A. M. GIBSON.

GAS ENGINE.

APPLICATION FILED JAN. 4, 1909.

1,043,221.

Patented Nov. 5, 1912.

4 SHEETS—SHEET 1.

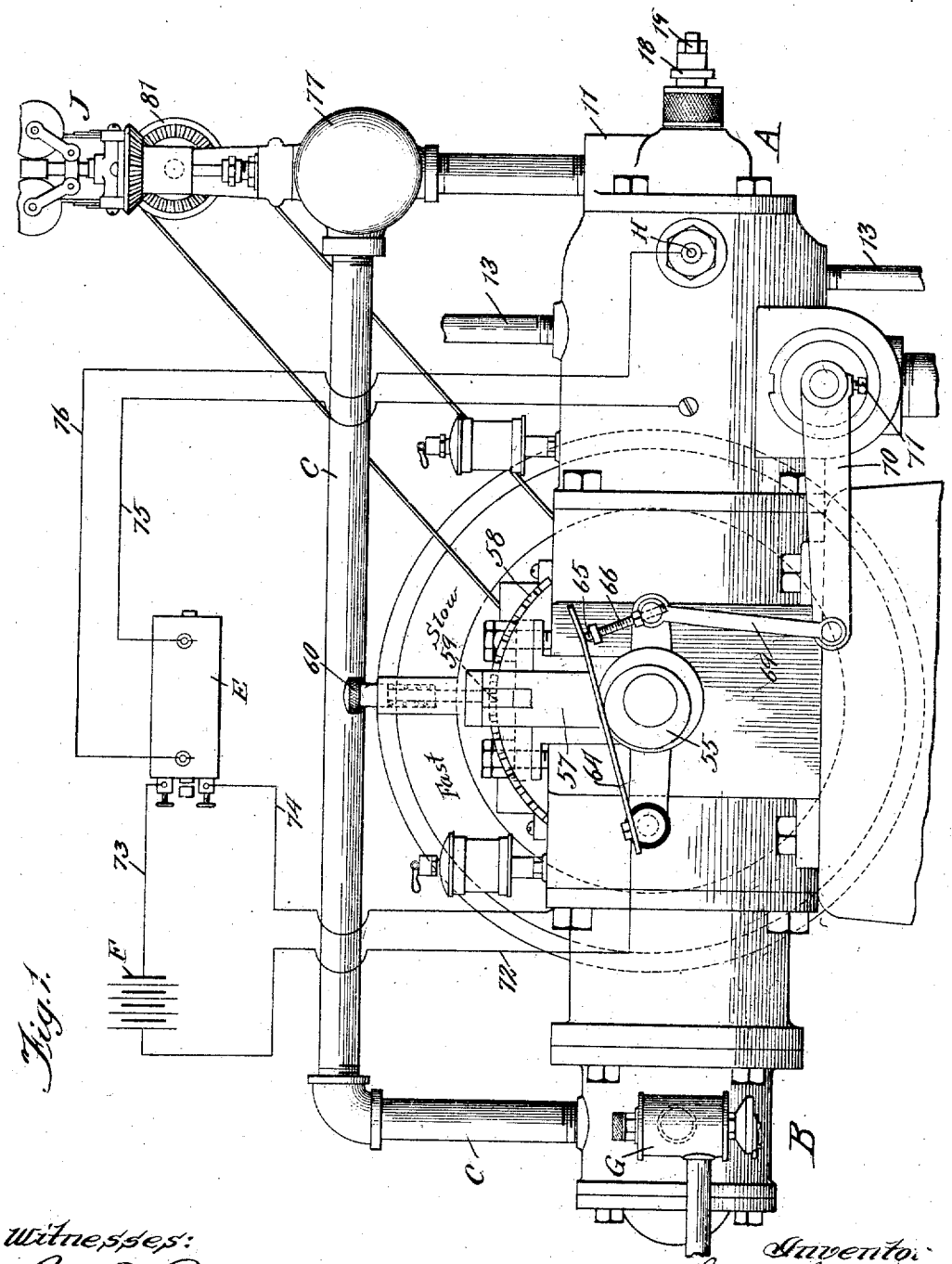

Fig. 1.

