No. 677,699. Patented July 2, 1901.

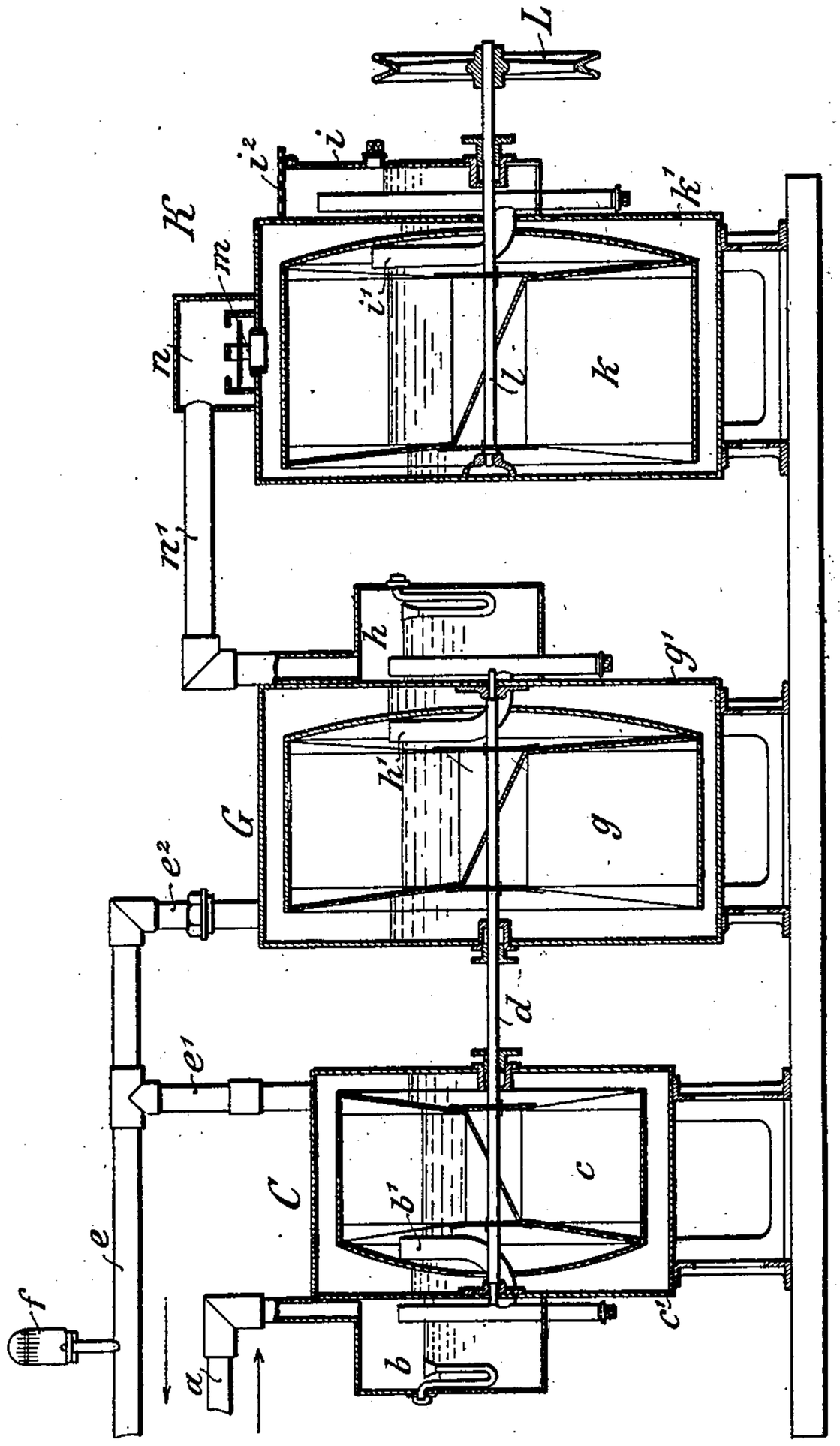
G. RAAP.

GAS AND AIR MIXER.

(Application filed Nov. 21, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



Witnesses.
Julius Lutz.
John Lotka

Inventor:
G. Raap
By Munn & Co
Attorneys.

No. 677,699. Patented July 2, 1901.

