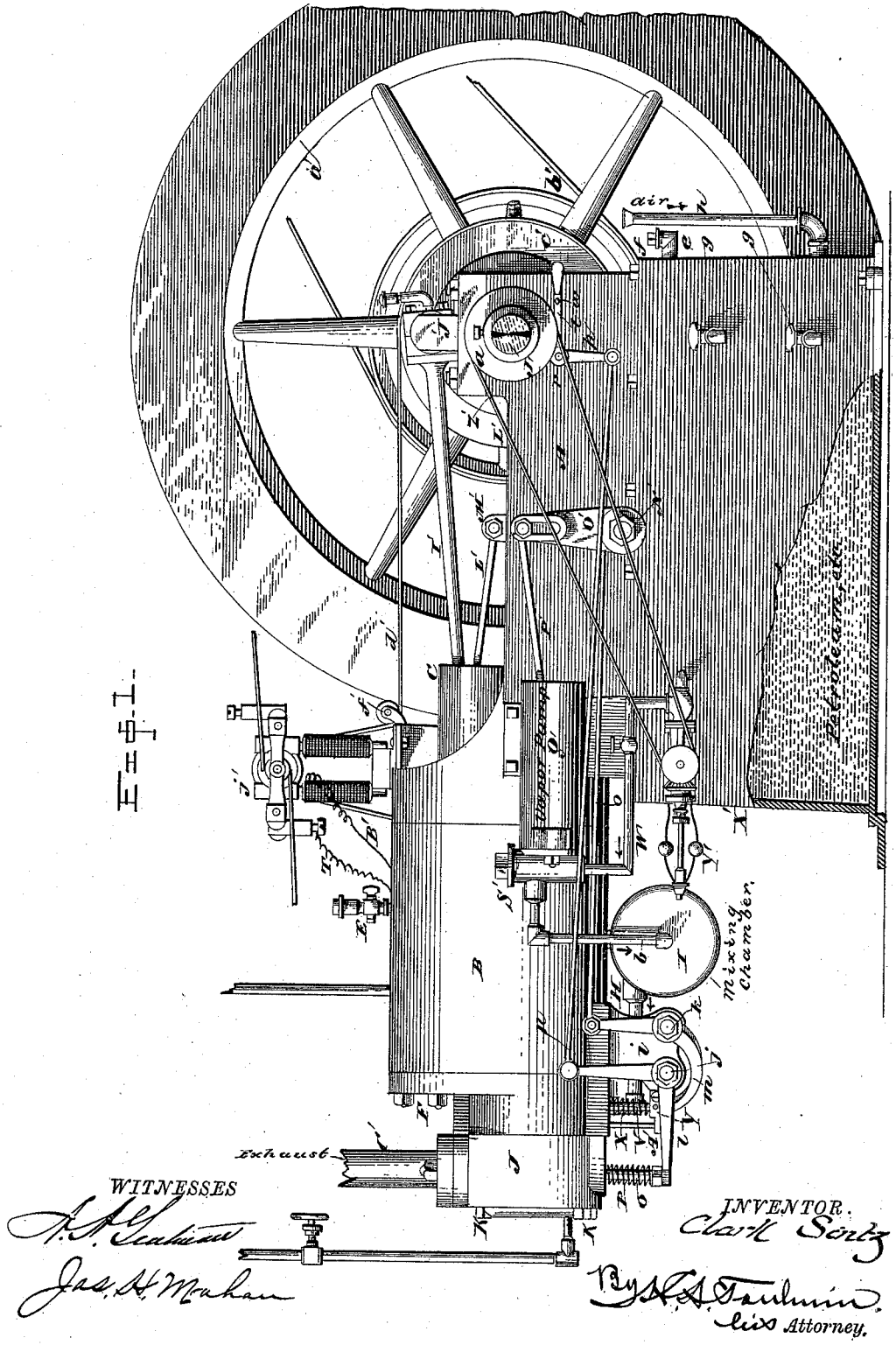
(No Model.) 7 Sheets—Sheet 1.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.



WITNESSES

Jas. A. Mahan

INVENTOR.

Clark Sintz

By A. S. Faulkner.

His Attorney.

(No Model.) 7 Sheets—Sheet 2.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.

Fig. 2.

