No. 723,888. PATENTED MAR. 31, 1903.

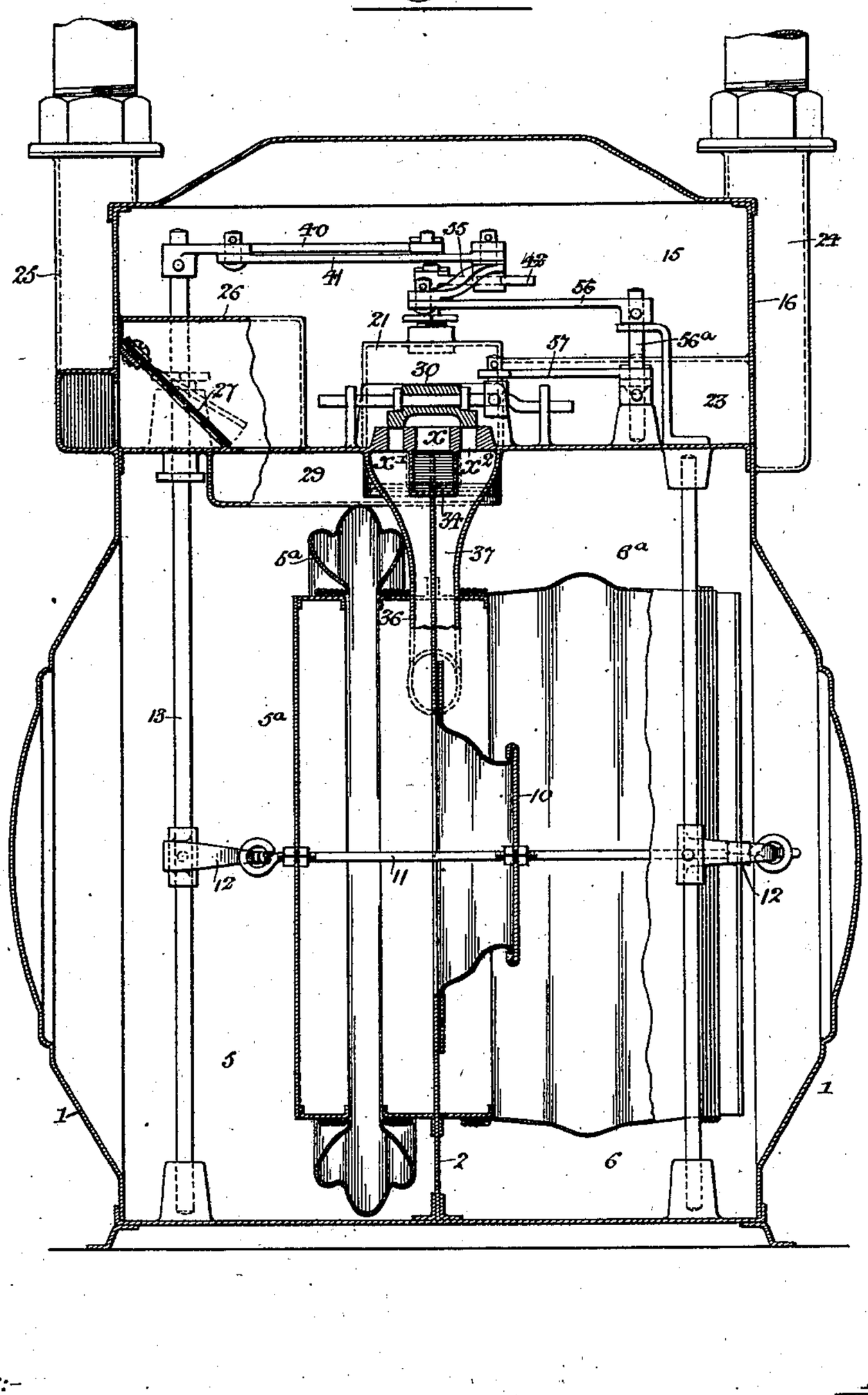
G. A. LOEBEN.

