(No Model.) 6 Sheets—Sheet 1.

J. SPIEL.

GAS ENGINE.

No. 302,045. Patented July 15, 1884.

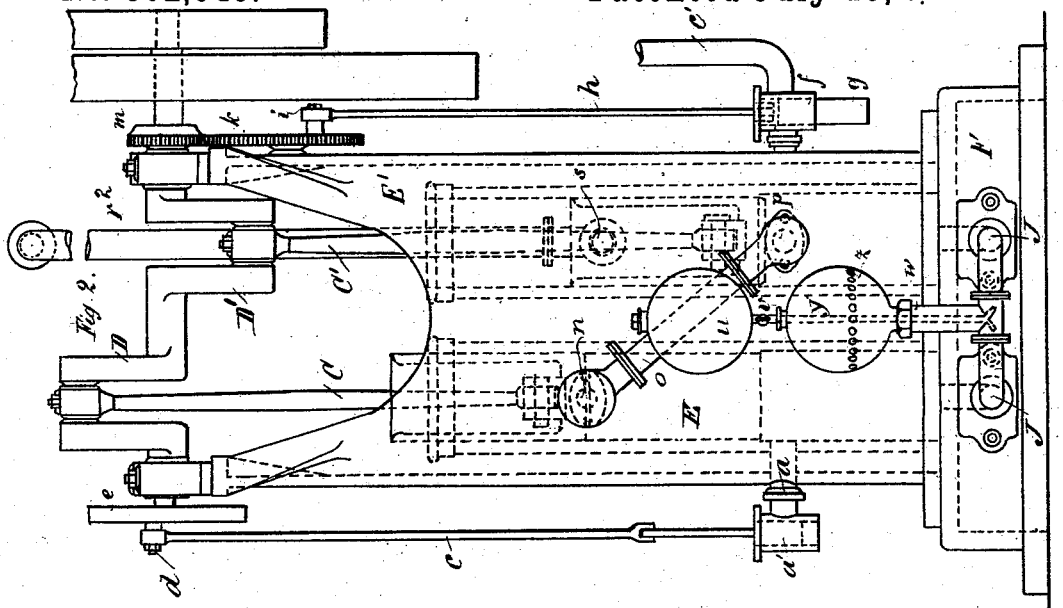


Fig. 2.

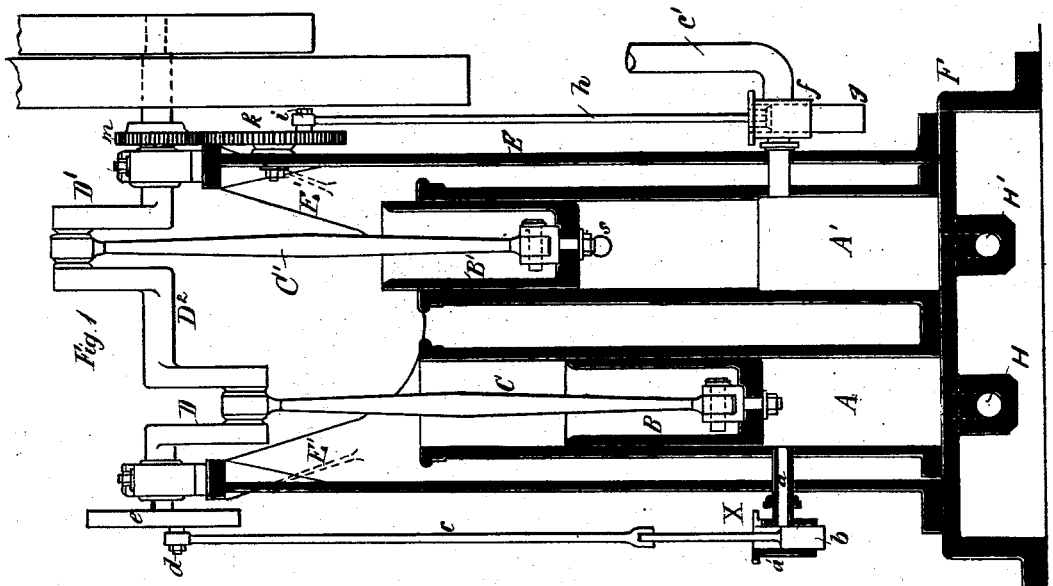


Fig. 1.

Witnesses:
Thos. G. Wootten
C. Sedgwick

Inventor:
J. Spiel
By Munn & Co
Attys.

