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UNITARY ENGINE COMPRESSOR

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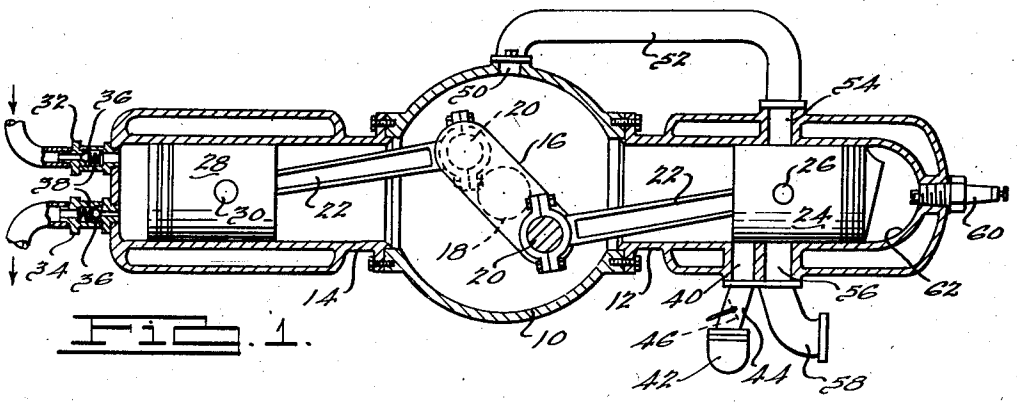

Fig. 1.

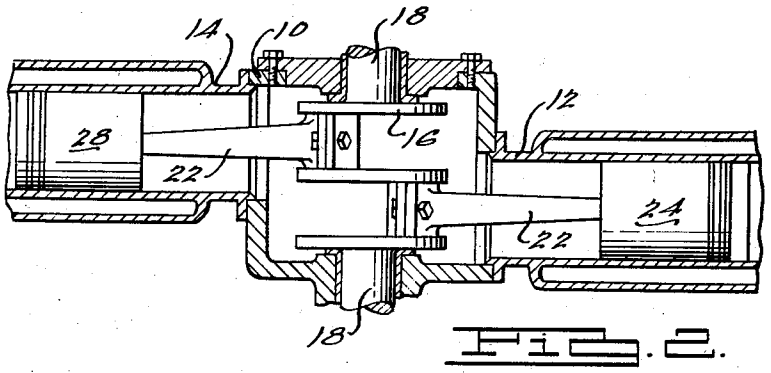

Fig. 2.

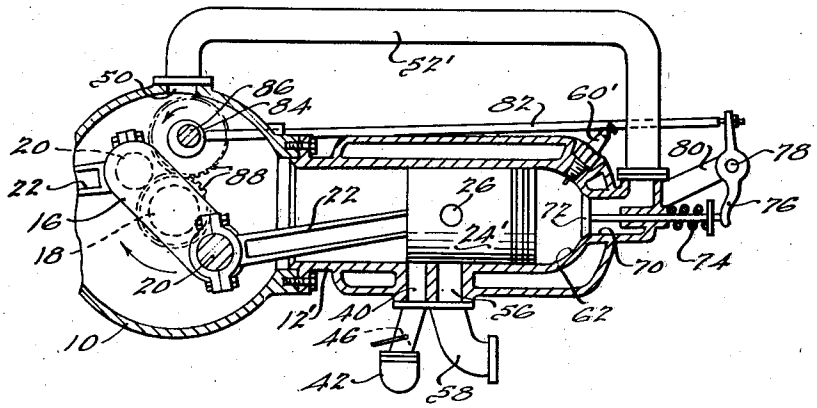

Fig. 3.

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UNITARY ENGINE COMPRESSOR

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5 Claims. (Cl. 230—56)

This invention relates to engine compressor units, that is to structures of the type in which an engine and an air compressor are built as a single unit employing a common crankshaft, the principal object being the provision of a simple and efficient unit of the character described.

