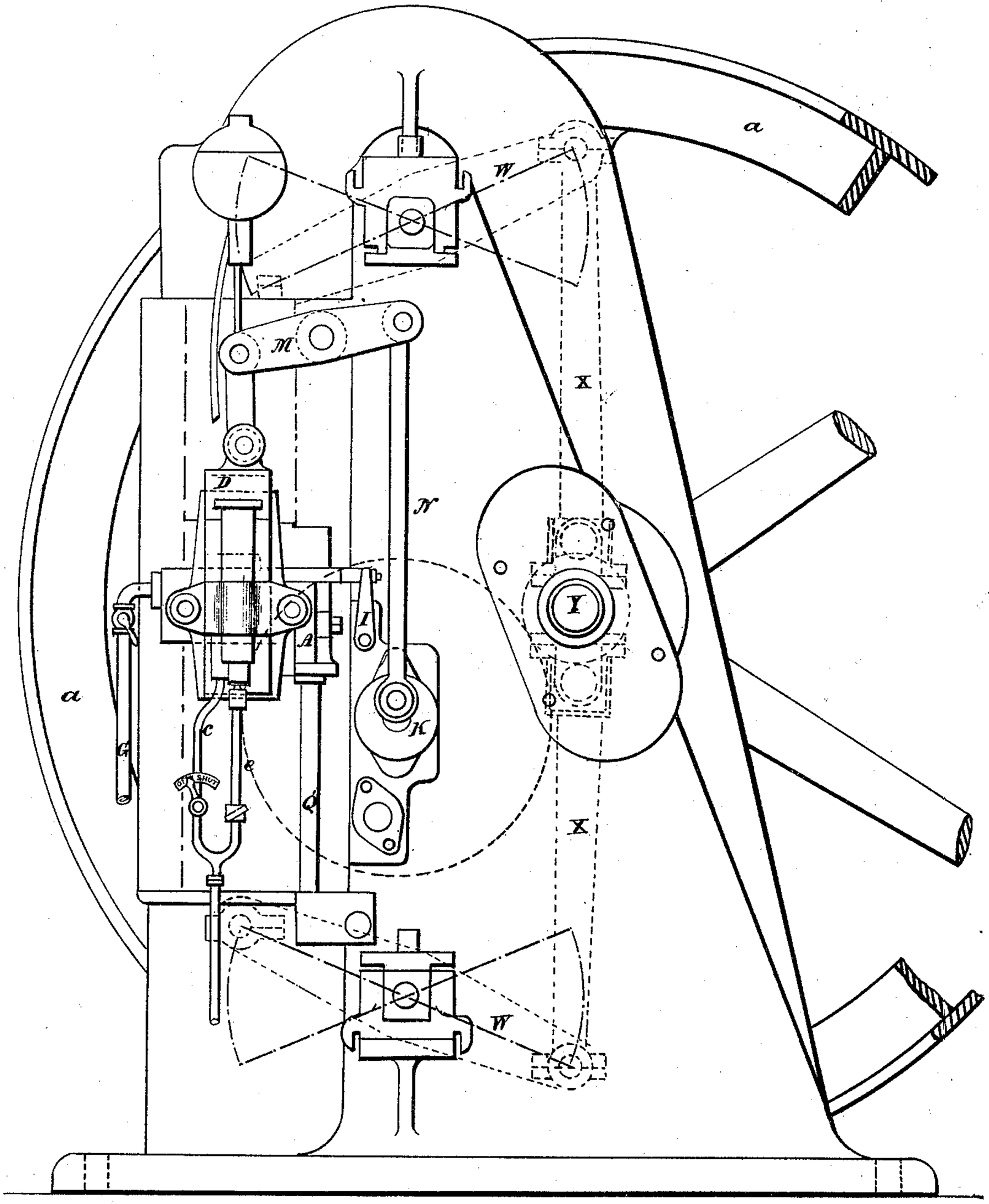
(No Model.) 4 Sheets—Sheet 1.

C. LINFORD.
Gas Engine.

No. 232,987. Patented Oct. 5, 1880.

Fig. 1.



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(No Model.)

4 Sheets—Sheet 2.

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Fig. 8.

