June 12, 1951 M. A. LIPKAU 2,556,623

MEANS FOR AUTOMATICALLY OPENING AND CLOSING A COMPRESSOR INTAKE

Filed Sept. 30, 1946 2 Sheets-Sheet 1

Fig. 1.

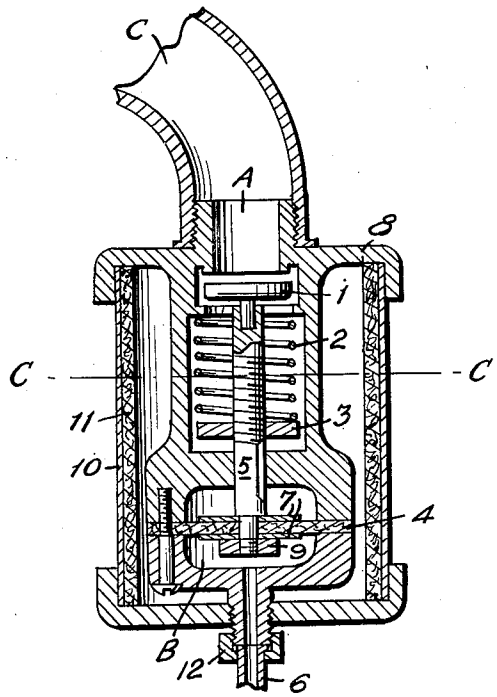
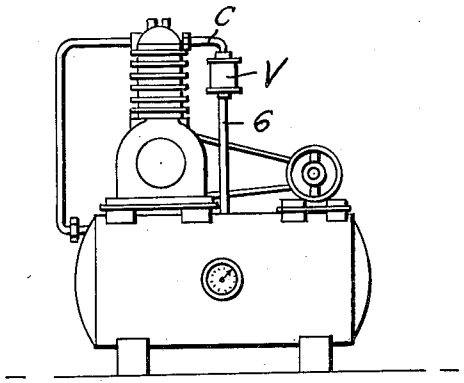


Fig. 2.



Inventor

Maximiliano A. Lipkau

By Glascock Downing Seek & Co

Attorneys

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Fig. 3.

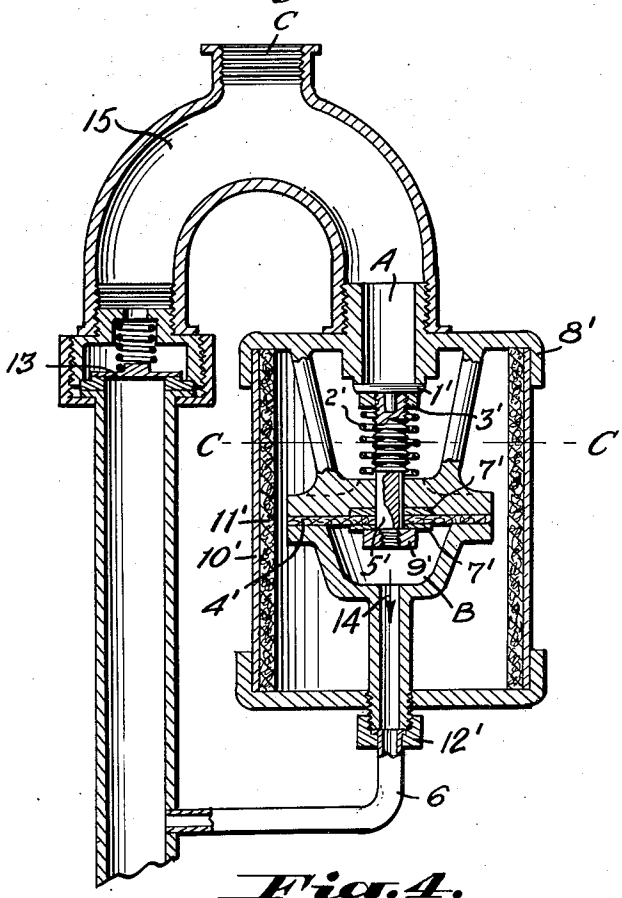
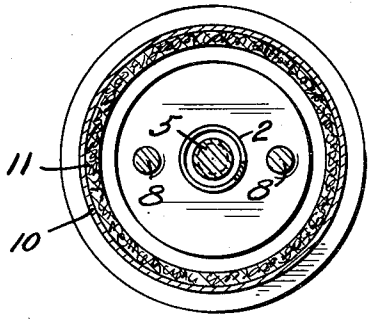


Fig. 4.



