NEON SIGN CONSTRUCTION

By ROBERT M. EWING, '32

During the past few years so many new inventions have been developed that it would be impossible for any one person to keep track of all of them. However, among the most notable of these is one which few people living in or near cities have failed to see. I am speaking of the neon sign, which is probably the greatest single development in the field of sign advertising since electricity was first used for this purpose. Anytime during the day or night on the business streets of a town or city may be seen these flaming red tubes spelling out the name of a firm, a product or a hotel. On a hill near Portland, Oregon, is one of these signs spelling the word "Richfield" in a row of letters sixty feet high and seven hundred twenty feet wide. The sign can be read for more than twenty miles.

Among the advantages of this type of sign over the ordinary type of electric sign is the fact that it is much more economical, as it draws very little current and will almost never wear out. Furthermore, the glass tubing used in the signs can be blown into almost any shape desired. Words are written out in script, or printed separately, and designs are made to suit. The Standard Oil Company of California has its service stations outlined with neon tubes, showing the stations up very advantageously.

Neon tubes are also used quite extensively in airport beacons, because the orange-red light which neon provides is peculiarly able to penetrate fog. Often neon beacons can be seen for ten or twenty miles through a haze when other lights are invisible. Likewise, the gas is used in instruments for high voltage indicators, lightning arresters, and ignition gauges. Its ability to light up and go out quickly makes it useful in television receivers. It is also used in tubes to detect radio waves and in photo-electric or other light sensitive cells.

Before going into the details of the construction and operation of the present type of sign it might be interesting to learn a little about its history. During the first part of the twentieth century many scientists, notable among them Burton, Waus Moore and Georges Claude, experimented quite extensively to find a method of lighting by passing a high voltage current through glass tubes which had been evacuated and then filled with gases at different pressures.

Moore, after experimenting for twelve years, made the first successful lamp of this kind at Newark, New Jersey in 1904. This lamp consisted of a glass tube 1¾ inches in diameter and 180 feet long. The air pressure in the tube was reduced to 1/1000 of an atmosphere and into each end was sealed a carbon electrode. When a potential of 15,000 volts was impressed across the electrodes, the tube glowed with a pale pink hue. One of the disadvantages of this type of lamp was that the air pressure had to be kept the same all the time. This was difficult because the rarefied air tended to combine chemically with the carbon electrodes.

Moore also made lamps filled with carbon dioxide, nitrogen, and other gases. The carbon dioxide lamp is still in use in a modified form, its length having been reduced to 2½ feet. It gives an excellent light for color matching, its light having the same color value as daylight.

The French scientist, Claude, made the discovery that a tube filled with neon and with electrodes in the ends would give off a bright reddish-orange light when a high voltage current was passed through it. He had it patented and holds the patents at the present time.

The gas itself is worthy of a brief study. It is one of the rare elements and was discovered in 1898 by Sir Walter Ramsey working with Morris Williams Travers. As soon as it became evident that helium and argon were members of the same group of elements, search was made for an element whose atomic weight would place it between helium and argon and just before sodium. For this purpose 18 liters of argon gas were prepared from liquid air and condensed to a liquid. By several distllations of this liquid, the element neon was isolated from the more volatile portion. The gas was not again obtained in pure form until 1910; consequently, its development has been very slow. It was at first thought that the gas would be useless commercially because it was very inactive and formed no compounds.

Neon occurs in the atmosphere in the proportion of one volume to about fifty-five thousand volumes of air. It is also found in some samples of natural gas and in gases evolved from certain hot springs. It is very hard to obtain in pure form because it collects in the middle fractions of the air which are the most difficult to purify. Claude's method was by the use of a fractionating column.

Neon and helium are alike in many respects although neon shows a greater variation from the expected values than any other member of the family. Watson has determined that a liter of neon weighs 0.9002 gram under normal conditions. In the behavior of neon one curious phenomenon appears which shows a relation to its action in the signs. When it is shaken or heated unequally with mercury a marked red glow appears. This is because of a difference of potential developed, sufficient to produce a glow in the neon on account of its high conductivity.

The first step in the manufacturing of the signs is to have the art department paint a picture of what is desired by the customer. In this way the customer can see that he is going to get what he wants, before any actual construction is done. The picture is then sent to the glass blowers who, by a combined heating and blowing process, twist the glass into the fantastic shapes required to make the advertising text. The next step in the operation is that of adding the electrodes to the tubes. They are small pieces of copper tubing one inch in diameter. These copper tubes are sealed in glass tubes, only slightly larger than the copper tubes and a lead brought through the glass. Provision is then made for removing the air. The electrode with the enclosing sealed case is placed

(Continued on Page 20)

NEON SIGN CONSTRUCTION

(Continued from Page 5)

in a strong magnetic field and the copper is heated to a red heat. This drives off the occluded gas and the impurities of the copper.

Now comes the assembling. The seal on the end of the electrode opposite that through which the lead is brought out is opened and the electrode welded to the tube forming the letters. When an electrode has been fastened to each end, the tubing is connected to a Langmuir condensation pump and as near a vacuum is reached as is possible. After this is done a quantity of neon gas is allowed to enter the tube. It is then sealed and put on a testing rack.

Usually the signs are made from more than one set of tubing. This not only makes it easier for the glass blower, but also prevents the possibility of one break causing the loss of all the gas contained in the sign. While on the testing rack all foreign matter and impurities are burnt out of the tubing as these would cause the light to be a pale pink in color.

The signs are made in three colors. The ordinary color is bright reddish-orange and it is obtained when the pressure is approximately nine microns. If a trace of mercury vapor is added and the pressure is increased to about twenty microns the light is blue. When the blue light is produced in an amber color tube the light becomes green. After the tubing has been taken from the testing rack it is mounted on the metal signs by means of glass insulators. The electrodes are bent at right angles to the tubing and are hidden from sight behind the metal sign front. A special transformer is supplied with the signs. It steps the voltage up from 110 or 220 volts to 14,000 volts and has taps for securing intermediate voltages. The average sign takes approximately 14,000 volts.

Neon gas is bought in thin-walled glass bulbs each containing about a quart, and costing approximately $20.00. A pound of the gas would cost about $10,000.00. However, this high cost of neon is balanced by the fact that very little of the gas is necessary to make a sign and the signs take such a small amount of current. That neon is more practical for this purpose than argon is shown by the following statements: A Moore tube filled with neon containing a little helium consumed 0.26 watts per Hafner candle, while a similar tube filled with argon consumed 45 watts. Neon lamps containing as much as 25 per cent helium are as efficient as those containing pure neon. It has been found that a neon lamp produces one hundred times as much luminosity for the same current consumption as can be obtained by using argon.

The neon sign has proved itself to be more efficient in every way than the old style electric signs and there is every reason to believe that before many years it will entirely supplant the old type. Work is now being done to find a method whereby the neon sign principle can be used for domestic illumination.

He—"I just got a set of balloon tires."

She (eagerly)—"Why, George I didn't know you had a balloon."—Motor.