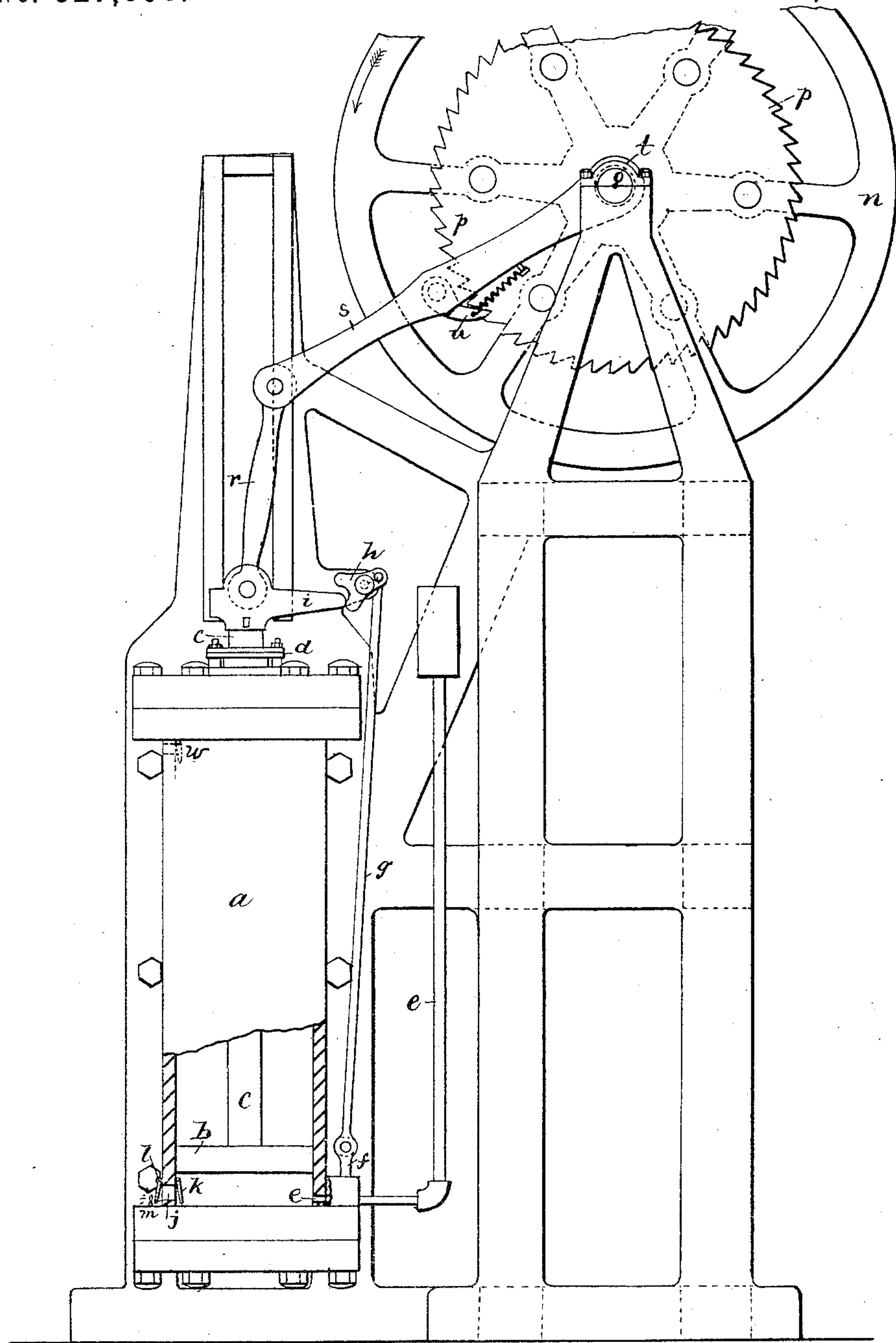


(No Model.)

M. G. CRANE.
GAS ENGINE.

No. 327,866.

Patented Oct. 6, 1885



Witnesses.
L. F. Connor.
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Inventor.
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Attest.

UNITED STATES PATENT OFFICE.

MOSES G. CRANE, OF NEWTON, MASSACHUSETTS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 327,866, dated October 6, 1885.

Application filed October 24, 1881. Serial No. 44,421. (No model.)

To all whom it may concern:

Be it known that I, MOSES G. CRANE, of Newton, county of Middlesex, State of Massachusetts, have invented an Improvement in Gas-Engines, of which the following description, in connection with the accompanying drawing, is a specification.

My invention relates to gas-engines in which the force of an explosion is employed as the motive power.

In engines of this class as heretofore constructed the force of the exploding gases has been applied directly to the engine, but as the said force is developed very suddenly a considerable portion of its effect is taken up in strains upon the rigid portion of the machinery, rather than in imparting motion to the moving parts. The force arising from the explosion is of very short duration, as the exploded gases almost immediately condense, so that the action of an ordinary explosive-engine is somewhat like a series of blows applied to the moving parts, instead of a continuous pressure.

My invention consists in applying the direct force of the explosion to the compression of a gas which is "permanent" or incapable of liquefaction at ordinary temperatures, allowing the said gas in expanding to actuate the moving parts of the engine. By this arrangement the sudden force of the explosion is applied to an elastic cushion capable of receiving it without shock, and the condensation of the exploded gases is utilized to form a vacuum, as in any condensing steam-engine.

