

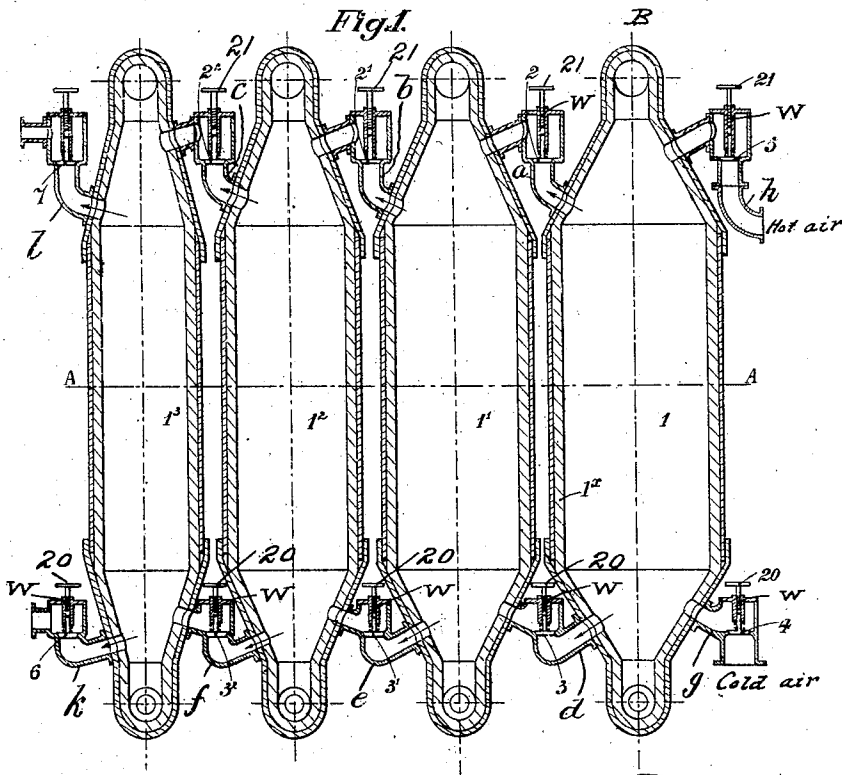
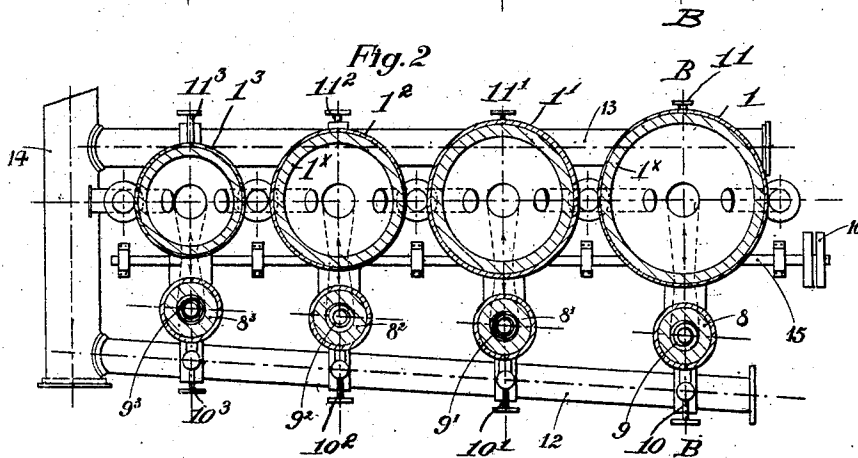
No. 846,302.

PATENTED MAR. 5, 1907.

E. GOBBE.
THERMIC COMPRESSOR FOR AIR AND GASES.

APPLICATION FILED MAR. 1, 1904.

2 SHEETS—SHEET 1.



Witnesses:

William S. Jones.

Edw. Kessler

Inventor

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By James L. Norris.

