No. 657,868. Patented Sept. 11, 1900.

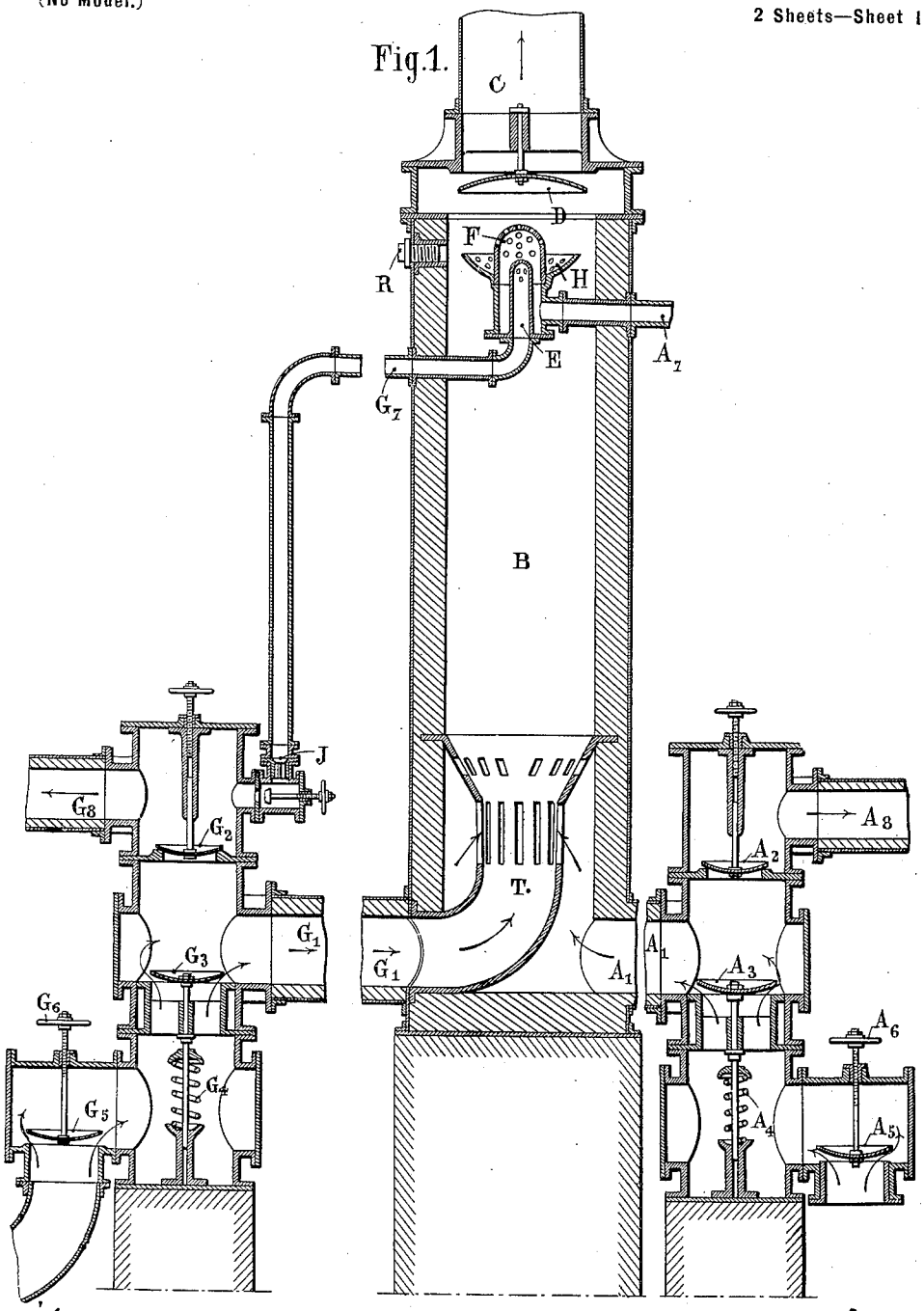
E. GOBBE.

APPARATUS FOR USE IN COMPRESSING AIR AND GAS.

(Application filed Dec. 27, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses,
Robt Everett.

Inventor.
Emile Gobbe.
By James L. Norris.
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 657,868. Patented Sept. 11, 1900.

E. GOBBE.

APPARATUS FOR USE IN COMPRESSING AIR AND GAS.

