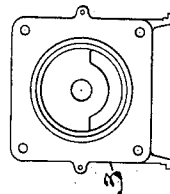
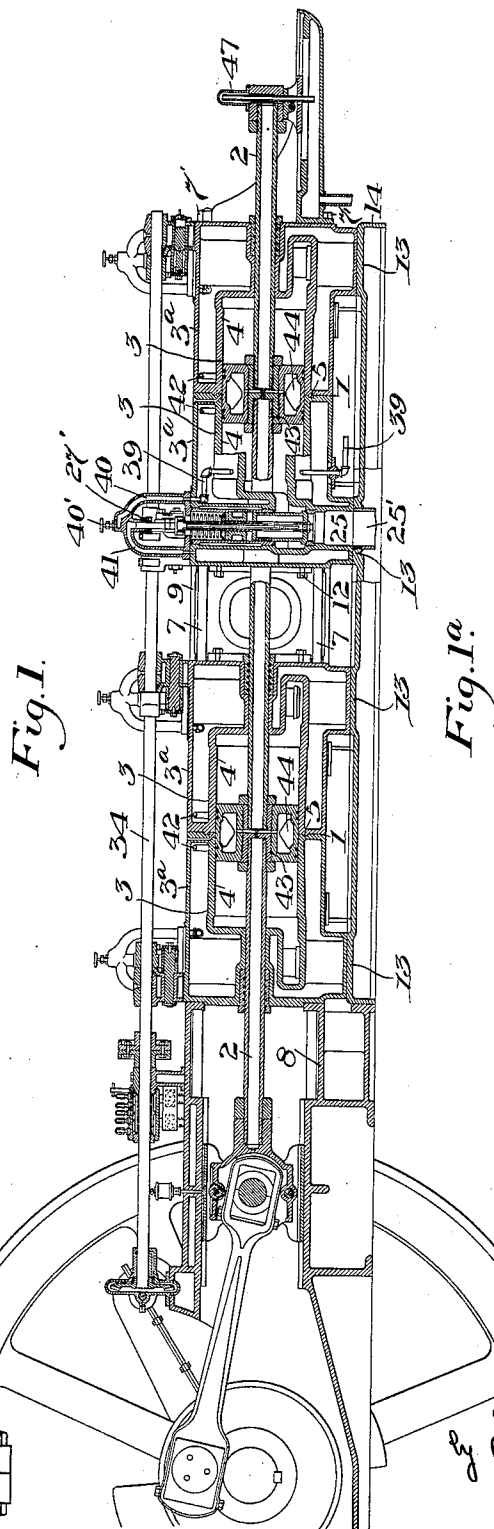


1,065,311.

E. GRAY.
GAS ENGINE.
APPLICATION FILED APR. 8, 1907.

Patented June 17, 1913.

4 SHEETS—SHEET 1.



WITNESSES

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4 SHEETS—SHEET 2.

