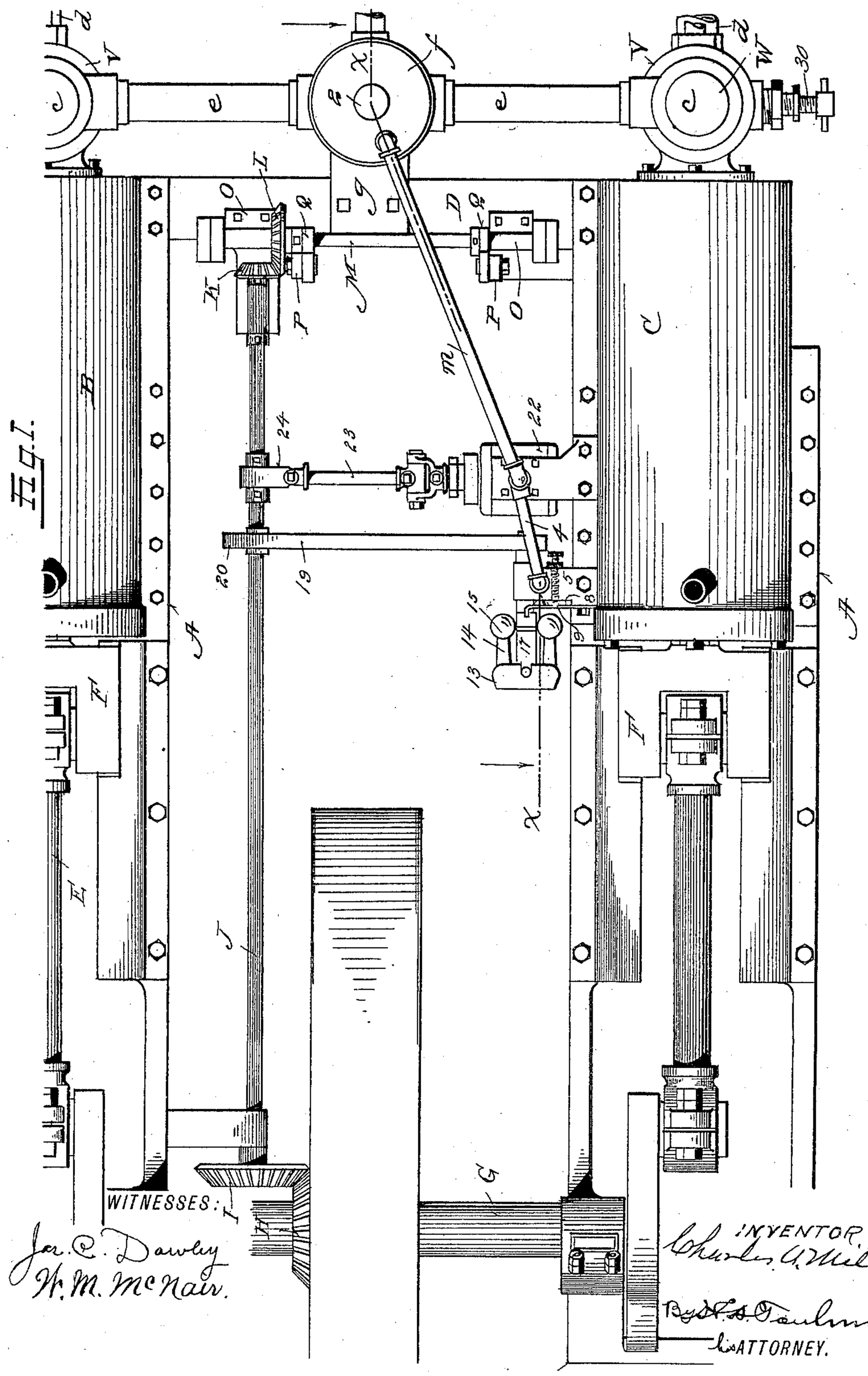

FIG. 1.

WITNESSES:

Jas. L. Dawley

H. M. McNair.

INVENTOR

Charles A. Miller

By H. S. Taubman

his ATTORNEY.

