Nov. 13, 1934. R. W. THOMAS 1,980,770

GAS MIXING APPARATUS

Filed April 14, 1931 3 Sheets-Sheet 1

Fig. 1.

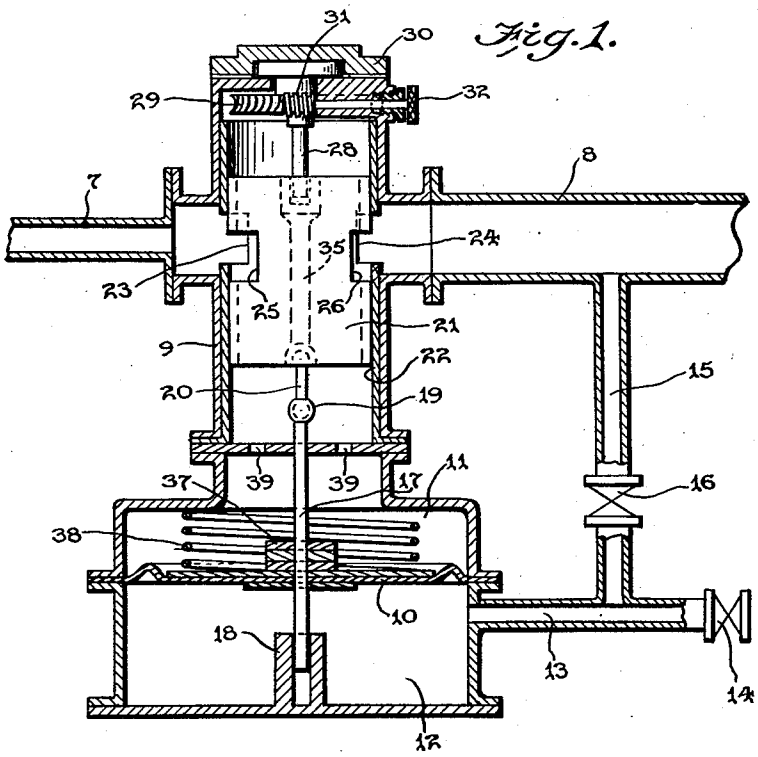
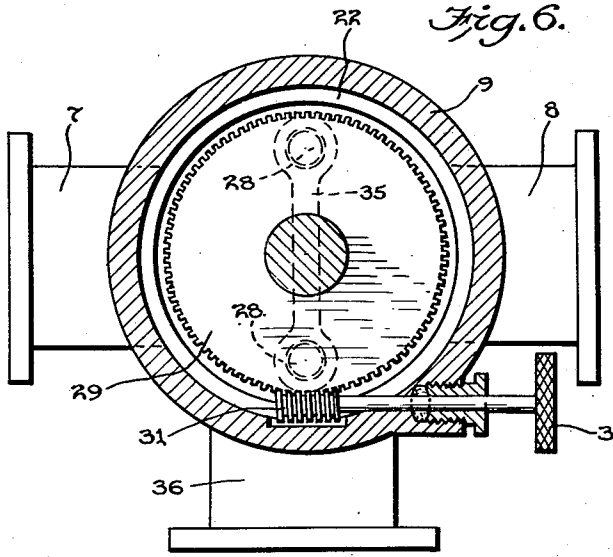


Fig. 6.



