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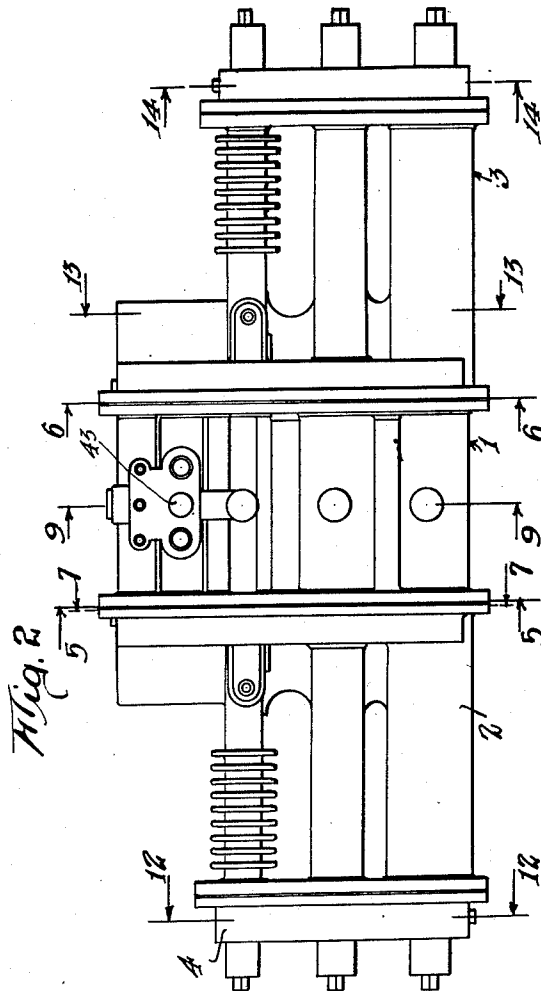
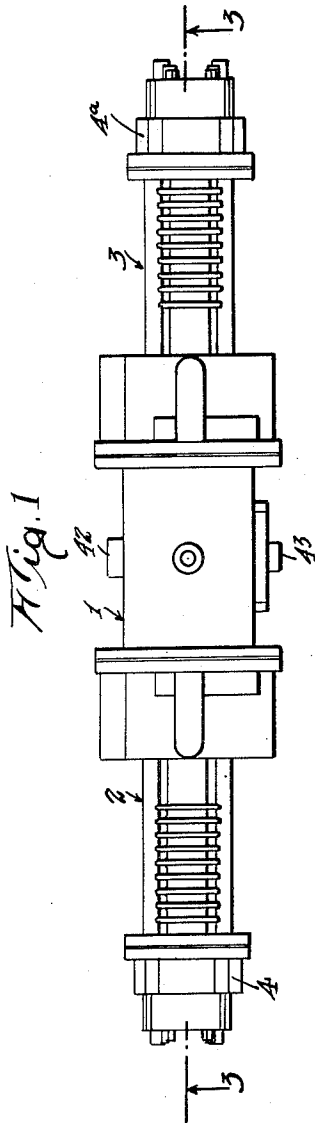
R. E. MITTON

