No. 652,539. Patented June 26, 1900.

W. W. GERBER.

GAS ENGINE.

(Application filed June 29, 1899.)

(No Model.)

2 Sheets—Sheet 1.

FIG. 1.

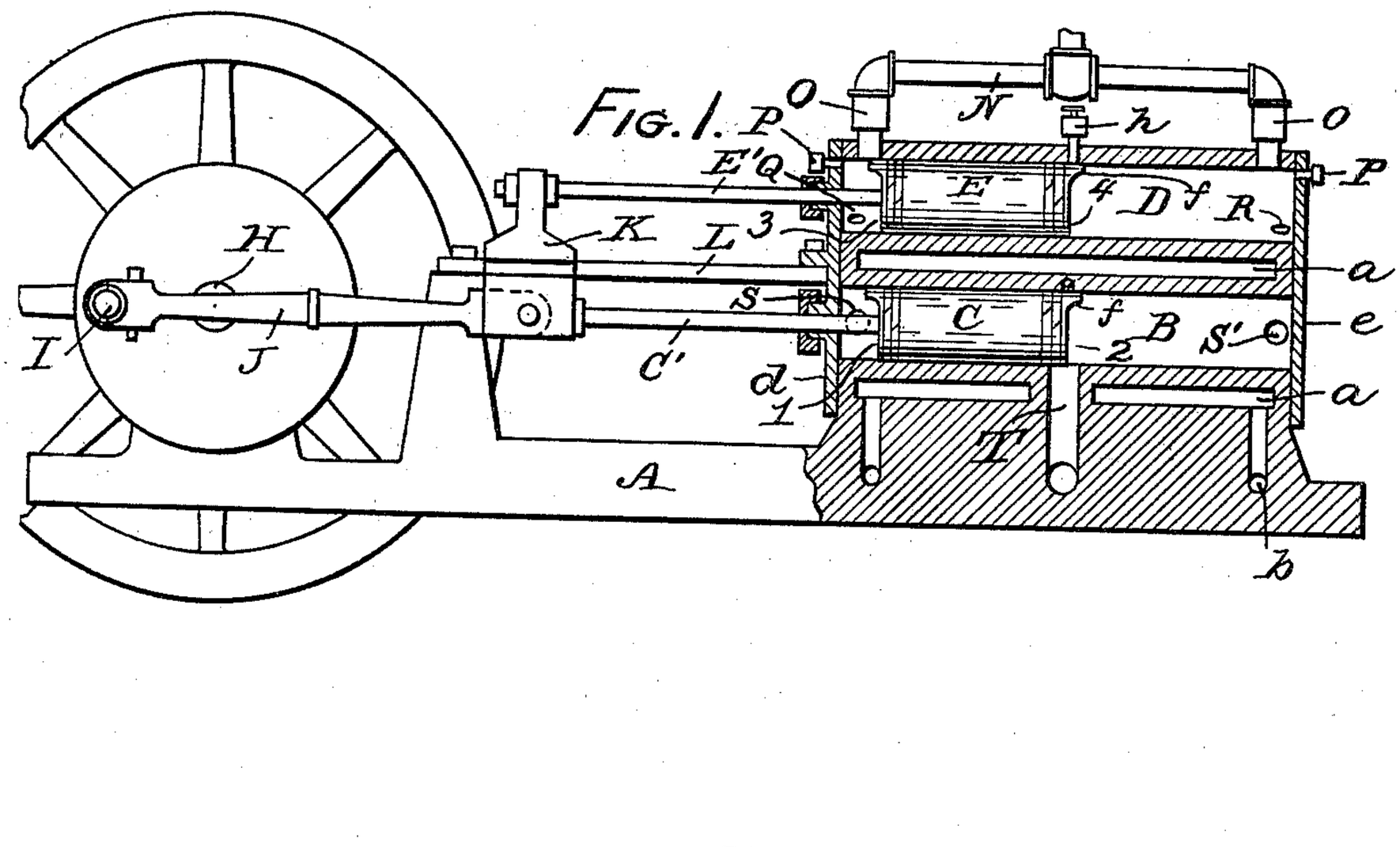


FIG. 2.