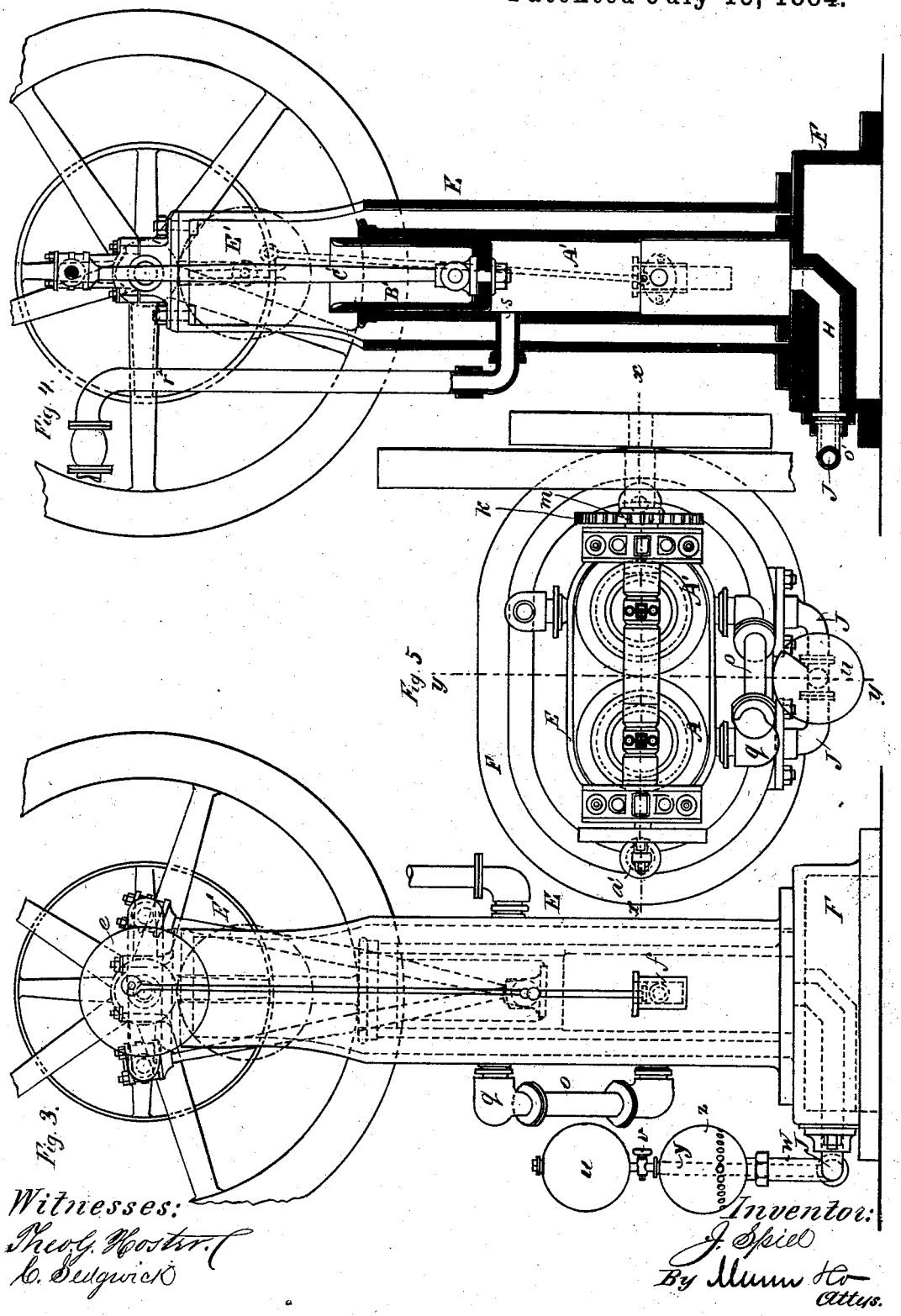
(No Model.)

6 Sheets—Sheet 2.

J. SPIEL.

GAS ENGINE.

No. 302,045. Patented July 15, 1884.



Witnesses:
Theo. G. Hoster.
C. Sedgwick

Inventor:
J. Spiel
By Munn & Co
Attys.

(No Model.) 6 Sheets—Sheet 3.

J. SPIEL.

GAS ENGINE.

No. 302,045. Patented July 15, 1884.

Fig. 6.

