G. CLAUDE.

NEON TUBE.

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1,189,664.

Patented July 4, 1916.

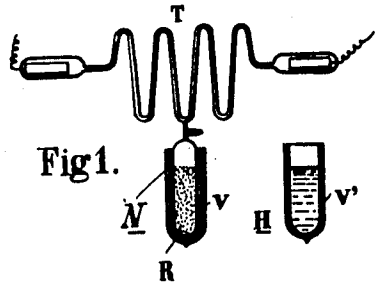


Fig.1.

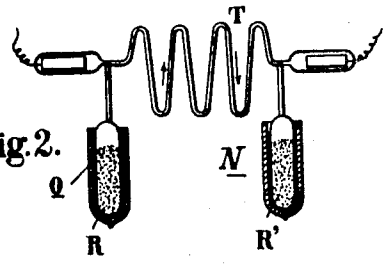


Fig.2.

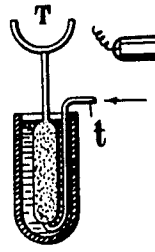


Fig.3.

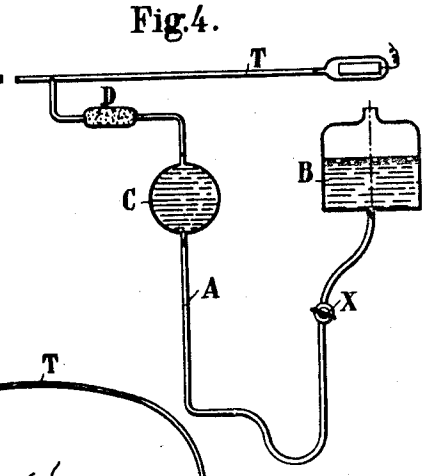


Fig.4.

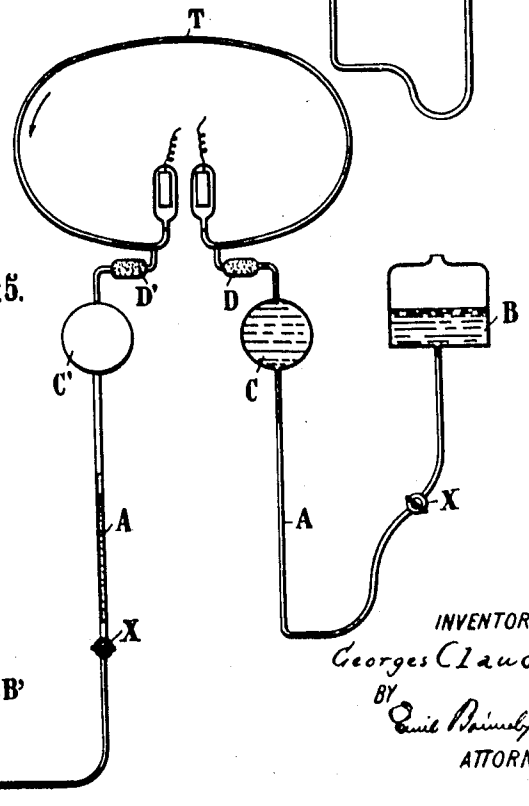


Fig.5.

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NEON-TUBE.

1,189,664. Specification of Letters Patent. Patented July 4, 1916.

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To all whom it may concern:

Be it known that I, GEORGES CLAUDE, a citizen of the Republic of France, and resident of Boulogne-sur-Seine, France, have invented new and useful Improvements in or Relating to Neon-Tubes, which improvements are fully set forth in the following specification.

It is well known now that the maximum degree of luminosity which neon possesses can only be obtained in the lighting tubes if the gas is in a highly pure condition. According to a known process, this high degree of purity may be obtained by providing the tube with one or more receptacles containing charcoal; and when the tube has been freed from its impurities by the action of vacuum and current, and then has been charged with neon to the desired degree and sealed, the receptacle, or receptacles, are plunged into liquid air and a current passed therethrough. Under these conditions, and owing to diffusion, all the impurities freed by the passage of the current between the electrodes, are gradually deposited upon the charcoal, and, after a greater or less length of time, the tube is finally completed. Now diffusion, however, acts very slowly, and this slowness increases rapidly when the pressure increases and the diameter of the tubes decreases. Forming a tube having a diameter of 7 millimeters and charged with neon under a pressure of 10 millimeters in cold condition, is practically impossible.