Witnesses:
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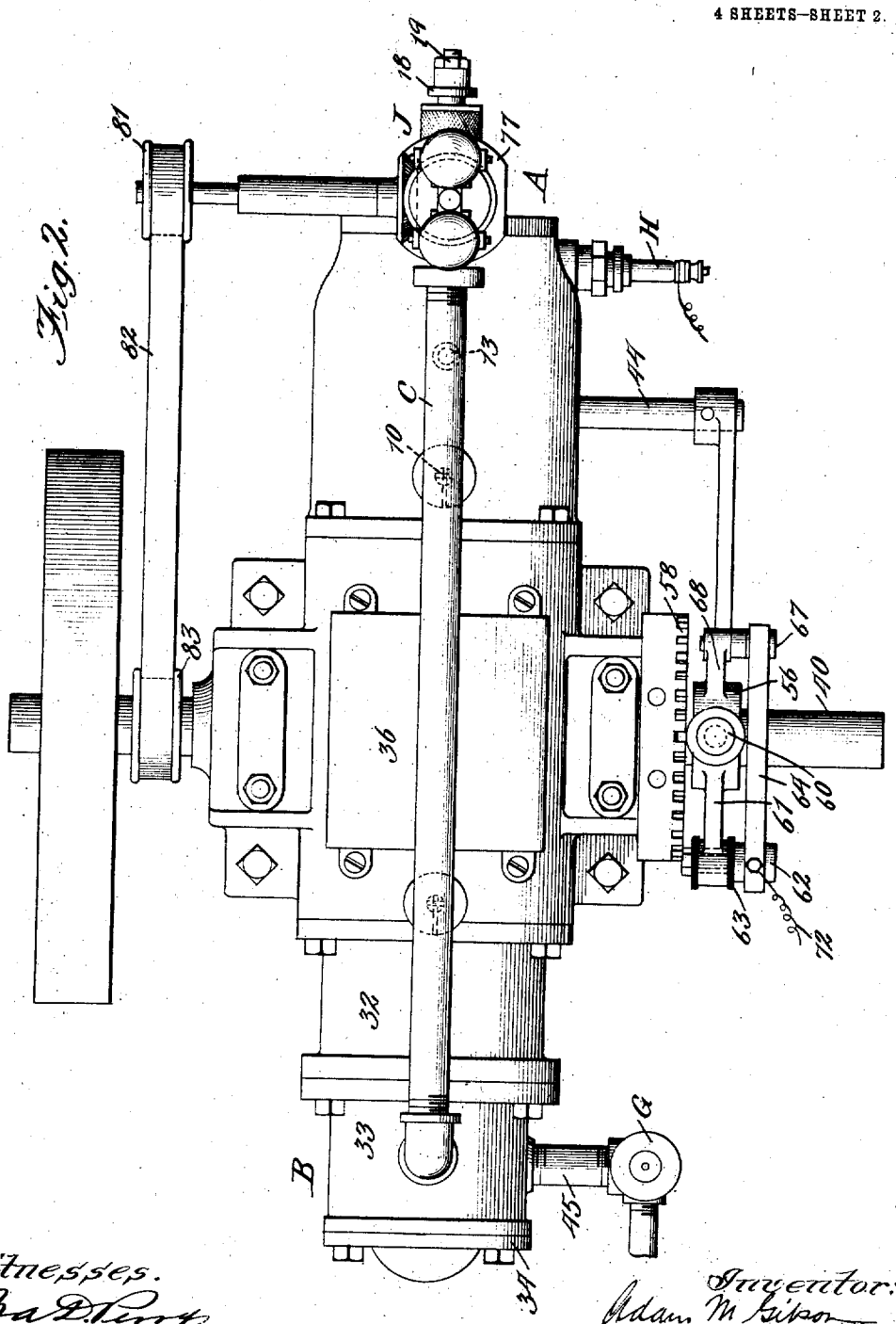
4 SHEETS—SHEET 2.

Fig. 2.



Witnesses.

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4 SHEETS—SHEET 3.