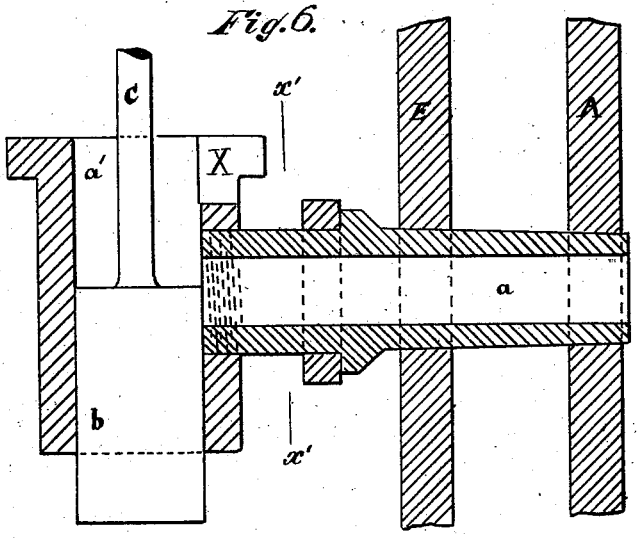


Fig. 7.

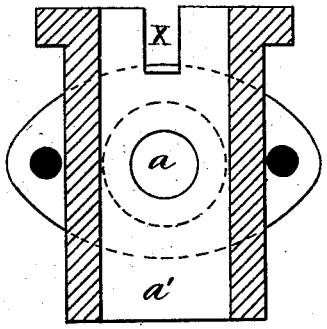


Fig. 8.

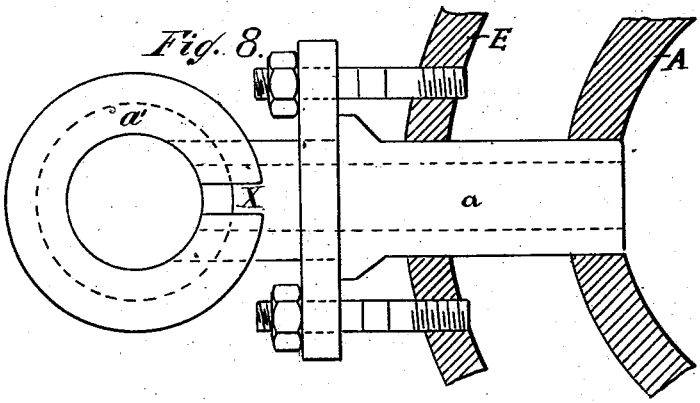


Fig. 10.

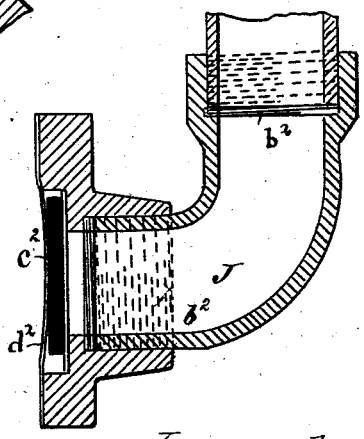
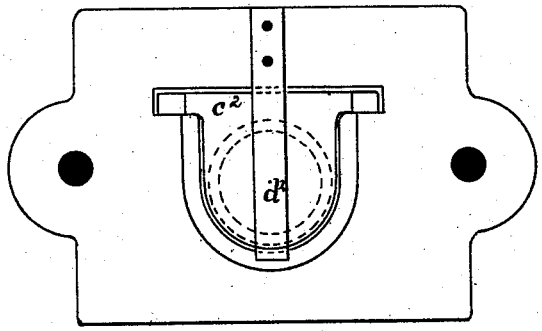


Fig. 9.



Witnesses.
Theo. G. Hoster
C. Sedgwick

Inventor:
J. Spiel
By Munn & Co
Attys.

(No Model.) 6 Sheets—Sheet 4.

J. SPIEL.

GAS ENGINE.

No. 302,045. Patented July 15, 1884.

Fig. 11.

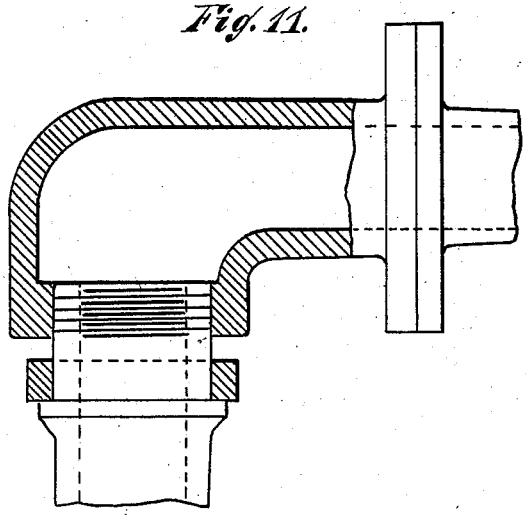


Fig. 14.

