(No Model.) 3 Sheets—Sheet 1.

H. H. BURRITT.

GAS MOTOR ENGINE.

No. 258,884. Patented June 6, 1882.

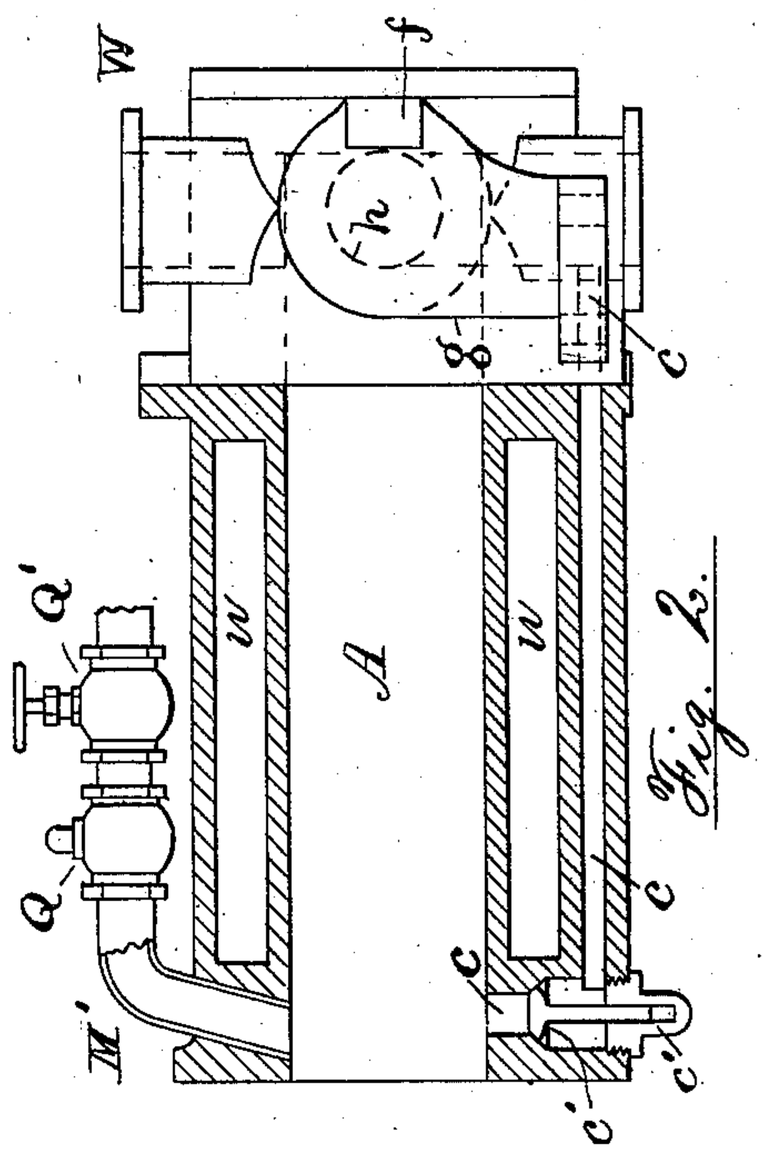

Fig. 2.

