April 28, 1925. 1,535,856

E. A. RIX

COMBINATION AIR COMPRESSOR AND VACUUM PUMP

Filed May 15, 1924 3 Sheets-Sheet 1

FIG. 1.

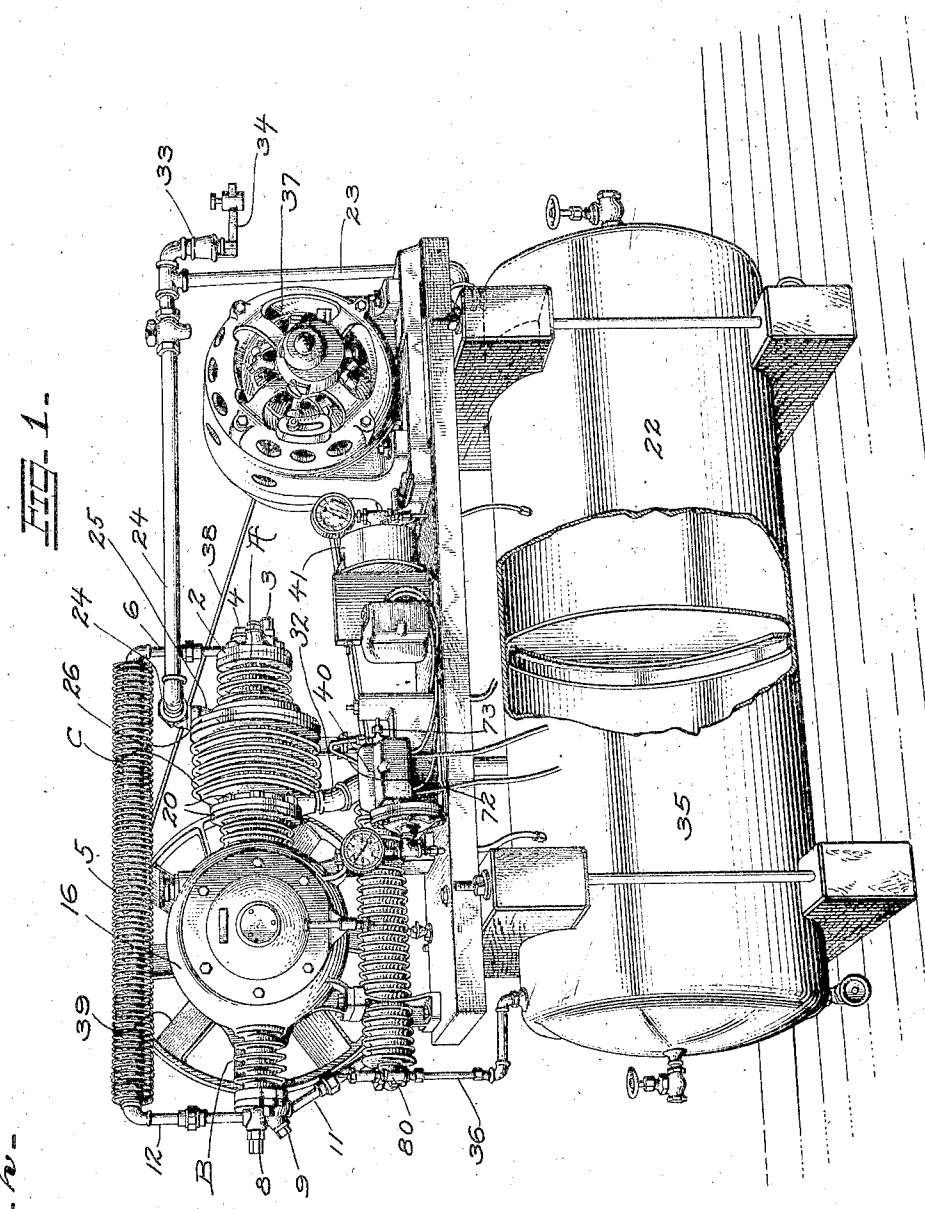
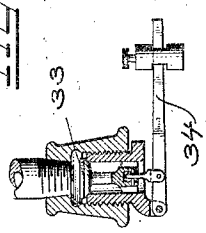



FIG. 2.