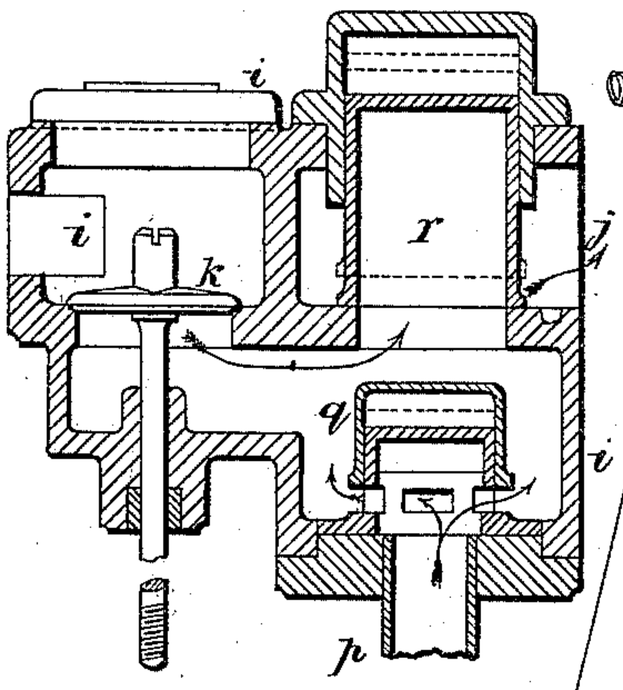

Fig. 2.