2,479,856

MULTIPLE STAGE AIR COMPRESSOR

Filed Sept. 17, 1945

6 Sheets-Sheet 1



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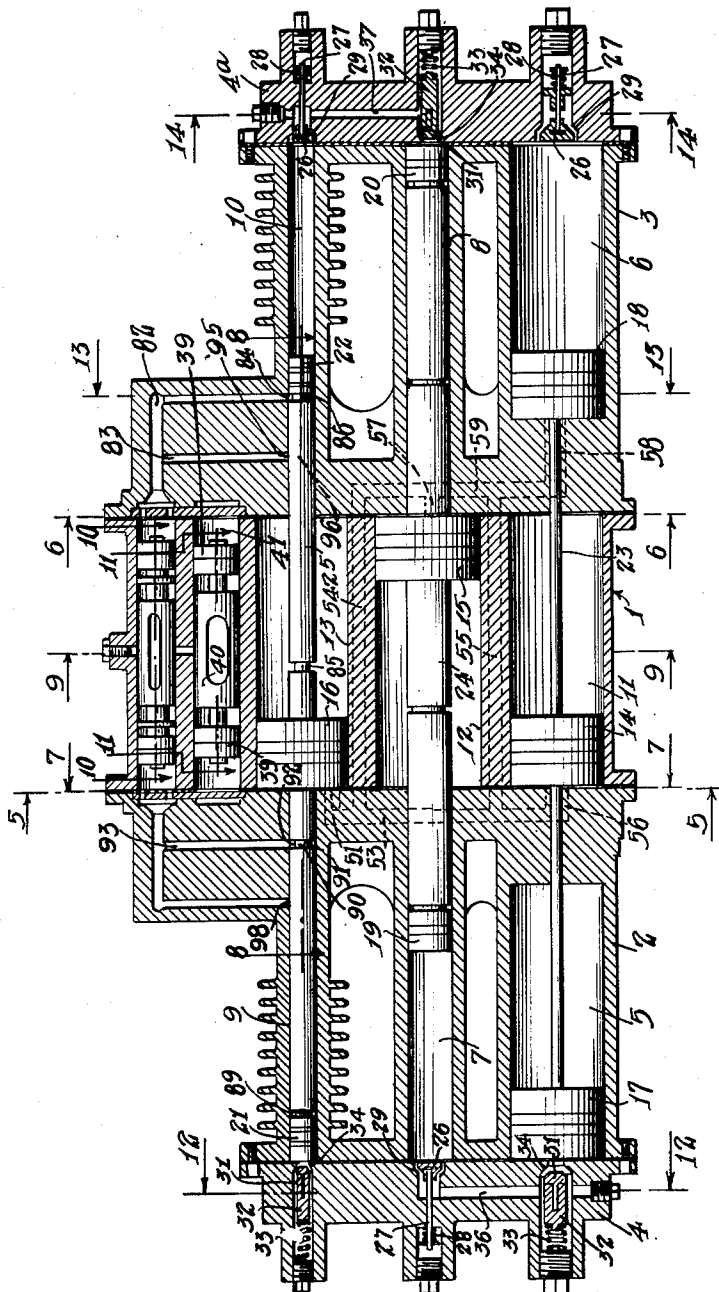


Fig. 3

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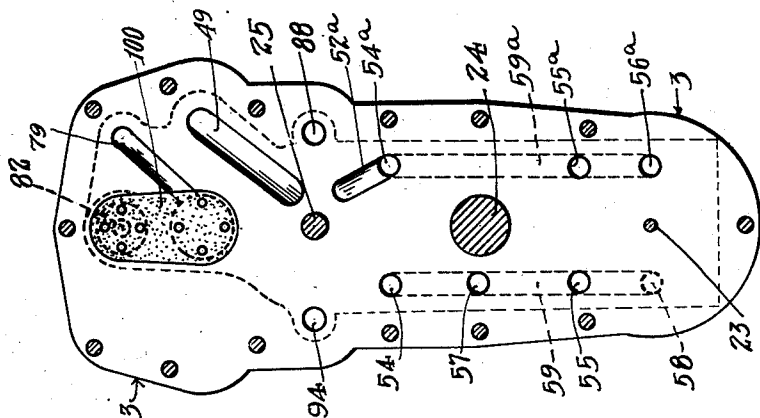


