H. A. BURT.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED SEPT. 18, 1908.

948,308.

Patented Feb. 8, 1910.

2 SHEETS—SHEET 1.

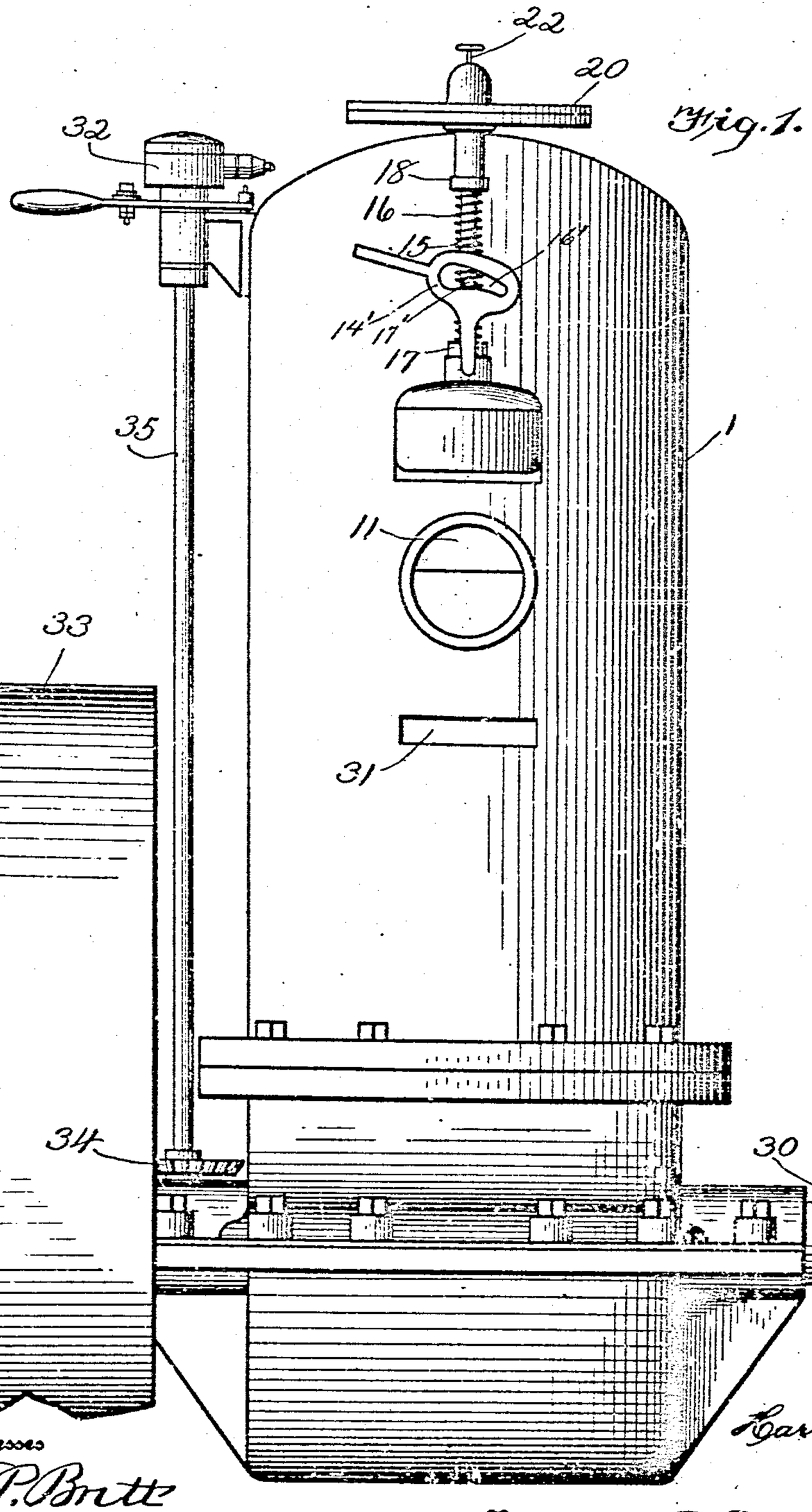

Fig. 1.

