

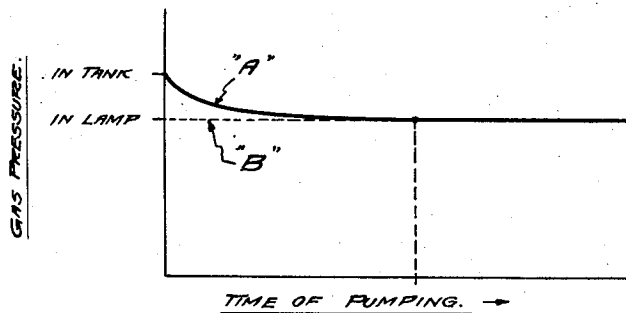
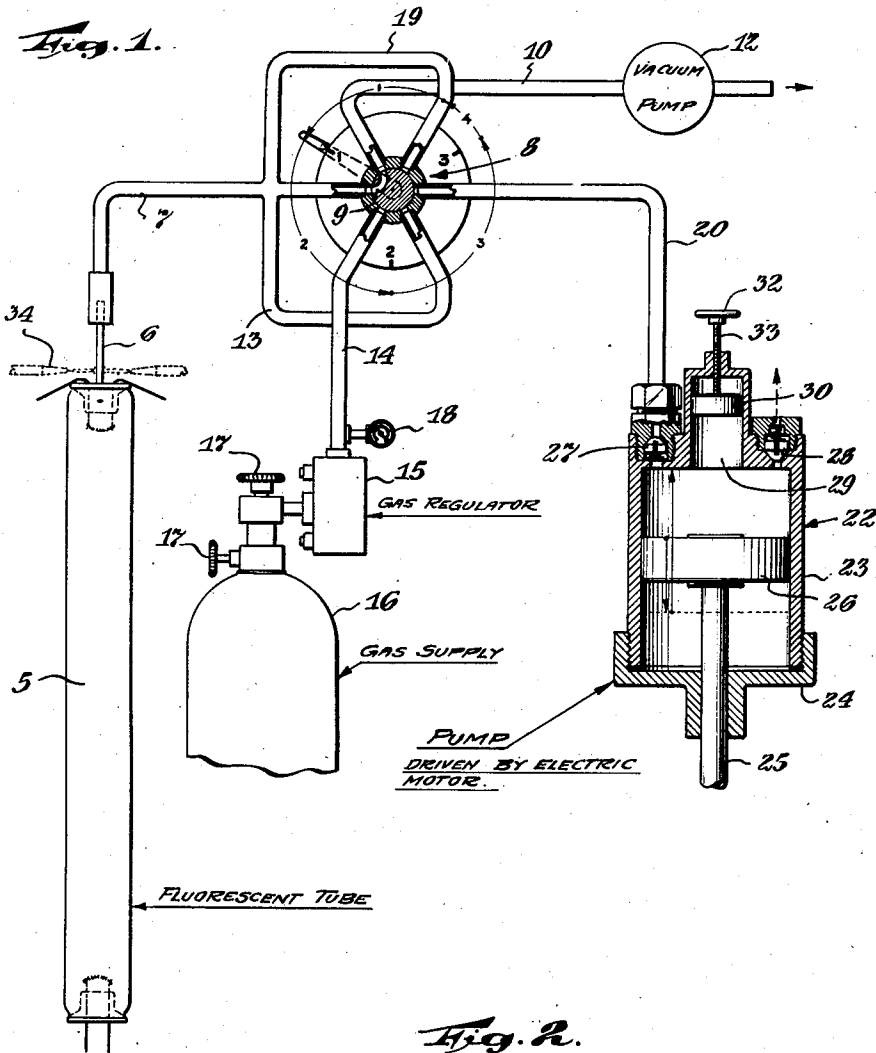
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METHOD AND APPARATUS FOR FILLING ENVELOPES

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METHOD AND APPARATUS FOR FILLING ENVELOPES

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The present invention relates to a method of and apparatus for filling a sealed container, such as an incandescent or discharge lamp as well as other electric energy translation devices, with a gaseous medium at a definite preselected pressure and in its more specific application it relates to a novel pump for controlling the precise pressure at which it is desired to fill the device.