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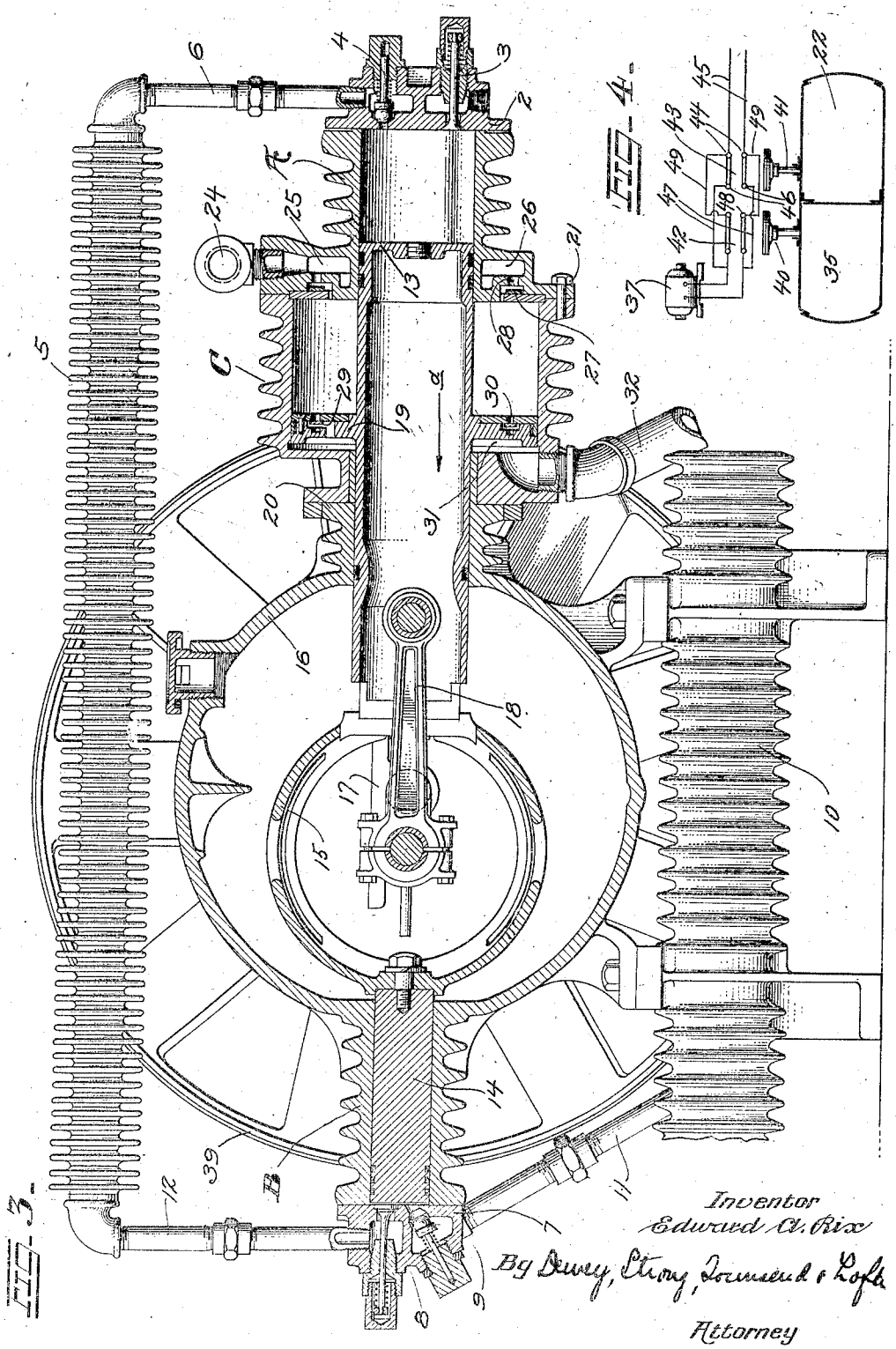



FIG. 3.

FIG. 4.

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Fig. 5.