In carrying out my invention a cylinder is employed containing a tight piston, which normally remains near one end of the said cylinder, the main portion of which, on one side of the said piston, is filled with air or other suitable gas at any desired pressure—as for instance, the ordinary atmospheric pressure.

In operation the explosive mixture is admitted into the cylinder at the side of the piston opposite to the space occupied by the gas just alluded to and exploded, it forcing the piston against the said air and compressing the same, and the connection of the said piston with the machinery to be actuated is such that it moves freely in this direction without engaging the said machinery, but

upon beginning and throughout its return movement it will engage the said machinery. By this arrangement the force of the exploded gases in expanding will act only upon the air in the cylinder upon the other side of the piston, compressing the same until its pressure is in equilibrium with the said force at its maximum, and while the force of the exploded gases is almost immediately reduced by their condensation the force derived from the said compressed air in expanding may be applied gradually and without shock to the mechanism, thus actuating the same economically and without undue strain upon its parts.

The drawing shows in side elevation a gas-engine constructed in accordance with this invention, the lower part of the cylinder being shown in longitudinal section.

The cylinder *a*, closed at both ends, is provided with a piston, *b*, having a piston-rod, *c*, passing out through a suitable packing or stuffing-box, *d*, in one of the heads.

The explosive material is admitted below the piston through an induction-passage, *e*, controlled in any suitable manner, as by a valve, *f*, operated by a link, *g*, and tappet-lever *h*, properly arranged to be engaged by a tappet, *i*, on the piston-rod, so that when the said piston is at the lowest point in its stroke, as shown in the drawing, the said induction-passage will be open; but the moment the said piston begins its upward movement under the force of the explosion it will be closed.

The arrangement employed for igniting the explosive mixture when gases are used may consist of the small passage *j* through the side of the cylinder, having valves *k l* at either end thereof, the former being properly adjusted to remain slightly open when the pressure at the ends of the said passage *j* is substantially equal, and adapted to be closed by an unbalanced pressure toward the said passage.

A small burner, *m*, properly protected, is located just at the outer end of the passage *j*, and serves to ignite the explosive mixture, which, having filled the space below the piston *b*, passes out through the passage *j*, the valves *k l* both remaining open until the said mixture is ignited, when the explosion ensues, producing a great pressure in the cylinder below the piston, which at once closes the

valve *k* and forces the piston up, compressing the air in the cylinder above it.

The piston *b* and its rod *c* are so connected with the machinery to be driven (the fly-wheel *n* and the main shaft *o* of which only are shown) that in the said upward movement of the piston, caused by the force of the explosion, the said main shaft and machinery connected therewith are not acted upon. As herein shown, the said fly-wheel is provided with a ratchet, *p*, and the piston-rod is connected by the pitman *r* with an arm, *s*, pivoted loosely at *t* upon the main shaft *o*, and provided with a pawl, *u*, so arranged that in the oscillation of the arm *s*, caused by the upward movement of the piston, the said pawl runs over the teeth of the ratchet *p*; but in the return movement of the piston the said pawl engages the said ratchet and transmits the force from the piston to the fly-wheel *n*.

It will be seen that the force of the exploded gases beneath the piston act through it only upon the air or gas contained in the cylinder above the said piston, which serves as an elastic cushion, and that consequently no shock is brought upon the rigid portions of the apparatus; but as soon as the exploded gases begin to condense and relieve the pressure beneath the piston it is forced downward by the expansion of the air compressed above it and acts upon the machinery throughout the downward stroke of the piston.

When the exploded gases have so condensed that their pressure is less than that of the atmosphere, the valve *l* is closed by the external pressure, so that the piston is relieved of back-pressure during its downward stroke and the entire energy derived from the explosion is imparted to the machinery to be actuated.

The upper portion of the cylinder *a* may be provided with an inlet-passage controlled by an inwardly-opening valve, (shown in dotted lines at *w*,) so that if any air has leaked out from the cylinder when compressed it will be replaced from the atmosphere when the piston arrives at the lower portion of its stroke, thus avoiding a reduction of the pressure in the cylinder above the piston below that of the surrounding atmosphere.

I do not desire to limit my invention to the particular form of connecting mechanism shown between the actuating-piston and the actuated mechanism, nor to any particular devices for introducing, mixing, or exploding the explosive materials.

If desired, the compressed air or gas in the cylinder above the piston *b* may be led away by a suitable conduit to operate upon any desired kind of motor, instead of being applied to the same piston by which the force of the explosion is received, and be transmitted therefrom directly to the machinery; but in such case it will be necessary to maintain the piston at the highest point attained by it after an explosion, keeping it there until the expansive force of the air so compressed has been sufficiently utilized.

I claim—

1. In a gas-engine, the cylinder and piston therein, the said cylinder containing upon one side of the piston an elastic fluid or gas, combined with means for introducing and exploding an explosive compound in the said cylinder on the other side of the piston, and connecting mechanism between the piston and the machinery to be actuated thereby, arranged to be operative on the said machinery only on the return-stroke of the piston produced by the expansion of the air compressed by the out-stroke of said piston incident to the explosion, substantially as and for the purpose described.

2. A cylinder provided with a piston dividing it into two compartments, one containing an elastic fluid or gas to be compressed, and to thereafter exert a useful effect by expansion, and the other receiving an explosive compound acting by explosive force to drive the piston against the body of elastic fluid or gas and compress it, and means to utilize the effective force of the compressed fluid or gas, substantially as described.

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

MOSES G. CRANE.

Witnesses:

G. W. GREGORY,
B. J. NOYES.