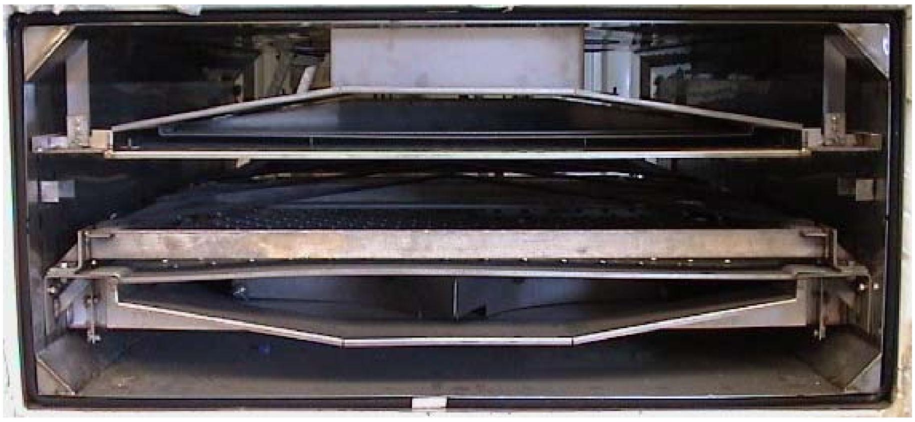
OPERATION



Contents

1 OVEN OPERATION

1.1 GENERAL

Our starting point being a new heat-transfer principle, impingement, and the possibilities of controlling humidity, we have developed a new type of hot air oven. Depending on the properties of the product, energy efficiency can rise by up to 30% in relation to conventional ovens.

1.2 PRINCIPLE

Impingement means “penetrate, infringe upon”. The impingement system is one of high air speeds and turbulence at the point at which the product is to be baked or dried. In the new oven, the air is aimed directly on and under the product by means of nozzles (see figure 3.1). This continual air stream then breaks through the outer layer of the product and results in an improved heat transfer and better moisture removal. A higher speed and greater turbulence around the product leads to a greater heat transfer and in that way a quicker processing time.

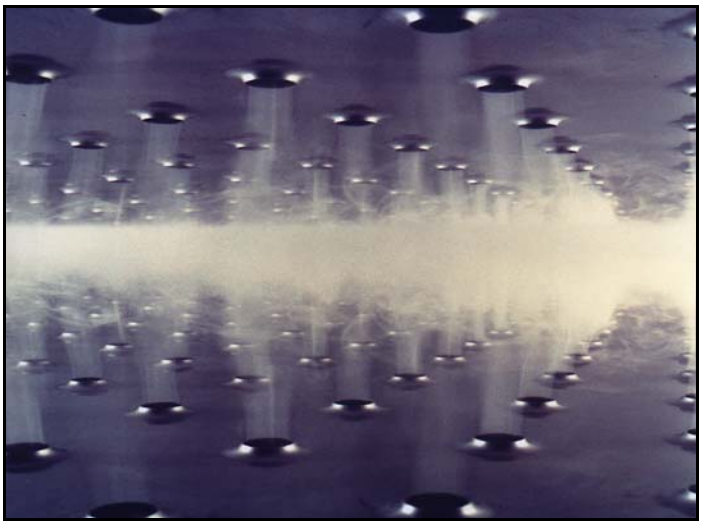


Figure 3.1 Nozzle operation

1.3 PROCESS

The process air is guided over the exchanger by means of two parallel switched circulation fans. After the exchanger, the air comes to a valve section which distributes the air over the upper and lower channels (plenums). The valves can be opened and shut steplessly by servo motors. These can also set the air speed from the nozzles for both the upper and lower plenum.

Figure 3.2 Servo motors for valves

In addition, there is the possibility of setting the process temperature and varying the speed of the circulation fans.