Fig. 6

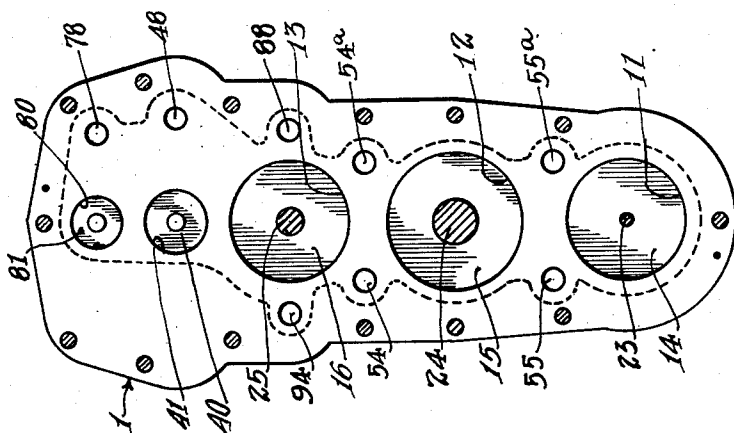


Fig. 5

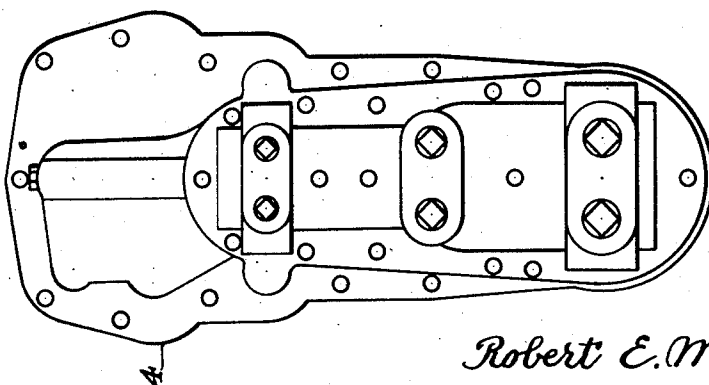


Fig. 4

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Fig. 8

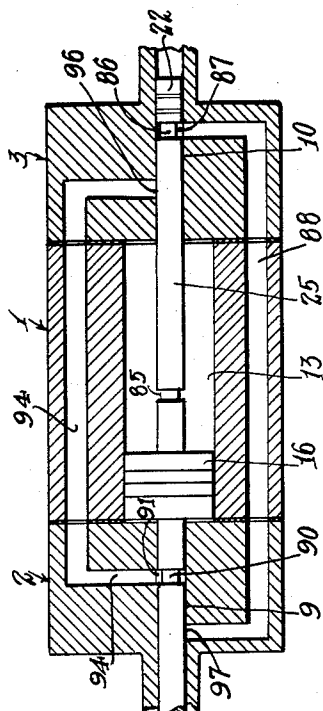
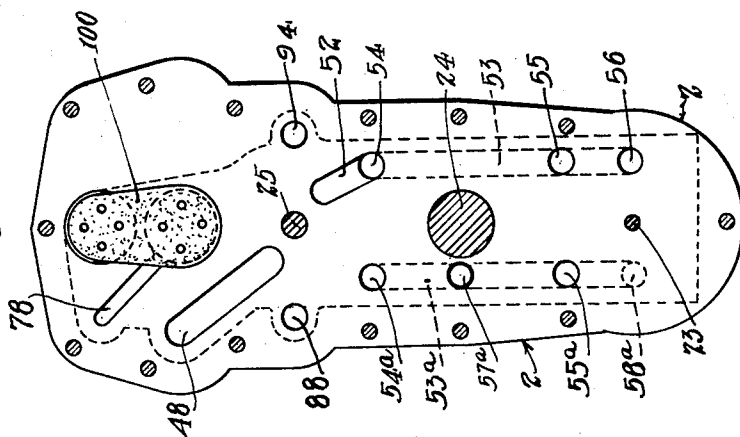


Fig. 7



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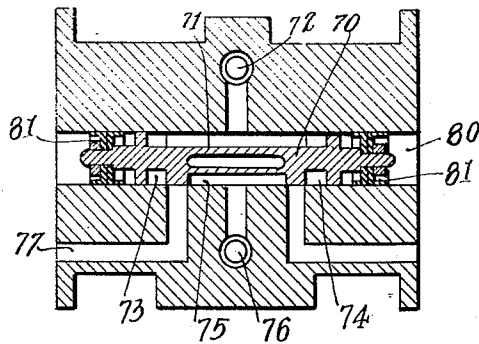


