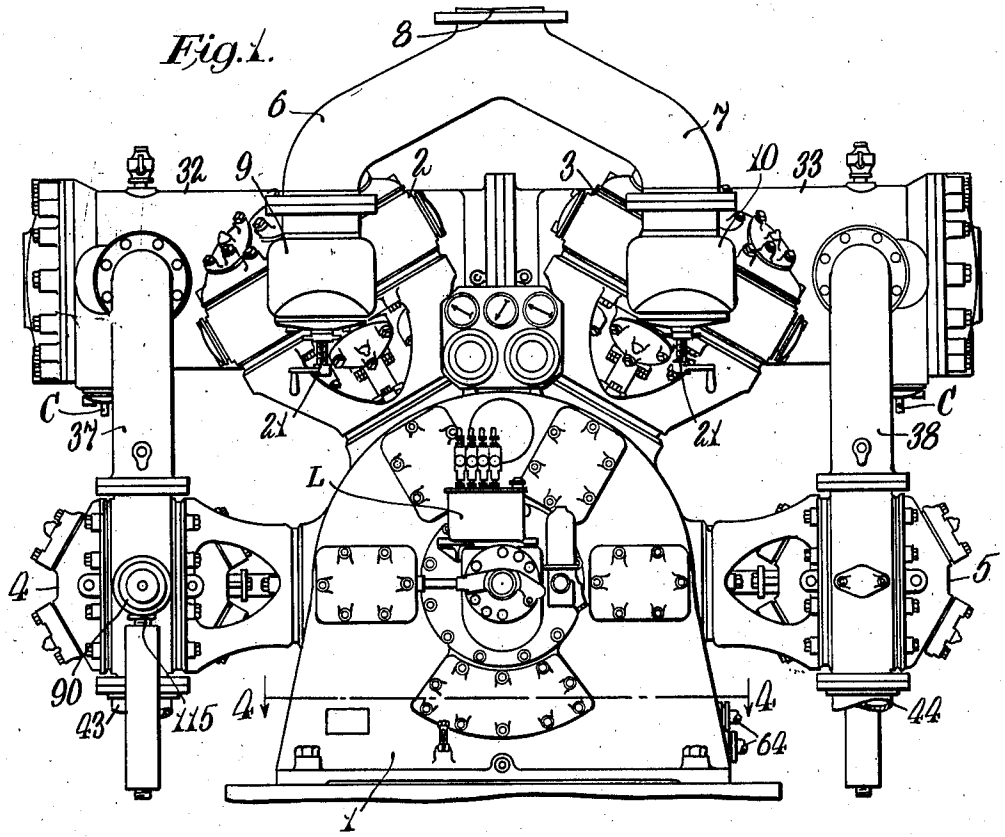
March 2, 1943. F. A. HALLECK 2,312,335

COMPRESSOR

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Fig. 1.



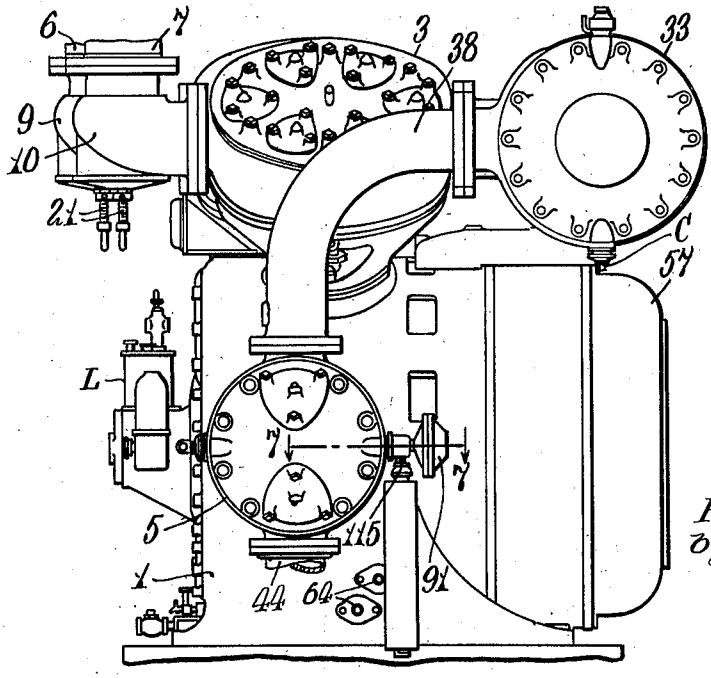


Fig. 2.

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COMPRESSOR

Filed April 24, 1939 7 Sheets-Sheet 2

Fig. 3.

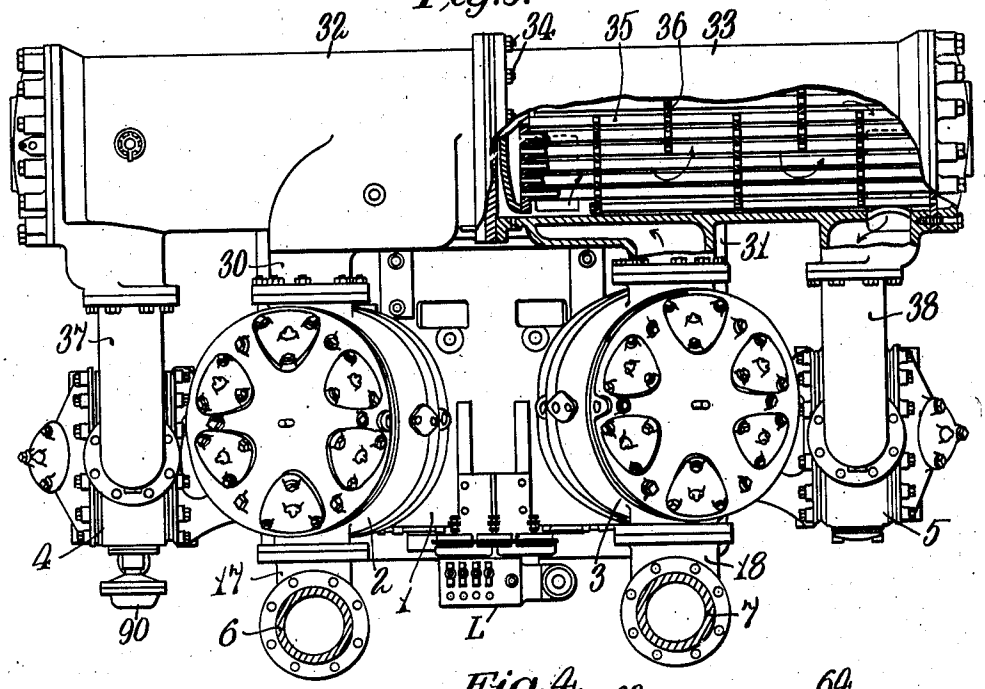
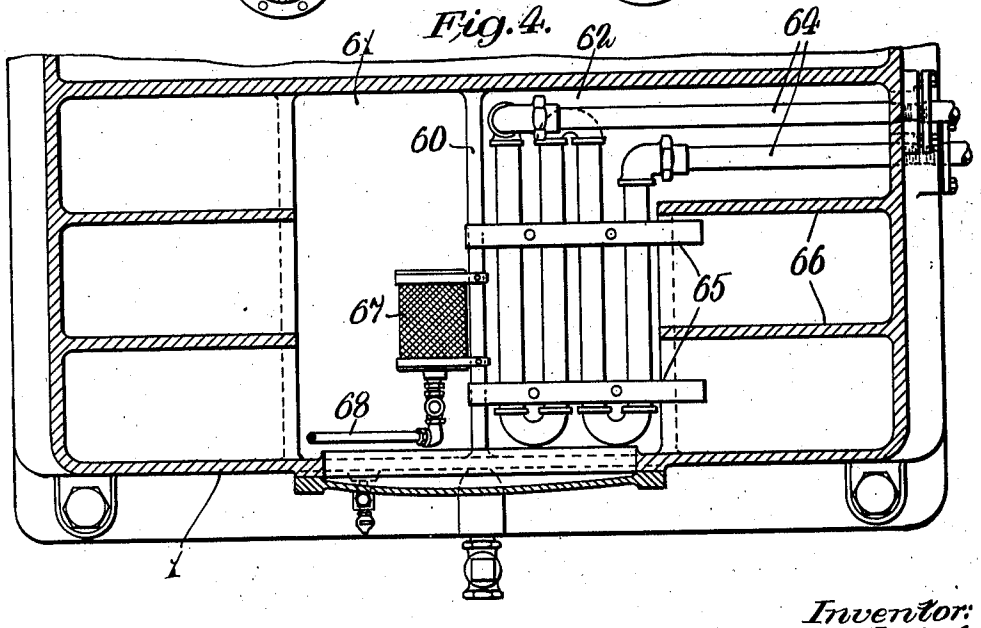