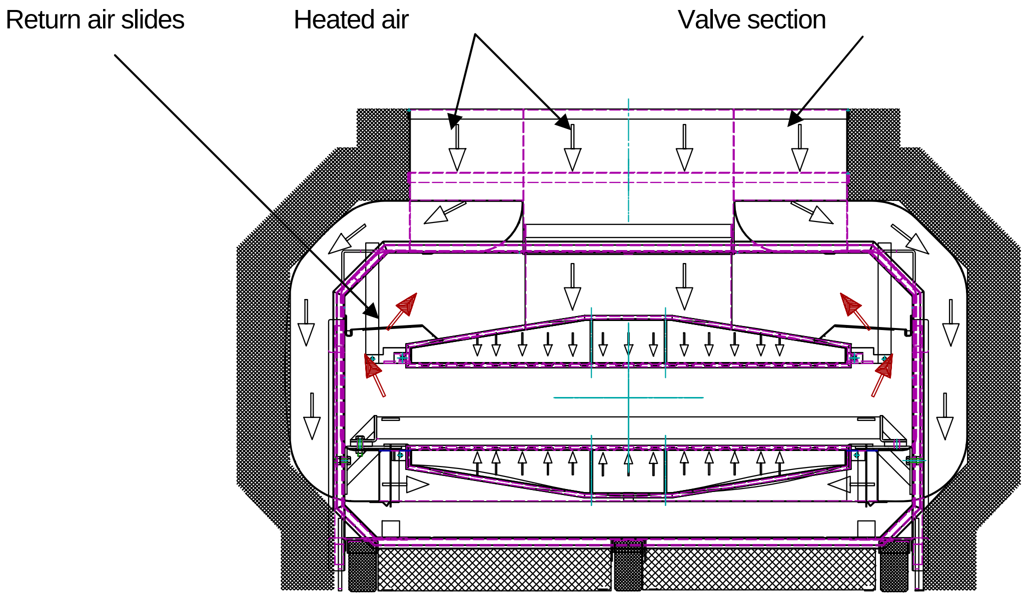


Figure 3.3 Basic module

It is thus possible to set the desired baking curve. Using the control valves, the ratio of upper to lower air can be controlled. By varying the speed of the circulation fans, the discharge speed can be controlled by the nozzles, and by varying the process temperature, the desired baking temperature for each zone can be set.

The system is provided with a differential pressure switch which controls the flow over the heat exchanger. The pressure differential over the exchanger must be a minimum of 3 mmWk (0,3mbar) and is monitored using a diaphragm switch.

1.4 BURNER

The burner installed in the oven is an atmospheric burner. The burner is provided with an electrically operated gas supply valve, ignition and a burner unit. This automatic burner ensures ignition, control of the gas valve and flame monitoring. Combustion air is supplied by a controlled fan.

During operation, the burner flames are continuously monitored.

