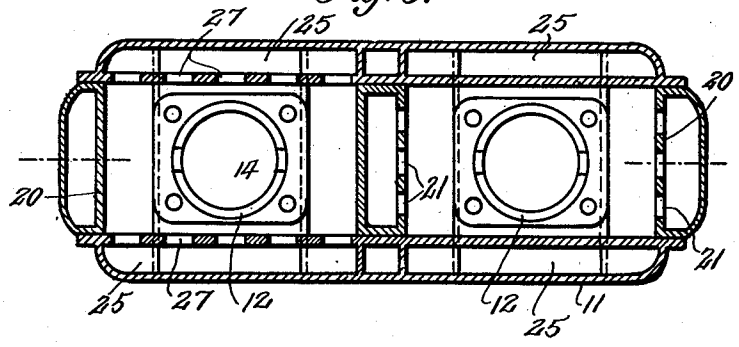
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SUPERCHARGER FOR INTERNAL COMBUSTION ENGINES

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Fig. 3.



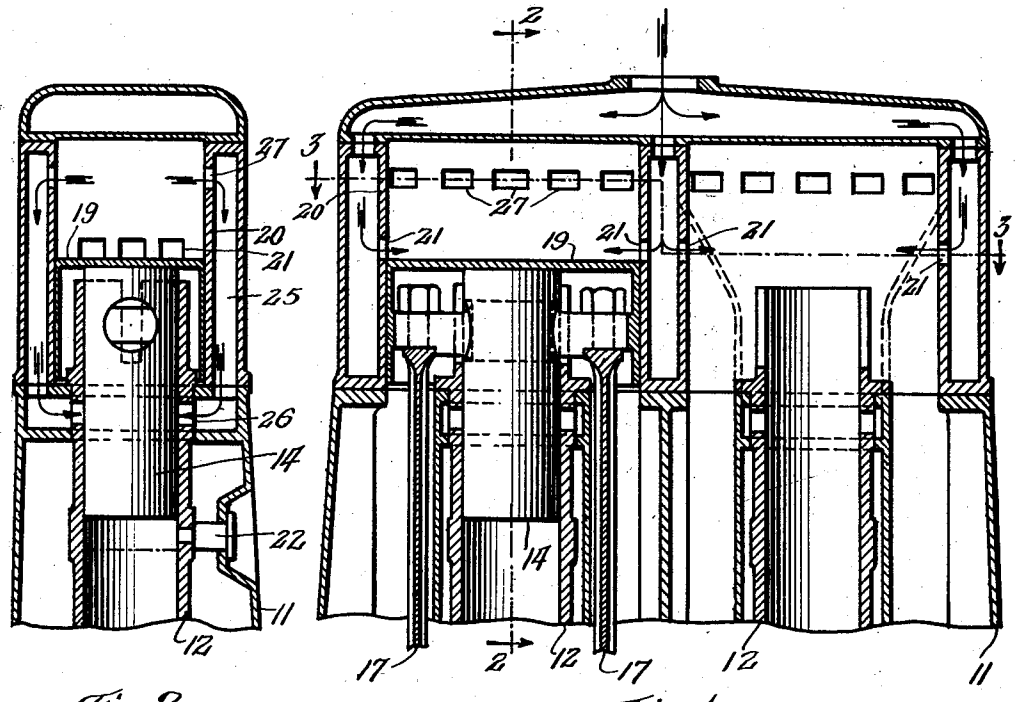


Fig. 2. Fig. 1.

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Fig. 4.

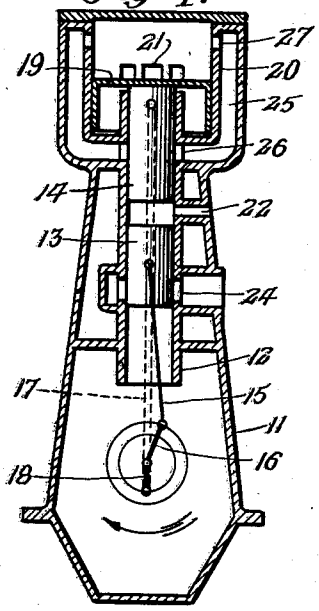


Fig. 5.