Fig. 4.



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COMPRESSOR

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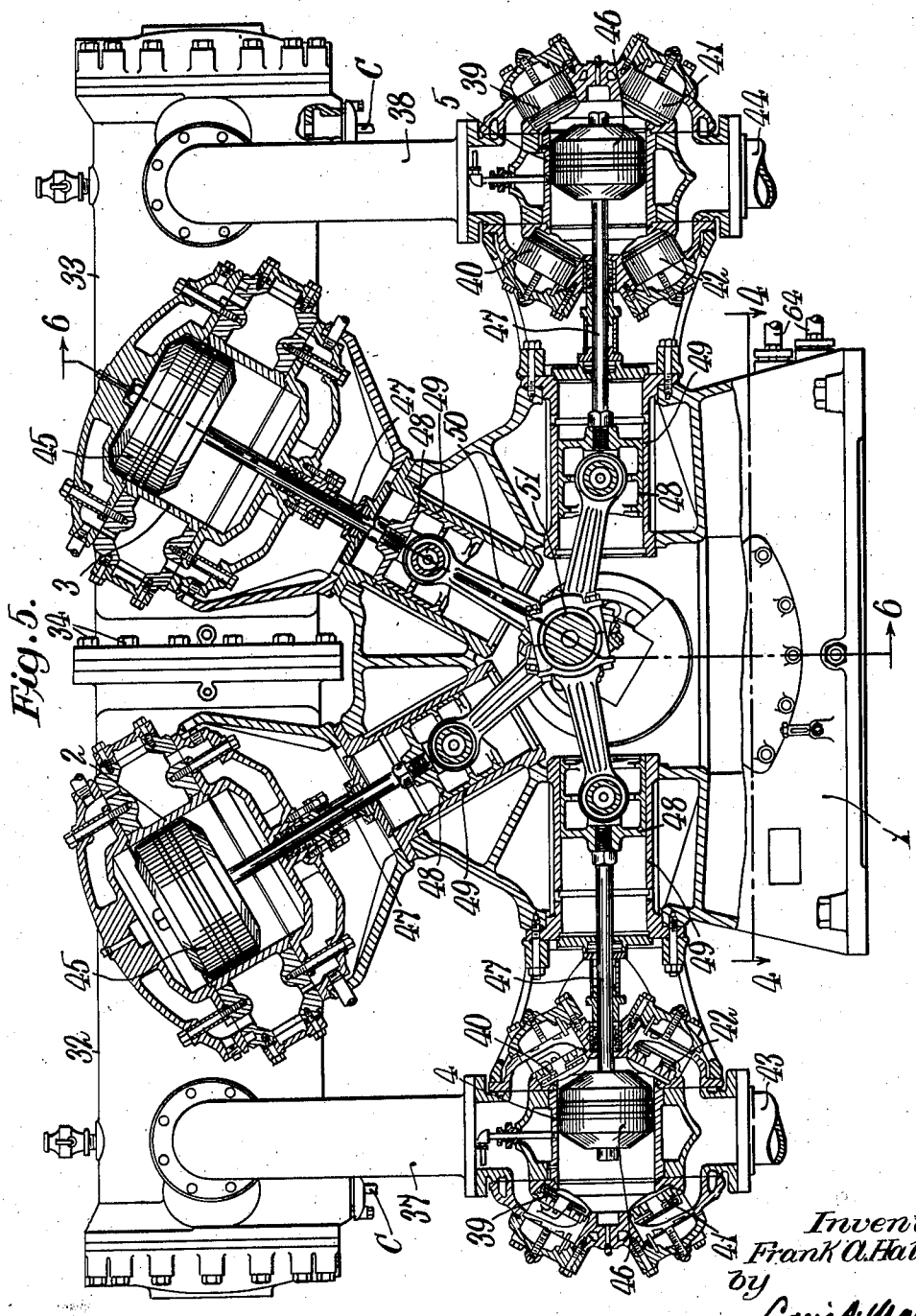


Fig. 5.