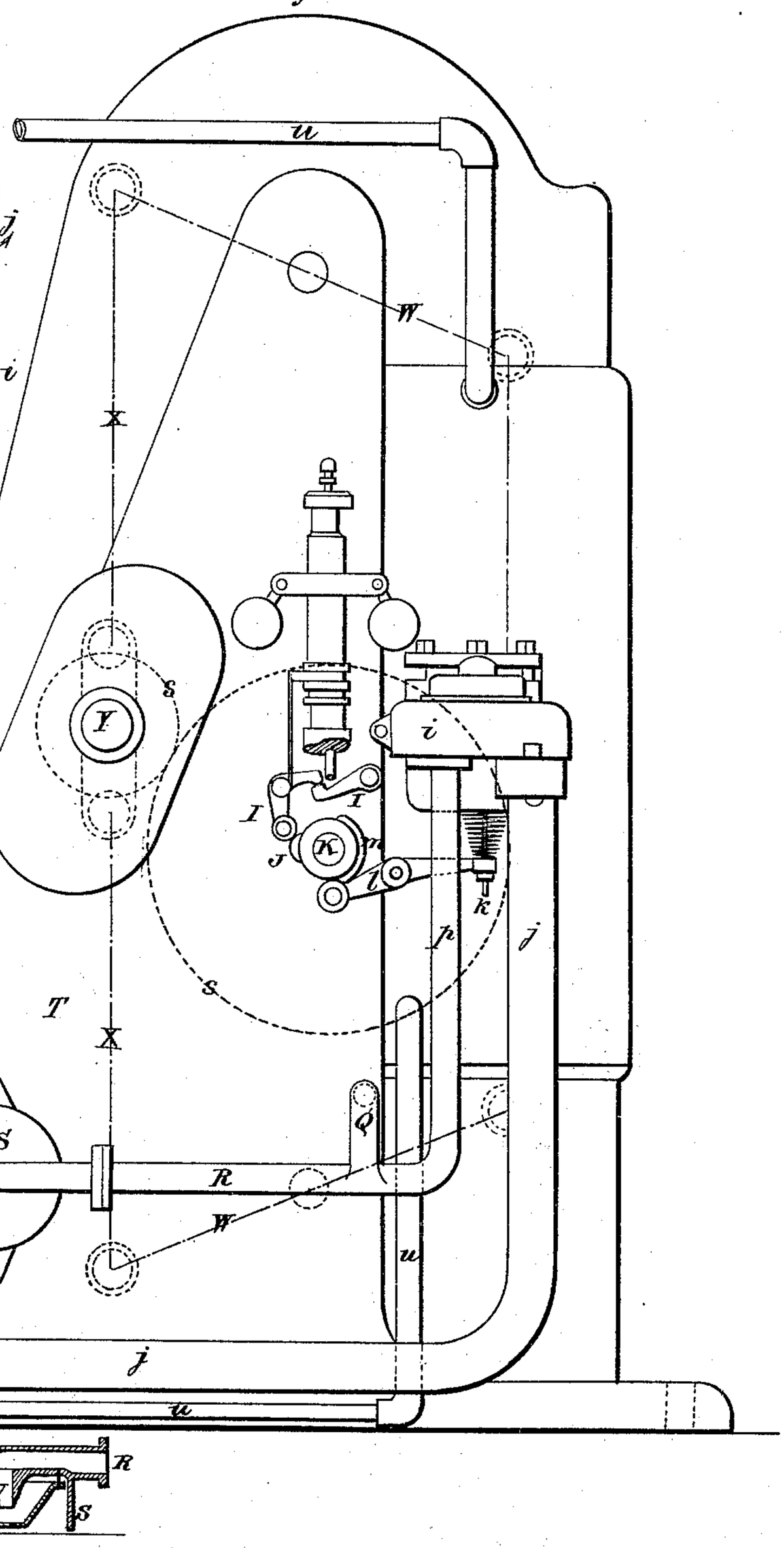

Fig. 9.

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C. LINFORD.

Gas Engine.

No. 232,987.

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Fig. 3.