The present invention has for its object to improve these conditions of formation, by completing or replacing the action of the diffusion by bodily, and repeatedly displacing the atmosphere of the tube toward the purifying chambers or receptacles.

By using charcoal receptacles having a capacity such that the quantity of neon inclosed therein represents several times the quantity contained in the atmosphere of the tube, and by passing the current through intermittently, the results will be improved considerably, because under these conditions the heating and the cooling of the gas in the tube bring about a very appreciable respiration, so to speak, between the tube and the charcoal, and conversely. This method, apart from the fact that the gaseous displacement affects each time only a fraction of the atmosphere, has the drawback that since the impurities are liberated only upon the passage of the current, the portion of the atmosphere which is driven back is almost pure neon, while the impurities accumulate in the remaining portion. This method, although adequate for tubes having a large diameter, is not sufficiently rapid for small tubes. This is particularly true in the frequently occurring case where the passage of the current, notwithstanding a very strong treatment before the charge of neon, liberates considerable quantities of impurities, producing a blue light whose spectrum has a luminous base which shows, in addition to the hydrogen lines, certain special lines the easiest to be observed being 516.5 line. In this case, and with tubes having a diameter of 6 or 7 millimeters, the formation may be prolonged to a very great extent in spite of the use of a plurality of charcoal receptacles, and thus involves an expenditure of current and liquid air, storage of material, and considerable expense incurred for supervision.

According to a more effective method, diffusion is completely abandoned as a means for the transport of the gaseous molecules; and the passage of the current is no longer relied upon to convey the impurities toward the purifying chamber, but is employed solely for liberating the impurities. In this case, the tubes, previously charged with the desired quantity of neon, are formed by exclusively utilizing physical or mechanical means which permit the rapid displacement of the entire impure gaseous contents of the tube, instead of merely a small portion thereof, as aforesaid, toward the purifying chamber, and conversely. The purifying chamber or chambers will most frequently comprise a receptacle or receptacles made of cold charcoal, but they may also contain suitable chemical re-agents such as magnesium, lithium, either heated or not, and so on. The entire impure atmosphere thus comes into contact with the purifying material, is freed from its impurities thereat, and returns in a purified condition to the tube where it is again charged with impurities, under the action of the current; and the cycle is completed. These steps may be carried out as rapidly as desired, the formation of the smallest tubes under the highest pressure being thus rendered very rapid. As will be explained hereinafter, it is even possible to create in the tube a real circulation extending over several times the capacity of the tube and dealing only with the previously-charged gases, because no extraneous gases can be intro-

duced since there is no communication with the outside atmosphere.

In the accompanying drawings Figs. 1 to 5 show several ways in which the process according to the present invention may be carried out.

One method of carrying these displacements of the impure atmosphere into effect may be realized, as indicated in Fig. 1, by providing a source of cold more intense than liquid air such as, for example, liquid hydrogen. The tube T to be formed is provided with the charcoal receptacle R, and is subjected as usual to the action of the vacuum and current, and then charged with such a quantity of neon that after immersion in liquid air, the pressure will be adequate. Current is again passed through, as soon as possible; and when the gas has again become impure, the vessel V' filled with liquid hydrogen is substituted for the vessel V filled with liquid air in which the charcoal receptacle is immersed. The gas is then rapidly absorbed and when, in turn, liquid nitrogen is substituted for hydrogen, pure neon is evolved, while the impurities remain in the charcoal. After the operation has been repeated a sufficient number of times, the tube is formed and may be separated from the charcoal.

