(No Model.) 3 Sheets—Sheet 1.

J. CHARTER.

GAS ENGINE.

No. 270,202. Patented Jan. 9, 1883.

Fig. 1.

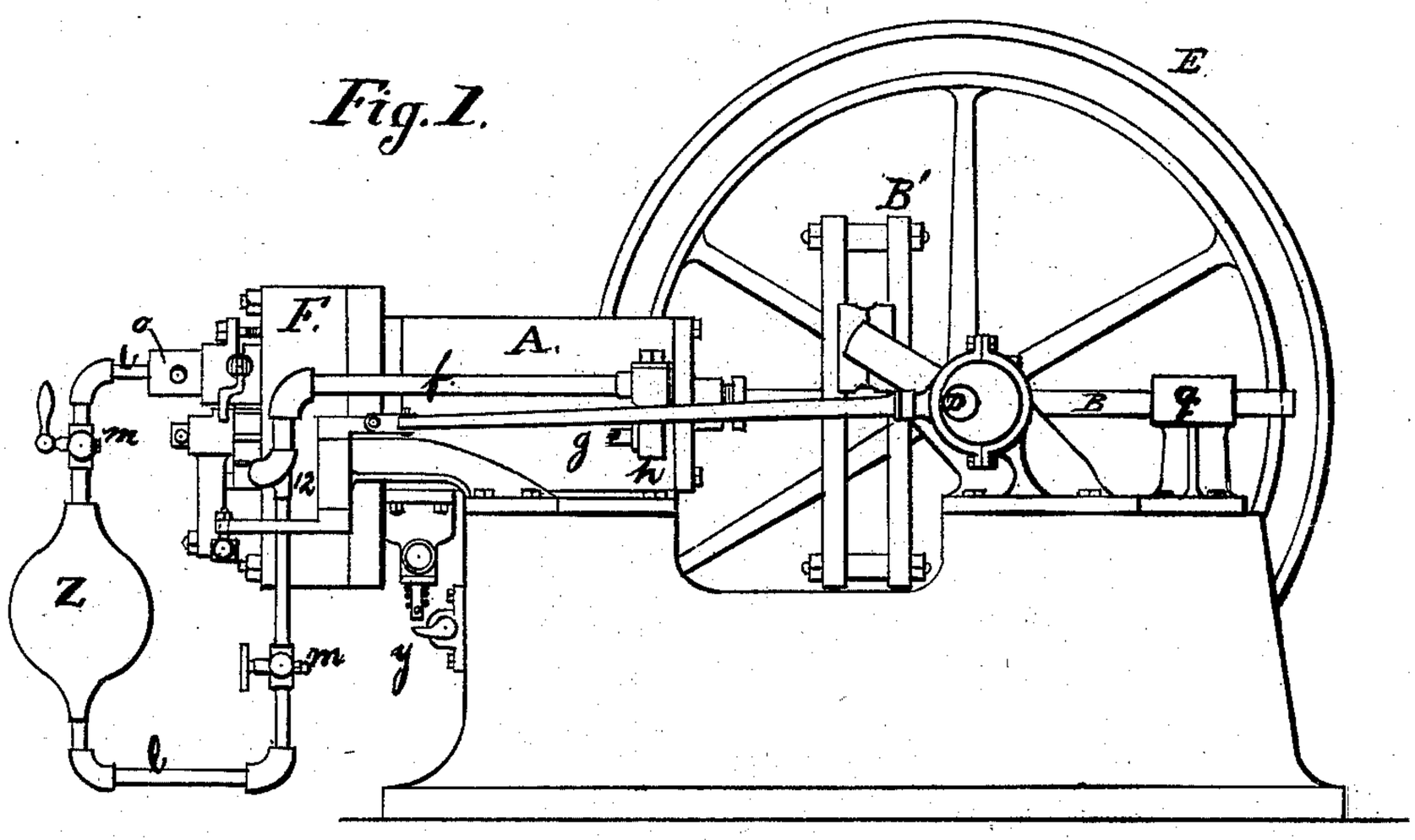
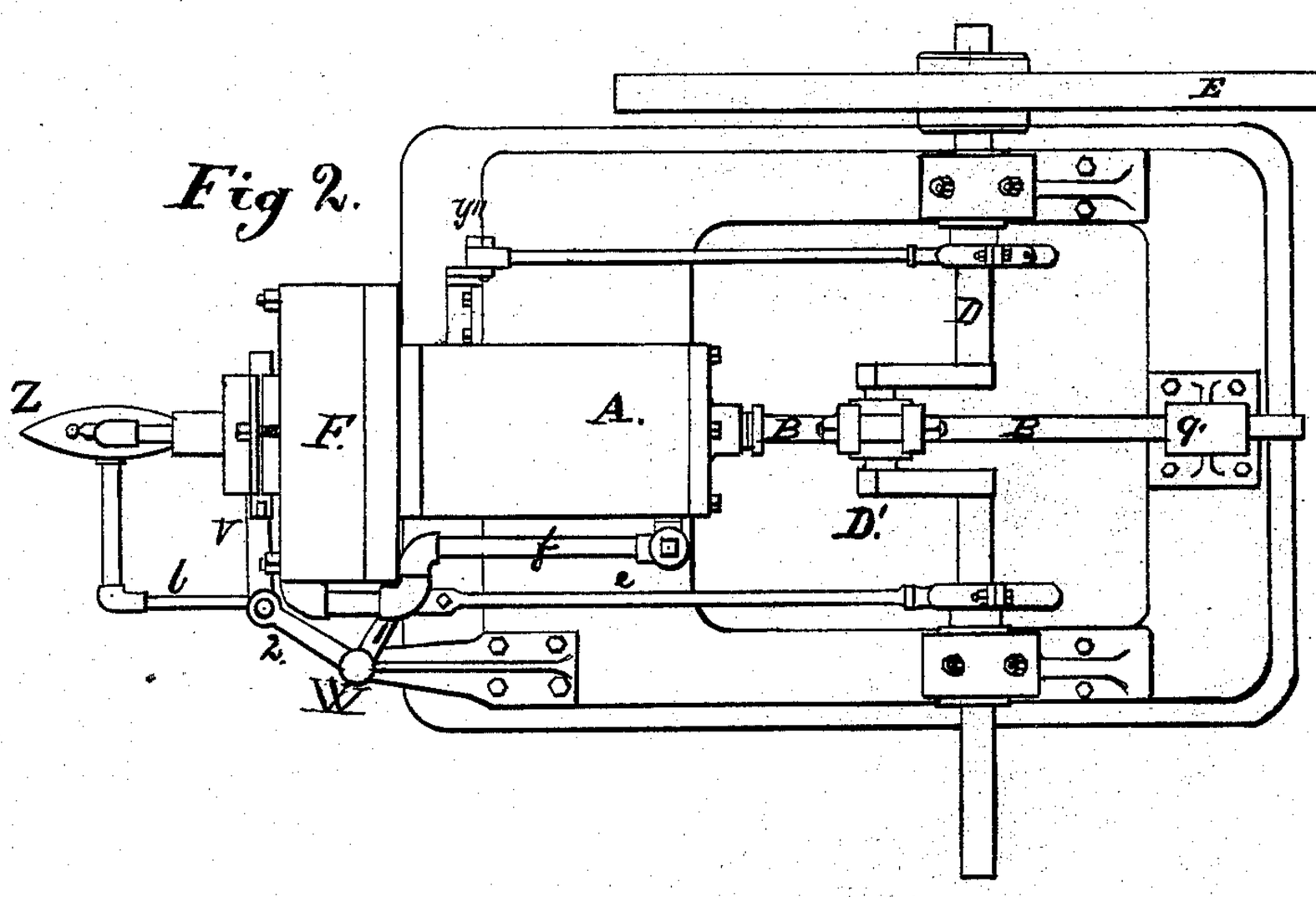