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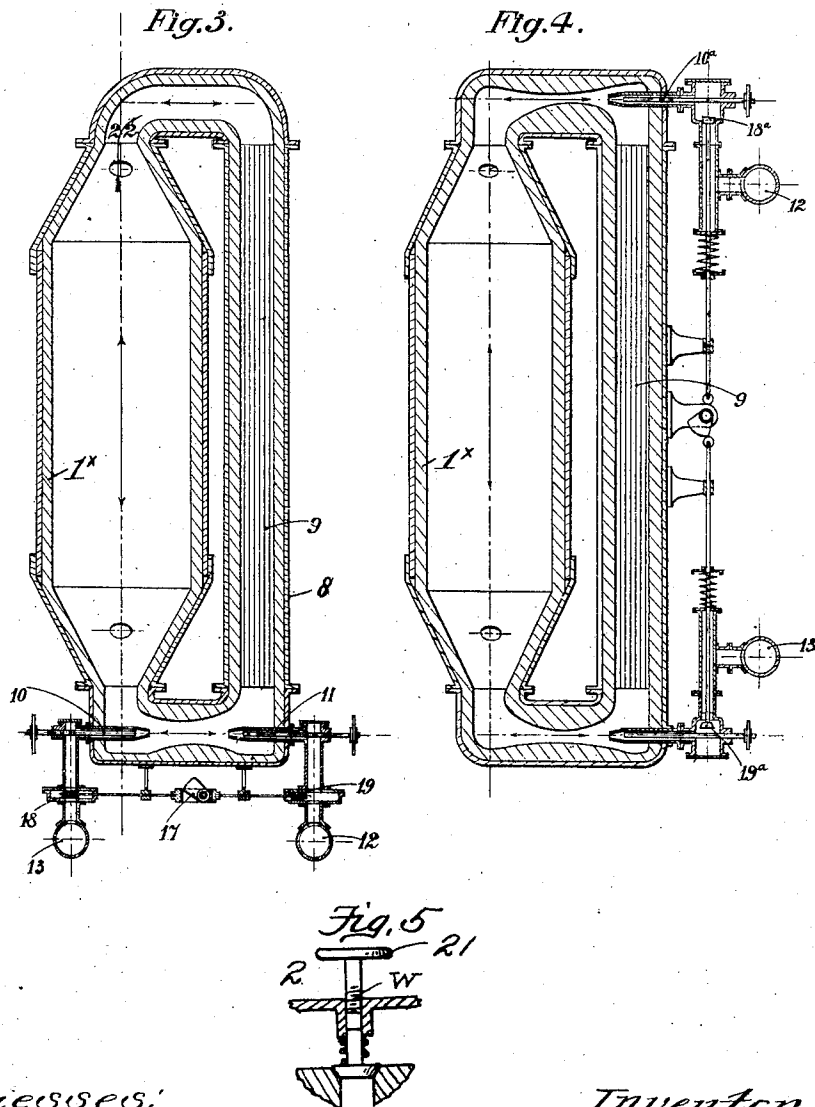
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UNITED STATES PATENT OFFICE.

EMILE GOBBE, OF JUMET, BELGIUM.

THERMIC COMPRESSOR FOR AIR AND GASES.

No. 846,302.

Specification of Letters Patent.

Patented March 5, 1907.

Application filed March 1, 1904. Serial No. 196,099.

To all whom it may concern:

Be it known that I, EMILE GOBBE, engineer, glass-founder, a subject of the King of Belgium, residing at Jumet, Belgium, have invented certain new and useful Improvements in Thermic Compressors for Air and Gases, of which the following is a specification.

The apparatus which forms the object of this invention is an automatic compressor which derives its mechanical energy from the heat of the hot air or gases which it has to compress. The principle of this apparatus is as follows:

A first reservoir of constant volume filled with hot air communicates, through a suction-valve, with a second reservoir containing hot air—for instance, at the atmospheric pressure—and through a forcing-valve with a third reservoir, in which the compressed air will be forced. The first reservoir communicates also by its ends with a temperature-interchanger, constituted, for instance, by a metallic gauze or a thin sheet of metal coiled up spirally. If the hot air contained in the first reservoir is displaced as it goes through the temperature-interchanger from top to bottom, for example, the heat of the air is absorbed by the gauze or metallic sheet of the temperature-interchanger and the air is cooled. Consequently a depression is produced in the first reservoir. When the pressure in the said reservoir becomes lower than the atmospheric pressure, the suction-valve opens and a certain amount of hot air from the second reservoir penetrates into the first reservoir after passing through the temperature-interchanger, where it is cooled. This operation is continued until the first reservoir is filled with cold air at the atmospheric pressure. The direction of the circulation of the air in the first reservoir and in the temperature-interchanger is then reversed. The cold air goes through the gauze or sheet of the interchanger in the inverted direction (from bottom to top) and is heated. The pressure in the first reservoir increases. The forcing-valve is opened and a part of the air passes from the first reservoir to the third reservoir, in which similar operations take place. The air circulates, being more and more compressed in many reservoirs, and finally is received in the last one, from which it is sent to the apparatus where it is used.