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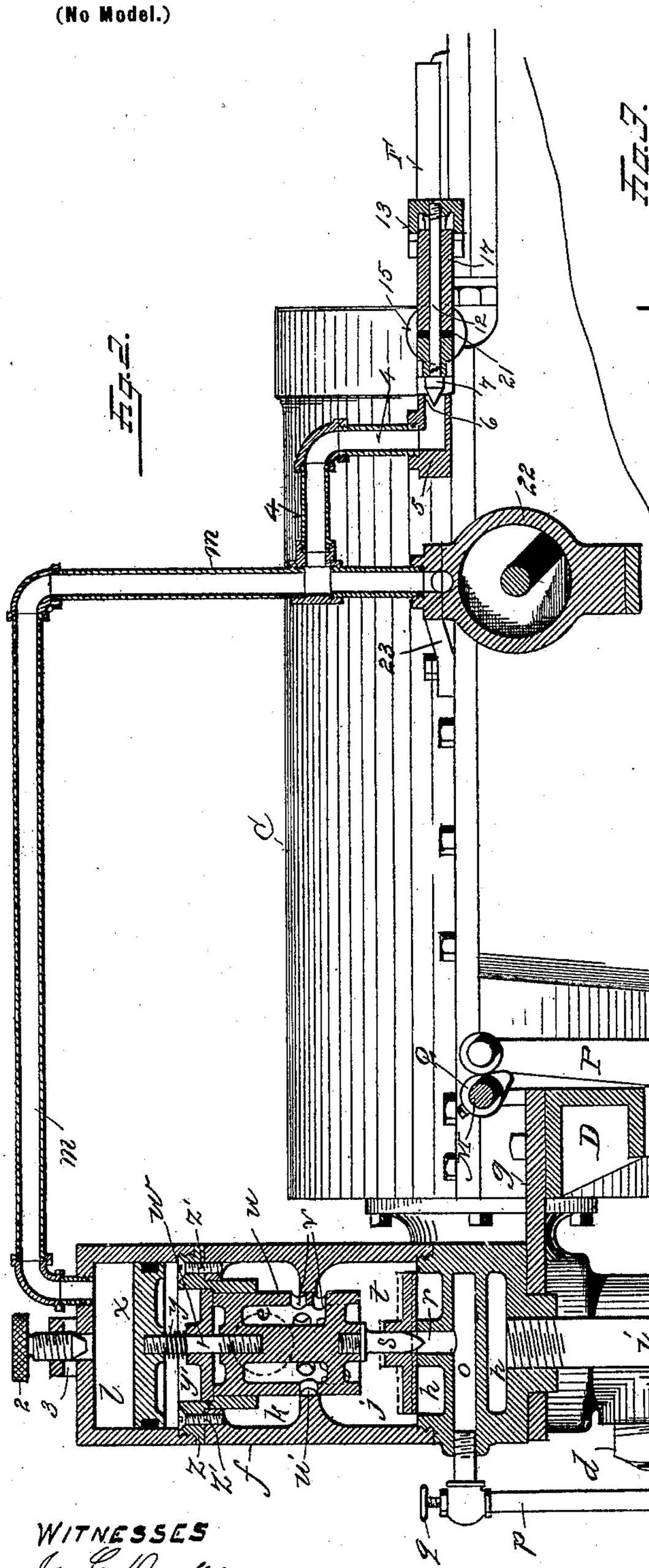
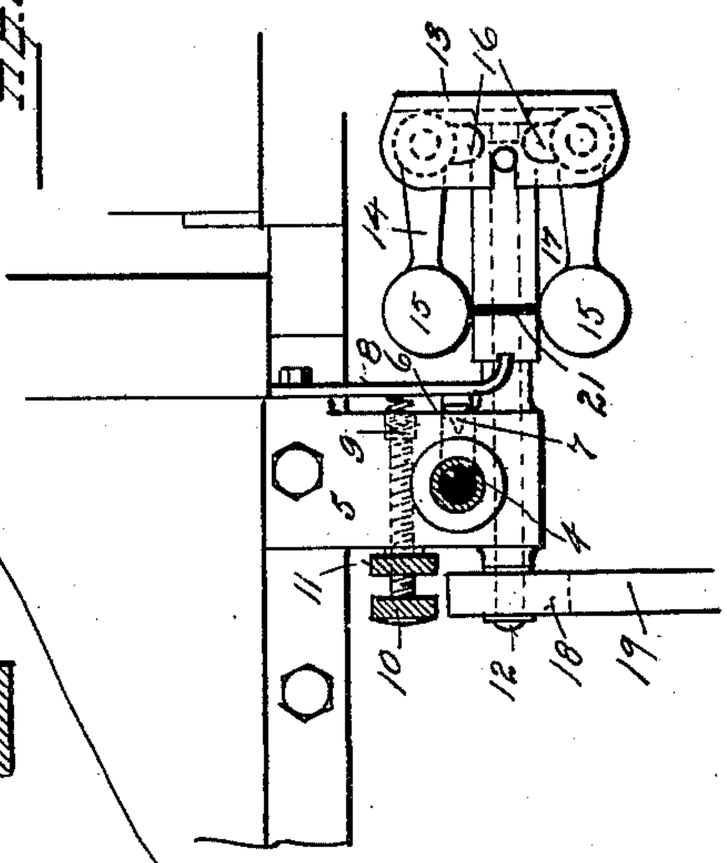
3 Sheets—Sheet 2.





