C. O. HEDSTROM.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 20, 1908.

943,072. Patented Dec. 14, 1909.

Fig. 1.

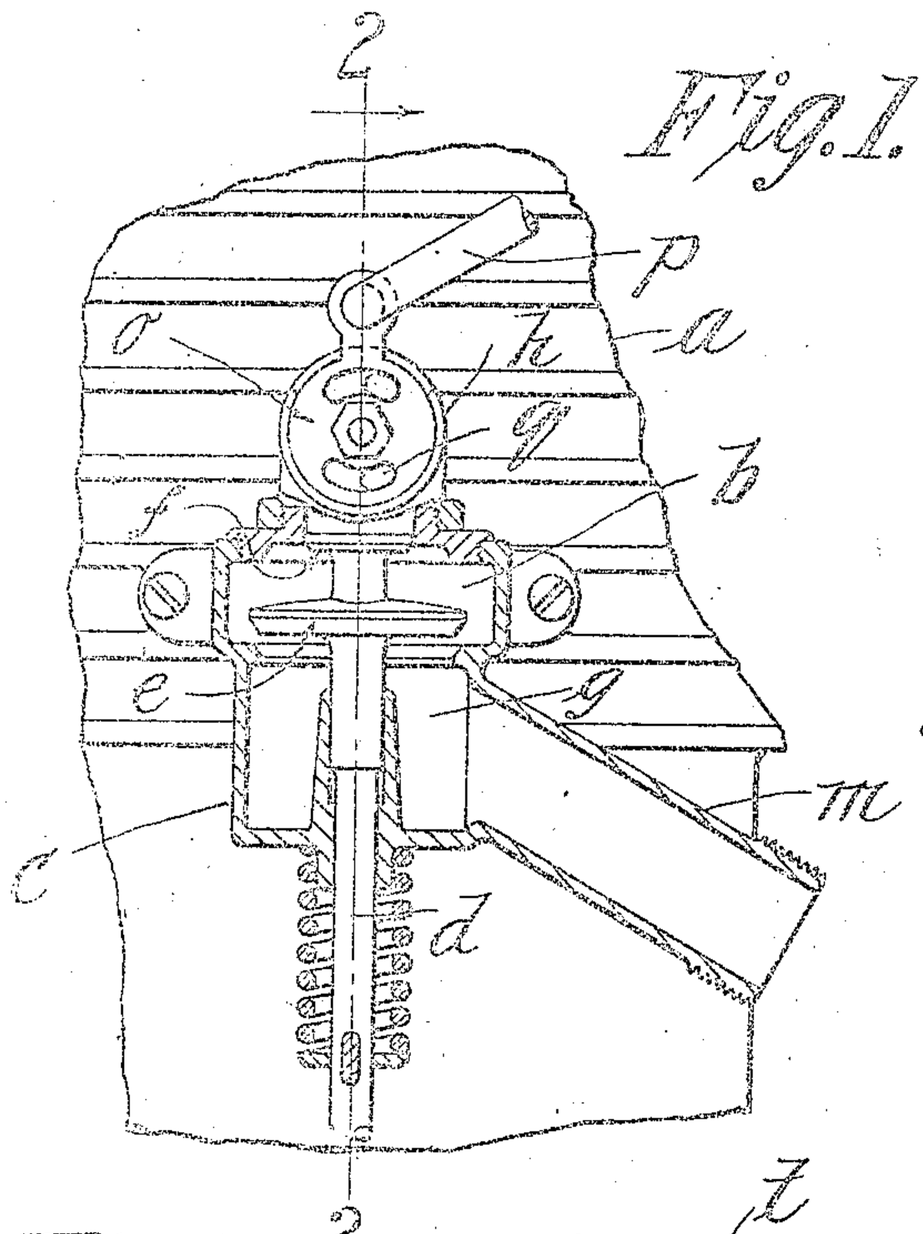


Fig. 2.

