W. J. WRIGHT.

EXPLOSIVE ENGINE.

APPLICATION FILED FEB. 7, 1906. RENEWED FEB. 27, 1911.

1,006,167. **Patented Oct. 17, 1911.**

3 SHEETS—SHEET 1.

Fig. 1.

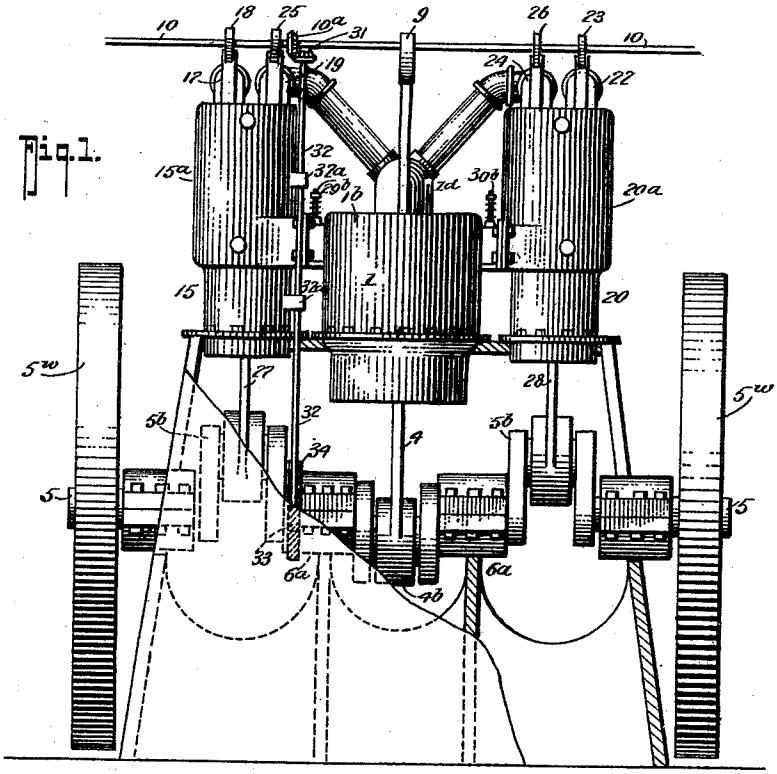


Fig. 2.

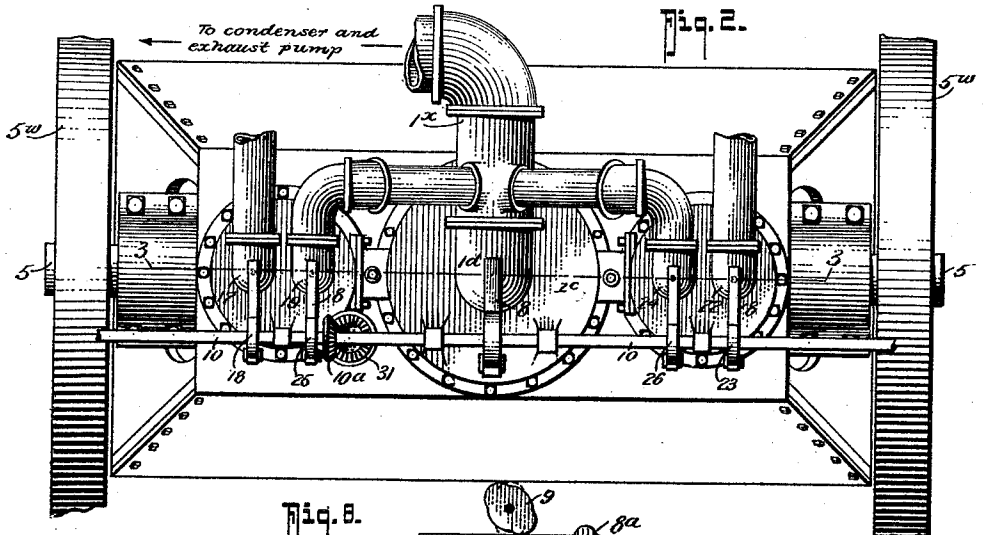
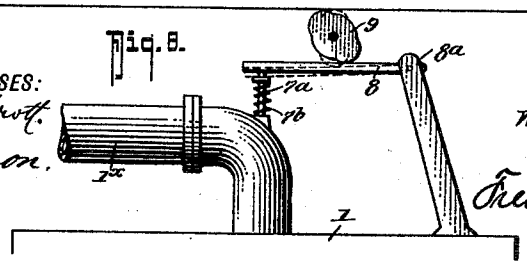


Fig. 3.