(Application filed Dec. 27, 1899.)

(No Model.) 2 Sheets—Sheet 2.

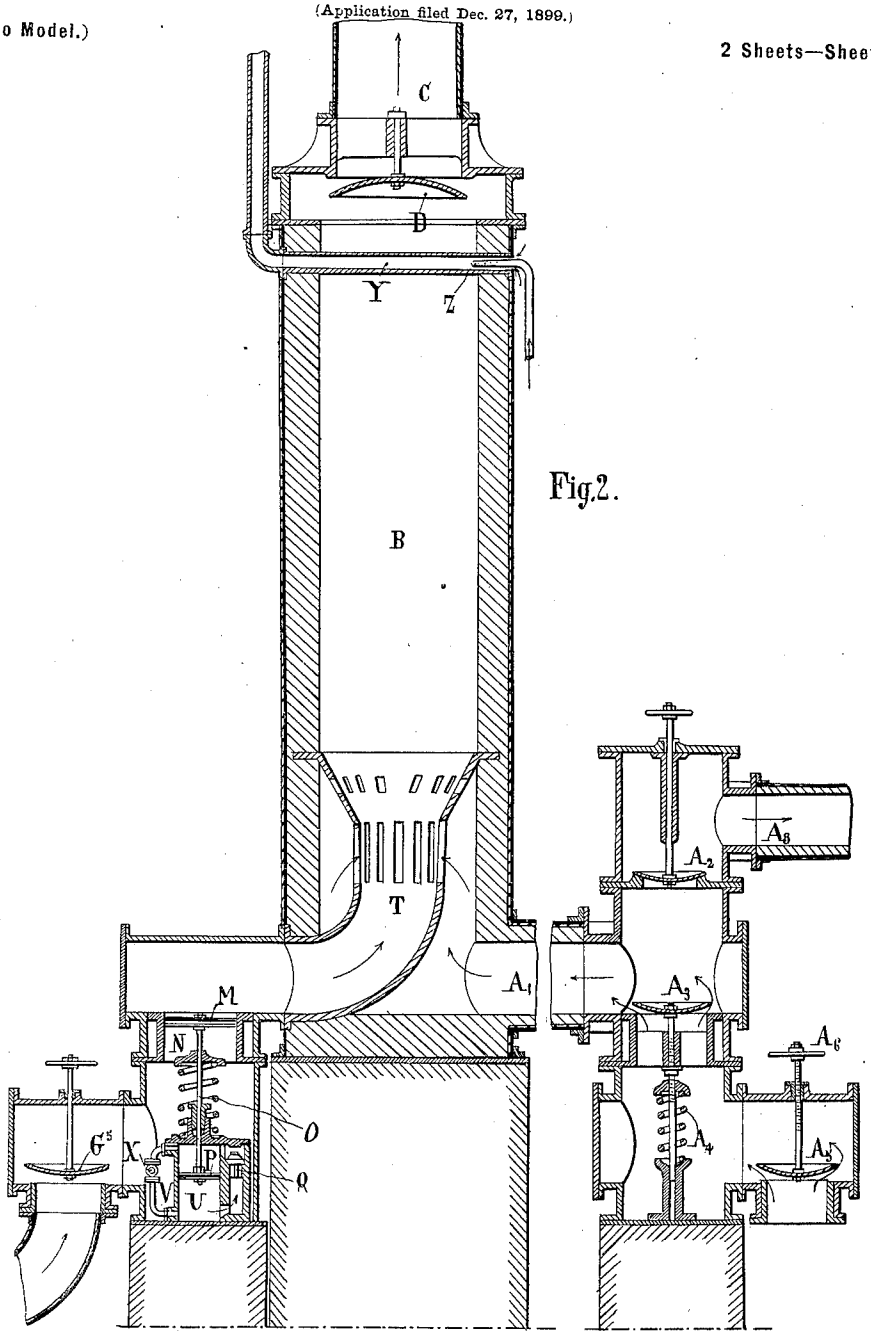


Fig. 2.

Witnesses
H. Lee Helms

Inventor
Emile Gobbe
by James L. Norris
Atty

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EMILE GOBBE, OF JUMET, BELGIUM.

APPARATUS FOR USE IN COMPRESSING AIR AND GAS.

SPECIFICATION forming part of Letters Patent No. 657,868, dated September 11, 1900.