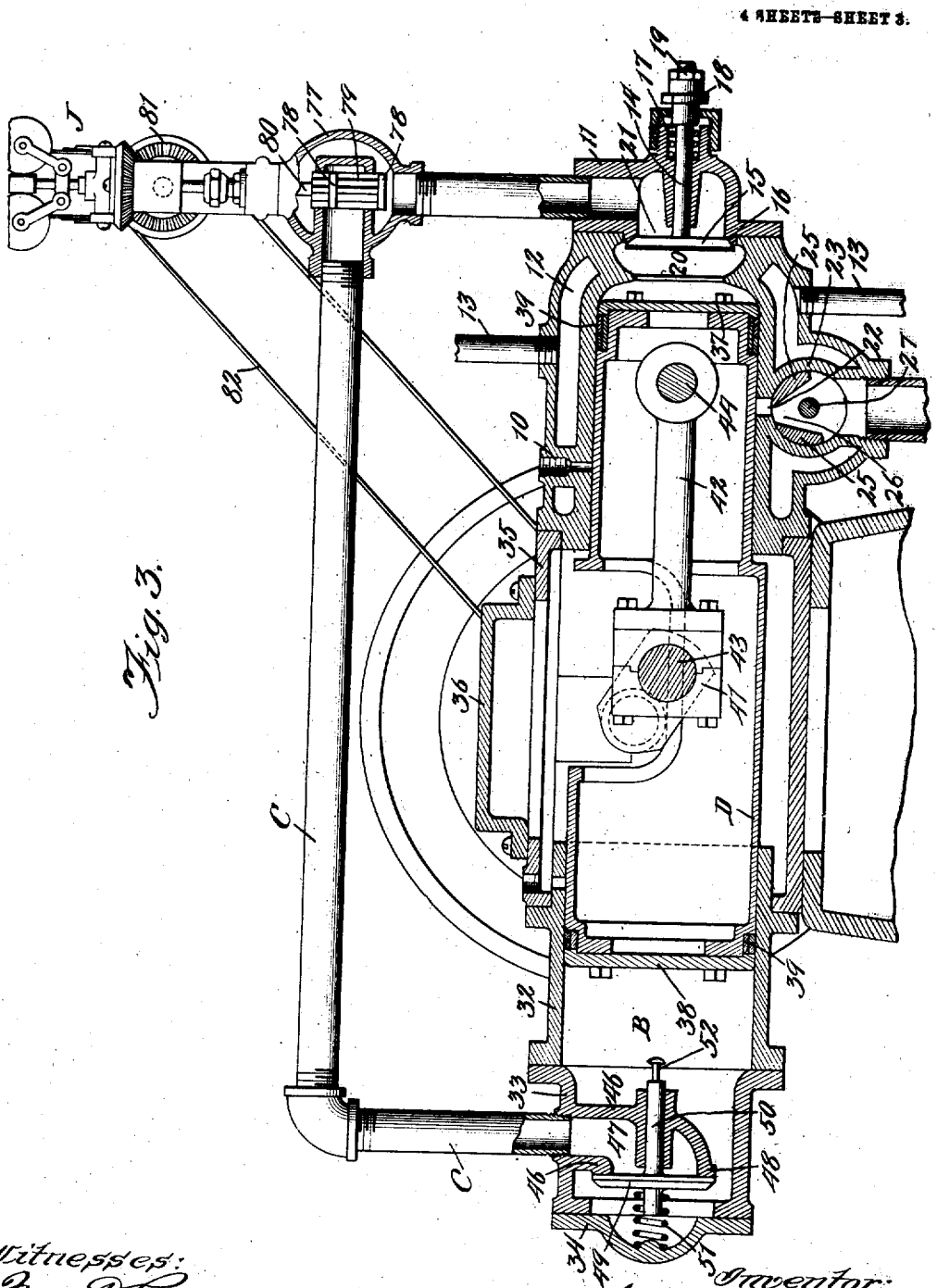

Fig. 3.

Witnesses:

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4 SHEETS—SHEET 4.

Fig. 5.

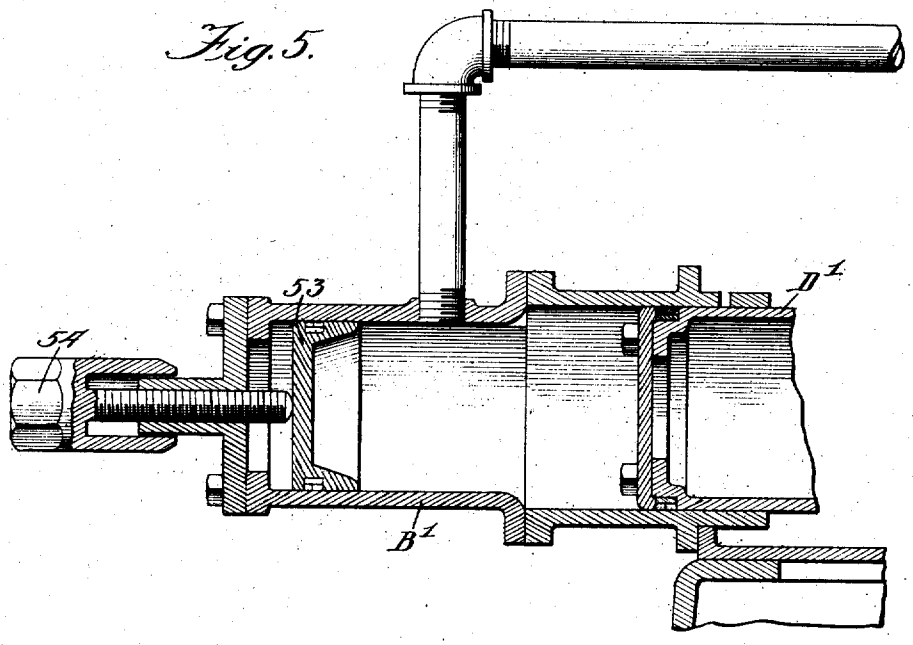
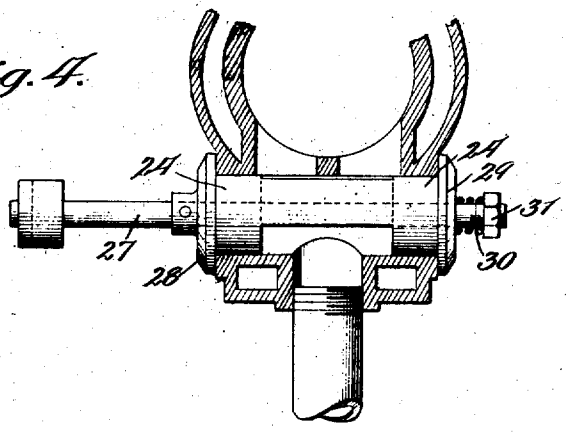


Fig. 4.



Witnesses:
Ira D. Perry
Albert J. Sauer

Inventor:
Adam M. Gibson
By Otto R. Barnett
Atty.

UNITED STATES PATENT OFFICE.

ADAM M. GIBSON, OF CHICAGO, ILLINOIS.

GAS-ENGINE.

1,043,221. Specification of Letters Patent. Patented Nov. 5, 1912.

Application filed January 4, 1909. Serial No. 470,613.

To all whom it may concern:

Be it known that I, ADAM M. GIBSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention relates to a gas engine and has for its object to provide an engine of the explosive type which shall be simple and inexpensive to construct, economical of fuel, which requires but little attention when running, and in which the liability of the parts to get out of order or adjustment is minimized.

More particularly, the invention has for an object to provide a two cycle, explosive engine provided with an exhaust port, the effective size of which can be varied according to the speed at which the engine is running; this construction making it possible to obtain the expulsion of all of the burnt gases, even when the speed is high, and to prevent at all times any appreciable escape of the charge.

The invention has for a further object to provide a peculiar construction for the explosion cylinder and a peculiar location of the intake and exhaust ports of the same, whereby the incoming charge effectually expels the burnt charge.