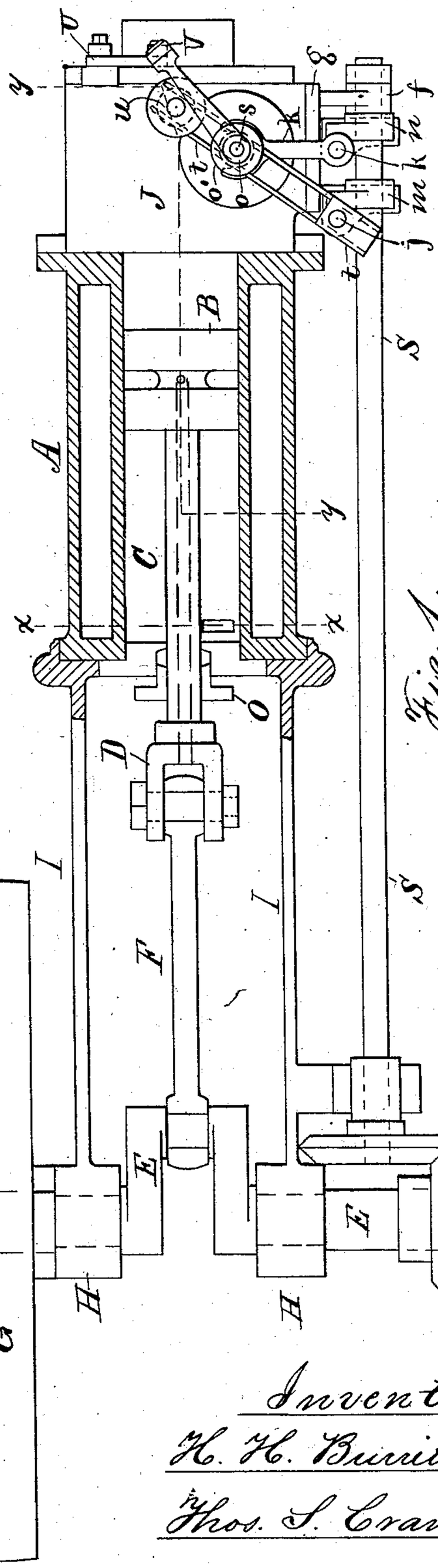

Fig. 1.

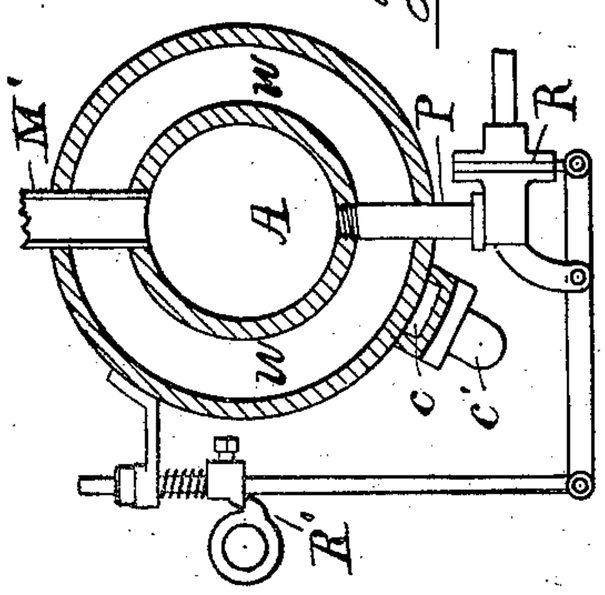

Fig. 3.

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Thos. S. Crane, Atty

(No Model.)

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Fig. 4.