Application filed December 27, 1899. Serial No. 741,749. (No model.)

To all whom it may concern:

Be it known that I, EMILE GOBBE, civil engineer, a citizen of Belgium, residing at Jumet, Belgium, have invented certain new and useful Improvements in Apparatus for Use in Compressing Air and Gas, of which the following is a specification.

This invention has for its object an apparatus for compressing air and gases by means of explosions.

In order that my invention may be well understood, I will describe the same with reference to the accompanying drawings, in which—

Figure 1 shows an apparatus used to compress simultaneously air and gas. Fig. 2 shows a modification of the apparatus used for compressing air only.

The apparatus constructed in accordance with my invention mainly consists of an explosion-chamber B, consisting of a sheet-metal cylinder lined with fire-resisting material protecting the metal from the action of heat. This explosion-chamber is connected at its lower part with two pipes, through one of which, A′, air is conducted into the explosion-chamber B, while the other, G′, similarly supplies the said chamber with gas. The said pipes A′ and G′ may be lined with fire-resisting material or not. At top the explosion-chamber B communicates with a chimney C of sufficient height to insure an adequate draft, for which purpose the said chimney may be connected with any suitable mechanical suction appliance or simply with a steam-jet extractor. A valve D is arranged at the base of the chimney C, which valve is kept open by its own weight and adapted to descend but a little distance below its seat.

At the extremities of the air and gas pipes A′ and G′, respectively, there are provided delivery-valves A^2 and G^2, which are maintained closed by their own weight, and suction-valves A^3 and G^3, which by means of springs A^4 and G^4 are raised a short distance above their seats. Regulating-valves A^5 and G^5, actuated by hand-wheels A^6 G^6, enable the amounts of air and gas admitted to be controlled or varied as required, so as to obtain a suitable mixture for explosion in the explosion-chamber B. The air and gas meet after passing through a twyer T, provided with a number of perforations which serve to agitate the air and gas to thoroughly mix them, while an igniter E, situated near the top of the explosion-chamber B, receives, respectively, by the conduits A^7 and G^7 compressed gases from collectors A^8 and G^8. The flame produced in this igniter passes through a number of small perforations of a fire-resisting piece forming the cap F of the igniter. This igniter is fitted with a perforated dish or "basket" H, adapted to receive incandescent charcoal or the like for starting the apparatus.

The operation is as follows: To start the apparatus, the gas-valve G^5 is closed and the basket H is filled with burning charcoal or the like, inserted through a charging-orifice R, which immediately after is tightly closed, for example, by a screw-plug. The valve D of the chimney being open, as is also the suction-valve A^3, the air drawn in by the chimney passes into the apparatus, taking its course through the regulating and suction valves A^5 and A^3 into the explosion-chamber B, and thence escaping through the chimney C. When there exists a proper draft, the gas-supply valve G^5 is opened by means of the hand-wheel G^6, so that a limited quantity of gas is admitted by the pipe G′ and mixes with the air in the twyer T. As the gas-supply valve G^5 continues to be operated the volume of gas drawn in increases, and when it is sufficient to produce with the air coming from A′ an explosive mixture which is ignited by contact with the aforesaid hot charcoal or the like contained in the basket H an initial explosion occurs, which spreads throughout the explosion-chamber B, which by this time is entirely filled with explosion mixture. The effect of the explosion is immediately to raise the pressure within the apparatus. The gases tend to escape through every outlet, and as they do so press the valve D, leading to the chimney, and the air and gas suction valves A^3 and G^3 to their seats, while the delivery-valves A^2 and G^2 open to the air and gas, respectively, in the pipes A′ and G′, connecting with the explosion-chamber, (under the pressure of the very hot and highly-expanded products of combustion which have been evolved during the explosion,) the air and gas being thus passed to the collectors

