INFRARED BURNERS
CHAPTER 9

INFRARED BURNERS

Conventional burners, that is all those we have examined thus far, liberate heat as a result of conduction and convection, that is via some matter (fumes) loaded with heat energy (temperature).
Another industrial heating method exploits the principle of heat transfer via radiation. This method requires the use of special burners, the so-called infrared burners. Though these burners work basically on the same principle as gas radiant panels, they must not be confused with them as their working features and results are very different.
Infrared energy is high-frequency electromagnetic radiation, whose wave length is higher than the wave length of the visible light. The radiating energy spreads just like light waves and is reflected or refracted according to optical laws.
All bodies when they are heated emit infrared radiation. Above the temperature of 700 °C they send out energy characterized by a shorter wave length and become luminous, yet most calorific energy is still liberated in the form of infrared radiation. Radiation, as we have already said, differs from convection and conduction in that it does not need the presence of any matter (solid, liquid or gaseous matter) for heat transfer.
When infrared rays are absorbed by a body, the temperatyre of the body increases. The medium through which the radiating energy is sent out (for instance air) is not heated though.

Infrared burners are usually made up of either steel or cast-iron receiving a mixture of gas and air in the proprtion usually comprised in the range from 80% to 100% of the theory, at a pressure comprised in a range from 6 to 50 mm H_2O. The radiant screen is applied onto one of the walls of the chamber. The nature and form of the screen may be very different as well as the way it is applied onto the wall. Some screens are made of porous ceramic material. In this case the mixture goes through the pores of the material and then catches fire along the walls of the ceramic material.
Some others are provided with screens made of a very thin network of Inconel. Also in this case the mixture catches fire with an almost invisible flame along the surface of the network on the outer wall of the mixture distributing chamber.
Other burners are provided with nozzles of different forms and areas on the same screen. The flame which comes out of the nozzles bumps into a refractory mass which becomes incandescent and acts like a radiating screen.
Each one of the above mentioned burners has different working features, a different use, advantages and disadvantages. They are usually made up of small elements but can be, more or less easily, combined one with the other, so as to cover practically unlimited surfaces. They are provided with conventional air-gas mixing systems which we have already examined.

INFRARED BURNERS: APPLICATIONS

Many industrial processes which need temperatures of up to 430 °C absorb heat from infrared radiation more easily than from convective or conductive sources. The quantity of radiating energy converted into calorific energy depends on different factors and basically:

1) the capacity of the material to be treated to absorb radiation or viceversa to refract them;
2) the type of emitted radiation that is its wave length;
3) the distance between the receiving item and the emitting source.

When choosing the best heat transmission mode to adopt in an industrial process, the desired temperature and the absorbtion coefficient of the radiating energy of the material are very important. As a matter of fact every material absorbs radiation of a specific wave length more easily than others. For most industrial processes the wave lengths ranging from 2 to 6 microns are the most adequate. Industrial burners with a screen made of Inconel send out 92% of the radiation in a wave length field above 2 microns, that is the invisible field. The only limit of this type of burners is their working temperature, which must not exceed 430 °C. For higher temperatures, burners equipped with ceramic fiber must be used instead though they send out less infrared radiation and more visible radiation at shorter wave length.

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Generally speaking, infrared burners equipped wih a metal screen are used with materials featuring a good absorbtion coefficient and for low temperatures, whereas ceramic fiber burners are used with materials featuring a rather low absorbtion coefficient and for temperatures up to 1,200 °C.

Infrared burners are used mainly in drying processes (drying and evaporation), melting or softening, flashing and cooking processes and many other applications.

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As the amount of heat per radiating unit is rather high, it is often necessary to leave some room between one radiating unit and the other. In this case some adequately inclined glasses made of aluminium alloys or chrome steel, designed to make the temperature distribution more even and homogeneous are usually placed in the empty room.

Specific devices moreover exploit the calorific energy of the fumes which allow for better results and a more homogeneous distribution of the temperature.

Sometimes, in order to enhance the conductive effect of fumes, special systems designed to blow fresh air are used. The blowing of fresh air following a particular mechanical criterion is aimed at cooling the manifolds and mixing chambers particularly when the radiating units are upside down, that is with the radiant surface are face down. In this case the metal parts of the burners are subject to the thermal effects of the fumes going upwards, and may cause the mixture to exceed 600 °C and hence result in explosion hazard.

The use of infrared burners makes the production of ovens easier as very often it is only necessary to provide (above the burner track) an aspirating hood for combustion products, an adequate blowing system and protection screens in insulated sheet-metal.