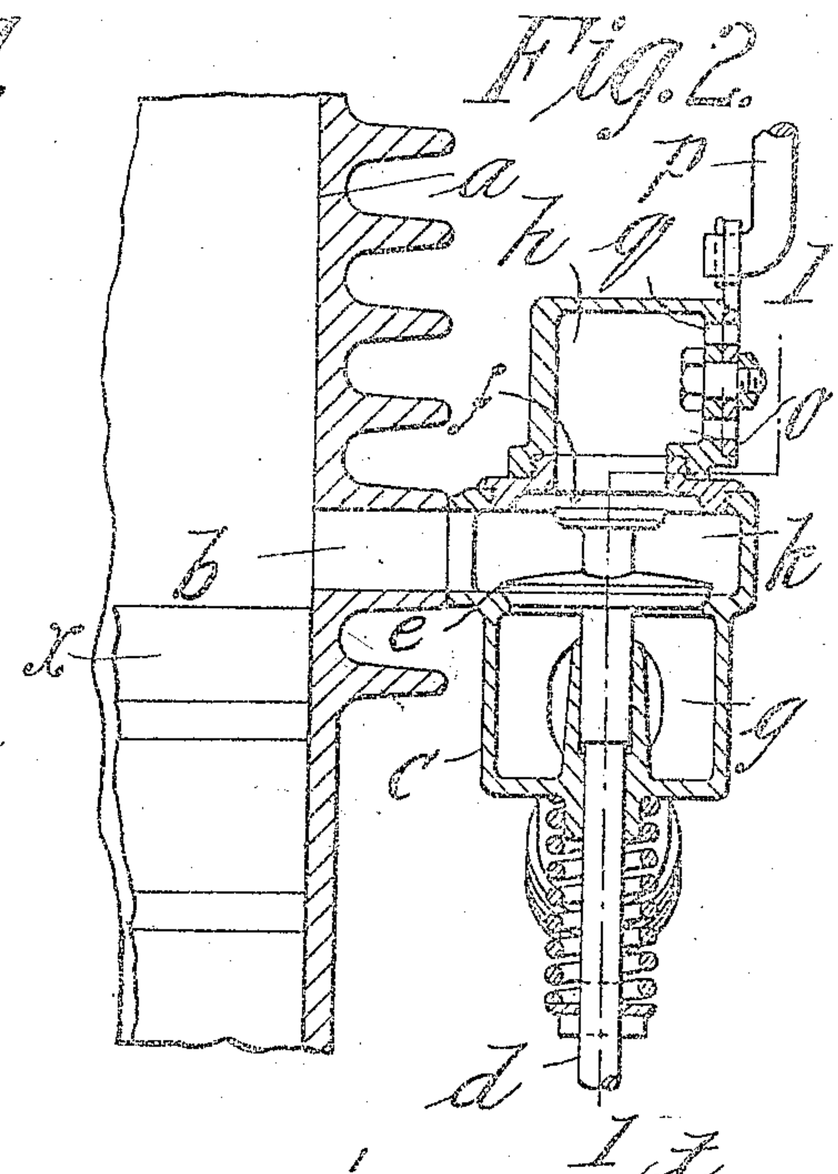
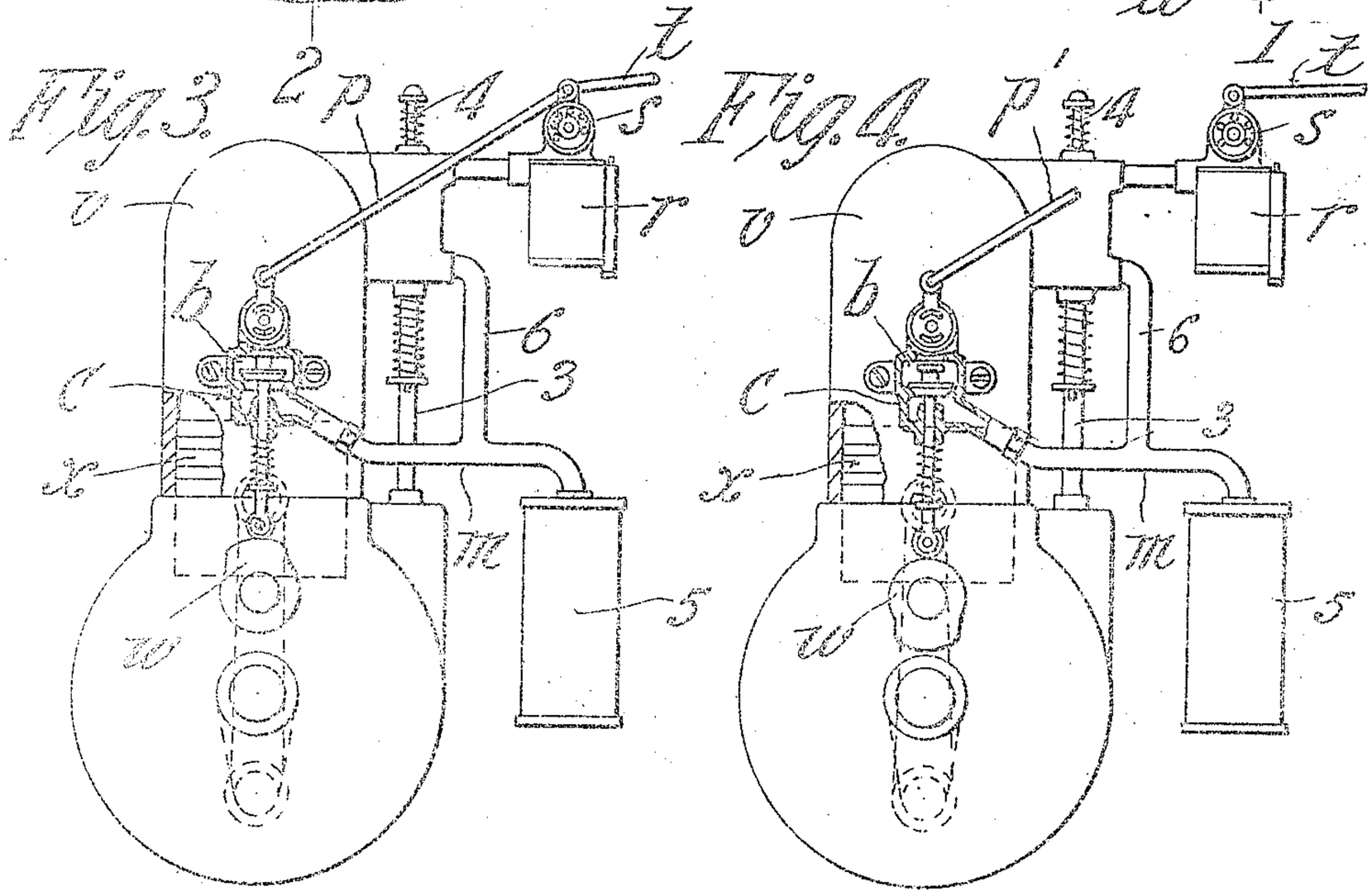