G. RAAP.

GAS AND AIR MIXER.

(Application filed Nov. 21, 1898.)

(No Model.) 3 Sheets—Sheet 2.

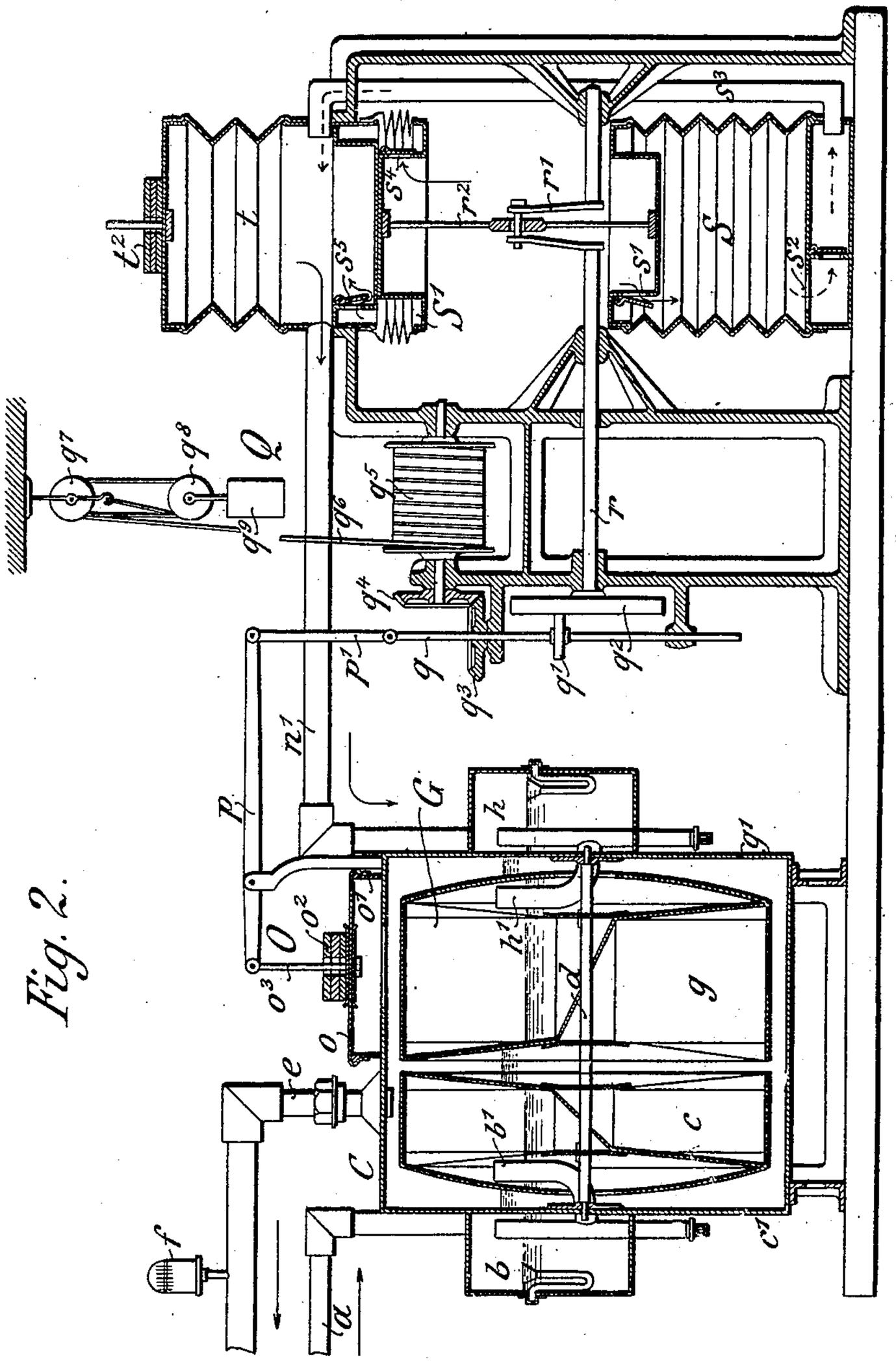


Fig. 2.

Witnesses
Julius Lutz.
John Lotka

Inventor.
G. Raap
By Munn & Co.
Attorneys.