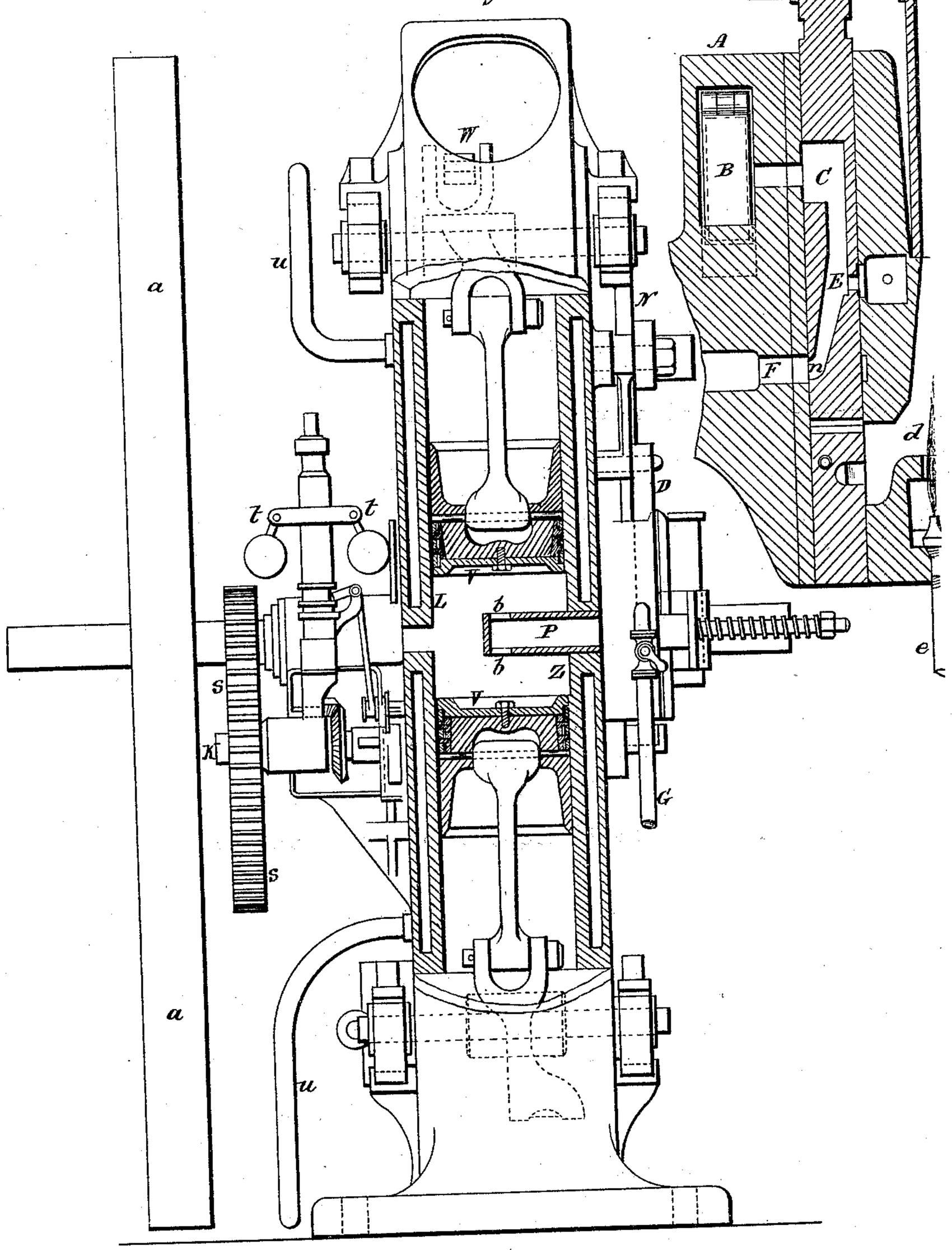

Fig. 10.

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C. LINFORD.

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Fig. 4.

