No. 701,590. Patented June 3, 1902.

G. A. LOEBEN.

GAS AND AIR MIXER.

(Application filed May 15, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

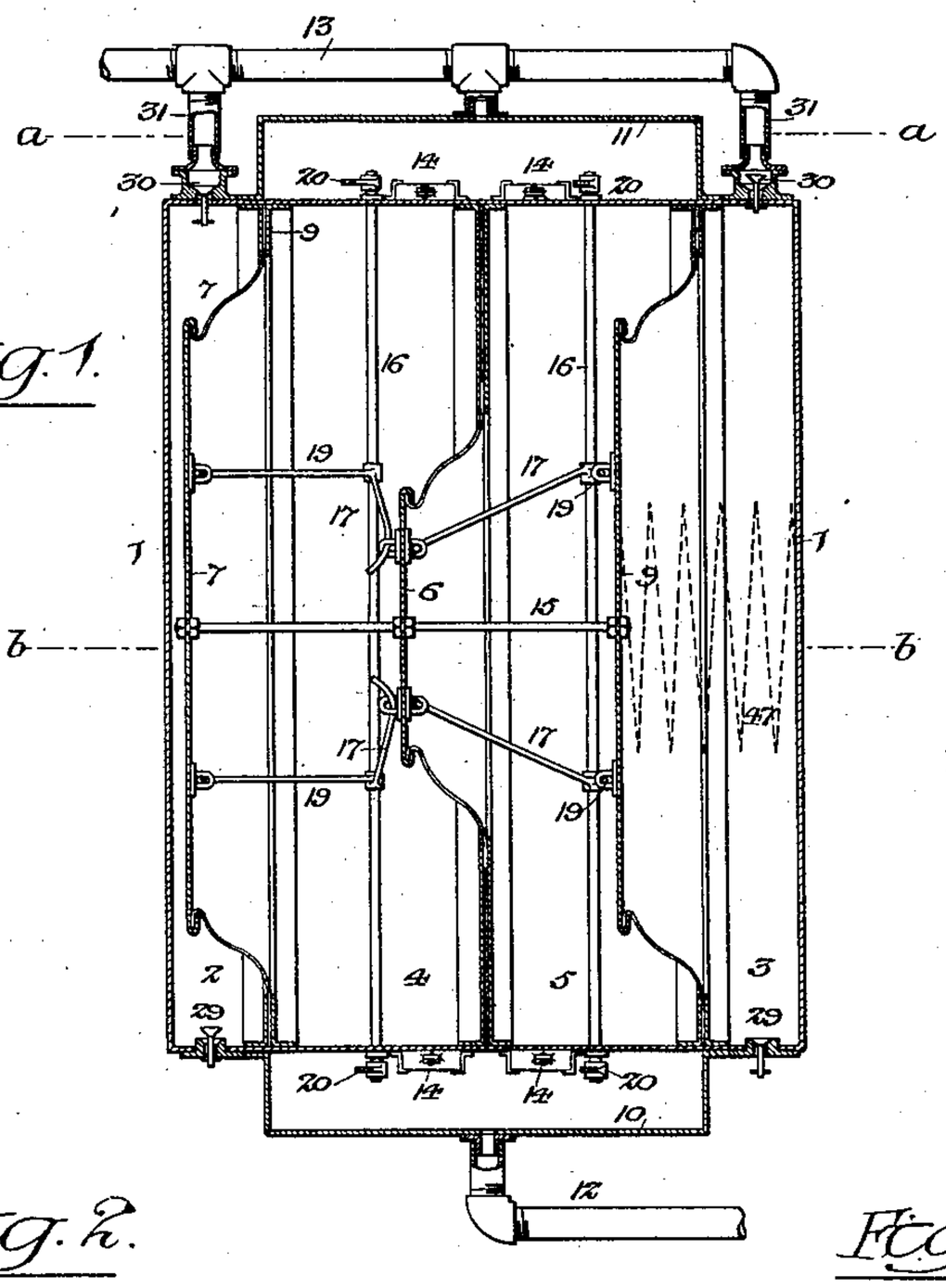


Fig. 2.