Fig. 3.

Fig. 4.



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INTERNAL-COMBUSTION ENGINE.

943,072. Specification of Letters Patent. Patented Dec. 14, 1909.

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To all whom it may concern:

Be it known that I, CARL O. HEDSTROM, a citizen of the United States of America, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines and has for one of its objects the provision of means whereby when the throttling device is opened beyond its normal position means are provided to permit the entrance into the cylinder of an auxiliary air supply; a further object of the invention being to provide means for effecting a primary exhaust of the cylinder at or near the end of the power stroke, the device for supplying auxiliary air and for effecting said primary exhaust being preferably combined in one mechanism though not necessarily so.

The regulation of the auxiliary air supply is controlled by the movement of the throttling mechanism although I do not limit myself to such a construction and may operate the auxiliary air supply independent of the throttle valve. This regulation of the auxiliary air supply permits the speed of the engine to be controlled within wide limits, since when it is desired to obtain a low piston speed a partial vacuum in the cylinder is necessary. When high speed is desired, the vacuum must be destroyed and the means of attaining this result is by means of a throttling device under the control of the operator, whereby air under atmospheric pressure is admitted to the cylinder. The present state of the art does not admit the speed of the engine to be controlled within wide limits by varying the volume of air admitted to the cylinder in proportion to the speed required. In order to accomplish the above objects, reference is made to the full description in the body of the specification.

