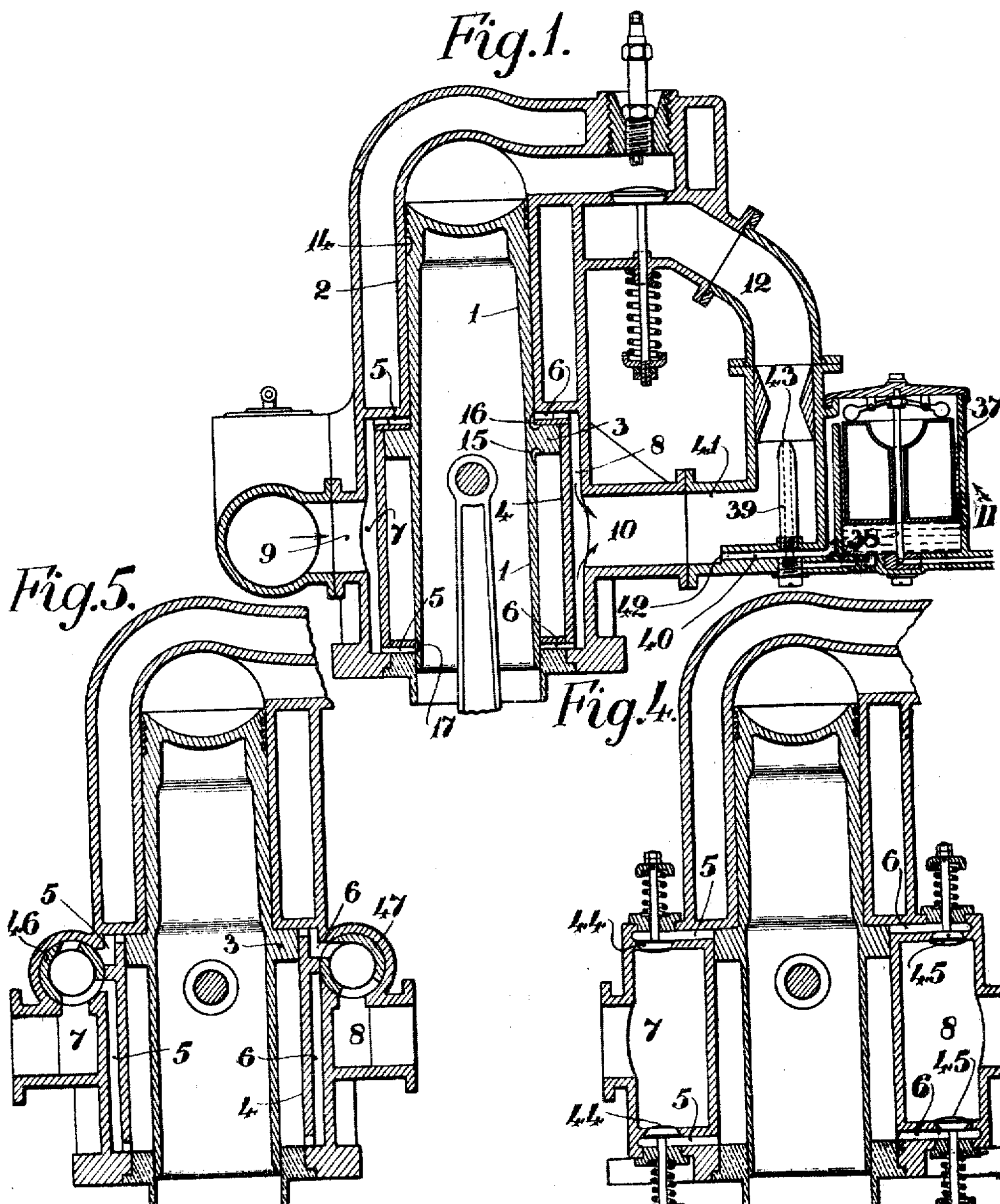
E. DERIHON.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED SEPT. 5, 1918.

1,298,468.

Patented Mar. 25, 1919.
4 SHEETS—SHEET 1.



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4 SHEETS—SHEET 2.

Fig. 2.