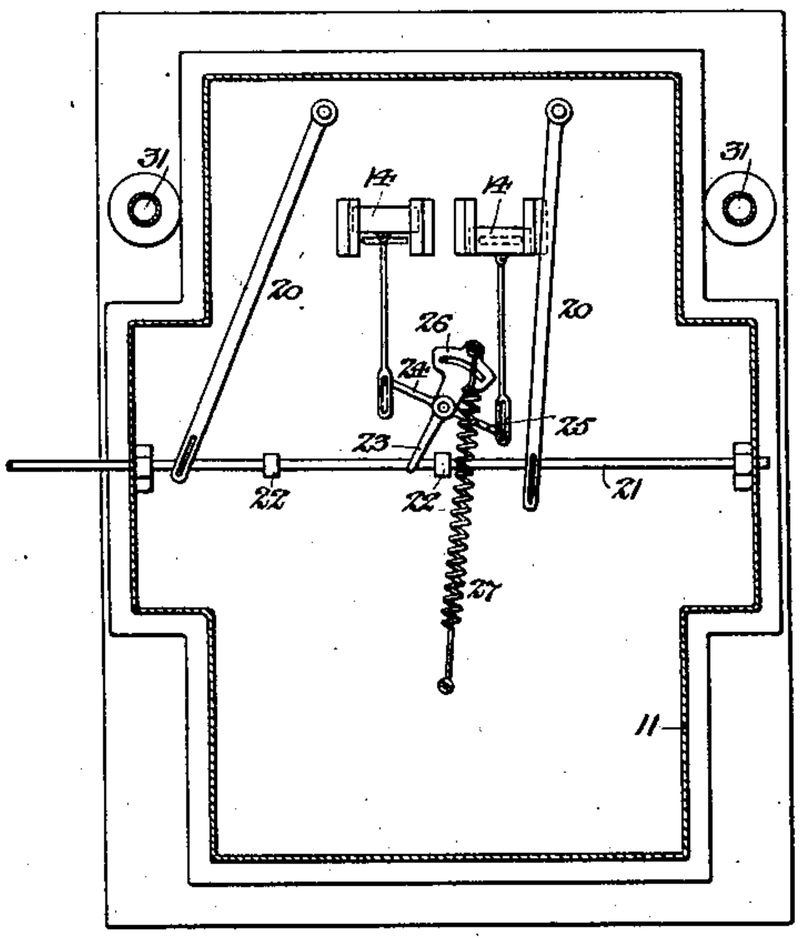
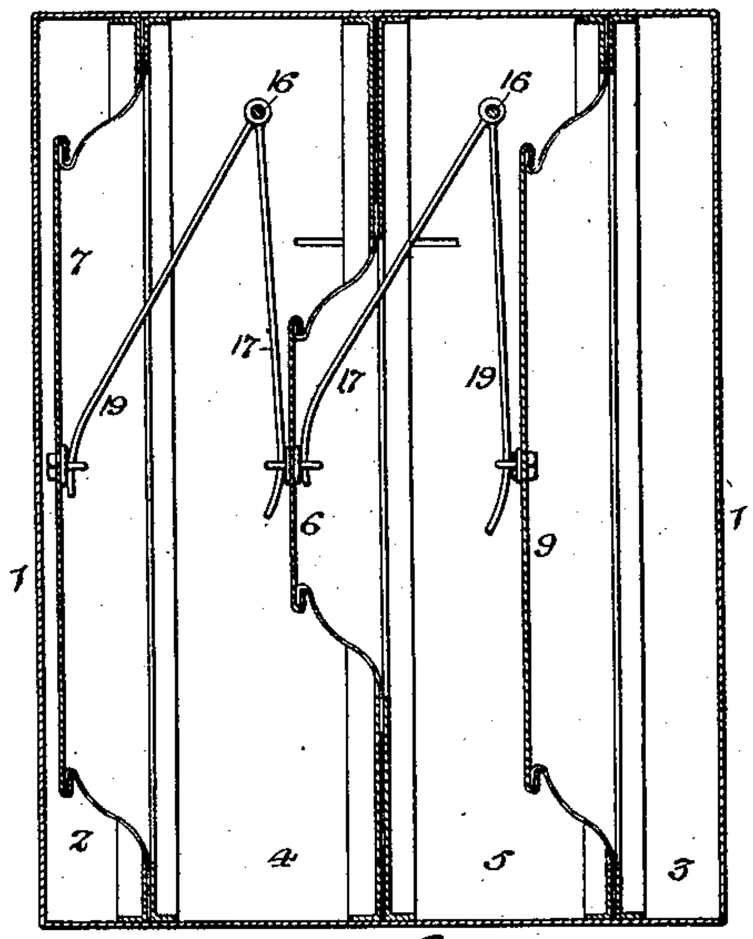


Fig. 3.



Witnesses
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Fig. 4.