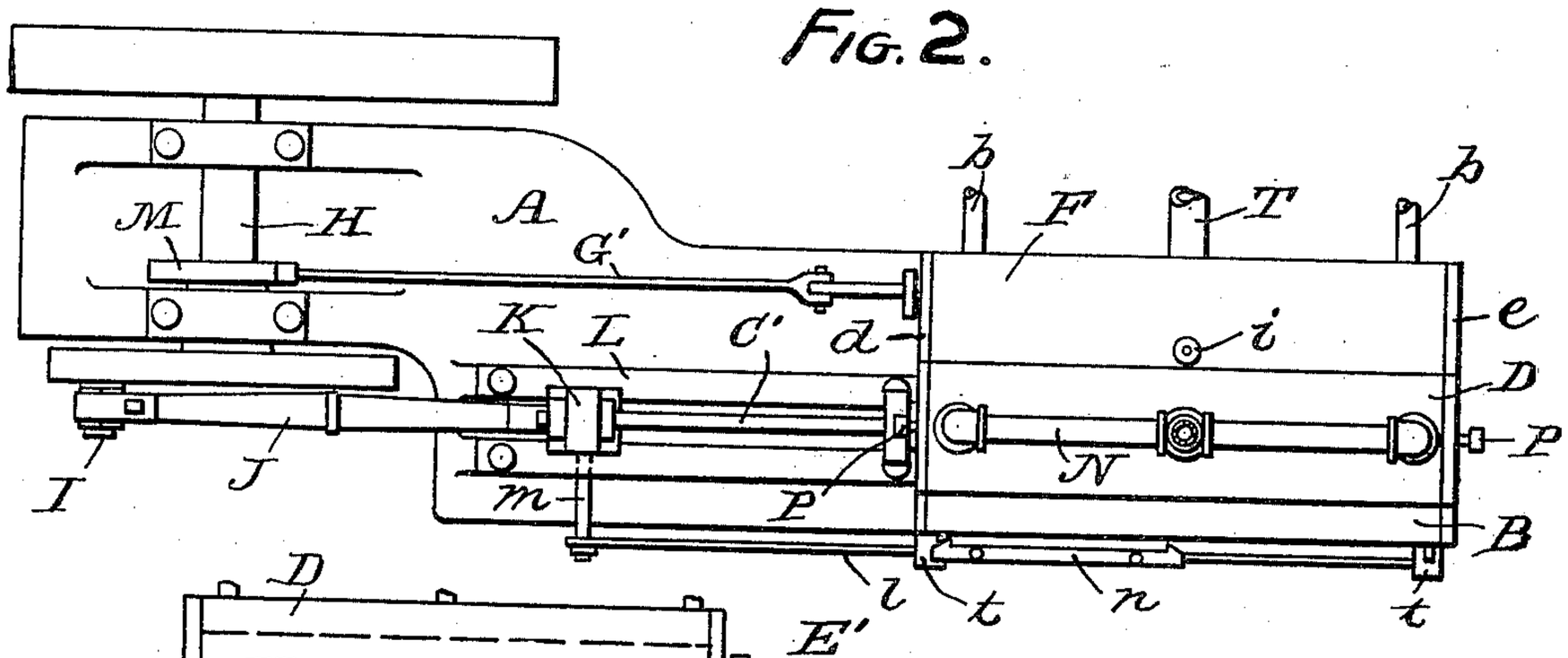
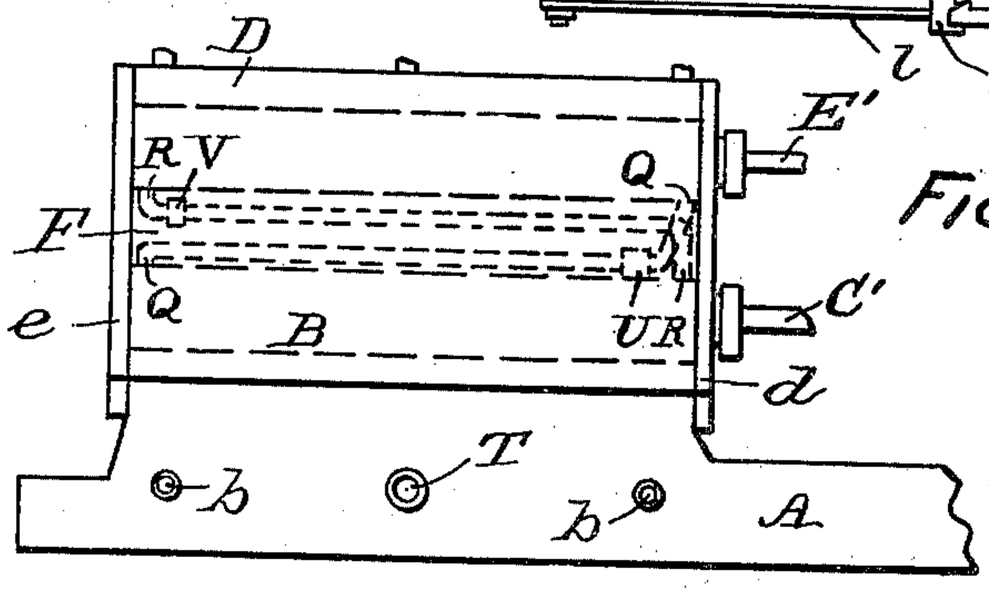


FIG. 3.