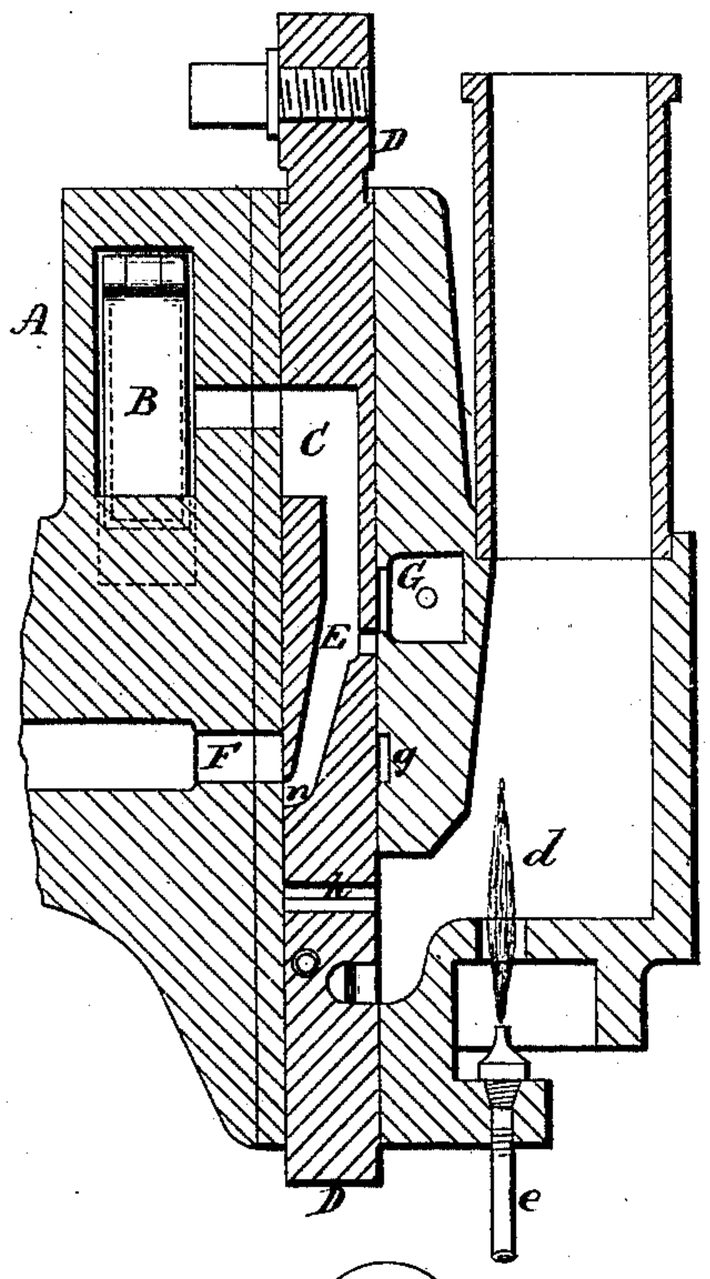


Fig 5

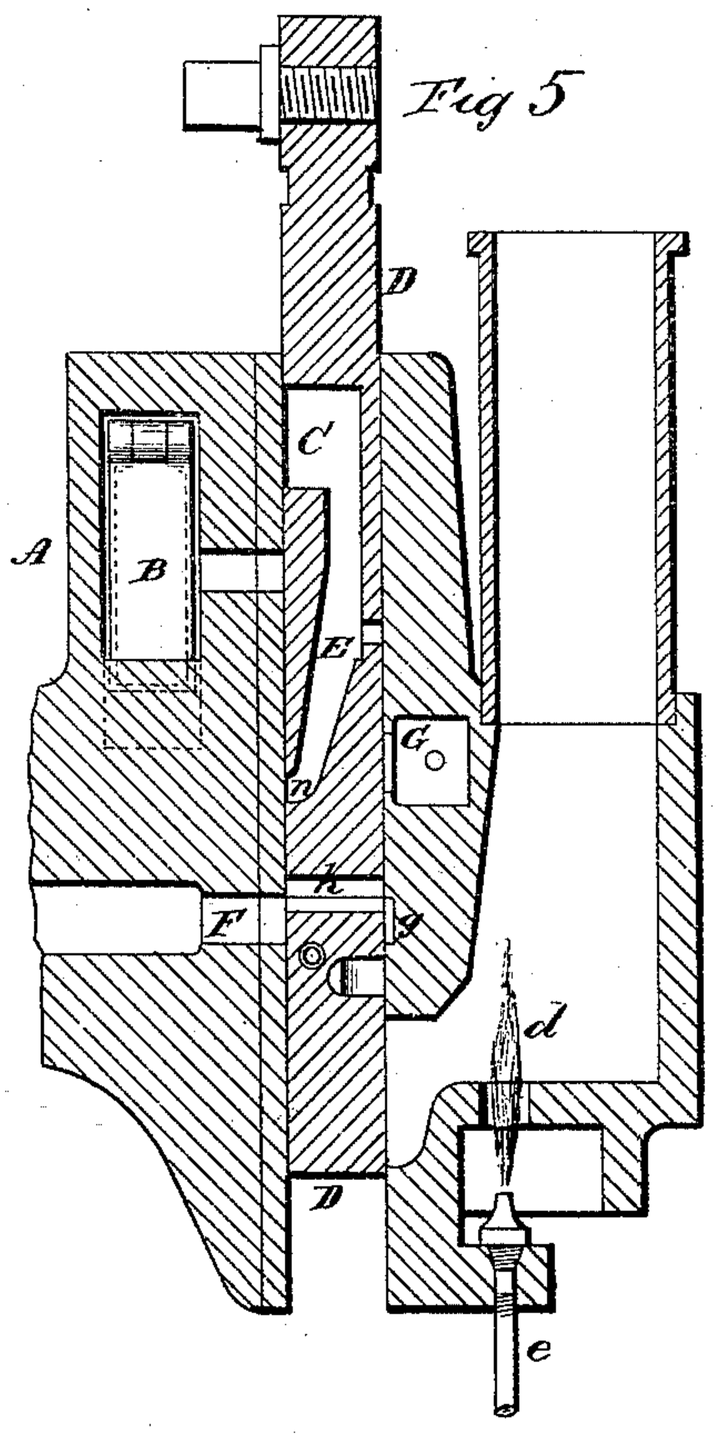


Fig. 6.