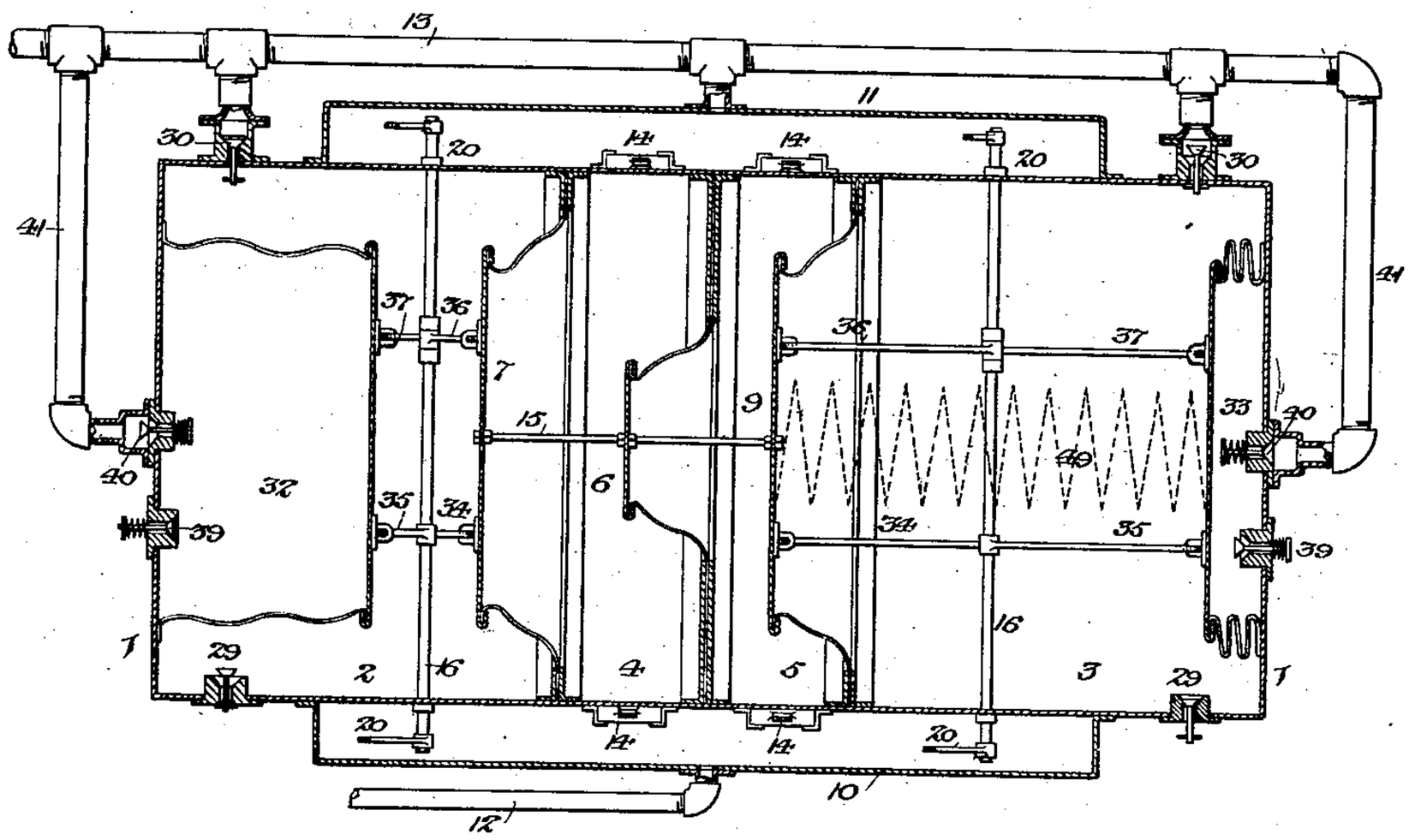

Fig. 5.

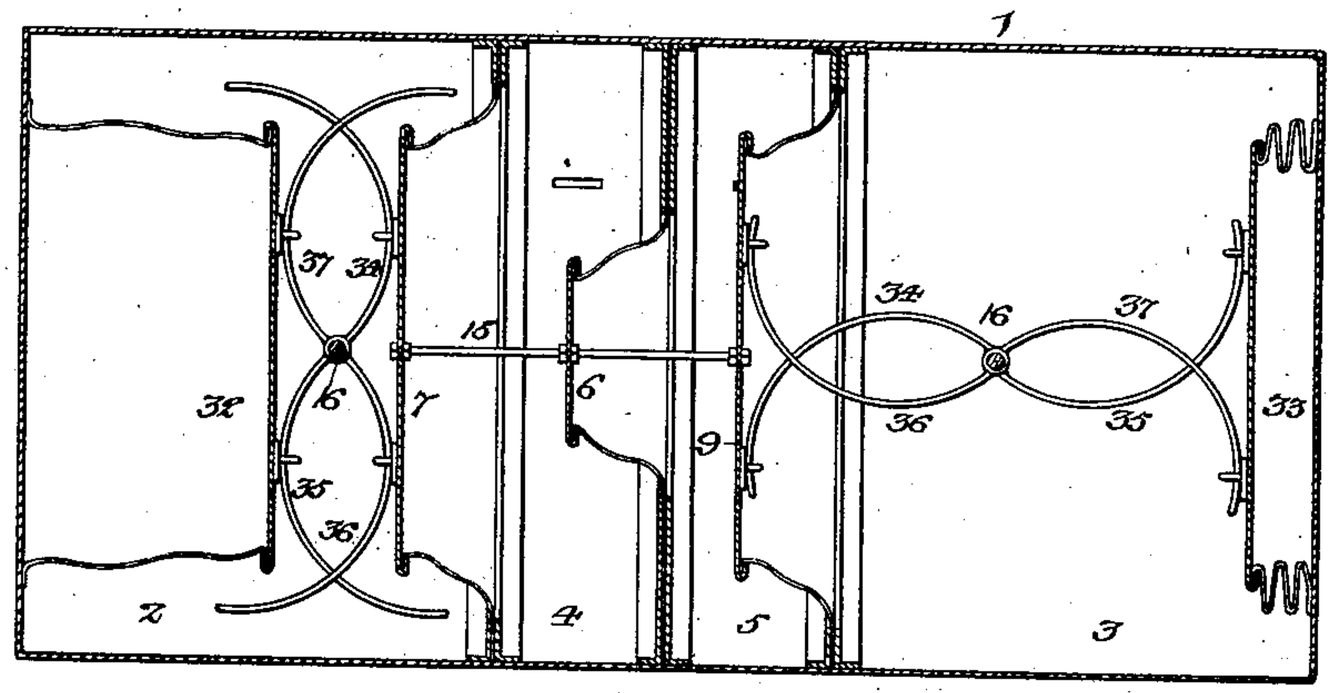

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Fig. 6.