Objects of the invention include the provision of an engine compressor unit in which the engine is of the two-stroke type and of unusually great power for its size; the provision of a unit of the type described in which the cylinders of the engine and compressor unit are so constructed and arranged as to be capable of delivering an unusually large amount of combustible mixture, or air to form the same, to the combustion chamber of the engine; the provision of a construction as above described in which the inward movement of the pistons of both the engine and the compressor is utilized to compress a combustible mixture, or at least air for a combustile mixture, in the crankcase of the device for delivery to the combustion chamber of the engine; the provision of a construction as above described including a crankcase having approximately opposed cylinders mounted thereon and a crankshaft rotatable in the crankcase, the crankshaft having opposed throws one connected to a piston in the engine cylinder and one connected to a piston in the compressor cylinder, the structure being so constructed and arranged as to draw air for supporting a combustible mixture, or a combustible mixture, into the crankcase of the engine upon outward movement of both the pistons in their respective cylinders and acting to compress such air or combustible mixture upon inward movement of the pistons in the cylinders, whereby to provide a means for delivering, when necessary, an unusually large charge to the combustion chamber of the engine, such charge being of greater volume for a corresponding pressure than the swept volume of the piston in the engine cylinder only.

The above being among the objects of the present invention, the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates suitable embodiments of the present invention, and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a vertical sectional view taken longitudinally through an engine compressor unit constructed in accordance with the present invention;

Fig. 2 is a partially broken, horizontal sectional view taken centrally through the engine shown in Fig. 1; and,

Fig. 3 is a fragmentary view of a modified form of the engine shown in Fig. 1 and taken in the same plane as the view in Fig. 1.

The principal object of the present invention is the provision of an engine compressor unit capable of being constructed in any desired size but particularly adapted for small size units, which is unusually economical to manufacture and is unusually efficient in operation. To that end it employs an engine of the two-cycle type particularly because of the economy in the cost of manufacture thereof. The compressor is of a conventional type preferably having a piston of the same bore as the engine and arranged with its cylinder in approximately opposed relationship with respect to the engine cylinder and having a base or crankcase common with the engine cylinder. The outer end of the compression cylinder only is employed for air compressor function and the inner end of the air compressor is open to the crankcase or base common to both it and the engine cylinder. A crankshaft having opposed throws is provided in the base or crankcase with one throw connected to the engine piston, and the other throw connected to the compressor piston so that the pistons of both the compressor and engine move outwardly and inwardly substantially simultaneously with one another in their respective cylinders.

The engine is of the type employing base compression so that as both the engine and compressor pistons move outwardly in their respective cylinders a suction is created in the base or crankcase which is employed for drawing a combustible mixture thereinto, or at least air for supporting a combustible mixture, and when the pistons of both compressor and engine move inwardly toward one another such combustible mixture or air is compressed and at a desired point in the stroke of the engine is delivered to the combustion chamber thereof in whole or in part.

It will be appreciated from the above description that in accordance with the present invention a construction is provided in which the movement of the compressor piston in its cylinder is not only employed for the purpose of compressing air to be employed for some useful purpose other than operating the engine itself but it is further employed for increasing the charge which

is capable of being delivered to the engine cylinder and through which the compressor is actuated, the increased charge thus capable of being delivered to the engine cylinder and which at least in some respects has a supercharging effect on the engine, enables the engine to deliver a greater power output than would otherwise be possible.

The particular point in the flow of air into the base or crankcase and from the base or crankcase into the combustion chamber of the engine at which the fuel charge is introduced into the air is, of course, unimportant from the standpoint of the invention. In other words, the air flowing into the engine may pass through a carburetor and thus be charged with fuel upon entering the engine. On the other hand, uncharged air may be drawn into the base or crankcase and charged with fuel therein as, for instance, in the manner disclosed and claimed in my Letters Patent of the United States No. 1,986,630 issued January 1, 1935, on Internal combustion engine, or the charging of the air with fuel may be withheld until the charge of air is being fed from the crankcase to the combustion chamber or until it has been introduced into the combustion chamber, at which time the charge of fuel may be injected into the air in accordance with any one of a number of conventional fuel injector devices. However, for the purpose of simplicity in description it will be assumed in the illustrated embodiment that the air flowing into the engine is first passed through a carburetor and, therefore, is in the form of a combustible mixture during passage from the carburetor to the engine and through the engine to the combustion chamber thereof, this being by way of explanation and not by way of limitation.

It will also be appreciated that while in the drawing a unit having a single engine cylinder and a single compressor cylinder is illustrated, that multiples of these units may be constructed employing a common crankcase and a common crankshaft, the main necessity in such case being that the base portion of the crankcase for each individual cylinder be sealed from open communication with the base portion for each other engine cylinder in accordance with well understood two-cycle practice.