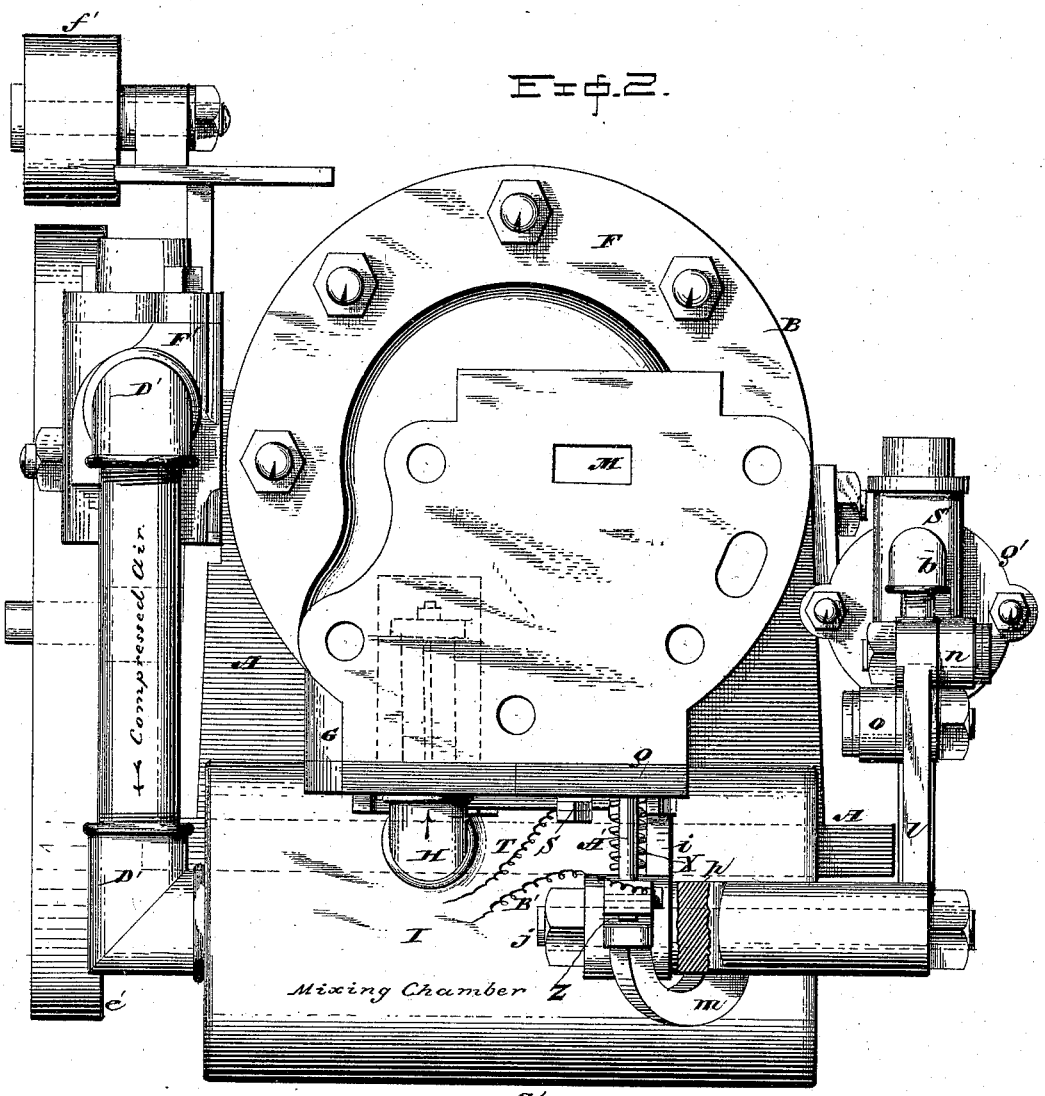
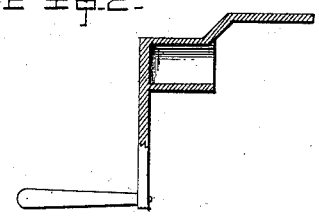


Fig. 2a.



WITNESSES.

A. D. Seaman.

Jas. A. Mahan.

INVENTOR.

Clark Sintz

By H. A. Faulmin,

his Attorney.

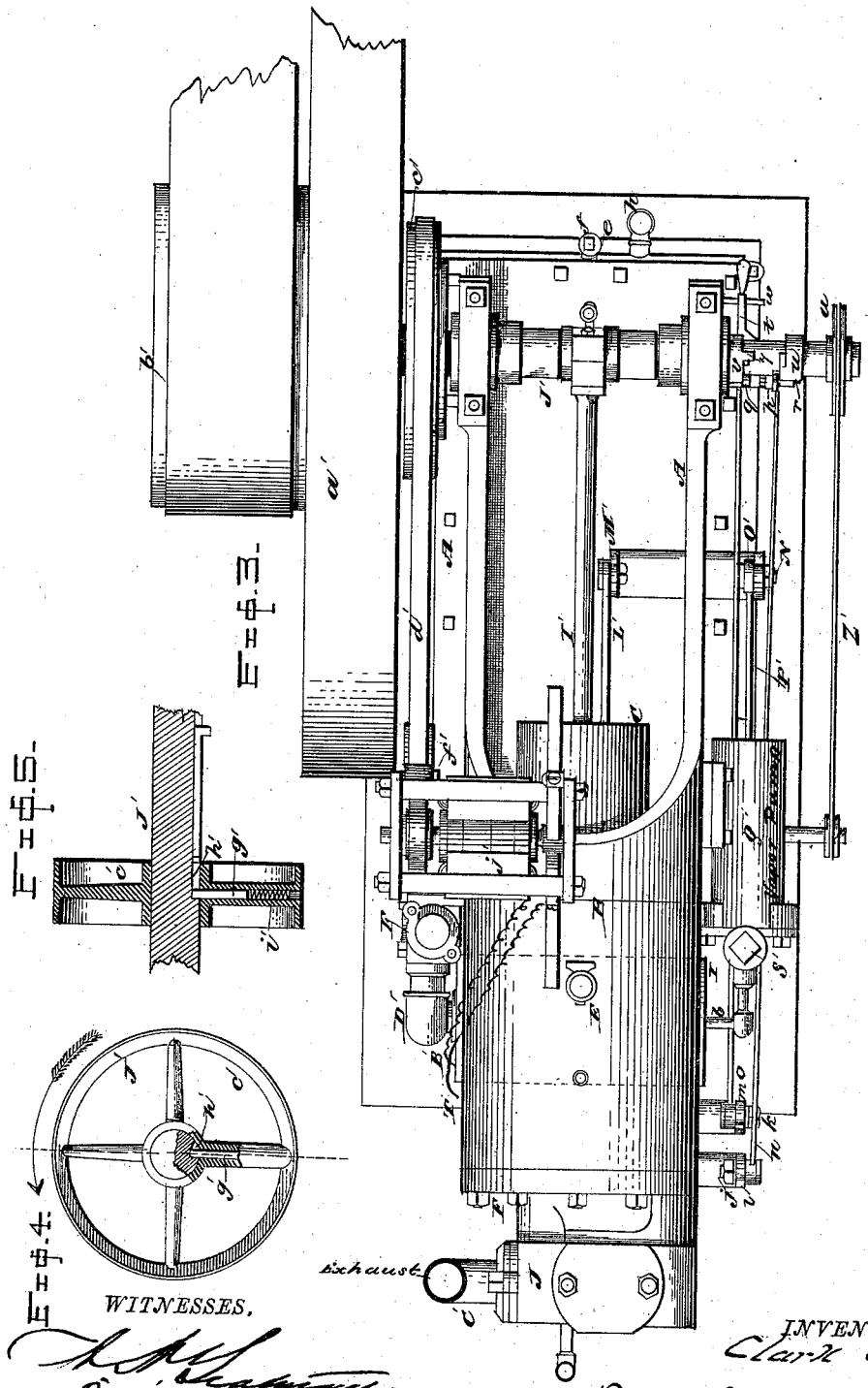
(No Model.)

