COMBUSTION EQUIPMENT

Introduction

Export Award winner in 1987, Le Four Industriel Belge (FIB), Belgium, specialises in the design and manufacture of gas-fired equipment based on a combustion technique which employs a mixture of air and gas to ensure full control of furnace atmosphere. Customers for FIB products include clients in the glass, wire, ceramic, and thermal treatment sectors world-wide.

Premix Heating Equipment

Premix has been in industrial use over many years in wire work installations; glass work fore hearths, feeders, melting furnaces, and lehrs; brick firing tunnel kilns; pottery and ceramic car bottom kilns; non-ferrous melting furnaces; heat treatment furnaces; autoclaves, etc.

Premix permits the proportion of air and gas to be precisely regulated by a "Constan mixer". With only simple adjustments, this type of multi-gas equipment makes it easy to obtain a mixture of air and gases for all the burners that heat a given area of a furnace. A single premix unit, composed of a constant mixer and a BZR gas governor, can feed various burners all doing their work under the same set of conditions.

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According to requirements, they can provide:

- Complete stoichiometric combustion
- Complete combustion with excess of air
- Complete combustion with excess of gas

This obviously affords definite advantages over the use of separate air-gas burner types.

Energy Savings: Facts and Figures

If an installation requires a calorific power of 720,000kcal/h, a capacity that will produce sufficient heat for the process and compensate for various neat losses, the exhaust gases produced will have a temperature of 1,100°C.

An installation heated by separate air-gas burnere

This type of burner - stoichiometrically difficult to control – usually operates with 10 per cent excess air. In these conditions, and at that temperature, combustion efficiency is 43 per cent.

Thus the required heat production is equivalent to 720,000kcal/h ÷ 0.43 = 1,674,418kcal/h. If a gas such as CH4 is used, the hourly consumption of gas will be: 1,674,418 ÷ 7,561 = 221.45kcal/Nm. (CH4 gas has a calorific value of less than 7,561kcal/Nm).

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An installation heated by FIB premix burners

Under conditions identical to the above, it is possible to obtain a stoichiometry with the use of the "Constan mixer" combined with a BZR gas governor. In this case, combustion efficiency will reach 48 per cent. The quantity of necessary gas will be 720,000kcal/h ÷ 0.48 = 1,500,000kcal/h. Hourly consumption will be 1,500,000 ÷ 7,561 = 198.38kcal/Nm, for a gas economy of 11.6 per cent.

The FIB Constant Mixer

The FIB constant mixer is a static device that operates in combination with a BZR gas governor to automatically provide a mixture of air and gas. The ratio between the two constituents remains constant over a range of flow rates varying from 1 to 15.

Acting only on the flow of air, it automatically mixes the gas in the correct proportions over the entire range of flows.

The FIB constant mixer is also a proportional mixer that furnishes a mixture of constant composition, independent of the pressure in the collector supplied by the mixer and of the cross - sectional output of the burners, or of the number of burners supplied by this collector.

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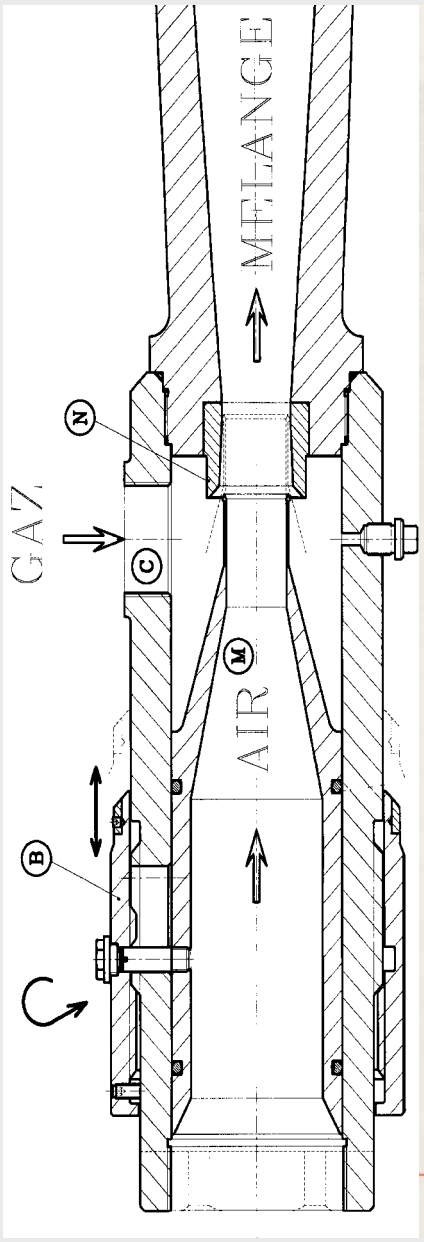