A^8 G^8 without the intermediate agency of a piston. When the pressure in the pipes A′ and G′ becomes equal to that existing in the collectors A^8 G^8, the delivery-valves A^2 G^2 close, and the cooling effect produced by the walls creates a partial vacuum in the said pipes A′ G′ and in the explosion-chamber B. The valve D to the chimney and the air and gas suction valves A^3 and G^3 then reopen, allowing the combustion-gases to escape through the chimney C and admitting further charges of air and gas, which drive the combustion-gases before them. A fresh explosive mixture is then contained in the explosion-chamber B, and a second explosion takes place when such mixture comes in contact with the hot charcoal or the like placed in the basket H. The combustion-gases resulting from this explosion are, as before, confined within the apparatus. As a result of the sudden closing of the valve D, leading to the chimney, and the air and gas suction valves A^3 and G^3 a further quantity of air enters the air-pipe A^8 by the delivery-valve A^2, which is opened, and a new quantity of gas enters the gas-pipe G^8 by the delivery-valve G^2, and so on for each new explosion. The explosions will be the more frequent as the chimney-draft is more powerful and as the regulating-valves A^5 and G^5 are wider open. It will be readily understood that by properly controlling the air and gas supplies by way of the hand-wheels A^6 and G^6 it is easy to proportion the explosive mixture so as to secure as remunerative a yield as possible at a minimum expenditure of gas. By the time the collectors A^8 and G^8 contain a small quantity of air and gas under pressure the igniting device E will come into operation, as the gas and air (from the collectors) issuing from the igniter will ignite through contact with the hot charcoal or the like in the basket H. The igniter will be extinguished again after each explosion; but it will ignite again when the gas comes into contact with the perforated fire-resisting part of the igniter, which will be sufficiently hot to insure ignition. It is advisable to arrange back-pressure valves I and J at the bases of the pipes A^7 and G^7, leading to the igniter, to prevent the passage of combustion products into the collectors A^8 and G^8.

This apparatus will prove particularly serviceable in compressing air and gas to pressures exceeding the usual power of centrifugal fans or steam-jet injectors—say, in cases where it is desired to confine air and gas under a pressure varying between 0.10 centimeters and five or six meters of water. The yield in that case will be very considerable, as the products of combustion upon being suddenly raised to from six to ten atmospheres of pressure may expand to $1/10^e$ to one one-hundredth atmospheres, driving before them a very large volume of air and gas without the use of a mechanical device for the purpose.

To prevent the combustion-gases from reaching the collectors A^8 and G^8, it is only necessary to make the pipes A′ and G′, leading to the explosion-chamber, sufficiently long. It will further be advisable not to make the diameter of the said pipes and of the explosion-chamber B too large, so as to avoid any mixture of the products of combustion with the air or gas. Not only will the yield of this apparatus be considerable as regards the volume of compressed air and gas, respectively, but the heat of the products of combustion will also be utilized and recuperated by the air and gas when these have swept past twice (going and returning) through the said pipes A′ and G′, which are also swept twice by the products of combustion before they escape through the chimney. The said pipes therefore serve as recuperators of heat and heat the compressed air and gas to several hundred degrees, which will be very advantageous whenever it is necessary that the gas just stored up should be immediately consumed or that a hot-air blast should be provided for a gas-generator or a blast or other furnace. The said pipes A′ and G′ may contain bars or tubes or the like of fire-resisting material, laid one upon the other within the said pipes, so as not to interfere unduly with the air and gas in motion, or wrought or cast iron pipes or iron bars or rods adapted to store up the heat of the combustion-gases, with a view to immediately yielding it up again to the compressed air and gas may be used.

Fig. 2 shows an apparatus according to this invention arranged to compress air only to a pressure which may, for example, be sufficient to work blast-furnaces, cupolas, furnaces generally, gas-producers, or the like. The air portion is the same as in the arrangement hereinbefore described, but for the gas portion is substituted simply a gas-inlet opening into the twyer T and explosion-chamber direct. The gas-inlet valve may be so modified that the period when it opens may be regulated at will, so that the gas reaches the twyer T at the same time as the air supplied through the air-supply pipe A′, which being filled with combustion-gases after each explosion must discharge its contents before the air enters the twyer. To accomplish this object, I replace the gas-valve by a seatless valve consisting of a piston M, working in a cylinder N. This piston M is connected by a rod O to another smaller piston P, inclosed in a cylinder U, filled with water or oil or simply with air. A narrow side pipe V, fitted with a cock X, communicates between the bottom and top parts of such cylinder. A wider pipe fitted with a valve Q also communicates between the two ends of the said cylinder. For the gas-igniter there may be substituted an incandescent tube Y, and in either case any igniting device may be used in connection with apparatus. The operation of this arrangement is as follows: The igniter Y is brought to a white heat, for which purpose gas or petroleum vapors may be burned