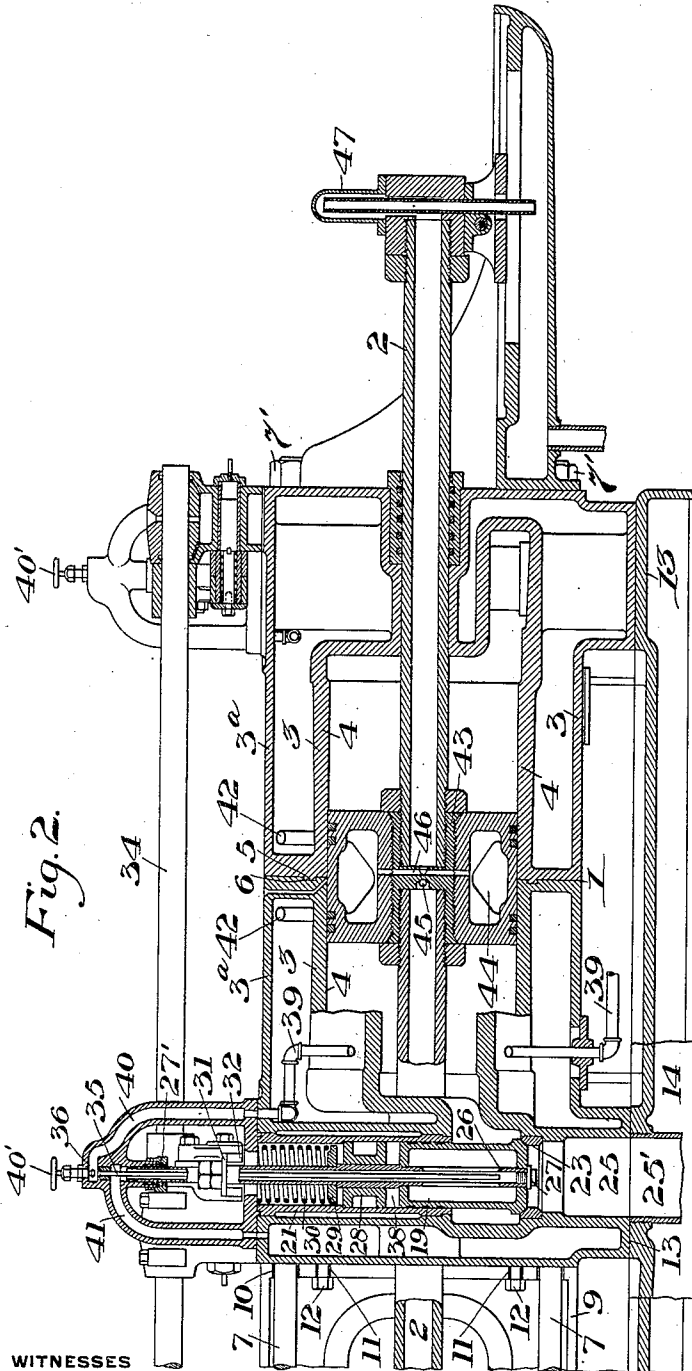


Fig. 2.

WITNESSES

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4 SHEETS—SHEET 3.

Fig. 5.

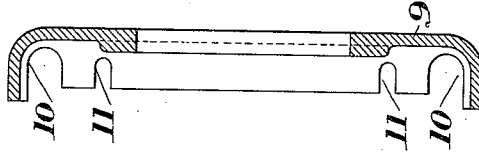
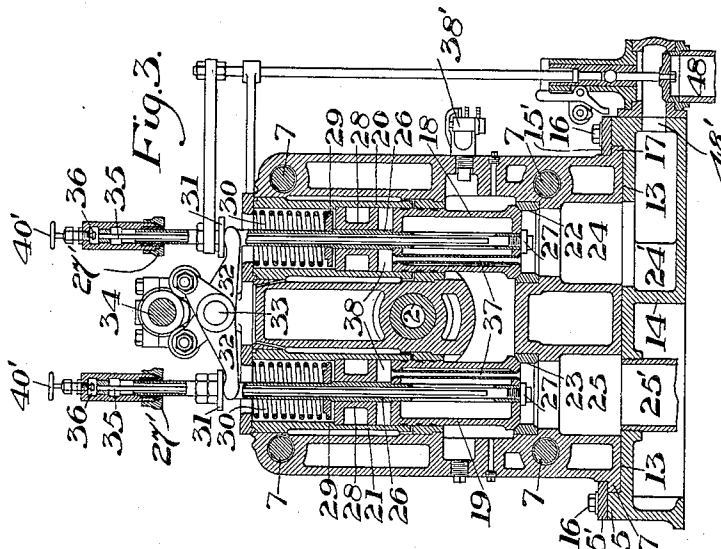
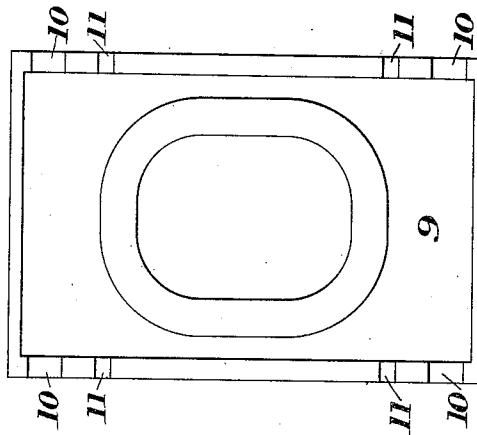


Fig. 4.