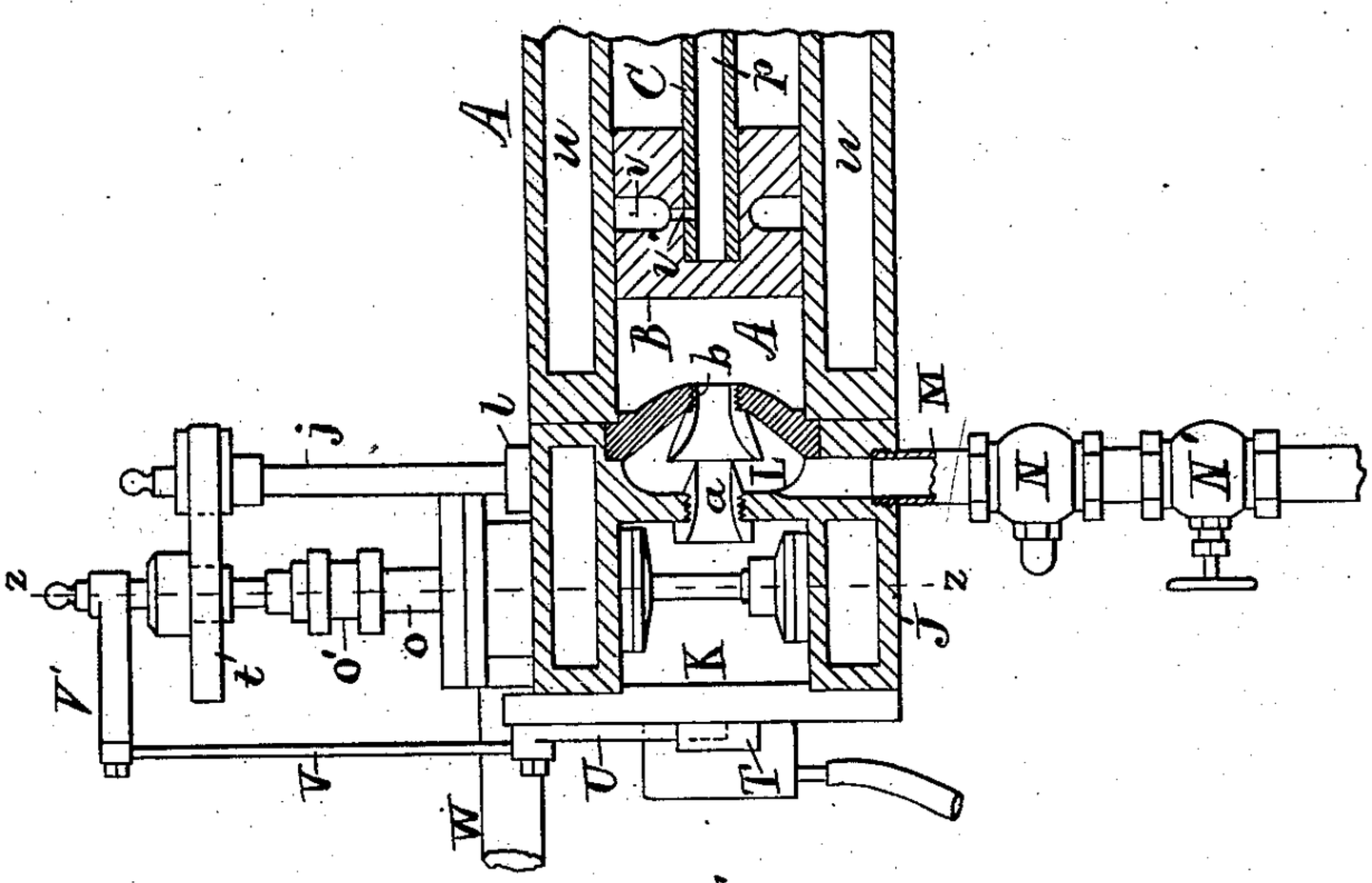


Fig. 5.