In the accompanying drawings, Figure 1 is a section of an apparatus according to the in-

vention. Fig. 2 is a section on the line A A of Fig. 1. Fig. 3 is a section on the line B B of Fig. 1. Fig. 4 is the same section as Fig. 3, showing a modification. Fig. 5 is a detail sectional view showing one of the suction-valves.

The apparatus, Figs. 1, 2, and 3, consists of a series of reservoirs $1\ 1' 1^2\ 1^3$, covered internally with any heat-non-conducting material, such as refractory lining 1^x , and having communication at their upper ends by means of pipes a, b , and c , provided with valves $2\ 2'\ 2^2$, and at their lower ends by means of pipes d, e , and f , provided with valves $3\ 3'\ 3^2$.

The reservoir 1 communicates at its lower end with the atmosphere through a pipe g , closed by a suction-valve 4, and at its upper end with a reservoir containing hot air through a pipe h , closed by a suction-valve 5. The reservoir 1^3 communicates through pipes k and l , respectively, having valves 6 7, either through a reservoir or directly with the apparatus where it is used. Each reservoir $1\ 1' 1^2\ 1^3$ communicates at its lower end with a vertical conduit $8\ 8'\ 8^2\ 8^3$, surrounding the temperature-interchanger, constituted by a sheet of metal coiled up spirally, (designated by $9\ 9'\ 9^2\ 9^3$.) Two injectors, as 10 11, are arranged opposite each other at the lower part of each reservoir, as shown by Fig. 3, and connected to pipes 12 13 to supply air under high compression. Each of the successive reservoirs is provided with like pairs of injectors $10'\ 11'\ 10^2\ 11^2\ 10^3\ 11^3$, as indicated by Fig. 2, and all connected to the pipes 12 and 13, the pipes 12 13 being connected to a compressed-air reservoir 14, as also shown by Fig. 2. A shaft 15, driven by a pulley 16, actuates eccentrics 17, coöperating with each set of injectors alternately to open and close slides 18 19 in the connecting-pipes carrying the injectors to control the feed of air to the said injectors and reservoirs.

The operation of this apparatus is as follows: It will first be supposed that the valves $4\ 3\ 3'\ 3^2\ 6$ are closed by operating the hand-wheel 20 of the pipe 4 and the hand-wheels of the remaining valves of this series and that the hand-wheel 21 of the valve 5 and like wheels of valves $2, 2', 2^2$, and 7 have been operated to completely open the latter valves. To start the apparatus, it must first be suitably heated by blowing into it hot air or gases through the valve 5 and opening the other valves $2\ 2'\ 2^2\ 7$, the last one of which,

7, opens into the atmosphere. This hot air will circulate in the upper part of the reservoirs 1 1' 1² 1³, which it will heat, together with the upper part of the temperature-interchangers 9 9' 9² 9³. After this preliminary operation the shaft 15, carrying the eccentrics 17, is rotated so as to open and close alternately the slides 19 18 and alternately admit compressed air to the injectors 11 and 10. The eccentrics 17 are disposed in such a manner that the injectors 10 10² are in operation simultaneously, the injectors 10' 10³ closed, and the injectors 11' 11³ opened. The hot air passes through the valve 5 to the reservoir 1. The injector 11 being opened, the air is drawn in the direction of the arrow 22 and passes through the temperature-interchanger 9, where it is cooled before passing to the reservoir 1. The operation is continued until the reservoir is filled with cold air at the same pressure as the hot air sent through the valve 5—that is, at the atmospheric pressure. The slide 19 is then closed and the slide 18 opened. The injector 10 is set in operation. The cold air contained in the reservoir 1 passes from bottom to top through the temperature-interchanger 9. The cold air passing through the hot temperature-interchanger is heated, and the pressure in the reservoir 1 increases. The suction-valve 5 is closed by reason of the increase of pressure in the reservoir 1, and the valve 2 is opened. A part of the hot air contained in the reservoir 1 passes to the reservoir 1'. At the same time the injector 11' is at work, the hot air in the reservoir 1 is fed to the reservoir 1' and passes through the temperature-interchanger 9' from top to bottom, where it is cooled. Hot air will pass from reservoir 1 to reservoir 1' until the two reservoirs are filled with air at the same pressure, this air being hot in the reservoir 1 and cold in the reservoir 1'. At this moment the slide 18 closes and the slide 19 opens, and the hot air from the reservoir 1 passes from top to bottom through the interchanger 9, where it is cooled, and the pressure in the reservoir 1 decreases. The valve 5 is then opened and a new charge of hot air passes into the reservoir 1. The reservoir 1' works similarly with respect to the reservoir 1² and the reservoir 1² with respect to the reservoir 1³. The pressure increases progressively from one reservoir to the following one. If it be supposed that in each reservoir a difference of temperature of 273° centigrade is obtained between the extreme temperatures and the coefficient of dilatation of the air is one two-hundred-and-seventy-third, and the volume of each reservoir remains constant theoretically in each reservoir, the pressure of the air doubles when the air is brought from the lowest to the highest temperature. As the reservoir 1 communicates with the atmosphere the final pressure in this reservoir