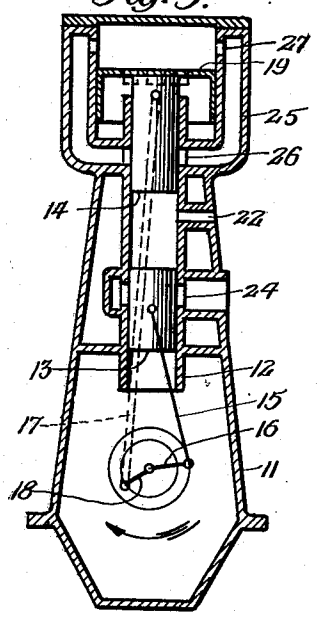
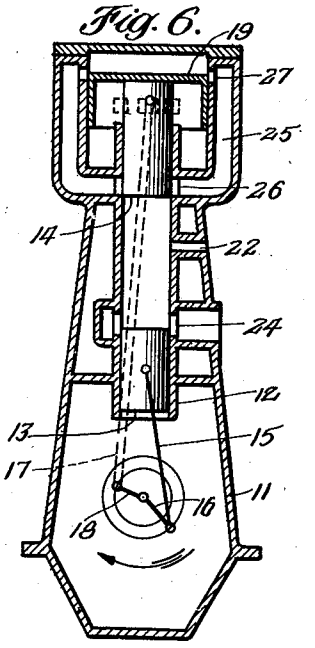


Fig. 6.



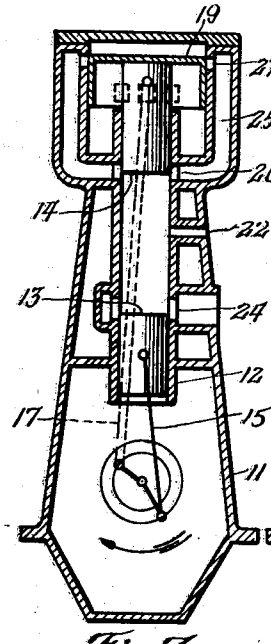


Fig. 7.

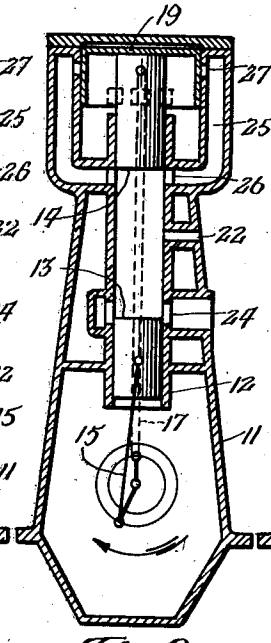


Fig. 8.

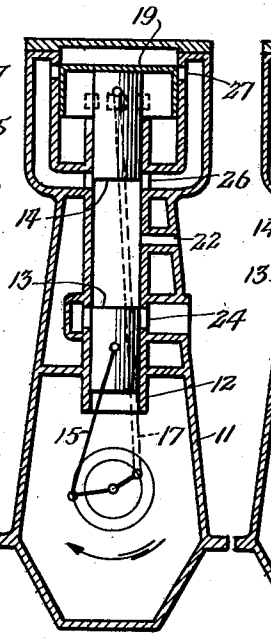


Fig. 9.

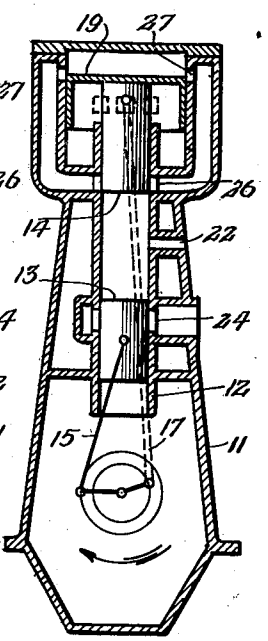


Fig. 10.