The construction in which the invention is embodied is shown in the drawings forming part of this application, and in the drawings,—Figure 1 shows a portion of the cylinder wall of an engine of the type referred to having applied thereto a valve casing in section showing an air in-take valve and exhaust-valve on the same stem, the exhaust-valve being open and the air in-take valve closed. Fig. 2 shows the inlet and exhaust valves in section in the same position but in a plane at right angles to that of Fig. 1, as on line 2—2, the cylinder wall being also in section to show the port therein communicating with said in-take and exhaust valves and showing the exhaust valve closed and in-take valve open. Fig. 3 is a side elevation of a cylinder and crank-casing of an engine on a smaller scale having the valves shown in Figs. 1 and 2 applied thereto and showing means to actuate said valve, and showing means connected with the throttling device on a carbureter to control the supply of air to said in-take valve, the exhaust valve in this view being open, as at the end of the exhaust stroke. Fig. 4 is a view in all respects like Fig. 3, except that the exhaust valve is shown in closed position, as at the end of the in-take stroke, and in-take valve open for admission of air, and means for operating the auxiliary air in-take valve independently of the throttle valve.

As generally constructed, when an internal combustion motor is running under full throttle, that is at its maximum speed, the area of the in-take passages is not sufficient to permit the cylinder to fill completely. On account of this failure of the cylinder to completely fill at high piston speeds, a partial vacuum is consequently produced back of the piston, thus preventing the engine from producing its full power. This loss of power comes from the mixture of gasolene and air being improperly proportioned, and further from the fact that the piston is creating a partial vacuum in the cylinder which of course acts as a drag on the engine. In order to overcome these two defects, an auxiliary inlet or air-port is provided near the end of the stroke which is uncovered by the piston during its travel. The uncovering of this auxiliary air inlet port of course instantly restores the pressure within the cylinder to atmospheric pressure which destroys the partial vacuum and at the same time supplies an additional volume of air to the mixture therein, whereby the correct proportion of air to gasolene vapor is brought about. As a result of this arrangement the power of the engine is greatly increased, since, as stated, the partial vacuum is overcome and the desired volume of air is simultaneously admitted to form a proper mixture. The admission valve for such air is connected with the throttling mechanism of the engine whereby the volume of aux-

iliary air which may be permitted to enter the cylinder will be in exact proportion to the opening of the throttle beyond the degree of its opening required for normal conditions of operation, although, as will be described, such auxiliary valve may be operated independently of the throttle.

Referring to the drawings, *a* indicates a portion of the wall of a cylinder of an engine of the type referred to in which is located a port *b* which serves the double purpose of, at one point during the cycle of the piston, admitting air, and at another point in said cycle serving for the ejection of the exhaust gases, as follows: Secured to the cylinder wall in any way is a valve casing *c*, and extending into this casing is a valve-stem *d* carrying the exhaust-valve *e*, and a valve *f* for the admission of air. The valve-casing is provided with two chambers, (*g*, at the lower part thereof, and *h* at the upper part thereof) located respectively on opposite sides of the port *b*, opposite which is a centrally located chamber *k* in the valve-casing with which, by means of the exhaust valve and the air-inlet valve, the chambers *g* and *h* are respectively placed in communication at the proper time. An exhaust pipe *m* communicates with the chamber *g* and in the chamber *h* is an air-throttling admission valve *o* (which may be of any suitable construction) whereby, by means of a suitable connection, as *p*, which extends to the throttling mechanism of the engine, one or more air-ports *q* in the chamber *h* may be opened or closed by the movements of the throttling devices, or I may operate the valve *o* independently of the throttling mechanism as by means of the rod p^1 (see Fig. 4).