APPARATUS FOR MIXING FLUIDS.

APPLICATION FILED JUNE 9, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 3 SHEETS—SHEET 2.

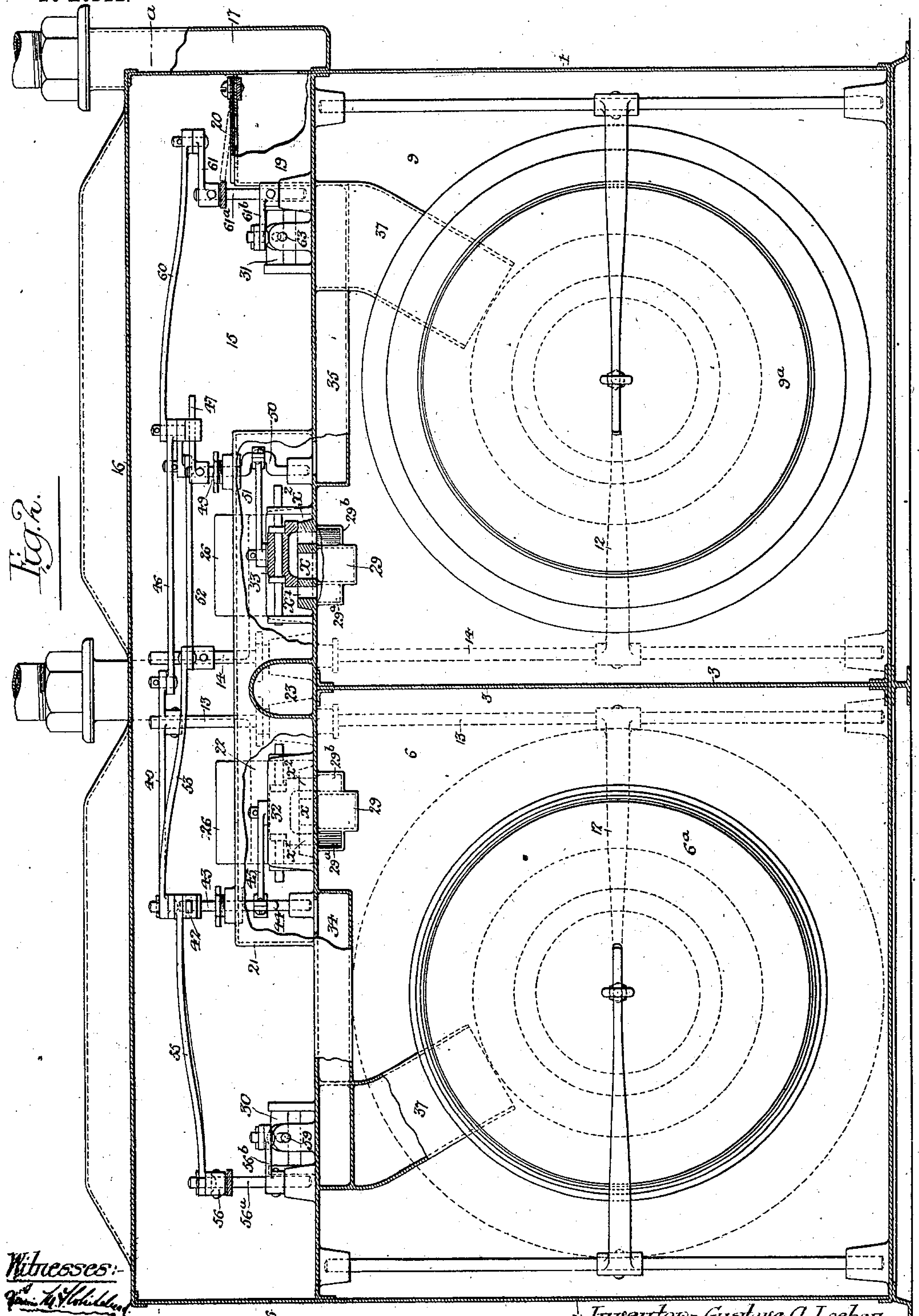

Fig. 2.