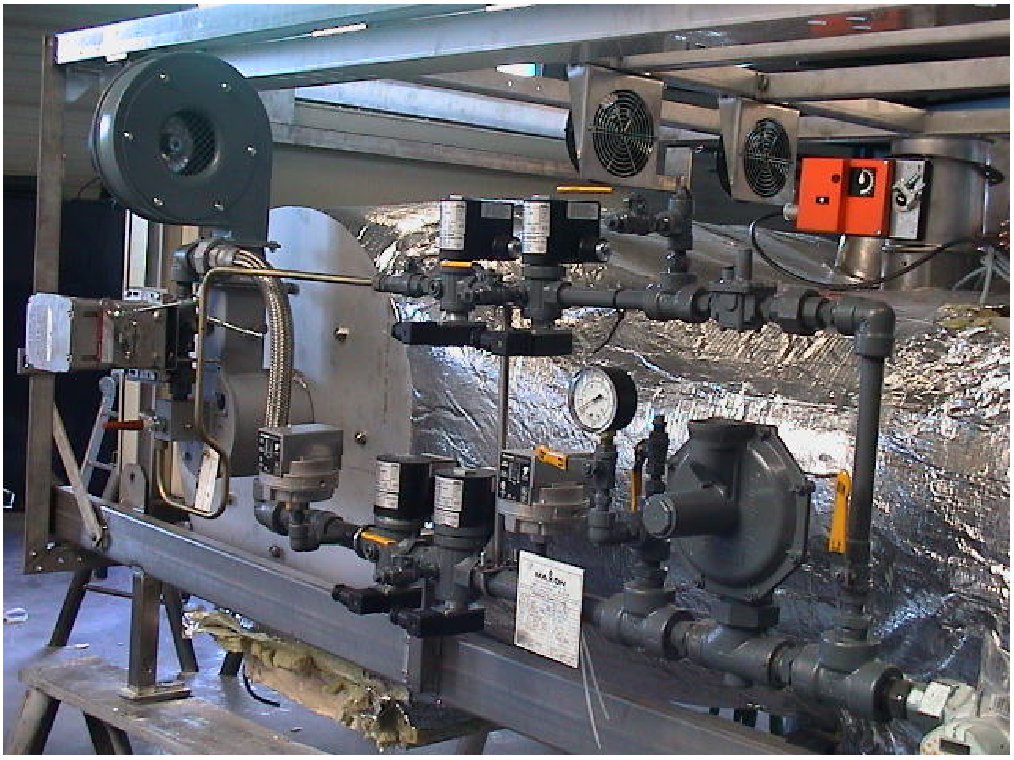


Figure 3.4 Burner + Gas line

1.4.1 GAS SUPPLY

The gas supply system consists of:

- main stop valves
- filter
- solenoid valve
- governor
- gas pressure pressostats

The burner is constructed to function best at the supply pressure present, ± 10%. See chapter 2, Technical connection data).
The reducing valve ensures, at sufficient pressure, a constantly reduced pressure.
The filter in the gas supply system collects any possible impurities to protect the sensitive equipment from damage.
Especially with new pipes or after repairs there is the danger of impurities. During normal operation the chance of contamination of the filter is remote.
The gas pressostats monitor the pressure in the gas supply line.

1.4.2 BURNER AIR SUPPLY

Fresh air is necessary for the combustion of gas. This is supplied by the so-called burner air supply fan.

The operation of the fan is continually monitored by a differential pressure switch, mounted on the burner.
Good functioning of the air supply is also a pre-requisite for the gas supply. In case of a failure the gas supply to the oven is closed.

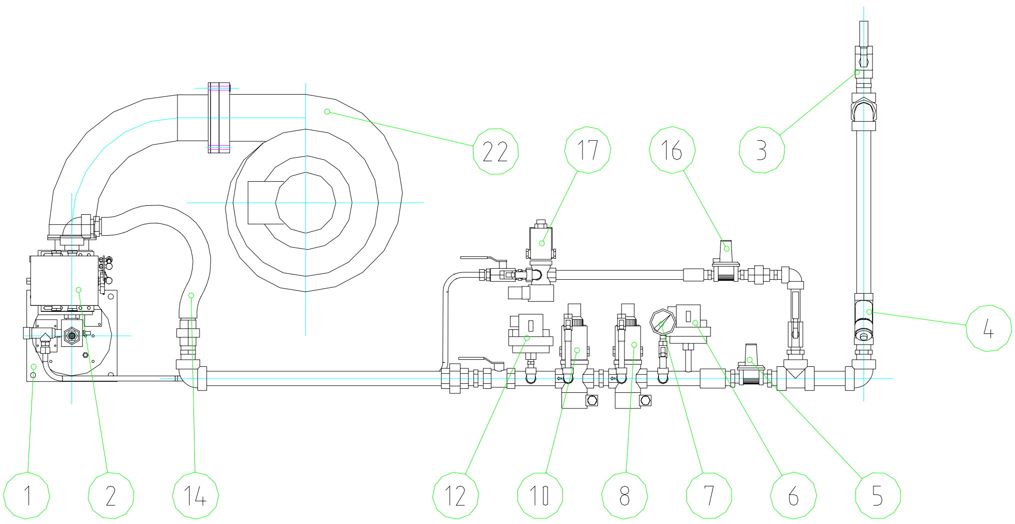


Figure 3.5 Example of a Gas line

Key to the Nos.