Inventor

Maximiliano A. Lipkau

By Glascock Downing Seibold

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MEANS FOR AUTOMATICALLY OPENING AND CLOSING A COMPRESSOR INTAKE

Maximiliano Alvarez Lipkau, Barcelona, Spain

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4 Claims. (Cl. 230—24)

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The present invention relates to a device or apparatus for automatically effecting the opening and closing of the admission of atmospheric air directly into a compressor or the like, or into a compressor working as a vacuum machine, or working in both capacities at the same time, in dependence upon the raised pressure or partial vacuum established in a reservoir communicating with the device. Such a device is fitted without modifying the compressor in any way, all that is necessary being to couple it to the inlet connection of the compressor, leaving the usual valves of the compressor as they were. When applied to a machine working as a compressor properly so called it has the result that the latter, without ceasing to function, discontinues compressing air into the storage vessel when the pressure therein reaches its maximum, and resumes compression when it falls to its minimum, the said maximum and minimum being adjustable. Similarly, when applied as a modification to a compressor working as an exhaust pump or vacuum machine, or to a compressor operating simultaneously as a compressor and as a vacuum machine, it maintains, in a vessel provided for the purpose, a predetermined degree of vacuum fixed between two limits, a maximum and a minimum, the values of which are adjustable.

One important problem resides in the desirability of ensuring that the closing and opening of the admission are effected suddenly, without equilibrium of forces being produced, which would keep the valve "floating." This has been solved by utilising the inherent suction force of the compressor, as hereinafter explained.

Essentially the device in question comprises a diaphragm or like resilient element or a piston or other displaceable element, or some element equivalent thereto in its action, combined, with mechanical interengagement or dependence, with a valve which opens and closes the admission of atmospheric air. This diaphragm, piston or equivalent element forms the terminus of a communication with the storage vessel annexed to the compressor in which the compressed air is stored, if the compressor is working as a compressor properly so called, or with the annexed reservoir in which the vacuum is created, if the compressor is mounted or is being utilised as an exhaust pump. The device comprises two chambers: one constituting the inlet connection for the admission of atmospheric air to the compressor, this chamber being opened and closed by the valve to which reference is made above, and the other closed permanently on one side by

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the resilient diaphragm or piston or equivalent element, and communicating on the other side with the reservoir, either of vacuum or of compressed air.

In the device in question, the valve and the diaphragm or piston are interconnected or mechanically dependent on one another preferably in tandem, and are mounted in such a way that whether there is or is not any axial clearance which leaves the valve a certain amount of intrinsic mobility, the latter is guided and controlled by a rod or like member which follows the movements of the diaphragm or piston. Different effective areas are provided for the valve and for the diaphragm or piston, for the purpose of obtaining a differential pressure action, or else a spring is provided which acts upon the said elements; or preferably both arrangements are adopted in combination with one another.

To enable the invention to be more clearly understood, reference is made to the accompanying diagrammatic drawings, in which:

Figure 1 shows in longitudinal section a form of the device suitable for mounting on a compressor functioning as such;

Figure 2 is a sketch in outside elevation of an installation incorporating the device;

Figure 3 shows in longitudinal section a form of the device suitable for mounting on a compressor operating as a vacuum machine; and

Figure 4 is a cross section on the line C—C in either Figure 1 or Figure 3.