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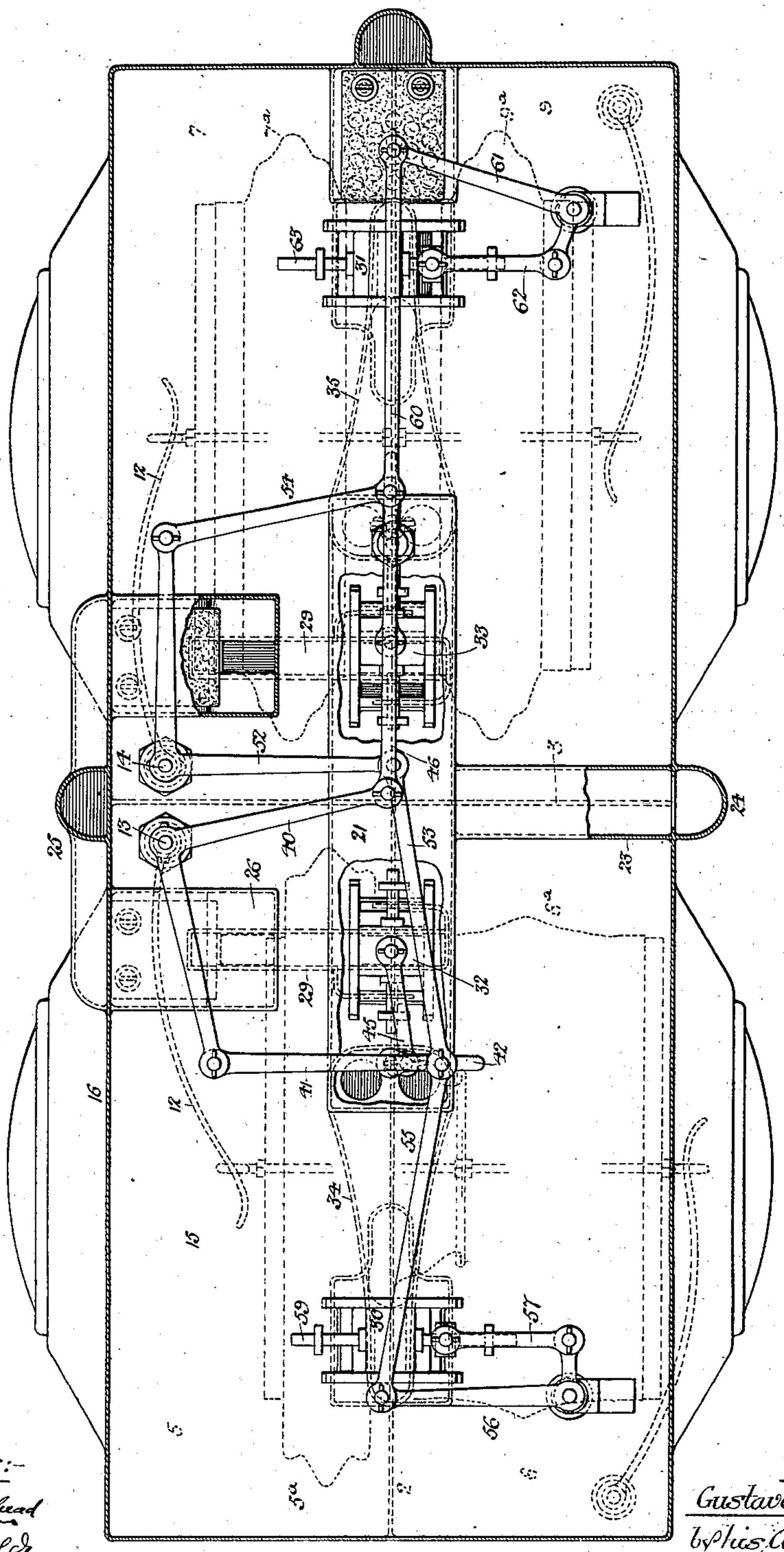
NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

GUSTAVE A. LOEBEN, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR MIXING FLUIDS.