1	gas burner
2	servo motor
3	shut-off cock
4	gas filter
5	governor
6	minimum pressure switch
7	pressure gauge
8	electro-magnetic switch
10	electro-magnetic switch
12	maximum pressure switch
14	gas pipe (flexible)
16	governor light
17	control valve light
22	burner air fan

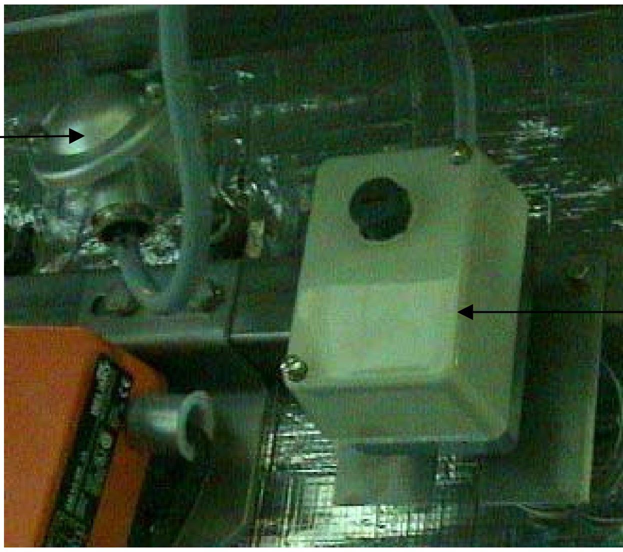
1.5 TEMPERATURE CONTROL

By means of very sensitive sensors, the PT 100 elements, the temperature in each section is measured. The values of these measurements are digitally indicated on the control panel, for all oven sections.
If the measured value differs from the set value, the temperature will be adjusted on receiving the signals.

A temperature detector and a maximum thermostat for control and safety are located in the process air channel.

The temperature needed to reach the required baking curve can be set via the electronic temperature controllers. This controls the air temperature in the heat exchanger for each burner and indirectly the heating area temperature in the sections governed by the burner.

PT100



ATHf

Figure 3.6 PT 100 and maximum thermostat

1.6 MOISTURE MANAGEMENT

The drying time can be very accurately controlled due to the controlling of the moisture content in the oven.
For an even development and even baking surface, it is necessary that a balance be struck between evaporation of moisture on the surface and moisture transport from core of the product.
The drying time can be controlled by the temperature, air speed and/or moisture content of the process air.
These are the three control parameters needed to create the correct baking characteristics in the oven.
Colouring, crispness and the ultimate moisture content can be easily controlled, guaranteeing a constant product quality. This guarantees constant product quality.

To get a desired moisture content an extra steam supply can be necessary, depending on the product.
In general this steam supply is applied in the first section of the oven.
The condensation of the steam in the first part provides a good warming up of the product. Also it prevents a dehydration of the crust.