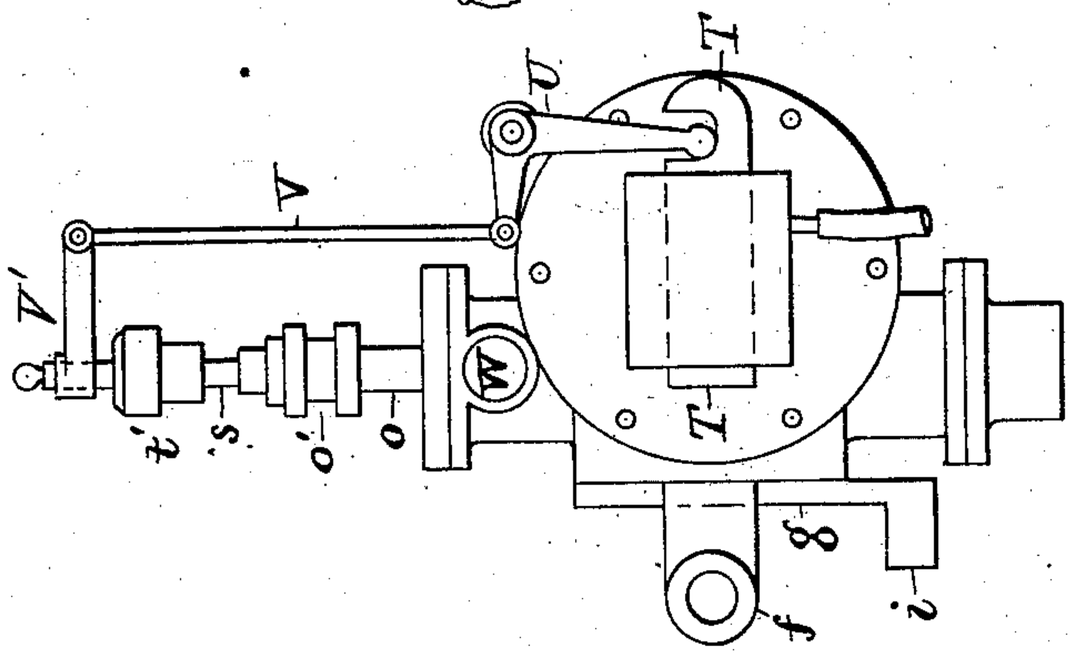
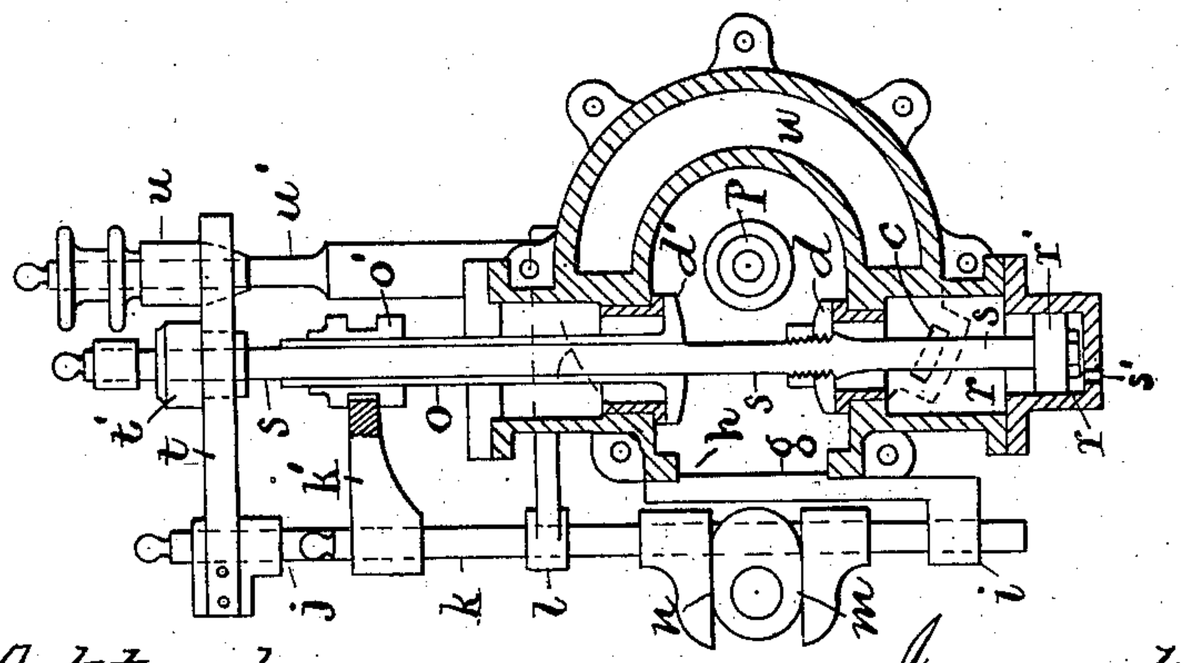


Fig. 6.