Fig. 10

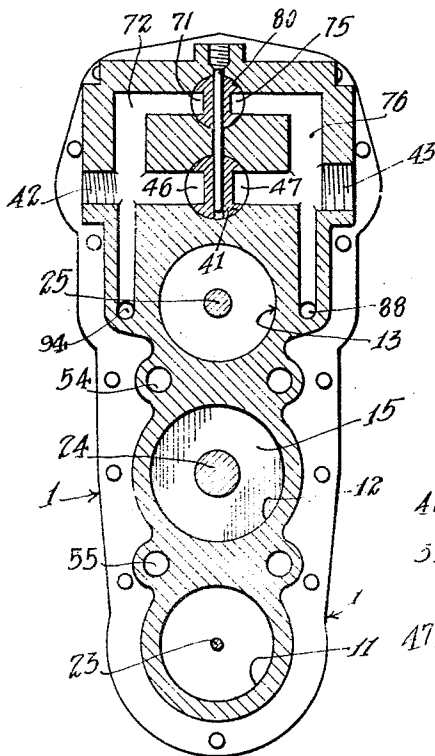


Fig. 9

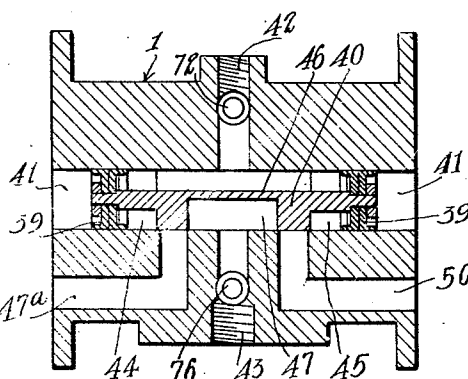


Fig. 11

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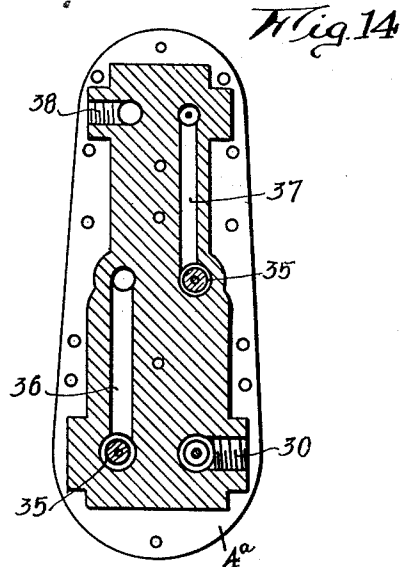
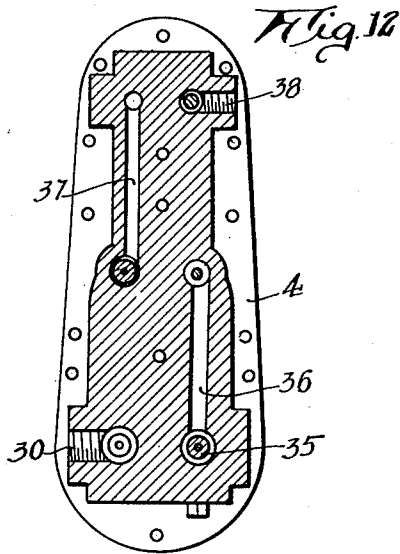
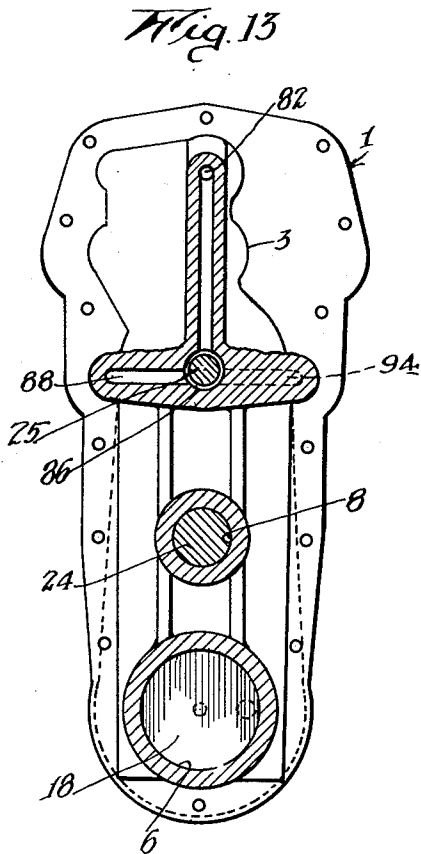
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MULTIPLE STAGE AIR COMPRESSOR