WITNESSES:

John T. Schwitt.

F. L. Gibson.

INVENTOR

William J. Wright.

BY

Fred G. Dieterich & Co.

ATTORNEYS.

W. J. WRIGHT.

EXPLOSIVE ENGINE.

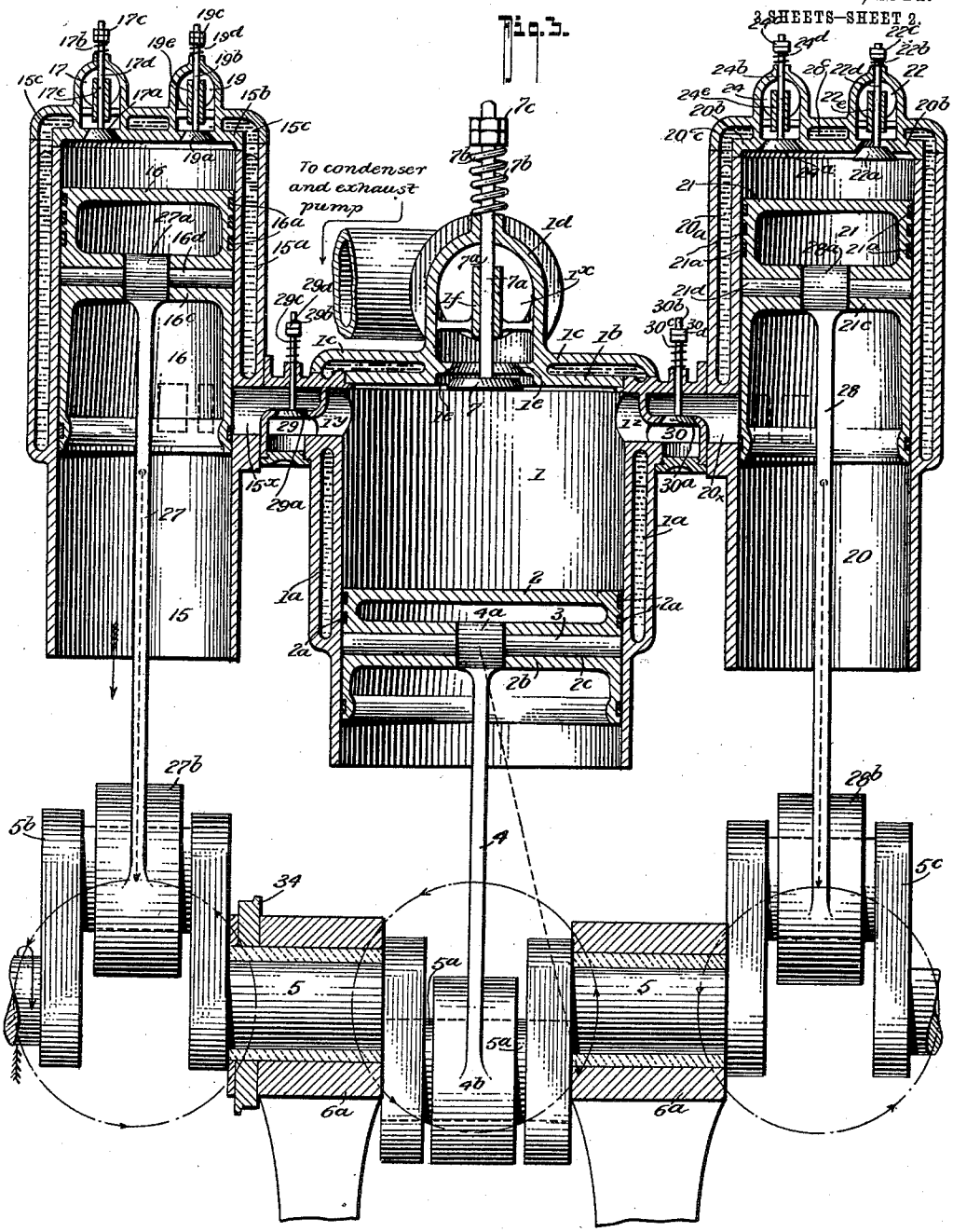
APPLICATION FILED FEB. 7, 1906. RENEWED FEB. 27, 1911.