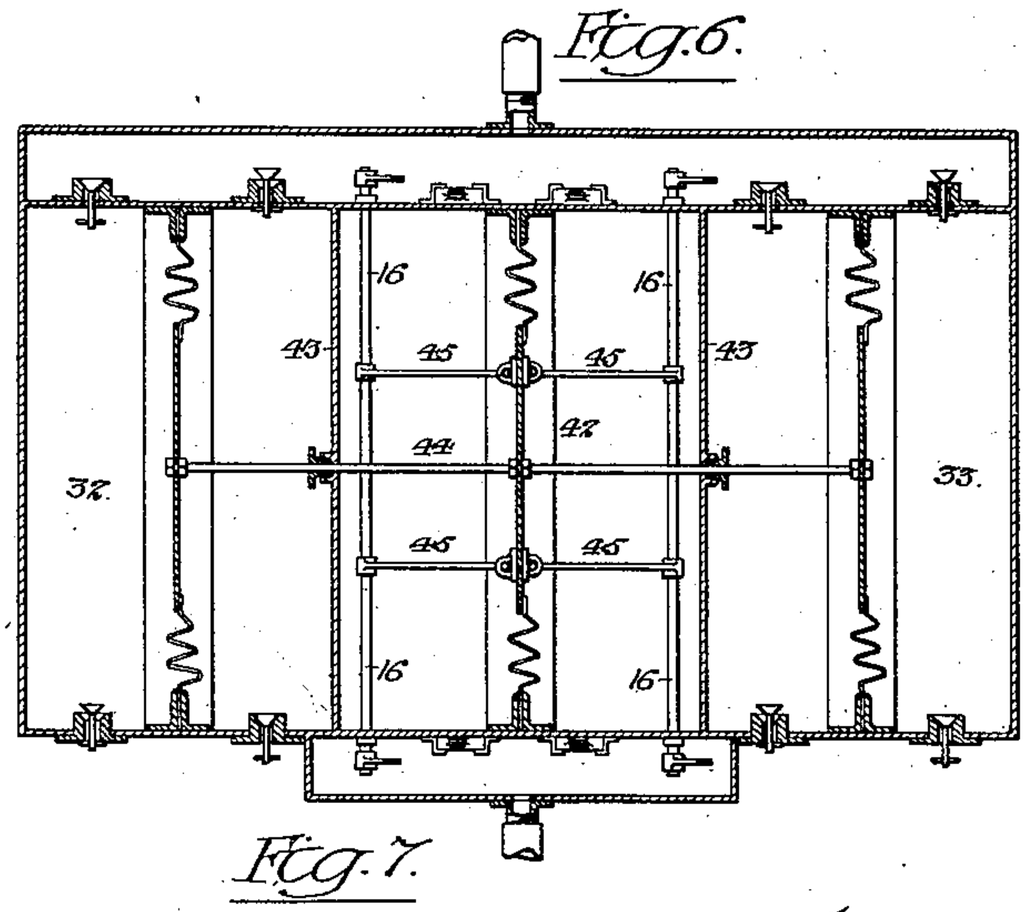
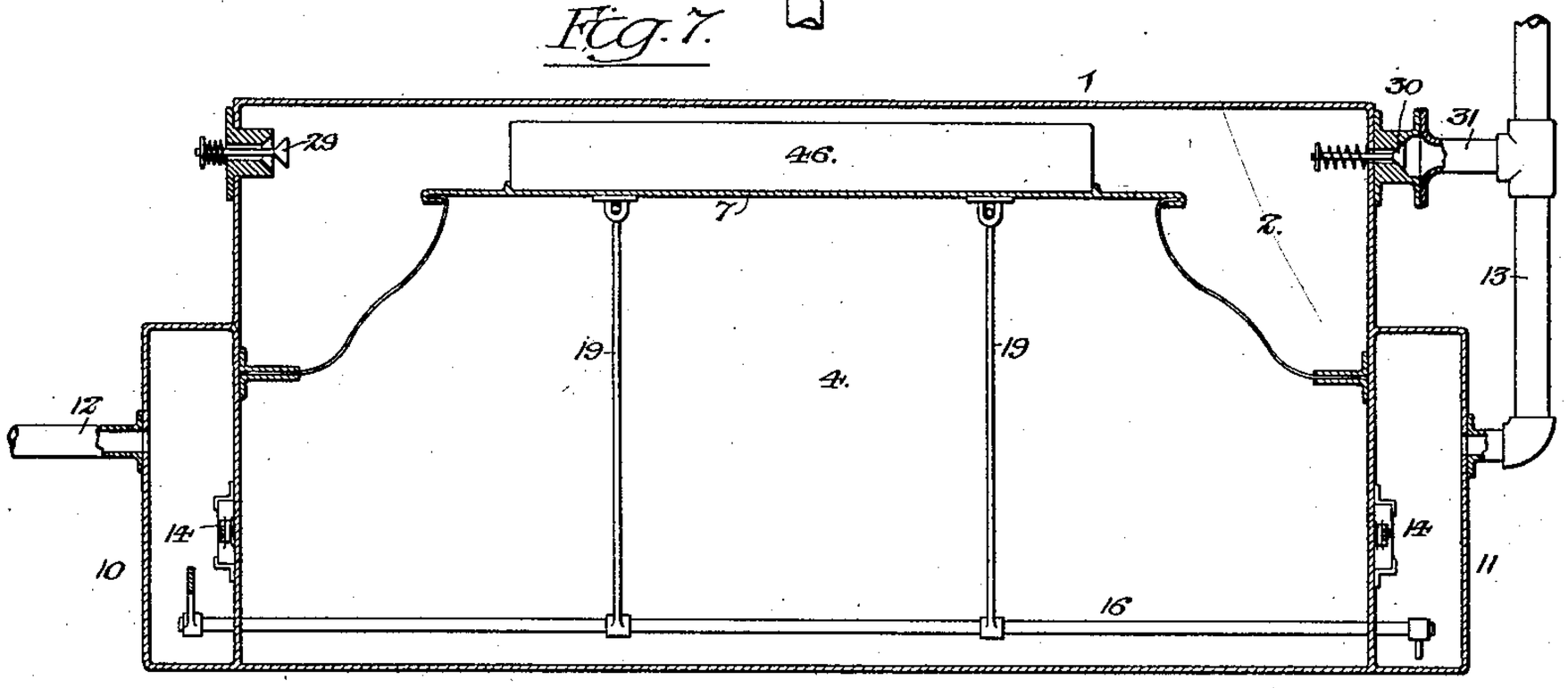