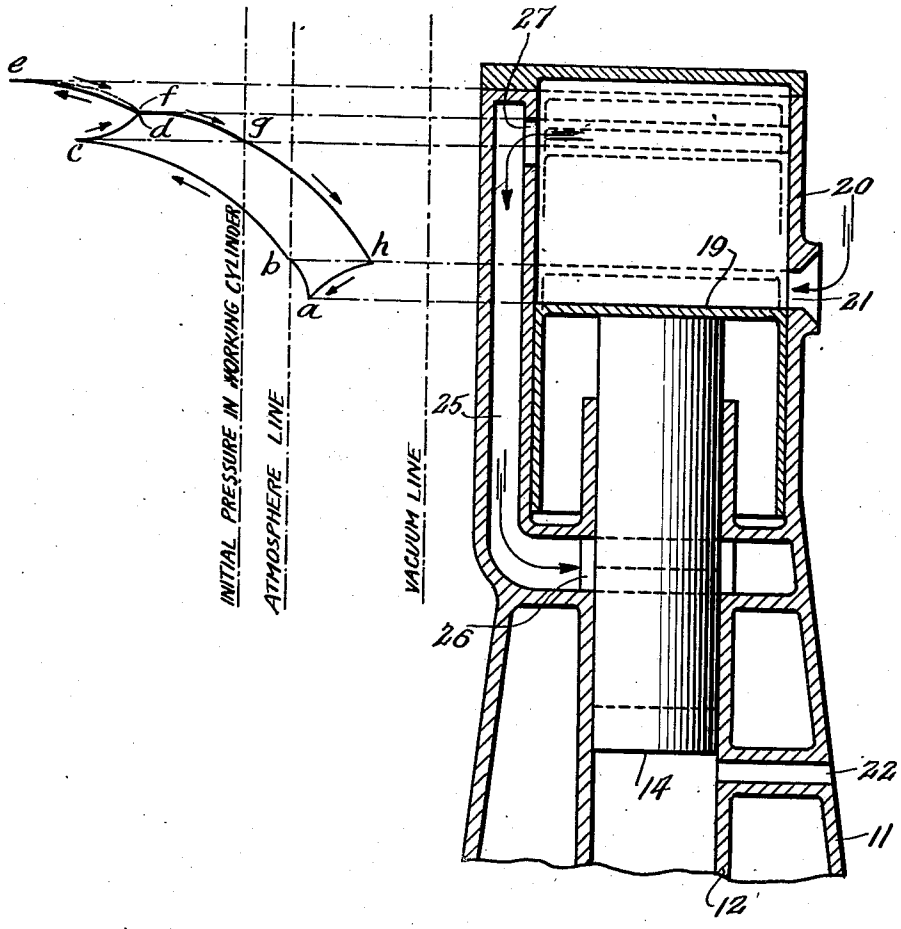
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Fig. 11.



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UNITED STATES PATENT OFFICE

2,085,547

SUPERCHARGER FOR INTERNAL COMBUSTION ENGINES

Oscar G. Schrom, Philadelphia, Pa.

Application April 30, 1935, Serial No. 19,004

7 Claims. (Cl. 123—71)

This invention has particular reference to the provision of an improved supercharging device for use on a two-cycle internal combustion engine of Diesel type and I have shown it particularly as applied to the engine structure shown in my copending application Serial No. 17,759, filed April 23, 1935.

The general construction of the engine is substantially the same as that shown in said copending application, i. e., as in the previous case, I employ the arrangement of two opposed pistons connected by connecting rods to a three-throw crank and having above the upper piston and operatively moving therewith a scavenging piston of larger diameter than the working pistons. The improvements in the present case reside in an arrangement of parts by which the air charged into the cylinder of the working pistons will be augmented in pressure or supercharged. I also contemplate advancing the crank on the main crank shaft for the lower working piston rather than having it directly opposite or at 180° to the cranks for the upper working piston and scavenging piston. This arrangement is advantageous in that it enables the exhaust ports and scavenging ports to be so dimensioned in length that they will be covered and uncovered at such points in the cycle as will give the most effective results.

It is known that the power output of a Diesel engine is proportional to the pressure of the air enclosed in the working cylinder at the beginning of the compression stroke and this pressure under conditions otherwise similar is itself proportional to the initial pressure at which the filling of the working cylinder with air takes place.

In my earlier application the cylinder of the engine described does not charge the working cylinder with pressure above atmospheric. It is one of the objects of this present invention to provide for such supercharging effect in an engine of the type set forth in the previous application.

In carrying out this invention I have embodied my improvements in a structure shown in the accompanying drawings, in which—

Figure 1 is a vertical sectional view through an engine embodying this invention.

Figure 2 is a transverse vertical section taken on the line 2—2 of Figure 1.

Figure 3 is a horizontal section taken on the line 3—3 of Figure 1.

Figures 4 to 10 inclusive show different positions of the moving parts in the operation of the engine, and

Figure 11 is a partial sectional view with a projection at the left giving the card of the compression charge of the scavenging piston.