Fig 2.



WITNESSES

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

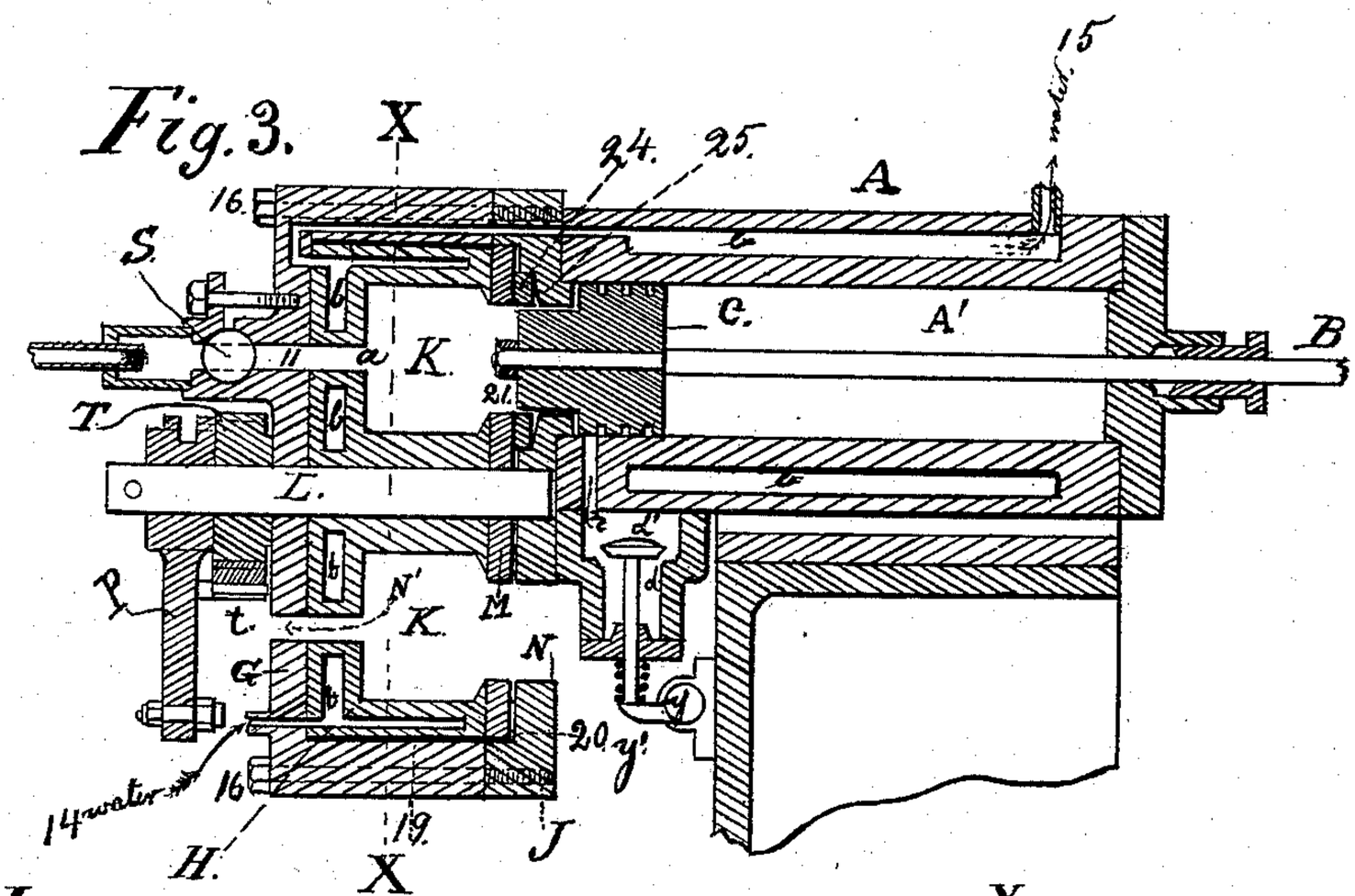


Fig. 4.

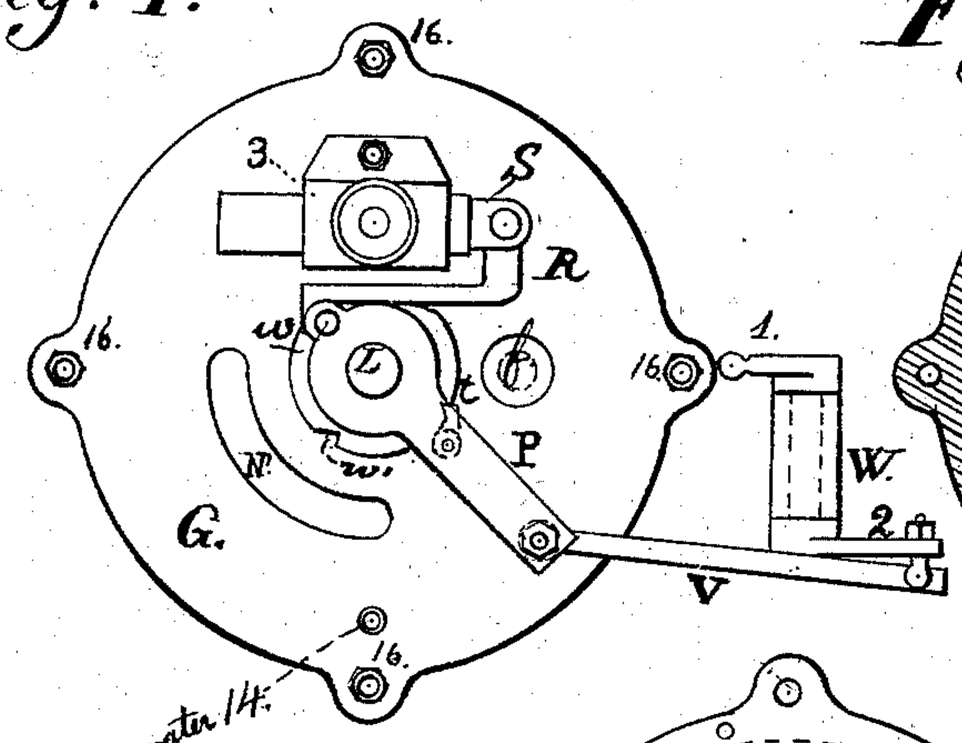


Fig 5.