Referring to Fig. 3, it will be seen that the throttling devices shown herein are connected directly with the carbureter *r*,—the throttling device being lettered *s*, but are not so connected in Fig. 4. This device may be considered as being represented only conventionally and any of the many well known types may be used, it being actuated by means of a connection *t* extending to within convenient reach of the operator. The throttling device is so connected by means of the rod *t* with the air throttling admission valve *o* that the ports *q* will not be uncovered by any movement of the throttling mechanism up to and including the normal speed of operation of the engine; but if the throttling device be actuated to increase the speed beyond this point then the ports *q* will be gradually uncovered in proportion to the degree to which the throttle may be opened thus permitting the entrance of air into the cylinder through the chamber *h* of the valve-casing *c*; and, inversely, these ports will be closed by the closing movement of the throttling devices. The exhaust valve *e* and the air inlet-valve *f* are on the same stem *e* and therefore when one is closed the other will be opened, and the valve-stem may be actuated by a suitable cam, as *w*, shown in one position in Fig. 3, and in the opposite position in Fig. 4. The piston of the engine, indicated by *x*, coöperates with the valve mechanism heretofore described, in that the port *b* is opened and closed by the movement of the piston. Referring further to the last named figure, 3 may represent the stem of an exhaust valve which is located at the upper end of the cylinder; 4 may represent an in-take valve located, as usual, between the carbureter and the upper end of the cylinder; 5 being a muffler with which the exhaust-pipe *m* from the valve-casing *c* connects, the exhaust-pipe 6 communicating with the upper end of the cylinder, being made into this pipe *m* before the latter enters the muffler.

The operation of the hereinbefore described devices is as follows: Assuming the piston to be at the limit of its upward movement on the compression stroke, and that the charge of combustible is ignited, the piston moves downward, and as the upper end thereof reaches the port *b*, the cam *w*, as shown in Fig. 3, raises the exhaust valve *e* from its seat and permits the products of combustion to escape under the valve *e* into the chamber *c* and out through the exhaust-pipe *m*. This primary exhaust will clear the cylinder of the greater part of its contents, the valve *f* at this time remaining closed. As the piston begins its upward movement on the scavenging stroke, the primary exhaust valve *e* closes, which movement causes the inlet valve *f* to open, but at about this time the upward movement of the piston will have covered the port *b* so that the opening of a passage through the valve *f* to the atmosphere is of no effect. During the scavenging stroke, the exhaust valve 3 at the upper end of the cylinder opens, as usual in the four-cycle type of engines, closing at the beginning of the next downward suction stroke of the piston. If, when this downward stroke takes place the throttle of the engine is opened to a degree beyond the normal, the ports *q* leading to the chamber *h* will gradually open in proportion to the actuation of the throttling device, and, as described, more or less of a vacuum will be formed behind the piston owing to its greatly increased speed, but will be destroyed by reason of the air entering the cylinder through the auxiliary inlet valve *f*. The port *b* through the wall of the cylinder is so located that before the piston has completed its stroke, the port will be uncovered and the inlet valve *f* being open at this point of the engine cycle, air will enter through the port *q* at atmospheric pressure past this valve *f* which will immediately allow the cylinder

to fill, that is, it will equalize the pressure between the interior of the cylinder and the atmosphere and at the same time produce a correct mixture of air and gasolene in the cylinder chamber. The next half-stroke upward of the piston is the compression stroke which completes its cycle, and this takes place against a completely filled cylinder. It is to be noted that the air throttling intake valve *o* may be so adjusted as to admit air in any quantity desired and independently of the throttle valve *s* by means of the rod p^1.

By the use of the herein described devices, it is possible to obtain an increase in power from the engine by reason of an increased charge which can not be obtained when the partial vacuum is present.

When the device is used in connection with an air-cooled engine, it is possible to maintain a much lower cylinder temperature, first, because of the primary exhaust at the end of the power stroke; and, secondly, because of the relatively low temperature of the auxiliary air supply which is admitted through the valve *f*.

It should be stated that the exhaust valve *e* is normally closed on its seat and the intake valve *f* normally open by means of the spring encircling the valve-stem *d*; but when the cam *w* opens the exhaust-valve *e* and closes the in-take valve *f* the products of combustion are prevented from flowing into the chamber *h* and out through the air-throttling admission valve *o* as readily understood. The operator can, if he chooses, completely close the ports *q* by the rod p^1 and permit the engine to slow down by reason of the production of the partial vacuum behind the piston, as described, or he may speed up the engine more or less by opening the ports *q* and permitting the atmospheric air to flow into the cylinder through the port *b* and past the intake valve *f* as described.