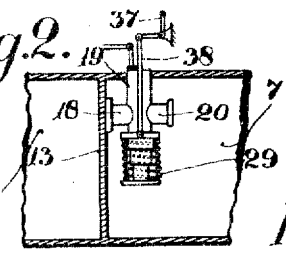


Fig. 3.

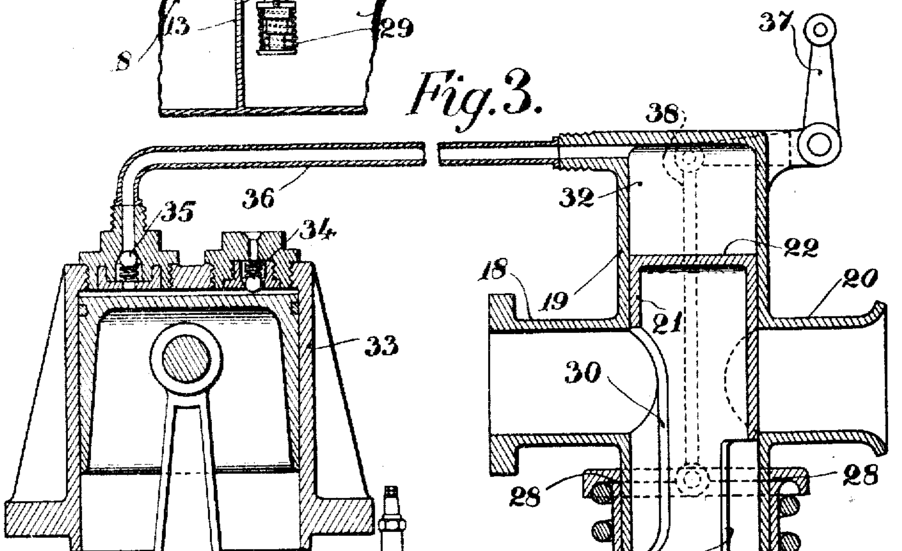
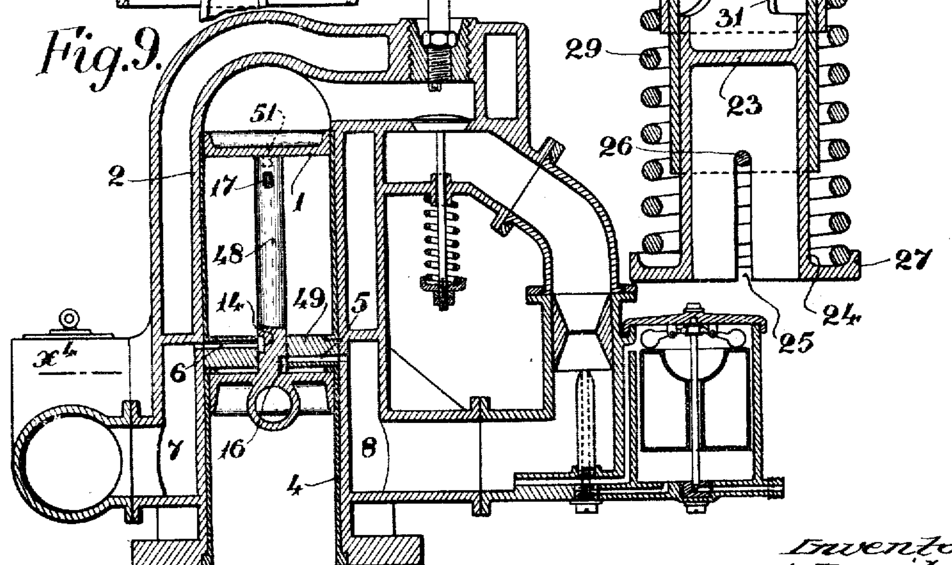


Fig. 9.



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4 SHEETS—SHEET 3.

Fig. 7.