7 Sheets—Sheet 3.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.



WITNESSES.

Jno. H. Mahan.

INVENTOR.

Clark Sintz.

By H. C. Fonlmin,

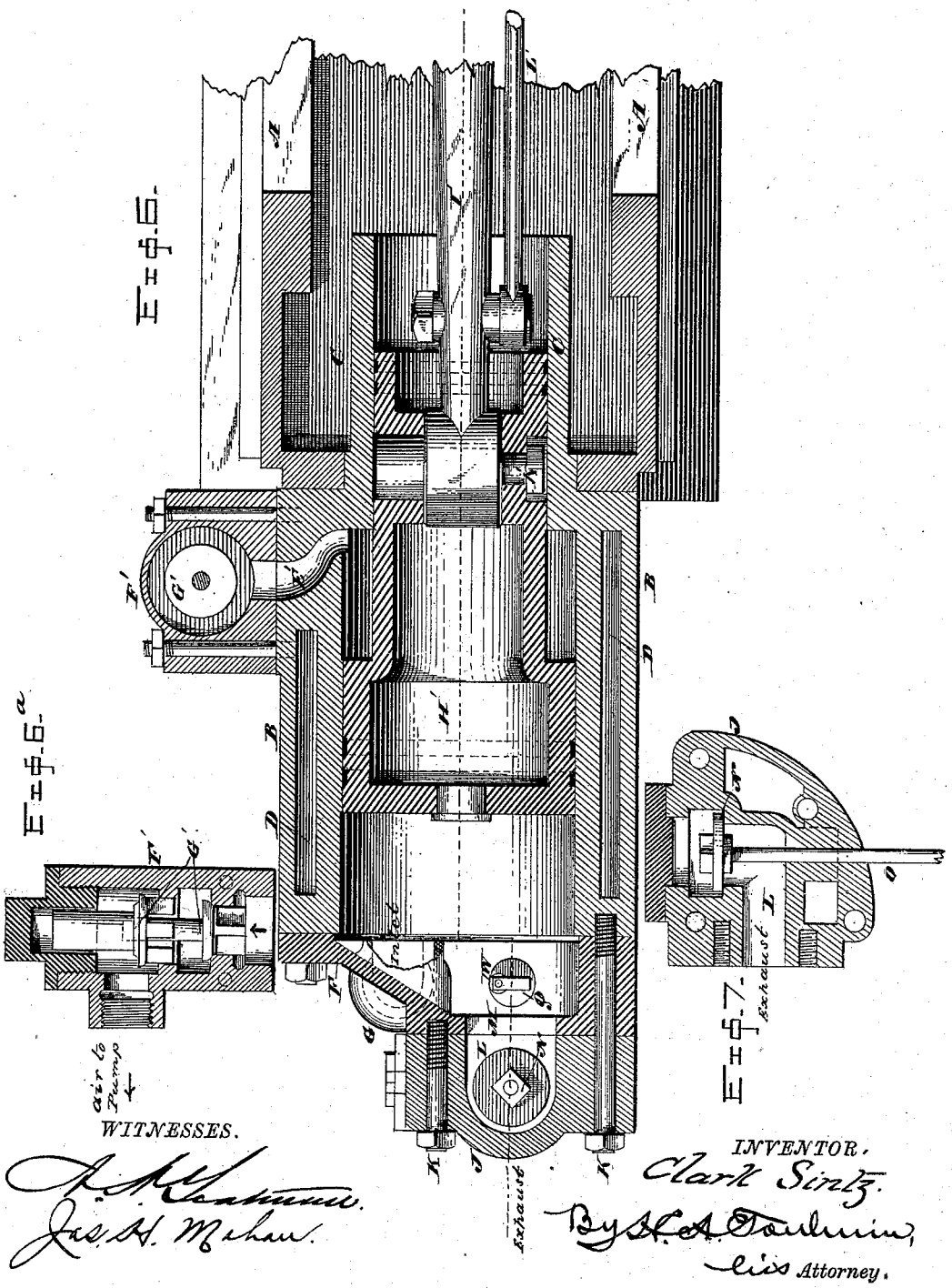
his Attorney.

(No Model.) 7 Sheets—Sheet 4.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.



WITNESSES.

Jas. A. Mehan.

INVENTOR.

Clark Sintz.