The invention has for a further object to provide a feed cylinder having a piston working simultaneously with the piston of the explosion cylinder, the feed cylinder being so connected with the explosion cylinder that the charge first drawn into the feed chamber is compressed and forced into the explosion cylinder under pressure, thus insuring the expulsion of the burnt gases and the filling of the explosion cylinder with fresh gas. To this end, the feed cylinder is preferably of greater volume than the explosion cylinder, measured by corresponding positions of the respective pistons; and means may be provided for varying the effective volumetric contents of the feed cylinder in order to vary the pressure at which the charge is introduced into the explosion cylinder.

The invention further contemplates arranging the two cylinders in line with each other and employing a double piston, consisting of a single, rigid structure, and journaling the crank shaft centrally of the piston and out of line with the connecting rod.

The invention has for a secondary, but nevertheless important, object, to provide a gas engine in which the driven shaft may be oscillated back and forth, less than a full revolution, when desired, instead of being rotated continuously in the same direction.

The invention has for further objects such new and improved constructions, devices and arrangements in gas engines, and particularly in gas engines of the two cycle type, as will be described in the accompanying specification and particularly set forth in the claims appended thereto.

One embodiment of my invention is shown in the accompanying drawings, wherein—

Figure 1 is a side elevation of a gas engine of the two cycle type, the ignition apparatus and its circuits being, however, shown in diagram. Fig. 2 is a plan view of the engine. Fig. 3 is a longitudinal, vertical section. Fig. 4 is a detail, cross section of the exhaust valve; and Fig. 5 is a detail, longitudinal section illustrating a modified construction of the feed cylinder.

Like characters of reference indicate like parts in the several figures of the drawings.

A represents the explosion cylinder, B the feed cylinder, C a connecting pipe leading from the latter to the former, D the double piston, E the spark coils and F the battery for the same. The explosion cylinder A is constructed, as here shown, of the castings 10 and 11, the former provided with the water chamber 12, to which lead the pipes 13. The casting 11 is perforated for the stem 14 of the intake valve 15, the valve being held against its seat 16 by a spring 17 abutting against an adjustable nut 18, which may be held in proper position by the nut 19. Any other construction of check valve might be employed. The end of cylinder A is preferably formed with a contracted throat 20, preferably of less diameter than the intake port 21, which is controlled by the check valve. This contracted throat is produced, as I have shown it, by causing the cylinder to taper at the end.

The charge, it will be understood, is compressed in the feed cylinder B and, at the proper time, forced through the connecting pipe C and into the explosion cylinder at

the end thereof. The contracted throat of the cylinder causes the incoming charge to be concentrated directly back of the body of burnt gases and the widening of the cylinder beyond the throat causes, as I apprehend it, a spreading of the incoming gases behind and against the burnt charge, with the result of very effectively expelling all of the burnt gases from the explosion cylinder.

The exhaust port 22 extends through the under side of the cylinder and is located preferably at some little distance from the end of the cylinder. One of the important objects of my invention is to provide means for varying the effective size of this port in accordance with the speed at which the engine is running. To this end, in the construction shown, a valve casing 23 is provided on the under side of the casting 10, in which is located a rotatable valve, a preferred construction of which is shown in Figs. 3 and 4. The valve consists of the end pieces 24, 24 connected by the segments 25, 25, which are spaced apart, making a port 26 of the same width as port 22. This valve piece is mounted on a shaft 27 on which is pinned a disk 28, which closes the valve chamber 23 at one end, the other end being closed by a disk 29, against which presses a spring 30, the tension of which may be adjusted by nut 31. By rotating this valve, one of the segments 25 may be made to partially close the port 22 and I have provided means, which will be described later, for effecting this adjustment in accordance with the speed at which the engine is running. Any other construction of valve might be employed in this connection.

The feed cylinder B is composed, as shown, of the castings 32, 33 and 34, suitably bolted together, as shown. The cylinders A and B are bolted to a central casting 35 with an opening at the top which is preferably provided with the removable cap 36.

The piston D may be made of a single casting provided at the ends with the heads 37 and 38. Packing of any desired form may be employed, such as the packing rings 39. The casting forming the piston is hollow and has an opening in the top, and the connecting rod and cranks are within the piston. I have shown the driven shaft 40 of the engine provided with cranks 41, to the crank pin 43 of which is connected, in the usual manner, the connecting rod 42, which is connected to the forward end of the piston by the pin 44. It will be seen that the crank shaft is journaled above the point of attachment of the connecting rod with the piston. By this arrangement, during the working part of the stroke, the connecting rod is substantially in line with the line of travel of the piston, which, of course, is the most favorable position. The inclination of the connecting rod is, of course, increased on the forward stroke, but that is of little importance.

The feed cylinder B is connected by a pipe 45 with the carbureter G, of any desired construction. As the carbureter forms in itself no part of my invention, it is not shown nor described in detail. When the piston D moves forward, a charge of gas and air is drawn into the feed chamber through pipe 45, which charge is compressed by the back stroke of the piston and is forced through the pipe connection C into the explosion cylinder A. Preferably I make the feed cylinder B of greater diameter than the explosion cylinder, so that there is always more than enough gas in the feed cylinder to fill the explosion cylinder, as well as the connecting pipe C. This insures a full charge.

