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MEANS FOR AND METHOD OF EFFECTING GASEOUS MIXTURES

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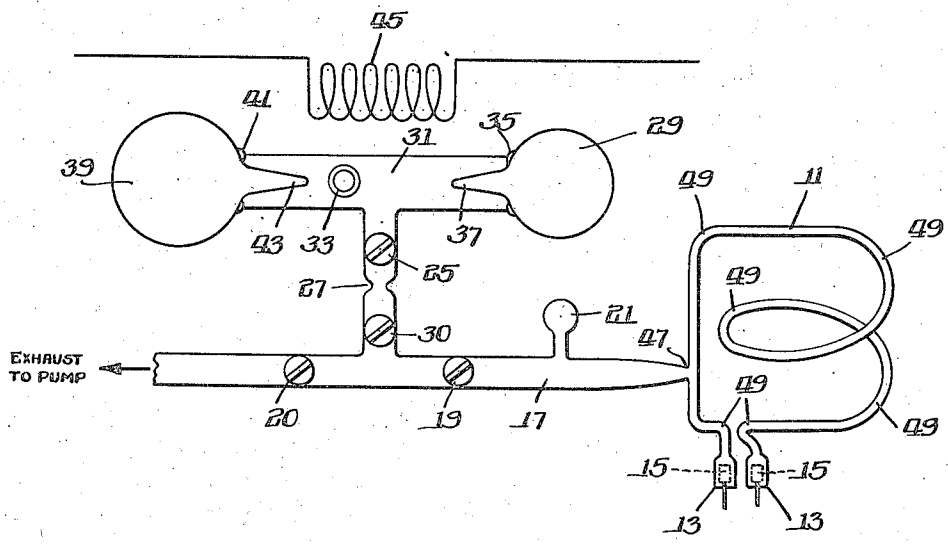

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MEANS FOR AND METHOD OF EFFECTING GASEOUS MIXTURES

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My invention relates in general to gaseous mixtures and has more particular reference to the method of and apparatus for producing a mixture of gases, including a relatively light gas and a relatively heavier gas, in desired proportions, the invention including a means for and method of introducing the predetermined mixture of gases into an envelope to be loaded, as for example the envelope of a gaseous conduction device; and while my present invention has particular utility in the fabrication of gaseous conduction devices, it is not necessarily so restricted.

Gaseous conduction devices have a characteristic tendency to develop inequalities in operating temperature in localized areas in the conduction path. Where mercury vapor is utilized as a conduction medium in devices of the character mentioned, the vapor tends to accumulate and condense in the relatively colder portions of the conduction path. This tendency increases as the external temperature falls, and results in a "spotty" appearance clearly apparent in mercury vapor lamps in outdoor operation in cold weather. I have discovered that this unfavorable lamp condition may be obviated by maintaining the lamp within a ten per cent temperature variation throughout its gaseous conduction path. I propose to accomplish the necessary temperature regulation by incorporating, with the condensible conduction medium, a gas or gases, at least one of which has a relatively high resistance to electrical discharge, even when ionized, so that heat generated by electrical discharge in the gas may serve to maintain the entire conduction path within a temperature range sufficient to prevent segregation or condensation of the mercury in localized areas of the device.

To this end I propose the use of helium, which has a higher resistance to electronic discharge than any of the noble gases, and consequently is well suited for temperature regulating purposes. If, however, an excessive volume of helium is used in the discharge device, excessive heating may result in localized portions of the conduction path and relatively cold spots may thus develop, as for example at the cathode of the device, permitting condensation of the mercury. To overcome this difficulty I may temper the heating effect of the helium by mixing one or more of the other noble gases, such as crypton, or argon, which have a lesser resistance to electronic discharge and consequently generate less heat. I desire, therefore, to employ in the mixture only enough helium to maintain a desired operating temperature, tempering the heating effect of the medium employed by adding in the mixture a suitable quantity of crypton, neon or argon. In certain instances I may even eliminate the use of helium entirely and rely upon the heating effect provided by crypton alone.

Helium is relatively light in weight and difficulty may be encountered in maintaining desired gaseous mixtures of helium and other heavier gases while loading the same in the envelopes of discharge devices. Mixtures of gases of unlike weight tend to stratify and separate in layers comprising the components of the mixture. This may occur in a bomb or receptacle from which the gaseous mixture is delivered into an envelope to be filled, even though the component gases are previously in proper proportions in the bomb, thus making it difficult to maintain the mixture in desired proportions in filling the envelope of the device. An important object of my present invention, therefore, is to provide means for producing and loading a desired mixture of gases, including relatively light and relatively heavy gases, into a sealed envelope, such as the envelope of a discharge device.

Another important object of the invention is to provide an improved method for loading a desired mixture of relatively light and relatively heavy gaseous components into a sealed envelope.