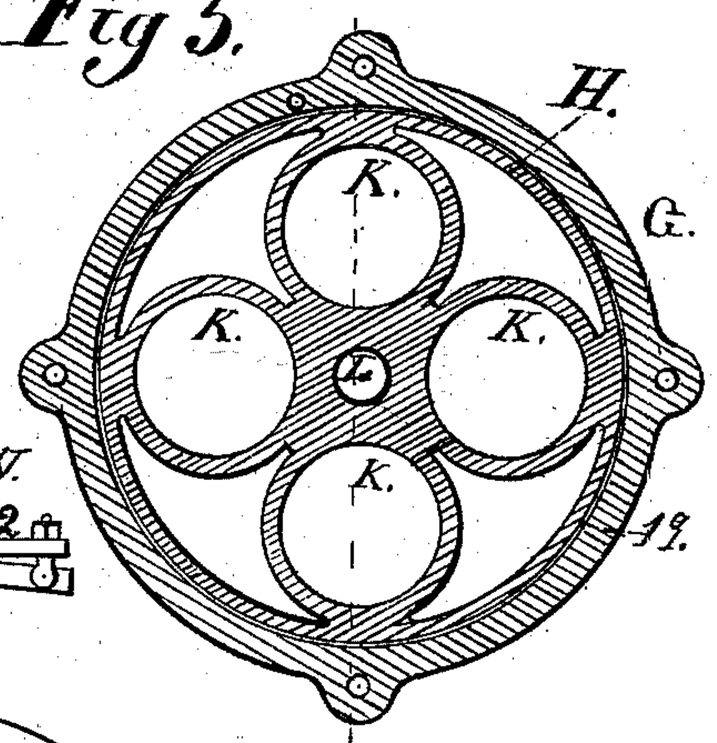
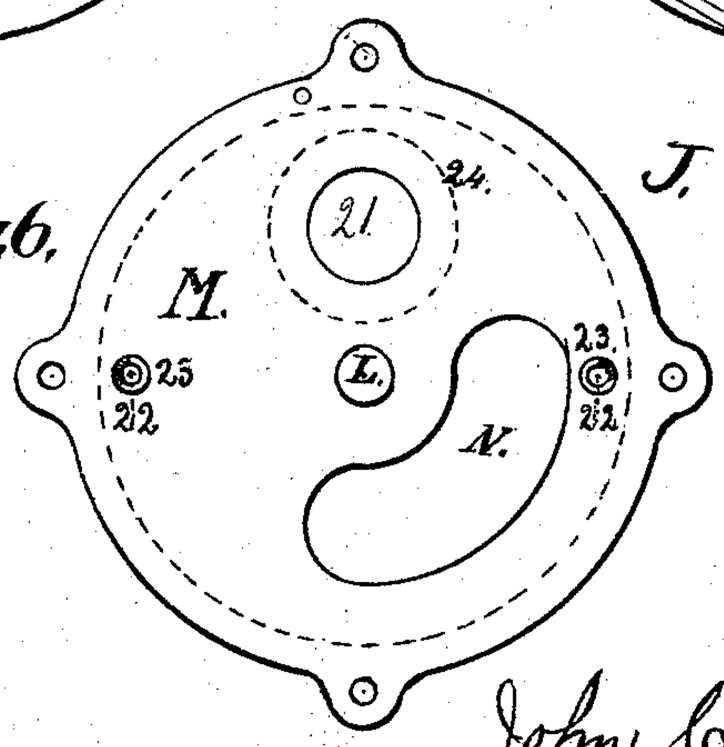


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 7.

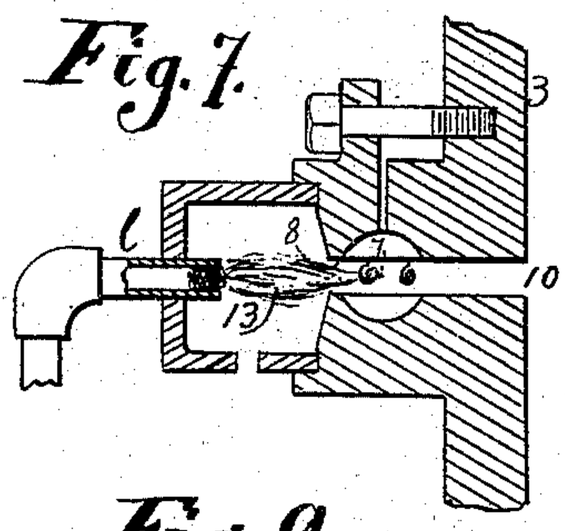


Fig. 8.

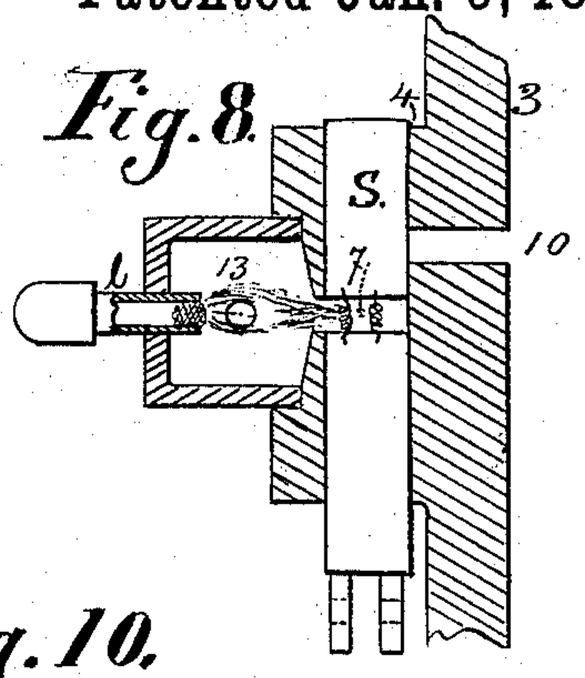


Fig. 9.

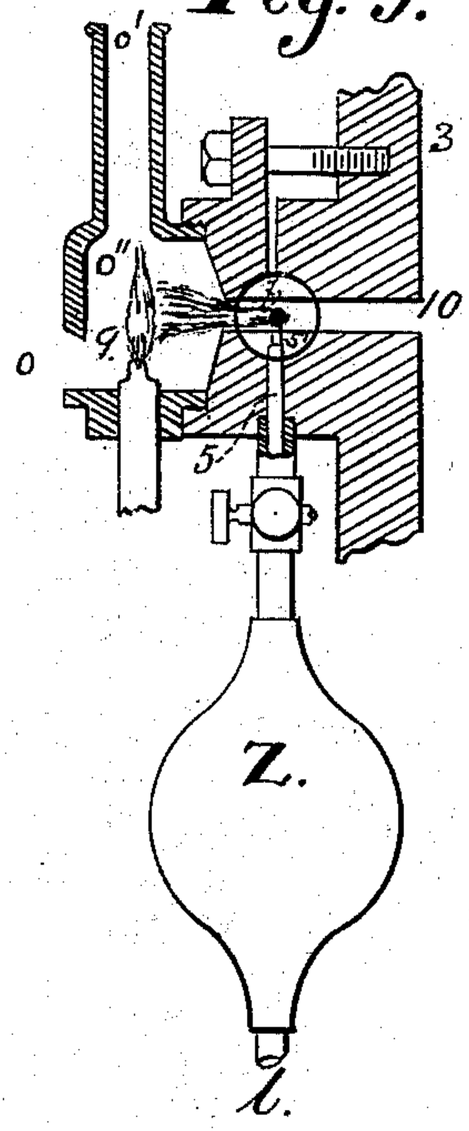


Fig. 10.