The engine will operate successfully without a separate valve for the outlet from cylinder B. Such a valve may, however, be employed. I have shown in the drawings a suitable valve which is so constructed as to open just at the proper time. The casting 33 is formed with the internal web 46, constituting an outlet port 47, to which the pipe C is connected, and affording a seat 48 for the disk valve 49, the stem 50 of which extends through a perforation in the web. A spring 51 holds the disk against its seat. With a back stroke of piston D, the gas in cylinder B is compressed, this pressure assisting the spring in holding the valve to its seat. Before the piston reaches the end of the stroke, it engages with the stem of the valve, forcing the valve open long enough to allow the charge, which is under very considerable pressure, to escape through pipe C and into the explosion cylinder. As there will be need of an initial adjustment of this timing feature, I provide the stem or the head of the piston with an adjustable part which may be set to the proper position after the engine has been set up and tested. I have shown in the drawings a screw 52 in the end of stem 50. As stated, the entire valve might be omitted, as the check valve 15 operates against the pressure in cylinder A and is arranged as to open only when the pressure is lowered after the explosion has taken place.

In Fig. 5 I have shown a modified and preferred construction of the feed cylinder, in which the adjustable timing valve may be omitted and which has advantages not possessed by the construction shown in the other features. The feed cylinder B′ is, in this case, provided with a suitably packed disk 53, which can be adjusted to various positions in the cylinder by the set screw 54, which is threaded through the end of the cylinder. The position of the disk 53 will obviously vary the volumetric

contents of the cylinder for any given position of the piston, indicated in this figure by D′, which will, of course, vary the pressure and amount of the charge taken into the cylinder provided the feed cylinder for all positions of the disk has greater capacity than cylinder A.

I prefer to connect the valve controlling the exhaust port of the explosion cylinder with the ignition apparatus of the engine, so that the effective size of the exhaust port will be increased as the spark is advanced and the speed of the engine increased. To this end, I provide the driven shaft 40 with an eccentric 55 and make the contact in the battery circuit between this eccentric and an adjustable device, the position of which controls the position of the valve. Loose on the shaft 40 is a collar 56 having a handle 57 which can be set at various angular positions upon a toothed sector 58, the handle being provided with a tooth 59 which is operated by the thumb piece 60 in the manner usual to constructions of this sort. The collar is provided with the arm 61, in the end of which is pivoted a pin 62, these parts being completely insulated by means of the washer 63, of rubber compound or other insulating material. To the pin 62 is connected one end of a bar 64, the other end of which rests on the insulating button 65 on the end of the screw 66, which can be adjustably set in a pin 67 pivoted to the arm 68 extending from collar 56 in the opposite direction from arm 61. The arm 68 is connected with the shaft 27 of the valve controlling exhaust port 22 by means of the links 69 and 70, the latter being preferably secured to shaft 27 by the set screw 71, which permits an initial adjustment of the links.

The battery circuit consists of the wire 72 leading from pin 62, which, with the bar 64, is completely insulated from the rest of the machine, to the battery F; wire 73 leads from the battery to one primary terminal of the spark coil box (the latter being of any desired construction and not here shown in detail); wire 74 from the other primary terminal of the spark coil box to the engine; the wires 75 and 76 lead from the secondary terminals of the spark coil, respectively, to a point on the engine and the spark plug H. The latter may be of any desired type and extends into the explosion cylinder at its forward end in the usual manner.

As the movement of the operating handle 57 toward the right (Fig. 1) will slow down the spark and a movement in the opposite direction will advance it, then, with the slowing of the spark, the exhaust valve will be rocked so as to bring the right hand segment 25 (Fig. 3) partly over the port 22, thus decreasing the effective size of the opening through which the interior of the explosion cylinder is in communication with the atmosphere. As the spark is advanced, the size of the opening will be gradually increased by a rotation of the valve in the opposite direction.

It has been customary, so far as I am aware, to govern gas engines at the point at which the charge is first taken into the engine. I have found that there are advantages, particularly in the construction of engine above described, in governing the amount of the charge which goes to the explosion cylinder at a point between the two cylinders. Without confining myself to any particular form of valve or governor, I have shown apparatus for controlling the supply of gas which goes to the explosion cylinder without directly affecting the taking in of the gas in the feed cylinder. In the pipe C is located a valve casing 77, in which is a sliding valve consisting of the solid disks 78 and the guides 79, which are spaced apart. This valve is connected to the rod 80 of a governor J of ordinary type, which need not be described in detail, the driven pulley 81 of this governor being connected by a belt 82 with a pulley 83 on the driven shaft 40 of the engine. As the engine speeds up, the rod 80 of the governor lifts the valve and shuts off, to a more or less extent, the inflow of gas into the explosion cylinder.

The operation of the engine is as follows: When the piston moves forward, the charge is drawn into cylinder B from the carbureter G. A backward movement of the piston compresses the gas in cylinder B and, (in case the timing valve is employed), when the piston head 38 reaches the screw 52, valve 49 is opened against the spring 51 and the pressure in the cylinder and the charge is driven around through pipe C, past the valve 78 and valve 15, into the end of the explosion cylinder. The part of the piston in cylinder A has by this time uncovered port 22 and the incoming charge, which is concentrated by passing through the contracted throat at the end of the cylinder, expands behind the body of burnt gases and, as I apprehend it, has a scouring action around the curved surface within the throat, and thus forces the body of burnt gases through the cylinder and out of the exhaust port 22. The cross sectional area of this opening has been determined by the position of handle 57, which controls the ignition apparatus. When the spark is slow, the port 22 is partly closed, because, in such case, the engine is running slow and there is ample time for the expulsion of all of the burnt gases. The opening should be no larger than is necessary to insure a clean cylinder, because, if too large, there is danger that some of the fresh charge will escape. As the engine is speeded up, the