Fig. 7.



Witnesses
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Gustave A. Loeben
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UNITED STATES PATENT OFFICE.

GUSTAVE A. LOEBEN, OF PHILADELPHIA, PENNSYLVANIA.

GAS AND AIR MIXER.

SPECIFICATION forming part of Letters Patent No. 701,590, dated June 3, 1902.

Application filed May 15, 1901. Serial No. 60,380. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE A. LOEBEN, a subject of the Emperor of Germany, and a resident of Philadelphia, Pennsylvania, have invented certain Improvements in Gas and Air Mixing Apparatus, of which the following is a specification.

The object of my invention is to provide means whereby a flow of gas under pressure is caused to compress air for admixture therewith, the apparatus providing for the admixture of air and gas in any desired relative volumes for use in connection with gas-burners, gas-engines, or for other uses where mixtures of air and gas are required.

In the accompanying drawings, Figure 1 is a longitudinal section of an air and gas mixing apparatus constructed in accordance with my invention. Fig. 2 is a sectional plan view of the same on the line *a a*, Fig. 1. Fig. 3 is a sectional plan view on the line *b b*, Fig. 1. Fig. 4 is a longitudinal section of a gas and air mixing apparatus embodying my invention and intended for supplying a larger volume of air than gas. Fig. 5 is a sectional plan view on the line *c c*, Fig. 4. Fig. 6 is a longitudinal section of another form of the same class of apparatus, and Fig. 7 is a longitudinal section of a single-acting apparatus embodying my invention.

In Figs. 1, 2, and 3 of the drawings, 1 represents the outer casing of the apparatus, which is divided into air-chambers 2 and 3 and gas-chambers 4 and 5 by means of three flexible diaphragms 6, 7, and 9, each of these diaphragms consisting of a central rigid disk connected by means of a flexible bellows structure to a flange on the inside of the casing 1, the flange which carries the central diaphragm 6 being much deeper than that which carries the two outer diaphragms 7 and 9, whereby the central diaphragm is of considerably less area than said outer diaphragms.

At one side or at the bottom of the casing 1 is a casing 10, containing a gas-inlet chamber, and at the other side or top of the casing 1 is a casing 11, containing a gas-outlet chamber, the gas-inlet chamber communicating with a gas-supply pipe 12, and the gas-outlet chamber communicating with a discharge or delivery pipe 13.

Communication between the gas inlet and outlet chambers and the chambers 4 and 5 of the main casing is controlled by valves 14, operated in the manner described hereinafter by the vibrating diaphragms of the apparatus, said diaphragms being connected by a central rod 15, so as to move in unison, which construction is permitted because of the use of the central diaphragm 6.

Each of the chambers 4 and 5 contains a rock-shaft 16, the rock-shaft of the chamber 4 having arms 17 and 19, engaging, respectively, with the diaphragms 6 and 7, while the rock-shaft 16 of the chamber 5 has like arms 17 and 19, engaging, respectfully, with the diaphragms 6 and 9, so that as said diaphragms move to and fro within the casing 1 vibrating movement will be imparted to said rock-shafts 16.