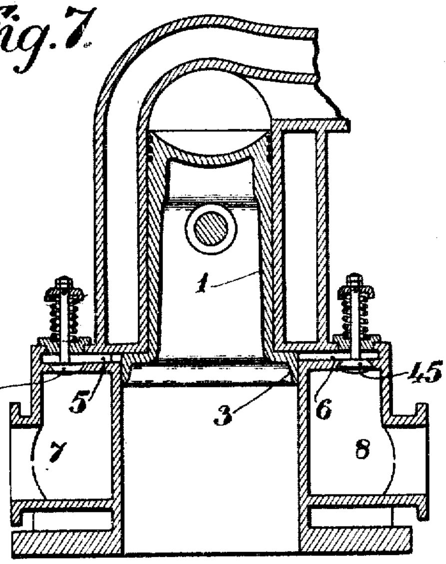


Fig. 8.

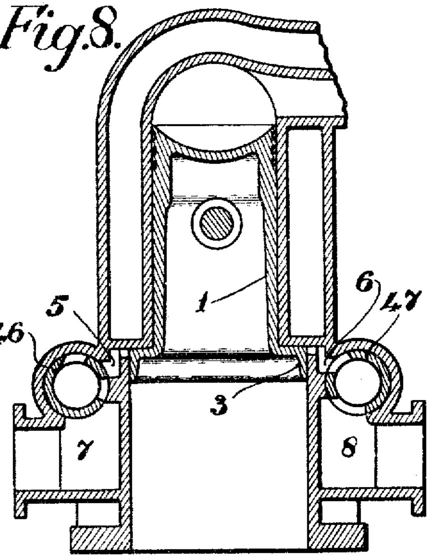
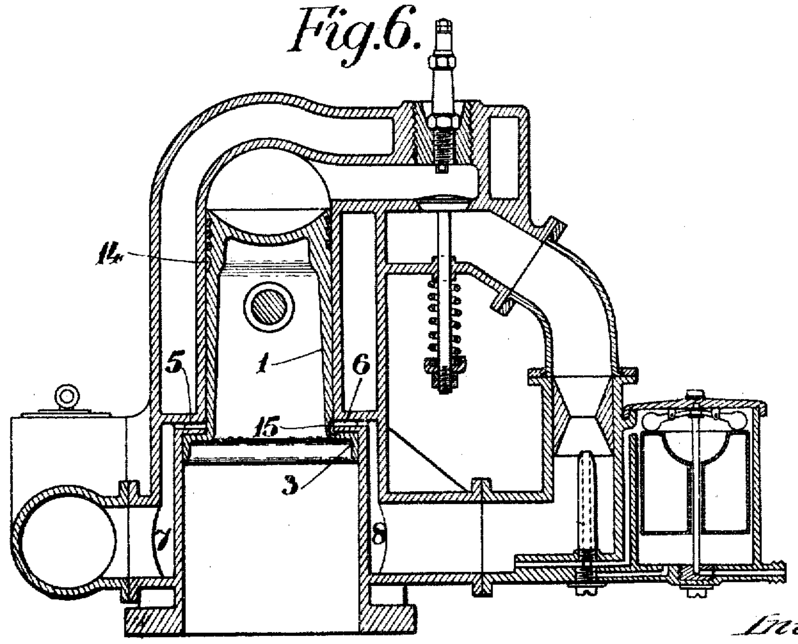


Fig. 6.