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As a result:

- The "Constan mixer" can operate at any mixing pressure. Thus, there is no constraint to the operating pressure;
- With the "Constan mixer", a number of burners and variations in the flow rates to those burners can be accommodated, without the need to adjust the proportions of air and gas that remain constant;
- The proportions of air and gas supplied by the constant mixer are not affected by the variations in pressure that may occur in a furnace.

FIB IMP Burners

With FIB premix impulsion burners Type IMP, there is no flame in the furnace. Complete combustion takes place within the burner block prior to the ejection of the totally burnt hot gases into the furnace cavity. This jet of burnt gas - moving at very high-speed due to combustion thermal expansion and the narrow burner block exit - aspirates and combines with the existing furnace atmosphere. However, since total combustion occurs within the burner block, the mixture of gases produced by the burner jet and those prevailing in the furnace contains no combustible components. No secondary reaction will occur. Thus, if the burner has been adjusted to provide a reducing exhaust into the furnace cavity, the furnace atmosphere will remain reduced. Carburising reactions may be increased in the latter zones of the furnace by injecting, under accurate control, a suitable hydrocarbon that will yield ionised methane.

When FIB premixed impulsion burners, a carefully controlled and controllable reducing atmosphere can be obtained with absolutely no decarburisation of the wire surface.

As a matter of demonstrated fact, a carburising environment can be obtained by injecting propane into the last zone of the furnace.

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FIB also produces a wide range of Premix burners for various applications, with features for ignition, flame control, and refractory housing for installation on existing furnaces. FIB premix burners cover an output range from 6,000 to 440,000kcal/h per unit. They assure full combustion in the burner block, with flame precluded from the furnace chamber.

TE and TESE Safety Heads

FIB has developed a safety head that works as an explosion relief device to discharge the overpressure in the burner manifold and avoid any hazard to the equipment and piping.

All FIB safety heads will relieve any pressure over 1,500mmWC (1.75psi). Standard models comprise three sizes: 11/2" and 2" BSP threaded; 3" BSP threaded; and DN80 flanged. TE is the standard model, while TESE is provided with a micro-switch.

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Proving the Theory

When one of FIB's customers changed the primary fuel from propane to natural gas on a patenting furnace for prestressed concrete wire, certain phenomena occurred.

The furnace was equipped with the patented FIB combustion system, consisting of "Microconstan mixers" and IMP burners which had been adjusted to provide a slightly reducing atmosphere in the furnace. All input rod scale was deposited in the first and second zones of the furnace, and the patented output wire was free of oxidation.

With the conversion to natural gas, after one day of service the customer observed the presence of oxides in the third zone, which was nearer the furnace exit. Believing that this condition was caused by lean mixture at the burners and attendant oxidising atmosphere, the customer adjusted the mixers to provide more gas to the burners, in the expectation of achieving a reducing furnace atmosphere. But oxide production increased. After two days, the opening at the furnace exit was almost totally choked with scale.

Immediately dispatched to the customer's facility, FIB technicians established that the excess gas with insufficient air was such that combustion was no longer completed inside the impulsion burners. It continued in the furnace, as would be the case with ordinary(classic) burners. The mixers were thereupon adjusted to reduce the gas excess and ensure that complete combustion occurred within the burner block, not in the furnace. Everything re turned to normal for the production of patented wire free of oxidation.

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Conclusions

This example demonstrates the success of FIB direct-fired patenting and annealing furnaces heated by means of impulsion burners Type IMP. FIB furnaces are able to submit the wires simultaneously to thermal treatment and/or chemical surface treatment without any risk of oxidation or decarburisation of the wire surface.

The process imparts:

- Heating of rod without decarburising;
- Desoaping and surface preparation for zinc adherence in the case of annealed-galvanised wires;
- Desoaping, austenitising, or annealing of wires with high carbon content.

The stability of chemical properties in the atmosphere in FIB furnaces is obtained by feeding the burners with a gas/air premixture precisely controlled by the company's "Microconstan mixers". These are the only mixers on the mark et that ensure a constant air/gas ratio within a burner output range of 1 to 10, no matter what counter pressure is exerted in the furnace.

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