WITNESSES

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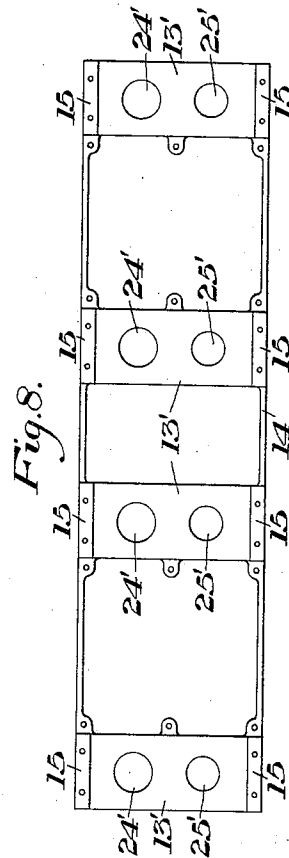
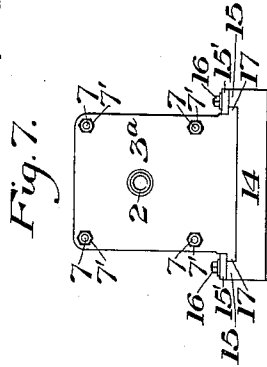
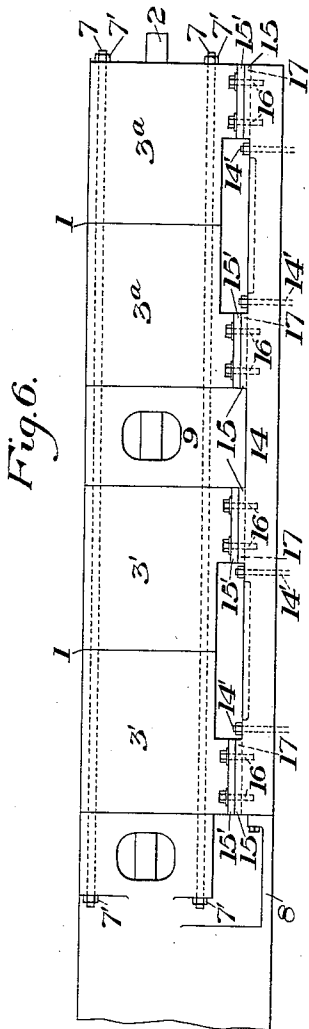
E. GRAY.
GAS ENGINE.

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1,065,311.

Patented June 17, 1913.

4 SHEETS—SHEET 4.



WITNESSES

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UNITED STATES PATENT OFFICE.

EDWARD GRAY, OF OIL CITY, PENNSYLVANIA, ASSIGNOR TO RIVERSIDE ENGINE COMPANY, OF OIL CITY, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

GAS-ENGINE.

1,065,311.

Specification of Letters Patent.

Patented June 17, 1913.

Application filed April 8, 1907. Serial No. 366,896.

To all whom it may concern:

Be it known that I, EDWARD GRAY, of Oil City, Venango county, Pennsylvania, have invented new and useful Improvements in Gas-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal vertical section through the center of a double-acting tandem gas engine and through the center of one exhaust valve; Fig. 1^a is a cross section of a power cylinder where sections of cylinders are joined together; Fig. 2 is an enlarged vertical section through the center of the rear cylinder and one exhaust valve and shows also one end of a distance piece; Fig. 3 is a cross section through the valves and cylinder base; Figs. 4 and 5 are detailed views of one of the distance pieces; Fig. 6 is a vertical side view, of double-acting tandem cylinders, the removable distance pieces, the cylinder base, part of the engine bed, tie bars, etc.; Fig. 7 is an exterior end view of a cylinder section; and Fig. 8 is a plan view of the cylinder base.

My invention relates to gas or combustion engines.

One of the improvements consists in making the double-acting cylinder in two or more sections with the cylinder head an integral part of one of the sections, the sections joined together by a transverse annular tongue and grooved joint, thus doing away with the customary joints between the ends of the cylinder and the cylinder heads, and also by making this joint so that it is accessible and easily connected or disconnected; and as a further improvement, I employ long through tie bars for holding the sections together. These tie bars run through all the cylinder sections, through slots in the distance pieces and through a portion of the engine bed, with nuts or keys at their ends, thus holding them all firmly together when the engine is in operation, and thus doing away with the great number of bolts ordinarily used.

Another feature of my improvement consists in placing the inlet and the exhaust valves side by side within the cylinder heads in line transversely to the cylinder bore and at right angles thereto, so that the valves may be lifted vertically from above the cyl-

inders by a cam shaft placed longitudinally with relation to the cylinders, the inlet valve on one side of the center of the cylinder, and the exhaust valve on the opposite side of the center of the cylinder. The valve seats are placed a little below the cylinder bore by which arrangement all burning carbon or other dirt is ejected through the exhaust valve at the end of each power stroke, thus avoiding all back-firing or premature explosions caused by burning carbon or dirt igniting the gas mixture before the proper time for ignition, which is such a drawback in gas engines as ordinarily constructed. This placing of all the valve lifting mechanism and attendant parts on top of the cylinders, renders them all accessible from the top within easy reach of a crane or other vertical lift, which is decidedly the easiest way to either place them in position or remove the same for repairs or other purposes. I preferably make these cylinder sections rectangular in form in their transverse section, so as to make a place in four corners for the tie bars and to adapt the top for the valve-operating mechanism and to hold lubricating oil pumps, and to adapt the bottom of the cylinder head sections to contain the ports for the exhaust and inlet valves and to form a base and a sliding surface for the cylinder sections.