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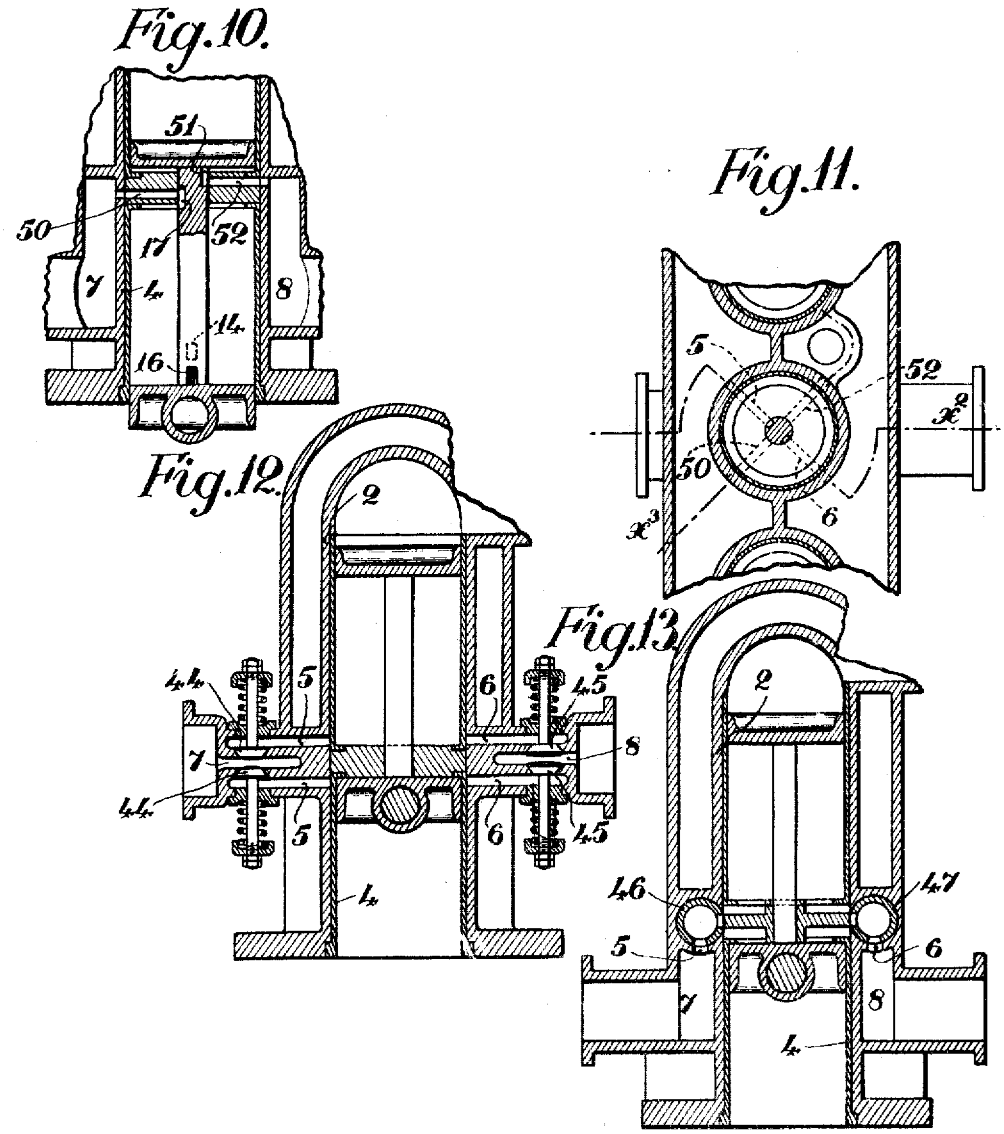
4 SHEETS—SHEET 4.



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ERNEST DERIHON, OF LONDON, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

1,298,468. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed September 5, 1918. Serial No. 252,767.

To all whom it may concern:

Be it known that I, Ernest Derihon, a subject of the King of Belgium, residing at London, England, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines of that kind in which carbureted air is supplied to the engine at a constant or practically constant pressure and density irrespective of variations in the pressure or density of the atmosphere due to variations in altitude (in the case of aviation motors) or in speed, or other causes; the air being drawn into a compressor operated from the engine and being discharged into a reservoir situated between the compressor and the intake of the engine, and a relief valve being fitted to the reservoir which opens more or less so as to maintain the pressure in the reservoir at a constant or practically constant value.

The principal object of the present invention is to provide improved and self-contained means for insuring the supply of carbureted air at constant pressure.

According to the present invention the compressor is self-contained with the engine and comprises an auxiliary piston connected to or carried by the engine piston and working in a cylinder (independent of the engine cylinder) either of larger diameter than, or of the same diameter as, the engine cylinder and acting either independently of or in conjunction with the engine piston for the purpose of compressing the air, so as to deliver to the compressed-air reservoir during each cycle a greater quantity of air than the maximum quantity required to be supplied to the engine, so that under all circumstances the constant pressure is maintained in the reservoir; the relief valve being arranged to reduce the pressure to a constant or practically constant value.

Figure 1 of the accompanying drawings represents a vertical section through an engine and double-acting compressor constructed in accordance with one form of the present invention.