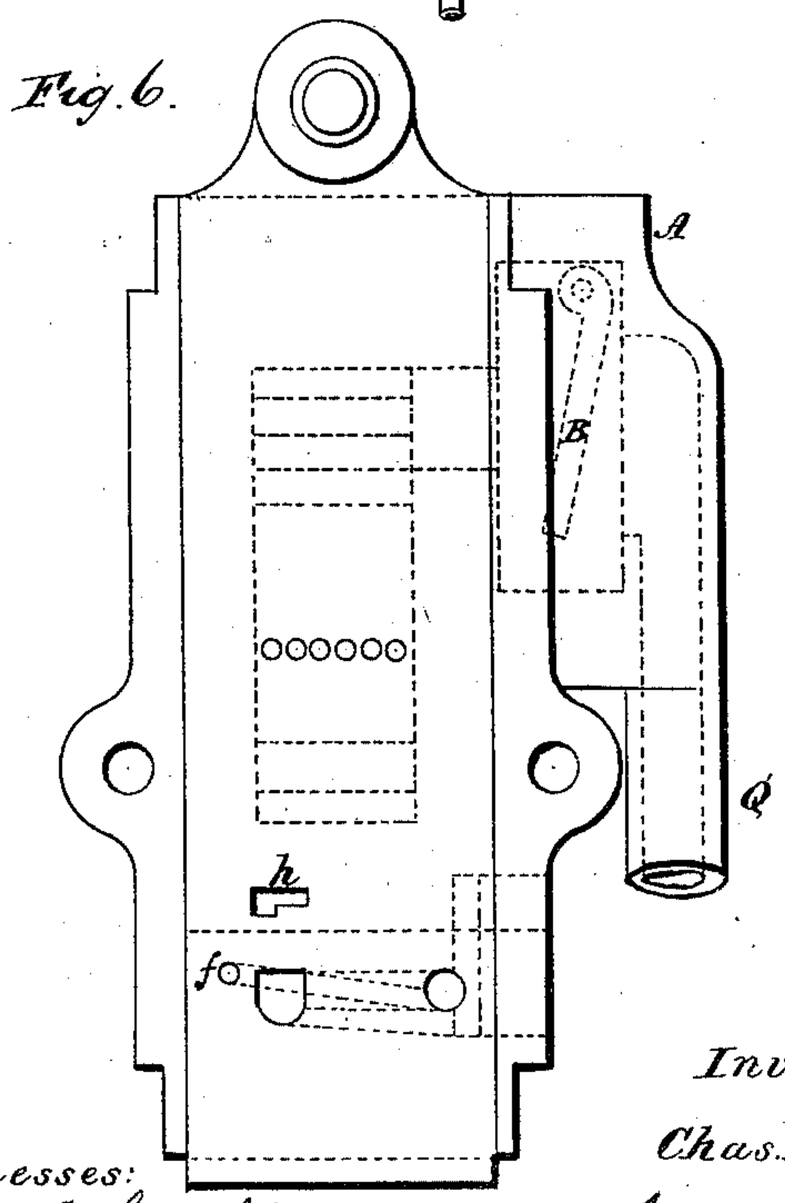
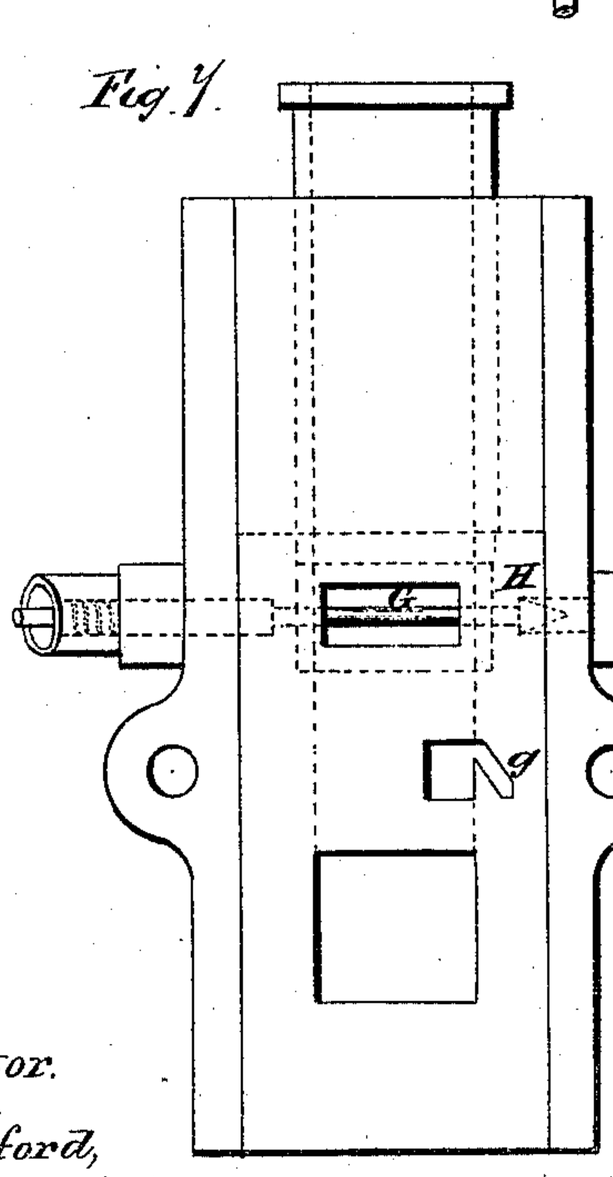


Fig. 7.