WITNESSES
Jas. C. Dawley.
H. M. McNair.

INVENTOR
Charles A Miller
By R. A. Toulmin, his
ATTORNEY.

No. 652,544. Patented June 26, 1900.

C. A. MILLER.

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(No Model.) 3 Sheets—Sheet 3.

Fig. 4.

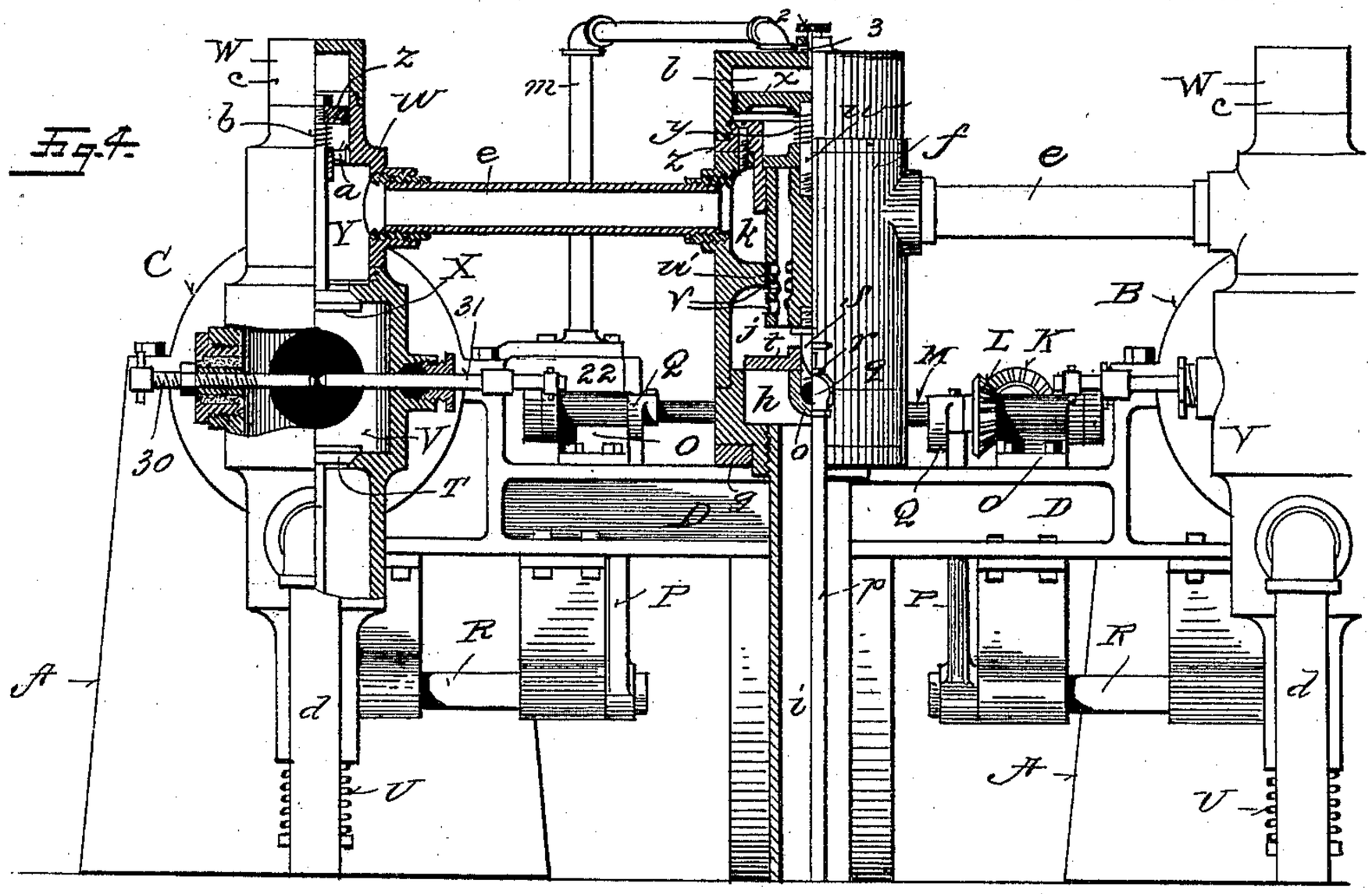


Fig. 5.