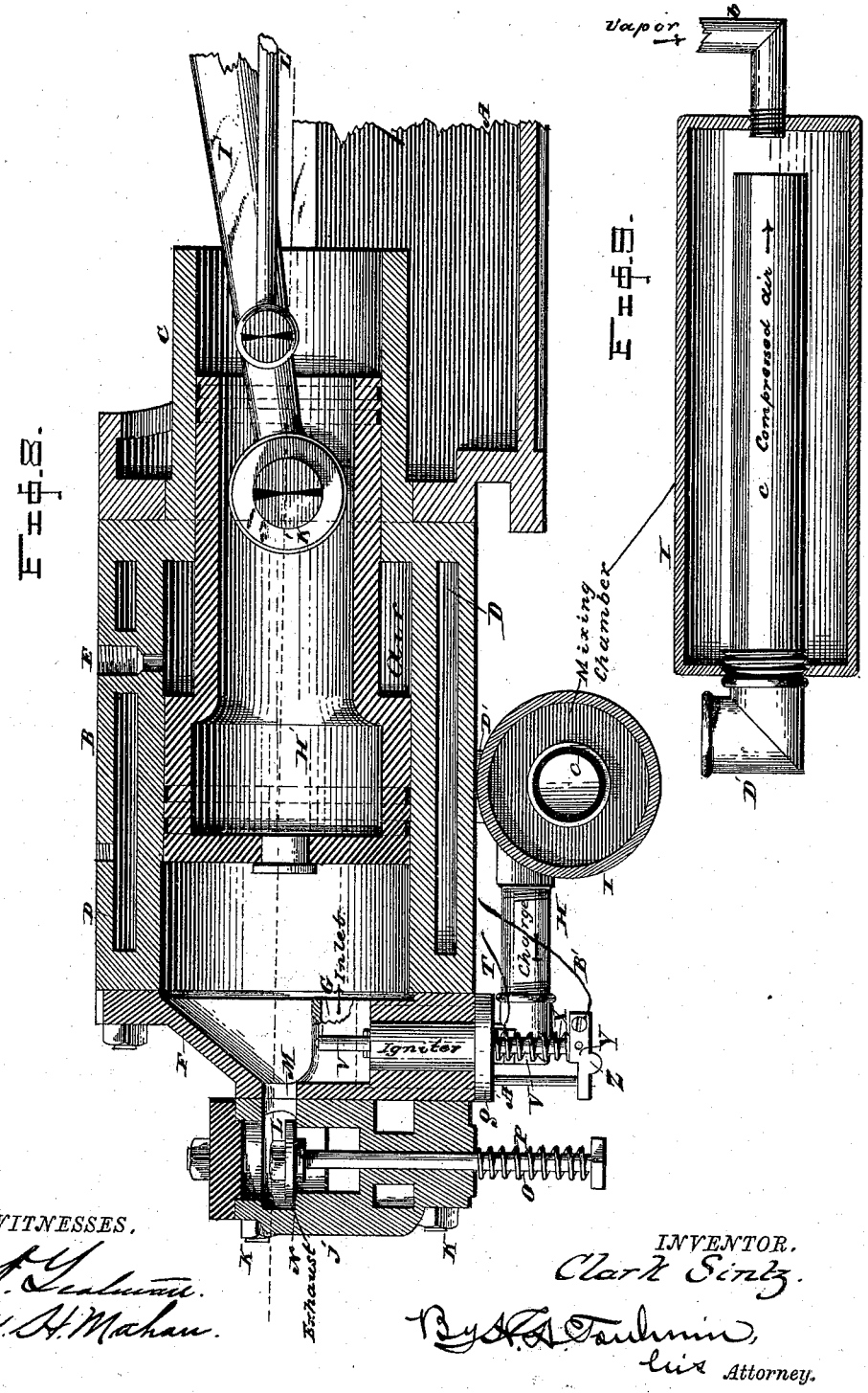
By his Attorney.

(No Model.) 7 Sheets—Sheet 5.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.



WITNESSES.

A. P. Graham.

Jno. A. Mahan.

INVENTOR.

Clark Sintz.

By A. P. Graham,

his Attorney.

(No Model.) 7 Sheets—Sheet 6.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.

Fig. 10.

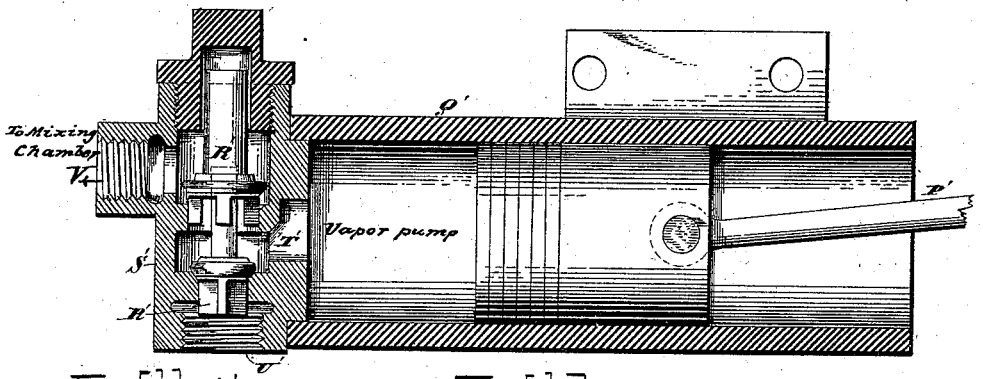


Fig. 11.

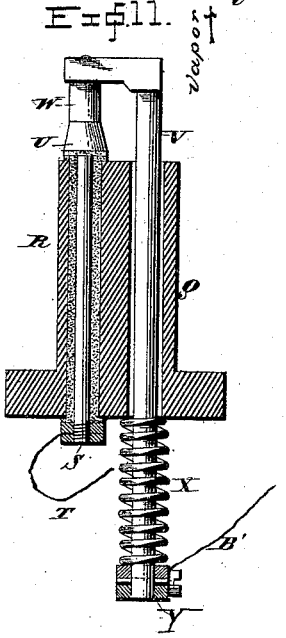


Fig. 12.