Referring now to the drawing and particularly to Figs. 1 and 2 it will be understood that the device comprises a base or crankcase 10 to one side of which is suitably fixed an engine cylinder 12 and to the opposite side of which is fixed a compressor cylinder 14, the cylinders 12 and 14 being approximately diametrically opposed to each other with respect to the axis of the crankshaft 16 rotatably mounted within the crankcase 10 and both cylinders 12 and 14 opening freely into the crankcase 10. Preferably and as shown, for reasons of running balance, the cylinders 12 and 14 are of the same bore and the pistons which operate therein have the same stroke and weight.

The crankshaft 16 is provided with main journals 18 having suitable bearing in the end walls of the crankcase 10 and diametrically opposed crank pins 20 which are preferably offset from one another axially of the crankcase as shown. As brought out in Fig. 2 the engine cylinder 12 is preferably centrally aligned with one of the crank pins 20, while the compressor cylinder 14 is preferably centrally aligned with the other crank pin 20, this for the purpose of enabling straight connecting rods to be employed. A conventional two-cycle type of slanting head piston 24 is reciprocably mounted in the engine cylinder 12 and connected to its corresponding connecting rod 22 by a conventional piston pin 26. A piston 28 is reciprocably mounted in the compressor cylinder 14 and connected to its corresponding connecting rod 22 by means of a piston pin 30.

Where as is usually desirable, the pistons 24 and 28 are of the same diameter, the same weight, and the piston pins 20 are arranged with their axes at the same distance from the axis of rotation of the crankshaft 16 so that the pistons 24 and 28 have the same stroke in their respective cylinders, as is usually desirable but not necessary, then the reciprocating forces of the pistons and connecting rods on opposite sides of the crankshaft axis balance themselves out as will be appreciated, thus resulting in a smoother running mechanism.

The head of the compressor cylinder 14 is provided with an air inlet connection indicated generally at 32 embodying a suitable valve mechanism permitting flow of air therethrough only in the direction of to the cylinder 14 and is provided with a similar connection indicated generally at 34 provided with a suitable valve mechanism permitting flow of air therethrough only in the direction of from the cylinder 14. These valve mechanisms are, therefore, generally in the nature of a check valve each including, in the particular structure shown by way of example, a ball valve 36 and a cooperating spring 38 constantly urging it towards its seat, the ball valve for the inlet valve opening inwardly towards the cylinder upon a suction being exerted in the cylinder 14 between the piston 28 and the head of the cylinder during inward movement of the piston 28, and closing under the force of its corresponding spring 38 and the pressure of the air compressed in the cylinder 14 during outward movement of the piston 28. Under the latter conditions the pressure of the air built up in the cylinder 14 between the piston 28 and the head of the cylinder exerted on the valve 36 of the connection 34 will cause the valve 36 to raise against the force of the spring 38 and permit the escape of the compressed air out through the connection 34 to a suitable point of storage or use.

While any suitable or conventional method of introducing combustible mixture, or air for forming the same, into the base or crankcase 10 may be employed, that shown by way of illustration is the conventional third port system in which the cylinder 12 is provided with a conventional inlet port 40 normally closed by the piston 24 but uncovered by the piston 24 when the latter approaches the outer limit of its travel in the cylinder 12. In the present case and as previously mentioned a carburetor indicated generally at 42 is shown connected to the intake passage 48 by means of a tubular connection 14 in which a conventional butterfly type of throttle valve 46 is positioned to enable conventional control of the volume of combustible mixture being fed to the engine and, therefore, to control the speed of the engine. It will be appreciated that when the port 40 is opened by the piston 24 the carburetor 42 is in open communication past the throttle valve 46 with that portion of both cylinders 12 and 14 inwardly of their corresponding pistons 24 and 28 and with the interior of the crankcase 10.

In accordance with conventional two-cycle practice the base or crankcase 10 is provided with an outlet port 50 which is connected by a tube 52 with a port 54 opening onto the bore of the cylinder 12. The port 54 is so positioned in the

length of the cylinder 12 that when the piston 24 approaches the inner limit of its movement in the cylinder 12 the piston 24 will uncover the port 54. At the same time the piston 24 will uncover the exhaust port 56 which discharges into an exhaust manifold 58 or the like. A conventional spark plug such as 60 is, of course, provided for firing the charge of combustible mixture in the combustion chamber 62 provided into the outer end of the cylinder 12 outwardly of the head of the piston 24.