Another feature of my improvement is the cylinder base which is more fully described hereafter, and is so constructed that it provides a means for sliding the cylinder sections or parts of a cylinder longitudinally endwise for purposes of access without displacing the sections in any other direction. This manner of getting access to the interior of the cylinders and to the pistons for inspection and repairs, or for the entire removal is a vast improvement upon the practice of other engine builders, taking only hours where the necessary method in other engines takes days. The cylinder base described also eliminates much exterior piping.

In the drawings hereto attached, which show my invention as applied to a tandem double-acting engine, 2 represents a sectional, through piston rod, extending through the cylinders and through stuffing boxes in the cylinder heads. Fig. 6 shows two double-acting cylinders each in two sections 3', 3' in side elevation similar to those shown in section in Fig. 1 and 3^a, 3^a, each section

consisting of one piece, with one cylinder head cast integral with it, and of cubical form, squared or rectangular in cross section, as shown, although the sections may have other shapes without departing from my invention. Between the outer wall 3 and the inner wall 4 is the jacket for the circulation of cooling fluids, usually water. These water jackets continue into and through the cylinder heads encircling the valve openings, the valve seats and the valve ports, but they do not continue through the joint 1 which connects the sections together. Joint 1 is preferably made by providing an annular tongue 5, encircling the cylinder bore of one section and a corresponding groove 6 in the opposite section into which the tongue fits closely. All faces of this joint, including the bottom of the tongue and the groove, are preferably plane surfaces at right angles to the cylinder bore, as shown. When the sections 3' or 3^a are used as a double-acting cylinder, the cylinder bore of each half section is bored out like that of the other, the diameter of the bores being the same and registering with each other so that the piston and piston rings travel smoothly over this joint. The long through tie bars 7 pass through the corners of the cylinder sections and through slots 10 in distance pieces 9, and into engine bed 8, and by the use of nuts 7' hold together the cylinder sections, the double-acting cylinders, the distance pieces and the engine bed, and forming, together with the cylinder base, a guide to slide the cylinder sections apart endwise for purposes of access to different parts. I have shown the tie bars 7 as continuous and single bars, although they might readily be made in several sections in any well known manner. I employ a distance piece in two sections 9, one on each side of the piston rod, near the outer edge of the cylinder ends, and removable clear down to the cylinder base. They are temporarily held in place against opposite ends of the cylinder by cap screws 12 in slot 11. By taking out cap screws 12 and loosening nuts 7', the sections of the distance piece can be removed.

The lower portion of each cylinder section containing a cylinder head is machined to a flat smooth surface 13, to rest upon and be slid upon a similar flat smoothly machined raised surface 13' on the cylinder base 14, which extends under all the cylinders and has on its top a horizontal slide, and is held on any suitable foundation by anchor bolts 14'. The flanges 17 extending outward on the cylinder sections fit within longitudinal side ribs 15 on the cylinder base and they are held down firmly in place by removable clamping plates 15', screwed in place by cap screws 16, and yet permitting necessary expansion and contraction of the cylinders during operation. By loosening the cap

screws 16 and the nuts on the ends of the tie bars 7 and removing the distance pieces 9, the cylinder sections guided by the cylinder base, can be slid apart endwise a sufficient distance to give access to the interior of the cylinders and to the pistons for inspection or repairs or to permit the removal of the entire piston without displacing the cylinder sections in any direction except longitudinally endwise. Inlet port 24 and exhaust port 25 connect in one chamber with the lower part of the end of the cylinder bore and then separately extend down through the under side of the cylinder heads through the flat machined surface 13 and through the smooth flat top 13' of the cylinder base. These even smooth surfaces make a good joint for the ports while the engine is in operation.

Extending through the cylinder base 14 on one side thereof is a conduit 24', shown in Fig. 3, which conveys the gas mixture from any suitable outside reservoir 48', through openings 48' into the several inlet ports 24. Exhaust ports 25 connect in the cylinder base with pipes 25', which convey the exhaust gases to any desired exterior point. The cooling water enters the cylinder jacket from the water pipe 41, and escapes through outlet pipes 42 near the joint 1.