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UNITED STATES PATENT OFFICE.

CHARLES LINFORD, OF LEICESTER, ENGLAND.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 232,987, dated October 5, 1880.

Application filed September 3, 1880. (No model.) Patented in England April 17, 1879, and January 24, 1880.

To all whom it may concern:

Be it known that I, CHARLES LINFORD, a subject of the Queen of Great Britain, residing in Leicester, England, have invented new and useful Improvements in and connected with Gas-Engines, (for which I have obtained patents in Great Britain, No. 1,500, bearing date April 17, 1879, and No. 330, bearing date January 24, 1880,) of which the following is a specification.

This invention relates to and consists in a novel arrangement of appliances which, in double-acting engines, give an impulse to each one and a half revolution of the crank-shaft, and in a single-acting engine one impulse to every three revolutions of the crank-shaft. This is effected in the following manner: I admit a charge of gas and air as a combustible body during the travel of the piston or pistons in one direction. I compress the said charge (gas and air) during the return-stroke of the piston or pistons. I fire the said charge during the next travel of piston or pistons. I exhaust the residues of combustion during the next travel of the piston or pistons. I admit a distinct column or current of atmospheric air from the atmosphere and free from any admixture of gas during the next travel of the piston or pistons, and then I exhaust the said column or current of atmospheric air during the next travel of the piston or pistons, before the next body of gas and air is admitted to the cylinder or cylinders, the admission and emission of the distinct column or current of the atmospheric air into and from the cylinder or cylinders after and following each exhaust of the residues of combustion being to scavenger or wash out any débris or refuse portions which may be left in the cylinder or cylinders after the usual exhaust of the spent explosive charge, said distinct current of air being sucked into and discharged from the cylinder by the working piston or pistons without the aid of pumps or other extraneous appliances or apparatus for charging the cylinder with said air. I attain this object by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a right-hand side view; Fig. 2, a left-hand side view; Fig. 3, a transverse section through the cylinder of a two-piston balanced gas-engine of my invention, Figs. 4, 5, 6, and 7 showing the slide-seating, the slide, and the slide-cover on a larger scale. Fig. 8 shows a sectional view of the exhaust-box and its valves.

I fit on the side of the slide-valve seating or adjacent thereto a box, A, containing a valve, B, Figs. 1, 4, 5, and 6, which valve is set open, that atmospheric air may freely pass into the port C of the slide D and the mixing-chamber E, and mix with the gas as it enters the main port F from the gas-supply G, which is controlled by the cone H under the action of the tappet and levers I from the cam J on the second-motion shaft K, the movement of the slide D, by its connection with the beam M and rod N from the second-motion shaft K, shutting off the port C when sufficient air has passed into the chamber E.

The port F terminates in a pipe, P, with openings top and bottom for distributing the explosive charge well within the cylinder.

The box A has its air-supply pipe Q formed as a branch from the main air-pipe R, this terminating in a bell-shaped apparatus, S, attached to the side of the engine-framing T.

The bell-shaped apparatus shown in section at Fig. 9 has within it a conical partition with a clearance around its edge, that atmospheric air may enter the pipe R by the nozzle U, as indicated by the arrows.

The pistons V V having been moved apart by the action of the beams W W and rods X X from the cranks of the first-motion shaft Y for the admission of the explosive charge into the cylinder Z, they return, under the momentum of the fly-wheel *a*, to compress the charge within the firing-chamber *b*, and as they commence their return-stroke the charge is fired by the ignition of live gas supplied by the pipe *c*, which comes into contact with the outside flame, *d*, from the pipe *e* when the cavity *f* of the slide D and ⌐-shaped aperture *h* are brought down to coincide with the angled slot *g* of the cover, Fig. 7, the slot then forming a communication by the through-aperture *h* of the slide D to the port C, as shown by Fig. 5.