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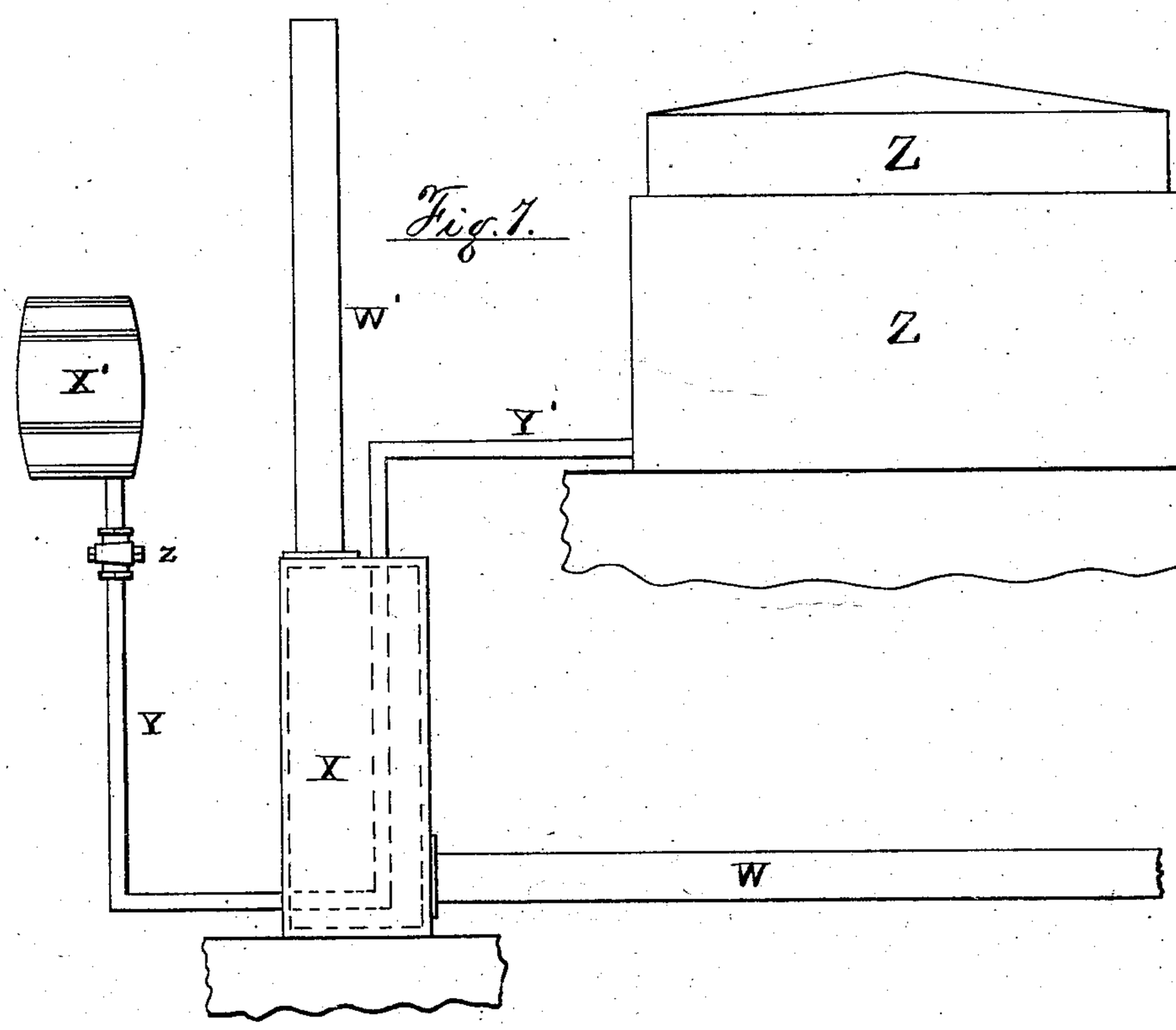

Attest:
Chas. C. Herrick
W. F. D. Crane.

Inventor.
H. H. Burritt. per
Thos. S. Crane. atty.

UNITED STATES PATENT OFFICE.

HARVEY H. BURRITT, OF NEWARK, NEW JERSEY.

GAS-MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 258,884, dated June 6, 1882.

Application filed October 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, HARVEY H. BURRITT, a citizen of the United States, residing in the city of Newark, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Gas-Motor Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

My invention relates to an improvement in gas-motors; and it consists in an improved method of compressing the explosive mixture and firing it behind the piston; in an improved method of utilizing the heat generated by the gas, and thus preventing excessive temperature in the motive cylinder, and in various combinations of mechanism for effecting these operations.

In the drawings annexed, Figure 1 is a plan of an engine constructed with my improvements, the cylinder and adjacent framing being shown in section. Fig. 2 is a side view of the cylinder and ignition-chambers, the former being in section and the latter showing the bracket for guiding the valve-moving rods. Fig. 3 is a section of the cylinder at *x x* in Fig. 1, to show the mechanism for working the gas-valve. Fig. 4 is a side view of the ignition-chamber and rear part of the cylinder, certain parts being shown in section on line *y y* in Fig. 1 Fig. 5 is a rear elevation of the ignition-chamber, and Fig 6 a section of the same on line *z z* in Fig. 4. Fig. 7 shows devices for utilizing the waste heat.