No. 677,699. Patented July 2, 1901.

G. RAAP.

GAS AND AIR MIXER.

(Application filed Nov. 21, 1898.)

(No Model.) 3 Sheets—Sheet 3.

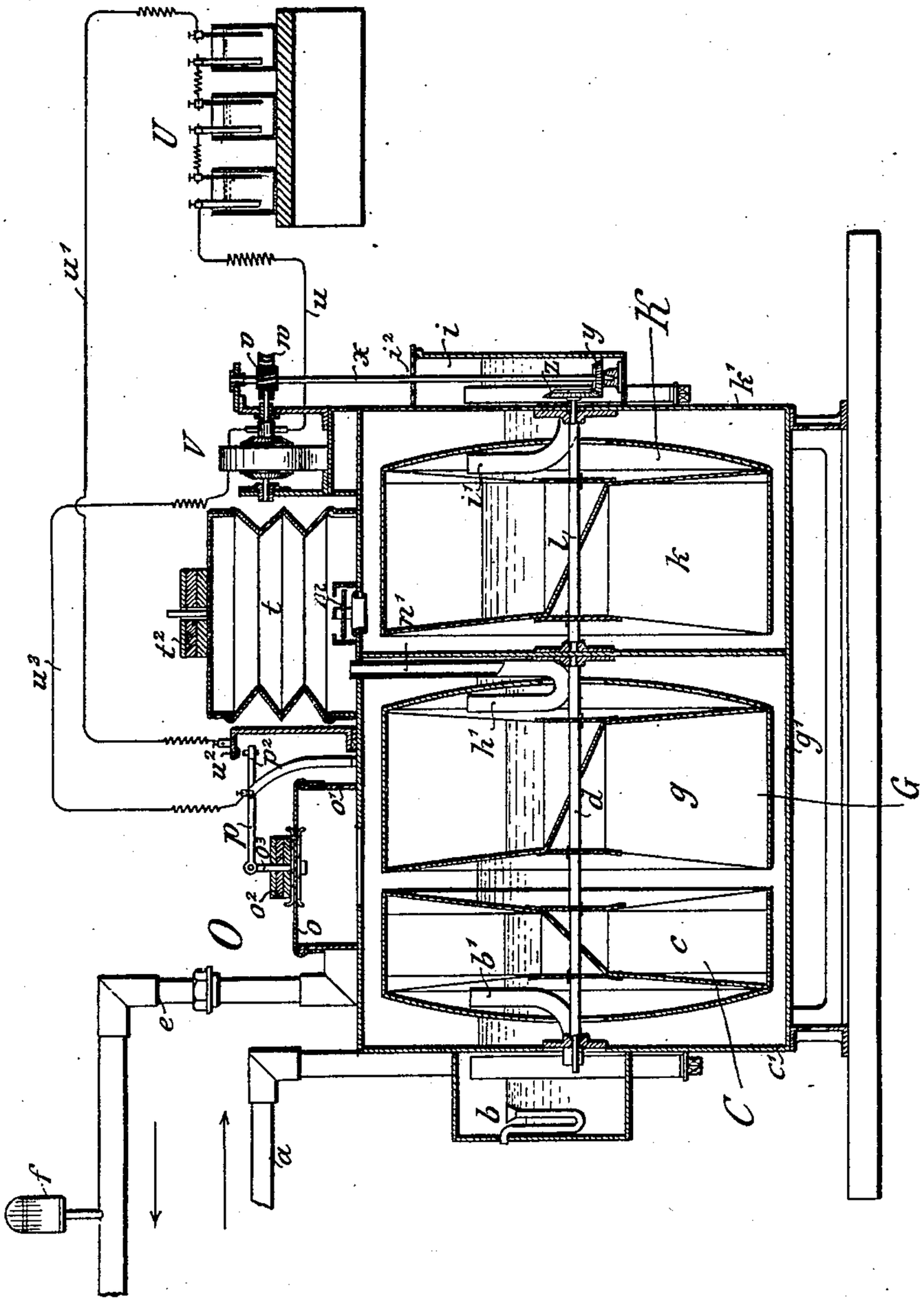


Fig. 3.

Witnesses,
Julius Lutz
John Lotka

Inventor:
G. Raap
By Munn & Co
Attorneys

UNITED STATES PATENT OFFICE.