It is well known in the art of electric energy translation devices to fill the device with a gaseous medium for various purposes. For example, it is customary to fill the envelope of an incandescent lamp with an inert gas to reduce vaporization of the filament. Although such a medium is sometimes used in other devices as radio tubes and discharge lamps for the same purpose, a gaseous medium is more generally employed in these latter devices for imparting thereto desired operating characteristics. In many discharge tubes and lamps their operation is dependent not only upon the gaseous medium with which they are filled but more significantly the pressure of the medium since the latter often determines the voltage at which they operate and the current flow therethrough.

For this reason it is imperative that the pressure of the gaseous medium be substantially exact. However, in the prior art this has been a troublesome problem resulting in many devices being rejected in the process of manufacture because of their failure to meet fixed standards of voltage and current due to variation in the gas pressure. To obviate this, rather elaborate and expensive equipment has heretofore been required, in order to assure filling of the device with the gaseous medium at a desired preselected accurate pressure.

It is accordingly an object of the present invention to provide a method of filling a sealed container with a gaseous medium at a precise preselected pressure.

Another object of the present invention is the provision of an apparatus for filling a sealed container with a gaseous medium at a precise preselected pressure.

Another object of the present invention is the provision of an apparatus of relatively simple and economical construction for filling a sealed container with a gaseous medium at a precise preselected pressure.

A further object of the present invention is the provision of a pump for controlling the precise pressure of the gaseous medium with which the electric energy translation device is filled.

Still further objects of the present invention

will become obvious to those skilled in the art by reference to the accompanying drawing wherein:

Figure 1 is more or less of a schematic illustration of the apparatus of the present invention and showing the most essential parts in cross-section, and

Figure 2 is a graphic illustration showing the relationship of gas pressure to time of pumping.

Referring now to the drawing in detail, the apparatus as shown in Fig. 1 is connected to a discharge lamp 5, such as what is now known to the art as a fluorescent lamp, which is to be exhausted and filled with a gaseous medium as argon, neon, or the like, to facilitate starting of a discharge therein, and since the starting voltage is dependent on the pressure of the gas, the latter must be substantially exact.

The exhaust stem 6 of the lamp 5 is connected by a tube 7 to a three-way valve, shown generally at 8. In what is indicated as the first position of the valve 8 a substantially U-shaped port 9 establishes communication between the tube 7 and a tube 10 leading to a vacuum pump 12 for the purpose of evacuating the lamp 5. After complete exhaust of the latter the valve 8 is turned to position 2 which thus shifts the port 9 so that communication is established between a tube 13, constituting a branch of the tube 7 leading to the lamp 5, and a tube 14 extending through a gas pressure regulator 15 to a source of supply such as a tank or cylinder 16. The valves 17 are regulated so that the lamp 5 is filled with gas from the cylinder 16 to a pressure slightly in excess of that finally desired for the lamp which pressure will be indicated by the gauge 18.

Next the valve 8 is rotated to its third position so that the port 9 will establish communication between another tube 19, also constituting a branch of tube 7 leading to the lamp 5, and a further tube 20 leading to a pump 22. Although this pump may be of the rotary or piston type it is shown as comprising a cylinder 23 provided with a detachable head 24 through which a piston rod 25 extends to a piston 26 within the cylinder 23, the piston rod being reciprocated by an electric motor (not shown). The opposite closed end of the cylinder 23 is provided with a spring pressed inlet valve 27 aligning with the tube 20 and a similar type outlet valve 28 which exhausts to the atmosphere.