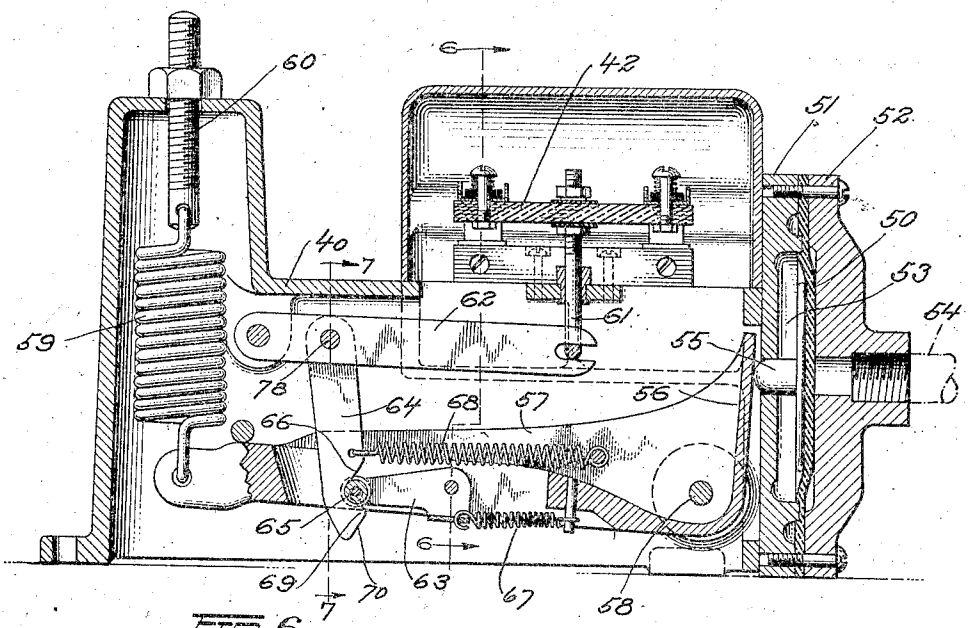



Fig. 6.

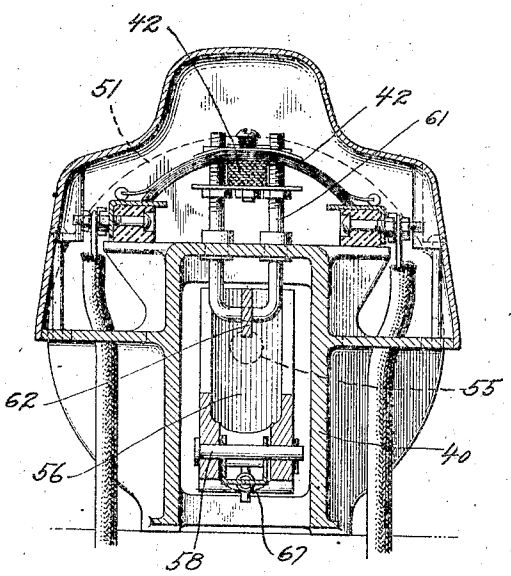
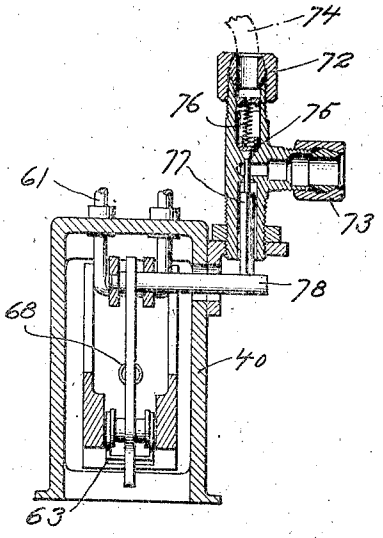



Fig. 7.




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# UNITED STATES PATENT OFFICE.

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## COMBINATION AIR COMPRESSOR AND VACUUM PUMP.

Application filed May 15, 1924. Serial No. 713,399.

*To all whom it may concern:*

Be it known that I, EDWARD A. RIX, a citizen of the United States, residing at the city and county of San Francisco and State of California, have invented new and useful Improvements in Combination Air Compressors and Vacuum Pumps, of which the following is a specification.

This invention relates to a combination air compressor and vacuum pump, and to an automatic regulating device therefor.

Service stations for automobiles are common and numerous and they are becoming more and more a necessity as far as the motoring public is concerned.

Considerable competition exists between the service stations of different oil companies and otherwise and the stations are as a result becoming forced to install elaborate equipment, such as air compressing units, etc., to be in a position to render every assistance possible. Practically every station is equipped with an air compressing unit and tanks to permit inflation of tires, etc., and a considerable number of stations are equipped with so-called visible dispensing machines which require a vacuum pump to elevate the gasoline from the submerged storage tanks to the visible containers, from which the gasoline is delivered by gravity to the tanks of the automobiles.