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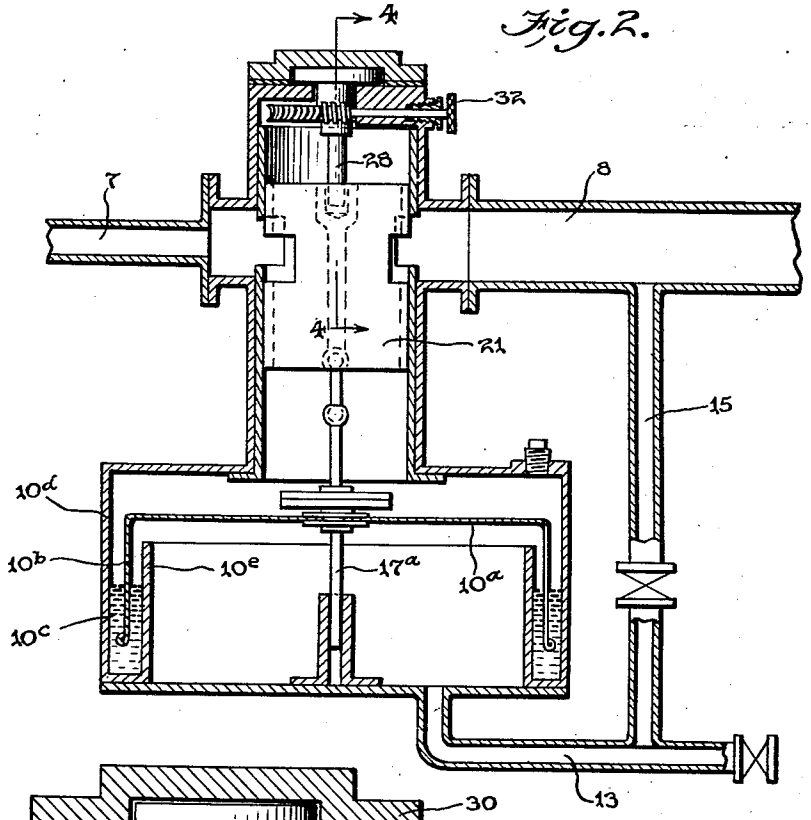
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GAS MIXING APPARATUS

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Fig. 2.



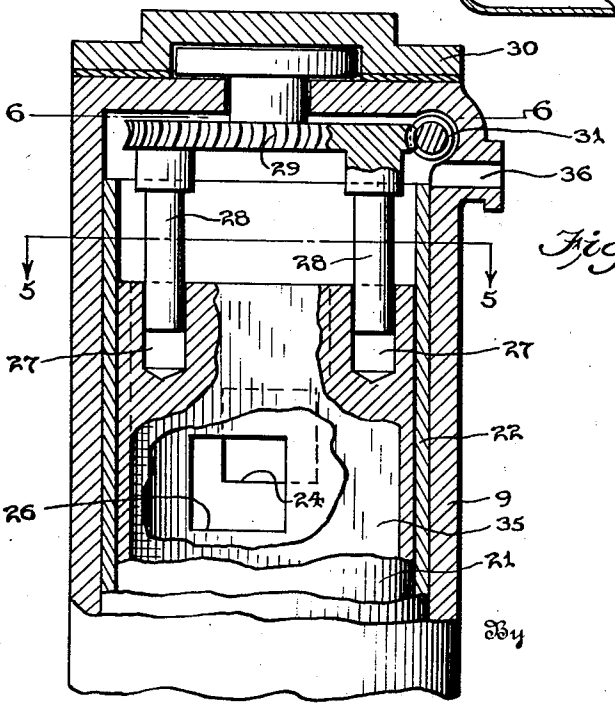


Fig. 4.

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GAS MIXING APPARATUS

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Fig. 3.