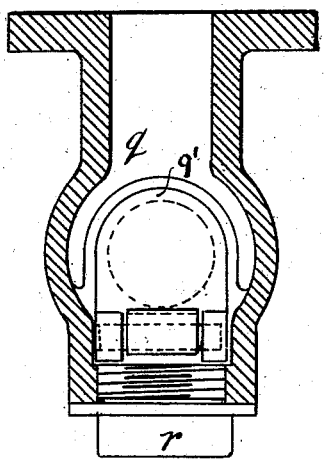


Fig. 12.

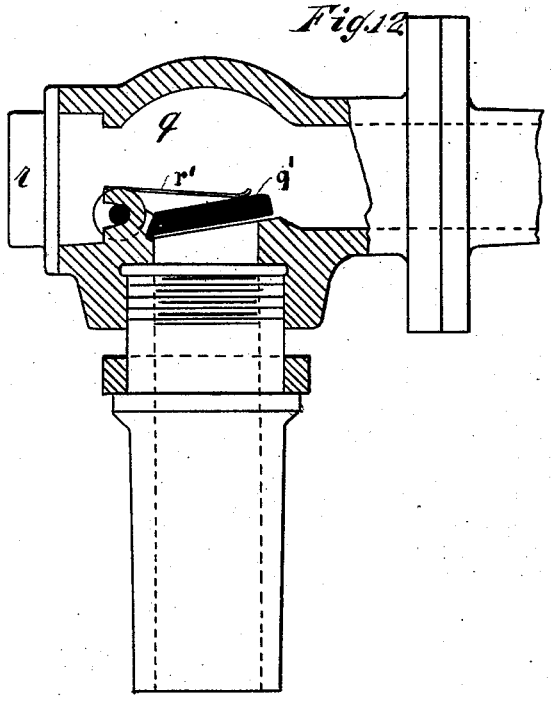
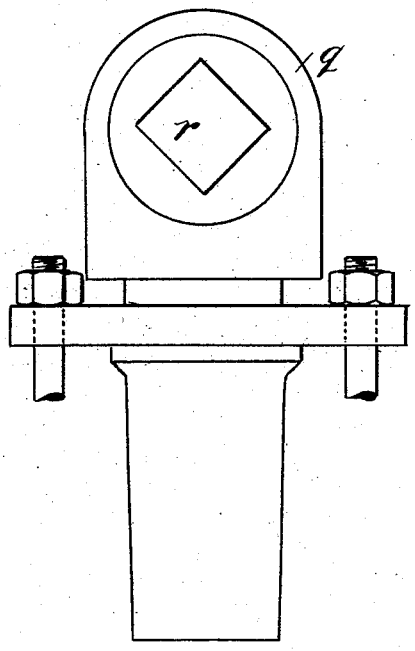


Fig. 13.



Witnesses:
Theo. G. Hoster
C. Sedgwick

Inventor
J. Spiel
By Munn & Co
Attys.

(No Model.) 6 Sheets—Sheet 5.

J. SPIEL.

GAS ENGINE.

No. 302,045. Patented July 15, 1884.