Fig. 2 is a diagrammatic view showing how the relief valve is arranged between the inlet chamber and the compressed air reservoir.

Fig. 3 is a section through the relief valve and the vacuum pump which is used in connection therewith.

Figs. 4 and 5 show modified means for controlling the admission and discharge of the air to and from the compressor.

Fig. 6 represents a modification in which a single acting compressor is employed.

Figs. 7 and 8 show means similar to those shown in Figs. 4 and 5 for controlling the admission and discharge of the air to and from the single-acting compressor represented in Fig. 6.

Fig. 9 is a vertical section on line x^2, Fig. 11, with the piston at the top of its stroke.

Fig. 10 is a vertical section on line x^3 Fig. 11 with the piston at the bottom of its stroke, and Fig. 11 is a horizontal section on line x^4, Fig. 9, showing another modification.

Figs. 12 and 13 show controlling valves as in Figs. 4 and 5 and in Figs. 7 and 8, as applied to the compressor represented in Figs. 9 to 11.

In the form shown in Figs. 1 to 3, the piston 1 of the motor moves in the engine cylinder 2, either water or air cooled as usual. The piston 1 is extended beyond the cylinder 2 and is provided with a collar or supplementary piston 3 of larger diameter constituting the piston of the compressor. This piston 3 moves in a cylinder 4 and reaches the end of its stroke simultaneously with piston 1. The opposite ends of cylinder 4 communicate, by means of channels 5, 5, and 6, 6, with an inlet chamber 7 and with a compression reservoir 8 respectively. The inlet chamber 7 communicates with the atmosphere by a branch 9 while the compression reservoir 8 communicates with the intake of the engine either through the medium of the branch 10 carbureter 11 and induction pipe 12, or directly by the branch 10 and pipe 12 without the carbureter. In the latter case the carbureter would be placed at the entrance to the inlet branch 9.

The compression reservoir 8 is separated from the admission chamber 7 of the compressor by a partition 13 (see Fig. 2).

As the piston 1 descends the piston 3 creates a vacuum in the cylinder 4 until, at the end of the stroke, a recess 14 in piston 1 places the upper channel 5 in communication with the interior of the said cylinder 4, which fills with air. During this downward stroke the air in cylinder 4 beneath the piston 3 has been compressed by the latter, until at the end of the stroke, a recess 15 in the trunk extension of piston 1 places the cylinder 4 in communication with the lower channel 6, and the compressed air is discharged into reservoir 8. On the return stroke the air in cylinder 4 is compressed by piston 3 until, at the end of the stroke, another recess 16 in piston 1 places the cylinder in communication with the upper channel 6 to admit of the discharge of the compressed air into reservoir 8; and at the same time a vacuum is created beneath piston 3 until, at the end of the stroke, a recess 17 in the trunk or piston 1 places the bottom channel 5 in communication with the cylinder, which thus fills with air.

In considering the operation in connection with a four-stroke cycle engine, each suction stroke of the piston occurs every two revolutions, while the compressor 3 draws in and compresses a cylinder full of air during each half revolution, so that, between successive suction strokes of piston 1 a volume of air equal to four times the volume of cylinder 4 has been compressed and discharged into reservoir 8. If the motor has the cylinder 4 equal to cylinder 2 then there will be discharged into reservoir 8 a quantity of air equal (at atmospheric pressure) to four times the volume of cylinder 2; and should the atmospheric pressure fall an amount of air equivalent to four volumes of cylinder 4 is discharged into reservoir 8 during each cycle, but at a lower pressure than in the previous case.

In order, therefore, to maintain the pressure in the reservoir at a constant value notwithstanding variations in the atmospheric pressure, a relief valve is employed. Thus as shown in Figs. 2 and 3, situated in the admission chamber 7 and attached to partition 13 by a branch 18, is a cylinder 19 open at its lower end but closed at the upper end. The branch 18 coincides with an opening in the partition 13 so as to communicate with the reservoir 8, and at the opposite side is a branch or outlet port 20 opening into the chamber 7. Within the cylinder 19 is a sliding piston valve 21 of tubular form, same being closed at its upper end at 22 and closed to the atmosphere at its lower end by a diaphragm 23, thus constituting a double piston. The walls of the valve 21 are continued below the diaphragm 23 in the form of a sleeve 24 slotted at 25 to engage a stop pin 26. The lower end, of the sleeve 24 carries a flange 27 between which, and an adjustable collar 28 upon the outside of the cylinder 19, a coiled spring 29 is interposed, tending to lower the valve 21. The walls of the latter are cut away to form two ports 30, 31, the former always registering with the branch 18 whatever may be the position of the valve, and the latter being considerably shorter so as to more or less uncover the outlet branch 20 according to the position of the piston 21 in the cylinder.