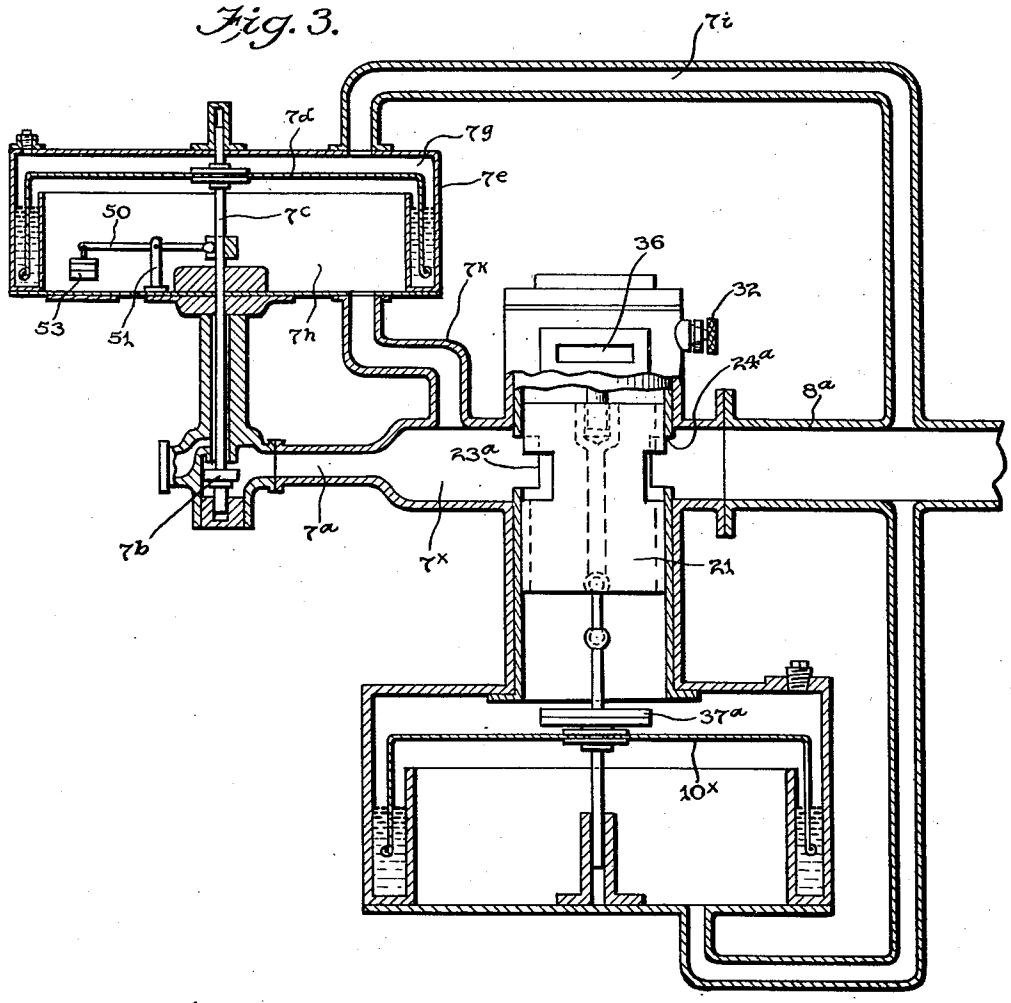
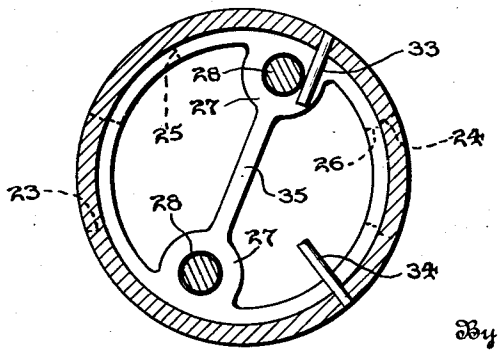


Fig. 5.



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UNITED STATES PATENT OFFICE

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GAS MIXING APPARATUS

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Application April 14, 1931, Serial No. 530,091

2 Claims. (Cl. 48—184)

This invention relates to improvements in gas mixing apparatus, and particularly to novel proportioning apparatus designed especially for use in proportioning and mixing a plurality of fluid streams.

One of the objects of the invention is to provide an apparatus for this purpose including a ported sleeve valve which is longitudinally shifted by a movable partition which moves in response to pressure variations on opposite sides thereof; means also being provided for rotating the valve about its axis for varying the size of the ports through which the fluids are admitted to the interior of the valve.