The motor is shown constructed with an operative cylinder, A, containing a piston, B, which is connected by a rod, C, to a fork-head, D, whence the power is transmitted to a crank-shaft, E, by a connection, F. The shaft is provided with a fly-wheel, G, and is mounted in suitable bearings, H, upon a frame, I, by which it is connected to the cylinder A. The cylinder is attached at its rear end to a casting, J, containing an ignition-chamber, K, and an injector-chamber, L, the latter being interposed between the cylinder and chamber K for the purpose of drawing air into the cylinder with the ignited gases as they emerge after explosion from the ignition-chamber. To effect this object the injector-chamber is provided with an air-supply pipe, M, furnished with a check-valve, N, and regulating-valve N′. The outlet from the ignition-chamber is provided with a nozzle, *a*, which discharges the exploded gas across the injector-chamber to a nozzle, *b*, leading into the cylinder, and the passage of the current of gas from one nozzle to the other induces a partial vacuum in chamber L, thus inducing a current of air through pipe M, which becomes intimately mixed with the heated gases, and is greatly expanded by the absorption of their heat. As air expands one four hundred and fifty-ninth of its volume for each degree Fahrenheit increase of temperature, and as the gases have a temperature near 2,000° Fahrenheit when exploded in certain proportions, it is evident that the bulk of the air may be increased several times by such expansion, and a pressure of two to three atmospheres secured. As this operation is not instantaneous, but prolonged throughout a great part of the stroke by the gradual passage of the heated gas through the contracted nozzle at *a*, it is obvious that the force of the engine is distributed throughout the stroke much more uniformly than in engines not constructed with such improvement.

To secure an explosion of compressed air and gas at each revolution of the fly-wheel, I employ the front part of the cylinder as a receiving and compressing chamber, and for that purpose close the front end by a stuffing-box, O, and provide air and gas supply pipes at M′ and P, to introduce the proper proportions of air and gas into the front part of the cylinder as the piston is retracted by the momentum of the fly-wheel after the forward impulsion.

The air-pipe is provided with a check-valve, Q, and regulating-valve Q′, and the gas is introduced by a gas-valve, R, operated by a cam, R′, upon a rotating shaft, S, driven by the crank-shaft once around at each of its revolutions by gears S′. The arrangement of the mechanism is shown in Fig. 3, and, as it is the same as is commonly used, needs no further description.

If desired, a regulating-cock can be inserted in pipe P, by means of which the flow of gas can be increased at pleasure, and the relative proportions of air and gas mingled in front of the piston easily regulated. The charge thus secured is transferred to the ignition-chamber

upon the return of the piston by a port, *c*, extended from the front end of the piston to the chamber K, a check-valve being inserted in the port near its entrance to the cylinder.

The ignition-chamber is provided with a cylindrical recess, *r*, where the port intersects it, and an inlet-valve, *d*, is provided between the chamber and recess to prevent the ingress of the gas and air to the chamber during compression. It is also provided at the opposite side of the chamber with an outlet or exhaust valve, *d'*, arranged and operated to discharge the contents of the cylinder after their operation behind the piston. Both inlet and outlet valves being constructed upon the same axial line, the stem of the former is made to pass upward and then out of the chamber through a hollow shank, *o*, formed upon the outlet-valve, beyond the end of which it projects far enough to receive motion from a cut-off mechanism. Both valves open inward to adapt them to resist the forces of explosion, and each is moved at proper intervals by a cam secured to the rotating shaft S, which extends by the side of the frame I, past the cylinder A to the chamber K, where it is supported in a bearing, *f*. This bearing is attached, as well as the lower guides, *i*, for the valve-moving rods, to a plate, *g*, employed to cover the entrance *h* to the chamber K. The rods are lettered *j* and *k*, and are guided at their upper ends by bearings *l*, attached to the top of the casting J. These bearings are omitted from the plan in Fig. 1 to expose the cams *m* and *n*, which respectively open the inlet and outlet valves *d* and *d'*.

To prevent the compressed gas in recess *r* from raising valve *d*, its stem *s* is extended to the lower part of the recess and provided with a piston, *r'*. The end of the recess being connected with the atmosphere by a hole, *s'*, the pressure acts equally upon the under side of the valve and upper side of the piston, and is fully or nearly balanced, as may be preferred. The cam *m* is adjusted to open the inlet-valve when the piston reaches the inner end of its stroke, and remains open only a moment to permit the compressed air and gas to expand from the port *c* and recess *r* into the ignition-chamber. The valve-lifter is constructed to then let the valve drop, and the latter in its descent moves a gas slide or igniter, T, with which it is connected by a bell-crank, U, and link V, attached by joint-pins to an arm, V', upon the top of the valve-rod.