Another important object resides in subjecting a gaseous mixture to the action of electrical impulses for the purpose of exciting the gaseous mixture in order to prevent stratification or separation of the mixture into its component gases.

Another important object is to provide a mixing and loading manifold having attached bombs, each containing a predetermined volume of a component of the mixture to be produced, including means for rupturing the several bombs to permit the contents thereof to enter the manifold and commingle therein.

These and numerous other important objects, advantages, and inherent functions of the invention will be apparent from the following description, which, taken in connection with the accompanying drawing, discloses a preferred embodiment of the invention.

Referring to the drawing:

The single figure of the drawing comprises a diagrammatic illustration of apparatus for loading an envelope, such as that of a discharge device, with a mixture of a relatively light gas, such as helium, and a heavier gas, in definite desired proportions.

To illustrate my invention, I have shown on the drawing a gas mixing and loading device embodying my present invention, the device being shown in position to deliver a gaseous mixture to a receiver to be filled. Although my present invention is not necessarily restricted to the loading of gaseous mixtures in the envelopes of discharge devices, it is however particularly well adapted to such purpose, and I have therefore shown the mixing and loading device in combination with a discharge device 11 comprising an elongated tubular envelope configurated to a desired shape and sealed at its opposed ends to form electrode receptacles 13 containing electrodes 15 of any desired construction. At least one of these electrodes 15 may comprise a "hot" cathode, that is to say, an electrode adapted to function as a permanent, separately excited cathode target, the other electrode, in such case, comprising an anode so that the lamp may be operated as a direct current device with discharge currents flowing from the anode to the cathode target along the line of the intermediate discharge path defined by the envelope 11. The electrodes, however, may be of any desired form and the device may, of course, be operated as an alternating current conduction element.

In order to condition such a device for operation, it is necessary first to evacuate the envelope and cleanse the same of impurities by bombardment, that is to say, by applying a sufficiently high potential between the electrodes to cause discharge through the evacuated envelope between the electrodes. As bombardment continues, impurities are vaporized and drawn off through an exhaust connection 17, by which the envelope is connected with a suitable exhaust pump (not shown). The connection 17 is preferably provided with a valve 19 and suitable means, indicated generally at 21, is or may be provided to permit the introduction of a globule of mercury into the connection 15 and thence into the envelope 11 after bombardment is completed. As heretofore mentioned, I provide means for loading the envelope also with a gas or gases adapted to develop a desired amount of heat in response to electronic discharge in the envelope in order to control or regulate the operating temperature of the device and, where mercury vapor is employed as a conduction medium, to prevent condensation of the mercury in localized portions of the envelope by maintaining a substantially constant temperature throughout the envelope during operation of the device. To this end, I provide loading means including a gas conduit 23 provided with a suitable valve 25 and adapted to be sealed to the exhaust connection 17, as at 27, at a point intermediate the valve 19 and the exhaust pump. If desired, an additional valve 20 may also be employed in the exhaust connection between the point 27 and the pump. Means, including a bomb 29, containing gas to be loaded into the envelope 11, is sealed to the conduit 23, so that, by exhausting the envelope 11 and then closing the valve 20 and opening the valves 19 and 25, gas from the bomb may be admitted into the envelope 11.

It is my purpose, however, to provide for the introduction of a mixture of gases and, to this end, the gas conduit 23 opens laterally into a manifold conduit 31, containing a ball 33 of relatively heavy material, such as steel, said ball being freely movable longitudinally of the manifold 31. The bomb 29 is sealed, as at 35, on one end of the manifold 31 with a frangible bomb portion 37 exposed in the interior of the manifold in position to be broken upon impact by the ball 33. A bomb 39, containing another of the gases to be introduced to the envelope, is sealed as at 41 at the opposite end of the manifold with a frangible portion 43 of said bomb exposed in the manifold in position to be broken upon impact by the ball 33. It will be noted that the bomb 29 is somewhat smaller than the bomb 39. The relative size of the bombs corresponds with the proportions of the gases to be mixed and introduced into the envelope 11. For example, where a mixture of helium and crypton is to be introduced, I may wish to load a mixture comprising one part helium to nine parts crypton so that the bomb 39 will contain say 125 cubic centimeters of crypton while the bomb 29 will contain 13.88 cubic centimeters of helium.

The manifold, with attached bombs and valved conduit 23, is or may be attached to the line 17 during bombardment, which takes place with the valves 19 and 20 open. The valve 25, however, will remain closed. After bombardment is completed, the valve 19 may be closed and the valve 25 opened in order to connect the manifold assembly to the exhaust pump in order to permit the manifold to be evacuated to the bomb seals 37 and 43. After the manifold has been exhausted in this fashion, the valve 25 is closed and the seal at 27 broken to remove the exhausted manifold assembly from the line. By tipping the assembly to alternately impact the ball 33 upon the seals 37 and 43, said seals may be broken to permit the gas to escape from the bombs 29 and 39 and enter the manifold, to the closed valve 25. After breakage of the seals, the manifolds should be maintained in a substantially horizontal position to prevent stratification of the gases.