Inlet and exhaust valves 18 and 19 operate in valve casings 20 and 21, which extend through vertical openings in the water jacket of the cylinder head. Valve seats 22 and 23 consisting of removable bushings are located a little below the line of the cylinder bore at the end of a chamber which connects the cylinder bore to the inlet and exhaust ports. Valve tube 26 is hollow, slotted at its lower end and is closed at its lower end by cap 27 and at its upper end reciprocates within a packed bushing in the lower central part of water arch 36. Above the valve within the casing is provided a packing sleeve 28, above which the valve tube is provided with plate 29, against which presses spring 30. Above the spring the valve tube is provided with a tappet 31, operated from lever 32, on rock pin 33, the lever being actuated by revolving cam shaft 34. Stationary water pipes 35, attached to and guided by the upper central part of the water arch, telescope reciprocatingly within valve tube 26, with water space between. The hollow valve body is provided with a tube 37, connecting space 38 with the valve port.

Ignition of the gases is effected by spark plug 38'.

In the construction shown, the cooling water enters pipe 39, flows into chamber 40 of the water arch, is regulated by the throttle valve 40', thence flows down within stationary pipe 35, thence through the slots in lower end of valve tube 26 into the valve body, thence upward within tube 26 into

outlet channel 41 of the water arch. The piston head with its annular water space 44 is cast around a steel core 43, into which the piston rods are screwed. Water-circulating holes 45 and 46 are each bored through the center of the piston head at about right angles to each other and connect with opposite ends of hollow piston rods. Trap 47 will keep the water in the pistons at a proper level and also provides an outlet for the water after it enters the piston rod at the other end of the engine, and circulates through the piston rods and piston heads.

Many changes may be made in the form and arrangement of the engine and its parts without departing from my invention.

The novel features of the engine which are not herein claimed form the subject matter of my divisional applications Serial Numbers 403,590; 403,591 and 403,592, filed November 25, 1907.

I claim:

1. In a gas engine, a power cylinder formed of several sections, a base for supporting said sections, and a guide on said base for the sections arranged to permit longitudinal movement of the sections and to prevent lateral movement thereof, and screw devices for securing the sections to the base; substantially as described.

2. A gas engine having a cylinder base, a flange guide on said base, tandem power cylinders each constructed in sections supported on said base and seated within the guide, a removable distance piece between the cylinders, said guides being arranged to permit the cylinder sections to be moved longitudinally along the base and to prevent lateral movement thereof, so as to retain the sections of the cylinders in line with each other, and means to secure the cylinder sections and the removable distance pieces together; substantially as described.

3. A gas engine having a bed, a power cylinder constructed in sections, a piston within said cylinder, and tie bars for securing the sections to the engine bed to transmit the strain between the cylinder and piston to the bed through said bars; substantially as described.

4. A gas engine having a base, a cylinder-supporting seat on said base, a power cylinder made in sections supported on said seat, and guide connections between said seat and cylinder sections, said guide connections being arranged to permit an endwise movement of the cylinder sections to give access

to the piston, or to entirely remove the piston without displacing the piston rod from its working position and without removing the cylinder sections from the seat; substantially as described.

5. A gas engine having a cylinder base, a guide having projections on said base, tandem power cylinders supported thereon between the projections, a sectional distance piece between the cylinders, said projections and guide being arranged to permit the cylinders to be moved longitudinally along the base and to prevent lateral movement thereof, so as to retain the cylinders in line with each other, means to secure the cylinders to said base, and means for securing the cylinders and distance pieces to each other; substantially as described.

6. A gas engine having a bed, a power cylinder of rectangular form constructed in sections, and four tie bars for holding the sections to each other, said tie bars passing through the sections of the cylinders at the corners thereof and into the engine bed; substantially as described.

7. A gas engine having a bed, a cross-head support on said bed, a cross-head movably mounted in said support, a base plate connected to said bed, a double-acting power cylinder in sections mounted on said base plate, a guide on said base plate for the cylinder sections, means on said guide for preventing lateral movement of the cylinder sections, said guide being arranged to permit the sections of the cylinder to be moved longitudinally, and through rods extending through the cylinder sections and into the engine bed for connecting all of the cylinder sections to the engine bed; substantially as described.

8. In a gas engine, a base plate having a seating surface, a power cylinder formed of several sections seated on said base, there being ports leading through both ends of the cylinder and communicating therewith, there being ports through the engine bed in communication with the ports in the cylinder, and means for securing the cylinder sections to the base; substantially as described.

In testimony whereof, I have hereunto set my hand.

EDWARD GRAY.

Witnesses:

JNO. B. SMITHMAN,
EDWD. S. McALEVY.