In its application to a compressor properly so called, as illustrated by way of example in Figures 1, 2 and 4, the device consists of a valve 1 and a resilient diaphragm 4, united with one another in tandem by a rod 5. The valve may be so mounted as to have a certain amount of lost motion or axial play, but this is not essential. The valve opens and closes the chamber A, which constitutes the inlet connection for atmospheric air, and communicates at C with the compressor suction spigot. The diaphragm 4 (for which a piston displaceable in a corresponding cylinder may be substituted if desired) divides the chamber B into two compartments, one of which communicates by a pipe or duct 6 with a storage reservoir for compressed air marked D in Figure 2, the valve and diaphragm device as a whole being marked V in that figure. The surface area of the valve 1 is different from that of the diaphragm 4, and a spring 2 has been provided, which bears against a washer 3, secured to the stem 5 of the valve 1, the position of the washer being adjustable by screwing it along a thread

on the valve stem 5. The other end of the spring 2 rests against a fixed ledge projecting inwards from the frame of the body or cage 8 of the device. The diaphragm 4 is secured to the rod 5 by means of washers 7 and a nut 9. The pipe 6 is coupled to the device by a union 12. A cylindrical filter 11, retained by a covering 10, precludes the entrance of dust and extraneous materials to the compressor intake.

This device operates in the following manner: When the upper limit or maximum pressure is reached in the storage reservoir D of compressed air, and therefore in the lower compartment of the chamber B, which is in open communication therewith, the diaphragm 4 bulges upwards, thereby displacing the rod 5 and the valve 1, which therefore approaches the mouth of the chamber A, after the resistance of the spring 2 has been overcome. As the valve 1 approaches the mouth of the chamber A it is also urged towards it by the suction, and moves quickly on to its seat, this action being facilitated by the axial play that may be provided between the valve and the diaphragm. When the valve bears against its seat it closes the admission of atmospheric air to the compressor, and is thereafter retained in this position by the vacuum in the chamber A.

When the pressure in the storage reservoir falls to the lower limit, an action opposite to that described above is produced, since the diaphragm 4 curves downwards, and drags down with it the rod 5 and the valve 1. When once the withdrawal of the valve from the mouth of the chamber A has been initiated the same separates therefrom promptly, since a pressure approaching atmospheric pressure becomes established almost immediately in the chamber A, where previously there was a vacuum. The passageway now remains open until the cycle of operations hereinbefore described recommences.

In its application to a compressor operating as a vacuum pump the device is supplemented, as illustrated in Figure 3 by a branch pipe or duct 15 leading directly from the vacuum reservoir to the suction spigot. In the pipe 15 is interposed a spring-controlled non-return valve 13. In other respects the device is analogous to that described for the preceding case, the various elements being denoted in Figure 3 by the same reference numerals as in Figure 1, with the addition of a tick or accent mark. The difference resides in the abovementioned conduit 15 with the stop valve 13, and in the fact that the spring 2' of Figure 3 acts in a direction opposite to that of the spring 2 in Figure 1, tending in the present case to keep the valve 1' pressed against the mouth of the chamber A. This chamber A, and likewise the branch conduit 15 in the part beyond the non-return valve 13, communicate with the suction intake C. The chamber B, and the part of the branch conduit preceding the valve 13, communicate with the reservoir in which a predetermined degree of vacuum is to be maintained, between limits adjusted by means of a nut 3', which can be screwed along a threaded portion of the valve rod 5'.

This form of the device functions in the following manner: When the highest vacuum (or in other words the lowest sub-atmospheric pressure) has been reached in the vacuum reservoir, the diaphragm 4' curves in the direction of the arrow 14 in Figure 3, or an equivalent piston slides in that direction, and draws down with it the valve 1', thereby opening the vacuum chamber A to atmospheric pressure, which reaches the intake C, and also helps to impel the valve 1' downwards. The free flow of atmospheric air through the chamber A to the intake C allows the valve 13 to close under the action of its own spring. When on the contrary the lower limit of vacuum is reached (or in other words the maximum sub-atmospheric pressure) in the vacuum storage reservoir, the spring 2' is strong enough to counteract the action of the vacuum exerted upon the diaphragm 4', and the valve 1' approaches the mouth of the chamber A, being then suddenly attracted thereto by the growing suction in the chamber A, this action being assisted as before by the axial play of the valve if such be provided. The valve then shuts off the admission, and is held firmly upon its seat by the vacuum then produced in the chamber A by the compressor, which then takes in air through the branch conduit 15 from the vacuum reservoir, the non-return valve 13 opening automatically against the action of its closing spring.