The manifold assembly may then be re-sealed to the line 17 at 27 and the line exhausted from the pump to the closed valves 19 and 25, after which the valve 20 may be closed and valves 19 and 25 opened to permit the gases to be drawn from the manifold into the exhausted envelope 11. Since the bombs 29 and 39 are in horizontal position and contain gas in the desired proportion, the gases will be drawn from both bombs and will enter the envelope in the desired proportions.

If desired, the manifold may be exhausted and removed from the lines and the bomb seals broken and the manifold replaced ready to load gas before bombardment is accomplished, in which case the mixed gases may be loaded immediately bombardment is completed. Alternately the conditioning of the loading manifold may be carried on contemporaneously with bombardment, providing an additional valve 30 is arranged between the manifold seal point 27 and the exhaust connection 17.

I find it desirable to place the bombs under the influence of a spark coil 45 adapted to generate high frequency impulses in order thus to excite the gas in the bombs. I find that such excitation of the gases seems to prevent stratification of the same in the manifold and facilitates the loading operation.

After the envelope 11 has been loaded with mixed gases and a predetermined quantity of mercury from the mercury loader 21, the envelope may be disconnected from the exhaust connection 17 and sealed at the point 47 in the usual fashion. Before this is done, it is preferable to close the valves 25 and/or 30 and cure the gases in the

envelope 11 by passing discharges in the device between the electrodes 15 for a period of time, during which the envelope is maintained at reduced pressure by keeping the valves 19 and 20 open during the curing operation. When curing is complete, the valve 19 may be closed and the envelope disconnected from the connection 17 as aforesaid.

I find that the foregoing procedure permits the envelope to be filled with a mixture of gases having exact, predetermined constituent proportions. The proportion of gases in the mixture in the envelope 11 is determined by the relative size of the bombs 29 and 39, it being understood, of course, that the bombs 29 and 39 each contain the quantity of constituent gas desired in the final mixture in the envelope 11.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction, and arrangement of the several parts of the illustrated apparatus without departing from the spirit or scope of my invention or sacrificing any of its attendant advantages, the form herein described being merely for the purpose of illustrating the invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is as follows:

1. The method of mixing gases of unequal weights in predetermined proportions, which consists in mingling predetermined quantities of the gases to be mixed and subjecting them to the effects of high frequency excitation to induce ionic activity to prevent stratification of the mixed gases.

2. The method of loading gases of unequal weight into a sealed envelope, which consists in mixing the gases in desired proportions and then loading the same in the envelope while exciting the gases to ionic activity to prevent separation and stratification of the same before the same are introduced into the envelope.

3. Apparatus for mixing gases of unequal weight comprising a mixing manifold, sealed gas bombs connected to said manifold and having each a frangible portion exposed in said manifold, said bombs containing each a gas to be mixed in the manifold, common means for rupturing both of the frangible bomb portions exposed in the manifold whereby to liberate the gases to the manifold.

4. Apparatus for mixing gases of unequal weight comprising a mixing manifold, sealed gas bombs connected to said manifold and having each a frangible portion exposed in said manifold, said bombs containing each a gas to be mixed in the manifold, means for rupturing the frangible bomb portions exposed in the manifold comprising an element freely shiftable in the manifold and adapted to be guided thereby to impact upon the frangible bomb portions.

5. Apparatus for mixing gases of unequal weight comprising a mixing manifold, sealed gas bombs connected to said manifold and having each a frangible portion exposed in said manifold, said bombs containing each a gas to be mixed in the manifold, means for rupturing the frangible bomb portions exposed in the manifold whereby to liberate the gases to the manifold, and means to excite the gases to ionic activity in said manifold.

6. Apparatus for mixing gases of unequal weight comprising a mixing manifold, sealed gas bombs connected to said manifold and having each a frangible portion exposed in said manifold, said bombs containing each a gas to be mixed in the manifold, common means for rupturing both of the frangible bomb portions exposed in the manifold whereby to liberate the gases to the manifold, and means forming a valved outlet from said manifold whereby mixed gases may be delivered from the manifold.

7. Apparatus for mixing gases of unequal weight comprising a mixing manifold, sealed gas bombs connected to said manifold and having each a frangible portion exposed in said manifold, said bombs containing each a gas to be mixed in the manifold, means for rupturing the frangible bomb portions exposed in the manifold comprising a ball freely shiftable in the manifold and adapted to be guided thereby to impact upon the frangible bomb portions.

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