SPECIFICATION forming part of Letters Patent No. 723,888, dated March 31, 1903.

Application filed June 9, 1902. Serial No. 110,822. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE A. LOEBEN, a subject of the Emperor of Germany, residing in Philadelphia, Pennsylvania, have invented Improvements in Apparatus for Mixing Fluids, of which the following is a specification.

My invention consists of an apparatus constructed and operating somewhat after the manner of an ordinary gas-meter, but serving to mix together two different fluids under pressure—such, for instance, as air and gas—the operation of the apparatus being automatic and the pressure of the mixture being the average of the two initial pressures when the latter are different.

In the accompanying drawings, Figure 1 is a transverse section of a fluid-mixing apparatus constructed in accordance with my invention, the section being on a line through the valve 30, Fig. 3, and looking toward the right. Fig. 2 is a longitudinal section of the same on a line below the central line of Fig. 1 looking toward the top of said figure with parts broken away to show the valve 33; and Fig. 3 is a sectional plan view on the line *a a*, Fig. 2.

In operating gas-engines or certain forms of gas-burners, such as those of the Welsbach type, it is of advantage to provide a mixture of air and gas under pressure and containing a certain volume of each, and my apparatus has been designed with the view of providing such mixture, although it is capable of use for mixing any fluids.

Each of the fluids may in the first instance be under like pressure, or the pressure of one of them may be greater than that of the other, or but one of them may be under pressure, the pressure of the mixture being dependent upon such initial pressure of the fluids.

For the purposes of description I will assume that the fluids to be mixed are air and gas and that the air is under heavier pressure than the gas.

The apparatus consists of a casing 1, the interior of which is divided by a central longitudinal partition 2 and a central transverse partition 3 into four chambers, which I have numbered, respectively, 5, 6, 7, and 9, (indicated by the dotted numerals in Fig. 3.) Each of these chambers contains a bellows similar to that of an ordinary dry gas-meter, the respective bellows being indicated at 5^a, 6^a, 7^a, and 9^a, the bellows 5^a and 6^a and the bellows 7^a and 9^a being connected in pairs, so that their diaphragms have corresponding movement. In order to avoid the necessity of employing stuffing-boxes in the central partition, the latter is provided with diaphragms 10 of small area, each of said diaphragms 10 being connected by a rod 11 to the diaphragm of each bellows of its pair, so that it is free to move with said diaphragms first to one side and then to the opposite side of said central partition. The diaphragm of each bellows is connected by an arm 12 to a shaft (technically termed a "flagstaff") located in each bellows-chamber, two of these shafts being shown, respectively, at 13 and 14, projecting from its respective bellows-chamber through a suitable stuffing-box into a valve-chamber 15, contained within a casing 16 on top of the bellows-chamber casing 1. To this valve-chamber the air under pressure has free access from the air-supply branch 17 through a box 19, provided with a valve 20, opening inwardly, so that any backflow from the valve-chamber 15 into the branch 17 is prevented. Within the valve-chamber 15 is a casing 21, containing a mixing-chamber 22, which is in communication through a conduit 23 with the gas and air discharge branch 24. The gas-inlet branch 25 is forked, so as to communicate with two boxes 26, contained in the chamber 15 and each having a partition with valve 27, whereby free flow is permitted from the branch 25 into the box 26, but any backflow through the same is prevented. Each box 26 communicates with a conduit 29, one on one side of the central transverse partition 3 and the other on the opposite side of the same, as shown in Fig. 2.

