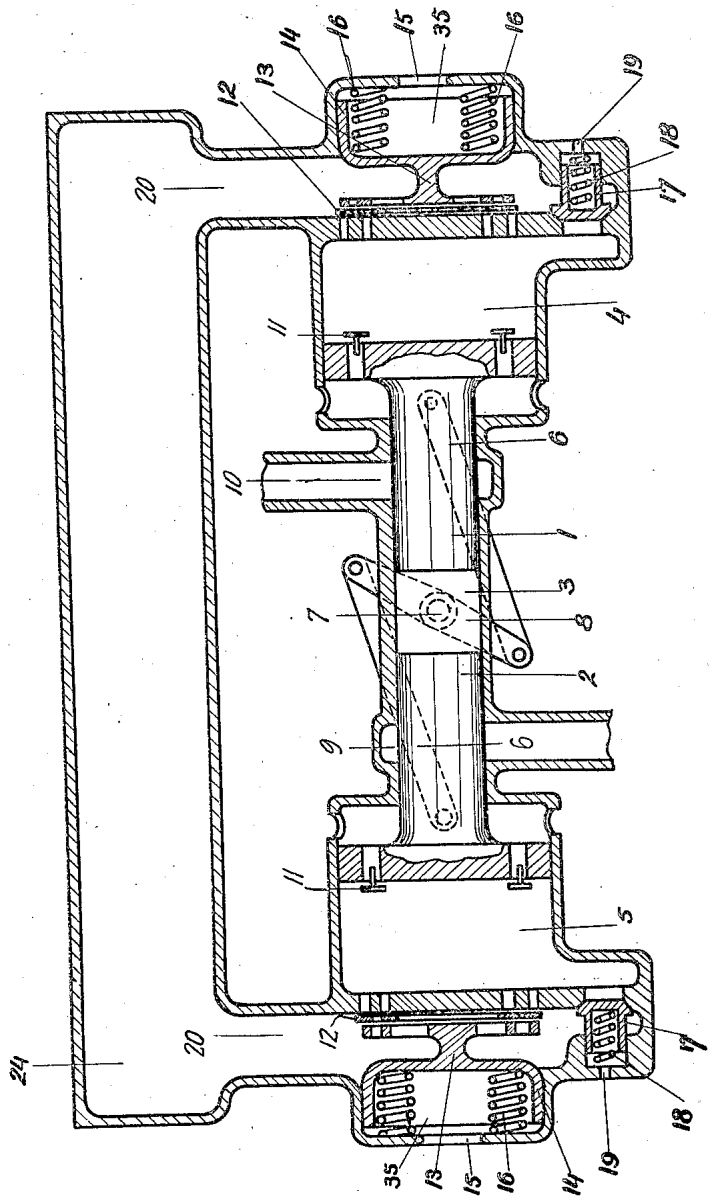
March 6, 1934. R. P. PESCARA 1,950,063

AIR COMPRESSOR

Filed July 11, 1931 2 Sheets-Sheet 1

Fig. 1

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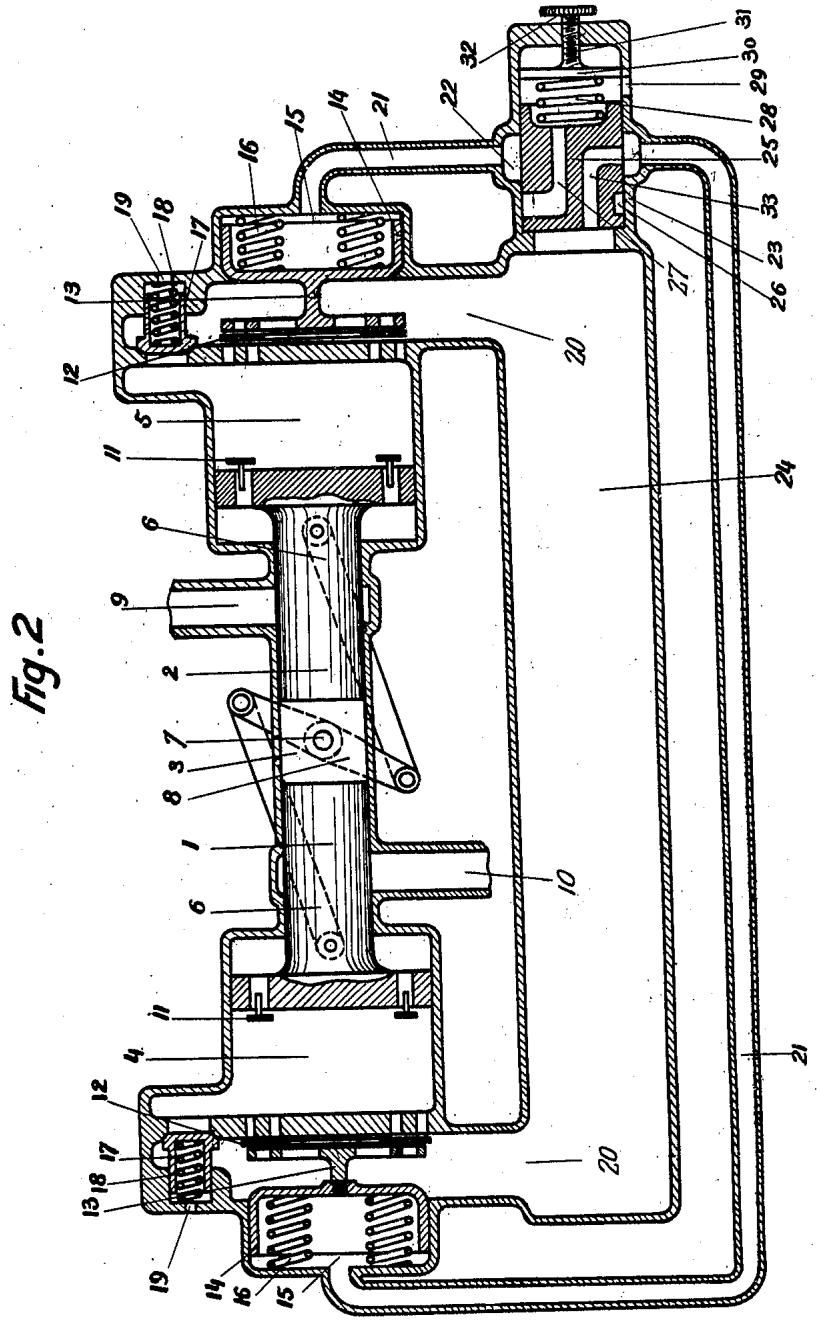


Fig. 2

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# UNITED STATES PATENT OFFICE

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## AIR COMPRESSOR

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In Germany August 16, 1930

6 Claims. (Cl. 230—56)

The invention relates to improvements in safety devices for starting motor-compressor apparatus having free pistons, especially to those which operate with a reservoir the pressure in which may, at starting, be below the normal running pressure.

The principal object of the invention is to assure the starting of machines of this kind, and to avoid certain disadvantages incurred in connection with the compressor described in French Patent 628,572. The specification of this patent shows auxiliary valves in series with the usual valves placed over the discharge apertures for the compressed air.

These valves, however, permit the dispersal of the air injected into the interior of the dead space of the compressor for starting purposes, causing a loss of charge which makes it practically impossible to employ this starting means in practice.

Further, during the first compression strokes, the air is compressed into the space between the normal discharge valve and the special safety valve, which does not allow sufficient work to be stored up in the cushion of air to ensure the return of the pistons to their central dead point.

The present invention consists essentially firstly in disposing on the discharge valves of the compressor cylinders an element constructed in such a manner that it opposes itself completely to their opening when the reservoir is below the normal running pressure and while the reservoir is filling. This result is obtained by means of springs which apply the said element to the valves and these latter to their seat. The invention consists secondly, in providing the closing element of the valves with a compensator piston, one surface of which is subjected to the atmospheric pressure and the other to that of the air of the reservoir of the apparatus, so that the resultant of these two forces progressively compensates the strength of the springs which control the discharge valves in proportion as the pressure rises in the reservoir, till this resultant force is annulled when the normal pressure is attained; thirdly, in providing the compressor with accessory means for the discharge of the fluid, independently of the normal running valves, and intended to operate only during the starting and until the closing element provided frees the normal discharge valves when the pressure in the reservoir has risen; fourthly, in so disposing the compensator piston that one of its surfaces which is normally under the action of the atmospheric pressure, remains on the contrary, subject to the pressure of the reservoir until this latter pressure attains a value in the neighbourhood of that at which the valves are released, by controlling it through a pilot device which makes at a determined moment, one of the surfaces of the compensator piston communicate suddenly with the atmosphere.