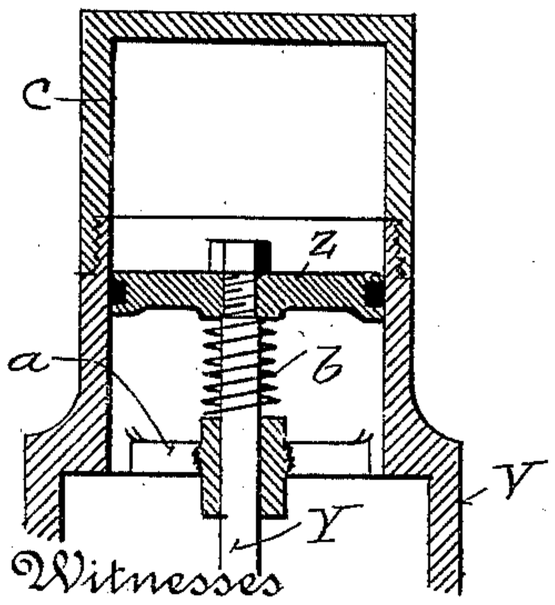
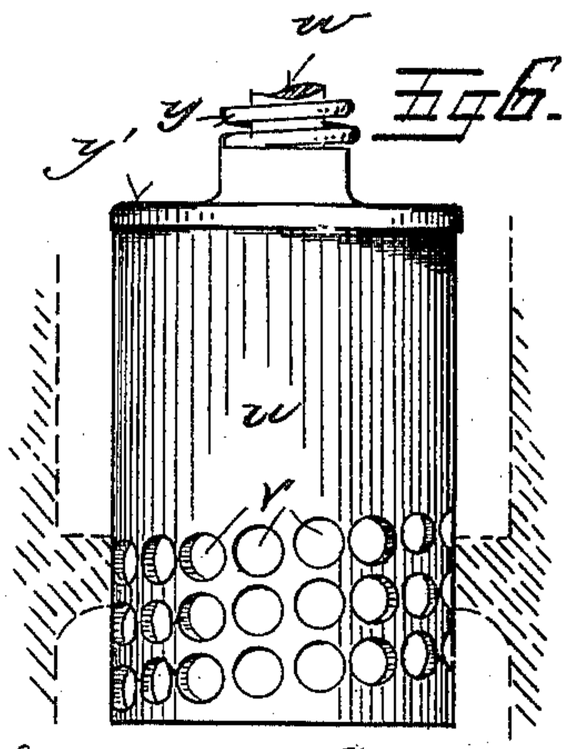


Fig. 6.



Witnesses
J. C. DAWLEY.
W. M. McNair.

Inventor
Charles A. Miller
By his Attorney
H. A. Toulmin

UNITED STATES PATENT OFFICE.

CHARLES A. MILLER, OF SPRINGFIELD, OHIO.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 652,544, dated June 26, 1900.

Application filed February 13, 1897. Serial No. 623,264. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. MILLER, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in gas-engines.

That part of this my present invention which relates to the pneumatic governor for controlling the admission of the explosive agent to the cylinder is designed as a further improvement upon the same general feature embraced in my application for Letters Patent of the United States filed January 6, 1896, Serial No. 574,491, for improvements in gas-engines.

My present improvements have reference to the construction and arrangement of the air-governor, admission-valve, and adjunctive features.

My invention also relates to details of construction and arrangement hereinafter appearing, and particularly pointed out in the claims.

In the accompanying drawings, on which like reference letters and numerals indicate corresponding parts, Figure 1 is a plan view of a double-cylindered engine with my said improvements applied thereto; Fig. 2, a vertical sectional view, on a larger scale, on the line *x x* of Fig. 1 looking in the direction of the arrows; Fig. 3, a detail enlarged view of the centrifugal governor and its adjacent parts; Fig. 4, a partial rear view and transverse sectional view of what is shown in Fig. 1; Fig. 5, an enlarged detail vertical sectional view of the parts composing the antipounding device for the check-valve; and Fig. 6, an enlarged detail elevation of the admission-valve, showing its arrangement of orifices.