The air-chamber 15 contains two reciprocating valves 30 and 31, similar to those of an ordinary gas-meter, one of these valves serving to control the flow of air into and from the bellows 5^a and 6^a and the other serving to control the flow of air into and from the bellows 7^a and 9^a, and in like manner the mixing-chamber 22 contains two valves 32 and 33, the valve 32 controlling the flow of gas into and from the bellows-chambers 5 and 6 and

the valve 33 controlling the flow of gas into and from the bellows-chambers 7 and 9. Each valve-seat has a central port x and two side ports x' x^2, as shown in Figs. 1 and 2. The central port x of the seat for the valve 30 is in communication through a conduit 34 with the mixing-chamber 22, and the central port of the seat for the valve 31 is likewise in communication with the mixing-chamber through a conduit 35. The port x' of the seat for the valve 30 is in communication through a conduit 36 with the interior of the bellows 5^a, and the port x^2 of said valve-seat is in communication through a conduit 37 with the interior of the bellows 6^a, and in like manner the ports x' and x^2 in the seat of the valve 31 communicate through similar conduits, respectively, with the bellows 7^a and 9^a. The central ports x in the seats 32 and 33 communicate, respectively, with the gas-inlet branches 29, the port x' in the seat of the valve 32 communicating through a passage 29^a with the bellows-chamber 6 and its port x^2 communicating through a passage 29^b with the bellows-chamber 5, while the port x' in the seat of the valve 33 communicates through a passage 29^a with the bellows-chamber 7 and the port x^2 in said seat communicates through a passage 29^b with the bellows-chamber 9.

When the valve 30 is in such position that it opens communication between ports x x^2 of its seat, communication will likewise be opened between the port x' and the chamber 15. Hence air under pressure will be directed into the bellows 5^a, so as to expand the same, while at the same time air is being forced from the bellows 6^a into the mixing-chamber 22, and when the position of the valve is reversed air under pressure will be admitted to the bellows 6^a to expand the same, and the air will be forced from the bellows 5^a into the mixing-chamber 22. In like manner the valve 31 alternately opens each of the bellows 7^a and 9^a to the chamber 15 and to the mixing-chamber. When the valve 32 establishes communication between the central port x in its seat and the port x', gas will be admitted to the bellows-chamber 6, while at the same time gas will be permitted to escape from the bellows-chamber 5 into the mixing-chamber, and when the position of the valve is reversed the bellows-chamber 5 will be open for the admission of gas and the bellows-chamber 6 will be in communication with the mixing-chamber, and in like manner the valve 33 operates to connect the bellows-chambers 7 and 9 alternately with the gas-supply and with the mixing-chamber.

The pressure of the mixture of air and gas will be the average of the initial pressures. Thus if the initial pressure of the air is twelve pounds per square inch and the pressure of the gas is four pounds per square inch the pressure of the mixture will be eight pounds per square inch, or thereabout, depending to some extent upon the freedom of movement of the parts of the apparatus. When this average pressure is attained in the mixing-chamber, the bellows will be in equilibrium, and there will be no movement of the same until there is such draft upon the mixture as to slightly lower the pressure in said mixing-chamber, whereupon the bellows will operate to supply more air and gas thereto in order to again restore the pressure. For instance, supposing that the bellows 5^a has just been opened to the air-pressure, the bellows 6^a to the mixing-chamber, the bellows-chamber 6 to the gas-pressure, and the bellows-chamber 5 to the mixing-chamber there will then be a pressure of twelve pounds in the bellows 5^a and a counter pressure of eight pounds in the bellows 6^a, giving a preponderance of four pounds in the bellows 5^a, and this will be increased to eight pounds by the assisting pressure of the gas in the chamber 6 and will be resisted by the gas-pressure of eight pounds in the chamber 5. Hence there will be no movement of the bellows until there is a slight reduction of pressure in the mixing-chamber. The same rule applies when both volumes of fluid are under the same pressure, the pressure of the mixture in that case being equal to the initial pressure.