In every way the invention will be easily understood with the aid of the explanations which follow and from the annexed drawings, which it is to be understood are only given by way of example of its application.

Fig. 1 represents a longitudinal section of a motor-compressor with free pistons, provided with devices according to the invention.

Fig. 2 represents a longitudinal section of a motor-compressor with free pistons as in Fig. 1 but provided in addition with a control device for the release of the discharge valves.

According to the invention and more particularly according to the embodiment shown in Figs. 1 and 2, the motor-compressor comprises two pistons 1 and 2 movable in opposite directions in the engine cylinder 3 and in the compressor cylinders 4 and 5. The two pistons are connected by a synchronizing system constituted by two pairs of connecting rods 6 and two cranks 8. These latter oscillate around an axle 7 through an angle less than 360°. The piston 2 controls at one of the extremities of the engine cylinder the exhaust ports 9, and the piston 1, at the other extremity of the engine cylinder, the inlet ports 10. The pistons 1 and 2 carry on their compressor surface the suction valves 11, and the air compressed in the cylinders 4 and 5 passes out during normal operation through the valves 12 and the conduits 20 for compressed air; the accumulated energy in the compressed air which remains in the dead spaces assures the return of the pistons to their initial dead point.

The device which is the object of the invention is constituted by the following elements: a discharge valve 12 for air, to which is applied the intermediate element 13 carried by a piston 14, springs 16, the space 35 communicating through an opening 15 with the outer air, a valve 17 with a spring 18, an orifice 19, a conduit 20 for compressed air and the reservoir 24.

Fig. 2 comprises the above-mentioned elements and in addition those which correspond to the control, means for the release of the discharge valves, namely: the conduit 21, the annular space 22, the cylinder 23, the reservoir for compressed air 24, the pilot piston 25 with an annular space 26 and the passages 27 and 33, the spring 28, the

opening 29, the support 30 for the spring, the screw 31 and its operating head 32.

The mechanism functions as follows:—

The springs 16 through the pistons 14 and the intermediate piece 13 apply the discharge valves 12 to their seats and prevent the opening of the said valves as long as the normal running pressure is not attained in the reservoir. This result cannot be obtained when the air leaves by the known discharge valves because their opening is so great that the closing cannot be effected quickly enough, as is shown by practical experiments, unless the pressure in the compressor cylinders is above the normal running pressure. The pressure exercised by the springs on the valve 12 diminishes in proportion as the pressure in 24 increases, because one of the surfaces of the piston 14 is subject to this pressure which operates against the springs. The piston 14 has a diameter such that the effort due to this air pressure surpasses that of the springs when the normal pressure is attained and then the piston is brought against the end of its cylinder when it frees the discharge valve 12 which is controlled by the element 13; the valve 12 then follows its normal functioning.

It is very advantageous to make the stroke of the piston 14 equal to that of the movement of the valve 12 and to utilize the element 13 as a stop to limit the movement of the valve 12 during its normal operation.

The valve 17 operates independently of the pressure of the reservoir 24. This is obtained owing to a special construction of the valve, one surface of which is opposed to the pressure from the interior of the cylinder whilst the other is in communication with the outer air through the opening 19.

The opening of the valve 17 can, however, be controlled by the pressure in 24 with the object of putting this valve out of operation when the running pressure is reached, by making the guide of the valve smaller than the valve itself. In this case, as the annular rear surface of the valve 17 around the stem is larger than the valve aperture, the said valve is held firmly on its seating when the pressure in container 24 reaches the normal working pressure.

The construction indicated in Fig. 2 has for its object to prevent the opening of the valve 12 before the running pressure is attained, and remedies the drawback of the system described that the building up of the discharge pressure through 17 can cause the opening of the valve before the normal functioning pressure is attained in the reservoir, which gives place to a diminution of the pressure of the cushion of air such that the return of the pistons to the necessary position may not be possible.

This drawback might be remedied by applying the valve 12 on its seating with such a force that this valve can only be opened if the discharge pressure goes far beyond the normal. Nevertheless, the force available diminishes as the pressure rises in the reservoir because the effort opposed against the spring 16 increases proportionally to the pressure on the piston 14, which is chosen sufficiently large so that when the maximum pressure is attained in the reservoir, the power of the said springs is overcome.