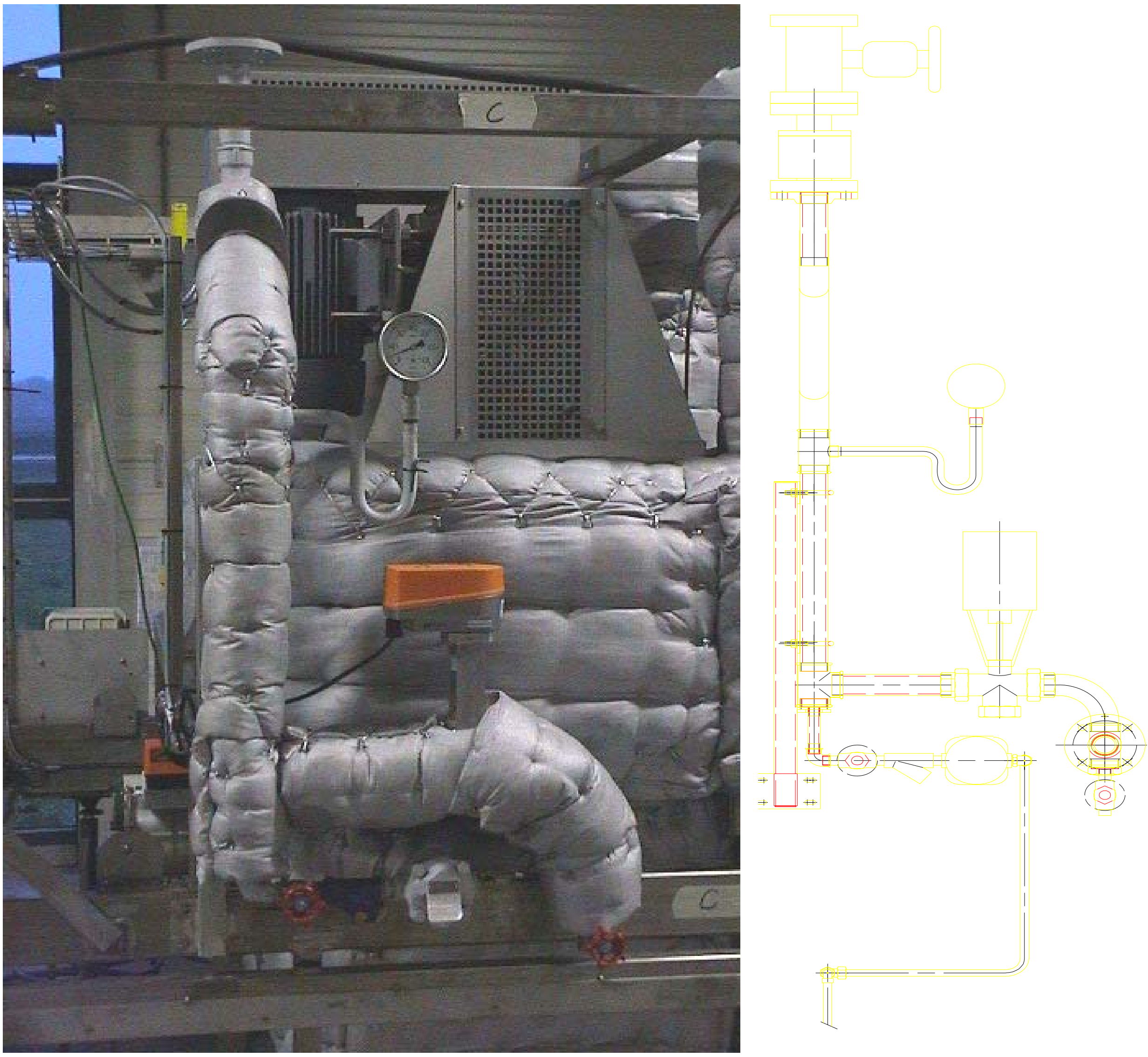


Figure 3.7 Steam unit

The moisture control is based on the measurement of the oxygen percentage in the process air (baking air).This percentage oxygen can be to a absolute humidity (in gr/kg). This absolute humidity will be related to a particular dew point.
With this measuring unit the moisture content of the process air can be controlled in a accurate way.

If the moisture content becomes too high, the vapour discharge valve and fresh air supply valve will be automatically opened. This ensures that the system remains balanced and no excessive over or under pressure is created in the circulation system.
If the moisture content becomes too low, steam is injected , if steam injection is present, and the (vapour) air discharge/supply valves are closed.

Figure 3.8 Vapour discharge valve

IMPORTANT

During operation, it is not permitted to bake with a closed control valve section for the upper and lower heat.
This causes damage within a very short time to the heat exchanger and burner.
The pressure cut-out and maximum thermostat will switch off the burner.

1.7 PRODUCT TRANSPORT MEANS AND TENSIONING GEAR

1.7.1 WIRE MESH BELT

The product to be baked is transported through the oven on a stainless steel wire mesh belt, type MTR. In combination with the special made drive roll and guide roll this is a so called Precision Self-Tracking Belt Systems. The fine-meshed spiral belt, in which the left and right wound spirals are connected by corrugated, specially treated cross-wires, is made according to the Flat Seat design. With this balanced Flat Seat, the hinge is designed with a flat, broad contact area. Each spiral hinge is accurately matched and precisely seated to its cross rod to prevent continuous rubbing of metal to metal. This reduces camber, wear and elongation, which increases belt life. The ends of the cross-wires are welded.

The specifically designed rolls are designed for high volume process conveyors and high temperature execution.
The rolls are creating a positive drive, self tracking, engineered to accommodate expansion/contraction and used in USDA approved environments.

The wire mesh belt must always be evenly loaded relative to the width of the oven. Uneven loading leads to misalignment of the conveyor and uneven baking.