1,006,167.

Patented Oct. 17, 1911.

3 SHEETS—SHEET 2.

Fig. 2.



WITNESSES:

John J. Schrott

F. C. Gibson.

INVENTOR

William J. Wright.

BY

Fred G. Dieterich & Co.

ATTORNEYS.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

W. J. WRIGHT.

EXPLOSIVE ENGINE.

APPLICATION FILED FEB. 7, 1906. RENEWED FEB. 27, 1911.

1,006,167.

Patented Oct. 17, 1911.

3 SHEETS—SHEET 3.

Fig. 5.

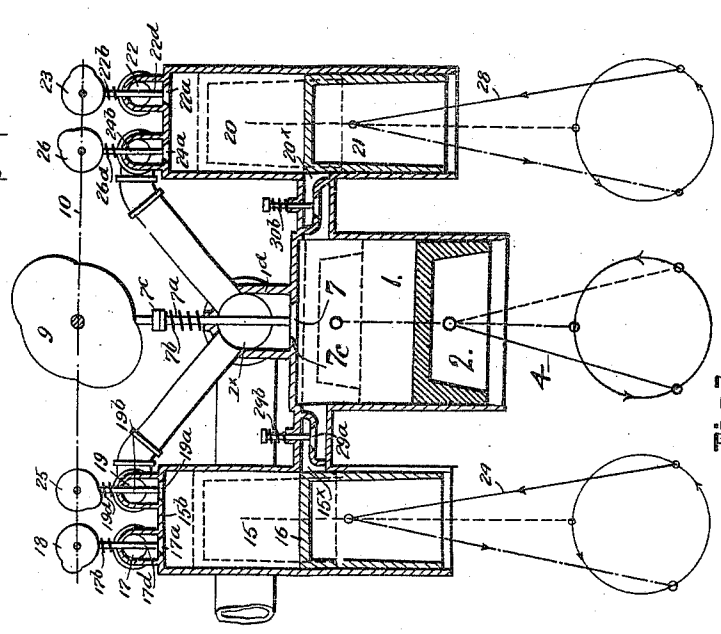


Fig. 7.

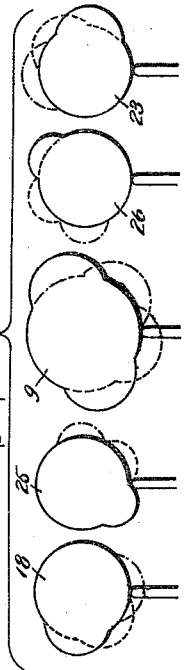


Fig. 6.

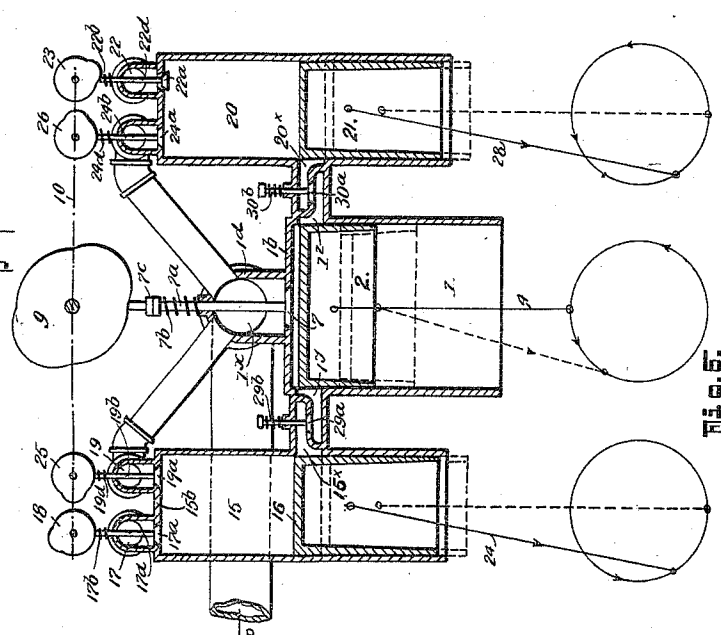
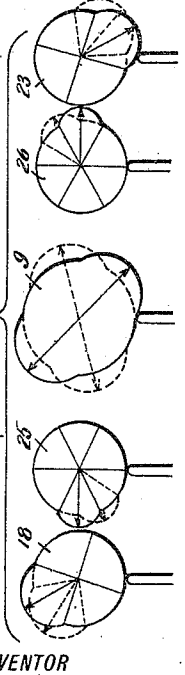