The valve-lifter consists of the cut-off fixture commonly used upon upright-cylinder marine-engines, and is formed by attaching two parallel leaf-springs flatwise, as at *t*, to the head of the rod *j* and extending them past opposite sides of the stem *s*, beneath a double collar, *t'*, secured to the latter. Beyond the stem *s* the springs are extended to embrace an opening-cone, *u*, which is mounted upon a pillar, *u'*, as shown in Figs. 1 and 6, and operates to separate the springs and disengage them from the shoulder formed on collar *t'* at the moment required for the closing of the inlet-valve. The gas-slide T being opened at the same instant by its connection with the valve-stem *s*, the explosion occurs in chamber K immediately thereafter, and the piston is driven forward, compressing the mixed charge before it into the port *c* and recess *r*, in readiness for another explosion. The exhaust-valve is operated by its cam *n*, rod *k*, hollow stem *o*, and an arm, *k'*, affixed to the top of the rod and fitted to a grooved collar, *o'*, upon the stem O, and is arranged to be open during the entire return-stroke of the piston B to release the waste products from the cylinder A. In passing to the exhaust-valve the gases may flow from the cylinder to chamber K through the injector-nozzles *a* and *b*, as shown in the drawings at Fig. 4, or be conducted through some auxiliary passage provided with a check-valve opening into the chamber, such valve preventing the exploded gas from reaching the cylinder except through the injector. Although the exploded gases pass through the injector at high pressures, there is no more tendency in the fluids to pass into the supply-pipe M than for steam to enter the suction-pipe of a water-injector, and the check-valve N is provided merely to prevent the waste products from escaping except at the exhaust-valve, whence they may be led in any direction by a pipe attached at the outlet-pipe W.

To prevent the ignited gases behind the piston from communicating fire to the compressed gases before it, I construct the piston in two sections, with an annular space, *v*, between them, and connect such space with the external atmosphere by an aperture, *v'*, extending from such space into a central hole, *p*, extending from the front end of the piston-rod C to the middle of the piston. Any compressed gas which escapes into the annular space *v* is thus offered a free escape to the atmosphere and has no tendency to pass behind the piston. The ignited gases find a similar outlet should any of them press over into the space *v*.

From the above description the operation of my invention will be readily understood, and it will be seen that the heat of the exploded gases is rendered a useful factor by the mixing of the hot gases with air during their passage into the working-cylinder A, instead of a detriment to the mechanism, as in many other constructions.

I have shown the cylinder provided with a water-jacket, *w*, as in similar engines, for use in cases where the temperature remains injurious.

My improvement in utilizing the heat of the exhaust-gases consists in bringing the same into contact with a pipe through which gasoline is conducted, and thereby generating from that fluid, or any other of suitable character, a gas to be used in operating the gas-motor or for any other purpose. As the heat of the escaping gases is otherwise of no value, and as the gasoline used for producing the combusti-

ble gas is vaporized at a comparatively low temperature and affords a much more permanent gas when produced by the application of heat, it is evidently a very profitable application of the waste heat to use it in generating such gas. The exhaust from pipe W may be brought in contact with a coil of pipe containing a supply of gasoline, or arranged as shown in Fig. 7, when X is a heating-chamber, through which the waste gases are conducted by pipes W W′.

X′ is a vessel of gasoline, Y a pipe conducting the fluid from the vessel through the chamber X, and Y′ is a pipe leading the resulting combustible gas to a receiver, Z. The flow of gasoline through the pipe Y is regulated by a cock, *z*, or by automatic devices controlled by the gas produced. The pipe Y would also be provided with suitable safety appliances to prevent heat or fire from extending toward the vessel X′. It is evident that with this appliance the cost of operating a gas-engine may be reduced to the mere cost of so much gasoline, and that no large amount of gas need be kept in store for the use of such an engine, as the production of gas is continuous when the engine is in motion and ceases soon after the engine stops.