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(No Model.) 2 Sheets—Sheet 2.

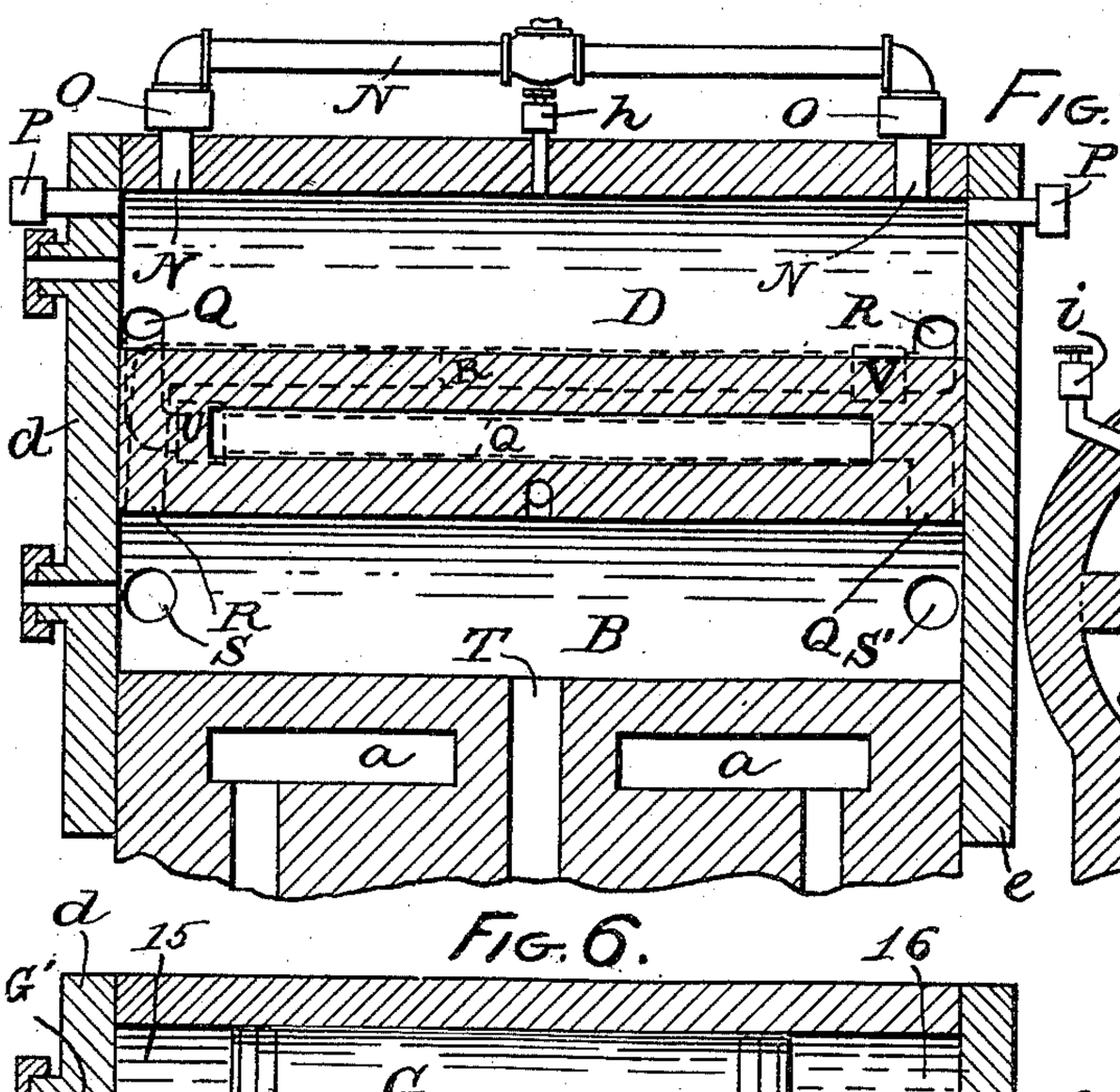


FIG. 4.