The air compressors and vacuum pumps are usually driven by independent electric motors and are automatically actuated to the extent that a variation in pressure or vacuum will make or break the motor circuit and as such automatically maintains predetermined pressures or vacuums. Such installations require separate compressors and vacuum pumps, and similarly separate electric motors, with connected automatic actuating mechanisms. The installations are as a result costly; they require considerable space, which is often an important factor, and while they are automatic in operation, a certain amount of attention, repair, etc., is nevertheless required.

The object of the present invention is to provide in a single unit a combined air compressor and vacuum pump which is driven by a single electric motor, and to provide an automatic control whereby the motor circuit will be actuated both by the compressed air and the vacuum, and which will furthermore permit the compressor and the vacuum pump to act in unison or independent of each other; the single unit thus provided reducing the space required to a minimum and permitting cost and other incidentals to be materially lessened.

One form which my invention may assume is exemplified in the following description and illustrated in the accompanying drawings, in which—

Fig. 1 is a perspective view of the combined compressor and vacuum pump, together with the tanks connected therewith and the electric motor driving the same, said unit also showing the position of the automatic controlling mechanism whereby the circuit through the motor is automatically opened and closed.

Fig. 2 is an enlarged detail sectional view of the vacuum relief valve.

Fig. 3 is a central vertical longitudinal section through the combined air compressor and vacuum pump.

Fig. 4 is a diagrammatic view showing the wiring diagram employed.

Fig. 5 is a central vertical longitudinal section through one of the switch controlling units.

Fig. 6 is a central vertical cross-section taken on line 6—6, Fig. 5.

Fig. 7 is a vertical cross-section taken on line 7—7, Fig. 5.

Referring to the drawings in detail, and particularly to Fig. 3, A indicates a low pressure air compressing cylinder, 2 the head, 3 the low pressure inlet valve, 4 the low pressure discharge valve, 5 an intercooler, 6 a pipe connecting the same with the low pressure discharge valve. B a high pressure cylinder, 7 a cylinder head, 8 the inlet valve, 9 the high pressure discharge valve, 10 a second intercooler, and 11 a pipe connecting the same with the discharge valve 9 of the high pressure cylinder. The inlet valve of the high pressure cylinder, indicated at 8, is connected with the intercooler 5 through means of a pipe 12, and the low pressure air discharged by the valve 4 is thus by-passed through the pipe 6, the intercooler 5 and the pipe 12 to the inlet valve 8 of the high pressure cylinder.

The respective cylinders are provided with pistons, as indicated at 13 and 14; those pistons being connected by a connecting yoke 15. The compressor is otherwise provided with a crank case 16 to which the respective cylinders are attached in any suitable manner. A crank shaft 17 is jour-

nalled in the case and reciprocal movement is transmitted to the pistons through a connecting rod 18.

The structure so far described is more or less common and discloses nothing more or less than a two-stage air compressor. By careful inspection of Fig. 3, it will, however, be noted that the piston 13 is a trunk type piston and that it is considerably elongated; further, that a step or enlargement is formed at the point 19, and that a secondary piston of larger area is thus produced. This piston travels in a cylinder C, which is interposed between the crank case and the low pressure cylinder A; the cylinder C being attached to the crank case by a flange and bolts as indicated at 20 and the low pressure cylinder being in turn secured to the outer end of the cylinder C by a flange and bolts as indicated at 21.

The cylinder C and the piston 19 operating therein form a vacuum pump, air being admitted to this pump from a tank 22 through means of pipes 23 and 24. The pipe 24 connects with an annular chamber 25 formed in a head 26 of the cylinder C. This head is also provided with a ring valve 27 which is adapted to automatically open and close a series of ports 28. The piston 19 is similarly provided with a ring valve 29 which is adapted to alternately open and close a series of ports 30 formed in the piston proper. Ports 28 are opened to admit air to the cylinder C when the piston travels in the direction of arrow *a*; ports 30 being simultaneously closed by the ring valve 29. During the reverse movement of the piston, valve 27 closes and valve 29 opens. The air previously admitted is thus transferred to the other side of the piston 19 and it is discharged into an annular chamber 31 and is there permitted to escape through a pipe 32 during the next stroke of the piston. Tank 22 may thus be evacuated to any degree desired but the exact amount of vacuum that should be maintained is, however, regulated by an automatic actuating mechanism hereinafter to be described, and also by means of a poppet valve 33 (see Figs. 1 and 2). This valve is interposed between the pipes 23 and 24. It is normally held on its seat by means of a weighted lever 34; the weight being so adjusted that the valve will be maintained on its seat until a predetermined vacuum is created. The valve will then lift and air will thus be automatically admitted to prevent the building up of a further vacuum. The automatic actuating mechanism just referred to will also function at this time and its construction and operation will later be described.