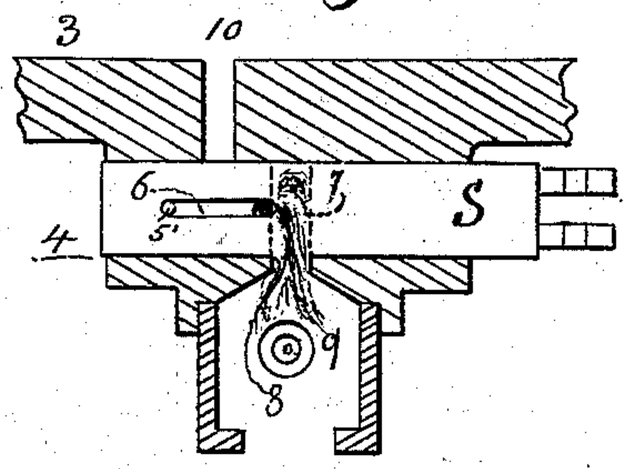
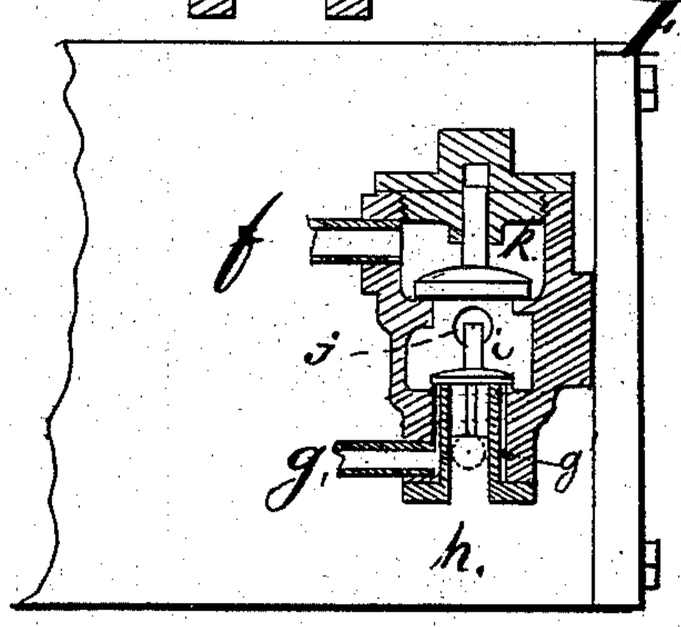


Fig. 11.



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JOHN CHARTER, OF STERLING, ILLINOIS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 270,202, dated January 9, 1883.

Application filed July 5, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOHN CHARTER, a citizen of the United States, residing at Sterling, in the county of Whiteside and State of Illinois, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention relates to certain improvements in that class of gas-engines in which the air and gas are used under compressions greater than one atmosphere; and it consists in the origin and employment of certain novel and useful devices to provide and utilize such mixture for the purpose named.

In the drawings, Figure 1 is an external side elevation of a machine embodying my invention. Fig. 2 is a plan view of the same. Fig. 3 is a sectional elevation longitudinally through the center of the machine. Fig. 4 is an end view of the circular case F. Fig. 5 is a cross-sectional view of the plate G in the line *x x* of Fig. 3, having within it the rotating cylinder containing the annular charging chambers K K K K. Fig. 6 is a detached inside view of the two plates M and J, the former being exhibited within the latter in dotted lines. Fig. 7 is a vertical transverse sectional view of the platinum igniter and its adjacent parts. Fig. 8 is a sectional plan view of the same igniter. Fig. 9 is a transverse vertical sectional view of the gas-jet igniter. Fig. 10 is a sectional plan view of the last above. Fig. 11 is an enlarged view of the working-cylinder A and the devices for admitting and expelling the gaseous mixture in the process of compressing the same preparatory to explosion.

A is the motive cylinder, having within it the cylindrical chamber A′, within which latter is fitted and operates the piston C. (Shown in Fig. 3 at the limit of its instroke.)

B is the piston rod or shaft, attached by means of the yoke B′ to the crank D′ of the revolving shaft or axle D, to which latter the balance or fly wheel E is affixed. The outer end of the piston-rod B plays in the stationary sleeve or bearing *q* to steady the motion of such rod.

F is a circular case, composed of the circular plates G, H, J, and M, the plate H being fitted to revolve inside of the rim or flange of plate G intermittently with the horizontal pin L, to which pin the plate H is rigidly attached. The plate H contains four chambers, K K K K, which, in the intermittent revolution of such plate, are successively brought into conjunction with and removed from the inner open end of the chamber A′. The rotating cylinder has its center of motion or axis below the cylinder A. By the devices hereinafter described each chamber K is successively charged with an explosive mixture of air and gas immediately before being carried to conjunction with the open inner end of the chamber A′, and such mixture is there ignited and discharged into the chamber A′ of the cylinder A and behind the piston C.