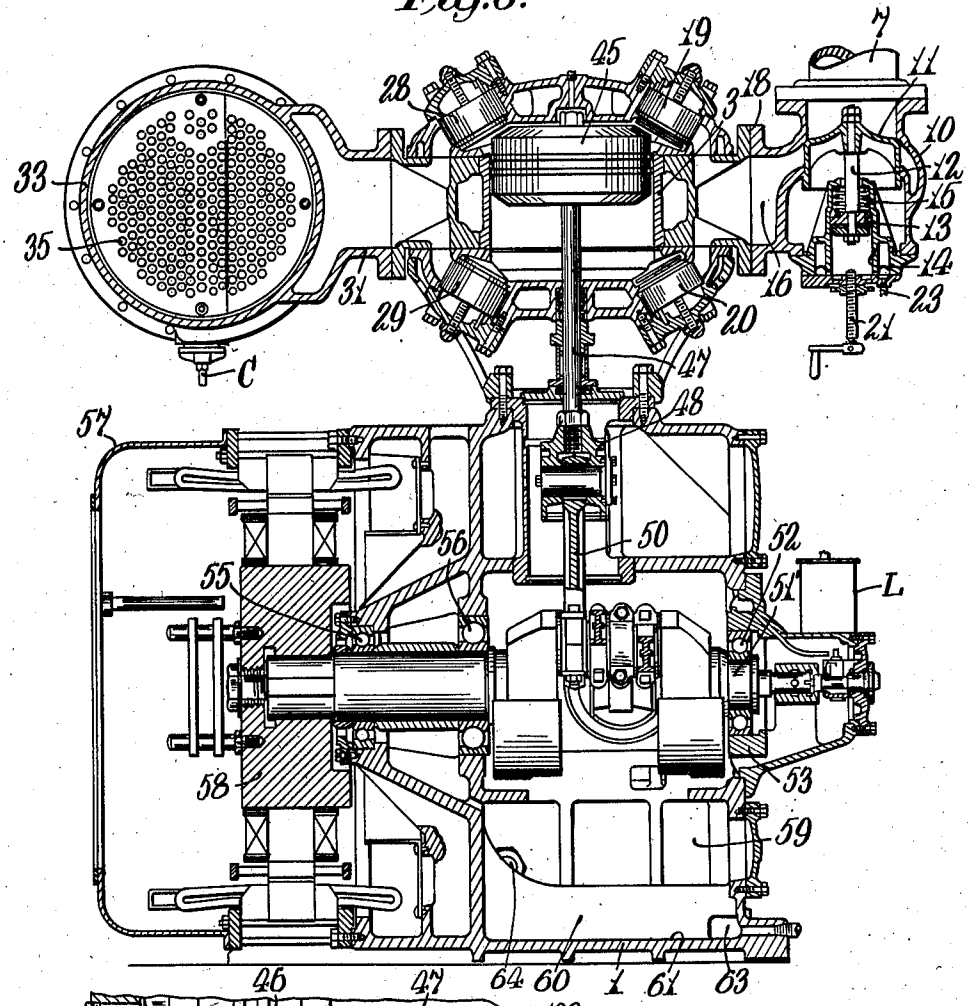
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March 2, 1943. F. A. HALLECK 2,312,335

COMPRESSOR

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Fig. 6.



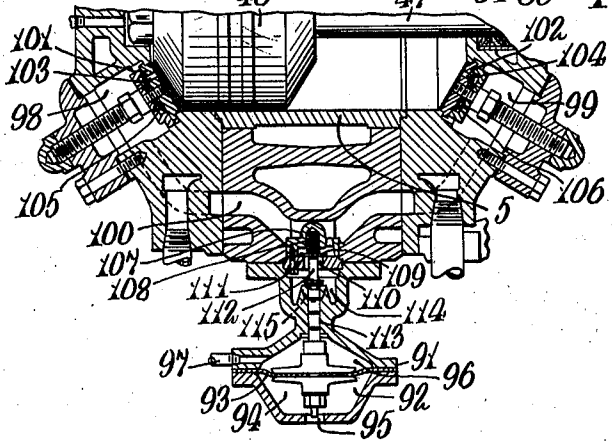


Fig. 7.

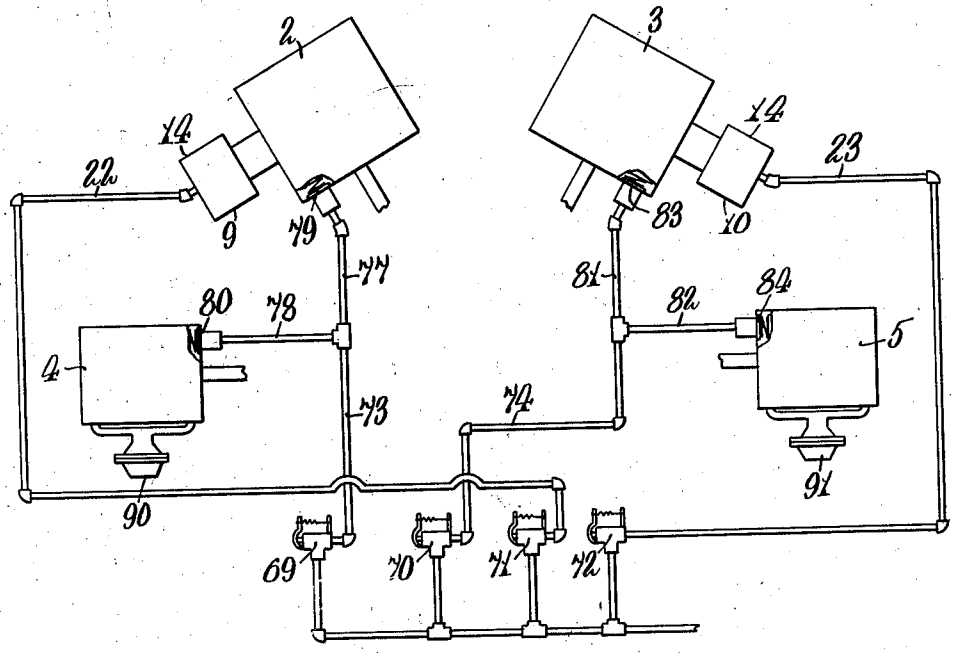
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COMPRESSOR

Filed April 24, 1939 7 Sheets-Sheet 5

Fig. 8.