Another object is to provide such an apparatus in which the volume of one of the fluids admitted to the ported valve, is controlled by an independent valve actuated by a movable partition which moves in response to variations in pressure in the fluid inlet conduits on the upstream sides of the ports of the ported valve.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

In the drawings,

Fig. 1 is a vertical sectional view of one embodiment of my improved apparatus.

Fig. 2 is a similar view of a modification.

Fig. 3 is a like view of another and preferred embodiment of the invention.

Fig. 4 is an enlarged sectional view of a detail partly broken away to illustrate the means for rotating the ported valve.

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 4.

Fig. 6 is a transverse sectional view taken on the line 6—6 of Fig. 4.

Referring first to Fig. 1, 7 indicates a fluid inlet conduit and 8 a second fluid inlet conduit, both of which discharge into a casing 9. The apparatus may be used for various fluids, but if it is employed for use as an air-gas mixer, butane may enter the casing through conduit 7, and air can pass in from conduit 8.

The lower portion of the casing is divided by a movable partition or diaphragm 10 of any suitable construction, into an upper gas-tight compartment 11 and a lower gas-tight chamber 12. A pipe 13 is connected to the lower compartment and is provided with a valve 14. A branch pipe 15 connects the pipes 8 and 13, and has an interposed valve 16. When the valve 16 is closed and the valve 14 is opened, chamber 12 is in communication with the atmosphere, but when valve 14 is closed and valve 16 is opened, said chamber is in communication with the conduit 8.

A rod 17 is rigidly secured to the diaphragm and is guided at its lower end by a sleeve 18 that projects upwardly from the bottom of the casing. The upper end of the rod is connected by any suitable swivel or universal joint 19 to an upper rod 20 which is connected to an axially movable and rotatable ported sleeve valve 21. A stationary liner 22 in the casing forms a guide for said valve and is provided with diametrically oppositely disposed ports 23 and 24, the former communicating with conduit 7 and the latter communicating with conduit 8. These ports cooperate with opposite ports 25 and 26 in the wall of the valve, and it will be understood that when the valve is rotated in one direction, the port 26 will tend to expose a greater area of port 24, while the wall of the valve surrounding the port 25 will tend to block off a greater area of the port 23. Of course, reverse rotation will have the opposite effect. For the purpose of rotating the valve, the latter, as best shown in Figs. 5 and 6, is provided at its upper end with sockets 27 which slidably engage pins 28 which are diametrically opposite one another and depend from a worm gear 29. This gear is swiveled to the head 30 of the casing by any suitable means, and may be rotated by a manually operated screw 31 which has a handle 32 arranged at the exterior of the casing.

As shown in Fig. 5, the depending pins 28 cooperate with stop pins 33 and 34 which are rigidly secured to the liner of the casing. When one of the depending pins is in engagement with the stop 33, the ports 25 and 23 are entirely out of register, while the ports 24 and 26 are in exact registration. When the valve is turned to bring the other depending pin 38 into contact with the stop 34, the ports 23 and 25 will be in registration and the ports 26 and 24 will be out of registration.

A diametrical vertical partition 35 extends through the sleeve valve from end to end, and it not only affords places for the sockets 27, but also prevents eddy currents from upsetting the flow through the two orifices provided by the ports 23—25, and 24—26.

As best shown in Figs. 4 and 6, the upper portion of the casing is provided with an outlet 36 for the mixed fluids, and this outlet may be

connected to the intake of a blower, compressor or the like, if suction is employed to feed the fluids through the apparatus, or the outlet 36 may be connected to any suitable or conduit holder if the fluids are to be forced through the apparatus.

The diaphragm 10 may be moved to its lowermost position by any suitable means such as weights 37, a spring 38 or by both, and when in its lowermost position, the sleeve valve will close the ports 23 and 24.