Fig. 6.



To condenser and exhaust pump

WITNESSES:

John T. Schrott.

E. C. Gibson.

INVENTOR

William J. Wright.

BY

Fred G. Dieterich & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

WILLIAM J. WRIGHT, OF FRANKLIN, PENNSYLVANIA.

EXPLOSIVE-ENGINE.

1,006,167. Specification of Letters Patent. Patented Oct. 17, 1911.

Application filed February 7, 1906, Serial No. 299,894. Renewed February 27, 1911. Serial No. 611,233.

To all whom it may concern:

Be it known that I, WILLIAM J. WRIGHT, residing at Franklin, in the county of Venango and State of Pennsylvania, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

My invention relates to certain new and useful improvements in explosive engines and it more particularly seeks to provide an engine combining a pair of four cycle engines with a two cycle engine to form a compound engine and includes means for automatically operating the various inlet and exhaust valves of the different cylinders at proper predetermined times, and means for drawing off the final exhaust to reduce the pressure within the various cylinders.

In its more detailed nature, my invention comprises certain novel combination, arrangement and operation of parts all of which will be first described in detail and then be specifically pointed out in the appended claims, reference being had to the accompanying drawings, in which:—

Figure 1, is a side elevation of my invention complete, parts being broken away to show interior mechanism. Fig. 2, is a top plan view thereof. Fig. 3, is an enlarged central vertical longitudinal section of the engine on the line 3—3 of Fig. 2, the parts being shown in their first position with the high pressure pistons at the extreme upward position, the one just about to operate under an exploded charge, the other drawing in working agent, while the low pressure piston is exhausting. Fig. 4, is a diagrammatic view showing the position of the parts after the main drive shaft has rotated one-third of a revolution from the position shown in Fig. 3, Fig. 5, is a similar view to Fig. 4, showing the parts in the position they assume when the main drive shaft has turned through two-thirds of a revolution from the position shown in Fig. 3. Fig. 6, is an enlarged detail diagrammatic view of the cam devices for operating the valves, showing them in the position they are in, in Fig. 4. Fig. 7, is a similar view showing the cams in the position they are in, in Fig. 5. Fig. 8, is a detail view of one of the valve operating levers and cams.

Referring now to the accompanying drawings in which like numerals and letters of reference indicate like parts in all of the figures, 1 designates the low pressure cylinder which may be water jacketed as at 1^a as shown. Within the low pressure cylinder 1, the low pressure piston 2 is operable and the piston 2 is provided with a series of packing rings 2^a and alining internal bosses 2^b that are apertured at 2^c to receive a rod 3 on which the head 4^a of the low pressure piston rod 4 is mounted, the other end of the piston rod 4 being provided with a bearing 4^b to receive the crank 5^a of the main drive shaft 5 which is mounted in suitable bearings 6^a—6^a, as shown.

The lower end of the low pressure cylinder 1 may be opened, as shown, while the upper end is closed by a cap 1^b suitably water jacketed at 1^c, as shown. The cap 1^b has a pipe section 1^d and is provided with a valve seat 1^e upon which the main exhaust valve 7 seats, the valve 7 being provided with a stem 7^a that passes through a bearing 1^f, as shown, and the valve 7 is normally seated on its seat 1^e by a spring 7^b whose tension may be adjusted by the check nut 7^c.

8 designates a lever pivotally mounted at 8^a to a suitable support and passing over the valve stem 7^a through the medium of which lever 8 the main exhaust valve operating cam 9 operates the valve, and the cam 9 is mounted upon the valve operating shaft 10, all of which parts will be more fully referred to later.