The letter A designates the bed of the engine, which is in two parts, one for either cylinder B C, said parts of the bed being interconnected by one or more of the cross-beams D, one being shown. Each engine has a piston connected by a pitman through a cross-head F with the crank-shaft G, mounted on the bed, and geared through miter-gears H I with an operating-shaft J, itself geared through miter-pinions K and L with another operating-shaft M, mounted in bearings O, secured to the piece D.

The shaft J operates the centrifugal governor and the air-pump, while the shaft M operates the movable electrode, (in a manner not shown, because no part of the present invention.) It also operates the arms P through cams Q, by which the rock-shafts R are rocked with their arms S, the latter lifting on the exhaust-valves T, which are spring-seated by springs U in the igniting-chamber V. Each cylinder is provided with this chamber, exhaust-valve, and rock-shaft equipment, as shown more clearly in Fig. 4.

The upper ends of the igniting-chambers are provided with antipounding-chambers W, which form a part of the antipounding device for the check-valve X, seated in the upper end of the igniting-chamber V. The stem Y of the valve X has a piston Z, fitted to reciprocate in the chamber W as the valve seats and unseats. A spider *a* guides the valve-stem and supports a spring *b*, which seats the valve X after a charge is drawn or sucked in by the engine-piston. Ordinarily the reseating of these check-valves causes a clatter or pounding, making a disagreeable noise, as well as acting to wear the valve and seat. To prevent this is the object of this part of my invention. The upper part of the chamber W is in the form of a removable cap *c*, and this cap forms a chamber in which the air acts as a cushion against the piston Z and counteracts the spring *b* enough to prevent the spring from pounding the valve X against the seat. These igniting-chambers are secured one to each cylinder, as seen particularly in Fig. 1, and each has an exhaust-pipe *d*, as shown in Fig. 4. The chambers W are connected by pipes *e* to the air-governor casing *f*, so that the charge which passes through this governor-casing is conveyed past the check-valves X and thence into the igniting-chambers V. This air-governor casing is supported on a bracket *g*, as seen in Fig. 2, which bracket is secured to the cross-beam D. The interior of such casing is divided into an air-chamber *h*, fed by a pipe *i*, a mixing-chamber *j*, a discharge-chamber *k*, and an air-pressure chamber *l*, which latter is fed by a pipe *m* with air under pressure supplied by an air-

pump or pressure-creating device to be presently referred to.

Extending across the chamber *h* is a passage *o*, fed with gas by a gas-pipe *p*, controlled by a cock *q*. A gas-valve orifice *r* leads from the gas-passage *o* and is controlled by a tapering stem *s*, actuated in a manner presently to appear, in such wise that as it moves in and out of the orifice *r* it cuts off or admits more or less of the gas into the mixing-chamber *j* as the valve *t* is raised by the suction of the engine-pistons, as suggested by the dotted lines. The air passing through the pipe *i* into the chamber *h* and past the valve *t* mixes with the gas passing through the passage *o*, orifice *r*, and by the valve *s* when such air and gas meet in the chamber *j*. This charge or mixture thence passes through the orifices in the admission-valve *u* and into the chamber *k* and thence through the pipes *e*. This admission-valve has a spiral row of perforations *v*. The spiral position of the perforations opens a gradually-increasing proportion of each orifice, so that the graduation of increase or decrease of the area of these perforations is very finely adjusted and increases or decreases but a little at a time as the mixing-valve *u* reciprocates under the varying pressure of air in the chamber *l* of this air-governor, said valve *u* being shown in its highest position in Figs. 2 and 4. A stem *w* connects the admission-valve *u* with a piston *x*, which is lifted by a spring *y*, resting on a disk *y'*, supported by a gland *z*, held by screws *z'*, as shown in Fig. 2, or otherwise. When the spring *y* lifts on the admission-valve *u*, the amount of charge admitted to the chamber *k* and thence to the pipes *e* is increased; but when the piston presses down on this valve *u* the amount of charge admitted is decreased. Therefore the action of the spring *y* in lifting the valve *u* is controlled by the degree of pressure of air in the chamber 1, and this degree of pressure is in turn varied by the speed of the engine and the load it is carrying. A thumb-screw 2 controls a let-off orifice 3, which may or may not be used, according to circumstances; but the automatic control of the air-pressure in the air-governor is accomplished by a centrifugal governor of any approved type arranged to control a let-off orifice at some suitable point relatively to the pump or air-pressure-creating device and the air-governor. I have selected one location, as shown in the accompanying drawings, in which a branch pipe 4 from the pipe *m* enters a bracket 5, secured to the bed, and provided with a let-off orifice 6, controlled by a tapering valve 7, supported by a spring 8, and adjusted by a spring 9 and a thumb-screw 10, fixed by a jam-nut 11, said spring 9 and thumb-screw being carried by the bracket 5. It is now clear that if the valve 7 is withdrawn more or less out of the orifice 6 the air will be let off or allowed to escape, and hence the pressure of air in the chamber 1 would be varied accordingly, and therefore the position of the piston *x* and the consequent position of the orifices *v* in the admission-valve *u* will be varied relatively to the cut-off flange *u'*, and so the amount of charge admitted be thus controlled and varied. Now the position of the valve 7 is dependent upon the action of the governor. The spring 9 tends to force the valve 7 out of the orifice 6, so that the maximum escape is the normal condition. The centrifugal governor overcomes this tendency or yields to it, according as the engine is running slow or fast or has a heavy load or a light load imposed upon it. For instance, if the engine is running fast with a light load the governor will move the valve 7 farther in and decrease the amount of escape, and this in turn will increase the pressure of air in the air-governor and cut off more and more of the orifices *v* above a flange *u'* and decrease the quantity of the charge. On the other hand, if the engine is running slow, as with a heavy load, the valve 7 will move outward and increase the let-off of the air and so decrease the air-pressure in the air-governor, and thus permit the spring *y* to lift the admission-valve *w* to expose more of the area of the orifices *v* above the flange *u'* and so increase the quantity of the charge. Thus a light load and high speed decrease the let-off of air and increase the air-pressure in the air-governor, while slow speed and a heavy load increase the let-off of air and decrease the air-pressure in the air-governor. This automatic balancing of the proper relation of air-pressure and amount of charge admission takes place in all of the intermediate conditions from the extremes of high speed and light load to low speed and heavy load. What is here described is based upon the actual operation of a full-sized equipment, and the results are found to be highly satisfactory and practical.