Even then, however, the valve 12 may open too soon and cause the stoppage of the machine. To remedy in a definite manner the premature opening of the valve 12, the two faces of the compensator piston 14 are subjected to the pressure of the reservoir. In this way the compensator pistons 14 are subjected to the pressure of the reservoir and the effort of the springs is made constant.

The additional device of Fig. 2 functions for this purpose as follows:—

The openings 15 of the end surface of the cylinder corresponding to the piston 14 communicate with the annular space 22. In Fig. 2, this space 22 communicates through the passage 33 with the reservoir 24. If the piston 25 is carried towards the right, the space 22 will communicate through the passage 27 and through the opening 29 with the atmosphere.

When the pressure is low in 24, the spring 28 regulated suitably by the knob 32 causes the piston 25 to occupy the position of Fig. 2. When the pressure in 24 increases, it tends to move the piston 25 and compress the spring 28, and further does compress it when the pressure is sufficient. This causes the opening 15 to communicate with the atmosphere through the passage 27, and consequently the piston 14 is rapidly displaced, to free the valve 12.

What I claim and desire to secure by Letters Patent of the United States of America is:—

1. In an internal combustion air compressor, the combination of an intermediate explosion cylinder, a compressor cylinder at each end thereof, a main discharge valve for each cylinder, a member arranged over said discharge valve, spring means tending to press said member against the discharge valve and prevent the opening thereof and means for rendering said spring means inoperative when a sufficient pressure has been attained in a receiver.

2. In an internal combustion air compressor, the combination of an intermediate explosion cylinder, a compressor cylinder at each end thereof, a main discharge valve for each cylinder, an auxiliary discharge valve having an enlarged stem of a diameter smaller than the diameter of the valve passage, means for applying atmospheric pressure to the opposite surface of said auxiliary discharge valve, a member arranged over said main discharge valve and adapted to apply said valve to its seat, spring means to press said member against the main discharge valve and the latter upon its seat to prevent said main discharge valve opening during the filling of a receiver and means for retracting said member when the pressure in the receiver for compressed air attains substantially its normal value.

3. In an internal combustion air compressor, the combination of an intermediate explosion cylinder, a compressor cylinder at each end thereof, a main discharge valve for each cylinder, a piston having a reduced stem connected to a portion adapted to press upon said main discharge valve, a cylinder slidably accommodating said piston opening into a portion in communication with the receiver for compressed air, whereby said piston is subjected on one face to the pressure in said receiver, means for applying atmospheric pressure to the opposite surface of said piston and spring means co-operating with the said opposite surface of said piston tending to clamp the said portion thereof against the main discharge valve to prevent the latter opening, the air pressure acting on said piston to retract said portion away from said valve when normal pressure has been attained in the receiver.

4. An internal combustion air compressor as claimed in claim 3, having an auxiliary discharge valve with a hollow stem at the rear of said valve

engaging in a suitable housing, a communicating passage between said housing and the atmosphere and a spring within said hollow stem tending to close said valve, the arrangement being such that the air pressure around the stem of said valve prevents actuation of said valve when the pressure is normal.

5. An internal combustion air compressor comprising an intermediate explosion cylinder, a compressor cylinder at each end thereof, compressor pistons each common to said explosion cylinder and one of said compressor cylinders, inlet and discharge valves associated with said compression cylinders, a member tending to apply each said discharge valve to its seat to prevent said valve opening, a controlling piston connected to said member, a housing slidably accommodating said piston and opening at one side into a pressure air receiver, spring means to press said member against the discharge valve, a pilot valve, a housing therefor, a passageway between the opposite side of said controlling piston and a port in said pilot valve housing, spring means actuating said pilot valve in one direction, means whereby the pressure in the receiver influences said pilot valve in the opposite direction, portways in said pilot valve serving to communicate the receiver pressure to said opposite side of said controlling piston while the receiver pressure is below normal and further portways which on displacement of said piston valve against its controlling spring when normal pressure is attained in the receiver make communication between said opposite side of said controlling piston and the atmosphere to retract said member and allow the discharge valve to function.

6. An internal combustion air compressor as claimed in claim 5, embodying an auxiliary discharge valve, means for subjecting the inoperative face of said valve to the pressure in the receiver whereby said valve is operative only until the normal pressure is attained in the receiver and spring means to apply said auxiliary valve on to its seat.

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