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COMPRESSOR

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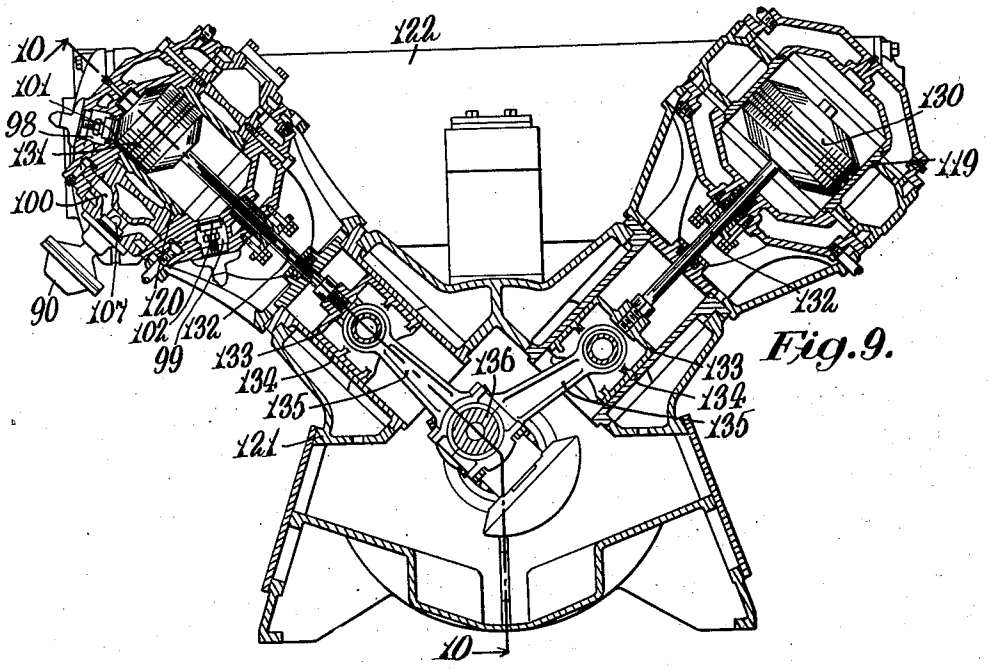


Fig. 9.

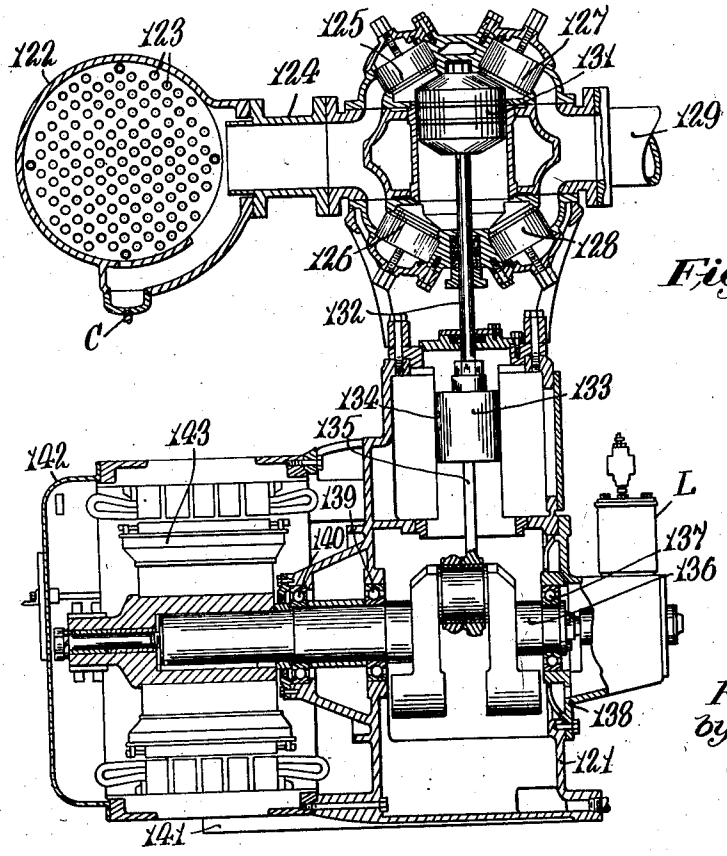


Fig. 10.

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COMPRESSOR

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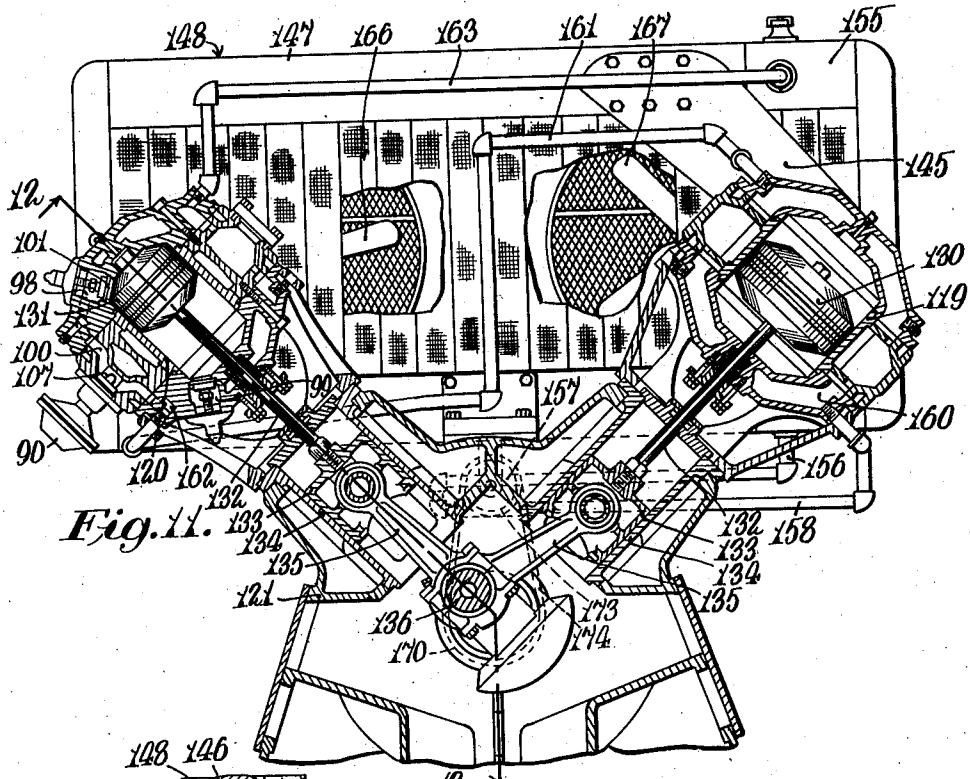


Fig. 11.

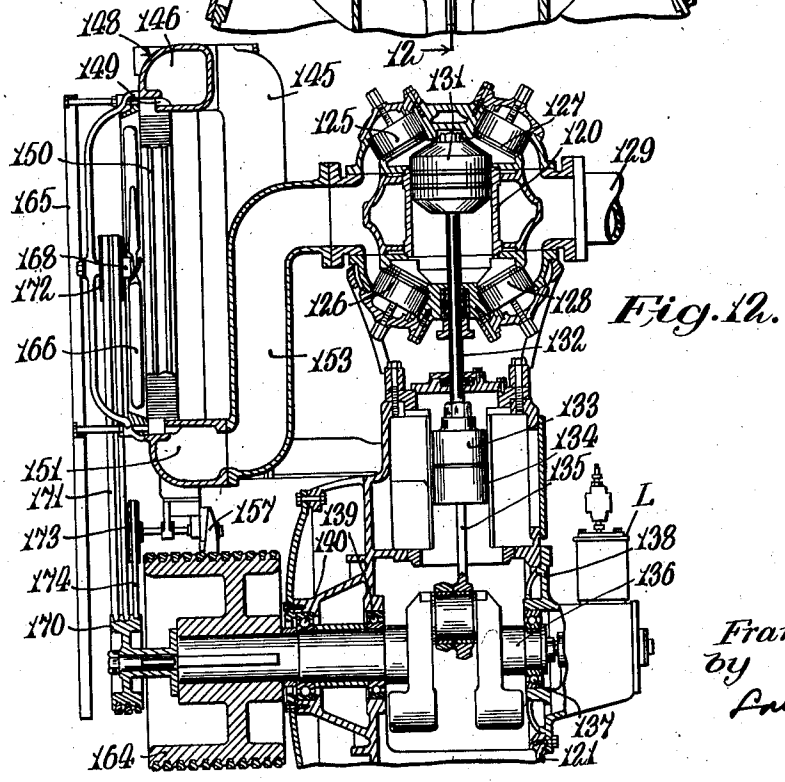


Fig. 12.