In operation it will be appreciated that as the crankshaft rotates from a position in which the pistons 24 and 28 are at the inner limit of their reciprocable positions in their corresponding cylinders 12 and 14, a suction will be created in the base or crankcase 10 and those portions of the cylinders 12 and 14 inwardly of their corresponding pistons 24 and 28. The suction thus created will be as a result of the displacement of both pistons 24 and 28 outwardly in their corresponding cylinders instead of merely by the displacement of one cylinder outwardly in its cylinder as occurs in conventional two-cycle engines of the base compression type. This suction in the crankcase 10 will increase until the piston 24 reaches substantially the position illustrated in Fig. 1 during such outward movement at which time the piston 24 will begin to uncover the port 40 and thus permit the flow of air through the carburetor and port 40 to the crankcase 10 and those portions of the cylinders 12 and 14 inwardly of their corresponding pistons. This flow will usually continue until the crank pins 20 have passed dead center position and the piston 24 has returned on its inward stroke to substantially the position illustrated in Fig. 1 at which time it again closes the port 40. At this time the crankcase 10 and the inner ends of the cylinders 12 and 14 are filled with the maximum amount of combustible mixture capable under the particular degree of opening of the throttle valve 46 then prevailing and as the pistons 24 and 28 continue their inward movements toward each other they will act to compress the combustible mixture thus drawn into the crankcase 10 and inner ends of the cylinders 12 and 14. This compression will continue until the piston 24 has moved inwardly a sufficient amount to permit its upper end to uncover the port 54 which thereby provides a substantially free passage for the flow of the compressed combustible mixture from the base 10 into combustion chamber 62 provided in the outer end of the cylinder 12 outwardly of the head of the piston 24. Any previously burned charge of combustible mixture in the combustion chamber 62 will simultaneously escape out the exhaust port 56 to the manifold 58. In this respect it will be appreciated the exhaust passage 58 may be so constructed and arranged as shown as to be opened slightly in advance of opening of the port 54 in accordance with conventional practice.

It will be appreciated from the above that movement of the piston 28 in the cylinder 14 not only serves to draw air into, compress, and discharge air from the outer end of the cylinder 14 to provide a suitable supply of compressed air for any useful purpose, but additionally that the movement of the piston 28 in the cylinder 14 further provides a means whereby a greater amount of combustible mixture, or air for forming a combustible mixture charge, is capable of being delivered to the combustion chamber of the engine cylinder than in conventional two-cycle types of construction, and this without adding any additional mechanism than is required in providing a simple engine compressor unit. It will also be appreciated that the ability to deliver a greater volume of combustible mixture to the combustion chamber of the engine cylinders enables a relatively greater power output to be obtained from the engine portion of th device than would otherwise be capable of being obtained in conventional constructions of the same size.

This added charge capable of being delivered to the combustion chamber of the engine may be likened to a supercharging effect which, as is well recognized, is capable of materially increasing the maximum power output of an internal combustion engine. Where a more positive action in this respect is desired resort may be had to a modified form of two-cycle engine wherein mechanically operated valve means other than the piston is employed for controlling the flow of combustible mixture, or air for providing a combustible mixture, to the engine cylinder, one form of which is illustrated in Fig. 3.

In Fig. 3 the only change from the construction shown in Figs. 1 and 2 is in the last-mentioned connection and, therefore, only these changes will be described, it being understood that the remaining part of the structure will be identical to that shown and described in Figs. 1 and 2. Those parts of Fig. 3 identical to those shown in Figs. 1 and 2 are indicated by the same numerals and do not require further description.