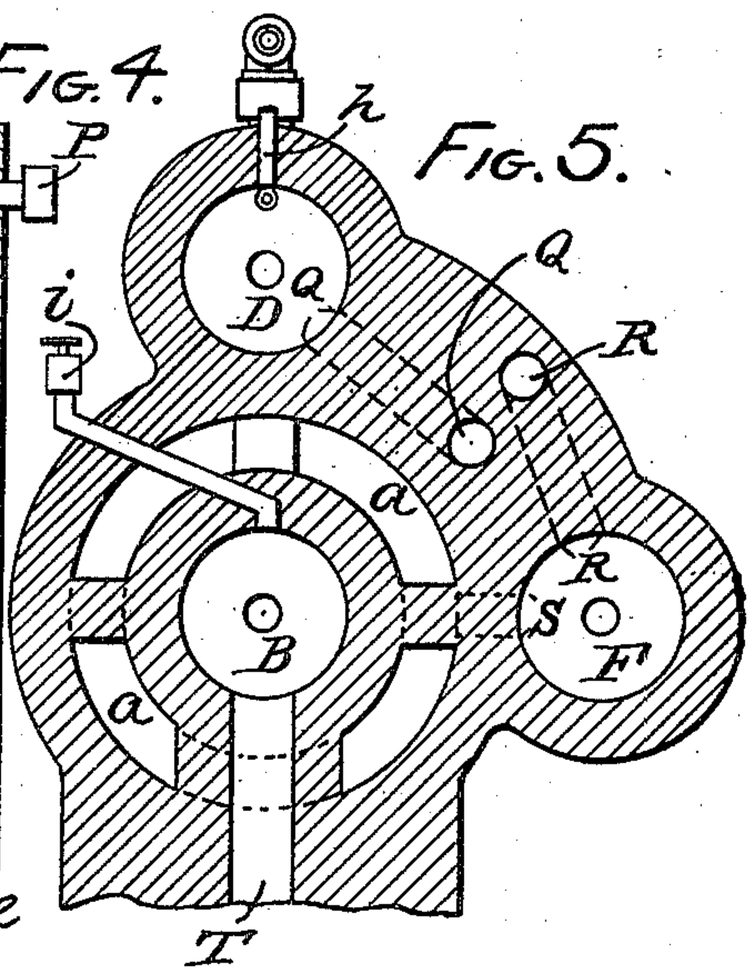


FIG. 5.