The construction and operation of two embodiments of the invention have been described in detail, but it must be borne in mind that the details may differ in practice from those that have been set forth and illustrated by way of example.

I claim:

1. For use in conjunction with a compressor adapted to be operated as an exhaust pump and with a vacuum reservoir, a suction nozzle through which the exhaust pump draws in air, a pipe connecting the vacuum reservoir with the suction nozzle, an inlet branched on to the said pipe, through which atmospheric air can pass directly to the said suction nozzle, a valve for opening and closing the said inlet, an element movable in response to air pressure, the said movable element being mechanically coupled to the valve to control its opening and closing, the side of the pressure-responsive element nearer to the valve being open to atmospheric pressure, and a duct establishing communication between the other side of the pressure-responsive movable element and the interior of the reservoir.

2. For use in conjunction with a compressor adapted to be operated as an exhaust pump and with a vacuum reservoir, a suction nozzle through which the exhaust pump draws in air, a pipe connecting the vacuum reservoir with the suction nozzle, a spring-controlled non-return valve in the said pipe to prevent fluid flowing therethrough towards the reservoir, an inlet branched on to the said pipe between the said non-return valve and the suction nozzle, through which inlet atmospheric air can pass directly to the suction nozzle, a valve for opening and closing the said inlet, an element movable in response to air pressure, the said movable element being mechanically coupled to the valve to control its opening and closing, the side of the pressure-responsive element nearer to the valve being open to atmospheric pressure, a duct establishing communication between the side of the pressure-responsive element remote from the valve and the interior of the reservoir and a spring tending to close the valve against the suction of the reservoir pressure acting upon the movable element.

3. For use in conjunction with a compressor adapted to be operated as an exhaust pump and with a vacuum reservoir, a suction nozzle through which the exhaust pump draws in air, a pipe connecting the vacuum reservoir with the suction nozzle, a spring-controlled non-return valve in

the said pipe to prevent fluid flowing therethrough towards the reservoir, an inlet branched on to the said pipe between the said non-return valve and the suction nozzle, through which inlet atmospheric air can pass directly to the suction nozzle, a valve seat in the said inlet facing outwards, a valve moving inwards and outwards for opening and closing the said inlet, an element movable in response to air pressure, a lost-motion connection mechanically coupling the said movable element to the valve, so that when the valve approaches its seat it will be drawn smartly into contact therewith by suction, and when it is pulled off its seat it will move smartly away therefrom owing to the approximate equalization of pressure on both sides of the valve, the side of the pressure-responsive element nearer to the valve being open to atmospheric pressure, a duct establishing communication between the side of the pressure-responsive element remote from the valve and the interior of the reservoir, a spring tending to close the valve against the suction of the reservoir pressure acting upon the movable element and means for adjusting the force of the spring and thereby varying the reservoir pressures at which the valve opens and closes.

4. In a device for controlling the air intake of a suction pump adapted to be connected to a reservoir containing air at sub-atmospheric pressure, a conduit for connecting the reservoir

to the suction pump, a casing forming an air intake and connected to said conduit, a valve adapted to close communication from said casing to said conduit, a spring biasing said valve to closed position, means defining a chamber within said casing, a duct connecting said chamber to the conduit communicating with the reservoir, a movable member in said chamber and exposed to the atmosphere on one side and the sub-atmospheric pressure in the reservoir on the other side and movable in response to the differential thereof, a rod connecting said member with said valve for moving the valve in accordance with the movement of the member, said rod having a channel therein for providing restricted communication of atmospheric air to said other side of the member.

MAXIMILIANO ALVAREZ LIPKAU.

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