Filed Sept. 17, 1945

6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,479,856

MULTIPLE STAGE AIR COMPRESSOR

Robert E. Mitton, Lemongrove, Calif., assignor of fifteen per cent to D. W. Sneath, El Cajon, one per cent to Edwin T. Padfield, La Mesa, one per cent to Alvin G. Crawford, National City, one per cent to George H. Roberts, National City, one per cent to Noah H. Highsmith, San Diego, and two per cent to Lynold L. Claydon, San Diego, Calif.

Application September 17, 1945, Serial No. 616,714

2 Claims. (Cl. 230—54)

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My invention comprises a multiple stage air compressor and more specifically a multiple stage air compressor which can be operated from any source of fluid power either by steam, compressed air, hydraulically or by power derived from an induced vacuum.

In my compressor there is no mechanical linkage or connecting rods. All the parts are actuated by the fluid pressure moving through a series of ports and slots. The only operating members are reciprocating pistons and valves which do not have connecting rods or cams.

It is therefore the object of my invention to provide a multiple stage air compressor in which the pistons and valves are directly motivated by the fluid pressure transmitted through ports in the engine housing.

Another object of my invention is to provide means to actuate the pistons and valves of my compressor through open connections without mechanical linkage or connection between the pistons and valves in the respective stages or in the compression chambers.

Another object of my invention is to provide a compressor which can be effectively operated when installed at any angle and which may be actuated by steam, air pressure, hydraulic pressure, gas or other expansive fluid or by an induced vacuum.

Another object of my invention is to provide a compressor which can be reversed in action and used to create a vacuum for laboratory or other purposes.

Another object of my invention is to provide a compressor which can be used on trucks, automobiles and the like to compress the air used in air brakes and which can be actuated by the same source of power as the conventional windshield wiper, i. e., from the vacuum formed in the engine intake manifold.

In the following description the preferred embodiments of my invention are set forth.

In the drawings:

Figure 1 is a top plan view of my invention;

Figure 2 is a side elevation;

Figure 3 is a cross-section taken on the line 3—3 of Figure 1;

Figure 4 is an end elevation;

Figure 5 is a cross-section taken on the line 5—5 of Figures 2 and 3;

Figure 6 is a cross-section taken on the line 6—6 of Figures 2 and 3;

Figure 7 is a cross-section taken on the line 7—7 of Figures 2 and 3;

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Figure 8 is a cross-section taken on the line 8—8 of Figure 3;

Figure 9 is a cross-section taken on the line 9—9 of Figures 2 and 3;

Figure 10 is a cross-section taken on the line 10—10 of Figure 3;

Figure 11 is a cross-section taken on the line 11—11 of Figure 3;

Figure 12 is a cross-section taken on the line 12—12 of Figures 2 and 3;

Figure 13 is a cross-section taken on the line 13—13 of Figures 2 and 3.

Figure 14 is a cross-section taken on the line 14—14 of Figures 2 and 3.

A multiple stage air compressor constructed in accordance with my invention comprises a series of castings bolted together. A central casting forms a housing 1 for the engine operating mechanism. Castings 2 and 3 bolted on the ends of the housing 1 comprise housings for the multiple stage compressor and carry slots and bores for the actuation of the engine installed in the housing 1. At the ends of the castings 2 and 3 are the cylinder heads 4 and 4a, respectively.