The cylinder 12' in Fig. 3 is substantially the same as the cylinder 12 shown in Figs. 1 and 2 except that the port 54 is eliminated and instead the cylinder 12' is provided with an axially directed port 70 in its head which port is connected by the tube 52' with the port 50 in the base 10. The port 70 is controlled by a poppet valve 72 constantly urged towards closed position by means of a coil spring 74. It is operated against the force of the spring 74 by means of a rocker arm 76 pivoted at 78 on a bracket 80 fixed with respect to the cylinder 12'. The opposite arm of the rocker arm 76 is connected by a push rod 82 with a cam 84 formed on a cam shaft 86 rotatably mounted in the crankcase 10. The cam shaft 86 is driven at the same speed as the crankshaft 16 by means of a pair of gears 88 operatively connected to both. The contour of the cam 84 obviously may be such as to control the opening and closing of the valve 72 at any desired position of the piston 24' in the cylinder 12' and the flow of combustible mixture to the cylinder is, therefore, not so restricted in this respect as when a port such as 54 controlled by movement of the engine piston, as shown in Figs. 1 and 2, is employed. It will be appreciated by changing the contour of the cam 84 the point of opening and closing the valve 72 may be varied and the flow of combustible mixture to the combustion chamber 62 may be continued even after the exhaust port 56 has been closed by the piston 24'. The piston 24' in this case may be a flat top piston as shown in Fig. 3 instead of the conventional slanting head piston as illustrated in Figs. 1 and 2 and, of course, as illustrated in Fig. 3 the spark plug 60' requires that it be shifted out of the position illustrated in Figs. 1 and 2 in order to accommodate the valve 72.

Other conventional forms of two-cycle engine structures may, of course, be employed in place of the specific construction shown without departing from the spirit of the present invention as long as the feature of employing the movement of both the engine and compressor pistons

for drawing in combustible mixture, or air for forming the combustible mixture, into the crankcase and there compressing it for delivery to the combustion chamber of the engine cylinder, is employed.

What I claim is:

1. In an engine compressor unit, in combination, a crankcase, a crankshaft having approximately diametrically opposed crank pins rotatably mounted in said crankcase, a cylinder secured to said crankcase and projecting therefrom in approximately radial relation with respect to the axis of rotation of said crankshaft, a second cylinder fixed to said crankcase and projecting therefrom in approximately radial relation with respect to the axis of rotation of said crankshaft and in approximately diametrically opposed relation with respect to the first-mentioned cylinder, a piston reciprocably received in each of said cylinders, a connecting rod connecting one of said pistons to one of said pins, a connecting rod connecting the other of said pistons with the remaining of said pins, a head for each of said cylinders, means for introducing air into one of said cylinders between the head thereof and the piston therein under the influence of a suction created between said head and piston during inward travel of the piston therein and blocking the escape of air from said cylinder therethrough, means for discharging air compressed in said one of said cylinders between said head thereof and the said pistons therein during outward movement of the said pistons therein and blocking the return flow of air therethrough, means for introducing air into said crankcase under a suction created therein by outward movement of both said pistons in their corresponding cylinders, said other of said cylinders having an exhaust port formed therein controlled by movement of the corresponding piston therein and provided for the escape of burned products of combustion from said other of said cylinders between the head thereof and the corresponding piston therein, said other of said cylinders having another port therein arranged for open communication with the bore of said first-mentioned cylinder between said head thereof and the corresponding piston therein when said piston has approached the inner limit of its movement in said other of said cylinders, and means forming an open passageway between said other port and said crankcase for delivery of fluid compressed in said crankcase by inward movement of said pistons in their corresponding said cylinders.

2. An engine compressor unit comprising, in combination, a crankcase, a crankshaft rotatable in said crankcase, a pair of approximately diametrically opposed cylinders fixed and sealed to said crankcase, a piston reciprocable in each of said cylinders, said crankshaft having approximately diametrically opposed crank pins, a connecting rod connecting one of said pistons to one of said crank pins, a connecting rod connecting the other of said pistons to the other said crank pin, the inner ends of said cylinders being in open communication with the interior of said crankcase, a pair of one-way valve mechanisms associated with one of said cylinders operable to introduce air into said cylinder between the head thereof and the piston therein under the influence of a suction created by the inward movement of said piston therein and for discharging air compressed therein by outward movement of said piston therein, means associated with said engine for introducing air into said crankcase during movement of said pistons toward the outer limit of their strokes, the other of said cylinders having an exhaust port therein adapted to be uncovered by the piston therein when said piston therein approaches the inner end of its stroke therein, the combined displacement of both of said pistons in their corresponding cylinders during outward movement thereof in said cylinders serving to create a suction in said crankcase for drawing air thereinto through said means, said air being compressed by the combined displacement of both said pistons in their respective cylinders during inward movement of said pistons in said cylinders, and means for delivering said compressed fluid to said other of said cylinders when the corresponding piston therein approaches the inner limit of its stroke.