In practice, I preferably connect the main exhaust pipe 1^d with a suitable condenser and exhaust pump (not shown) to draw off the exhaust from the low pressure cylinder 1 and create a vacuum therein as the piston 2 is moving on its return stroke to exhaust the cylinder.

Preferably arranged on each side of the low pressure cylinder 1 is a pair of high pressure cylinders 15 and 20 which are suitably water jacketed at 15^a and 20^a, as shown, and the cylinders 15 and 20 are provided with working agent inlet ports 17 and 22 respectively which are normally held closed by valves 17^a and 22^a respectively, which valves are held seated by springs 17^b and 22^b whose tension may be adjusted by the nuts 17^c and 22^c, as shown.

The valves 17^a have their stems 17^d held in bearings 17^e as shown, while the valves 22 likewise have their stems 22^d held in bearings 22^e and the valves 17^a—22^a are all precisely of the same construction and the ports 17 and 22 are each connected with a source of working agent supply, (not shown).

On the valve operating shaft 10, a pair of cams 18 and 23 are secured, which cams respectively operate the valves 17^a, and 22^a, either directly or through the medium of levers similarly mounted and arranged to the levers 8. The inlet ports 17, and 22 respectively are preferably formed in the heads 15^b and 20^b of the cylinders 15 and 20, which close one end of said cylinders, and which heads are water jacketed as at 15^c and 20^c respectively.

In each head 15^b and 20^b respectively, I form exhaust ports 19 and 24, each connected with the main exhaust port 1^x of the low pressure cylinder 1 and with the condenser and exhaust pump (not shown). Each of said exhaust ports 19 and 24, is respectively controlled by valves 19^a and 24^a, whose rods 19^b and 24^b are suitably supported in bearings 19^e and 24^e and are normally held seated by springs 19^d and 24^d respectively. The tension of such springs can be regulated through the nuts 19^e and 24^e, as shown.

The valves 19^a and 24^a are respectively operated through the medium of cams 25 and 26 respectively, mounted on the shaft 10, which cams 25 and 26 may directly engage the valve stems 19^b and 24^b or may engage such stems through the medium of levers similar to the lever 8.

Mounted within the cylinders 15 and 20, are high pressure pistons 16 and 21 respectively, which pistons are provided with suitable packing 21^a and 16^a, as shown, the pistons 16 and 21 being provided with internal alining lugs 16^c and 21^c which respectively receive the rods or shafts 16^d and 21^d upon which the bearings 27^a—28^a of the high pressure piston rods 27 and 28 are held. The piston rods 27 and 28 have bearing heads 27^b—28^b to receive the cranks 5^b and 5^c respectively, of the drive shaft.

Each high pressure cylinder 15 and 20 is provided with outlet ports 15^x and 20^x, which communicate through valved conduits or laterals 29 and 30 with the inlet ports 1^y—1^z respectively of the low pressure cylinder 1.

Each lateral 29 and 30 is respectively provided with valves 29^a—30^a which are normally spring pressed to their seated positions by springs 29^c and 30^c that are adjustably held on the valve stems 29^b and 30^b of the respective valves 29^a and 30^a by nuts 29^d and 30^d, as shown.

The high and low pressure cylinders of the drive shaft 5 are suitably supported as shown, in Fig. 1 and the drive shaft 5 carries the usual fly wheels 5^w—5^w, as shown.

To turn the shaft 10, which must rotate in my present invention, one revolution to every two revolutions of the drive shaft 5, I provide the shaft 10 with a bevel gear 10^a which meshes with a bevel gear 31 on a shaft 32 that is mounted in suitable bearings 32^a projected from the cylinder 15, and the rod or shaft 32 has a worm gear 33 on its lower end which meshes with a worm wheel 34 on the drive shaft, the arrangement and pitch of the worm gear wheel teeth and the worm teeth being such, that one revolution of the shaft 5 will impart but one-half revolution to the shaft 10.

The arrangement of the various cams 18, 25, 9, 26 and 23 with respect to one another can be best understood by reference to either of the diagrammatic figures, Figs. 5 and 7.