Each rock-shaft has in the gas-delivery chamber an arm 20, slotted for engagement with a projecting pin on a slide-rod 21, mounted in suitable bearings on the casing 11, and this rod has collars 22, adapted to engage with one arm 23 of a four-armed lever mounted in the delivery-chamber, other arms 24 and 25 of said lever engaging with the slotted stems of the valves 14 and the fourth arm 26 being acted upon by a coiled spring 27 and being slotted for engagement with a stop-pin, which determines the limit of its movement in either direction. A similar arrangement is employed for operating the valves 14 in the gas-receiving chamber, and the valves are so disposed and so operated that one valve in each chamber is open when the other is closed, the valve in the delivery-chamber being open when its corresponding valve in the receiving-chamber is closed, and vice versa.

One valve in each chamber governs communication with the chamber 4 of the casing 1 and the other with the chamber 5 of said casing. Hence gas will be admitted to one chamber while it is being discharged from the other, the gas entering the chambers alternately. Thus supposing the flexible diaphragms to be in the position shown in Fig. 1, the gas-inlet of the chamber 5 being open and the outlet closed and the gas-inlet of the chamber 4 being closed and the outlet open, free access of gas in the chamber 4 to the delivery-pipe 13 is permitted and gas under pressure has free access to the chamber 5. Hence

owing to the difference in area between the diaphragm 9 and the central diaphragm 6 the series of diaphragms will as soon as the pressure in the pipe 13 falls sufficiently below that in the pipe 12 be moved in the direction of the arrow, Fig. 1, the chamber 5 gradually expanding in capacity and filling with gas, while the chamber 4 is gradually diminishing in capacity, the gas being driven therefrom into the outlet-pipe 13.

The air-chambers 2 and 3 of the apparatus are each provided with an automatic inlet check-valve 29 and an outlet check-valve 30, the outlet-valve chests communicating through branches 31 with the gas-delivery pipe 13. When, therefore, the flexible diaphragms in the casing 1 move in the direction of the arrow, air will be expelled from the chamber 3 through the outlet check-valve 30 of said chamber and through the branch 31 into the gas-delivery pipe 13, in which pipe said air will be mixed with gas, and at the same time air will be drawn into the chamber 2 of the apparatus, the pressure of the delivered air being the same as that of the gas delivered from the chamber 4, since it is due to the same compressing force—namely, the pressure exerted upon the left-hand side of the diaphragm 9 in excess of that exerted upon the right-hand side of the same and of the diaphragm 7.

When the position of the valves is changed, a reverse movement of the diaphragms takes place, gas entering the chamber 4 and being expelled from the chamber 5 and air being expelled from the chamber 2 and drawn into the chamber 3. In order that quick movement of the valves may be effected, so that the inlet and outlet valve of either chamber 4 or 5 will never be open at the same time, the collars 22 upon the slide-rod 21 are so disposed that the lever-arm 23 will only be acted upon thereby when the diaphragms are approaching the limit of their movement in either direction, the movement thereby imparted to the lever being sufficient to shift it from one extreme position to a position just beyond the center in the other direction, whereupon the lever comes under the influence of the spring 27 and is quickly moved to its extreme limit in that direction.

The slotting of the stems of the valves 14 for engagement with the arms 24 and 25 of the lever prevents any movement of either of said valves while the lever is being moved by the action of the collars 22 thereupon, only the quick movement of the lever due to the action of the spring 27 being imparted to the valves.

That embodiment of my invention shown in Figs. 4 and 5 is intended to provide a much larger volume of air than gas, and in said apparatus the air-chamber 2 of the casing contains a bellows 32 and the chamber 3 contains a like bellows 33, one of the rock-shafts 16 being located between the bellows 32 and diaphragm 7 and the other between the bellows 33 and the diaphragm 9, said rock-shafts occupying a central position in the casing and each shaft having curved arms 34 and 35 secured thereto and projecting in opposite directions therefrom, one of said arms engaging with the bellows 32 or 33 and the other with the diaphragm 7 or 9. Arms 36 and 37 likewise project in opposite directions from each rock-shaft; but these arms are loosely mounted on the shafts, being intended simply to aid in the guidance and support of the bellows-heads and movable diaphragms. Owing to this connection of bellows-head and diaphragm, they move from and toward each other and are simultaneously expanded and contracted. Each bellows is provided with an inlet-valve 39 and an outlet-valve 40, the outlet-valve chests communicating through branches 41 with the gas-outlet pipe. Hence when the disks of the bellows 32 and diaphragm 7 move toward each other and the disks of the bellows 33 and diaphragm 9 move away from each other air will be expelled from the chamber 2 and bellows 33 and drawn into the chamber 3 and bellows 32, and when the movement is in the opposite direction the air will be expelled from the chamber 3 and bellows 32 and drawn into the chamber 2 and bellows 33. Hence the volume of air supplied will be considerably in excess of the volume of gas, and this may be varied as desired by a proper proportioning of the parts.

In the apparatus shown in Fig. 6 the two gas-chambers 4 and 5 are separated by a flexible diaphragm 42, and each gas-chamber is separated from the adjoining air-chamber by a solid partition 43, these partitions having stuffing-boxes for a rod 44, which is connected to the diaphragm 42 and to the diaphragms of the bellows 32 and 33. A rock-shaft 16 in each gas-chamber has arms 45 connected to the diaphragm 42, and these rock-shafts operate the valves 14 in the gas inlet and outlet chambers in the manner before described.