In Fig. 11 will be seen an enlarged view of the devices for feeding the air and gas in proper proportions into the chamber A′ preparatory to compression. As the piston C passes to the position of its extreme instroke, as shown in Fig. 3, air is drawn into the chamber A′ through the tube *h* and gas through the tube *g*. Such air and gas, by virtue of the suction from the piston C, raise the automatic valve *i* and pass together through the opening *j* into the chamber A′. Under the valve *i* is provided an annular recess or chamber, *g′*, which is an extension of the tube *g* and surrounds the tube *h*, and, with the latter, is closed and opened by the valve *i*. Thus both of the tubes *g* and *h* are opened and closed simultaneously and by but one valve. When the piston C has reached the end of its instroke, as shown in Fig. 3, the chamber A′ of the cylinder A is filled with a mixture of air and gas of ordinary density, and in such proportions as may be desired. A discharge then takes place against the opposite or inner end of the piston C from the contents of one of the chambers K previously charged. As the piston C passes to the end of its outstroke the mixture of air and gas in the chamber A′, as aforesaid, is forced out of such chamber through the opening *j* and through the upwardly-opening valve *k* into the tube *f*, and by means of the latter and through the outer-plate, G, into the chamber K under

the desired compression, such chamber K being the one to be next discharged. The extent of the compression will be governed by the proportionate capacity of the chamber A′ and that of the chamber K, supplemented by the communicating-tube *f*. The downwardly-closing valve *i* drops to its seat the instant the piston C reaches the end of its instroke, and is held closed by the force of expulsion during the passage through the valve *k* of the mixed air and gas from the chamber A′. After the mixture has been driven into the tube *f* and chamber K, as aforesaid, through the medium of the valve *k*, the latter closes and the piston C, on its return, opens the valve *i* to admit into the chamber A′ another quantum of proportioned gas and air. The relative proportion of the gas and air in such supply can be readily controlled by check-valves in the tubes *g* and *h*. There is one explosion to each revolution of the axle D, each explosion driving the piston C to its outward limit, and the momentum of the fly-wheel E returning such piston to the end of its instroke.

The rotating cylinder is rotated and the charges in the chambers K therein are successively fired as follows: The pin L passes loosely through the plates G, J, and M, while the rotating cylinder is rigidly attached to the pin L and revolves with it. A rod, *e*, is eccentrically connected to the axle D, and pivotally attached at its inner end to the arm 1 of the vertical rock-shaft W. (See Fig. 4.) The other arm, 2, of the rock-shaft W is pivotally attached at its outer end to the connecting-arm V. The inner end of the arm V is pivotally attached to an oscillating lever, P, which, on the outside of the plate G, is fitted around and oscillates upon the pin L. A ratchet-wheel, *w*, having ratchets *w′*, is rigidly affixed to the pin L.

A pawl, *t*, is so located on the lever P as to engage ratchets *w′*, and at each alternate action of the lever P to partially rotate the wheel *w*, and with it the pin L and rotating cylinder. The ratchets *w′* are placed at such intervals and the oscillation of the lever P is of such degree as to revolve the rotating cylinder one-fourth of a revolution at each upward action of the lever P, or, in other words, to remove one chamber K from conjunction with the chamber A′ in the cylinder A and bring the next succeeding chamber K into such conjunction in a position to be ignited.

In order to ignite the charge in the chamber K when the latter is rotated to a position in which it virtually forms a prolongation of the chamber A′, I make the following provision: To the outside of the plate G, and directly in the rear of the chamber K when the latter is in position to be discharged, I attach the casing 3, having transversely through it the hole 4. In the hole 4 plays the slide S, shaped to conform to such hole. The slide S is actuated longitudinally by the connecting-arm R, one end of which is fastened pivotally to the end of the slide S and the other end fastened in like manner to the upper end of the oscillating lever P. (See Fig. 4.) Thus each oscillation of the lever P gives one end movement to the slide S. In the center of the bottom of the casing 3 is a vertical port, 5, through which mixed gas and air are communicated to the hole 4 in such casing from a gas-bag, Z. The port 5 communicates, through a vertical port, 5′, in the bottom of the slide S, with a channel, 6, Fig. 10, made lengthwise in the center of the slide S, and which channel 6 communicates with the port 7, passing transversely through the slide S. (See Figs. 7, 8, 9, and 10.) At the outstroke of the slide S the port 7, which registers alternately at each end, communicates, through a transverse port, 8, in the outside of the casing 3, with an ordinary gas-jet, 9, and at the instroke of the slide S the other end of the port 7 communicates, through a transverse port, 10, on the inside of the casing 3, and through port 11 in plate G and port *a* in the back wall of the chambers K, with the charge in that one of the chambers K which is then in position for being ignited. The mixed gas and air is supplied to the bag Z by the pipe *l*, which communicates with the pipe *f* at 12. (See Fig. 1.) As the mixed air and gas in pipe *f* is under pressure, the amount, and therefore the pressure, of such mixture admitted to the bag Z is regulated by a check-valve, *m*, in the pipe *l*, Fig. 1. The mixed gas and air enters the channel 6 and port 7 in the slide S the instant such slide is at the end of its outstroke. Such mixture is there ignited by coming in contact with the gas-jet 9. (A wire-gauze or flame check at the intersection of the channel 6 and port 7 prevents the flame from passing into the gas-bag Z.) When the slide S has passed to the end of its instroke, the channel 6 and port 7, being meanwhile cut off from the ports 5 and 8, communicate, through the ports 10, 11, and *a*, with the mixture in the chamber K to be ignited, and the flame causes a discharge. By using the mixture of gas and air to carry the flame from the gas-jet 9 to the discharging-chamber K the flame is fed and kept by the oxygen in the mixture, though for a moment cut off from the outside atmosphere. The gas-jet 9 is placed in the chamber *o*, and a horizontal hole, *o′*, and vertical hole *o″* therein furnish air for such jet and means of lighting the same.