in a burner Z, inclosed within the igniter. When the igniter Y is brought to a sufficiently-high temperature, the air-supply valve A^5 is opened, as is also the gas-supply valve G^5. As the air and gas inlet valves A^3 and M and the valve D to the chimney are open the latter draws air and gas into the explosion-chamber B, where they mix, an explosion taking place when the mixture comes in contact with the incandescent tube Y. The increase of pressure produced by the explosion has the effect of closing the air and gas inlet valves A^3 and M and the valve D to the chimney and of opening the delivery-valve leading to the collector. The length of the air-pipe A', leading from the explosion-chamber, should be sufficient to prevent the entrance of products of combustion into the pipe A^8. Immediately after the air has been expelled the products of combustion cool down and a partial vacuum forms in the interior of the apparatus. The compressed-air delivery-valve A^2 closes, while the air-supply valve A^3 opens, as does also the chimney-valve D, and as the products of combustion are expelled through the chimney a fresh supply of air is drawn into the apparatus. While the products of combustion escape through the chimney, the piston M, acting as a valve, slowly rises under the pressure of its spring, its speed being regulated by the area of aperture of the cock X on the smaller communicating pipe, which allows oil to pass from below the piston P to the space above it, the flow being slower according as the aperture is more restricted. Thus by opening the said cock X more or less the speed of the piston M can be so regulated that a fresh supply of gas will not be admitted until all the products of combustion have been expelled from the air-pipe A' and until air arrives at the twyer T. At this juncture a fresh explosive mixture forms in the explosion-chamber B and another explosion takes place as soon as the mixture comes into contact with the igniting-tube Y. It will thus be seen that the piston or valve M enables any unnecessary expenditure of gas to be avoided. It may be closed rapidly under the influence of the pressure produced by the explosion, because the valve Q in the larger communicating pipe from one side to the other of the piston P has a large sectional area and allows the fluid which is to be transferred from one side of the piston to the other to pass through rapidly; but the said piston-valve opens more slowly because of the limited sectional area of the smaller communicating pipe V, which may, moreover, be throttled at will by means of the cock X, as aforesaid.

By apparatus constructed as described large quantities of air can be compressed by means of very simple apparatus, inexpensive in construction and capable of being kept in repair at little cost, the yield or useful effect of which, however, is very considerable, seeing that the force of the explosion is efficiently utilized. Besides, the heat of the combustion-gases is lost only in part and serves to heat the compressed air.

With three or four apparatus of this description a sufficient blast may readily be provided for a blast-furnace, in doing which a material saving will be effected, considering that at the present time very costly blowing-machines are used in compressing air for blast-furnaces, such blowers being operated by means of steam-engines of great power, which involve much expense, necessitating, as they do, an extensive system of steam-generators.

Not only can these machines now be replaced by apparatus whereof the cost of erection is extremely small, but the said apparatus can be fed from the blast-furnace direct with a very small quantity of gas and will then supply a blast heated beforehand to from 300° to 400° centigrade, a circumstance which will enable the dimensions of Cowper and other similar apparatus employed in heating the blast to be substantially reduced, or these appliances may be dispensed with altogether.

Having now particularly described and ascertained the nature of my invention, and in what manner the same is to be performed, I declare that what I claim is—

1. In an apparatus for compressing aeriform fluids, the combination of an explosion-chamber having a chimney provided with a valve, an igniter in the upper portion of said chamber, a twyer located in the lower portion of the explosion-chamber and provided with lateral openings, a valved gas-pipe communicating with said twyer, the air-pipe A' communicating with the explosion-chamber through the lateral openings of the twyer, the air-regulating valve A^5 and suction-valve A^3, the air-collector A^8 and the delivery-valve A^2 intermediate said collector and air-pipe, substantially as described.

2. In an apparatus for compressing aeriform fluids, the combination of an explosion-chamber having a chimney provided with a valve, an igniter in the upper portion of said chamber, a twyer located in the lower portion of the explosion-chamber, the air-pipe A' having valves A^2 A^3 and A^5 the air-collector A^8, the gas-pipe G' having valves G^2, G^3 and G^5, and the gas-collector G^8, the said air and gas pipes being in communication with the explosion-chamber through the twyer, substantially as described.

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

EMILE GOBBE.

Witnesses:
HENRY SCHWAB,
EMILE KLOTZ.