The pistons, having received their impulse under the expansion of the exploded charge, return to force the residues of combustion through the exhaust-box *i* and pipe *j*, the valve

k (see sectional view, Fig. 10) opening for that purpose under the action of the tappet *l* and cam *m* on the second-motion shaft K. The cam *m* extends to nearly one-half the circumference of second-motion shaft K, as shown by Fig. 2, that the valve *k* may remain open during the next out-travel of the pistons V V, the slide D at the commencement of this out-travel of the pistons moving down to open the passage *n*, with the port C, as shown at Fig. 10, for the inflow of clean atmospheric air to the cylinder, in this action the gas-supply being shut off. A further supply of clean atmospheric air passes also into the cylinder by the pipe *p* and exhaust-box *i*, the valve *q* being lifted and opened and the exhaust outlet-valve *r* closed by the outward sucking action of the pistons. The cylinder by this means becomes filled with clean atmospheric air, which on the next or return stroke of the pistons is forced out through the exhaust-pipe *j*, the valve *q* becoming closed and the valve *r* opened under the internal pressure. At the return of the pistons for the exhaust of the clean atmospheric air the valve B instantly closes, and insures the passage of the air through exhaust, together with any particle of the previous residue of combustion which may have remained in the firing-chamber *b* after the last primary exhaust.

The particular formation of the through-aperture *h* in the slide D, in conjunction with the angled slot *g* in the cover, is an important feature in my invention, because all back-flash of the fire at the instant of explosion is prevented, the slide by its movement carrying the ignited inner flame in the slide so suddenly past the opening where it received its ignition from the outer flame *d*.

The second-motion shaft K receives its rotation by the three-to-one gearing *s*, the governor *t*, as in an ordinary steam-engine, regulating the speed.

u u are the water-jacket pipes.

I have particularly described my invention as applied to a two-piston gas-engine; but it is obvious that I can employ my details—namely, the valve B in the air-supply leading to the slide, the peculiar or Γ-shaped through-aperture *h* in the slide, and the angled slot *g* in the slide-cover—in other constructions of gas-engines, wherein I can, by a three-to-one arrangement of gearing and cam actions, substantially as hereinbefore described, admit a distinct current of clean atmospheric air into and discharge the same from the cylinder after each exhaust of the residues of the ordinary combustion and before the admission of a fresh charge of combustible gas, as herein set forth.

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

1. In a gas-engine, the hinged set-open valve B in the air-supply Q, leading to the slide D, substantially as described.

2. In a gas-engine, the Γ-shaped through-aperture *h* in the slide, in combination with the angled slot *g* in cover, constructed and arranged substantially as shown and described.

3. The combination, with the valve B in the air-supply, formed as shown, of air-chamber C and mixing-chamber E in slide D, as and for the purpose set forth.

4. The live-gas aperture *f* and channels leading therefrom in slide D, arranged as shown at Fig. 6, and for the purpose described.

5. The cam *m* on second-motion shaft K, in combination with tappet *l*, for keeping exhaust-valve *k* open for ordinary exhaust and during admission and emission of scavenger charge, substantially as described.

6. In combination with an exhaust-box of a gas-engine, the valves *k q r*, arranged substantially as shown and described.

7. In a gas-engine, the mode of using the air-passages in valve seating and slide D, for supplying a scavenger charge, substantially as described.

8. In an air-engine, the attachment to the air-feed, consisting of pipe R, with bent nozzle U, and the conoidal partition with clearance, arranged substantially as shown and described.

9. The two-holed distributing-pipe P, arranged in the two-piston gas-engine herein described, constructed substantially as shown and described.

10. The balanced two-piston gas-engine, with the several appliances, arranged as shown and acting in the manner described, whereby a distinct charge of clean air is admitted to and expelled from the cylinder by the working-pistons to scavenger said cylinder after each ordinary exhaust of the residues of combustion, substantially as described.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CHARLES LINFORD.

Witnesses:
HENRY GARDNER,
RICHARD CORE GARDNER.