So far as described, the manner in which my invention operates, will be best understood by reference to Figs. 3, 4, 5, 6 and 7 of the drawings. Assume the parts to be in the position shown in Fig. 3, with the high pressure pistons at the upward limit of their stroke the low pressure piston having passed through one-third of its stroke, and the working agent within the high pressure cylinder 15 just having exploded, the valves 17^a, 19^a, 24^a, 29^a and 30^a being closed and the valves 7, and 22^a open. The high pressure pistons 16 and 21 operating in unison and arranged in the same relative position, will move downwardly, the exploded charge in the cylinder 15 forcing the piston downwardly in the direction of the arrow in Fig. 3, to rotate the shaft 5 in the direction of the indicating arrow on the shaft. Now as the high pressure pistons move downwardly to rotate the shaft 5, the low pressure piston will move upwardly to aid in exhausting the low pressure cylinder, the exhaust pump and condenser serving principally to draw out the exhaust and create a vacuum in the low pressure cylinder which tends to suck the piston 2 toward the top of the low pressure cylinder to reduce the space ahead of the piston. Now as the shaft 5 rotates in the direction of the arrow from the position shown in Fig. 3 to the position shown in Fig. 4, namely one-third of a revolution, the high pressure pistons will be in the position shown in full lines in Fig. 4, just ready to uncover the outlet ports 15^x and 20^x of the respective high pressure cylinders 15 and 20, it being understood that as the exploded charge in the high pressure cylinder 15 moves piston 16 from the position shown in Fig. 3, to the position shown in full lines in Fig. 4, the piston 21 of the other high pressure cylinder will draw in a new charge of working agent through the port 22 to fill the cylinder 20, and the piston 21 continues drawing in a new charge during one-half revolution of the shaft 5, as will be better understood presently. Now as soon as the parts are in the position shown in full lines in Fig. 4, the exploded charge in the cylinder 15 will have reduced in pressure from the initial pressure at the instant of explosion but will not have reached atmospheric pressure. As the high pressure piston moves from the position shown in Fig. 3 to that