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Patented Mar. 2, 1943

2,312,335

UNITED STATES PATENT OFFICE

2,312,335

COMPRESSOR

Frank A. Halleck, Michigan City, Ind., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application April 24, 1939, Serial No. 269,610

8 Claims. (Cl. 230—26)

My invention relates to fluid compressors, and more particularly to improvements in compound compressors and in driving, cooling, and unloading means therefor.

An object of my invention is to provide an improved compressor. Another object of my invention is to provide an improved compound compressor that is exceedingly compact and highly efficient. A further object of my invention is to provide an improved compound compressor having improved cooling means for the compressed fluid. Yet another object is to provide an improved compressor having improved cooling means for the lubricating fluid. Other objects and advantages of my invention will hereinafter more fully appear.

In the accompanying drawings, in which several embodiments of different aspects of my invention have been shown,

Fig. 1 is a front elevational view of a multistage compressor in which one illustrative form of my invention is incorporated.

Fig. 2 is a side elevational view of the compressor shown in Fig. 1.

Fig. 6 is a plan view, partially in section, of the compressor shown in Fig. 1.

Fig. 4 is an enlarged horizontal sectional view through the crank case of the compressor shown in Fig. 1, the section being taken on the horizontal plane corresponding to the line 4—4 of Figs. 1 and 5.

Fig. 5 is an enlarged view, partially in elevation and partially in vertical section, through the compressor shown in Fig. 1.

Fig. 6 is a sectional view on the planes of the line 6—6 of Fig. 5.

Fig. 7 is an enlarged horizontal sectional view through an unloading control device and a portion of a high pressure cylinder, the section being taken on the plane of the line 7—7 of Fig. 2.

Fig. 8 is a schematic diagram showing the compressor cylinders and the unloading control mechanism therefor.

Fig. 9 is a sectional view similar to Fig. 5, showing a modification of the invention.

Fig. 10 is a sectional view on the planes of the line 10—10 of Fig. 9.

Fig. 11 is a sectional view similar to Fig. 9, showing another modification of the invention.

Fig. 12 is a sectional view on the planes of the line 12—12 of Fig. 11.

In the illustrative embodiment of the invention shown in Figs. 1 to 8 inclusive, there is shown a compound compressor having a base frame 1 on which are mounted at opposite sides of a vertical plane and approximately 60° from a horizontal plane, two low pressure cylinders 2 and 3, and on a horizontal plane but extending from the base frame at an angle of 180° apart, two high pressure cylinders 4 and 5. Fluid is supplied to the low pressure cylinders from intake lines 6 and 7 branching from a common intake line 8 and communicating with casings 9 and 10, which contain intake closure valves 11 for controlling the admission of fluid to the cylinders. Extending centrally through the intake closure valves are valve stems 12 which are connected to pistons 13 reciprocably mounted in cylinders 14 formed within the casings 9 and 10. The valves are normally held in open position by springs 15, thereby permitting fluid to flow freely through passages 16 in connections 17 and 18 to inlet valves 19 and 20 in the head and crank ends of the low pressure cylinders. The intake closure valves are limited in their opening movement by adjustable stop members 21, and are actuated to closed position by fluid pressure conducted to the cylinders 14 through pipes 22 and 23. Fluid is compressed in the low pressure cylinders and discharged through discharge valves 28 and 29 and connections 30 and 31 to intercoolers 32 and 33, which are arranged in axial alinement in the same series of horizontal planes with the low pressure cylinders, and with their adjacent ends abutting each other and fastened together, as by bolts 34. The intercoolers are identical in construction and contain longitudinally extending tubes 35 for conducting a cooling fluid, such as water; and baffle plates 36 extending transversely to the tubes 35 direct the compressed fluid in a circuitous path through the intercoolers and across the cooling tubes.

The compressed fluid flows from the intercoolers through connections 37 and 38 to the high pressure cylinders 4 and 5, through inlet valves 39 and 40. The fluid is compressed again in the high pressure cylinders and discharged through discharge valves 41 and 42 to discharge pipes 43 and 44 that conduct the fluid to a receiver (not shown). Reciprocably mounted in the low pressure cylinders are pistons 45, and in the high pressure cylinders are pistons 46. The pistons 45 and 46 are connected by piston rods 47 to crossheads 48 reciprocably guided in crosshead guides 49 suitably supported in seats formed in the base frame 1. Connecting rods 50 connect the crossheads to a common crankpin 51 carried by a crankshaft 51' journaled at one end in a bearing 52 carried by a plate

53 attached to the side of the base frame, and journaled at its other end in bearings 55 and 56 supported by the base frame 1. Attached to the side of the base frame, beneath the alined intercoolers and in axial alinement with the crankshaft, is an electric motor 57 having its rotor 58 keyed to the end of the crankshaft for driving the crankshaft and through it the compressor pistons 45 and 46.

Formed in the lower portion of the base frame is a chamber 59 containing oil for lubricating the moving parts of the compressor. A partition 60 extending centrally across the chamber divides the chamber into spaces 61 and 62, and an opening 63 in the partition 60 adjacent the bottom of the chamber provides for circulation of oil between the spaces 61 and 62. A means is provided for cooling the oil in the chamber and comprises a pipe 64, shown arranged in the space 62, for conducting a cooling fluid, such as water. Baffle plates 65, and fins 66 formed integral with the base frame, direct the oil across the cooling pipe 64 and through the opening 63 to the space 61, whence it is drawn through a strainer 67 and a pipe 68 and pumped by a suitable lubricator L through tubes not shown to parts of the compressor to be lubricated.