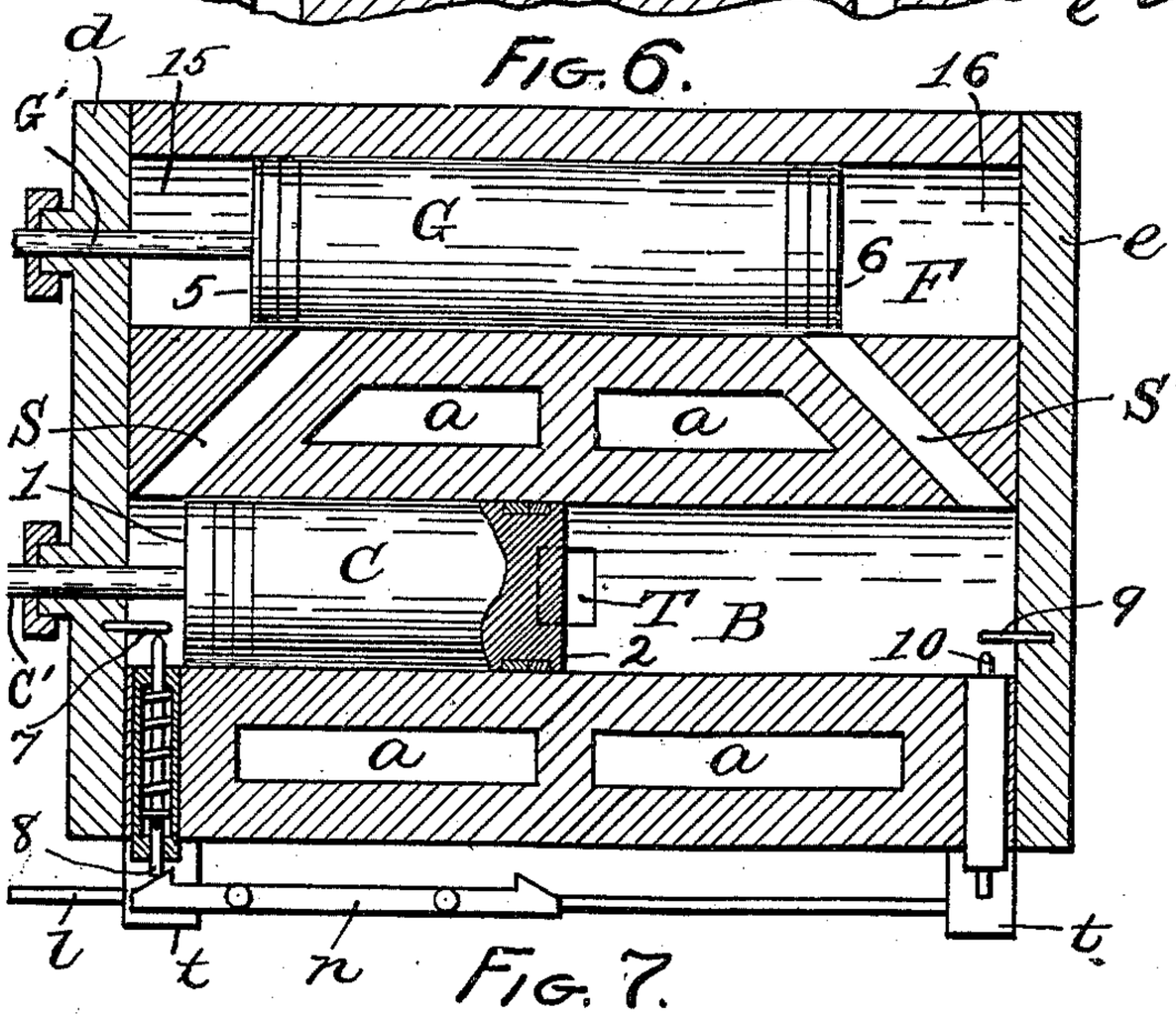


FIG. 6.

FIG. 7.

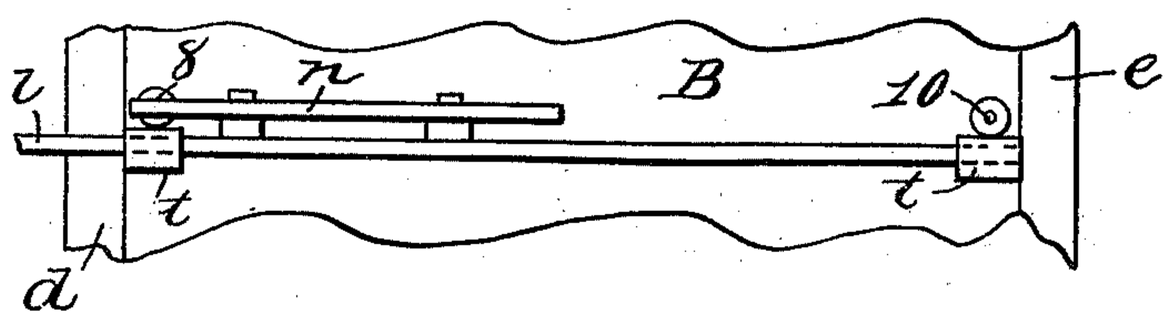
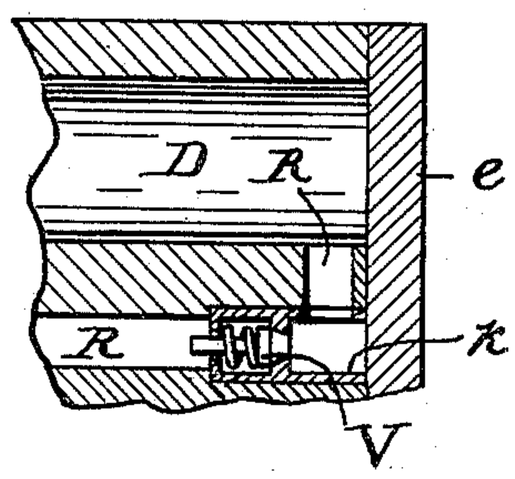


FIG. 8.



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UNITED STATES PATENT OFFICE.

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GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 652,539, dated June 26, 1900.

Application filed June 29, 1899. Serial No. 722,223. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. GERBER, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Gas-Engines; and I do 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 the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to explosive-engines of the type commonly known as "gas-engines," and has reference more particularly to the cylinder and allied elements thereof; and it consists in an explosion-cylinder having a head at each end, a double-acting piston working in the cylinder, a combined mixing and compression cylinder and piston, an admission-valve and chest, and an igniter mechanism operated by the cross-head or its equivalent, all of new and novel form; and the invention consists, further, in the parts and combination and arrangement of parts particularly described hereinafter and pointed out in the claims.

My objects are to provide, first, an engine that shall employ gas economically; second, an engine of simple construction; third, a gas-engine in which the intricate mechanism commonly employed in construction, which is liable to derangement and excessive wear, is eliminated, and, fourth, an improved device whereby the mixture of the gas and air is most effectively accomplished. These objects are fully attained in my invention illustrated in the accompanying drawings, in which similar letters and numerals of reference designate similar parts throughout the several figures.