The mode of ignition which I have heretofore described is that exhibited in Figs. 9 and 10. In Figs. 7 and 8 is shown a manner of ignition somewhat different, and which consists in dispensing with the gas-jet 9, port 5, and channel 6, and in bringing the tube *l* from the bag Z to the same elevation as the port 8 in the casing 3, Fig. 1, and projecting a flame, 13, into the outer end of the transverse port 8 in the slide S. One or more pieces of platinum are suitably placed in the port 7, and are heated by the flame 13 at the outstroke of the slide S, and at the instroke of such slide ignite the charge in the chamber K through the medium of the gaseous mixture forced from the cham-

ber K into the ports 10, 11, and *a*. After each explosion the chamber K last discharged is revolved or removed from conjunction with the chamber A′ and to lineal communication with the opening N in plates M and J, and N′ in plate G, and thereby with the outer air. By this means each chamber K, after an explosion therein, is at once washed out and cooled off by fresh air, and little or no water is required. After each explosion the instroke of the piston C forces the burned gases out of the chamber A′ through the exhaust-port *n*. The exhaust-port *n* communicates with the outer air through the medium of the chamber *d*, in which is seated the inwardly-opening positive valve *d′*, Fig. 3. The valve *d′* is raised to permit the escape of the residuum of combustion by means of the stud *y′* on the horizontal rock-shaft *y*. The rock-shaft *y* is actuated by a short crank-connection with the rod y^2, which latter is eccentrically attached to the axle D.

The movement of the chambers K is so proportioned to that of the piston C that the chamber K to be discharged does not pass into conjunction with the chamber A′ until the piston C has cleaned out the burned gases and closed the port *n*. A water-jacket, *b b b*, surrounds (more or less) the chambers K and A′, the water having ingress at 14 and egress at 15.

The parts constituting the case F are held together by threaded bolts 16, as shown, and the case F is affixed to the cylinder A by means of horizontal bolts passing through flanges on the latter or in any suitable manner.

One difficulty heretofore experienced in the use of gas-engines has been the expansion of parts consequent upon the heat generated by the explosion. I obviate this by providing an annular recess, 19, outside of the chambers K to permit lateral expansion of such chambers. Between the plate J and the front face of the chambers K there is further provided a transverse space, 20, to permit the expansion lengthwise of the chambers K.

To prevent the escape of the mixture into the last-named space prior to explosion, I place the thin plate M (represented by the dotted line in Fig. 6) on the pin L and directly in front of the chambers K. The plate M has the opening 21 therein for the passage into chamber A of the gases resulting from explosion. The plate M does not fill the space 20, but is held from rotating by dowel-pins 22, seated in the plate M and the adjacent face of the plate J. The plate M is held adjustably against the face of the chambers K by means of spiral springs 23 on the dowel-pins 22. By this means the springs 23 yield to any necessary lineal expansion of the chambers K, and yet hold the plate M with sufficient force against the faces of the chambers K to prevent the escape of the contents of the latter until in readiness for ignition.

To prevent the explosion from forcing the gaseous mixture into the space 20, and thus impeding the action of the plate H, I provide a ring, 24, having an opening to correspond to the opening 21 in the plate M, and place such ring in the recess 25 on the inner face of the plate J and immediately in front of said opening 21. The outer wall of the recess 25 slopes from the side of the ring 24, forming an annular space around the outside of such ring, into which space the explosive material forces itself and presses the ring 24 against the outer face of the plate M, thus effectually closing the space 20 around the opening 21. By my invention I attain an explosion at each revolution of the axle D, and at each outstroke of the piston C, I economize space and material, and procure a regular and certain action. By the instroke of the piston C the residuum of combustion is certainly and entirely expelled.

The number of chambers K may be increased or diminished by changing correspondingly the movement of the rotating cylinder.

I do not limit myself to the mode precisely as shown of transferring the chambers K to and from conjunction with the chamber A′ in the cylinder A, for it is obvious that such chambers may be moved to and fro by an oscillating or reciprocal action, and such chambers K might be seated in the periphery of a wheel having its axis perpendicular to the cylinder A, and by the revolution of such wheel such chambers K be brought successively into conjunction with the chamber A′; but the distinguishing feature of my invention is filling a chamber with compressed mixture, transferring such chamber while thus filled into conjunction with the chamber A′, and removing the chamber first named after its contents are exploded.

The usual governor and adjustable valve can be affixed to the pipe *f* to regulate the speed.