The various positions and movements of the parts shown in Figures 4 to 10 are generally similar to those shown in my previous application Serial No. 17,759. However, figures are included to illustrate the manner in which supercharging is obtained through my novel construction of the scavenging piston cylinder and associated ports. The arrangement is illustrated more particularly in Figures 1, 2, and 3. As will be clear from these figures and from the following description I have provided a means whereby the scavenging piston not only operates to accomplish scavenging but in addition serves to charge the working cylinder with air under pressure above atmospheric pressure to provide the desired supercharging effect.

By my improved arrangement I am enabled to so dimension the exhaust ports with respect to the scavenging ports that the scavenging ports will be uncovered and the exhaust ports covered by the piston in that part of the cycle where the supercharging is to be effected whereby air under higher pressure than atmospheric will be delivered from the scavenging pump to the working cylinder as a supercharge. The particular arrangement of the crank shafts illustrated in the drawings is advantageous in bringing about this result.

Referring to the drawings, I have illustrated an engine casing 11 and a cylinder 12 containing opposed pistons 13 and 14, the lower piston 13 being connected by connecting rod 15 to a crank 16 and the upper piston 14 being connected by a couple of connecting rods 17 to cranks 18. Above the upper working piston and connected with it so as to move in unison is a scavenging piston 19 working in a cylinder 20 and provided with air inlet ports 21, this constituting the scavenging pump, the piston of which controls the air inlet ports 21. This is the same construction as in my said previous application.

In this present invention, however, I provide additional ports in the cylinder of the scavenging pump located at 27, there being a plurality of these ports arranged around the walls of the cylinder as clearly shown in Figures 1, 2, and 3.

Referring to the drawings it will be seen that in Figure 5 the air inlet ports 21 have just been covered so that the air in the chamber above the piston and in the receiving chamber 25 is at atmospheric pressure. From this point on this air is compressed and when the piston 19 reaches the position shown in Figure 6, the air in the

chamber above the piston is well compressed as is also the air in the receiving chamber 25, it being noted that the working piston 14 at this time still covers the port 26 at the bottom of the receiving chamber 25.

As the piston 19 continues its upward movement there is a slight interval when both the port 27 and the port 26 are open, but this is not sufficient to allow the air pressure in the space above the piston 19 to drop to atmospheric because of factors such as the short time element, the proportion of parts, the resistance to flow and the presence of sluggish burnt gases in the working cylinder. When such factors are considered it will be realized that the pressure of the air in the chamber above the piston 19 is not reduced to atmospheric. It will thus be seen that when the piston 19 is in the position shown in Figure 7 in which it has just covered the port 27, air at pressure above atmospheric is confined in the space above the piston. In this position the port 26 is uncovered as is also the exhaust port 24 so that the working cylinder is cleared of burnt gases,

As the piston 19 continues its upward movement to the position shown in Figure 8 and from thence downward to the position shown in Figure 9, nothing is gained in the way of added pressure in the upstroke because this pressure is lost in the equivalent downstroke. However, when this additional upstroke started, the air was above atmospheric and, therefore, when the piston returns in downstroke to the position shown in Figure 9, the air is still at the same pressure above atmospheric that it was at when it started the additional upstroke, thus making air at above atmospheric pressure available for supercharging purposes.

While the additional up and down stroke of the piston represented in Figures 7, 8 and 9 has no utility insofar as increasing pressure is concerned, it has, however, decided utility in a mechanical sense because it is during this portion of the engine cycle that the lower working piston 13 keeps the exhaust port 24 open to completely clear the working cylinder of burnt gases and then finally moves upward to the position shown in Figure 9 to cover the exhaust port 24 before the scavenging piston 19 uncovers the port 27 and before the upper working piston 14 covers the port 26. Therefore, in Figure 9 a condition exists in which air above atmospheric pressure is present in the space above the piston 19; clean air at atmospheric pressure is present in the working cylinder and in the receiving chamber 25; and in which the piston 19 is just ready to move downwardly to uncover the port 27 before the piston 14 covers the port 26 so as to let pressure air from above the piston 19 enter the working cylinder as a supercharge, it being noted that this happens in a position between the positions shown in Figures 9 and 10.

The fuel inlet is by means of an injection device at 22 (not shown) as in my previous application.