Witnesses

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2 SHEETS—SHEET 2.

Fig. 3.

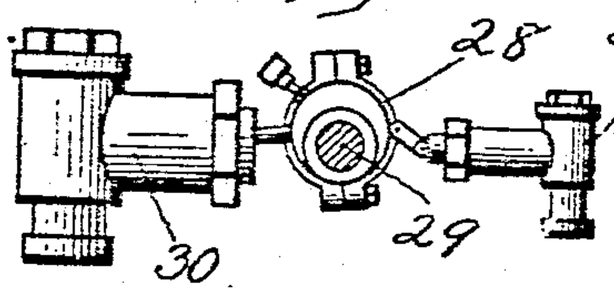

Fig. 2.

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INTERNAL-COMBUSTION ENGINE.

948,308. Specification of Letters Patent. Patented Feb. 8, 1910.

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To all whom it may concern:

Be it known that I, HARRY A. BURT, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Internal-Combustion 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 figures of reference marked thereon, which form a part of this specification.

My invention relates to the class of internal combustion engines, and has for its object to provide an engine so constructed and arranged that the engine cylinder is effectually scavenged of all burned gases remaining therein after each explosion within the combustion chamber.

A further object of my invention is to provide an internal combustion engine so constructed and arranged that the power stroke may be longer than the compression stroke, in such manner that the gas therein will exhaust therefrom at substantially atmospheric pressure, or it may be arranged so that the power stroke is equal in length to the compression stroke, and the gas exhausted from the engine at usual pressure.

With all these objects in view my invention consists in the novel construction and arrangement of parts, and particularly in the location and arrangement of the auxiliary valve and port located at a point in the engine cylinder above the usual exhaust port, and in the construction and operation of this valve automatically.

My invention farther consists in certain other novel details of construction and in combinations of parts, all of which will be first fully described and afterward specifically pointed out in the appended claims.

Referring to the accompanying drawings: Figure 1 is a side elevation of the internal combustion engine constructed in accordance with my invention. Fig. 2 is a transverse vertical sectional view through the same, and Fig. 3 is a detail view illustrating the water circulating pump and fuel pump connected to the eccentric on the engine shaft.

Like numerals of reference indicate the same parts throughout the several figures in which:

1 indicates the engine which comprises the combustion chamber 2, cylinder 3, water jacket 4, crank case 5 and piston 6. As will appear from Fig. 2 the piston 6 is enlarged at its bottom portion forming an auxiliary or differential piston 7, said piston 7 operating within the auxiliary or differential cylinder 8. The working piston 6 and the auxiliary or differential piston 7 are provided with suitable compression rings 9 as clearly shown.

Connecting the crank case 5 with the combustion chamber 2 is a bypass 10 and at a point in the cylinder substantially opposite the opening of the bypass therein is arranged the exhaust port 11. Arranged above the exhaust port 11 and at a suitable point in the wall of the cylinder 3 is an auxiliary port 12, said auxiliary port communicating with a valve chamber 13, within which chamber is a balanced puppet valve 14, said valve 14 being carried on a stem 15 over which stem is a coil spring 16, one end of said spring being in engagement with the guide 17 on the valve chamber 13; the other end of said spring 16 being in engagement with a collar 18 secured to the stem 15, the normal tendency of said spring being to unseat the valve 14.

19 indicates a diaphragm arranged over the end of the valve stem 15 and normally in engagement therewith, said diaphragm 19 being housed within a suitable casing 20. Connected with the diaphragm casing 20 and with the explosion chamber 2 of the engine is a pipe 21, within which pipe is arranged a suitable valve 22 for the purpose of closing communication between the diaphragm casing 20 and the engine cylinder. Suitably arranged in the head 23 of the cylinder is a spark plug 24, the same being preferably what is usually termed a "jump spark plug," although as is clearly evident any other suitable type of ignition device can be employed, the location of the sparking points 25 being preferably as shown in Fig. 2.