The diaphragm 23 or lower end of the piston is subjected to the pressure of the atmosphere, but within the chamber 32 above the end 22 of the piston a vacuum is maintained by any convenient means. Thus, as shown, a vacuum pump 33 driven by the engine and provided with suction and discharge valves 34 35, may be connected to the said chamber 32 by a pipe 36.

The compression of the spring 29 may be adjusted as desired by any suitable means, such as a bell-crank lever 37 connected by a rod 38 to the sliding collar 28.

As above described the compressor discharges into the reservoir 8 a greater quantity of air than is required to be supplied to the engine. To maintain the pressure in this reservoir at normal or sea-level atmospheric pressure it is necessary to allow a portion of the air to return to the inlet chamber 7. This excess air is arranged to be returned through the branch 18, ports 30, 31, in piston valve 21 and outlet branch 20.

The lower end of the valve 21 being subjected to atmospheric pressure, say normal or sea-level pressure, and the upper end being under the influence of a vacuum, it follows that the valve is raised and spring 29 is compressed until a position of equilibrium is reached, the compression of the spring being adjusted so that this position of equilibrium of the valve is such that the port 31 opens the outlet 20 just sufficiently to allow of the excess quantity of air to escape in order to maintain the pressure in the reservoir at sea-level atmospheric pressure.

If, now, the engine ascends to a higher altitude the atmospheric pressure acting on the end 23 of the valve 21 is diminished. Consequently (the vacuum in chamber 32 being constant) the valve will descend until a new position of equilibrium is reached, thereby reducing the size of the outlet to branch 20 and allowing of a smaller quantity of air being returned to the chamber 7, the reduction being in proportion to the reduction in atmospheric pressure, so that the pressure in the reservoir 8 is maintained constant at sea-level atmospheric pressure.

Instead of employing a vacuum pump 33 for maintaining a vacuum in the chamber 32, any other suitable source of suction may be utilized for this purpose. For instance, the pipe 36 may be connected to the induction pipe or inlet manifold of the engine.

When the carbureter is placed at 9 it may be of the ordinary type, as it operates directly under the influence of the suction, as in an ordinary engine. If, however, it is placed as shown in Fig. 1, between the passages 10 and 12, it must be of the construction represented. Thus, the float chamber 37 is hermetically sealed and the fuel is admitted at a determined pressure. The admission of fuel is cut off by valve 38 when the level is at the same height as the top of the jet 39. A channel 40 connects the upper part of chamber 37 with the passage 41, the end 42 being at right-angles to this passage. When the motor is working there is a current of air in 10, 41, 12, which has both a static pressure due to the pressure in the reservoir 8, and a dynamic pressure due to the acceleration of this current, and the open end 42 of channel 40 transmits both the static pressure and the dynamic pressure to chamber 37 by means of the said channel 40. This static pressure, plus the dynamic pressure acting on the surface of the fuel, is thus transmitted also to the jet 39. This jet 39 being situated longitudinally in the pipe 41 is subjected at the extremity 43 to a pressure equal to the difference between the static pressure and the dynamic pressure, so that at 43 the resultant pressure causing the delivery of the fuel is equal to twice the dynamic pressure. Under these conditions the quantity of fuel furnished by the carbureter is proportional to the velocity of the air in the pipes, 10, 12; that is to say, proportional to the speed of the engine.