It will be seen from the above that the construction of the vaporizing apparatus is immaterial to my invention, which consists in producing the vapor of gasoline unmixed with air by the action upon such gasoline of the heat contained in the exhaust from the engine, and in mingling such gas in any desired proportions with air, and exploding the mixture or burning the same to propel the piston of the engine.

I am aware that vaporizers have been used before for absorbing the latent heat of steam, and thereby utilizing a part of such heat, as in Patent No. 4,806, Reissued March 12, 1872, and in Patent No. 127,250, of May 28, 1872, and I do not therefore claim utilizing latent heat, broadly, in such manner, but only the supplying of a gas-motor with its own gas from the vapor of gasoline in the manner claimed.

I am aware that there is nothing new in various parts of my apparatus, as shown in the drawings, the water-jacket, the gas-slide for igniting the charge, the mixing of the air and gas to constitute the explosive charge, and the use of inlet and outlet valves operated by a cam-shaft, all being known prior to my invention; but it is equally true that many features of my invention are new in principle, and therefore capable of adaptation to mechanism different from that shown herein. Thus the compressing of the charge by the piston in the front end of the cylinder enables me to make twice as many explosions behind the piston as engines of many other kinds, and thus to secure a greater uniformity of speed in the power developed by the fly-wheel; but this operation can be performed by other constructions, and need not therefore be confined to an engine of the precise form set forth. The same is true in regard to the operation of the injector, as its function is to draw cold air into the cylinder with the ignited gases, which can be performed by other arrangements of nozzles than that shown herein, and which can be productive of as great advantage in motors procuring their charge by other means than that I have described. For instance, the motor may be supplied with its explosive charge by an independent compressor, but still employ my device for mixing cold air with the exploded gases, and, vice versa, the devices I have devised for compressing and retaining the charge before ignition may be used without the injector for diluting the ignited gases.

As the construction and operation of the gas-slide and other old features of my motor are already fully understood, I have not shown them in any detail, but confined the illustrations chiefly to the novel constructions.

Having thus fully described my invention, I claim the same in the following manner:

1. The method herein described of supplying a compressed charge of mingled air and gas to the cylinder of a gas-motor, consisting, first, in drawing the air and gas in suitable proportions into one end of the cylinder by the reverse movement of the operative piston; second, in compressing the same into a recess or cavity near the ignition-chamber by the forward movement of the piston; third, in retaining the mixture in the recess by a suitable valve until the commencement of the succeeding forward stroke; and, fourth, in discharging the compressed mixture into the ignition-chamber at such time by suitable valve, substantially as and for the purpose set forth.

2. The improved method of converting the heat of explosion into useful power, consisting, first, in exploding the gaseous mixture in a chamber separate from the operative cylinder; second, in conducting the products of the explosion through a chamber located between the ignition-chamber and the cylinder and mingling cold air with the heated gases on their passage to the cylinder; and, third, in conducting the products of the explosion, mingled with cold air, to the cylinder, to operate conjointly upon the piston, substantially as and for the purpose set forth.

3. The combination, in a gas-motor, of the cylinder A, provided with an operative piston, an ignition chamber supplied with an explosive charge for the purpose set forth, and an intermediate injector-chamber, constructed and operated to supply a current of air through a feed-pipe, M, to the ignited gases on their passages to the operative cylinder, substantially as and for the purpose described.

4. The combination, in a gas-motor, of an operative cylinder and piston, substantially as described, an injector-chamber supplied with air-inlet and nozzles *a b* for the purpose specified, and ignition-chamber supplied with an explosive charge for the purpose set forth, inlet and outlet valves combined with the ignition-

chamber, as described, and a gas-slide operated to fire the charge by connection to the inlet-valve, so as to open when the latter is closed, substantially as herein shown and described.

5. The combination, with the piston of a gas-motor, of a hollow rod, as C *p*, an annular space in the body of the piston, as *v*, and a connection between the two, as *v'*, substantially as and for the purpose set forth.

6. The method herein described for generating and supplying the vapor of gasoline to a gas-motor, consisting in vaporizing the gasoline in a suitable vessel in contact with the heated gases exhausted from the gas-motor, and in mixing the vapor of the heated gasoline with air and applying it to charge and operate the motor, substantially as herein described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

HARVEY H. BURRITT.

Witnesses:

THOS. S. CRANE,

G. M. WARD.