Referring now to one form of suitable governor, it will be seen that a shaft 12 is mounted in the bracket 5 and carries a head 13, in which are pivoted governor-arms 14, with balls 15 at one end and studs 16, which press upon a sleeve 17, slidable on the shaft 12 and adapted to press inward on the spring 8 as the governor-balls fly outward and to move in the other direction as the balls return inward. The shaft 12 has a pulley 18, driven by a belt 19, itself driven by a pulley 20 on the operating-shaft J. A revoluble collar 21 on the sleeve 17 relieves friction between the sleeve and the balls 15 when the governor is revolving slowly.

Referring now to the pump or air-pressure-creating device, it will be understood that any kind of air-pump will answer the purpose. At 22 an air-pump is designated and actuated by a pitman 23, connected with an eccentric 24 on the operating-shaft J. This pump supplies air to the pipe *m*.

While I have shown and described my improvements in connection with a double-cyl-

inder engine, they will be understood to be applicable to engines with one cylinder. In fact, I have so applied them.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a gas-engine, the combination with an air-governor, a reciprocating admission-valve, a piston in the governor to actuate such valve in one direction and a spring to actuate it in the other, an air-pump connected to the air-governor, a governor-controlled air-let-off valve, between said pump and said air-governor, and means connecting an operating part of the engine with the valve-governor, for the purpose described.

2. In a gas-engine, the combination with an air-governor including a piston, a perforated reciprocating admission-valve connected to the piston, a spring lifting said valve, an air-chamber above the piston to depress the piston and valve by air-pressure, a pump connected with said chamber, a branch in the connection having a let-off orifice, a governor-controlled valve for said orifice, and means connecting the latter governor with an operating part of the engine.

3. In a gas-engine, an air-governor consisting of a casing having a gas passage and orifice, an air-inlet chamber, a mixing-chamber, a discharge-chamber, and an air-pressure chamber, a web between the mixing and discharge chambers, an admission-valve working in said web and controlling communication between said latter chambers, a piston in the pressure-chamber to move the valve in one direction and a spring to move it in the other, an air-valve between the mixing-chamber and air-inlet chamber and a tapering gas-valve in the gas-orifice connected with the admission-valve.

4. In a gas-engine, the combination with an air pipe or conduit having a let-off orifice, a valve therefor supplied with a spring-arm, an adjusting screw and spring acting on the arm to unseat the valves, and a governor acting on the arm oppositely to seat the valve, and means connecting the said governor with an operating part of the engine.

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

CHARLES A. MILLER.

Witnesses:
OLIVER H. MILLER,
W. M. MCNAIR.