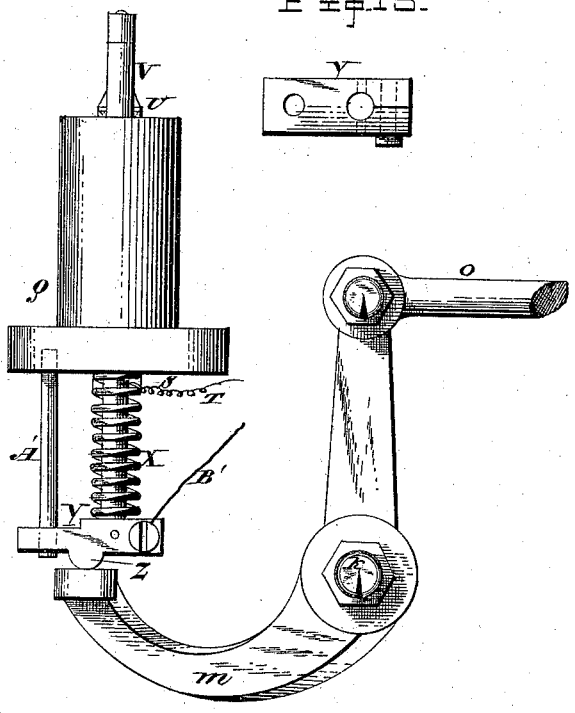


Fig. 13.

WITNESSES.

Jas. A. Mahan.

INVENTOR.

Clark Sintz.

By H. A. Toulmin,

his Attorney.

(No Model.) 7 Sheets—Sheet 7.

C. SINTZ.

GAS ENGINE.

No. 383,775. Patented May 29, 1888.

Fig. 15.

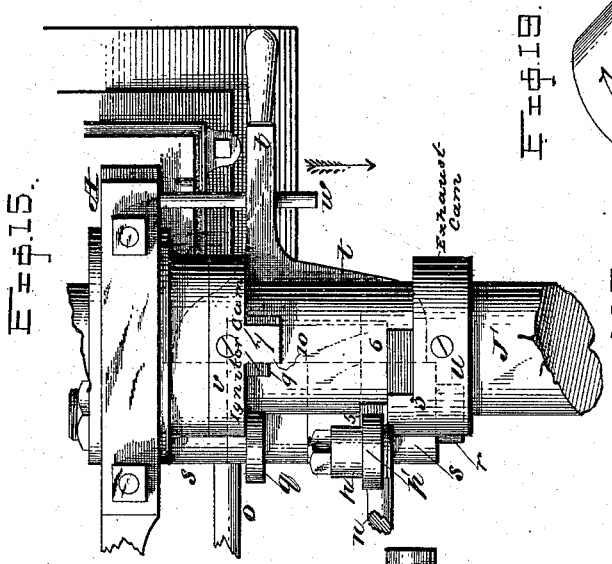


Fig. 18.

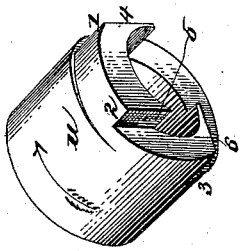


Fig. 13.

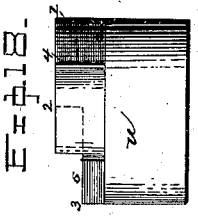


Fig. 14

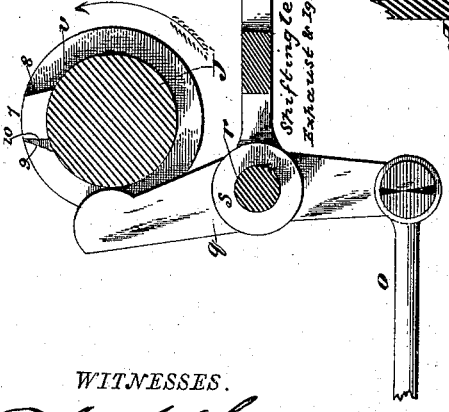


Fig. 16

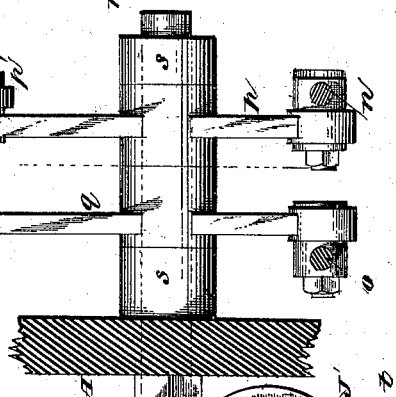
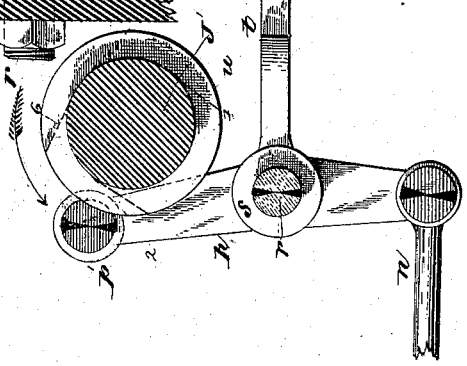


Fig. 17



WITNESSES.

A. P. Lenhard.

Jas. A. Mahan

INVENTOR.

Clark Sintz

By A. A. Fordmire,

his Attorney.

UNITED STATES PATENT OFFICE.

CLARK SINTZ, OF SPRINGFIELD, OHIO.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 383,775, dated May 29, 1888.

Application filed November 30, 1887. Serial No. 256,488. (No model.)

To all whom it may concern:

Be it known that I, CLARK SINTZ, 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 improvements in gas-engines, and is designed with special reference to the employment of carbureted air commingled with the proper proportion of atmospheric air as the explosive and motive agent.

There are several cardinal principles or characteristics which are of primary importance in practically carrying out this invention, among which are the following:

First. That of utilizing the cylinder and a differential piston as an air pump, and in operating an air or vapor pump proper in conjunction therewith whose supply of air is had through an interposed carbureting agent—as gasoline—and in connecting the cylinder and pump with a common receiving-chamber in which the two products, atmospheric air and carbureted air, can commingle and the resulting product flow into the cylinder back of the piston.