The closed end of the cylinder 23 is provided with an extension forming a compression chamber 29 containing a piston 30 which is adjustable within the chamber 29 by means of a control knob 32 and threaded shaft 33 for the purpose of alter-

ing at will the capacity of the compression chamber 29 and hence the volume of the gas therein. Although the compression chamber 29 is shown as an integral part of the pump 22 it may be separate therefrom but connected with the pump by a conduit when desired so that a standard pump may be utilized. On the other hand the capacity of the cylinder 23 is fixed at some definite figure of say 1000 c. c.

Whenever it is desired to fill a lamp at a given pressure the lamp, as above mentioned, is filled at a pressure in excess of that required. The pump 22 is then operated to pump the gas into the cylinder 23 after which the volume is decreased by compression with some of the gas being exhausted to the atmosphere through the outlet valve 28, while the remainder is trapped and compressed within the compression chamber 29. When the volume of the compressed gas within the compression chamber 29 is finally such that when expanded to the whole volume of the cylinder 23 it is at the same pressure as that within the lamp 5, equilibrium is established and no further reduction in gas pressure can result.

This may be better appreciated from the following formula:

$$P_A V_A = P_B V_B$$

wherein

P_A = Pressure in compression chamber 29

V_A = Volume of compression chamber 29

P_B = Pressure in cylinder 23

V_B = Volume of cylinder 23

When equilibrium is established for a given condition then:

$$(760 \text{ mm.}) (1 \text{ c. c.}) = (.76 \text{ mm.}) (1000 \text{ c. c.})$$

due to the fact that the capacity of cylinder 23 is fixed and hence the volume of the expanded gas is about 1000 c. c., while the pressure in the compression chamber 29 is fixed at atmospheric pressure of 760 mm. thus establishing a definite ratio between the pressure and volume of the gas in the cylinder 23 and the pressure and volume of the gas in the compression chamber 29.

Assuming it is desired to fill the lamp 5 at a pressure of 4 mm. the lamp is first filled from the tank 16 at a pressure of say 6 mm. In order to ascertain the required volume for the compression chamber 29 when a pressure of 4 mm. is desired in the lamp 5 the above formula is then applied as follows:

$$V_A \times 760 \text{ mm.} = 4 \text{ mm.} \times 1000 \text{ c. c.}$$

which gives

$$V_A = \frac{(4)(1000 \text{ c. c.})}{760}$$

or

$$V_A = 5.26 \text{ c. c.}$$

Having thus determined the required capacity or volume for the compression chamber 29, the control knob 32 is then rotated so as to move the piston within the chamber 29 until this desired capacity or volume of 5.26 c. c. is obtained. To facilitate such adjustment the threads on the shaft 33 may have a definite pitch and number per inch corresponding to a desired capacity or volume in cubic centimeters within the chamber 29 and a suitable gauge or other indicia provided on the shaft 33 will reveal at a glance the volume within the chamber at any position of the shaft 33.

During the suction or intake stroke of the piston 26 gas from the lamp 5 (at 6 mm. pressure) is drawn into the cylinder 23 and upon the com-

pression stroke inlet valve 27 closes and outlet valve 28 opens exhausting the gas from the cylinder 23 to the atmosphere except for the volume compressed in the chamber 29. Continued reciprocation of the piston thus withdraws gas from the lamp 5 and exhausts it to the atmosphere until the volume of gas (approximately 5.26 c. c.) compressed within the chamber 29, when expanded to whole volume of the cylinder 23, equals the pressure desired in the lamp or 4 mm. pressure, at which time equilibrium is established since the pressure in the lamp 5 is equal to the pressure of the expanded gas within the cylinder 23 and continued operation of the pump 22 will have no effect on further reduction of gas pressure. The lamp 5 is then sealed-off in the customary manner such as by applying fires 34 to the exhaust stem 6 after which the lamp is ready for basing and complete fabrication.

This may be appreciated by reference to the graph of Fig. 2 wherein the ordinate represents gas pressure and the abscissa time of pumping. The curve A indicates the pressure of the gas in the tank, i. e., initial filling of the lamp at a pressure in excess of that desired, and the line B indicates the preselected desired pressure in the lamp. After a few minutes of pumping the pressure is decreased from that of the initial filling to that desired and, as shown, continued pumping has no further effect on the final lamp pressure, as previously mentioned.