It will be understood from the above that the apparatus embodies the ported piston valve principle, where a weighted or spring loaded diaphragm 10 moves a sleeve valve 21 to maintain an approximately constant differential across the proportioning ports, and that the valve and liner ports are so arranged that revolution of the valve in one direction will cut down on the supply of hydrocarbon gas and increase the supply of air until the hydrocarbon gas port 23 is entirely closed off and the air port 24 is fully opened. Revolving of the valve in the other direction increases the opening of the port 23 and decreases the opening of the port 24 until the air is entirely closed off and 100% hydrocarbon gas is passing through the valve. Any ratio between these two 100% extremes can be readily obtained by means of the micrometer adjusting screw handle 32 controlling screw 31.

It is obvious that as the valve raises, both ports 23 and 24 are opened at the same rate, until, with the diaphragm 10 in its uppermost position, the ports in the valve and the ports in the liner will register completely, and the valve will be wide open or working at its maximum rate of flow. On the other hand, when the demand on the system ceases, the weights 37 and spring 38 pull the valve to a closed position, so that leakage of the fuel gas out through the air port is avoided.

It will also be understood that the chamber 12 is arranged to communicate either with the atmosphere or the air inlet line 8, the latter being a preferred arrangement at all times, particularly if an air filter or long air inlet line is used. This means that the differential across the proportioning valve ports will be constant in inches of water or in pounds differential, and the equalizing line 13, 15, connects to the air inlet conduit just ahead of the air proportioning port. If the equalizing line is closed off from the conduit 8 and opened to the atmosphere, the differential may vary slightly at various rates of flow, depending on the amount of frictional drop in the air intake 8.

Obviously, the differential across the proportioning valve will remain constant on the air side if the equalizing line 13, 15, communicates with the conduit 8. It is also obvious that the pressure existing in the mixture outlet line 36 will also exist in the interior of the valve 21 and in the chamber 11, due to the apertures 39, which means that any vacuum or pressure in the mixture outlet line will result in an equivalent vacuum or pressure in the chamber 11. Hence, any given weighting or spring loading of the diaphragm 10 will result in a fixed differential drop across the air port.

The apparatus shown in Fig. 2 is practically identical with that shown in Fig. 1, with the exception that a different type of movable partition is employed. In this embodiment, a gasometer type bell 10*a* is substituted for the diaphragm. This bell is rigidly connected to the valve actuating rod 17*a*, and it has a depending skirt 10*b* which extends into a liquid seal 10*c* formed by an annulus of suitable liquid arranged between the wall 10*d* of the casing, and an internal annular wall 10*e*.

The operating principles are the same. However, the liquid seal bell has more effective area than does a diaphragm, and it also moves upward and downward without friction or binding. In other words, a proportioning valve equipped with a liquid sealed gasometer type bell will be more sensitive and have greater accuracy than will the diaphragm type, assuming equivalent sizes of diaphragm or bell diameters.

The modification shown in Fig. 3 is really the preferred embodiment of the invention, and it is identical with Fig. 2, with the following exceptions. The hydrocarbon gas or vapor inlet line 7*a* is controlled by any suitable form of valve 7*b* which is shifted by a rod 7*c*. The rod is rigidly connected to a liquid sealed bell 7*d* that divides a casing 7*e* into upper and lower gas-tight compartments 7*g* and 7*h*. A tube 7*i* places the chamber 7*g* in communication with the air conduit 8*a* at the upstream side of the port 24*a*, and another tube 7*k* places the chamber 7*h* in communication with the hydrocarbon gas conduit 7*a* on the upstream side of the gas port 23*a*.