Second. That of breaking the electric circuit which furnishes the igniting-spark proportionately quicker as compared to the speed of the balance-wheel when the engine is first started than after the engine has been running a while, for the purpose, as I have ascertained by trial, of more certainly creating a spark than when the circuit is broken slowly.

Third. That of holding the exhaust-port open longer when the engine is first started than after it has been run a few minutes, so as to in the beginning get rid of a part of the incoming charge and prevent resistance to the return movement of the piston.

Fourth. That of exploding the motive agent as the crank is just on or reaching the dead-center on the back or return stroke, so as to partially utilize the explosive force in arresting the momentum of the piston in overcoming the resulting inertia and in reversing its movement, and so as to fully utilize the explosive force as well at the beginning of the outstroke as during the full period of that stroke by the expansibility of the exploded charge acting with continued force against the piston.

Fifth. That of closing the exhaust-port by the time the piston reaches midway its return-stroke, for the purpose of allowing the greater portion of the exploded product to escape from the cylinder during the incoming of the explosive charge, the latter acting, as I have ascertained by trial, to thus expel said product.

In the accompanying drawings, forming a part of this specification, and on which like reference-letters indicate corresponding parts, Figure 1 represents a side elevation of my improved gas-engine with some of the parts broken away; Fig. 2, a rear elevation of the engine with the dynamo and the exhaust-shell removed; Fig. 2ª, a detail sectional view of a crank for operating the dynamo by the hand; Fig. 3, a plan view of the engine; Fig. 4, a detail side view of the power-driving wheel for the dynamo; Fig. 5, a sectional view thereof and of the engine-shaft; Fig. 6, a horizontal sectional view of the cylinder, the piston, and carbureting-chamber, showing some of the parts in plan; Fig. 7, a detail transverse sectional view of the exhaust shell, showing its valve in elevation; Fig. 8, a vertical sectional view of the cylinder, the piston, the mixing-chamber, and the frame, showing some of the parts in side elevation; Fig. 9, a longitudinal sectional view of the mixing-chamber, showing the atmospheric-air and carbureted-air pipes; Fig. 10, a vertical sectional view of the pump, showing the piston, connecting-rod, and check-valves; Fig. 11, a detail view of the circuit-breaker in elevation and section; Fig. 12, a side elevation of the circuit-breaker and its operating-lever; Fig. 13, a detail plan view of the circuit-breaker cross-head; Fig. 14, a sectional view of the main shaft and rocking-arm shaft, and a side elevation of the circuit-breaking cam, the rocking arm, its pitman, and the adjusting-lever; Fig. 15, a plan view of a portion of the engine-bed, the main shaft, the cams thereon, the rocking arms, and their adjusting-lever; Fig. 16, a rear elevation of the rocking arms, their supporting-shaft, and a portion of the engine-bed in section; Fig. 17, a similar view

to Fig. 14 of the exhaust-cam, the rocking arm, its connecting-rod, and its adjusting-lever; Fig. 18, a plan view of the exhaust-cam, and Fig. 19 a perspective view thereof.

The letter A designates the frame or bed of the engine, and the letter B the cylinder, both being constructed in one piece, or separately and secured together. The cylinder is provided with a cylindrical extension, C, which forms that part of the cylinder in which the smaller portion of the piston reciprocates. The water-space D is also formed round the cylinder, and an oil-cup is fitted thereon at E. It will be observed that the forward end of the cylinder is open, while the rear end is strongly closed by a cap or head, F, of peculiar construction, secured by bolts and nuts in the usual way, or otherwise secured. The inlet-passage G of the motive agent is made through this head or cap, as more clearly seen in Fig. 6, with which passage the pipe H connects. This pipe also connects with the mixing-chamber I, as clearly seen in Figs. 2 and 8. The said passage is provided with a check-valve of the ordinary or any approved construction, as seen in the dotted lines in Fig. 2. This valve rises when the agent is passing from the mixing-chamber into the cylinder, but automatically closes against the return of said agent. To the cap F is secured the exhaust-valve shell J by the bolts K, or otherwise, as seen in Fig. 6. The passage L in this shell forms the exhaust-port, which leads through an opening, M, in the head F into that head, and thence into the cylinder. The proper valve-seat is formed within the port L for the exhaust-valve N, the stem O of which is provided with a spiral spring, P, which serves to hold the valve-head normally down against its seat.

In an opening in the head F, I snugly fit a bushing, Q, bored out to receive a non-conducting medium, R—as asbestus—in which is fitted a conductor, S, connected by a wire, T, with one pole of a dynamo, hereinafter to be spoken of. This conductor has a contact terminal, U, also insulated from the bushing Q. The bushing Q is also bored to receive a reciprocating conductor, V, having a terminal contact at W, and provided with a spiral spring, X, whose function is that of drawing the terminal W normally down into intimate contact with the terminal U. Secured to the terminal V is a cross-head, Y, having a lug, Z, with which the operating-lever engages, and slidingly fitted to a guide-rod, A′, secured to the bushing Q. To the cross-head Y is also connected a wire, B′, which runs to the other pole of the dynamo.

I will hereinafter refer to the mechanism which lifts the exhaust-valve and the circuit-breaker, for it will be understood that the dynamo-circuit remains normally closed.