The compressed air discharging from the intercooler 10 is delivered to a tank indicated at 35 through means of a pipe 36 (see Fig. 1), and means are employed for maintaining a predetermined air pressure in the tank. This means is automatic in operation and its construction will be more clearly described by referring to Figs. 5, 6 and 7.

Before entering into a detail discussion of the construction of this mechanism, it might be well to state that the combined compressor and vacuum pump here illustrated is driven by means of an electric motor such as indicated at 37, the power of the motor being transmitted to the crank shaft of the compressor by means of a belt 38 and a driving pulley 39. It might also be well to state that the circuit through this motor is controlled by two separate mechanisms, generally indicated at 40 and 41 (see Figs. 1 and 4). The mechanism indicated at 40 is controlled by the air pressure in the tank 35, and the mechanism illustrated at 41 is controlled by the vacuum maintained in the tank 22. Both of these controlling mechanisms are substantially identical in construction and function, and the description of one should therefore suffice. These mechanisms control a pair of switches, diagrammatically illustrated at 42 and 43. These switches are connected in parallel, the switch 43 having two main terminals 44 which are connected with the power circuit through means of feed wires 45. The opposite terminals of the switch 43, indicated at 46, are connected through wires 47 with the motor 37. The second switch indicated at 42 is provided with a pair of main terminals 48 which are connected through wires 49 with the feed wires 45, and the second set of terminals in switch 42 is connected directly with the feed wires of the motor.

By providing this parallel connection it is possible to open one switch or the other without breaking the circuit through the motor, and it is impossible to break the circuit through the motor without opening both switches. The switches, as previously stated, are actuated by the automatic controlling mechanisms indicated at 40 and 41, and the structure of these mechanisms will now be described.

Again referring to Figs. 5, 6 and 7, it will be noted that a casing 40 is illustrated. One end of the casing is provided with a flexible diaphragm 50 disposed between two head members 51 and 52. An air tight chamber 53 is thus formed on one side of the diaphragm and this chamber is connected through means of a pipe 54 with the pressure receiving tank 35. The diaphragm is provided with a plate and a button such as indicated at 55 and the button extends through an opening in the head member 51.

It here engages the one end 56 of a lever 57 which is pivotally mounted in the casing 40 at the point indicated at 58. The opposite end of the lever is connected with a helical spring 59 and the tension of this spring may be regulated by means of an adjusting screw 60.

If it is desired to maintain an air pressure of 120 pounds in the tank 35, the tension of the spring 59 is so regulated that the diaphragm will not be able to impart a rocking movement to the lever 57 until this pressure is exceeded; that is, chamber 53 is in constant communication with the tank 35 through means of pipe 54 and similar pressures are thus maintained on one side of the diaphragm 53 and in the tank 35. When this pressure is exceeded spring 59 yields and a rocking movement is thus imparted to the lever 57 through means of the diaphragm and the button 55. This rocking movement serves the function of opening the switch 42 (see Figs. 4 and 5), the movement being transmitted through a yoke 61, a pair of levers 62 and 63, and a connecting link 64. The lever 63 is pivotally attached to the lever 57 and its outer end is provided with a roller 65 which is normally maintained in engagement with a notch 66 formed in the lower end of the link 64, the roller being maintained in this position by means of a spring 67 and also by a second spring 68 which is attached to the lever 57 at one end and to the link 64 at the opposite end.