shown in Fig. 4, the low pressure piston will have completed its upward stroke and be in the position shown in full lines in Fig. 4, it being understood that the low pressure piston is set one-third behind the high pressure piston for a purpose presently more clearly understood. Now as the pistons continue their movement from the position shown in full lines in Fig. 4, to that shown in dotted lines in Fig. 4, the pistons 16 and 21 will uncover the outlets 15^x and 20^x of the respective high pressure cylinders 15 and 20, thus allowing the exploded charge from the cylinder 15 to pass through the lateral 29 into the low pressure cylinder and thus expend the remainder of its energy in forcing the low pressure piston 2 down from the position shown in full lines in Fig. 4 to that shown in dotted lines in Fig. 4, it being understood that the new charge drawn into the high pressure cylinder 20 during its movement will not enter the low pressure cylinder for the reason that the pressure in the low pressure cylinder due to the partially exhausted charge it has received from the high pressure cylinder is greater than the pressure of the new working agent within the high pressure cylinder 20, and hence the valve 30^a will not open. The low pressure piston is moved by the exhaust charge from the high pressure cylinder 15, from the position shown in full lines in Fig. 4 to that shown in dotted lines in Fig. 4, during the time the high pressure pistons are moving from the position shown in full lines in Fig. 4 to that shown in dotted lines in Fig. 4, and while the main shaft is moving through one-sixth of a revolution. The partly exhausted charge from the high pressure cylinder 15 that has passed into the low pressure cylinder continues to exert its force during another sixth of the rotary movement of the shaft until the high pressure pistons have again closed off the ports 15^x and 20^x and the parts are then in the position shown in full lines in Fig. 5. It should be understood that when the parts are in the position shown in full lines in Fig. 4, the valves 17^a, 19^a, 7 and 24^a are closed, while the valve 22^a is open, and the valve 22^a remains open until piston 21 has reached the position shown in dotted lines in Fig. 4, when it is closed. When the parts have reached the position shown in full lines in Fig. 5, the piston 21 is compressing the charge within the high pressure cylinder 20, both valves 24^a and 22^a being closed. At the same time, as soon as the parts reach the position shown in full lines in Fig. 5, the cam 26 just begins to open the exhaust valve 19^a to allow the charge within the cylinder 15 to be withdrawn to the condenser and exhaust pump, thus serving to create a vacuum in the cylinder 15 and aiding to suck the piston 16 back to the position shown in Fig. 3, which position is one-third of a revolution of the drive shaft 21 from that shown in full lines in Fig. 5 to that shown in dotted lines in Fig. 5. As the parts move from the position shown in full lines in Fig. 5, to exhaust the charge in the cylinder 15, and to compress that in the cylinder 20, the valve 7 of the low pressure cylinder opens and remains open until the piston 2 has again reached the position shown in full lines in Fig. 4, namely, during one-half revolution of the drive shaft. As soon as the parts reach the position shown in dotted lines in Fig. 5, the high pressure piston 16 will have exhausted its cylinder 15 and the valves 19^a will have closed. At the same time, the piston 21 will have compressed its charge within the cylinder 20, and the low pressure piston 2 will have moved two-thirds its distance from the position shown in Fig. 5 toward the position shown in full lines in Fig. 4. As soon as the parts reach the position shown in dotted lines in Fig. 5, the charge in the cylinder 20 is exploded and forces the piston 21 downwardly from the position shown in dotted lines in Fig. 5 to the position shown in full lines in Fig. 5, with the exception that the position of the piston rods of the high pressure cylinders will be that shown in dotted and dash lines in Fig. 5 instead of that shown in full lines in Fig. 5, and the position of the piston rod 4 in the low pressure cylinder will be that shown in dot and dash lines in Fig. 5, while the position of the piston 2 is that shown in dotted lines in Fig. 5. As soon as the high pressure pistons are moved to uncover the ports 15^x and 20^x, the exploded charge from the cylinder 20 will be fed into the low pressure cylinder to force the low pressure piston downwardly from the position shown in full lines in Fig. 4, to that shown in dot lines in Fig. 4, and in this case no charge will pass from the cylinder 15 into the low pressure cylinder since this charge has only an atmospheric pressure, while that in the low pressure cylinder 1 is at greater than atmospheric pressure. Thus the charge from the cylinders 20 will operate the piston 2 in the same manner as that from cylinder 15 had previously operated the piston 2, and as the high pressure pistons move from the position indicated by dot and dash lines in Fig. 5, to that indicated by dotted lines in Fig. 5, the parts will be drawn back to the position shown in Fig. 3 and the operation can be again continued.

In Figs. 6 and 7 I have shown the positions of the valve operating cams in full lines in the position they will be when the parts are in the positions shown in full lines respectively in Figs. 4 and 5, while the dotted position of the cams corresponds with the dotted positions shown in Figs. 4 and 5 respectively. The dot and dash position of

the cams in Figs. 6 and 7 correspond with the dot and dash positions of the cams in Figs. 4 and 5, so that their operation can be more clearly understood.

From the foregoing it will be seen that the high pressure cylinders are of the four cycle type, namely an explosion once in every four movements of the piston, while the low pressure cylinder operates under the two cycle type, namely receiving an impulse once in every two movements of the piston.

While I have described my engine as having the main exhaust ports of the high and low pressure cylinders connected through a condenser to an exhaust pump to create vacuums in the cylinders 15, 1 and 20 during their exhausting periods, yet I may use my engine without such condenser and exhaust pumps, but in that event the respective pistons will serve to force out the charge ahead of them through the various exhausts when opened.

From the foregoing description taken in connection with the accompanying drawings, it is thought the complete construction, operation and many advantages of my invention will be readily understood by those skilled in the art to which it appertains.

What I claim, is:—

1. A gas engine of the character specified, comprising in combination with a pair of high pressure cylinders, of a low pressure cylinder having valved communication with ports in the high pressure cylinder, valve controlled working agent inlet ports for the high pressure cylinders, valve controlled exhaust ports for the high pressure cylinders, and a single valve controlled exhaust port for the low pressure cylinder, a drive shaft, high and low pressure pistons for the respective cylinders operatively connected with the drive shaft, means for operating the inlet and exhaust valves at predetermined times, and a condenser and exhaust pump connected with the various exhaust ports, substantially as shown and described.