GUSTAV RAAP, OF BERLIN, GERMANY, ASSIGNOR TO THE "SELAS" GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, OF SAME PLACE.

GAS AND AIR MIXER.

SPECIFICATION forming part of Letters Patent No. 677,699, dated July 2, 1901.

Application filed November 21, 1898. Serial No. 696,994. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV RAAP, a subject of the German Emperor, residing at Berlin, in the Kingdom of Prussia, Germany, have invented new and useful Improvements in Apparatus for Producing Air and Gas Mixtures, of which the following is a specification.

For mixing air and gas in a constant proportion for illuminating, heating, or other purposes certain apparatuses have hitherto been employed, consisting each of a gas-meter and an air-sucking apparatus connected positively to operate in unison, and thereby delivering a mixture of gas and ordinary air to the discharge-piping. Such apparatuses are, however, unreliable, especially when the pressure of the gas is comparatively low, since the pressure of the gas is required for driving not only the gas-meter, but also the air-sucking apparatus, whereby it is apt to be reduced more or less. The proportion of the gas and of the air in the mixture also is not constant, since the level of the liquid in the air-sucking apparatus will vary with the pressure therein.

My invention relates to improvements in said apparatuses; and the objects of my invention are, first, to provide a device for producing compressed air and for conducting it to the air-sucking apparatus, which serves as an air-meter, and, second, to provide a device for regulating the work of the above device producing the compressed air, this device being placed under the control of the pressure of the gas and air mixture within the discharge or service piping. I attain these objects by the apparatus illustrated in several modes of execution in the accompanying drawings, wherein—

Figure 1 is a vertical longitudinal section of an apparatus the gas-meter of which is separated from the air-meter, while the compressed air is produced by an air-sucking apparatus of a similar construction driven from without. Fig. 2 is a vertical longitudinal section of an apparatus the gas-meter and the air-meter of which are arranged inside a common casing, while the compressed air is produced by a pair of bellows driven by a weight; and Fig. 3 is a vertical longitudinal section of an apparatus the gas-meter and the water-meter of which are arranged inside a common casing, while the compressed air is produced by an air-sucking apparatus of similar construction driven by a battery and an electric motor.

Similar letters refer to similar parts throughout the several figures.

In the apparatus shown in Fig. 1, C is the gas-meter, G the air-meter, and K the air-sucking apparatus. These three apparatuses are similar in construction to the common gas-meter and are arranged separately. The drum *c* of the gas-meter C and the drum *g* of the air-meter G are rigidly connected by means of their common shaft *d*, passing through suitable stuffing-boxes of the two casings *c'* and *g'*. The air-sucking apparatus K is driven from without by means of a rope placed around the pulley L on the shaft *l* of the drum *k*. As in a common gas-meter, both the casing *k'* and the chamber *i* are partly filled with a liquid, (water, glycerin, or the like.) During its revolution the drum *k* draws in air through the sieve i^2, located on top of the open chamber *i*, and through the bent pipe *i'* and discharges it compressed into the space above the liquid and thence into the chamber *n*. This chamber may be considered as a store-room for the compressed air and serves, as it is constructed, as an air vessel. From the chamber *n* the compressed air is conducted by the piping *n'*, the chamber *h*, and the bent pipe *h'* to the drum *g* of the air-meter G, which drum will therefore be revolved by the compressed air. The gas is conducted by the piping *a*, the chamber *b*, and the pipe *b'* to the drum *c* of the gas-meter C, which it will likewise revolve. Since the two drums *c* and *g* are rigidly connected by their shaft *d*, both the compressed air and the gas under pressure serve to drive the two drums simultaneously. The compressed air conducted from the air-meter G through the pipe e^2 and the gas conducted from the gas-meter C through the pipe *e'* enter the common main piping *e*, where they mix together before they are conducted farther to the places of consumption—say to incandescent gas-lamps, such as *f*, or to motors to be driven or to stoves or other apparatuses, as the case may be. To preserve the pressure of the compressed air under any circumstances, a back-

pressure valve m may be inserted between the chamber n and the casing k'. The two drums c and g of the gas-meter C and of the air-meter G, respectively, being coupled are obliged to revolve simultaneously, so that the gas and the compressed air are always mixed in the correct proportion. This proportion of course depends upon the sizes of the two drums c and g, and the pressure in the main discharge-piping e will equally depend upon the pressure of the gas and that of the compressed air conducted to the air-meter. It will be obvious that by regulating the pressure of the compressed air the pressure in the main discharge-piping e may be kept at a certain height. Any failure in the working of the apparatus will therefore be prevented, even when the pressure of the gas drops.