When the fluids are under different initial pressures, the apparatus acts not only as a mixer, but also as a pump to increase the pressure of the fluid having the lower initial pressure.

The automatic reciprocation of the valve is effected from the shafts 13 and 14 in the following manner: The shaft 13 carries a bell-crank lever 40, one arm of which is connected by a link 41 to a crank-arm 42 at the upper end of a shaft 43, which passes through a suitable stuffing-box in the top of the mixing-chamber casing 21 and has within said chamber a crank 44, which is connected by means of a link 45 to the valve 32. The other arm of the bell-crank lever 40 is connected by a link 46 to a crank-arm 47 on a shaft 49, which passes through a stuffing-box at the opposite end of the mixing-chamber casing 21 and has a crank 50, connected by a link 51 to the valve 33. The shaft 14 has a bell-crank lever 52, one arm of which is connected by a link 53 to the crank-arm 42, the other arm of said lever being connected by a link 54 to the crank-arm 47. By means of this double connection the intermittent expansion and contraction of the bellows 5^a and 7^a causes continuous rotation to be imparted to the crank-shafts 43 and 49, so as to effect the proper operation of the valves 32 and 33. Rotation of the crank-shafts also effects reciprocation of the valves 30 and 31 in the following manner: The crank-arm 42 is connected by a link 55 to an arm 56 on a shaft 56^a, mounted in a suitable bearing in the chamber 15, this shaft having another arm 56^b, which is connected by a link 57 to a stud on the guided rod 59, which carries the valve 30, and in like manner the crank-arm 47 is connected by a link

60 to an arm 61 on a shaft 61^a, which has an arm 61^b, connected by a link 62 to a stud on the guide-rod 63, which carries the valve 31.

While the present invention has been designed especially for mixing fluids each of which is under pressure, some of its features may also be used to advantage in apparatus in which only one of the fluids is under pressure. Thus if the supply of air only is under pressure gas will be drawn into each bellows-chamber while the bellows therein is being collapsed and will be forced from said bellows-chamber while the bellows therein is being expanded, and if the gas only is under pressure air will be drawn into each bellows while it is being expanded and forced from each bellows while it is being collapsed.

Although I have shown the apparatus in duplex form—that is to say, with two pairs of bellows and two pairs of double-acting valves—a single form of the apparatus may in some cases be employed. In this case the bellows 5^a and 7^a could be used, the valves could be single acting, and springs or weights could be employed to press upon the bellows with a force equal to the difference between the initial pressure of the low-pressure fluid and the pressure of the mixture in order to insure the collapse of said bellows, or the reverse if low pressure was exerted on the inside of the bellows.

It will be observed that the initial pressure of the air in the chamber 15 serves to hold the valves 30 and 31 down upon their seats, this pressure being greater than the pressure in the mixing-chamber and which is exerted beneath the valves, and in like manner the pressure in the mixing-chamber serves to hold the valves 32 and 33 down upon their seats, this pressure being greater than the initial pressure of gas in the conduits 29, which is exerted beneath said valves.

My present invention is distinguished from that forming the subject of my prior patent, No. 701,590, dated June 3, 1902, in that the valves which govern the flow of both supplies of fluid are operated positively by connection with the expanding and contracting bellows, whereas in the former machine only the valves which controlled the flow of gas were so actuated.

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

1. The combination, in apparatus for mixing fluids, of a casing containing a bellows-chamber with bellows therein, two independent sources of fluid-supply, a mixing-chamber, valves controlling the flow of one fluid into the bellows-chamber and from the latter into the mixing-chamber, and the flow of the other fluid into the bellows and from the latter into the mixing-chamber, and valve-operating mechanism interposed between said valves and the bellows, whereby the expansion and contraction of the bellows is caused to effect movement of the valves, substantially as specified.