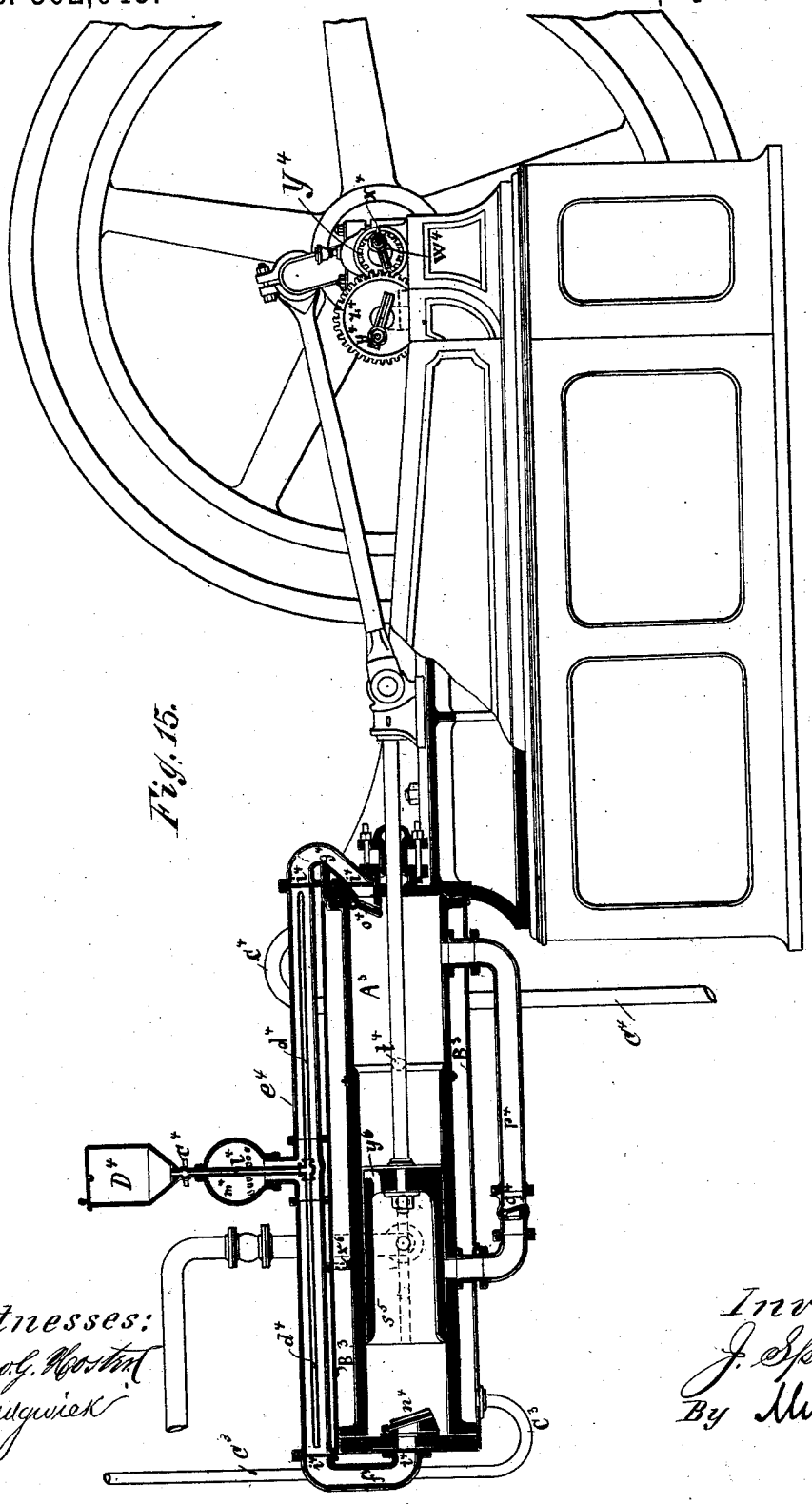


Fig. 15.

Witnesses:
Theo. G. Hoster
C. Sedgwick

Inventor:
J. Spiel
By Munn & Co
Attys.

(No Model.) 6 Sheets—Sheet 6.

J. SPIEL.

GAS ENGINE.

No. 302,045. Patented July 15, 1884.

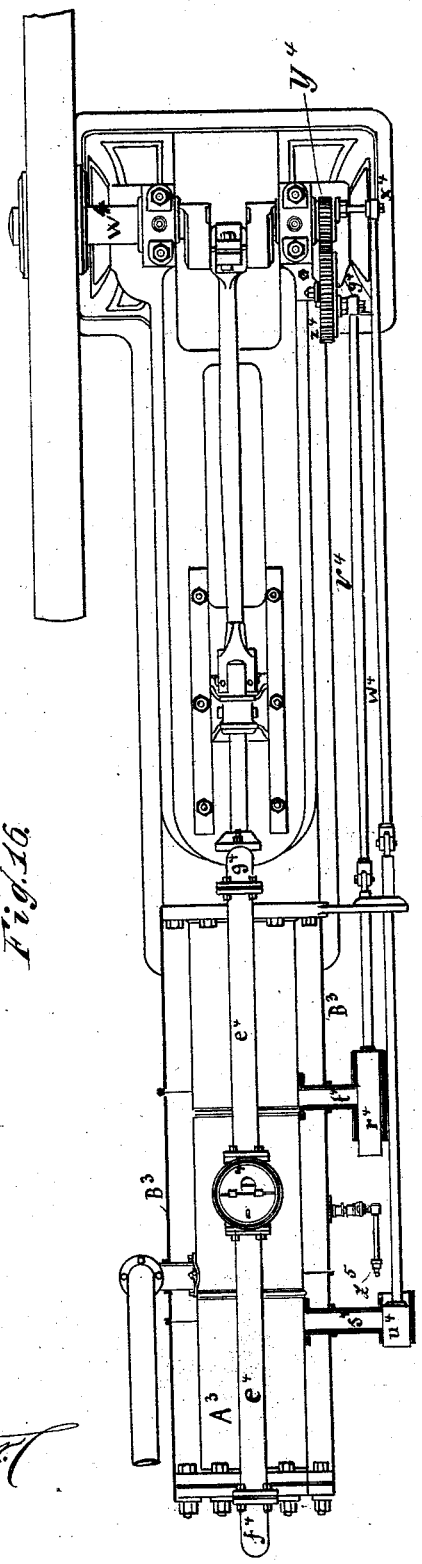


Fig. 16.