Fig. 7 shows a single-acting apparatus having but a single gas-chamber 4 and a single air-chamber 2, separated by a single diaphragm 7, which is raised by the pressure of gas in the chamber 4 and depressed by a weight 46, the rock-shaft 16 being connected to the diaphragm by arms 19 and serving to operate valves 14 in the gas inlet and delivery chambers in the usual manner.

While I prefer in all cases to employ movable diaphragms as a means of separating the various chambers of the apparatus one from another, it will be evident that pistons movable in cylinders between the chambers may be employed, if desired, especially where the gas-pressure is comparatively heavy. Hence the term "movable diaphragm" as used in the claims is intended to cover a movable piston or like modification on the diaphragm as well.

In apparatus of the character shown in Figs. 1 and 4 springs—such, for instance, as shown by dotted lines at 47 in Fig. 1 and at 49 in Fig. 4—may be employed to act upon the dia-

phragms interposed between the gas and air chambers in opposition to the pressure of the gas, and when such springs are employed a solid partition between the gas-chambers may replace the partition with movable diaphragm 6.

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

1. A gas and air mixing apparatus in which are combined a casing having valved inlet for external air and closed against outflow thereto and containing a gas-chamber and an air-chamber, valve mechanism governing the flow of gas into and from said gas-chamber, a movable diaphragm acted upon by the gas in the gas-chamber, and means whereby the movement of said diaphragm is caused to effect compression of air in the air-chamber for admixture with the gas, substantially as specified.

2. A gas and air mixing apparatus in which are combined a casing having valved inlet for external air and closed against outflow thereto and containing a pair of gas-chambers and a pair of air-chambers, valve mechanism governing the flow of gas into and from said gas-chambers, one or more movable diaphragms acted upon by the gas in the gas-chambers and caused to move by the difference in pressure of the gas in said chambers, and means whereby the diaphragm movement is caused to effect inflow of air into one air-chamber simultaneously with the expulsion of air under pressure from the other air-chamber for admixture with the gas, substantially as specified.

3. A gas and air mixing apparatus in which are combined a casing having valved inlet for external air and closed against outflow thereto and containing gas and air chambers, valve mechanism governing the flow of gas into and from said gas-chamber, a movable diaphragm separating said gas and air chambers, and means whereby the flow of gas into and from the gas-chamber is caused to effect movement of the diaphragm separating the gas and air chamber and thereby compress air in the air-chamber for admixture with the gas, substantially as specified.

4. A gas and air mixing apparatus in which are combined a casing having valved inlet for external air and closed against outflow thereto and containing a gas-chamber and an air-chamber, valve-passages governing the flow of gas into and from said gas-chamber, a movable diaphragm acted upon by the gas in the gas-chamber, means whereby the movement of said diaphragm is caused to effect compression of air in the air-chamber for admixture with the gas, and valve-operating mechanism actuated by the movable diaphragm, substantially as specified.

5. A gas and air mixing apparatus in which are combined a casing having valved inlet for external air and closed against outflow thereto and containing a pair of gas-chambers, and a pair of air-chambers, valve-passages governing the flow of gas into and from said gas-chambers, one or more movable diaphragms acted upon by the gas in the gas-chambers and caused to move by reason of the difference in pressure in said gas-chambers, means whereby the diaphragm movement is caused to effect inflow of air into one air-chamber simultaneously with the expulsion of air under pressure from the other chamber for admixture with the gas and valve operating mechanism actuated by connection with the movable diaphragm structure of the apparatus, substantially as specified.

6. A gas and air mixing apparatus in which are combined a casing having valved inlet for external air and closed against outflow thereto and containing gas and air chambers, valve-passages governing the flow of gas into and from said gas-chamber, a movable diaphragm separating said gas and air chambers, and means whereby the flow of gas into and from the gas-chamber effects movement of the diaphragm separating the gas and air chambers, means whereby such movement of the diaphragm is caused to compress air in the air-chamber for admixture with the gas, and valve-operating devices actuated by connection with the movable diaphragm, substantially as specified.

7. A gas and air mixing apparatus in which are combined a casing having two gas-chambers and two air-chambers, movable diaphragms separating said gas and air chambers, and having connection with each other inside of the casing, valve mechanism whereby the gas is admitted to and exhausted from the gas-chambers alternately, and the diaphragms are caused to move by reason of the difference in pressure in the two gas-chambers, and means whereby the movement of the diaphragms is caused to effect inflow of air into one air-chamber simultaneously with the expulsion of air from the other air-chamber for admixture with the gas, substantially as specified.

8. A gas and air mixing apparatus in which are combined a casing having two gas-chambers and two air-chambers, movable diaphragms separating said gas and air chambers, and having connection with each other inside of the casing, valve-passages whereby the gas is admitted to and exhausted from the gas-chambers alternately so as to cause movement of the diaphragms by reason of the difference of pressure in the two gas-chambers, means whereby the movement of the diaphragms is caused to draw air into one air-chamber simultaneously with the expulsion of air under pressure from the other air-chamber for admixture with the gas, and valve-operating devices actuated by connection with the movable diaphragm structure of the apparatus, substantially as specified.