When lever 57 moves downwardly, due to expansion of the diaphragm, roller 65 rides downwardly over the notched end of the link 64 and the moment it passes over the point 69 it strikes an inclined face 70, thus freeing the link 64. The inclined face 70 permits the spring 68 to function and it thus imparts an upward movement to the link 64 and the lever 62. This movement is quick and snap-like and it is in turn transmitted to lift the yoke 61 and the switch 42 carried thereby. When the air pressure drops in the tank 35, and consequently in the chamber 53, the tension of the spring 59 overcomes the pressure exerted on the diaphragm and lever 57 is pulled upwardly. This movement causes roller 65 to ride upwardly on the inclined end 70 of link 64 and when it passes over the high point 69 a quick downward movement is imparted to the link 64, lever 62 and yoke 61, this movement being imparted by means of spring 68. This downward movement again closes the switch 42. The switch is accordingly automatically opened and closed with variations in air pressure and a predetermined pressure may thus be maintained.

The actuating mechanism indicated at 41 is substantially identical in construction to that illustrated in Figs. 5, 6 and 7, the only difference being that the position of the head members 50 and 51 is reverse, and that chamber 53 is connected with the vacuum tank. In other words, a suction is produced in chamber 53 and this exerts a pull on the diaphragm and imparts movement thereto, the movement being transmitted through a link which is connected with lever 57. The mechanism 41 will thus automatically maintain a predetermined vacuum in the tank 22 as switch 43 is opened and closed by variations of vacuum maintained in tank 22. In other words the automatic actuating mechanism indicated at 40 serves the function of maintaining a predetermined air pressure in the tank 35, while the actuating mechanism indicated at 41 maintains a predetermined vacuum in the tank 22. These mechanisms in turn actuate the switches 42 and 43 and as the motor circuit is controlled thereby, it can readily be seen that the circuit through the motor will be automatically opened and closed as required and that continuous operation will not be required.

To further illustrate the operation of the combined compressor and vacuum pump here illustrated, and the functioning of the controlling mechanism indicated at 40 and 41, it will be assumed that it is desired to maintain 120 pounds air pressure in tank 35 and a 20 inch vacuum in the tank 22. If the vacuum is less than 22 inches and the air pressure is less than 120 pounds, both switches 42 and 43 will be closed. The circuit through the motor will thus be established and reciprocal movement will be transmitted to the several pistons in unison as power is being continuously transmitted to the crank shaft of the unit through means of the belt 38 and the pulley 39. If an evacuated condition of 20 inches is reached before the desired pressure 120 pounds is obtained in tank 35, switch 43 will be opened, but switch 42 will continue to remain closed. The relief valve 33 will simultaneously open as the weighted lever 34 has been properly adjusted. Air will thus enter the pipe 24 through the valve 33 and an evacuated condition of 20 inches will be automatically maintained. The high and low pressure compressing cylinders A and B will continue to operate and air under pressure will continue to be delivered to the tank 35 until a pressure of 120 pounds is reached. The diaphragm 50 (see Fig. 5) will then expand, due to the fact that it will overcome the tension of the spring 59, and switch 42 will thus be opened and as the switch 43 has already been opened it can be seen that the circuit through the motor 37 will be broken and the unit as a whole will come to rest.

If the pressure or vacuum drops, one or another of the switches 42 or 43 will be closed and the circuit through the motor

will thus be closed and the unit will again be set in operation. It can, therefore, be seen that the circuit may be closed by either of the switches, but the circuit will not be broken except when both switches are opened. This is important as it permits either the compressing unit or the vacuum pump to function independently of each other even though they are operated and driven in unison. For instance, if a pressure of 120 pounds is obtained in the tank 35 before the desired evacuated condition is obtained in tank 22, it will be seen that switch 42 will be opened. Switch 43, however, remains closed as the desired vacuum is not obtained. The unit, therefore, continues to operate as the motor circuit is not broken, but the air pressure in tank 35 will not be increased, as the relief valve is opened which permits the air from the cyinders A and B to be disclosed to the atmosphere. This relief valve is best illustrated in Fig. 7. It is mounted on the casing 40 and in appearance resembles an elbow fitting. It is provided with an inlet connection 72 and an outlet connection 73. The inlet is connected through means of a pipe 74 with the intercooler 10, while the connection 73 may be opened directly to the atmosphere. A check valve 75 is interposed between the connections and is normally retained on its seat by means of the air pressure and also by means of a spring 76. The valve is provided with a downwardly projecting stem 77 and this is in turn mounted in alignment with a pin 78. This pin is also illustrated in Fig. 5 and it forms a pivotal connection between the levers 62 and the link 64.