Witnesses:
Theo. G. Hoster
C. Seligmick

Inventor:
J. Spiel
By Munn & Co
Attys.

UNITED STATES PATENT OFFICE.

JOHANNES SPIEL, OF BERLIN, GERMANY.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 302,045, dated July 15, 1884.

Application filed November 1, 1881. (No model.) Patented in England September 30, 1881, No. 4,244; in Belgium October 31, 1881, No. 56,031; in France November 9, 1881, No. 145,156; in Germany March 10, 1883, No. 20,953, and in Austria-Hungary December 16, 1883, No. 31,600 and No. 46,090.

To all whom it may concern:

Be it known that I, JOHANNES SPIEL, of Berlin, Germany, have invented a new and Improved Gas-Engine, of which the following is a full, clear, and exact description.

The object of my invention is to provide a new and improved engine which can be operated by gas, petroleum, or other hydrocarbon vapors or spray, in combination with steam or without steam.

The invention consists in a gas-engine provided with two explosion-chambers which are united by a tube, so that after the explosion in one cylinder or chamber the burning gases will ignite the gases in the other cylinder or chamber automatically. The gases used may be a mixture of air and coal-gas, or air and hydrocarbon spray or vapor, which is formed by condensing air and petroleum or some other hydrocarbon through tubes containing fine wire sieves or bunches of wire.

The invention further consists in a perforated metal ball arranged in the bottom of each cylinder, and connected with a water-pipe for condensing water into these balls, which water is converted into steam by coming in contact with the heated ball, this steam assisting in driving the engine.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a longitudinal sectional elevation of my improved gas-engine on the line *x x*, Fig. 5. Fig. 2 is a front elevation of the same. Fig. 3 is a longitudinal or side elevation of the same. Fig. 4 is a cross-sectional elevation of the same on the line *y y*, Fig. 5. Fig. 5 is a plan view of the same. Fig. 6 is a longitudinal sectional elevation of the piston for forming an opening to admit the flame. Fig. 7 is a cross-sectional elevation of the same on the line *x' x'*, Fig. 6. Fig. 8 is a plan view of the same. Fig. 9 is an elevation of the inner end of the gas or vapor feed pipe. Fig. 10 is a longitudinal sectional elevation of the same. Fig. 11 is a longitudinal sectional elevation of the elbow of the pipe connecting the two cylinders. Fig. 12 is a longitudinal elevation of the exhaust pipe and valve of one of the cylinders. Fig. 13 is an end elevation of the same. Fig. 14 is a cross-sectional elevation of the same. Fig. 15 is a longitudinal sectional elevation of a single-cylinder double-acting engine of my improved construction. Fig. 16 is a plan view of the same.

I will first describe the double-cylinder engine shown in Figs. 1 to 14, inclusive. This engine is constructed with two vertical cylinders, A A', in which the plungers B B' fit, respectively, to which plungers the connecting-rods C C' are pivoted, the upper ends of these connecting-rods being pivoted to the cranks D D' of the crank-shaft D^2, which cranks project in opposite directions. The cylinders A A' must be cooled continually, and for this purpose are contained in a water-tank, E, which is provided with vertical extensions E', having sufficient strength to carry the bearings of the shaft D^2. The cylinders A A' and the tank E rest on a base, F, which is the foundation for the entire engine or machine, and contains the pipes and tubes for conducting the gases and vapors to the cylinders.

The tube *a* is secured in the walls of the cylinder A and of the tank E with perfectly water-tight joints, and serves to conduct the igniting-flame located at X into the cylinder A, to ignite the mixture of explosive gases. In the vertical open cylinder *a'*, connected with the tube, a piston, *b*, fits, which is connected by a rod, *c*, with an eccentric-pin, *d*, on a disk, *e*, mounted on the shaft D^2.

The cylinder A' is provided with a like small cylinder, *f*, in which a long piston, *g*, is moved up and down by a connecting-rod, *h*, journaled on the eccentric-pintle *i* of a cog-wheel, *k*, which engages with a smaller cog-wheel, *m*, rigidly mounted on the shaft D^2. The proportion of the wheel *m* to the wheel *k* is as one to two or three to four—that is, the piston or plunger *g* makes one stroke for every two or more revolutions of the shaft D^2.