2. In an engine of the character stated, the combination with a pair of high pressure cylinders, high pressure piston working therein, valved controlled inlet and exhaust ports therefor, of a low pressure cylinder, a valved exhaust for said low pressure cylinder, valved inlets for said low pressure cylinder in communication with piston controlled ports in said high pressure cylinders, said low pressure piston receiving the partially spent charge from the high pressure cylinders to operate against the low pressure piston during a portion of its stroke, means for operating said inlet and exhaust valves of the high pressure cylinders and said exhaust valve of the low pressure cylinder, and means independent of the high and low pressure piston for evacuating the high and low pressure cylinders at times, substantially as shown and described.

3. In an engine of the class described, the combination with a pair of alternately acting high pressure cylinders and their working pistons, of a low pressure cylinder, a low pressure piston therefor, a drive shaft, piston rods operatively connecting the high and low pressure pistons with the drive shaft, said drive shaft having cranks for receiving said piston rods, the low pressure piston crank being set approximately one-third revolution behind the high pressure piston cranks, valve laterals connecting the outlet ports of the high pressure cylinders with inlet ports of the low pressure cylinder, valve controlled exhausts for the high pressure cylinders and a single valve control exhaust for the low pressure cylinder, valve controlled working agent inlets for the high pressure cylinders, and means operated from the drive shaft for operating said inlet and exhaust valves at predetermined times, substantially as shown and described.

4. An engine of the class described, comprising the combination with a pair of alternately acting four cycle engines having valve controlled working agent ports and valve controlled exhaust ports and piston controlled outlets, of a two cycle engine, having valve controlled inlet ports in communication with the outlets of the four cycle engines, and said two cycle engine having a single valve controlled exhaust, a single drive shaft having cranks coöperatively connected with the working pistons of all of said engines, and means operable from said shaft for predeterminedly controlling the working agent inlet valves and the exhaust valves of the four cycle engines, and the exhaust valve of the two cycle engine, substantially as shown and described.

5. An engine of the class described, comprising the combination with a pair of four cycle engines having valve controlled working agent inlet ports and valve controlled exhaust ports, and piston controlled outlets, of a two cycle engine, having valve controlled inlet ports in communication with the outlets of the four cycle engines, said two cycle engine having a valve controlled exhaust, a single drive shaft having cranks coöperatively connected with the working pistons of all of said engines, means operable from said shaft for predeterminedly controlling the working agent inlet valves and the exhaust valves of the four cycle engines, and the exhaust valve of the two cycle engine, and means coöperatively connected with the exhausts of the four cycle and two cycle engines for evacuating their cylinders when the exhaust valves are opened, substantially as shown and described.

6. In an engine of the class described, the combination with a pair of engines operat-

ing under a certain cycle, of a third engine operating under a different cycle, inlet ports for the third engine in communication with outlets from the first mentioned engines, said third engine operable by the partially spent working agent from the first mentioned engine, and means for drawing off the spent charge from the several cylinders of the several engines when their exhaust ports are opened, said third engine having a single exhaust port, substantially as shown and described.

7. In an engine of the class described, the combination with a pair of engines, and a crank shaft, said engines having pistons similarly connected with the crank shaft and operable alternately, of a third engine operable by the partially spent charge from the first mentioned engines, said third engine having its piston coöperatively connected with the crank shaft in the position one-third revolution behind the pistons of the first mentioned engines, substantially as shown and described.

8. In an engine, a pair of alternately acting high pressure engines operating under a certain cycle and a low pressure engine operating under a different cycle by the partly spent gases of the high pressure engines, and means for drawing in a new charge in one high pressure engine while the other high pressure engine and the low pressure engine is being actuated under an exploded charge and means independent of the low pressure and high pressure pistons for evacuating the low pressure cylinder at times.

9. In an engine, a pair of high pressure cylinders and their pistons and a low pressure cylinder and its piston, a crank shaft and connections between the crank shaft and the pistons of all of said engines, means for admitting working agent into all of said engines whereby a new charge will be drawn into one of the high pressure cylinders while an exploded charge is operating in the other high pressure cylinder, and means for admitting the partially spent charge from the high pressure cylinders alternately into the low pressure cylinder to actuate the piston thereof and means independent of the piston for evacuating the low pressure cylinder at times.

WILLIAM J. WRIGHT.

Witnesses:
ALBERT E. DIETERICH,
JOHN T. SCHROTT.