In this form of the invention, means is provided for effecting a step-by-step unloading of the compressor in accordance with compressor discharge or receiver pressure. This means comprises pilot valves 69, 70, 71 and 72, which may be of any suitable type, and which are herein illustrated as so-called RC pilot valves, arranged to control communication between the compressor discharge line or a receiver and pipes 73, 74, 22 and 23, and between said pipes and the atmosphere. Pipe 73 communicates with pipes 77 and 78 connected to suitable valve opening devices 79 and 80 for opening an inlet valve in one end of the low pressure cylinder 2 and an inlet valve in one end of the high pressure cylinder 4. Pipe 74 communicates with pipes 81 and 82 connected to inlet valve opening devices 83 and 84 in the low pressure cylinder 3 and the high pressure cylinder 5. Pipes 22 and 23 communicate respectively, as explained above, with cylinders 14 controlling the intake closure valves for the low pressure cylinders 2 and 3.

With nothing more than the structure already described, the high pressure cylinders would, so long as any way available, take in fluid from their respective intercoolers to the ends of the cylinders, where the inlet valves are allowed to operate in a normal manner, after the intake closure valves are closed. Thus, if there were any leakage past the intake closure valves fluid might be drawn into the high pressure cylinders at quite low pressure. Any fluid taken in during unloaded operation would certainly be at a lower pressure than when the compressor operates loaded, and its compression to receiver pressure would result in an increased generation of heat. To avoid this, means are provided for automatically venting the ends of the high pressure cylinders to atmosphere when a partial vacuum exists in the intercoolers. Automatic vent control devices 90 and 91 are attached to the sides of the high pressure cylinders 4 and 5, and as shown in Fig. 7, in the sectional view of the control device 91 attached to the high pressure cylinder 5, there is formed within the device a diaphragm chamber 92 having a diaphragm 93 therein. A space 94 within the chamber at one side of the diaphragm is open to atmosphere through an opening 95, and a space 96 in the chamber at the other side of the diaphragm is connected to the intercooler 33 through a pipe connection 97. Formed in the walls of the high pressure cylinder are chambers 98 and 99 connected together by a passage 100. Supported in the chambers 98 and 99 at the ends of the high pressure cylinder are plates 101 and 102 provided with small passages 103 and 104 opening into the cylinder bore and controlled by check valve mechanisms 105 and 106. In the passage 100 is a valve guard 107 supporting a spring 108 that acts to hold a valve 109 in position to close a passage 110 opening through a plate 111 attached to the wall of the cylinder. A rod 112 clamped to the diaphragm 93 extends through an opening 113 in the device 91 and the passage 110 to unseat the valve 109 against the pressure of the spring 108 when the diaphragm 93 moves to decrease the size of chamber 96. A chamber 114 in the device 91 is open to atmosphere through a pipe connection 115 and communicates with the valve controlled passage 110.

The mode of operation of this form of the invention is as follows.

Assuming that the receiver pressure is low and the compressor is operating fully loaded, air will be taken into the low pressure cylinders 2 and 3 through intake connections 6 and 7, and be compressed and discharged to the intercoolers 32 and 33. The compressed air is taken from the intercoolers 32 and 33, passing across the tubes 35 and through discharge connections 37 and 38 to the high pressure cylinders 4 and 5. The air is compressed again in the high pressure cylinders and discharged through discharge connections 43 and 44 to a receiver (not shown). If the demand for air is low and the pressure in the receiver attains a predetermined value, the pilot valve 69 operates to admit pressure fluid to the pipe 73 and through pipes 77 and 78 to the inlet valve opening devices 79 and 80 in the low pressure cylinder 2 and the high pressure cylinder 4, thereby effecting the first step of unloading. If the receiver pressure continues to increase, it will, at a predetermined higher pressure, operate the pilot valve 71 to supply pressure fluid through pipe 22 to the cylinder 14 and close the intake closure valve in the low pressure cylinder 2. On a still higher increase in receiver pressure, the pilot valve 70 operates to admit pressure fluid to the inlet valve opening devices 83 and 84 in the low pressure cylinder 3 and the high pressure cylinder 5, thereby effecting a three-quarter unloading of the compressor. On a still higher increase in receiver pressure, the pilot valve 72 operates to admit pressure fluid to the cylinder 14 in the casing 10 to move the intake closure valve in the low pressure cylinder 3 to its closed position and completely unload the compressor. As soon as a partial vacuum is created in the intercoolers by the pumping of fluid in the not-directly-unloaded ends of the high pressure cylinders after the intake closure valves are closed, the vent control devices 90 and 91 operate in the following manner to vent the ends of the high pressure cylinders. Considering the control device 91, it will be noted that a partial vacuum will exist in the space 96 due to its connection with the intercooler 33 through pipe 97, and the higher pressure in the space 94 will move the diaphragm 93 against the reduced pressure in the space 96 to open the valve 109 and connect the passage 100 to atmosphere through the passage 110, chamber 114 and atmospheric connection 115. Any material compression of air in the high pres-

sure cylinder 5 will then open the valves 105 and 106 to connect the ends of the high pressure cylinder through the chambers 98 and 99 and the passage 100 to atmosphere.

If the demand for air increases and the receiver pressure drops to a predetermined pressure, the pilot valve 72 operates to vent pressure from the cylinder 14 associated with the cylinder 3, and the intake closure valve 11 controlling admission of air to the low pressure cylinder 3 opens. Air is then taken into the low pressure cylinder 3 to be compressed in one end and discharged to the intercooler 33. The increased pressure in the intercooler causes a corresponding increase in pressure in the space 96 within the control device 91, which moves the diaphragm 93 against the atmospheric pressure in the space 94, and the valve 109 closes to cut off the connection of passage 100 to atmosphere. The compressed air in the high pressure cylinder 5 passes through the openings 103 and 104 in the plates 101 and 102 to the chambers 98 and 99 and passage 100 until the pressure in the chambers and passage is sufficient to maintain the valve mechanism 105 and 106 closed and prevent communication between the cylinder 5 and the chambers 98 and 99. Air is then compressed in one end of the low pressure cylinder 3 and in one end of the high pressure cylinder 5 and discharged to the receiver. At a lower predetermined pressure in the receiver, the pilot valve 70 operates to vent pressure fluid from the inlet valve opening devices 83 and 84, thereby permitting the inlet valves in the ends of the low pressure cylinder 3 and the high pressure cylinder 5 to operate in a normal manner. If the receiver pressure drops to a still lower pressure, the pilot valve 71 operates to vent pressure from the cylinder 14, and the intake closure valve for the low pressure cylinder 2 opens. Air is compressed again in one end of the low pressure cylinder 2, and if the venting device 90 for the high pressure cylinder 4 had previously operated to vent the cylinder to atmosphere, it will, on an increase in pressure in the intercooler 32, operate to close the cylinder vent in the same manner as the venting means for the high pressure cylinder 5 explained above, and permit compression in one end of the high pressure cylinder 4. On a still further decrease in receiver pressure, the pilot valve 69 operates to vent pressure from the inlet valve opening devices 79 and 80 and permit the inlet valves in the low and high pressure cylinders 2 and 4 to operate in their normal manner, and the compressor operates fully loaded to compress air and discharge it to the receiver.