A supplementary cylinder and piston may be used for drawing in the air and gas and charging the chambers K, in which case the outer end of the cylinder A could be left open.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. In a gas-engine, one or more rotating explosion-chambers, K, in combination with the cylinder A and piston C, substantially as shown, and for the purpose described.

2. The combination, in a gas-engine, of a cylinder, A, piston C, and one or more rotating explosion-chambers, K, and the communicating-tube *f*, whereby a charge drawn in on one side of such piston is compressed, transferred to and exploded at the opposite side of such piston, substantially as shown, and for the purpose specified.

3. In a gas-engine, in combination with the cylinder A and piston C, rotating cylinder H, having one or more exploding-chambers, K, for receiving the explosive charge, and a plate, M, in front of such chambers, substantially as shown, and for the purpose set forth.

4. In a gas-engine, the combination of the piston C, one or more rotating chambers, K, plate M, tube *f*, and the cylinder A, provided with inlet and exhaust ports, as shown, where-

by the charge of gas and air is drawn in on one side of such piston and transferred to the opposite side thereof by the alternate action of said piston C, substantially as shown, and for the purpose described.

5. In a gas-engine, the cylinder A, having suitable inlet and exhaust ports, as shown, in combination with one or more rotating exploding or discharging chambers, K, the communicating-tube *f*, and piston C, such inlet and exhaust ports being so located that the indrawing of the mixed gas and air into such cylinder shall be coincident with the expulsions from such cylinder of the residuum of the next previous combustion, substantially as shown, and for the purpose described.

6. In combination with a cylinder, A, having chamber A′, the piston C, rotating cylinder H, provided with chambers K, and a plate, M, having openings N and 21, whereby the front face of such chambers K is sealed except at times of explosion and cleansing, substantially as shown, and for the purpose specified.

7. In a gas-engine, one or more chambers, K, so arranged as to be loaded with a compressed explosive mixture and brought in conjunction with the chamber A′ and withdrawn therefrom, substantially as shown, and for the purpose mentioned.

8. In a gas-engine, the combination and arrangement of the inlet-pipes *g* and *h*, the cylinder A. the piston C, the tube *f*, and chamber K, whereby gas and air, at one action of such piston, are drawn into said cylinder A, and at the reverse action of such piston compressed into the chamber K through the medium of said tube *f*, substantially as shown, and for the purpose described.

9. In combination with the rotating cylinder H, the cylinder A, the piston C, axle D, rod *e*, rock-shaft W, oscillating lever P, provided with the pawl *t*, pin L, having the ratchet-wheel *w*, the inlet-tubes *g* and *h*, and communicating-tube *f*, whereby at each revolution of the axle D there is alternately drawn into the cylinder A a mixture of air and gas, and such mixture compressed in one of the chambers K, and the latter brought in conjunction with the chamber A′ in the cylinder A and removed therefrom at each alternate stroke of said piston, substantially as shown, and for the purpose specified.

10. In a gas-engine, the cylinder A, piston C, axle D, rotating cylinder H, and interposed mechanism between said axle and cylinder, as shown, in combination, whereby the chambers K in such cylinder H are successively charged with the compressed mixture and brought in conjunction with the chamber A′ in the cylinder A and removed therefrom, substantially as shown, and for the purpose mentioned.

11. In a gas-engine, the rotating cylinder H, containing the chambers K, the pin L, the plate M, provided with the openings N and 21, the plate G, having opening N′, and the mechanism shown for revolving such pin, in combination, whereby the chambers K are closed while loaded, then rotated into conjunction with the chamber A′, and after the explosion brought into communication with the outer air, substantially as shown, and for the purpose specified.

12. In a gas-engine, the reciprocating slide S, provided with the transverse port 7, which registers alternately at each end, and the channel 6 and vertical port 5, substantially as shown, and for the purpose mentioned.

13. In a gas-engine, the casing 3, having the hole 4, vertical port 5, and lateral ports 8 and 10, substantially as shown, and for the purpose described.

14. The combination of the casing 3, provided with the hole 4, vertical port 5, and lateral ports 8 and 10, and the reciprocating slide S, provided with the vertical port 5′, the channel 6, and the duplex registering-port 7, substantially as shown, and for the purpose herein named.

15. In a gas-engine, the wheel E, the axle D, the cylinder A, provided with the exhaust-port *n* and inlet *j*, the piston C, removable chambers K, mechanism shown for revolving such chambers, inlet-tubes *g* and *h*, and the communicating-tube *f*, in combination, whereby the momentum caused by the explosion is employed to expel the burned gases and draw into the cylinder A a fresh charge of the gaseous mixture, while each outward stroke of such piston compresses a charge of such mixture in each succeeding chamber K, substantially as shown, and for the purpose described.

16. In a gas-engine, the casing 3, provided with the hole 4, vertical port 5′, and lateral ports 8 and 10, the slide S, provided with the vertical port 5, channel 6, and transverse port 7, and removable chambers K, having the firing-port *a*, in combination, substantially as shown, and for the purpose mentioned.

17. In a gas-engine, the combination of a movable chamber, K, to receive a compressed charge of explosive gaseous mixture and transfer the same so compressed to a motor-cylinder, and a cylinder and piston to charge such chamber with said mixture, in the manner substantially as shown, and for the purpose mentioned.

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

JOHN CHARTER.

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JOHN W. ALEXANDER.