3. An engine compressor unit comprising, in combination, a crankcase, a crankshaft rotatable in said crankcase, a pair of approximately diametrically opposed cylinders fixed and sealed to said crankcase, a piston reciprocable in each of said cylinders, said crankshaft having approximately diametrically opposed crank pins, a connecting rod connecting one of said pistons to one of said crank pins, a connecting rod connecting the other of said pistons to the other said crank pin, the inner ends of said cylinders being in open communication with the interior of said crankcase, a pair of one-way valve mechanisms associated with one of said cylinders operable to introduce air into said cylinder between the head thereof and the corresponding piston therein under the influence of a suction created therein by the inward movement of said corresponding piston therein and for discharging air compressed therein by outward movement of the corresponding piston therein, means associated with said engine for introducing air into said crankcase during movement of said pistons toward the outer limit of their strokes, the other of said cylinders having an exhaust port therein adapted to be uncovered by the piston therein when said piston therein approaches the inner end of its stroke therein, the combined displacement of both of said pistons in their corresponding cylinders during outward movement thereof in said cylinders serving to create a suction in said crankcase for drawing air through said means thereinto, said air being compressed by the combined displacement of both said pistons in said cylinders during inward movement of said pistons in said cylinders, said other of said cylinders having a third port therein adapted to be uncovered by the corresponding of said pistons when said corresponding piston approaches the inner limit of its travel therein, and a passageway connecting said third port with the interior of said crankcase whereby fluid compressed in said crankcase by the combined displacement of said pistons during their inward travel in their corresponding said cylinders is discharged into said other of said cylinders between the corresponding piston therein and the head thereof when said corresponding piston therein approaches the inner limit of its stroke therein.

4. An engine compressor unit comprising, in combination, a crankcase, a crankshaft rotatable in said crankcase, a pair of approximately diametrically opposed cylinders fixed and sealed to said crankcase, a piston reciprocable in each of said cylinders, said crankshaft having approximately diametrically opposed crank pins, a connecting rod connecting one of said pistons to one

of said crank pins, a connecting rod connecting the other of said pistons to the other said crank pin, the inner ends of said cylinders being in open communication with the interior of said crankcase, a pair of one-way valve mechanisms associated with one of said cylinders operable to introduce air into said cylinder between the head thereof and the piston therein under the influence of a suction created therein by the inward movement of said piston therein and for discharging air compressed therein by outward movement of the piston therein, means associated with said engine for introducing air into said crankcase during movement of said pistons toward the outer limit of their strokes, the other of said cylinders having an exhaust port therein adapted to be uncovered by the piston therein when said piston therein approaches the inner end of its stroke therein, the combined displacement of both of said pistons in their corresponding cylinders during outward movement thereof in said cylinders serving to create a suction in said crankcase for drawing air through said means, said air being compressed by the combined displacement of both said pistons in said cylinders during inward movement of said pistons in said cylinders, said other of said cylinders having a third port therein, passage forming means connecting said third port with the interior of said crankcase, a valve controlling the opening and closing of said third port, and means for operating said valve in timed relation with respect to rotation of said crankshaft whereby to deliver said compressed air to said other cylinder outwardly of the piston therein.

5. An engine compressor unit comprising, in combination, a crankcase, a crankshaft rotatable therein, a pair of cylinders fixed to said crankcase in radial relation thereto, a piston in each of said cylinders, means operatively connecting each of said pistons to said crankshaft, the construction and arrangement of said cylinders and crankshaft being such that said pistons will move inwardly in their respective cylinders approximately simultaneously and outwardly in their respective cylinders approximately simultaneously, the inner ends of said cylinders being in open communication with the interior of said crankcase, a pair of one-way valve mechanisms associated with one of said cylinders operable to introduce air into said cylinder between the head thereof and the piston therein under the influence of a suction created by the inward movement of said piston therein and for discharging air compressed therein by outward movement of said piston therein, means associated with said engine for introducing air into said crankcase during movement of said pistons toward the outer limit of their strokes, the other of said cylinders having an exhaust port therein adapted to be uncovered by the piston therein when said piston therein approaches the inner end of its stroke therein, substantially the combined displacement of both of said pistons in their corresponding cylinders during outward movement thereof in said cylinders serving to create a suction in said crankcase for drawing air thereinto through said means, said air being compressed by substantially the combined displacement of both said pistons in their respective cylinders during inward movement of said pistons in said cylinders, and means for delivering said compressed fluid to said other of said cylinders when the corresponding piston therein approaches the inner limit of its stroke.

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