It should be understood that my compressor can be either a single stage, double, triple, or multiple stage without departing from the spirit of my invention, and in the preferred form shown in the drawings, to be hereinafter described, is shown a triple stage compressor.

In the castings 2 and 3 are bored the low pressure cylinders 5 and 6, intermediate cylinders 7 and 8 and the high pressure cylinders 9 and 10. In the engine housing 1 is bored the cylinder 11 which carries the driving piston 14 for the low stage compressor, cylinder 12 for the piston of the intermediate compressor and the cylinder 13 for the piston of the high stage compressor. These pistons are numbered, respectively 14, 15 and 16. In the cylinders 5, 6, 7, 8, 9 and 10 are positioned the compressor pistons 17, 18, 19, 20, 21 and 22 which are connected together by the piston rods 23, 24 and 25 which connect the pistons of the compressor of the same stage together with the driving piston of that stage. It should be noted that the compressor situated in the casting 2 and the one in casting 3 are identical except that they are in opposite phase to each other. Therefore, I shall describe only the operation of the compressor in the casting 3 as the other compressor and its action are identical.

In the cylinder heads 4 and 4a for each stage of the compressor are positioned inlet and outlet valves. The inlet valves comprise a rubber valve 26 carried by the valve stem 27 and actuated by

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a spring 28 that causes the same to sit on a valve seat 29. The outlet valves comprise a rubber valve 31 mounted on a valve stem 32 and held closed by a spring 33. A valve 26 opens the cylinder 6 to the atmosphere through the port 30 and acts as the inlet to the compressor. When the piston 18 is moved to the left in Figure 3, the suction applied to a valve 26 causes the same to open against the pressure exerted by the spring 28 and to draw air into the cylinder 6. When the piston 18 is moved to the right, and starts to compress the air in the cylinder 6, it forces a valve 26 to seat, sealing the port 30. When the pressure in the cylinder 6 becomes sufficient a valve 31 is moved from its seat 34 opening the port 35, allowing the air in the cylinder 6 to be forced through the port 35 and the bore 36 into the cylinder 8, past a valve 26. Similarly when the stroke is reversed, the piston 20 will force the air previously forced into the cylinder 8 by the piston 18 out through a valve 31, through the bore 37 into the cylinder 10 past a valve 26. Again, when the piston 22 is in its compression stroke, it forces the air out through a valve 31 through the outlet port 38 into whatever type of supply or compression chamber is connected to the compressor. When the pistons 18 and 22 are in their compression stroke, the piston 20 is in its intake stroke.

To operate this triple stage compressor I have provided the engine positioned in the housing 1 whose actuating members are the pistons 14, 15 and 16. To actuate these pistons and drive the compressor I provide an engine valve 40 positioned in the cylinder 41. The engine valve 40 communicates with the port 42 which is the intake for fluid pressure, and with the port 43 which is the exhaust. The engine valve 40 has at its ends pistons 39 upon which it slides back and forth in the cylinder 41. At the ends just inside of the pistons 39 are annular grooves 44 and 45. On one side of the valve 40 is a flattened surface 46 which opens into the annular grooves 44 and 45 and communicates with the inlet port 42. On the other side of the valve 40 is a milled slot 47 which communicates with the exhaust port 43. When the engine valve 40 is moved to the right in Figure 3 or 11, the fluid pressure can then flow through the port 42 out through the annular groove 44 into the bore 47a which communicates with a slot 48 milled in the face of the casting 2. This slot communicates with the end of the cylinder 13 and allows the fluid pressure to flow into the cylinder 13 on the left side of the piston 16. This pressure will thus force the piston 16 to the right. At the same time a milled slot 49 in the face of the casting 3 allows the exhaust fluid in the cylinder 13 to be forced out through the slot 49 and the port 50 past the milled slot 47 and through the exhaust 43. By moving the engine valve to the left, the exhaust and intake are reversed, and the piston 16 would be forced to the left. To drive the other two stages of the compressor emerging from the cylinder 13 is a port 51 which opens into the slot 52 communicating with the bores 53, 54, 55 and 59 and the ports 56, 57 and 58. The port 56 enters into the cylinder 11 at the left end, and the port 58 enters into the cylinder 6 at the left end, and the port 57 enters into the cylinder 12 at the right. When the engine valve 40 is at the right end it admits pressure on the left side of the pistons 14, 16 and 18 and the right side of the piston 15. As one of the chief purposes of my multiple stage compressor is to act as an air compressor for air