Referring to the drawings, Figure 1 represents a side elevation of an engine in which the cylinder elements conforming to my invention are shown in a central vertical sectional view; Fig. 2, a top plan view of such an engine; Fig. 3, a side elevation of the cylinder-casting to illustrate the course of the ports between the compression-cylinder and the valve-chamber; Fig. 4, a central vertical sectional view through the main cylinder and compression-cylinder; Fig. 5, a transverse vertical central sectional view taken through the cylinders and valve-chamber; Fig. 6, a central horizontal sectional view taken through the main cylinder and valve-chamber; Fig. 7, a side elevation of a fragment of the main cylinder, showing the circuit-breakers for the igniters; and Fig. 8, a fragmentary sectional view showing a type of check-valve which may be employed.

In practically carrying out my invention I may employ various styles of bed-plate or base A to support the various parts, and the cylinders and valve chamber or chest may be cast either together with the base or separately, as may be most convenient. I provide a main cylinder B, which preferably combines the explosion-chambers at the ends, although I may employ separate explosion-chambers communicating with the ends of the main cylinder. A suitable water-chamber a, having inlet and outlet pipes b, surrounds the cylinder. A compression-cylinder D is formed, preferably, above the main cylinder or alongside and parallel therewith, and it is suitably of the same length and diameter as the main cylinder, although I may adopt other ratios. By this arrangement the piston C in the main cylinder and the piston E in the compression-cylinder are both operatively connected through the medium of the piston-rods C′ and E′ and the cross-head K, of suitable design, working in suitable guide-bars L. The cross-head is connected by a pitman J to a crank-pin I, operating the main shaft H, suitably supported. Suitably located, preferably at one side of the main cylinder, is a valve-chamber F, which may be most conveniently cast together with the cylinder and of the same length, but usually of a less diameter, particularly in the larger sizes of engines. Two ports or gas-passages Q and R are provided between the ends of the compression-cylinder and the ends of the valve-chamber, the passages or ducts crossing in their courses, so that the duct Q, leading from one end of the compression-cylinder, enters the opposite end of the valve-chamber, and the duct R, leading from the opposite end of the compression-cylinder, en-

ters the other end of the main cylinder opposite to that in which the duct Q enters. This arrangement of the ports may be modified so that they do not cross, if a rocking arm is connected with the piston-rod, so as to cause the compression-piston to travel in opposite directions to the main piston; but I prefer the simple arrangement shown in the interest of economy. The port-ducts are preferably cored in the main casing, but may obviously consist of strong piping situate outside of the casting or cylinder walls. Each duct is provided with a suitable check-valve situate near the compression-cylinder and adapted to operate to prevent the gas-charges reëntering the compression-cylinder from the ports. Such checks may be similar to that shown in Fig. 8, in which a case *k* is fitted removably into the port R and retained by the cylinder-head, the port being cut into from the end of the casting and a valve V spring-pressed to its seat in the case, this type being well known. If desired, the ports may be formed partly in the cylinder-heads. As a matter of economy, I preferably form the cylinder-heads *d* and *e* each of one piece to cover the ends of the main cylinder, the compression-cylinder, and the valve-chamber, one head being provided with suitable packing-boxes for the piston-rods C′ and E′ and valve-stem G′, working through the head. A suitable eccentric or cam device M operates the valve G in the valve-chamber. This valve may be of any suitable type, the form shown being best adapted for the purpose, being of truncated form, cylindrical, as is its chamber, and practically filling the chamber diametrically, but free to slide therein and provided with suitable packing-rings. When desired, a plane-faced valve suitably retained upon its seat may be employed, the valve-chamber being in such case adapted to such valve. The pistons C and E are preferably somewhat truncated and provided with packing-rings at each end, and also at the top of each end is a projecting lip *f* to cover the opening of the duct from the oil-cups *h* for the compression-cylinder and *i* for the main cylinder. The exhaust-port T is situate at the longitudinal center of the main cylinder B and is partly uncovered only when the piston C is at either end of its stroke. A port S communicates between adjacent ends of the valve-chamber and main cylinder or explosion-chest therefor, and a like port S′ communicates between the opposite adjacent ends of such cylinders, the ports being both closed by the valve G when in mid-position. Each end of the compression-cylinder D is connected by a gas-supply pipe N, provided with a suitable check-valve O, and an air-inlet having a check-valve P, so that at each end both gas and air enter and are drawn into the cylinder, where they are most thoroughly mixed by reason of the action of the compression-piston causing agitation while compressing the gas and air together and forcing the same through the ports to the valve-chamber, thus proving advantageous.