It thus becomes obvious to those skilled in the art that a method of and apparatus for exhausting and filling the envelope of an electric energy translation device with a gas at a precise preselected pressure is herein provided. Moreover, this is accomplished primarily by utilizing a pump provided with an adjustable compression chamber so that the area of the chamber can be regulated to preselect the volume of the gas trapped therein. When such gas is expanded to the whole volume of the adjacent connecting cylinder it will finally be pumped to a pressure equal to that preselected for the envelope of the device.

Although one specific embodiment of the present invention has been shown and described it is to be understood that still further modifications thereof may be made without departing from the spirit and scope of the appended claims.

We claim:

1. The method of filling the envelope of an electric energy translation device with a gas at a preselected definite pressure comprising filling the envelope with gas from a source of supply and at a pressure in excess of the desired preselected pressure, pumping the gas from the envelope into a normally closed chamber of definite capacity, compressing a preselected volume of the pumped gas within the chamber while exhausting the remainder until the pressure of such preselected volume when expanded to the definite fixed volume of the chamber equals the pressure desired in the envelope, and sealing-off the envelope.

2. The method of filling the envelope of an electric energy translation device with gas at a preselected definite pressure comprising filling the envelope with gas from a source of supply and at a pressure in excess of the desired preselected pressure, pumping the gas from the envelope into a normally closed chamber of definite volumetric capacity, cyclically compressing a preselected volume of the pumped gas within the chamber while exhausting the remainder and expanding such volume to the definite fixed volume of the chamber until equilibrium is established between

the pressure of the expanded fixed volume and the pressure in the envelope, and sealing-off the envelope.

3. An apparatus for filling the envelope of an electric energy translation device with a gas at a definite preselected pressure comprising a source of gas supply connected to said envelope for filling the latter with gas at a pressure in excess of that desired, means for pumping gas from said envelope into a normally closed chamber of definite volumetric capacity to decrease the pressure in said envelope, and means for compressing a preselected volume of said gas within said chamber while exhausting the remainder during pumping of said envelope which compressed volume when expanded to the definite fixed volume of said chamber finally establishes a pressure equilibrium with the preselected pressure desired in said envelope after which said first mentioned means becomes automatically ineffective to further decrease the gas pressure in said envelope.

4. An apparatus for filling the envelope of an electric energy translation device with a gas at a definite preselected pressure comprising a gas supply connected to said envelope for filling the latter with gas at a pressure in excess of that desired, and means connected to said envelope for reducing the initial filling pressure within said envelope to that preselected including a pump provided with a cylinder having a predetermined fixed volume and operable to decrease the pressure in said envelope, a compression chamber communicating with the cylinder of said pump for compressing a preselected volume of said gas

while exhausting the remainder during pumping which compressed volume when expanded to the whole volume of the cylinder of said pump finally establishes a pressure in equilibrium with the desired preselected pressure in said envelope thereby rendering said pump ineffective to cause a further decrease in the pressure within said envelope.

5. An apparatus for filling the envelope of an electric energy translation device with a gas at a definite preselected pressure comprising a gas supply connected to said envelope for filling the latter with gas at a pressure in excess of that desired, and means connected to said envelope for decreasing the initial filling pressure within said envelope to that preselected including a pump provided with a cylinder having a predetermined fixed volume and an intake valve for decreasing the pressure in said envelope, an outlet valve for said pump to exhaust said gas to the atmosphere, a compression chamber communicating with the cylinder of said pump for compressing a preselected volume of gas during exhaustion thereof to the atmosphere, and said pump being operable to expand the preselected volume of gas to the whole volume of its cylinder until the pressure of the expanded volume establishes equilibrium with the pressure in said envelope rendering said pump thereafter ineffective to further reduce the pressure in said envelope and thus fixing the pressure in said envelope at that desired.

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