The lever 62 moves upwardly when switch 42 is opened and as switch 42 is not opened until the desired air pressure is obtained, it can be seen that this movement may be utilized to open the relief valve 75. In other words the valve 75 is only opened when the switch is opened and it is merely opened for the purpose of permitting the air discharged by the compressing cylinders to escape freely to the atmosphere when tank 35 has been charged to a predetermined pressure.

Valve 75 is not in communication with the tank 35 as the air from the intercooler is delivered to the tank through the pipe indicated at 36. This pipe is provided with a check valve generally indicated at 80 and no air can thus escape from the tank when valve 75 is opened as it is connected with the opposite end of the intercooler through the pipe 74.

The unit as a whole is simple and compact in construction and requires comparatively little space; this being particularly true when it is considered that most service stations or plants requiring vacuum and compressed air service employ two separate motor driven units, one being an air compressing unit and the other a vacuum pumping unit. In other words the assembly shown in the present application requires, practically speaking, only one-half the space; the amount of mechanism liable to get out of order is substantially reduced to one-half; the cost is reduced, and as the operation of the structure as a whole is automatic comparatively little attention is required.

While certain features of the present invention are more or less specifically illustrated, I wish it understood that various changes in form and proportion may be resorted to within the scope of the appended claims. I similarly wish it understood that the materials and finish of the several parts employed may be such as the experience and judgment of the manufacturer may dictate or various uses may demand.

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

1. A device of the character described, comprising a pair of cylinders, a piston in each cylinder, one cylinder serving as an air compressor and the other as a vacuum pump, a tank for the reception of the compressed air, a tank connected with the second cylinder and adapted to be evacuated thereby, means for transmitting a reciprocal movement to the pistons, an electric motor for driving said means, means actuated by a predetermined pressure in the compressed air receiving tank for automatically throwing the compressing cylinder out of action, and means actuated by a predetermined vacuum in the other tank for throwing the vacuum producing cylinder out of action.

2. In a device of the character described, an air compressor and a vacuum pump both driven in unison and by a single electric motor, a tank connected with the compressor, a second tank connected with the vacuum pump, and means for automatically breaking the circuit through the motor when a predetermined pressure and vacuum is obtained in the respective tanks.

3. A device of the character described, comprising an air compressor and a vacuum pump, an electric motor adapted to drive said compressor and vacuum pump in unison, a tank in communication with the compressor, a second tank in communication with the vacuum pump, means connected with the vacuum pumping unit for breaking the circuit through the motor when a predetermined vacuum is obtained, and means connected with the air compressing unit for breaking the circuit through the motor when a predetermined air pressure is obtained, said circuit breaking means being only operable when they act in unison or when successively actuated.

4. A device of the character described,

comprising an air compressing unit and a vacuum pump, an electric motor adapted to drive the same in unison, a tank connected with the air compressor, a tank connected with the vacuum pump, and an electric motor circuit making and breaking mechanism for each unit, said units adapted to prepare and break the motor circuit, but neither being adapted to break the circuit unless it has been prepared by the other unit.

5. A device of the character described, comprising an air compressor and a vacuum pump, a single means for driving the same in unison, a tank connected with the compressor, a second tank connected with the vacuum pump, and separate means connected with each tank and adapted to maintain predetermined pressures therein, said means adapted to jointly render the driving means inoperative.

6. A device of the character described, comprising an air compressor and a vacuum pump, a single means for driving the same in unison, a tank connected with the compressor, a second tank connected with the vacuum pump, separate means connected with each tank and adapted to maintain predetermined pressures therein, said means adapted to jointly render the driving means inoperative, and either means adapted to render the driving means operative.

7. A device of the character described, comprising an air compressor and a vacuum pump, means for driving the same in unison, a tank connected with the compressor, a second tank connected with the vacuum pump, means for automatically maintaining a predetermined pressure in the air tank, means for maintaining a predetermined vacuum in the second tank, and means actuated jointly by both of said last named means for rendering the driving means inoperative, either of said means also adapted to render the driving means operative upon a drop either in pressure or vacuum.

8. A device of the character described, comprising an air compressing unit and a vacuum pump unit, an electric motor adapted to drive the same in unison, a tank connected with each unit one adapted to receive air under pressure and the other to be evacuated, means for automatically maintaining a predetermined air pressure in one tank, and means for automatically maintaining a predetermined vacuum in the other tank, both of said last named means adapted to jointly break an electric circuit through the motor and either of said means adapted to close said circuit.