2. The combination, in apparatus for mixing fluids, of a casing containing separated chambers each with bellows therein, two independent sources of fluid-supply, a mixing-chamber, a valve governing communication between one fluid-supply and the bellows-chambers and between said bellows-chambers and the mixing-chamber, another valve governing communication between the other fluid-supply and the interiors of the bellows and between said bellows and the mixing-chamber, and mechanism interposed between said valves and the bellows, whereby the expansion and contraction of the bellows is caused to effect movement of said valves, substantially as specified.

3. The combination, in apparatus for mixing fluids, of a casing containing two pairs of bellows-chambers, and two pairs of bellows, one in each chamber, two independent sources of fluid-supply, a mixing-chamber, a duplex valve structure governing the flow of one fluid into the bellows-chambers and from the latter into the mixing-chamber, another duplex valve structure governing the flow of the other fluid into the bellows and from the latter into the mixing-chamber, and mechanism interposed between said duplex valve structures and the bellows whereby said valves are operated by the expansion and contraction of the bellows, substantially as specified.

4. The combination, in apparatus for mixing fluids, of a casing containing separated chambers with bellows in each chamber, two independent sources of fluid-supply, a mixing-chamber, valves located one in the mixing-chamber and the other in one of the fluid-supply chambers, one valve controlling the flow of one fluid into the bellows-chambers and from the latter into the mixing-chamber and the other valve controlling the flow of the other fluid into the bellows and from the latter into the mixing-chamber, and mechanism interposed between said valves and the bellows, whereby said valves are operated by the expansion and contraction of the bellows, substantially as specified.

5. The combination, in apparatus for mixing fluids, of a casing having two pairs of bellows-chambers with a bellows in each chamber, a mixing-chamber, duplex valve structures located one in the mixing-chamber and the other in one of the fluid-supply chambers, one valve structure governing the flow of one fluid into the bellows-chambers and from the latter into the mixing-chamber, and the other valve structure governing the flow of the other fluid into the bellows and from the latter into the mixing-chamber, and mechanism interposed between said duplex valve structures and the bellows whereby said duplex valve structures are operated by the expansion and contraction of the bellows, substantially as specified.

6. The combination, in apparatus for mixing fluids, of a casing having a bellows-chamber with bellows therein, independent sources of supply for each fluid, a mixing-chamber, valve mechanism governing the flow of one fluid into the bellows-chamber and from the latter into the mixing-chamber and the flow of the other fluid into the bellows and from the latter into the mixing-chamber, and a valve independent of said governing-valves for preventing backflow of fluid into the supply-pipe, substantially as specified.

7. The combination, in apparatus for mixing fluids, of a casing having a bellows-chamber with bellows therein, independent sources of supply for each fluid, a mixing-chamber, valve mechanism governing the flow of one fluid into the bellows-chamber and from the latter into the mixing-chamber and the flow of the other fluid into the bellows and from the latter into the mixing-chamber and valves independent of said governing-valves for preventing backflow of each fluid into its supply-pipe, substantially as specified.

8. The combination, in apparatus for mixing air and gas, of a casing having a closed chamber containing a bellows, a gas-supply, means for supplying air under pressure, a mixing-chamber, valves for governing the flow of air and gas into the bellows and bellows-chamber, and from the latter into the mixing-chamber, and means whereby the operation of the air-controlling valve or valves is effected by the movement of the bellows, substantially as specified.

9. The combination, in apparatus for mixing air and gas, of a casing having a plurality of closed chambers each with bellows therein, a gas-supply, means for supplying air under pressure, a mixing-chamber, valves for governing the flow of air and gas into the several bellows and bellows-chambers, and from the same into the mixing-chamber, and means whereby the operation of the air-controlling valve or valves is effected by the movement of the bellows, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GUSTAVE A. LOEBEN.

Witnesses:
F. E. BECHTOLD,
JOS. H. KLEIN.