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brakes on trucks and other motor vehicles, and I plan to drive the same from the vacuum created by the intake manifold of the engine, it is apparent that the driving energy of my compressor is rather small and to secure sufficient pressure to actuate the low stage compressor I have found it desirable to use the pistons 17 and 18 as driving pistons as well as the piston 14. This is accomplished by the cross porting, such as the port 58 which opens into the cylinder at the left of the piston 18. The reverse stroke of the pistons 14 and 15 is actuated by the fluid emerging from the cylinder 13 at its right end through the bores and ports identical with, but of an opposite pattern to, those leading from the left end and opening into the cylinders 5, 11 and 12 on the opposite side of the pistons 14, 15, 17 and 18. For purposes of clarity I have numbered these ports, bores and slots 51a, 52a, 53a, etc., to correspond with the first described ports, etc. By reversing the engine valve 40, the piston is thus connected through this last set of bores and ports to drive the pistons while the original set of bores described provide for the exhaust.

To actuate the engine valve 40 I provide a pilot valve 70 which has a flattened surface 71 communicating with the port 72 opening into the intake port 42 and the annular grooves 73 and 74. A milled slot 75 communicates with the exhaust port 43 by way of the bore 76. When the pilot valve 70 is moved to the right, the annular groove 73 lines up with the bore 77 and allows the fluid pressure to move through the bore 77 and the slot 78 into the cylinder 41 at the left side of the piston 39, moving the engine valve 40 to the right. At the same time the fluid in the cylinder 41 at the right end of the valve 40 is exhausted through the slot 79 in the casting 3 past the milled slot 75 and out through the bore 76 and the exhaust port 43. The movement of the pilot valve actuates the engine valve which in turn actuates the engine pistons.

While the pilot valve 70 can be operated by any means such as a cam, direct linkage, or by an electric solenoid control, I prefer to actuate the same by the fluid pressures actuating my entire compressor. To actuate the pilot valve 70 the same is provided at each end with pistons 81. The right end of the cylinder 80 is connected with a bore 82 which communicates with the ports 83 and 84 in the cylinder 10. However, the piston rod 25 is a sliding fit in the cylinder 10 and of sufficient diameter to seal the ports 83 and 84. There are annular grooves 85 and 86 upon the piston rod 25. When the piston rod 25 is in the position shown in Figure 3, the annular groove 86 opens a passage from the port 84 into a port 87 at the end of the bore 88. This bore 88 opens into the exhaust port 43. Any fluid pressure at the right end of the cylinder 80 can be discharged out through the exhaust port 43. Upon the other end of the piston rod 25 where it slides in the cylinder 9 are the annular grooves 89 and 90. As shown in Figure 3, when the piston 16 is at the left end of its stroke, the groove 90 opens a passage between ports 91 and 92. The port 92 communicates with the bore 93 which opens into the left end of the cylinder 80 while the port 91 at the end of the bore 94 opens into the intake port 42. When the piston 16 is at the left end of its stroke, fluid pressure passes through into the left end of the cylinder 80 forcing the pilot valve 70 to the right and, by the previously described passages for the fluid pressure, moves the engine valve 40 to the right, reversing the travel

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of the pistons 14, 15, 16, 17 and 18. When the piston 16 is at the right end of its stroke, the annular groove 85 opens a passage from the port 95 which opens into the bores 82 and 83 to the port 96 at the end of the bore 94, allowing the fluid pressure to flow into the right end of the cylinder 80 and force the pilot valve 70 to the left. The pressure in the left end of the cylinder 80 is exhausted through the bore 93 and out through the port 98 past the annular groove 89 into the port 97 which is at the end of the bore 88 communicating with the exhaust port 43.