Instead of the air admitted into and discharged from the compressor being controlled by recesses in the piston as in Fig. 1, the arrangement shown in Fig. 4 may be adopted, the inlet channels 5, 5, communicating with the inlet chamber 7 by means of automatic valves 44, 44, and the discharge channels 6, 6, communicating with the reservoir 8 by means of automatic valves 45, 45, as in an ordinary compressor. Or, as shown in Fig. 5, the inlet channels 5, 5, and discharge channels 6, 6, may communicate with the inlet chamber 7 and reservoir 8 respectively by means of ported and oscillating sleeve valves 46, 47, which, by their partial rotation, alternately place the upper and lower parts of cylinder 4 in communication with chamber 7 and reservoir 8 at each stroke of piston 3.

Instead of the compressor being of the double-acting type, as in Figs. 1 to 5, it may be of the simple single-acting kind, as in Figs. 6 and 8. In this construction the trunk piston 1 is not extended beyond the compressor piston 3, which latter only compresses the air by its upper face, the single inlet and discharge passages 5, 6, from and to the chambers 7, 8, being controlled, in the form shown in Fig. 6, by recesses 14, 16, respectively in the piston 1; in the form shown in Fig. 7, by the automatic valves 44, 45; and in Fig. 8 by the rotary sleeve valves 46, 47. Otherwise, the action is the same as in the form shown in Figs. 1 to 5.

In the modified form of double-acting compressor shown in Figs. 9 to 11, the compressor piston 3 is of the same diameter as the engine piston 1, these two pistons being connected by a piston rod 48, and the engine cylinder 2 being separated from the compressor cylinder 4 by a partition 49 through which the piston rod 48 works. When the piston 1 is at the top of its stroke, as in Fig. 9, the cylinder 2 is filled with air owing to a recess 14 in the rod 48 placing said cylinder in communication with the passage 6 leading from the inlet chamber 7. At the same time a recess 16 places the upper end of cylinder 4 in communication with passage 5 leading to the compression reservoir 8 so that the air compressed by the upstroke of piston 3 is discharged into the said reservoir. On the down stroke the air in cylinder 2 is compressed by piston 1 and a vacuum is created in cylinder 4. At the end of the stroke, as shown in Fig. 10, another recess 17 in the piston rod places cylinder 4 in communication with a second passage 50 leading from chamber 7, so that said cylinder fills with air, and at the same time a recess 51 places the cylinder 2 in communication with a passage 52 leading to the reservoir 8, so that the air compressed by the piston 1 is discharged into said reservoir.

The form shown in Fig. 12 is the same as in Figs. 9 to 11 except that the admission of air from chamber 7 to the cylinders 2, 4, through passages 5, 5, is controlled by automatic valves 44, 44, and the discharge through passages 6, 6, into reservoir 8 is controlled by automatic valves 45, 45.

Likewise, in Fig. 13, a rotary sleeve valve 46 controls the admission of air from chamber 7 through passage 5 into the cylinders 2, 4, while the discharge through passage 6 into reservoir 8 is controlled by a similar valve 47.

The application of the invention to a two-stroke cycle engine differs in no essential respect from its application to a four-stroke cycle engine, as above described, the air compressed in the reservoir being admitted to the cylinder at or toward the end of each inward or downward stroke of the piston, the compressor being designed to supply the reservoir between the compressor and the inlet port of the cylinder, during each revolution, with an amount of air greater in volume (at ordinary atmospheric pressure) than the volume of the engine cylinder.

Having fully described my invention, what I desire to claim and secure by Letters Patent is:—

1. In an internal combustion engine, the combination with the engine cylinder having a piston therein, of a compressor drawing in air comprising an auxiliary piston directly connected to or carried by the engine piston and working in a cylinder independent of but in axial alinement with the engine cylinder for the purpose of compressing the air and delivering during each cycle

of the engine a greater quantity than the maximum quantity required to be supplied to the engine; a reservoir between the compressor and the intake of the engine into which the compressed air is delivered; and a relief valve for maintaining the pressure in said reservoir at a constant value irrespective of variations in the pressure of the atmosphere, substantially as described.