As it is designed to produce an explosion of moderate and economic force at each end of every stroke of the main piston C, the igniters are most conveniently operated by means actuated by the cross-head or equivalently. Any suitable form of igniter may be employed, that shown being designed to illustrate the mechanism employed for their operation. A stationary laterally-springing pole 7 is secured to the cylinder-head, and a movable pole 8 is mounted in the wall of the cylinder at one end, and similar poles 9 and 10 are mounted at the opposite end of the cylinder B. Either one of the poles may be insulated, but preferably the movable one, which may also advantageously be adjustable lengthwise to compensate for wear of the points. The outer end of each one of the removable poles projects at the outside of the cylinder and is engaged by an end of a bar *n*, having a wedge-shaped contact-face at each end thereof and suitably attached to a slide-bar *l*, mounted in guide-bearings *t*, an end of the slide-bar being connected to an arm or bracket *m*, rigidly attached to the cross-head K, so that the slide-bar moves in unison with and parallel to the piston C. After the bar *n* by contact causes a contact of the electrodes the reverse movement of the bar *n* permits the spring-pressed pole to break contact, and thus throw off the igniting-spark.

In assembling and adjusting the movement of the several operative parts, as before stated, the main and compression pistons and the bar *n*, which is the circuit-breaker, travel in unison, and the valve G is arranged to travel approximately with them, but may act either slightly in advance of the main piston or following, as the proportions of the valve may be predetermined, the eccentric or cam being set on the main shaft accordingly, as is well understood.

In operation the compression-piston E draws in a mixed charge alternately at each end 3 and 4 and compresses such charge both in its cylinder and connecting ports against the valve G, which at the proper time admits a charge alternately at the ends 5 and 6 to the explosion end or chamber of the main cylinder B, where it is compressed further by the ends 1 or 2, as the case may be, and is exploded by a spark from the igniter at such end of the cylinder. In Fig. 1 the main piston C and compression-piston E are at one end of their stroke, in which position the piston E is ready to compress a charge assumed to have been drawn in at the end 4 of the piston. In its advance the piston would force such charge through the port R to the end 15 of the valve-chamber. It is assumed that a charge has been exploded in the main cylinder by the igniters 9 10 (as shown in Fig. 7 at the opposite end) and has passed out the uncovered exhaust-port T and that the valve G has slightly opened the port S′ and has ad-

mitted sufficient gas from the end 16 to force the burned gases from the cylinder. While the end 2 of the piston C closes the exhaust-port T immediately after the cylinder being cleansed, the valve G continues to open the port S′ until the charge desired is admitted, which takes place by the time the piston C shall have made about half of its stroke, the valve then closing the port, after which the piston C will compress the charge until the end of its stroke, when the charge is exploded, and a similar action will take place at the opposite end and alternately at each end of the stroke of the main piston corresponding to every half-revolution of the main shaft, as will be apparent. Thus a small charge suffices to produce a regular and even movement of the engine, using the most economic mixture of explosive, all the essential parts of the machine being direct acting and positive in operation.

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

1. In a gas-engine, the combination of a main or explosion cylinder, a main piston, a main-piston rod, a cross-head connected to the main-piston rod, guides for the cross-head, a pitman connected to the cross-head, a crank-shaft, a compression-cylinder, a compression-piston, a compression-piston rod connected to the cross-head, a valve-chamber, a valve in the valve-chamber, ports between the compression-cylinder and the valve-chamber, ports between the valve-chamber and the main cylinder, an eccentric on the crank-shaft operating the valve in the valve-chamber, a supply-port at each end of the compression-cylinder, and a check-valve in each inlet-port, substantially as shown and described.

2. In a gas-engine, the combination of a main or explosion cylinder having an inlet-port at each end and an exhaust-port at the longitudinal center thereof, a main piston extending from substantially one end to the longitudinal center of the main cylinder and having the projecting lips at the upper parts of the ends thereof, an oil-inlet at the longitudinal center of the top of the main cylinder, the closed head at one end of the main cylinder and the head having a packing-box at the opposite end of the main cylinder, cross-head guides at one end of the main cylinder, the cross-head working in the guides, the igniters, the bar mounted slidingly at the outside of the main cylinder and connected with the cross-head and engaging the igniters alternately, a compression-cylinder adjoining and alongside the main cylinder, a compression-piston in the compression-cylinder and extending from substantially one end to the longitudinal center thereof and having the lips at the upper portion of the ends thereof, the inclosing head at each end of the compression-cylinder one of which has a packing-box, the main-piston rod connected to the cross-head and extending through the packed head and attached to the main piston, a compression-piston rod connected also to the cross-head and working through the packed head and attached to the compression-piston, inlet-ports at the ends of the compression-cylinder, the valve-chamber and the valve therein, ports communicating between the valve-chamber and the main cylinder, a port having a check-valve therein between one end of the compression-cylinder and the opposite end of the valve-chamber, and a port having also a check-valve therein between opposite ends of the valve-chamber and the compression-cylinder, substantially as set forth.