The exhaust-pipe C′ is connected with the shell J, as seen in Fig. 3. I have already referred to the mixing-chamber I. This consists of a metallic cylinder of suitable dimensions, preferably placed crosswise of the cylinder and beneath the same, as clearly seen in Figs. 1, 2, and 8. A pipe, D′, leads from this chamber to the air-port E′ in the cylinder (see Figs. 2, 6, and 9) through the valve-shell F′. This shell is provided with the valves G′, by which, when the piston in the cylinder makes its back-stroke, air is admitted into the passage E′, and by which, when the piston makes its forward stroke, air is ejected through the passage E′, is prevented from escape, and directed into the pipe D′. From these remarks it will be understood that the differential piston H′ in conjuncture with the forward part of the cylinder constitutes an air-pump by which the mixing-chamber I is supplied with atmospheric air, which is one ingredient of the motive agent, and is the one which determines the explosive tendency and force of that agent, these things being regulated by the quantity of carbureted air which enters the chamber as compared to the atmospheric air which enters it.

The letter I′ refers to the connecting-rod between the piston and the crank in the crank-shaft J′. The connection between the piston and this rod may be of any desired form, but consists in the present instance of a bolt, K′, fitted to openings in the piston and to an eye in the rod. (See Fig. 6.) An actuating-rod, L′, is connected with the rod I′, and with a crank, M′, of a rock-shaft, N′, carrying a slotted crank, O′. To this latter crank is adjustably connected (so as to determine its throw) a connecting-rod, P′, (see Fig. 1,) which actuates the plunger of a pump, Q′. (See Fig. 10.) This pump, which is of the ordinary construction, is secured to the bed or frame A, and provided with check-valves R′, which act as usual in pumps of this kind. These valves are carried by a valve-shell, S′, having a pump-port, T′, and inlet and outlet ports U′ and V′. The former of these ports connects through a suitable pipe, W′, with the carbureting-tank X′ above the level of the carbureting-liquid. The governor Y′, of any approved construction, controls the communication between the tank X′ and the pump by means of the usual governor cut-off, motion being imparted to the governor through a belt, Z′, and a pulley, *a*, secured to the crank-shaft. (See Fig. 1.) The latter outlet V′ of the valve-shell S′ communicates through a suitable pipe, *b*, with the mixing-chamber I.

It will be observed that when the piston of the engine makes its back-stroke it draws air into the cylinder, while during this movement the piston of the pump forces the contents thereof into the mixing-chamber; and, also, that when the engine-piston makes its forward stroke it expels the air from the cylinder and into the mixing-chamber, while at the same time the pump draws in a quantity of carbureted air from the carbureting-tank X′. Thus it will be seen that atmospheric air and carbureted air are alternately introduced into the mixing-chamber. To effect a more thorough intermixing of these two constituents of the

motive agent, I extend the pipe D′ through an extension, *c*, nearly through the mixing-chamber and opposite the end of the pipe *b*. The air rushing from the pipe *c* somewhat enters the pipe *b*, and also strikes the end of the mixing-chamber and is deflected back into the chamber, while the carbureted air rushing from the pipe *b* somewhat enters the pipe *c* and also spreads into the chamber. Thus any tendency of stratification in the ingredients of the motive agent is effectually overcome. The carbureting-tank is preferably formed of cast-iron and affords a convenient formation for the frame A, as seen in Fig. 1. An inlet-pipe, *e*, having a cock, *f*, is supplied, as also several cocks, *g*, to determine the height of the carbureting-liquid. An inlet-pipe, *h*, communicates with the interior of the tank near the bottom thereof and extends somewhat above the highest level of the carbureting-liquid. Thus it will be seen that when the pump is in operation it draws atmospheric air through the pipe *h* into and through the liquid, thus carbureting it. I prefer to use gasoline, as I find it suits the purpose admirably, the present engine having been operated by it and used to run the machinery of a shop for a considerable period of time. In instances where a carbureting-liquid is dispensed with and gas used the tank X′ constitutes a convenient receiver therefor, the gas-supply pipe being connected, if desired, with the pipe *h*.

I will now refer to the means for actuating the exhaust-valve and circuit-breaker.

The letter *i* (see Figs. 1 and 2) designates a stout metallic plate secured to the cylinder and cap, and supporting short fixed shafts *j* and *k*, upon which are pivotally mounted two bell-crank levers, *l* and *m*, the lower members of which respectively engage the exhaust-valve stem and the cross-head of the circuit-breaker, while to their upper ends are connected actuating-rods *n* and *o*. These rods connect, respectively, with the rocking arms *p* and *q*, pivotally mounted upon a short fixed shaft, *r*, secured to the frame A. (See Fig. 16.) These arms are placed between the eyes *s s* of a slotted lever, *t*. (See Figs. 15 and 16.) By moving this lever in the direction of the crank-shaft of the engine the rocking arms *p* and *q* are adjusted opposite the different cam-faces of the cams *u* and *v*. These cams are in the form of rings, secured rigidly to the engine-shaft, and are for the purpose of actuating the rocking arms, so as to operate the bell-cranks *l* and *k* through the rods *n* and *o*. I have already spoken of holding the exhaust-valve open longer when the engine is first started, and of breaking the circuit quicker at that time than after the engine has been operating a few minutes. The reason for doing this is that by so keeping the exhaust-valve open so much of the residuum of the explosion escapes as not to offer much resistance to the return stroke of the piston; and the reason for so breaking the circuit is to more certainly cause a spark to fly from the contact-points, whereby the explosive agent is more effectively ignited. The cams to secure these ends are constructed as follows: The cam *u*, which actuates the exhaust-valve, has two cam-surfaces of different lengths, one extending from 1 to 2 and the other from 1 to 3. The surface 1 to 2 has a head-incline, 4, and a tail-incline, 5, while the surface 1 to 3 has a tail-incline, 6. Thus it will be observed that when the rocking arm *p* or its anti-friction roller *p′* is running on the surface 1 to 2, as in Fig. 15, (in which it is just leaving the tail-incline 5,) the exhaust-valve will be held open a shorter length of time than when it is running upon the surface 1 to 3. The cam *v*, which actuates the circuit-breaker, has a single cam-surface, 7, with a tail-incline, 8, but two head-inclines, 9 and 10, at different angles, the incline 10 being more abrupt than the incline 9. Thus when the incline 9 strikes the rocking arm *q* (as it is about to do in Fig. 15) it will not actuate it so quickly and will not break the circuit so quickly as when it is actuated by the incline 10. The position of cams with respect to the rocking arms, as shown in Fig. 15, is that in which they are placed after the engine has been well started. When, however, the engine is first started, the engineer takes hold of the lever *t* and draws it in the direction of the arrow, Fig. 15. This slides the rocking arms *p* and *q* on the shaft *r* until they stand, respectively, opposite the head-incline 10 and the surface 1 to 3 and the head-incline 4. The bar *w* serves as a guide of the handle *t*.