cross-sectional area of the opening is increased by the rotation of the valve. The increased speed of the engine makes a larger outlet for the burnt gases necessary and, if the initial adjustment of the valve, which can be effected by means of the set screw 71, is correct, the size of the exhaust opening will be so proportioned to the spark that for all speeds the burnt gases will be completely expelled without material loss of the fresh charge. With a forward movement of the piston, a new charge is taken into cylinder B and the charge received in cylinder A is compressed, the piston as soon as it moves forward closing the exhaust port 22. When the piston reaches the proper point, this being determined by the position of handle 57, the charge is exploded and the piston driven back, as above described. The position of the handle 57 times the spark relative to the position of the piston by shifting the angular position of the bar 64 relative to the shaft 40, so that the enlarged part of the eccentric comes into contact with the bar sooner or later in its revolution, as the case may be. The valve controlling the exhaust is given just the same amount of rotation as the bar 64 when the position of handle 57 is changed. When the eccentric comes into contact with bar 64, the circuit is closed through the primary coil of the sparker, current being induced in the secondary, which produces the spark in the explosion cylinder.

It will be seen that, by introducing the fresh charge into the end of the cylinder in such a manner as to drive the whole body of burnt gases through the cylinder toward the exhaust port, the forward end of the cylinders, where the spark is produced, is sure to be filled with clean gas, even though, for some reason, the burnt gases are not completely exhausted. Such burnt gases as may remain will be crowded away from the forward end of the cylinder, so that there is no danger of the engine missing fire if any new charge at all is introduced into the cylinder.

By making the piston a single, rigid structure which is guided at each end by contact with the cylinders, that is practically a combined piston and cross head, I avoid any rocking motion of the piston, likely to cause wear and noise. This double piston is always working against a pressure of gas at each end and, for this reason the engine is very quiet in its action, the crank connections particularly being kept from rattling. The space within casting 36 beneath the piston can be filled with oil, so that the piston will be self-oiling.

By journaling the crank shaft above the center of the piston, the connecting rod is in the most favorable position for doing work during the working part of its stroke, because it is in a substantially horizontal position through the movement backward of the piston. This involves, of course, having the connecting rod at an increased inclination during a part of the forward stroke, but that is a matter of little importance, because at this time the parts are moving by their momentum and because of the pressure in cylinder B.

By governing the charge at a point between the two cylinders, I insure keeping the feed cylinder full of gas, which makes the engine easier to start after a momentary stop. Ordinarily it has been the custom to govern the engine at the carbureter or intake, which means that, after the governor has acted to stop the inflow for any reason, both the explosion cylinder and the feed cylinder, or its equivalent, have to be filled up with gas before the engine can start or continue its regular operation. The feed cylinder acts not only to force the charge into the explosion cylinder under pressure, but also as a mixer. This latter function is increased when the cylinder is made of greater volume than the explosion cylinder, because there is then in the feed cylinder always a certain amount of gas which has been churned up by a previous movement of the piston.

When the construction of feed cylinder shown in Fig. 5 is employed in connection with the features of my engine, several advantages are obtained. The timing valve controlling the outlet from the feed cylinder may be omitted. It will be observed that valve 15 which controls the inflow of the charge to explosion cylinder necessarily operates against the pressure in the cylinder so that this arrangement itself times the charging of the explosion cylinder. A back stroke of the piston compresses the gas in the feed cylinder and in connecting pipe C, (assuming that valve 49 is omitted), but until there has been a reduction of pressure in cylinder A, caused by the exhausting of burnt gases through port 22, no fresh charge will pass valve 15. In the construction of Fig. 5, the adjustability of disk 53 by varying the pressure in the feed cylinder, which pressure can be thus made more or less, according to whether the engine is running at high speed or low speed, takes the place of the adjustment of the timing valve shown in Fig. 3. If the engine is to run at 100 revolutions, the disk will be relatively far back in the feed cylinder. If the engine is to run at 500 revolutions, the disk may be advanced, in which case a greater pressure will be exerted on the back of valve 15, tending to open this valve more quickly when the engine is thus running at the higher rate of speed. Under such circumstances there is no danger that the increased pressure of the charge entering the

explosion cylinder will cause a loss through the exhaust port because the opening through this port will be made smaller when the engine is running at a high rate of speed.

In four cycle engines, in order to obtain greater pressure in the cylinder of a given engine, it is necessary to decrease the volumetric contents of the cylinder by making, for example, the cylinder shorter. In my construction of engine, the pressure in the explosion cylinder may be increased without decreasing the volumetric contents of such cylinder. By a forward adjustment of disk 53, the pressure in the feed cylinder will be increased which will give an increase both of the amount of gas and of pressure in the explosion cylinder, provided, of course, the feed cylinder is always larger than the explosion cylinder. This adjustable feature is also valuable in adapting the engine to different fuels. Less pressure is needed when the fuel is gasolene, for example, than when ordinary illuminating gas is used. Where the charge is timed by relative pressures on opposite sides of the valve 15, a full cylinder is insured, even under varying conditions. Even after the piston has begun to move forward and closed the exhaust port, the charge will continue coming into the cylinder, provided the pressure warrants it.