1 is two atmospheres, and, the reservoir 1' communicating with the reservoir 1, when the air is at the pressure of two atmospheres in the reservoir 1, the final pressure in reservoir 1' will be four atmospheres. In the reservoir 1² the final pressure will be for the same reason eight atmospheres and in the reservoir 1³ sixteen atmospheres. In practice, in consequence of losses by friction and by the working of the apparatus, the final pressure reaches only six to ten atmospheres. The regulating of the pressure is obtained by operating the hand-wheels 20 and 21, preventing more or less the opening of the valves 5 2 2' 2² 7 and allowing the opening of the valves 4 3 3' 3² 6. The valve 4 feeds cold air to the reservoir 1, and the valves 3 3' 3², respectively, feed to the reservoirs 1' 1² 1³ air at a temperature lower than that passing through the valves 2 2' 2², because there is never a perfect mixture in the reservoirs, the air being colder at the lower portions of the reservoirs. The temperature, and in consequence the pressure, is thus regulated in each reservoir. It is obvious that if the air compressed in the last reservoir, communicating with the engine, is not utilized it will continue to be compressed until a maximum pressure is reached and be held in said reservoir for use when desired. If the compressed air passes to the engine and is used, the apparatus will work continuously.

Fig. 4 shows an apparatus operating in the same manner as those hereinbefore described, but with this difference: the injectors are situated one at the top and the other at the bottom of the apparatus. In this apparatus the passage 12 receives hot air or gas for the purpose of supplying directly the heat units required for the working of the apparatus. When the bottom valve 19^a is open, the top valve 18^a is closed, and the compressed air of the reservoir 13 carries with it the air that has just passed through the interchanger 9 in a downward direction, so that the automatic compressor becomes filled up with cold air, which operation causes a low pressure, followed by a suction of air into the apparatus. When the currents are reversed by closing the valve 19^a and opening the valve 18^a, the injector 10^a injects into the apparatus a jet of gas which ignites spontaneously because of the high temperature existing at the place where the gas issues. The heat units due to the combustion of the gas are added to those which the air stored in the interchanger 9, thereby facilitating the increase of pressure. The same phenomena take place at each reversal of the currents.

The valves 4, 5, 2, 2', 2², 3, 3', 3², 6, and 7 operate as suction-valves; but it is obvious that these valves are intended to be automatically closed if the pressure is greater (for instance,

for the valves 2 3) in the reservoir 1' than in the reservoir 1. On the contrary, these valves 2 3 open if the pressure is greater in the reservoir 1 than in the reservoir 1'. As
5 shown by Fig. 5, each of the valves is provided with a screw W, which permits them to be maintained closed. The valves are closed if the screw W is operated in the proper direction to maintain the valve on its
10 seat, and, conversely, the valve will be opened if the screw is operated in the reverse direction to allow the valve to work automatically.

Having thus fully described the invention, what is claimed is—

15 1. A compressor for air and gases having reservoirs with valved connections, a temperature-interchanger for each reservoir communicating with its reservoir at its lower and at its upper end, means for insuring the
20 circulation of the air in each reservoir in re-

verse directions, a hot-air-inlet pipe for the first reservoir having a closing valve, and an outlet-pipe for the last reservoir having a valve.

2. The combination of a series of con- 25 nected reservoirs each provided with two injectors arranged opposite each other, a compressed-air conduit for feeding these injectors, slides closing and opening alternately the communication of the conduit of 30 compressed air with the injectors, and means for controlling these slides.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EMILE GOBBE.

Witnesses:

JEVONNE LIÉTART,
EMILE DÉTÉ.