Many attempts have been made to actuate a reciprocating set of pistons by the use of fluid passages to actuate the valving mechanism. However, all of these devices have failed in operation, because there is always leakage around the ports and as the load on the engine increases this leakage will cause the engine valve to move to a dead center position and stop the entire operation. This is not possible in my device, because leakage cannot accumulate in the cylinder 41 and prevent the operation of the engine valve as the same will always be either at the extreme left or the extreme right depending upon the position of the pilot valve 70. There is no possibility of back pressure building up on the exhaust side of the engine valve. Only when the pilot valve 70 is cracked open to allow communication with the exhaust and the intake will the engine valve 40 begin to move and the slightest opening of the pilot valve will immediately cause the engine valve to slam to the opposite position so that even leakage that would normally stall the engine valve is immediately exhausted.

When my compressor is running on low pressure in the supply tank, it will cause a very violent movement of both the engine valve 40 and the pilot valve 70. At both ends of the cylinders 41 and 80, in the end of the castings 2 and 3 are positioned bumpers 100 formed of rubber or a like material to absorb the shock at the end of the stroke of these valves.

A particular feature of my invention is the open connections between the driving pistons 14, 15, 16, 17 and 18 which allows the pumping action to gradually slow as the pressure in the reservoir tank increases. The cross porting by the bores allows the piston to receive full pressure and yet the violence of the pistons' reciprocation is slowed by the back pressure.

While I have described the preferred embodiments of my invention, I am not limited to any of the details therein set forth except as described in the following claims.

I claim:

1. In a compressor, a housing, a cylinder in said housing, a power piston in said cylinder, a second cylinder in said housing, an engine valve in said cylinder, a third cylinder in said housing, a pilot valve in said cylinder, cylinder heads carried by said housing and having ports communicating with said engine valve and opposite sides of said power piston, a pressure intake port to said engine valve, an exhaust port to said engine valve, means carried by said engine valve for

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alternately opening said ports to said intake port and said exhaust port to reciprocate said piston, a pilot valve, ports from said pilot valve to said intake port and said outlet port and ports from said pilot valve to the opposite ends of said engine valve, means carried by said pilot valve for alternately opening said intake port and said exhaust port to reciprocate said engine valve, cylinders in said cylinder heads, compressing pistons in said cylinders, a connecting rod connecting said power piston and said compressing pistons whereby movement of said power piston will actuate said compressing pistons, and means carried by said connecting rod for actuating said pilot valve.

2. In a compressor, a housing, a cylinder in said housing, a power piston in said cylinder, a second cylinder in said housing, an engine valve in said cylinder, a third cylinder in said housing, a pilot valve in said cylinder, cylinder heads carried by said housing and having ports communicating with said engine valve and opposite sides of said power piston, a pressure intake port to said engine valve, an exhaust port to said engine valve, means carried by said engine valve for alternately opening said ports to said intake port and said exhaust port to reciprocate said piston, a pilot valve, ports from said pilot valve to said intake port and said outlet port and ports from said pilot valve to the opposite ends of said engine valve, means carried by said pilot valve for alternately opening said intake port and said exhaust port to reciprocate said engine valve, cylinders in said cylinder heads, compressing pistons in said cylinders, a connecting rod connecting said power piston and said compressing pistons whereby movement of said power piston will actuate said compressing pistons, and annular grooves on said connecting rods, and passages from the opposite ends of said pilot valve to a position in said cylinders in said engine housing adjacent to passages connecting with said intake port and said exhaust port, said annular grooves spaced to alternately connect said passages upon reciprocation of said connecting rod to alternately connect the ends of said pilot valve with said intake port and said exhaust port.

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