Figure 4 shows the parts just at the beginning of the power stroke.

Figure 5 shows the parts just as the air inlet ports to the scavenging cylinder close.

Figure 6 shows the parts with the exhaust 24 open from the power cylinder and the scavenging inlet ports 26 at the top just beginning to open.

Figure 7 shows the parts with the scavenging piston just closing the discharge ports 27 from the scavenging cylinder and with the scavenging inlet ports 26 and the exhaust 24 open. Thus pressure air from the receiving chambers 25 scavenges the cylinder and air under pressure is confined in the space above the scavenging piston.

Figure 8 shows the parts advanced with the scavenging piston in its extreme upper position and with the ports 27 still covered and ports 26 and 24 still open.

Figure 9 shows the scavenging piston and connected parts as they travel down far enough to begin to reopen the discharge ports 27, at which time the inlet ports 26 are still partially open but the exhaust ports 24 are closed. Thus the air under pressure enters the working cylinder as a supercharge.

Figure 10 shows the beginning of the compression stroke. Between Fig. 10 and Fig. 4, the charge has been compressed, and just previous to the position of elements in Fig. 4, the compressed charge has been exploded.

Figure 11 shows in the diagram the cycle of pressures, *a* being the lowermost position where the pressure above the scavenging piston is slightly below the atmospheric line; *b* shows the atmospheric line from which the pressure in the scavenging cylinder and receiving chamber rises until the point *c* is reached and then drops to the point *d* on further upward movement of the scavenging piston due to the opening of the scavenging ports 26, then again rising to point *e* where the scavenging piston is at its topmost position, then the air expands due to the downward movement of the scavenging piston to point *f* from which it strikes the point *g* at which the upper working piston closes the scavenging port 26.

The travel from *f* to *g* represents the supercharging period in the cycle, i. e., when the scavenging piston arrives at the point *g* the working cylinder has been charged with air above atmospheric pressure. This point also is the beginning of the compression stroke with the initial pressure in the working cylinder being above atmospheric. It will thus be seen that I have provided a very effective and simple arrangement for supercharging engines of the character described. It is also to be observed that the charging of the scavenging cylinder takes place during the movement of the scavenging piston from point *h* to *c* to *b*.

I claim:

1. A supercharged internal combustion engine having upper and lower working pistons and cylinder, a scavenging piston and cylinder, said scavenging piston being connected with the upper working piston to move in unison therewith, the ports in the wall of said scavenging cylinder so located as to be uncovered by the scavenging piston when it is at the bottom of its stroke, outlet ports in the wall of the scavenging cylinder positioned to be closed by the scavenging piston prior to its reaching the upper limit of its stroke, a receiving chamber with which said outlet ports communicate, outlet ports from the receiving chamber to the working cylinder, means for admitting fuel to the working cylinder, and exhaust ports leading from the working cylinder, crank means for said cylinders, said crank means being so proportioned and said ports so relatively located that air under pressure is admitted to the working cylinder from the scavenging cylinder as a supercharge.

2. A supercharged internal combustion engine

having upper and lower working pistons and cylinder, a scavenging piston and cylinder, said scavenging piston being connected with the upper working piston to move in unison therewith, inlet ports in the wall of said scavenging cylinder so located as to be uncovered by the scavenging piston when it is at the bottom of its stroke, outlet ports in the wall of the scavenging cylinder positioned to be closed by the scavenging piston prior to its reaching the upper limit of its stroke, a receiving chamber with which said outlet ports communicate, outlet ports from the receiving chamber to the working cylinder, means for admitting fuel to the working cylinder, and exhaust ports leading from the working cylinder, crank means for said cylinders, said crank means being so proportioned and said ports so relatively located that the working cylinder exhaust ports are covered by the lower working piston and the outlet ports of the scavenging cylinder and receiving chamber are uncovered by the scavenging piston and upper piston during a portion of the cycle of the engine whereby air under pressure is admitted to the working cylinder as a supercharge.