The cylinder A is provided with a very narrow opening or slot, *n*, which is so located that it will only be opened when the plunger B is at its highest position. In all its other posi-

tions the plunger closes the opening or slot *n*, which is connected by the pipe *o* with a like opening, *p*, of the cylinder A′. This opening or slot *p* is located below the lowest point the plunger B′ reaches, so that this opening or slot can never be closed by the plunger. The pipe *o* is provided at its upper end—that is, at the end connected with the cylinder A—with a valve-box, *q*, closed by a plug, *r*, as seen in Figs. 13 and 14, and containing a valve, *q′*, opening from the cylinder, and pressed on its seat by a spring, *r′*, or held on its seat by its own weight. The gases of explosion of the cylinder A′ pass off through the opening *s*, which is only opened by the plunger B′ when this plunger is in its highest possible position. (See Figs. 1 and 4.) From this opening the waste gases pass into a pipe, r^2.

The petroleum-vapor or other hydrocarbon vapor is obtained in the following manner: The petroleum is filled into the metal vessel *u*, and flows through the pipe *y* into the pipe W, which terminates in the channels H H′ in the base-plate F. The ball Z, provided with numerous perforations, permits air to enter and to mix with the petroleum-vapor in the tube W, thereby forming an explosive mixture, so that the petroleum or other hydrocarbon will be very finely divided. The knee-pieces or elbows J are provided with or contain a number of fine sieves, b^2, Fig. 10, which cause the petroleum to be distributed or spread on a very large surface. If desired, the knees or elbows J may be completely filled with sieves b^2, or with twisted and knotted fine wire, all for the purpose of forming most minute particles of petroleum—that is, petroleum vapor or spray. The knees or elbows J are each provided at their inner ends with a valve, c^2, which is held in a closed position by its own weight or by a spring, d^2, for the purpose of preventing a back-pressure by the gases of explosion.

For the purpose of carrying off all gases of explosion that might accidentally escape at the small cylinders *a′* and *f*, these cylinders can be provided with a waste-gas tube, *c′;* but in most cases these will not be required.

The operation is as follows: If the several parts of the engine are in the position shown in Fig. 1, and if the space in the cylinder A, under the piston B, is filled with a mixture of gas and air, or petroleum-vapor and air, the igniting-flame (at X) will pass through the tube *a* and ignite the mixture of gases in the cylinder A, causing an explosion. The opening through which the igniting-flame passes into the cylinder A is immediately closed by the piston *b*. When the plunger B has arrived at its highest position, the flame passes through the opening or slot *n*, passes the valve-box *q*, and, passing through the pipe *o* and the opening *p*, ignites the gases in the cylinder A′, causing an explosion. When the plunger B has reached its highest position, the gases of explosion pass off through the opening *s* and the pipe r^2, and so on. To start the engine, the fly-wheel is rotated several times, so that the plungers B B′ will create a vacuum, and will draw the mixture of explosive gases into the cylinders. The gas in the cylinder A explodes first, the shaft D^2 makes half a revolution, and then the gases in the cylinder A′ explode. It is evident that the explosions can only take place after every second, respectively, third, or fourth revolution of the shaft D^2, as otherwise there would not be sufficient time for the cylinders to be filled with explosive gases. The plunger or piston *g* is so arranged in relation to the shaft D^2 that it will make but one stroke to every two or three revolutions of the shaft D^2. The explosive gases will thus be compressed by the descending plungers B B′, for the piston or plunger *g* keeps the side opening closed, and at the same time prevents the fresh explosive gases that enter the cylinders from being forced out again. The compressed gases explode with much greater power than liberated gases, and the remaining gases or products of explosion will be forced out through the small openings which the pistons *b* and *g* form (at the ends of the pipes leading from the cylinders) during their strokes.

In Figs. 15 and 16 a horizontal machine or engine is shown, constructed on the principle described above; but instead of using two cylinders I have one double-acting cylinder. The cylinder A^3 is made of cast-iron and surrounded by a shell, B^3, in which the water for cooling it circulates. The cooling-water enters through the pipe C^3, and passes off through the pipe C^4. The petroleum (or other hydrocarbon) is filled into the vessel D^4, and flows through the cock c^4 into the tube d^4, which is provided with numerous fine perforations, and is contained in a larger tube, e^4, connected by the pipes f^4 g^4 with the ends of the cylinder A^3. These pipes f^4 g^4 contain a number of very fine wire sieves, i^4, which subdivide the petroleum, and mix it with the air entering through perforations in the ball l^4. To prevent the back-pressure of the explosion, I have provided the check-valves n^4 o^4. A pipe, p^4, with a valve, q^4, unites the two explosion-chambers of the cylinder A^3 in such a manner that the exploding gases can pass from one chamber to the other and ignite the gases in the second chamber.