The above mentioned exceptions means that the pressure or vacuum in the air inlet line 8*a* just ahead of the air orifice or port governs the functioning of the entire system, as a given weight 37*a* on the main bell 10*x* will produce a given differential from the upstream to the downstream side of the air ports. In order to maintain a constant proportioning, it is almost essential that the pressure on the upstream side of the hydrocarbon gas inlet port 23*a* be equivalent to the pressure on the upstream side of the air inlet port 24*a*. If these pressures are identical, the differentials through the two ports will be identical, and positive and accurate proportioning will result. It is apparent that with the chamber 7*h* of the hydrocarbon gas inlet regulator, communicating with the upstream side of the port 23*a*, and with the chamber 7*g* communicating with the upstream side of the air inlet port 24*a*, that the pressure in the line 7*a* can be made identical with that in the air inlet line 8*a*, or it can be varied to bear a direct relation to that in the air inlet conduit 8*a*, by weighting the partition or bell on the hydrocarbon gas or vapor regulator 7*e*. The weighting may be accomplished by mounting a lever 50 on a post 51 within the bell casing and connecting one end of this lever to the rod 7*c* and providing its other end with a variable weight 53.

All of the movable partitions of the various embodiments of the invention may be of the bell type or diaphragm tube, or one may be of one type and one of the other type.

It is evident that the limitation of the liquid sealed device is not easily reached as it is very easy to provide a liquid seal of sufficient depth to exceed the differential pressures employed through the proportioning orifices in the valve. It is therefore possible to run the entire mechanism at either approximately atmospheric pressure, sub-atmospheric pressures, or super-atmospheric pressures, all without blowing the liquid seals or interfering with the satisfactory and accurate proportioning of the device.

To sum the matter up, the liquid sealed gasometer type bells substituted for diaphragms, lend themselves to extremely accurate control and to

simplified and less costly construction, as well as to satisfactory and trouble free operation in service. Where the apparatus is to be used in exposed places, where freezing might result, the liquid seal may be glycerine, or glycerine water mixtures, or any one of a number of suitable mediums. As a matter of fact, a mercury seal is very satisfactory.

The device may be used for proportioning any two fluids, although its primary use will be the proportioning of gases. While I have mentioned butane as one such gas, and air as the other, the device is not limited to use with these particular raw materials. Furthermore, it is possible, with such apparatus, to accurately proportion predetermined quantities of three or more gases or fluids by arranging in series a combination of the proportioning valves. For instance, fluids A and B can be definitely proportioned in one apparatus, and then the A—B mixtures can be positively proportioned with fluid C in a second apparatus, into one inlet of which the A—B mixture is discharged or drawn. The proportioning possibilities are therefore almost limitless.

Apparatus of this kind may not alone be employed as a fluid proportioning device, but it may be used as a carburetor or mixing valve for internal combustion engines, and as a substitute for and an improvement over the conventional proportioning devices used on industrial furnaces.

While I have disclosed what I now consider to be some preferred embodiments of the invention in such manner that the same may be readily understood by those skilled in the art, I am aware that changes may be made in the details disclosed without departing from the spirit of the invention, as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. An apparatus of the class described, comprising a casing having first and second inlet ports, a sleeve valve movably mounted in said casing and having ports cooperating with said first and second ports, first and second gas-tight chambers, a movable partition separating said chambers, an outlet conduit for the casing communicating with the valve ports and with the first gas-tight chamber, means operatively connecting the movable partition and valve for causing movement of the partition to impart longitudinal movement to the valve, means for turning the valve to circumferentially adjust the valve ports relatively to said first and second ports, the means for turning the valve including slidably connected pin members and socket members, a rotatable worm gear carrying some of said members and having its axis of rotation coaxial with the axis of the valve, and a manually operated screw meshing with said gear for rotating said gear.

2. An apparatus of the class described, comprising a casing having first and second inlet ports, a sleeve valve movably mounted in said casing and having ports cooperating with said first and second ports, first and second gas-tight chambers, a movable partition separating said chambers, an outlet conduit for the casing communicating with the valve ports and with the first gas-tight chamber, means operatively connecting the movable partition and valve for causing movement of the partition to impart longitudinal movement to the valve, means for turning the valve to circumferentially adjust the valve ports relatively to said first and second ports, the movable partition comprising a gasometer type bell, and sealing members adapted to provide an annulus of sealing liquid into which the skirt of the bell projects.

ROSSWELL W. THOMAS.