3. In a gas-engine, the combination with the main or explosion cylinder and its piston and rod, of the compression-cylinder situate alongside of and parallel with the main cylinder, the valve-chamber situate alongside of and parallel with the main cylinder and the compression-cylinder, ports communicating between adjacent ends of the valve-chamber and the main cylinder, the compression-piston and its rod, the valve in the valve-chamber, the cross-head guides, the cross-head connected to both the main-piston rod and the compression-piston rod, the ports communicating between the compression-cylinder and the valve-chamber and having each a check-valve therein, and the supply-ports to said compression-cylinder, substantially as set forth.

4. In a gas-engine, the combination of the frame, the double-acting main cylinder having the double-acting piston therein, and the double-acting compression-cylinder having the double-acting piston therein and situate parallel with the main cylinder, the valve-chamber parallel at the side of the main cylinder and having the valve therein, ports between the valve-chamber and the compression-cylinder, ports between the valve-chamber and the main cylinder, the guides at the end of the main cylinder, the cross-head working in the guides and extending to the center line of the compression-cylinder, the rod connecting the cross-head and the piston in the main cylinder, and the rod connecting also the cross-head and the piston in the compression-cylinder, the igniters, and the sliding igniter-bar connected to said cross-head, substantially as set forth.

5. In a gas-engine, the combination of the main or explosion cylinder having the central exhaust-port, the main-cylinder heads, the igniter at each end of the main cylinder, the main piston having the lip at each end thereof, the central oilway in said main cylinder, the compression-cylinder having the central oilway and the inlet-port and valve at each end thereof, the compression-piston having the lip at each end thereof, the valve-chamber having the ports connecting with said main cylinder, the ports connecting the ends of said valve-chamber with opposite ends of said compression-cylinder, the cross-head

extending from the central line of said main cylinder to the central line of said compression-cylinder, the main-piston rod connected to said cross-head, the compression-piston rod, also connected to said cross-head, the cross-head guide, the valve, the cranked shaft, the pitman, the eccentric connected with the valve, and the sliding bar connected to said cross-head and engaging said igniters alternately at the ends of the strokes of said cross-head, substantially as set forth.

6. In a gas-engine, the combination of the frame, the main cranked shaft, the pitman, the guides, the cross-head having connections for two piston-rods and also for a circuit-breaker, the main cylinder, the main piston having a rod connected to said cross-head, the compression-cylinder, the compression-piston having a rod connected to said cross-head, the eccentric, the valve-chamber having ports communicating with said main cylinder and ports communicating with said compression-cylinder, the rod connecting said valve with the eccentric, the igniters at the ends of the main cylinder, and the circuit-breaker connected to said cross-head, substantially as set forth.

7. In a gas-engine, the combination of the frame, the main cylinder having the double heads and the inlet-ports and the central exhaust-port, the main piston having the rod working through one of the cylinder-heads, the central oilway in said main cylinder, the extension or lip at the ends of the main piston, the compression-cylinder having double heads and situate above the main cylinder, the central oilway in said compression-cylinder, the compression-piston having the rod working through one head of its cylinder, the extension or lip at the ends of the compression-piston, the valve-chamber at one side of the main cylinder and having the ports communicating with said main cylinder and having also ports provided with the check-valves communicating with said compression-cylinder, the valve in the valve-chamber and means whereby the same is operated, the guides, the igniters, the cranked shaft, the pitman, the circuit-breaker sliding at the side of the main cylinder, and the cross-head connected to the pitman and also connected to both of said piston-rods and to said circuit-breaker, substantially as set forth.

8. In a gas-engine, the combination of the main cylinder having the double heads and inlet and exhaust ports, the main piston having the rod working through one of the cylinder-heads, the central oilway, the extension at the ends of the main piston, the compression-cylinder having double heads and situate above the main cylinder, the central oilway in the compression-cylinder, the compression-piston having the rod working through one head of its cylinder, the valve-chamber at one side of the main cylinder and having ports communicating with the main cylinder and ports communicating with the compression-cylinder, the automatic check-valves in the port between the valve-chamber and the compression-cylinder, the valve in the valve-chamber and means whereby the same is operated, the guides, the igniters, the circuit-breaker sliding at the side of the main cylinder, and the cross-head connected to both of the said piston-rods and to the circuit-breaker, substantially as set forth.

9. In a gas-engine, the combination of the frame, and the casting comprising the integrally-formed main cylinder and the compression-cylinder and the valve-chamber all of equal length and having direct ports between adjacent ends of the main cylinder and the valve-chamber and having also direct ports between the opposite ends of the valve-chamber and the compression-cylinder; and a head at each end of the casting covering together the ends of the main cylinder and the compression-cylinder and the valve-chamber, substantially as shown and described.

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

WILLIAM W. GERBER.

Witnesses:
WM. H. PAYNE,
E. T. SILVIUS.