In the apparatus shown in Fig. 2 the drums c and g of the gas-meter C and the air-meter G are arranged inside the common casing c' g'. For producing the compressed air the pair of bellows S S' is employed, which is driven by the device Q in the following manner: The weight q^9, suspended from the block-pulleys q^7 q^8, exercises through the rope q^6 a pull upon the drum q^5, which transmits its revolution through the bevel-wheels q^4 q^3, the shaft q, and the friction-wheels q' q^2 to the shaft r. The crank r' on the shaft r will through a slot, link, or other means reciprocate the rod r^2 common to the covers of the two bellows S S', whereby the latter are worked. In the position of the various parts shown in Fig. 2 the air has entered the bottom bellows S through the valve s', so that on the rod r^2 going downward the air will be compressed and open the valve s^3 to escape through the piping s^3 to the vessel t. At the top bellows S', on the contrary, for the position shown the air previously admitted through the valves s^4 into the bellows and compressed has entered the vessel t through the valve s^5. For attaining an equal pressure of the compressed air the vessel t is constructed as a bellows, which can be loaded to any desired degree by suitable weights t^2, placed upon it. The compressed air is conducted through the piping n', the chamber h, and the pipe h' to the drum g, which it will revolve. By means of the weights t^2 bearing down upon the vessel t the advantage is obtained that the air-meter G is always driven by compressed air under a constant pressure. The gas is conducted, as before, through the piping a, the chamber b, and the pipe b' to the drum c, which it will revolve. Above the liquid inside the casing c' g' the compressed air and the gas leave their respective drums c and g and mix together, whereupon the mixture is conducted through the piping e to the places of consumption. For regulating the work of the apparatus for producing the compressed air the shaft q is in a well-known manner arranged for being shifted from the regulator O, as follows: The chamber o', placed on the casing c' g' and in open communication therewith, is at the top closed by a diaphragm o or a sliding piston. The diaphragm o or piston is loaded with suitable weights o^2 to produce the desired pressure in the main discharge-piping e. By means of the rod o^3, the lever p, and the rod p' the diaphragm o (or the piston, if this equivalent is used) is connected with the shifting shaft q. When the consumption of the air and gas mixture increases or decreases, the diaphragm o will be lowered or raised, respectively. Then by the transmission described the shaft q, with the friction-wheel q', will be shifted up or down for putting the apparatus producing the compressed air in or out of motion, as may be required. Thereby the supply of compressed air will be kept proportioned to the requirements. By altering the weights o^2 and t^2 the work of the air sucking and compressing apparatus may be regulated according to the circumstances. The device described for governing the work of the apparatus for producing compressed air is thus placed under the control of the pressure of the gas and air mixture being discharged into the service-pipe e. It serves two purposes—viz., first, to insure a uniform pressure under which the combustible mixture is conducted in the service-pipe to the places of consumption, and, second, to cause the air-compressor to supplement the store of compressed air in accordance with the consumption of the gas and air mixture. The air-forcing device will be driven only when required. It may be driven as long as the friction-wheel q is above the shaft r and again stopped when the friction-wheel q is in the same line with the shaft r.

In the apparatus shown in Fig. 3 the construction of the gas-meter C, the air-meter G, the vessel t, and the regulator O is the same as before, while the apparatus for producing the compressed air, described before, is replaced by an apparatus K, similar to that shown in Fig. 1. For driving this apparatus a battery U is employed, which is capable of supplying current to the electric motor V by means of the conducting-wires u u' u^3. The electric motor V will through the worm v, the worm-wheel w, the shaft x, the bevel-wheels y z, and the shaft l revolve the drum k, which latter draws in air through the sieve i^2, located above the open chamber i, and through the pipe i' and discharges it compressed into the space above the liquid and thence through the back-pressure valve m into the vessel t. When the consumption of the air and gas mixture decreases, the diaphragm o will be raised, whereby the lever p is so turned as to bring its arm p^2 out of contact with the contact-piece u^2, so that the circuit is broken, whereupon the electric motor V will stop and cease to revolve the drum k.