26 indicates a needle valve through which the fuel is led into the firing chamber 2, this construction providing for introducing the fuel into the firing chamber in a liquid state. Connected with the needle valve 26

by means of any suitable pipe or connection is a fuel pump 27 (Fig. 3), said pump being connected to and operated by a suitable eccentric 28 preferably on the engine shaft 29; it being of course understood that the pump 27 is so constructed, arranged and operated that it will force a sufficient quantity of fuel into the firing chamber 2 at the proper time and when the engine piston 6 is at a certain predetermined point in its stroke.

30 indicates the usual water circulating pump which obviously can be connected to and operated by the eccentric 28, while of course an engine constructed in accordance with my invention and of the air-cooled type obviates the necessity of the water circulating pump.

Referring now to Figs. 1 and 2 it will be seen that a port 31 is located in the auxiliary cylinder 8 at a point above the limit of the up stroke of the auxiliary or differential piston 7; and as will appear from Fig. 2 the bore of the auxiliary cylinder 8 is considerably larger than the bore of the engine cylinder 2.

Referring now to Fig. 1, 32 indicates a circuit breaker or timer which is geared to the fly-wheel 33 by means of a beveled gear 34 carried on the shaft 35 and a similar gear wheel attached to the fly-wheel, said last mentioned gear wheel not being shown.

While I have illustrated the circuit breaker or timer it is of course evident that any other system of ignition other than the jump spark can be employed, in which event no commutator or timer will be applied to the engine.

Having thus fully described the several parts of my invention its operation is as follows: Referring to Fig. 2 it will be seen that the piston 2 is at the limit of its upward stroke. We will consider that a proper quantity of fuel has been introduced into the cylinder and that the same is being fired. While the valve 14 is usually seated by the compression within the cylinder at the time of the explosion of the compressed gas, the explosion acting on the piston will move the piston downwardly on its power stroke and the pressure within the cylinder will pass through the pipe 21 and act upon the diaphragm 20, forcing said diaphragm into position shown in Fig. 2, and seat the valve 14. The piston will move until it reaches the exhaust port 11, at which point the exhaust will take place. As the piston uncovers the exhaust port 11 in one side of the cylinder it will also uncover the port of the bypass 10, and as the auxiliary or differential piston 7 has on its down stroke compressed the air within the crank case 5, the said air will pass up through the bypass 10 and into the cylinder, and the area of the auxiliary cylinder 8 being much greater than that of the engine cylinder 2 a correspondingly greater quantity of air is forced into the engine cylinder 2; in fact a greater quantity is forced into the engine cylinder 2 than can be accommodated therein; consequently the excess air will enter the engine cylinder and pass out through the exhaust port 11 carrying with it the burned gases. As soon as the exhaust takes place through the exhaust port, or when the pressure within the engine cylinder becomes equal to that of the atmosphere the spring 16 raises the valve 14. The piston now starts on its upward stroke, the valve 14 being opened. Consequently a large portion of the air and any remaining burned gases within the cylinder 2 will be forced out through the port 12 and valve 14 until the said port 12 is closed by the upward stroke of the piston. The port 12 being now closed by the piston the compression of the air remaining within the cylinder commences, and as the piston reaches the position shown in Fig. 2 the fuel is injected therein through the needle valve 26, the air within the compression space being under high compression the liquid fuel is instantly converted into gas and fired. It will thus be seen that the compression stroke of the piston is actually from the port 12 to the position shown in Fig. 2; while the power stroke of the piston is actually from the position shown in Fig. 2 to the exhaust port 11, that portion of the piston stroke from the port 12 to the exhaust port 11 allows the gas to further expand to such an extent that when the exhaust actually occurs through the exhaust port 11 the gases will have been expanded to substantially atmospheric pressure. In order to accomplish this the auxiliary port 12 must be located in the cylinder at a point above the exhaust port 11 so that the balance of the stroke of the piston will be long enough to allow the gas to expand to substantially atmospheric pressure. The relative locations therefore of the auxiliary port 12 and exhaust port 11 will vary to meet requirements of engines of different bores and strokes.