2. In an internal combustion engine, the combination with the engine cylinder having a piston therein, of an air compressor cylinder self-contained and in axial alinement with the engine cylinder, a piston in said compressor cylinder said piston being connected with the engine piston and arranged to deliver during each cycle of the engine a greater quantity of air than the maximum quantity required to be supplied to the engine, an air inlet chamber, a compressed air reservoir, a conduit between the reservoir and the intake of the engine, a vertical partition dividing the inlet chamber from the reservoir, and a relief valve carried by the partition which acts to maintain the pressure in the reservoir constant irrespective of variations in the atmospheric pressure.

3. In an internal combustion engine, the combination with the engine cylinder having a piston therein, of an air compressor cylinder self-contained and in axial alinement with the engine cylinder, a piston in said compressor cylinder, said piston being connected with the engine piston and arranged to deliver during each cycle of the engine a greater quantity of air than the maximum quantity required to be supplied to the engine, an air inlet chamber, a compressed air reservoir, a conduit between the reservoir and the intake of the engine, and means for maintaining a constant pressure in the compression reservoir comprising a spring-controlled piston valve controlling a passage leading from the reservoir to the atmosphere and having one end subjected to the pressure of the atmosphere (acting against the pressure of the spring) and the other end under the influence of a vacuum.

4. In an internal combustion engine, the combination with the engine cylinder having a piston therein, of an air compressor cylinder self-contained and in axial alinement with the engine cylinder, a piston in said compressor cylinder, said piston being connected with the engine piston and arranged to deliver during each cycle of the engine a greater quantity of air than the maximum quantity required to be supplied to the engine, an air inlet chamber, a compressed air reservoir, a conduit between the reservoir and the intake of the engine, and means for maintaining a constant pressure in the compression reservoir, said means comprising a spring-controlled piston valve controlling a passage leading from the reservoir to the atmosphere, and a cylinder in which the said piston slides, said cylinder having one end open to the atmosphere and having the other end closed and connected to a source of suction in order to maintain a vacuum within said end.

5. In an internal combustion engine, the combination with the engine cylinder having a piston therein, of an air compressor cylinder self-contained and in axial alinement with the engine cylinder, a piston in said compressor cylinder, said piston being connected with the engine piston and arranged to deliver during each cycle of the engine a greater quantity of air than the maximum quantity required to be supplied to the engine, an air inlet chamber, a compressed air reservoir, a conduit between the reservoir and the intake of the engine, a relief-valve cylinder having an inlet and an outlet communicating with the compression reservoir and with an inlet chamber respectively, said cylinder being open at one end but closed at the other, a source of suction, a conduit between the source of suction and the closed end of the cylinder, a hollow piston valve closed at each end and sliding within the cylinder in order to coöperate with the inlet and outlet thereof, and a spring acting upon the valve in a direction opposite to the atmospheric pressure so as to tend to close the passage from the compression reservoir to the inlet chamber.

6. In an internal combustion engine, the combination with the engine cylinder having a piston therein, of an air compressor cylinder self-contained and in axial alinement with the engine cylinder, a piston in said compressor cylinder, said piston being connected with the engine piston and arranged to deliver during each cycle of the engine a greater quantity of air than the maximum quantity required to be supplied to the engine, an air inlet chamber, a compressed air reservoir, a conduit between the reservoir and the intake of the engine, a relief-valve cylinder having an inlet and an outlet communicating with the compression reservoir and with the inlet chamber respectively said cylinder being open to the atmosphere at one end but closed at the other, a source of suction, a conduit between the source of suction and the closed end of the cylinder, a piston valve sliding within the cylinder in order to coöperate with the inlet and outlet thereof, a spring acting on the valve in a direction opposite to the atmospheric pressure so as to close the passage from the reservoir to the inlet chamber, and means for adjusting the compression of the spring.

7. In an internal combustion engine, the combination with the engine cylinder having a piston working therein, of an air com-

pressor cylinder in axial alinement with the engine cylinder, a piston in said compressor cylinder, means for connecting said compressor piston to the engine piston, an air inlet chamber, a compressed air reservoir, and a relief valve controlling an outlet from said reservoir, the said means for connecting the compressor piston to the engine piston having recesses coöperating with passages and adapted to place the compressor cylinder in communication alternately with the atmosphere and with the reservoir.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ERNEST DERIHON.

Witnesses:
HENRY NORTON SKERRETT,
HARRY OSMOND PRATT.