An engine constructed as above described is capable of being operated to give the crank shaft an oscillating instead of a rotary movement, that is, of turning the crank shaft back and forth for a fraction of a revolution. It is very desirable to have an engine which can be made to so operate, as, for example, when a reciprocating movement is to be given the driven part, as in pumping, churning or the like. By starting the engine with an advanced spark, I can obtain this oscillating movement of the crank shaft. The crank makes somewhat more than a half revolution until it gets approximately to the position of the greatest inclination of the piston rod, and then moves back again in the opposite direction. The force of this oscillating movement is very considerable. The capacity of the engine to so operate is due, as I apprehend it, partly to the position of the journals of the crank shaft above the center of the piston, and partly to the balancing of the piston by the bodies of gas in the two cylinders.

I do not limit myself to the particular devices, constructions and arrangements shown and described, as modifications might be devised which would come within my invention as defined by the claims.

I claim:

1. A gas engine, comprising an explosion cylinder having an exhaust opening, and means for varying by one operation the speed at which the engine is running and the cross-sectional area of the opening in accordance with the speed at which the engine is running.

2. A gas engine, comprising an explosion cylinder having an exhaust opening, a timing device for the spark, and means for varying the cross-sectional area of the exhaust opening in accordance with the position of the timing device.

3. A gas engine, comprising an explosion cylinder having an exhaust port, a valve to vary the effective size of said port, a variable ignition device, and a connection between the ignition device and the valve, whereby the position of one conditions that of the other.

4. A gas engine, comprising an explosion cylinder having an exhaust port, a valve to vary the effective size of the port, an ignition device comprising a member adapted to be set to control the time of the spark, and a link connection between the valve and said member.

5. A gas engine, comprising an explosion cylinder having an exhaust port, a valve to vary the effective size of the port, an ignition device comprising an eccentric driven by the engine, and a contact device adapted to be set at different positions with respect to the eccentric; and a connection between said contact device and the valve.

6. A gas engine, comprising an explosion cylinder having an exhaust port, a valve to vary the effective size of said port, an eccentric fixed on the shaft of the engine, a contact device rotatably mounted on said shaft, means for setting said contact device in different positions on the shaft, and a link connection between the contact device and said valve.

7. A gas engine, comprising an explosion cylinder and piston, said cylinder having an intake port at one end, and an exhaust port in the side of the cylinder; means for introducing the charge into the cylinder under pressure, a timing device for the spark, and means for varying the effective size of the exhaust port in accordance with the position of the timing device.

8. A gas engine, comprising an explosion cylinder with an intake port at one end, a feed cylinder, a connecting pipe leading from the feed cylinder to the intake port of the explosion cylinder, a double piston for said cylinders, an exhaust opening through the side of the explosion cylinder, a timing device for the spark, and means for varying the effective size of said exhaust opening in accordance with the position of the timing device.

9. A gas engine, comprising an explosion cylinder having an inlet port through the end thereof and an exhaust port through the side, a feed cylinder, a connecting pipe lead-

ing from the feed cylinder to the inlet port of the explosion cylinder, a check valve for said inlet port, a double piston for said cylinders, a centrally arranged crank in said piston to operate the same, a valve to vary the effective size of the exhaust port, an ignition device having an operating handle for timing the spark, and a connection between said handle and the valve controlling the exhaust port.

10. A gas engine, comprising an explosion cylinder, a piston, a feed cylinder in which the gas is compressed with a back stroke of the piston, means for introducing the gas from the feed cylinder into the explosion cylinder at times determined by the pressure in said explosion cylinder and means for varying the exhaust from the explosion cylinder in accordance with the speed at which the engine is running.

11. A gas engine comprising an explosion cylinder and a piston, said cylinder having an intake port and an exhaust port; a feed cylinder, means for introducing the gas from the feed cylinder into the explosion cylinder, means for varying the effective size of the exhaust port of the explosion cylinder, a disk fitted within said feed cylinder, and means for adjusting the position of the disk so as to vary the effective size of the feed cylinder; the volumetric contents of said feed cylinder being at all times greater than that of the explosion cylinder, whereby the pressure of the gas introduced into the latter may be increased without diminution of the amount of the charge.

12. In a gas engine the combination with an explosion cylinder and a piston, of means for varying the speed at which the engine is run, and means operated by said last named means for correspondingly varying the discharge of burnt gases from the explosion cylinder.

13. In a gas engine, the combination with an explosion cylinder and piston, of a timing device for the spark and means for varying the discharge of burnt gases from the explosion cylinder in accordance with the position of the timing device.

14. In a gas engine, the combination with an explosion cylinder and piston, of means comprising a spring pressed valve set in operation by a decrease in pressure in the explosion cylinder after an explosion for introducing a fresh charge of gas, means for varying the discharge of burnt gases from said explosion cylinder in accordance with the speed of the engine, and means for varying the amount of the fresh charge introduced into the explosion cylinder.

15. In a gas engine, the combination with an explosion cylinder and piston, of means comprising a spring pressed valve set in operation by a decrease in pressure in the explosion cylinder after an explosion, for introducing a fresh charge of gas, means for varying the discharge of burnt gases from said explosion cylinder in accordance with the speed of the engine, and means for varying the amount of the fresh charge introduced into the explosion cylinder in accordance with the speed of the engine.