With the apparatus in the various modes of execution shown it is essential that a device be provided for supplying the air-meter G with compressed air. The compressed air may be conducted to the apparatus, as shown

in Figs. 2 and 3, from a vessel *t*, storing a certain quantity of it. The apparatus for producing the compressed air may be of any kind, and the manner of introducing the compressed air into the vessel *t* may be altered to suit the circumstances. Special vessels filled with compressed air independently of the working of the apparatus may be employed. Blast-fans, blowers, compressors, or other machines may be employed for producing the compressed air. In case the gas-meter and the air-meter are combined with such a compressed-air-producing apparatus the device for regulating the work of this apparatus or for putting the same in and out of motion may, if employed, be of any kind, according to the construction of the said apparatus. The latter may be driven from any power source, be it water, hydraulic power, steam, electricity, or otherwise. Instead of the so-called "wet" gas-meter or air-meter, as illustrated, a so-called "dry" gas-meter or air-meter, respectively, or bellows and the like may be employed. The gas-drum *c* and the air-drum *g*, working positively together, may, instead of being coupled by a common shaft, be connected in any other manner. For example, their shafts may be placed parallel to each other and connected by gear-wheels, chain-wheels and chain, or pulleys and belt or rope. Instead of the vessel *t* for regulating the pressure other devices may be employed for the same purpose. The air-meter G being supplied with compressed air instead of air under atmospheric pressure the disadvantage is avoided that the gas alone is charged with the duty of driving the air-meter, which, according to experience, causes a considerable loss in the pressure of the gas, and hence a reduction of the pressure in the main discharge-piping, whereby, for example, in the case of employing the apparatus for feeding incandescent gas-lamps the illuminating power of the latter may be greatly reduced. The supply of the compressed air according to my invention offers the advantage that the compressed air itself will drive the air-meter, so that it is possible, according to the pressure of the compressed air, to save the pressure of the gas from being spent more or less upon the driving of the air-meter. The pressure of the compressed air may even exceed that of the gas and help to drive the gas-meter—*i. e.*, the drum, bellows, or other part of the same. Thus it is possible to attain a pressure of any height in the main discharge-piping as may be desired. It is important that the pressure of the gas and air mixture be utilized for actuating the device governing the action of the air-forcing device, as thereby the uniformity of this pressure will be insured under all circumstances, whether the consumption of the mixture be large or small. The air-forcing device may be stopped when it is not required to supplement the store of compressed air during the time of small consumption. On the contrary, if the consumption increases the said governing device will put the air-forcing device into operation to supply compressed air.

The apparatus described is intended chiefly for illuminating purposes; but it may also be employed for other purposes—for example, for heating purposes, for driving motors, and so on—where a constant mixture of air and gas under a certain pressure is required.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination of a gas-feed device and an air-feed device connected to move in unison, each of said devices having an inlet and an outlet independent of those of the other device with an air-forcing device for supplying a current of air to drive said air-feed device, while said gas-feed device is driven by the gas supplied from a gas-main, substantially as set forth.

2. The combination of a gas-feed device and an air-feed device connected to move in unison, with an air-forcing device for supplying a current of air to the air-feed device, a service-pipe into which both of said devices discharge, and a device controlled by the pressure within said service-pipe for governing the action of said air-forcing device, substantially as set forth.

3. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected with said gas-meter to move in unison therewith but having an independent inlet, a service-pipe into which both of said meters discharge, and an air-forcing device for supplying a current of air to said air-meter, substantially as set forth.

4. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected with said gas-meter to move in unison therewith, a service-pipe into which both of said meters discharge, an air-forcing device for supplying a current of air to said air-meter, and a device controlled by the pressure within said service-pipe, for governing the action of said air-forcing device, substantially as set forth.

5. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected with said gas-meter to move in unison therewith, means for collecting and mixing the gas leaving said gas-meter and the air leaving said air-meter, a service-pipe into which the gas and air mixture is discharged, an air-forcing device for supplying a current of air to said air-meter, and a device controlled by the pressure of the gas and air mixture for governing the action of said air-forcing device, substantially as set forth.

6. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected with said gas-meter to move in unison therewith, means for collecting and mixing the gas leaving said gas-meter, and the air leaving said air-meter, a service-pipe into which the gas and air mixture

is discharged, an air-forcing device, means for conducting the compressed air from said air-forcing device to said air-meter, and a device controlled by the pressure of the gas and air mixture for governing the action of said air-forcing device, substantially as set forth.

7. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected positively to operate in unison with said gas-meter, a service-pipe, an air-compressing device, means for conducting the compressed air therefrom to said air-meter, means for collecting and mixing the gas leaving said gas-meter and the air leaving said air-meter, means for conducting the gas and air mixture to said service-pipe, and a device controlled by the pressure within said service-pipe for governing the action of said air-forcing device, substantially as set forth.

8. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected positively to operate in unison with said gas-meter, a service-pipe, an air-compressing device, means for conducting the compressed air therefrom to said air-meter, a back-pressure valve arranged between said air-forcing device and said air-meter, means for collecting and mixing the gas leaving said gas-meter and the air leaving said air-meter, means for conducting the gas and air mixture to said service-pipe, and a device controlled by the pressure of the gas and air mixture for governing the action of said device, substantially as set forth.

9. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected positively to operate in unison with said gas-meter, a service-pipe, an air-forcing device, a storage vessel for receiving the compressed air, a back-pressure valve arranged between said air-forcing device and said storage vessel, means for conducting the compressed air from said storage vessel to said air-meter, means for collecting and mixing the gas leaving said gas-meter and the air leaving said air-meter, means for conducting the gas and air mixture to said service-pipe, and a device controlled by the pressure of the gas and air mixture for governing the action of said air-forcing device, substantially as set forth.

10. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected positively to operate in unison with said gas-meter, a service-pipe, an air-forcing device, a storage vessel, loaded with adjustable weights, for receiving the compressed air, a back-pressure valve arranged between said air-forcing device and said storage vessel, means for conducting the compressed air from said storage vessel to said air-meter, means for collecting and mixing the gas leaving said gas-meter and the air leaving said air-meter, means for conducting the gas and air mixture to said service-pipe, and a device controlled by the pressure of the gas and air mixture for governing the action of said air-forcing device, substantially as set forth.

11. The combination with a gas-meter arranged to be connected with a gas-main, of an air-meter connected positively to operate in unison with said gas-meter, a service-pipe, an air-forcing device, a storage vessel constructed as a bellows loaded with weights, for receiving the compressed air, a back-pressure valve arranged between said air-forcing device and said storage vessel, means for conducting the compressed air from said storage vessel to said air-meter, means for collecting and mixing the gas leaving said gas-meter and the air leaving said air-meter, means for conducting the gas and air mixture to said service-pipe, and a device controlled by the pressure of the gas and air mixture for governing the action of said air-forcing device, substantially as set forth.

12. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which meter is revolved by the gas introduced, of an air-meter of similar construction, the drum of which is connected with said gas-drum to move in unison therewith, a service-pipe into which both of said meters discharge, an air-forcing device for supplying a current of compressed air to said air-meter, so that the compressed air will revolve the drum of same, and a device controlled by the pressure within said service-pipe for governing the action of said air-forcing device, substantially as set forth.

13. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of said meter being revolved by the gas introduced, of an air-meter of similar construction, the drum of which is connected with said gas-drum to move in unison therewith, means for collecting and mixing the gas leaving said gas-drum and the air leaving said air-drum, a service-pipe into which the gas and air mixture is discharged, an air-forcing device for supplying a current of air to said air-meter, so that the compressed air will revolve the drum of the same, and a device controlled by the pressure of the gas and air mixture for governing the action of said air-forcing device, substantially as set forth.

14. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-meter of similar construction, the drum of which is connected with said gas-drum to move in unison therewith, while both drums are inclosed in a common casing, the space inside which above the liquid-level serves for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, an air-forcing device for supplying a current of air to said air-drum, so that the same will be revolved by the compressed air, and a device controlled by the pressure of the

gas and air mixture discharged, for governing the operation of said air-forcing device, substantially as set forth.

15. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and connected with said gas-drum to move in unison, the space above the liquid-level serving for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, an air-forcing device, means for conducting the compressed air therefrom to said air-drum, a back-pressure valve arranged between said air-forcing device and said air-drum, and a device controlled by the pressure of the gas and air mixture discharged, for governing the action of said air-forcing device, substantially as set forth.

16. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and connected with said gas-drum to move in unison, the space above the liquid-level serving for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, an air-forcing device, a storage vessel for receiving the compressed air, a back-pressure valve arranged between said air-forcing device and said storage vessel, means for conducting the compressed air from said storage vessel to said air-drum, which will be thereby revolved, and a device controlled by the pressure of the gas and air mixture discharged, for governing the action of said air-forcing device, substantially as set forth.

17. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and connected with said gas-drum to move in unison therewith, the space above the liquid-level serving for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, an air-forcing device, a storage vessel constructed as a bellows loaded with weights for receiving the compressed air, a back-pressure valve arranged between said air-forcing device and said storage vessel, means for conducting the compressed air from said storage vessel to said air-drum, which will be thereby revolved, and a device controlled by the pressure of the gas and air mixture discharged, for governing the action of said air-forcing device, substantially as set forth.

18. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and coupled to its drum by a shaft common to them, the space above the liquid-level serving for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, a bellows sucking in and compressing air, means for actuating said bellows, means for conducting the compressed air from said bellows to said air-drum which will be thereby revolved, a back-pressure valve arranged between said air sucking and compressing bellows and said air-drum, and a device controlled by the pressure of the gas and air mixture discharged for governing the action of said bellows, substantially as set forth.

19. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and coupled to its drum by a shaft common to them, the space above the liquid-level serving for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, a pair of bellows sucking in and compressing air, means for actuating said pair of bellows, means for conducting the compressed air from said pair of bellows to said air-drum, which will be thereby revolved, a back-pressure valve arranged between said pair of air sucking and compressing bellows and said air-drum, and a device controlled by the pressure of the gas and air mixture discharged for governing the action of said pair of bellows, substantially as set forth.

20. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and coupled to its drum by a shaft common to them, the space above the liquid-level serving for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, a bellows sucking in and compressing air, means for actuating said bellows, a storage vessel receiving the compressed air and constructed as a bellows loaded with weights, a back-pressure valve arranged between said air sucking and compressing bellows and said storage vessel, means for conducting the compressed air from said storage vessel to said air-drum, which will be thereby revolved, and a device controlled by the pressure of the gas and air mixture discharged, for governing the action of said bellows, substantially as set forth.

21. The combination with a wet gas-meter arranged to be connected with a gas-main, the drum of which is revolved by the gas introduced, of an air-drum of similar construction inclosed in the casing of said gas-meter and coupled to its drum by a shaft common to them, the space above the liquid-level serv-

ing for collecting and mixing the gas and the air leaving the two drums, a service-pipe into which the gas and air mixture is discharged, a pair of bellows sucking in and compressing air, means for actuating said pair of bellows, a storage vessel connected therewith for receiving the compressed air and constructed as a bellows loaded with weights, a back-pressure valve arranged between said pair of bellows and said storage vessel, means for conducting the compressed air from said storage vessel to said air-drum, which will be thereby revolved, and a device controlled by the pressure of the gas and air mixture discharged, for governing the action of said pair of bellows, substantially as set forth.

22. The combination of a gas-feed device and an air-feed device connected to move in unison and each having an independent inlet, and a service-pipe into which both of said devices discharge, with an air-forcing device for supplying a current of air to the air-feed device to operate the same.

23. The combination of a gas-feed device and an air-feed device connected to move in unison, and a service-pipe into which both of said devices discharge, with an air-forcing device for supplying a current of air to the air-feed device to operate the same, a mechanism for driving said air-forcing device, and mechanism, controlled by the pressure within the said pipe, and operatively connected with said driving mechanism to govern the action thereof.

24. The combination of a gas-feed device and an air-feed device connected to move in unison, with an air-forcing device for supplying a current of air to the air-feed device to operate the same, a mechanism for driving said air-forcing device, and a speed-changing device for said driving mechanism, controlled by the pressure within the said pipe.

GUSTAV RAAP.

Witnesses:
HENRY HASPER,
E. L. GOLDSCHMIDT.