On the cylinder A^3 there are two smaller cylinders, s^4 t^4, containing the plungers or pistons u^4 r^4, connected by the connecting-rods w^4 v^4 with the eccentric-pintles x^4 y^4, respectively. The pintle x^4 is on a cog-wheel, Y^4, rigidly mounted on the main crank-shaft W^4, and engaging with a cog-wheel, z^4, on which the pintle y^4 is fastened. The proportion of the wheel Y^4 to the wheel z^4 is as one is to two.

The igniting-flame Z^5 is arranged near the upper edge of the plunger S^5 and operates in the same manner as the igniting-flame described with the two-cylinder machine. The explo-

sion first takes place in the left-hand chamber; then the ignited or exploded gases pass into the right-hand chamber and ignite the gases there. The gases in the left-hand chamber can be ignited by a flame arranged at x^6, at which point there is an opening in the cylinder A^3. The plunger S^5 is provided with an opening, y^6, and when the openings x^6 and y^6 coincide the flame passes through them and ignites the gases.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A gas-engine constructed, substantially as herein shown and described, with two explosion-chambers connected by a suitable tube in such a manner that the burning or exploding gases in one chamber can ignite the gases in the other chamber, as set forth.

2. In a gas-engine, the combination, with two explosion-chambers, of a channel for uniting them and a single flame for igniting the gas in one of the chambers, substantially as shown and described, and for the purpose set forth.

3. In a gas-engine, the combination, with the cylinders A A′, provided with the apertures or slots *n p*, of the tube *o*, uniting the two cylinders, substantially as herein shown and described, and for the purpose set forth.

4. In a gas-engine, the combination, with the cylinders A A′, provided with the apertures or slots *n* and *p*, of the tube *o*, the valve-chamber *q*, and the valve *q′*, substantially as herein shown and described, and for the purpose set forth.

5. In a gas-engine, the combination, with the cylinders A A′, provided with the slots or apertures *n p*, of the tube *o*, the tube *a*, having a flame at X, the small cylinder *a′*, and the plunger or piston *b*, fitting therein, substantially as herein shown and described, and for the purpose set forth.

6. In a gas-engine, the combination, with the cylinders A A′, provided with the apertures or slots *n* and *p*, of the tube *o*, the tube *a*, having a flame at X, the cylinder *a′*, the plunger *b*, fitting therein, the cylinder *f*, and the plunger *g*, fitting therein, substantially as herein shown and described, and for the purpose set forth.

7. In a gas-engine, the combination, with the cylinders A A′, the pistons B B′, the connecting-rods C C′, and the crank-shaft D^2, of the tube *o*, the small cylinders *a′* and *f*, the pistons or plungers *b* and *g*, the connecting-rods *c* and *h*, the disk *e* on the shaft D^2, the cog-wheel *m* on the shaft D^2, and the cog-wheel *k*, engaging with the cog-wheel *m*, substantially as herein shown and described, and for the purpose set forth.

8. In a gas-engine, the combination, with the explosion-chambers, of a tank or vessel for receiving petroleum or other hydrocarbon, a perforated vessel below it for mixing the petroleum with air, and of tubes containing fine sieves or bunches of wire for converting the petroleum into vapor and conducting the gas or vapor and the air mixed therewith into the explosion-chambers, substantially as herein shown and described, and for the purpose set forth.

9. In a gas-engine, the combination, with the cylinders A A′, of the petroleum-receiving vessel *u*, the perforated vessel *z*, and the pipes J J, leading to the cylinders, substantially as herein shown and described, and for the purpose set forth.

10. In a gas-engine, the combination, with the cylinders A A′, of the petroleum-receiving vessel *u*, the perforated vessel *z*, the pipes J, containing fine sieves b^2, and provided with check-valves c^2, substantially as herein shown and described, and for the purpose set forth.

11. In a gas-engine, the combination, with the cylinders A A′ and the vessel *u*, connected to the former by the pipes *y* and W and channels H H′, of the serially-apertured chambers *h h′* and pipes *i i′*, whereby the products of explosion are assisted in driving the plungers, as set forth.

JOHANNES SPIEL.

Witnesses:
HUGO WILOP,
OSCAR MÜLLER.