What I claim, is:—

1. In an internal combustion engine, a cylinder, a suitable air-throttling mechanism therefor for controlling the flow of air to the cylinder and communicating with the atmosphere, and a piston for the cylinder, there being a port through the wall of the cylinder near the lower end thereof past which the piston moves, a valve-casing in communication with the cylinder through said port, means for admitting atmospheric air into said casing, and an auxiliary air intake valve in said casing, together with means for actuating said valve, said air-throttling mechanism being adapted to control the flow of air past the auxiliary air-intake valve, whereby at one point in the cycle of the engine communication may be established with the cylinder through the port, whereby any partial vacuum created by the piston may be destroyed.

2. In an internal combustion engine, a cylinder, and a piston for the cylinder, there being a port through the wall of the cylinder near the lower end thereof past which the piston moves, a valve-casing having a chamber therein in communication with said port, an air in-take valve in said chamber, an exhaust chamber in communication with said port, an exhaust valve in the exhaust chamber, means to open and close said air in-take valve at proper times, an air-throttling admission valve for controlling the flow of air to the air-intake valve and communicating with the atmosphere, said in-take valve being adapted to be closed when the exhaust valve is opened, whereby the exhaust gases are prevented from escaping through the air in-take valve.

3. In an internal combustion engine, a cylinder, a piston therein, a port in the cylinder wall opened and closed by the movements of the piston, a throttling valve for admitting air at atmospheric pressure into the cylinder in any desired quantities or volume, and means for operating said valve, whereby should a partial vacuum occur in the cylinder behind the piston, the partial vacuum may be overcome and at the same time the explosive mixture varied by the admission of air to the cylinder, as described.

4. In an internal combustion engine, a cylinder, and a piston for the cylinder, there being a port through the wall of the cylinder near the lower end thereof past which the piston moves, and an air in-take valve to open and close said port, and an air-throttling admission valve for controlling the flow of air through the air in-take valve.

5. In an internal combustion engine, a cylinder, a suitable throttling mechanism therefor, and a piston for the cylinder, there being a port through the wall of the cylinder near the lower end thereof past which the piston moves, a valve-casing in communication with the cylinder through said port, means for admitting atmospheric air into said casing, and an auxiliary air in-take valve in said casing, together with means for actuating said valve whereby at one point in the cycle of the engine communication may be established with the cylinder through the port, whereby any partial vacuum created by the piston may be destroyed, and controlling means for the admission of air into said casing.

6. In an internal combustion engine, a cylinder, a piston therefor, the cylinder having a port therein near the end of the piston stroke, a casing secured to the cylinder and provided with inlet and exhaust chambers having communication with the port, an inlet and an exhaust valve for controlling the flow of air into and the burned gases from the cylinder, means for operating said valves whereby at a point in the engine cycle

atmospheric air may be admitted to the cylinder and at another point in the engine cycle the burned gases may escape from the cylinder through said port, and an air-throttling device for controlling the flow of air past the inlet-valve.

7. The combination with the cylinder and piston of an internal combustion engine, a casing secured to the cylinder and provided with a chamber leading to a port in the cylinder and near the end of the piston-stroke, an air in-take valve mounted in the chamber, means for operating the same, and an air-throttling valve for regulating the volume of atmospheric air which may be admitted to the engine cylinder at a predetermined point in the engine cycle, as described.

8. The combination with the cylinder and piston of an internal combustion engine, the cylinder wall having an opening therethrough near the end of the piston-stroke, a casing secured to the cylinder, an air in-take and exhaust valve mounted therein and secured to a common stem, the air in-take valve being open during the suction compression and power stroke of the piston, and the exhaust valve closed, and an air-throttling mechanism for controlling the supply of air to said in-take valve, said exhaust valve being open and the in-take valve closed during the scavenging stroke, as described.

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Witnesses:
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H. W. BOWEN.