Whenever it is desired to give the engine a full power stroke, that is from the limit of its up stroke to the limit of its down stroke, the valve 22 within the pipe 21 is closed and the balanced valve 14 can be maintained in a seated position, by any suitable automatic or mechanical means. When in this position the air passing into the cylinder by means of the bypass 10 will cease to pass out from the exhaust port 11 as soon as said port is covered by the piston at the beginning of its up stroke. The compression of the remaining air within the cylinder will then commence as soon as the piston has covered the exhaust port 11 and said compression will continue until the piston has reached the position shown in Fig. 2. The fuel is injected into the cylinder when the piston is in this position and firing and the

power stroke will then continue until the piston has opened the exhaust port 11, the auxiliary port 12 and the valve 14 being cut out perform no function and therefore the gas is exhausted at the usual pressure because of the greater volume of the charge. However as is apparent the valve 22 may be closed in order to maintain the balanced valve in an open position in which event the cylinder starts, to exhaust as soon as the auxiliary exhaust port is uncovered by the piston and the power of the engine is thereby considerably reduced. In order to seat the valve 14 mechanically and prevent its operation, I provide a pivoted cam 14', said cam being provided with slots 16' acting on a pin 17' carried on the stem 15.

By reason of the complete scavenging of the cylinder on account of the introduction and exhausting of the excess air, which exhausting carries with it any remaining burned gases, a greater variation in the proportions of hydro-carbon and air can be ignited than is ordinarily possible for the reason that the mixture is not vitiated by the usual quantity of burned gases. Since practically none of the burned gases remain in the cylinder a better and more efficient combustible mixture can be obtained which results in an increase of power and in economy of fuel.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent of the United States, is;

1. An internal combustion engine comprising a cylinder a piston and a crank case, an auxiliary or differential piston formed on the lower end of said first mentioned piston and an auxiliary cylinder within which said differential or auxiliary piston operates said auxiliary cylinder opening into the crank case, the bore of said auxiliary cylinder being greater than the bore of said first mentioned cylinder, a bypass for causing communication between the crank case of the engine and the first mentioned cylinder, an exhaust port in said first mentioned cylinder controlled by the piston for exhausting the gas therefrom, an auxiliary port arranged in the first mentioned cylinder at a point between the limit of upstroke of the first mentioned piston and the said exhaust port, a valve commanding said auxiliary port, a valve stem, a diaphragm in engagement with said valve stem, means for communicating the pressure within the first mentioned cylinder to said diaphragm to close said valve commanding said auxiliary port, means for leading the fuel into the first mentioned cylinder and means for firing the same, the whole being arranged in such manner that an excess of air is delivered from the crank-case to the engine cylinder.

2. An internal combustion engine comprising a cylinder, a piston and a crank case, a bypass for effecting communication between the crank case of the engine and the engine cylinder, an exhaust port in said cylinder controlled by the piston for exhausting the gas therefrom, an auxiliary exhaust port located in said cylinder above said exhaust port, a valve commanding said auxiliary port, a valve stem, a diaphragm in engagement with said valve stem, means for communicating pressure within said cylinder to said diaphragm to seat said valve, means for leading the fuel into said cylinder, and means for firing the same.

3. An internal combustion engine comprising a cylinder, a piston and a crank case, a bypass for causing communication between the crank case and the engine cylinder, a piston controlled exhaust port for exhausting the cylinder, an auxiliary exhaust port arranged above said exhaust port, a valve commanding said auxiliary exhaust port, means for communicating the pressure within said cylinder to said valve to seat the same at the beginning of the power stroke of the piston, means for leading fuel to the engine cylinder and means for firing the same.