The letter *a′* designates the fly-wheel, and *b′* the belt-pulley, and *c′* a driving-pulley for actuating the dynamo, which supplies the current to ignite the explosion. The belt *d′* passes from the pulley *c′* over the pulley *e′*, over the dynamo-pulley, and under a guide-roller, *f′*.

The dynamo has to be turned rapidly to produce a current. As the engine-shaft revolves too slowly for this purpose in the start, a crank or other means is applied to the pulley *e′* to rotate it and the pulley *c′*, mounted independently upon the engine shaft in the direction of the arrow shown in Fig. 4. A convenient form of crank is that shown in Fig. 2ª, in which the socket fits over the shaft and the finger projects between the spokes of the pulley *e′*. The clutch-connection between the pulley *c′* and the engine-shaft consists of a sliding pin, *g′*, fitted in one of the spokes of the pulley and projected into a recess, *h′*, in the shaft by a spring, *i′*. This recess is shown in Fig. 4 as inclined at one side, so as to allow the pin to pass out of it when the wheel is turned in the direction of the arrow. This is the direction in which it is turned when operated by the crank above mentioned. When turned by the rotation of the engine-shaft, the radial shoulder of the recess comes against the pin, and thus carries the pulley with it. The key shown in Fig. 5 secures the fly-wheel *a′* to the engine-shaft. The dynamo is of the usual or any approved construction, and is disconnected at *j′*. The wires B′ and T respectively

connect with the field and brush magnets of the dynamo.

It is to be observed that the cam *v*, which actuates the circuit-breaker, is so placed with relation to the crank in the engine-shaft that as the crank is just on or reaching the dead-center in the back or return stroke the circuit is broken, the spark produced, the charge ignited, and the explosion effected. The result of this is, as already suggested, to partially utilize the explosive force for arresting the momentum of the piston, for overcoming the inertia of the piston as it proceeds to make its outward stroke, and also to fully utilize the explosive force at the beginning of the outstroke, as well as to utilize the expansibility of the exploded charge during the full period of that stroke, as the charge under the operation of the expansibility constantly forces the piston outward. The piston is relieved on the return-stroke by the exhaust-port being open during the first half of that stroke.

There are various modifications in the arrangement and construction of the invention, and I therefore wish to be understood as not confining myself to the particular arrangement shown and the means employed and here described.

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 the cylinder and a differential piston, of a mixing-chamber in communication with the cylinder, an inlet-passage to the cylinder, also communicating with said chamber, a pump communicating with said chamber and with the atmosphere through a carbureting-chamber and carbureting material, a suitable exhaust-port, an igniting device, and the engine-shaft and its adjuncts operatively connected with the piston and pump.

2. In a gas-engine, the combination, with the cylinder, a differential piston, a mixing-chamber, two valves, one opening toward the cylinder and the other from it, and a cylinder-inlet passage communicating with said chamber and having a valve opening toward the cylinder, of a carbureting-tank, a pump communicating with the atmosphere through said tank and communicating with said chamber, and governor mechanism controlling the communication between said tank and pump, and the engine adjuncts which actuate said piston, pump, and governor.

3. In a gas-engine, the combination, with an electrical generator, and a circuit leading into the cylinder and having contact-points within the same, of slow and quick actuating mechanism connected with one of said contact-points, for the purpose described.

4. In a gas-engine, the combination, with a cylinder, an electrical generator, and its circuit leading into the cylinder and having contact-points within the cylinder, of the engine-shaft, a slow and quick actuating-cam operated by the said shaft, and intermediate mechanism actuated by the cam and connected with one of said contacts, whereby the circuit is broken with different degrees of rapidity.

5. In a gas-engine, the combination, with the cylinder, a dynamo, its circuit composed in part of a fixed insulated rod projected into the cylinder, and a reciprocating rod also projected into the cylinder and having a holding-down spring and contacts between said rods, of a pivoted bell-crank lever engaging the reciprocating rod, a rocking arm connected to the bell-crank lever, the engine-shaft, and a cam thereon, which actuates the rocking arm and having two head-inclines, one of which is more abrupt than the other.

6. In a gas-engine, a cam for actuating an exhaust-valve, provided with head and tail inclines and a long and short surface between said inclines.

7. In a gas-engine, a cam for actuating a circuit-breaker, having two head-inclines, one of which is more abrupt than the other.

8. In a gas-engine, the combination, with the main shaft and two cams, one of which has two head-inclines, one more abrupt than the other, and the other of which cams has a long and a short cam-surface, of two pivoted rocking arms slidingly mounted, and an adjusting-lever therefor, whereby said arms are adjustable opposite the respective head-inclines and cam-surfaces.

9. In a gas-engine, the combination, with a mixing-chamber, of two pipes connected therewith, one of which extends near the opposite wall of the chamber from which it enters a terminus in proximity to the other pipe.

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

CLARK SINTZ.

Witnesses:
JAS. H. MAHAN,
A. A. YEATMAN.