9. A device of the character described, comprising an air compressing unit and a vacuum pump unit, an electric motor adapted to drive the same in unison, a tank connected with each unit one adapted to receive air under pressure and the other to be evacuated, means for automatically maintaining a predetermined air pressure in one tank, means for automatically maintaining a predetermined vacuum in the other tank, both of said last named means adapted to jointly break an electric circuit through the motor and either of said means adapted to close said circuit, and a relief valve for each unit adapted to be automatically opened or closed to permit either unit to charge or evacuate each tank independent of the other.

10. An automatic motor control, comprising, in combination with an air compressor and a vacuum pump, means actuated by the motor for driving the compressor and vacuum pump in unison, separate tanks for each, separate automatically operated switches, each controlled by the pressure in the adjacent tank, and means whereby the closing of either switch will close a circuit through the motor and the opening of both switches will be required to break said circuit.

11. A device of the character described, an air compressor, a vacuum pump, separate tanks for each, a common driving motor for said compressor and pump, a pair of switches connected in the electric circuit of the motor, means automatically actuated by the pressure in one tank for opening and closing one switch, and means automatically actuated by the pressure in the other tank for opening and closing the other switch, said switches being so connected in the motor circuit that the closing of either switch will close the motor circuit and the opening of both switches will be required to break the circuit.

12. A two-stage air compressor and vacuum pump, comprising a crank case, a crank shaft therein, a high pressure air compressing cylinder on one side of the case, an aligned vacuum pump cylinder, and a low pressure air compressing cylinder on the other side of the crank case and in alignment with the high pressure air compressing cylinder, a piston for each cylinder and all connected and adapted to be reciprocated in unison by the crank shaft, a tank connected with the vacuum pump cylinder and adapted to be evacuated thereby, means for transferring air from the low pressure cylinder to the high pressure air compressing cylinder, and a tank connected with said high pressure cylinder and adapted to be charged thereby.

13. A two-stage air compressor and vacuum pump, comprising a crank case, a crank shaft therein, a high pressure air compressing cylinder on one side of the case, an aligned vacuum pump cylinder and a low pressure air compressing cylinder on the other side of the crank case and in alignment with the high pressure air com-

pressing cylinder, a piston for each cylinder and all connected and adapted to be reciprocated in unison by the crank shaft, a tank connected with the vacuum pump cylinder and adapted to be evacuated thereby, means for transferring air from the low pressure cylinder to the high pressure air compressing cylinder, a tank connected with said high pressure cylinder and adapted to be charged thereby, a relief valve connected with the compressing cylinder, and means for automatically opening the same when a predetermined air pressure is obtained in the connected tank.

14. A two-stage air compressor and vacuum pump, comprising a crank case, a crank shaft therein, a high pressure air compressing cylinder on one side of the case, an aligned vacuum pump cylinder, and a low pressure air compressing cylinder on the other side of the crank case and in alignment with the high pressure air compressing cylinder, a piston for each cylinder and all connected and adapted to be reciprocated in unison by the crank shaft, a tank connected with the vacuum pump cylinder and adapted to be evacuated thereby, means for transferring air from the low pressure cylinder to the high pressure air compressing cylinder, a tank connected with said high pressure cylinder and adapted to be charged thereby, a relief valve connected with the vacuum pump cylinder, and means for automatically opening the same when a predetermined vacuum is obtained in the connected tank.

15. A two-stage air compressor and vacuum pump, comprising a crank case, a crank shaft therein, a high pressure air compressing cylinder on one side of the case, an aligned vacuum pump cylinder and a low pressure air compressing cylinder on the other side of the crank case and in alignment with the high pressure air compressing cylinder, a piston for each cylinder and all connected and adapted to be reciprocated in unison by the crank shaft, a tank connected with the vacuum pump cylinder and adapted to be evacuated thereby, means for transferring air from the low pressure cylinder to the high pressure air compressing cylinder, a tank connected with said high pressure cylinder and adapted to be charged thereby, a relief valve connected with the compressing cylinder, means for automatically opening the same when a predetermined air pressure is obtained in the connected tank, a relief valve connected with the vacuum pump cylinder, and means for automatically opening the same when a predetermined vacuum is obtained in the connected tank, said relief valves being turnable independent of each other.

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