No liquid hydrogen is required to establish a circulation of pure neon through the tube, as this has been rendered possible for the following reasons:—It has been observed that at the temperature of liquid oxygen, the charcoal can still retain with a sufficient tenacity, the impurities freed when the tube is treated; for instance, hydrogen, hydrocarbons and the like. The quantity of neon which the charcoal can retain at a given pressure, however, is about three times less than that at the temperature of liquid nitrogen. One way of utilizing this property, consists as shown in Fig. 2, in providing the tube to be formed with two charcoal receptacles R, R' located at its ends. The tube is purified by the vacuum pump and current, then charged with neon to the desired extent and closed, and then one of the receptacles is plunged into liquid oxygen and the other into liquid nitrogen. After a few moments, the positions of the two receptacles are very rapidly reversed, an additional receptacle of liquid being used if necessary, in order to effect the substitution. A considerable quantity of pure neon is evolved in the tube, and moves from the oxygen to the nitrogen; then the current may immediately be passed through to free the impurities. The receptacles are again reversed, the circulation taking place in the opposite direction, and so on until purification is completed. In either of these methods, it is obvious that other cold-producing materials may be used.

The charges of neon may be effected when the charcoal receptacles are already immersed in the liquid air, (Fig. 3); and in this case, it is advisable that the gas should be introduced by a suitable pipe t through the bottom of the receptacle, so as to traverse the cold charcoal and give off its impurities before reaching the tube. Owing to this arrangement, no disturbances are caused by air entering through valves or the gage, should the latter be maintained on the tube until entirely isolated. The above-described physical means for displacing the gaseous atmosphere may be replaced by suitable mechanical means combined, if necessary, with a chemical purifying means.

Fig. 4 illustrates one way in which a process similar to the liquid hydrogen process above-described, can be carried into effect. By lowering the container B, the sphere C is emptied of its mercury, the capacity of this sphere being large relatively to the volume of air contained in the tube T. This air is therefore caused to traverse the chamber or space D filled with suitable purifying materials, such as cold charcoal or calcium, lithium and the like, either heated or not. The container B being then raised, pure neon is discharged into the tube, and the operation is repeated a sufficient number of times to insure purification.

Finally, Fig. 5 also shows by way of example, how mechanical means may be used in a process similar to those carried out with liquid oxygen and liquid nitrogen.

The mercury containers B and B' secured to the two ends of the tube A are suitably operated in opposite directions so as to create a vacuum alternately in one of the spheres C and C', while compression takes place in the other. The impure gas of the tube is thus caused to circulate alternately in the tube from one to the other of the purifying chambers D and D', so that the tube is rapidly formed. The tubes A illustrated in Figs. 4 and 5, may be made of rubber and provided with stop valves X for the purpose of maintaining the level of the mercury after each operation.

Claims:

1. A process for forming luminous neon tubes partially purified by vacuum and by an electric current and previously charged with the required amount of neon, essentially consisting in displacing the entire polluted atmosphere of the tube by using means other than the electric current, the displacement taking place toward a purifying chamber connected to the tube, displacing the purified atmosphere from the purifying chamber toward the tube to be formed, liberating the fresh impurities under the action of the electric current, repeating the above-described displacements until the tube

is entirely formed, and then separating the purifying chamber from the formed tube.

2. A process for forming luminous neon tubes partially purified by vacuum and by an electric current and previously charged with the required amount of neon, essentially consisting in securing a charcoal purifying receptacle to the tube, absorbing the entire atmosphere of the tube by immersing the purifying receptacle in a bath of liquid hydrogen, displacing the purified atmosphere again by immersing the said receptacle in a bath having not so low a temperature, setting further impurities free by means of an electric current, repeating the above-described immersions alternately until the tube is entirely formed, and then separating the purifying chamber from the formed tube.

3. A process for forming luminous neon tubes partially purified by vacuum and by an electric current and previously charged with the required amount of neon, essentially consisting in connecting each end of the tube to a charcoal purifying receptacle, alternately dipping one of the receptacles in liquid oxygen and the other in liquid nitrogen, displacing the impurities set free by the current toward the coldest receptacle, repeating the above-described immersions alternately until the tube is entirely formed, and then separating the purifying chamber from the formed tube.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

GEORGES CLAUDE.

Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."