Regarding this embodiment of the invention, it will be noted that each of the four pistons 45, 45 and 46, 46 is connected through a separate connecting rod to a common crankpin. Each cylinder has a crosshead guide so arranged that the thrusts of the several crossheads are taken within the main frame of the machine. The four cylinders are independently mounted on the main frame and are subjected to no thrusts growing out of the operation of the machine except longitudinally of the studs or holding bolts which may be used to fix them to the frame. Since the several cylinders are arranged at substantially 60° angles to each other, and since each cylinder is double-acting and designed so that the work done is substantially the same in each cylinder, a very uniform driving load is provided. There is provided, moreover, the equivalent of a pair of angle-compound machines, each driven from a single crankpin; and yet said compressors are so arranged that unbalance in driving load is never very great, due to the unloading sequence provided. Each of the two constituent compressors has an advantageous intercooler arrangement both for itself and for the machine as a whole. An effective lubricant-cooling system is provided. An extremely compact arrangement, considering the air output, is presented. The driving motor may be kept within the projection on a horizontal plane of the machine as a whole and, being supported by the main frame, requires no special outside foundation. By the relatively-upright arrangement of the low pressure cylinders, the overall height of the machine and the height of the crank shaft above the supporting surface for the machine may be kept at a minimum. Condensate from the air undergoing compression may be more advantageously handled by this arrangement, moreover, since the discharges for the condensate are arranged at the points C, towards which the air in flowing through the intercoolers towards the intake to the high pressure cylinders tends to entrain the water and any other liquid condensed out of the air. It will be noted, further, that the valves will be more conveniently accessible, both inlet and discharge valves and loading and unloading controlling valves.

In the modification of the invention illustrated in Figs. 9 and 10, there is shown a compound compressor having a low pressure cylinder 119 and a high pressure cylinder 120 extending from a base frame 121 at opposite sides of a vertical plane and approximately 45° from a horizontal plane. Air is compressed in the low pressure cylinder and discharged to an intercooler 122 which is supported by the base frame in the same series of horizontal planes with the cylinders. The compressed air flows through the intercooler, about cooling tubes 123 extending longitudinally of the intercooler, and passes through a connection 124 and inlet valves 125 and 126 to the high pressure cylinder, where the air is compressed again and discharged through discharge valves 127 and 128 and a discharge connection 129 to a receiver (not shown). Reciprocably mounted in the low and high pressure cylinders are pistons 130 and 131 connected through piston rods 132 to crossheads 133 guided in crosshead guides 134 formed in the base frame 121. The crossheads are driven in their guides by connecting rods 135 connected to a common crank shaft 136 which is journaled at one end in a bearing 137 supported by a plate 138 attached to the side of the base frame and journaled at its other end in bearings 139 and 140 supported by the base frame. Extending from the side of the base frame beneath the intercooler and formed integral with the base frame is a support 141 on which a motor 142 is rigidly mounted, and the motor's rotor 143 is keyed to the end of the crank shaft 136. As in the embodiment first described, it will be noted that the horizontal intercooler in the same horizontal planes with the low pressure cylinder, and the motor beneath the intercooler, are employed.

In the modification of the invention illustrated in Figs. 11 and 12, a low pressure cylinder 119 and a high pressure cylinder 120 are supported by a base frame 121 in the same manner as in the modification illustrated in Figs. 9 and 10. Air is compressed in the low pressure cylinder and discharged through a connection 145 to a

chamber 146 extending along the top of the intercooler section 147 of an intercooler-radiator, generally designated 148. An opening 149 is provided along the bottom of the chamber 146 through which compressed air passes to tubes 150 supported in a vertical position, and through the tubes to a chamber 151 extending along the bottom of the intercooler section 147. A discharge passage 153 conducts compressed air from the lower chamber 151 to the high pressure cylinder through inlet valves 125 and 126, where the air is compressed again and discharged through discharge valves 127 and 128 and a connection 129 to a receiver (not shown). The intercooler-radiator 148 is provided with a radiator section 155 through which a cooling fluid circulates from an upper chamber through vertical tubes to a lower chamber in the same manner as in the section through which the compressed air passes. Connected to the lower chamber in this radiator section is a pipe 156 for conducting cooling fluid to a fluid pump 157 that forces the cooling fluid through a pipe 158 to a chamber 160 formed in the walls of the low pressure cylinder. A pipe 161 connects the chamber 160 at its upper level to a point in a chamber 162 formed in the walls of the high pressure cylinder, and a pipe 163 connects an upper point in the chamber 162 to the upper chamber of the radiator section.

Reciprocably mounted in the low pressure cylinder and the high pressure cylinder are pistons 130 and 131 connected by piston rods 132 to crossheads 133 reciprocably mounted in crosshead guides 134 formed within the base frame. Connecting rods 135 connect the crossheads to a common crank shaft 136. The crank shaft is journaled at one end in a bearing 137 carried by a plate 138 attached to the side of the base frame, and is journaled at its other end in bearings 139 and 140 supported by the base frame. Keyed to the end of the crank shaft beneath the intercooler is a drive pulley 164 which may be driven from a source of power not shown.

Attached to the side of the intercooler-radiator opposite the compressor is a frame 165 supporting cooling fans 166 and 167 on shafts 168. The cooling fans are driven by a pulley 170 keyed to a reduced extension of the crank shaft 136, through belts 171 and pulleys 172 keyed to the shafts 168 supporting the fans. A pulley 173 driven from the pulley 170 through a belt 174 drives the fluid pump 157.

In the operation of this modification of the invention, air is compressed in the low pressure cylinder and discharged to the chamber 146 in the air cooling section of the intercooler-radiator. The air flows from the chamber 146 through the vertically supported cooling tubes 150 to the chamber 151 extending along the bottom of the air cooling section of the intercooler-radiator, and from the chamber 151 through passage 153 to the high pressure cylinder, where it is compressed again and discharged through the discharge pipe 129. Cooling water is pumped from the bottom of the radiator section 155 through pipe 156, pump 157 and pipe 158 to the chamber 160 in the low pressure cylinder, and from chamber 160 through pipe 161 to the chamber 162 in the high pressure cylinder, then through pipe 163 to the top of the radiator section and through the vertical cooling tubes and back to the bottom chamber. Air is forced over the cooling tubes in the intercooler-radiator and over the low and high pressure cylinders by the fans 166 and 167 driven from the pulley 170 through belts 171.

The presence of certain features common to the embodiments previously described, together with certain features individual to this particular embodiment, will be apparent.