9. A gas and air mixing apparatus in which are combined a casing having a pair of gas-

chambers separated by a movable diaphragm, a pair of air-chambers separated from said gas-chambers by movable diaphragms of greater area than that which separates the gas-chambers, valve mechanism for controlling the flow of gas into and its discharge from each gas-chamber, and means whereby the movement of the diaphragms is caused to effect compression of air in the air-chambers alternately for admixture with the gas, substantially as specified.

10. The combination in a gas and air mixing apparatus, of a casing having a pair of gas-chambers separated by a movable diaphragm, a pair of air-chambers separated from said gas-chambers by movable diaphragms of greater area than that which separates the gas-chambers, valve-passages for controlling the flow of gas into and its discharge from each gas-chamber, means whereby the movement of the diaphragms is caused to effect compression of air in the air-chambers alternately for admixture with the gas, and valve-operating mechanism actuated by connection with the movable diaphragm structure of the apparatus, substantially as specified.

11. A gas and air mixing apparatus in which are combined a casing having a gas-chamber, an air-chamber containing a bellows, valve mechanism governing the flow of air and gas into and from said gas-chamber, a diaphragm acted upon by the gas in said gas-chamber, and means whereby the movement of said diaphragm is caused to effect movement of the bellows in the air-chamber and thereby alternately draw air into and expel it under pressure from said air-chamber and bellows for admixture with the gas, substantially as specified.

12. A gas and air mixing apparatus in which are combined a casing having a gas-chamber and an air-chamber containing a bellows, valve-passages governing the flow of gas into and from said gas-chamber, a movable diaphragm acted upon by the gas in the gas-chamber, valve-operating mechanism actuated by connection with said diaphragm, and means whereby the movement of the diaphragm is caused to operate the bellows in the air-chamber and thereby alternately draw air into and expel it under pressure from the air-chamber, and bellows, alternately for admixture with the gas, substantially as specified.

13. A gas and air mixing apparatus in which are combined a casing having a gas-chamber and an air-chamber containing a bellows, a movable diaphragm separating said gas and air chambers, valve mechanism governing the flow of gas into and from the gas-chamber, and means whereby the movement of the diaphragm under the varying pressures in the gas-chamber is caused to effect the operation of the bellows in the air-chamber and thereby alternately draw air into and expel it under pressure from the air-chamber and the bellows for admixture with the gas, substantially as specified.

14. A gas and air mixing apparatus in which are combined a casing having a gas-chamber and an air-chamber containing a bellows, valve-passages governing the flow of gas into and from said gas-chamber, a movable diaphragm separating the gas and air chambers and deriving its movement from the gas in the gas-chamber, and means whereby said movement of the diaphragm is caused to effect the operation of the bellows in the air-chamber so as to alternately draw air into and expel it under pressure from said air-chamber and bellows, and valve-operating mechanism actuated by connection with the movable diaphragm, substantially as specified.

15. A gas and air mixing apparatus in which are combined a casing having a pair of gas-chambers and a pair of air-chambers each containing a bellows, valve mechanism whereby the flow of gas into and from the gas-chambers is governed so as to cause one chamber to fill with gas as the other is being discharged, one or more movable diaphragms actuated by reason of the difference of pressure of the gas in the two gas-chambers, and means whereby the diaphragm movement is caused to actuate the bellows in the air-chambers so as to alternately draw air into and expel it from said air-chambers and bellows, substantially as specified.

16. A gas and air mixing apparatus in which are combined a casing having a pair of gas-chambers and a pair of air-chambers each containing a bellows, valve-passages for governing the flow of gas into and from the gas-chambers so that one chamber fills with gas as the other is being discharged, one or more movable diaphragms whose movement is caused by difference of pressure of the gas in the two gas-chambers, means whereby the bellows in the air-chambers are operated by the diaphragm movement so as to alternately draw air into and expel it under pressure from said bellows and air-chambers, and valve-operating mechanism actuated by connection with the movable diaphragm structure of the apparatus, substantially as specified.

17. A gas and air mixing apparatus in which are combined a casing having a pair of gas-chambers, and a pair of air-chambers each air-chamber containing a bellows, valve mechanism governing the flow of gas into and its discharge from each gas-chamber, movable diaphragms separating the gas-chambers from the air-chambers, and means whereby the movement of the diaphragms by reason of the difference of pressure of the gas in the two gas-chambers is caused to operate the bellows in the air-chambers and thereby alternately draw air into and expel it under pressure from said bellows and air-chambers, substantially as specified.

18. A gas and air mixing apparatus in which are combined a casing having a pair of gas-chambers and a pair of air-chambers, each of said chambers containing a bellows, valve-passages controlling the flow of gas into and its discharge from each of said gas-chambers, movable diaphragms separating the gas-chambers from the air-chambers, means whereby the movement of said diaphragms under the influence of difference of pressure of the gas in the two gas-chambers is caused to operate the bellows in the air-chambers and alternately draw air into and expel it under pressure from said bellows and air-chambers, and valve-operating mechanism actuated by connection with the diaphragm structure of the apparatus, 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.