16. In a gas engine, the combination with an explosion cylinder, of a feed cylinder, a conduit between the same, pistons in said cylinders which operate together, means for varying the size of the feed cylinder relative to any given position of its piston, and means for varying the discharge of burnt gases from the explosion cylinder in accordance with the speed of the engine.

17. In a gas engine, the combination with an explosion cylinder, of a feed cylinder, a conduit between the same, pistons in said cylinders which operate together, an inlet valve for the explosion cylinder arranged to be opened by pressure, said explosion cylinder provided with an exhaust port, and means operated by the timing device for the spark for varying the effective cross-sectional area of said exhaust port.

18. In a gas engine, the combination with an explosion cylinder, of a feed cylinder, a conduit between the same, pistons in said cylinders which operate together, an inlet valve for the explosion cylinder arranged to be opened by pressure, said explosion cylinder provided with an exhaust port, means for varying the effective cross-sectional area of said exhaust port, a valve between the feed cylinder and said inlet valve, and a governor to control the same in accordance with the speed of the engine.

19. In a gas engine, the combination with an explosion cylinder, of a feed cylinder, pistons in said cylinders which operate together, a conduit leading from the feed cylinder into the end of the explosion cylinder, an inlet valve for the explosion cylinder which is opened by pressure, said explosion cylinder being provided with an exhaust port, means for varying the effective cross-sectional area of said exhaust port, a valve interposed in said conduit between the feed cylinder and said inlet valve, and a governor to control the position of the inlet valve in accordance with the speed of the engine.

20. In a gas engine, the combination with an explosion cylinder, of a feed cylinder, pistons in said cylinders which operate together, a conduit leading from the feed cylinder into the end of the explosion cylinder, an inlet valve for the explosion cylinder which is opened by pressure, said explosion cylinder being provided with an exhaust port, means for varying the effective cross-sectional area of said exhaust port, a valve interposed in said conduit between the feed cylinder and said inlet valve, a governor to

control the position of the inlet valve in accordance with the speed of the engine, a timing device for the spark, and connections between the timing device and said means for varying the cross-sectional area of the exhaust port, whereby the position of the former determines the position of the latter.

21. A gas engine comprising an explosion cylinder having an inlet port and an outlet port, means for varying the effective size of the latter port in accordance with the speed at which the engine is running, means for compressing the gas before it enters the explosion cylinder, a conduit leading from said compressing means to the inlet port of said explosion cylinder, and a governor comprising a valve interposed in said conduit, the position of which is varied in accordance with the speed of the engine.

22. In a gas engine, the combination with an explosion cylinder having an inlet and an outlet port, of means for varying the effective size of the latter in accordance with the speed at which the engine is running; a feed cylinder, pistons which work simultaneously in said cylinders, and means for varying the effective size of the feed cylinder; the volumetric contents of the feed cylinder being at all times greater than that of the explosion cylinder, so that by decreasing the effective size of the feed cylinder an increased pressure is obtained in the explosion cylinder without any diminution in the amount of the charge.

ADAM M. GIBSON.

Witnesses:
P. H. TRUMAN,
H. L. PECK.

Corrections in Letters Patent No. 1,043,221.

It is hereby certified that in Letters Patent No. 1,043,221, granted November 5, 1912, upon the application of Adam M. Gibson, of Chicago, Illinois, for an improvement in "Gas-Engines," errors appear in the printed specification requiring correction as follows: Page 6, line 88, after the word "port" insert the words *a timing device for the spark;* same page, line 91, after the word "port" insert the words *in accordance with the position of the timing device;* and same page, line 102, after the word "same" and line 117, after the word "valve" insert the word *automatically;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of December, A. D., 1912.

[SEAL.]

C. C. BILLINGS,
Acting Commissioner of Patents.

control the position of the inlet valve in accordance with the speed of the engine, a timing device for the spark, and connections between the timing device and said means for varying the cross-sectional area of the exhaust port, whereby the position of the former determines the position of the latter.

21. A gas engine comprising an explosion cylinder having an inlet port and an outlet port, means for varying the effective size of the latter port in accordance with the speed at which the engine is running, means for compressing the gas before it enters the explosion cylinder, a conduit leading from said compressing means to the inlet port of said explosion cylinder, and a governor comprising a valve interposed in said conduit, the position of which is varied in accordance with the speed of the engine.

22. In a gas engine, the combination with an explosion cylinder having an inlet and an outlet port, of means for varying the effective size of the latter in accordance with the speed at which the engine is running; a feed cylinder, pistons which work simultaneously in said cylinders, and means for varying the effective size of the feed cylinder; the volumetric contents of the feed cylinder being at all times greater than that of the explosion cylinder, so that by decreasing the effective size of the feed cylinder an increased pressure is obtained in the explosion cylinder without any diminution in the amount of the charge.

ADAM M. GIBSON.

Witnesses:
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Corrections in Letters Patent No. 1,043,221.

It is hereby certified that in Letters Patent No. 1,043,221, granted November 5, 1912, upon the application of Adam M. Gibson, of Chicago, Illinois, for an improvement in "Gas-Engines," errors appear in the printed specification requiring correction as follows: Page 6, line 88, after the word "port" insert the words *a timing device for the spark;* same page, line 91, after the word "port" insert the words *in accordance with the position of the timing device;* and same page, line 102, after the word "same" and line 117, after the word "valve" insert the word *automatically;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of December, A. D., 1912.

[SEAL.]

C. C. BILLINGS,
Acting Commissioner of Patents.