3. A supercharged internal combustion engine having upper and lower working pistons and cylinder, a scavenging piston and cylinder, said scavenging piston being connected with the upper working piston to move in unison therewith, inlet ports in the wall of said scavenging cylinder so located as to be uncovered by the scavenging piston when it is at the bottom of its stroke, outlet ports in the wall of the scavenging cylinder positioned to be closed by the scavenging piston prior to its reaching the upper limit of its stroke, a receiving chamber with which said outlet ports communicate, outlet ports from the receiving chamber to the working cylinder, means for admitting fuel to the working cylinder, and exhaust ports leading from the working cylinder, crank means for said cylinder, said crank means being so proportioned and said ports so relatively located that the working cylinder exhaust ports are covered by the lower working piston and the outlet ports of the scavenging cylinder and receiving chamber are uncovered by the scavenging piston and upper piston during a portion of the cycle of the engine whereby air under pressure is admitted to the working cylinder as a supercharge, said crank means including a crank having connection with the lower piston and a crank having connection with the upper piston disposed approximately 180° apart.

4. A supercharged internal combustion engine having upper and lower working pistons and cylinder, a scavenging piston and cylinder, said scavenging piston being connected with the upper working piston to move in unison therewith, inlet ports in the wall of said scavenging cylinder so located as to be uncovered by the scavenging piston when it is at the bottom of its stroke, outlet ports in the wall of the scavenging cylinder positioned to be closed by the scavenging piston prior to its reaching the upper limit of its stroke, a receiving chamber with which said outlet ports communicate, outlet ports from the receiving chamber to the working cylinder, means for admitting fuel to the working cylinder, and exhaust ports leading from the working cylinder, crank means for said cylinders, said crank means being so proportioned and said ports so relatively located that the working cylinder exhaust ports are covered by the lower working piston and the outlet ports of the scavenging cylinder and receiving chamber are uncovered by the scavenging piston and upper piston during a portion of the cycle of the engine whereby air under pressure is admitted to the working cylinder as a supercharge, said crank means including a crank having connection with the upper piston and a crank having connection with the lower piston, said second mentioned crank being substantially opposed to the first mentioned crank but advanced with respect thereto in the direction of rotation.

5. A supercharger for internal combustion engines having a pair of opposed working pistons, a cylinder for said pistons, a scavenging piston, a scavenging piston chamber, inlet ports in the lower portion of the wall of the scavenging piston chamber so located as to be open when the scavenging piston is at the bottom of its stroke and to be closed by said scavenging piston in the first portion of its up-stroke, and outlet ports in the upper portion of the wall of said chamber so located as to be closed by the scavenging piston before said piston has reached the end of its up-stroke.

6. A supercharged internal combustion engine having upper and lower working pistons and cylinder, a scavenging piston and cylinder, said scavenging piston being connected with the upper working piston to move in unison therewith, air inlet ports in the wall of the scavenging cylinder positioned to be uncovered by the scavenging piston when it is in the lower portion of its stroke, outlet ports in the upper portion of the wall of the scavenging cylinder controlled by the scavenging piston, a receiving chamber with which said outlet ports communicate, outlet ports from the receiving chamber to the working cylinder controlled by the upper working piston, exhaust ports leading from the working cylinder controlled by the lower working piston, crank means, means connecting said pistons to the crank means, said ports being so relatively located that in one portion of the cycle of the engine the outlet ports which connect the scavenging cylinder and receiving chamber are uncovered by the scavenging piston, the outlet ports which connect the receiving chamber and working cylinder uncovered by the upper working piston and the exhaust ports leading from the working cylinder covered by the lower working piston.

7. A supercharged internal combustion engine comprising a power cylinder having ports for the admission of air under pressure and ports for the exhaust of burnt gases, an upper and a lower power piston in said cylinder the upper of which controls said admission ports and the lower of which controls said exhaust ports, a crank shaft operatively connected with both pistons, a scavenging piston connected to said upper power piston, a cylinder for said scavenging piston, ports in the lower portion of the wall of said scavenging cylinder for the admission of atmospheric air adapted to be covered and uncovered by the scavenging piston in the lower portion of its stroke, outlet ports in the upper portion of the wall of said scavenging cylinder adapted to be covered by the scavenging piston prior to its reaching the end of its up-stroke and to be uncovered by said scavenging piston in the early portion of its down-stroke, a chamber connecting the outlet ports of the scavenging cylinder with the admission ports of the power cylinder, and means for admitting fuel into the power cylinder.

OSCAR G. SCHROM.

CERTIFICATE OF CORRECTION.

Patent No. 2,085,547. June 29, 1937.

OSCAR G. SCHROM.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 57, claim 1, for "the" read inlet; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of August, A. D. 1937.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.