4. An internal combustion engine comprising a cylinder and a piston, an exhaust port in said cylinder, an auxiliary exhaust port covered by said piston during a portion of its stroke, a valve commanding said auxiliary exhaust port and means for utilizing the pressure within said cylinder to seat said valve at the time of the explosion within said cylinder.

5. An internal combustion engine comprising a cylinder and a piston, an auxiliary or differential piston formed on the end of the first mentioned piston, an auxiliary cylinder within which said auxiliary or differential piston operates, said auxiliary cylinder being larger in bore than the first mentioned cylinder, means for causing communication between the first mentioned cylinder and the auxiliary cylinder, a piston controlled exhaust port in the first mentioned cylinder, an auxiliary exhaust port in the first mentioned cylinder, said auxiliary exhaust port being adapted to be covered by the piston during a portion of its stroke, a valve commanding said auxiliary exhaust port and means for utilizing the pressure within the first mentioned cylinder to seat said valve when there is pressure within said cylinder.

6. An internal combustion engine comprising a cylinder and a piston, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder, said auxiliary exhaust port being adapted to be covered by the piston during a portion of the stroke of the piston, a valve commanding said auxiliary exhaust port, means for normally maintaining said valve in an un-

sealed position, and means for utilizing the pressure within said cylinder to seat said valve when there is pressure within said cylinder.

7. An internal combustion engine comprising a cylinder and a piston, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be covered by the piston during a portion of its stroke, a valve commanding said auxiliary exhaust port, means for seating the said valve by the pressure within the cylinder, and means for unseating the valve when the pressure has been relieved from the engine cylinder.

8. An internal combustion engine comprising a cylinder and a piston, means for introducing into said cylinder a volume of air greater than the capacity of said cylinder, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be uncovered by said piston during a portion of its stroke, a valve commanding said auxiliary exhaust port, means for utilizing the pressure within said cylinder to seat said valve during a portion of the power stroke of the piston, and means for unseating said valve when the pressure within the cylinder is relieved and for maintaining said valve in an unseated position during a portion of the return stroke of the piston.

9. An internal combustion engine comprising a cylinder and a piston, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be covered by the piston during a portion of its stroke, a valve commanding said auxiliary exhaust port, means for utilizing the pressure within said cylinder to seat said valve, and further means for maintaining said valve in a permanently seated position when said ports are uncovered by the piston.

10. An internal combustion engine comprising a cylinder and a piston, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be covered by said piston during a portion of its stroke, a valve commanding said auxiliary exhaust port, means for normally unseating said valve when said first mentioned exhaust port is uncovered by said piston, and means for maintaining said valve in a permanently seated position when said exhaust port is uncovered by said piston.

11. An internal combustion engine comprising a cylinder and a piston, an exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be covered by said piston during a portion of its stroke, a valve commanding said auxiliary port, means actuated by the pressure within said cylinder to seat said valve, and means for permanently relieving the valve seating means from the pressure within the cylinder in such manner that the said valve will not be seated thereby.

12. An internal combustion engine comprising a cylinder and a piston, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be covered during a portion of the stroke of the piston, a valve commanding said auxiliary exhaust port, means for normally unseating said valve during a portion of the normal compression stroke of the piston to exhaust the cylinder in such manner that the effective compression stroke of the piston is shorter than the normal stroke of the piston, and means actuated by the pressure within the cylinder for seating said valve.

13. An internal combustion engine comprising a cylinder and a piston, a piston controlled exhaust port in said cylinder, an auxiliary exhaust port in said cylinder adapted to be covered by said piston during a portion of its stroke, a balanced valve commanding said auxiliary exhaust port, and means for seating said balanced valve by the pressure within the cylinder.

14. An internal combustion engine comprising a cylinder and a piston, an exhaust port in said cylinder, an auxiliary exhaust port in said cylinder, a valve commanding said auxiliary exhaust port and means for seating said valve solely by the pressure within the cylinder.

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

HARRY A. BURT.

Witnesses:
C. HUGH DUFFY,
O. E. DUFFY.