While there are in this application specifically described several forms which the invention may assume in practice, it will be understood that these forms of the same are shown for purposes of illustration and that the invention may be further modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In combination, in a pump, a crankcase rotatably supporting a horizontal crankshaft having a single crankpin, a low pressure cylinder supported by said crankcase in a position with its axis making a substantial angle with the horizontal, a low pressure piston in said low pressure cylinder operatively connected with said crankpin, a high pressure cylinder supported by said crankcase with its axis making a substantial angle with the plane which includes the axis of rotation of said crankshaft and the axis of the low pressure cylinder, a high pressure piston in said high pressure cylinder operatively connected with said crankpin, and an intercooler supported by said cylinders and including a casing extending horizontally and substantially wholly in horizontal planes above the lowermost point in said low pressure cylinder whereby a driving motor for said crankshaft may have its casing supported by said crankcase above the bottom of the latter and below said intercooler.

2. In combination, in a pump, a crankcase rotatably supporting a horizontal crankshaft having a single crankpin, a pair of low pressure cylinders supported by said crankcase in positions such that their axes make at least substantially equal angles with the vertical plane in which the axis of rotation of the crankshaft lies, a pair of high pressure cylinders supported by said crankcase in positions such that their axes make at least substantially equal angles, different from the angles made by said low pressure cylinders with the vertical plane in which the axis of rotation of said crankshaft lies, pistons one in each of said cylinders and each operatively connected with said crankpin, said several cylinders further so disposed that a single plane to which the axis of rotation of said crankshaft is perpendicular intersects each of said cylinders, and intercoolers, one for the cylinders at each side of said vertical plane, receiving the discharges from the low pressure cylinders and delivering fluid to said high pressure cylinders.

3. In combination, in a pump, a crankcase rotatably supporting a horizontal crankshaft having a single crankpin, a pair of low pressure cylinders supported by said crankcase in positions such that their axes make acute angles with the vertical plane in which the axis of rotation of the crankshaft lies, a pair of high pressure cylinders supported by said crankcase in positions such that their axes make at least substantially equal angles with the vertical plane in which the axis of rotation of said crankshaft lies, the last mentioned angles greater than the acute angles made by the axes of said low pressure cylinders with said vertical plane, pistons one in each of said several cylinders and each operatively connected with said crankpin, said several cylinders

further so disposed that at least one plane to which the axis of rotation of said crankshaft is perpendicular intersects each of said cylinders, and intercoolers, one for the cylinders at each side of said vertical plane, receiving the discharges from the low pressure cylinders and delivering fluid to said high pressure cylinders, said intercoolers arranged in line with each other.

4. In combination, in a pump, a crankcase rotatably supporting a horizontal crankshaft having a single crankpin, a pair of low pressure cylinders supported by said crankcase in positions such that their axes make acute angles with the vertical plane in which the axis of rotation of the crankshaft lies, a pair of high pressure cylinders supported by said crankcase in positions such that their axes make at least substantially equal angles with the vertical plane in which the axis of rotation of said crankshaft lies, the last mentioned angles greater than the acute angles made by the axes of said low pressure cylinders with said vertical plane, pistons one in each of said several cylinders and each operatively connected with said crankpin, said several cylinders further so disposed that at least one plane to which the axis of rotation of said crankshaft is perpendicular intersects each of said cylinders, and intercoolers, one for the cylinders at each side of said vertical plane, receiving the discharges from the low pressure cylinders and delivering fluid to said high pressure cylinders, said intercoolers arranged in line with each other and at least largely in substantially the same series of horizontal planes with said low pressure cylinders.

5. In combination, in a pump, a crankcase rotatably supporting a horizontal crankshaft having a single crankpin, a pair of low pressure cylinders supported by said crankcase in positions such that their axes make acute angles with the plane perpendicular to the base of said crankshaft in which the axis of rotation of the crankshaft lies, a pair of high pressure cylinders supported by said crankcase in positions such that their axes make at least substantially equal angles with the aforesaid plane in which the axis of rotation of said crankshaft lies, the last mentioned angles greater than the acute angles made by the axes of said low pressure cylinders with said plane, pistons one in each of said cylinders and each operatively connected with said crankpin, said several cylinders further so disposed that at least one plane to which the axis of rotation of said crankshaft is perpendicular intersects each of said cylinders, and intercoolers, one for the cylinders at each side of said vertical plane, receiving the discharges from the low pressure cylinders and delivering fluid to said high pressure cylinders, said intercoolers arranged in line with each other and disposed substantially parallel to the axes of the high pressure cylinders and at least largely in substantially the same series of horizontal planes with said low pressure cylinders.

6. In combination, in a pump, a crankcase rotatably supporting a horizontal crankshaft having a single crankpin, a low pressure cylinder supported by said crankcase in a position with its axis making a substantial angle with the horizontal and also making a substantial angle with the vertical, a low pressure piston in said low pressure cylinder operatively connected with said crankpin, a high pressure cylinder supported by said crankcase with its axis making a substantial angle with the plane which includes the axis of rotation of said crankshaft and the axis of the low pressure cylinder, a high pressure piston in said high pressure cylinder operatively connected with said crankpin, and an intercooler supported by said cylinders and including a casing extending horizontally and at least mainly in horizontal planes above the lowermost point in said low pressure cylinder whereby space is provided for the disposition of a driving motor for said crankshaft beneath said intercooler with the driving shaft of said motor operatively connected with said crankshaft.

7. In a fluid compressor, in combination, a base frame, a crank shaft journaled on said base frame, cylinders mounted on said base frame and having pistons reciprocable therein, a cooling system for said compressor comprising a cooling device supported between said cylinders, said cooling device having a portion for conducting compressed fluid and another portion for conducting a cooling fluid, means for forcing the cooling fluid from said cooling fluid conducting portion through said cylinders, cooling fans arranged at the side of said cooling device opposite said cylinders for forcing cooling air over the portions of said cooling device and over said cylinders, and means attached to the end of said crank shaft under said cooling device for driving said cooling fans.

8. In a fluid compressor, in combination, a base frame, a crank shaft journaled on said base frame, cylinders mounted on said base frame and having pistons reciprocable therein, a cooling system for said compressor comprising a cooling device supported between said cylinders and having an intercooler portion and a radiator portion, means for conducting compressed fluid through the intercooler portion, means for conducting a cooling fluid from the radiator portion through said cylinders, and means for effecting a flow of cooling air through said cooling device and over said cylinders.

FRANK A. HALLECK.

CERTIFICATE OF CORRECTION.

Patent No. 2,312,335. March 2, 1943.

FRANK A. HALLECK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 25, for "Fig. 6" read --Fig. 3--; page 2, first column, line 52, for "way" read --was--; page 5, second column, line 35-36, for "conduccting" read --conducting--; 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 29th day of June, A. D. 1943.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)