1.7.1.1 Tensioning gear

To achieve sufficient friction between the conveyor and the drive pulley, a tension pulley has been fitted.
The wire mesh belt is tensioned by a pneumatic tensioning unit fitted in the oven output. This keeps the belt at the correct tension.
The belt remains at the correct tension if the oven is heated to operating temperature. The tension on the conveyor must not be greater than necessary to prevent slipping in a fully loaded warm oven.
If the tensioning unit has reached the end of the tensioning course, an alarm is sounded. It is possible that the correct belt tension has not yet been achieved. The length of the mat must be reduced.
If the oven cools off, the tensioning pulley is automatically (pneumatically) loosened, as otherwise the conveyor will be under too much pressure as a result of contraction.

Two cylinders, fitted either side of the exit, apply the necessary tension to the tensioning roller.
The tensioning roller consists of an internally bearing-mounted roller with a gear rack system. This guarantees exact and straight running of the roller.
The pneumatic line consists in the main of cocks, pressure-reducing units and pressure monitors. The system can be made pressureless by means of turning back the reducing valves R1 and R2. To re-adjust the system, see chapter 8.

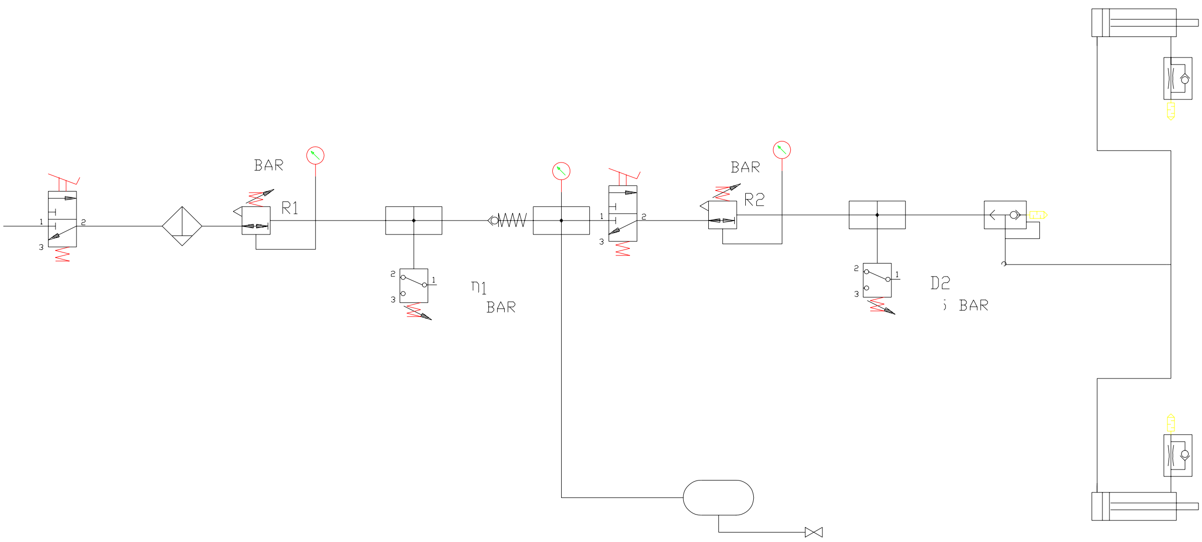


Figure 3.9 Pneumatic diagram

If the supply pressure falls away during operation, a fault message will appear. If there is sufficient pressure in the pressure vessel circuit, the oven will remain in operation.
Too low pressure in the pressure vessel circuit will result in an error message and the oven will stop.

1.8 DRIVE

The oven drive is achieved by means of a frequency-regulated three phase motor. This consists of a standard motor, the speed of which is set by the frequency regulator in the switch/control box.
The three phase motor drives a reduction gearbox via a V-belt transmission which reduces the speed to a desired level. A description of this reduction gearbox is included in the Appendix (Technical information – parts). The reducer is fitted directly to the drive pulley.

1.8.1 EMERGENCY MOTOR

If, as the result of a fault, the drive no longer functions, the oven can be emptied using the emergency motor.
Before this can happen, the V-belt of the three phase motor/reducer must be diverted to the emergency motor reducer.
Then connect the motor to a 480 V connection.