

***RN510 - RN515***  
***RN520 - RN525***

***Progressive, Fully-modulating***

***Heavy oil Burners***

MANUAL OF INSTALLATION - USE - MAINTENANCE

***CIB UNIGAS***

BURNERS - BRUCIATORI - BRULERS - BRENNER - QUEMADORES - ГОРЕЛКИ

## DANGERS, WARNINGS AND NOTES OF CAUTION

**THIS MANUAL IS SUPPLIED AS AN INTEGRAL AND ESSENTIAL PART OF THE PRODUCT AND MUST BE DELIVERED TO THE USER.**

**INFORMATION INCLUDED IN THIS SECTION ARE DEDICATED BOTH TO THE USER AND TO PERSONNEL FOLLOWING PRODUCT INSTALLATION AND MAINTENANCE.**

**THE USER WILL FIND FURTHER INFORMATION ABOUT OPERATING AND USE RESTRICTIONS, IN THE SECOND SECTION OF THIS MANUAL. WE HIGHLY RECOMMEND TO READ IT.**

**CAREFULLY KEEP THIS MANUAL FOR FUTURE REFERENCE.**

### 1) GENERAL INTRODUCTION

- The equipment must be installed in compliance with the regulations in force, following the manufacturer's instructions, by qualified personnel.
- Qualified personnel means those having technical knowledge in the field of components for civil or industrial heating systems, sanitary hot water generation and particularly service centres authorised by the manufacturer.
- Improper installation may cause injury to people and animals, or damage to property, for which the manufacturer cannot be held liable.
- Remove all packaging material and inspect the equipment for integrity.

In case of any doubt, do not use the unit - contact the supplier.

The packaging materials (wooden crate, nails, fastening devices, plastic bags, foamed polystyrene, etc), should not be left within the reach of children, as they may prove harmful.

- Before any cleaning or servicing operation, disconnect the unit from the mains by turning the master switch OFF, and/or through the cut-out devices that are provided.
- Make sure that inlet or exhaust grilles are unobstructed.
- In case of breakdown and/or defective unit operation, disconnect the unit. Make no attempt to repair the unit or take any direct action.

Contact qualified personnel only.

Units shall be repaired exclusively by a servicing centre, duly authorised by the manufacturer, with original spare parts.

Failure to comply with the above instructions is likely to impair the unit's safety.

To ensure equipment efficiency and proper operation, it is essential that maintenance operations are performed by qualified personnel at regular intervals, following the manufacturer's instructions.

- When a decision is made to discontinue the use of the equipment, those parts likely to constitute sources of danger shall be made harmless.
- In case the equipment is to be sold or transferred to another user, or in case the original user should move and leave the unit behind, make sure that these instructions accompany the equipment at all times so that they can be consulted by the new owner and/or the installer.
- For all the units that have been modified or have options fitted then original accessory equipment only shall be used.
- This unit shall be employed exclusively for the use for which it is meant. Any other use shall be considered as improper and, therefore, dangerous.

The manufacturer shall not be held liable, by agreement or otherwise, for damages resulting from improper installation, use and failure to comply with the instructions supplied by the manufacturer. The occurrence of any of the following circumstances may cause explosions, polluting unburnt gases (example: carbon monoxide CO), burns, serious harm to people, animals and things:

- Failure to comply with one of the WARNINGS in this chapter
- Incorrect handling, installation, adjustment or maintenance of the burner
- Incorrect use of the burner or incorrect use of its parts or optional supply

### 2) SPECIAL INSTRUCTIONS FOR BURNERS

- The burner should be installed in a suitable room, with ventilation openings complying with the requirements of the regulations in force, and sufficient for good combustion.
- Only burners designed according to the regulations in force should be used.
- This burner should be employed exclusively for the use for which it

was designed.

- Before connecting the burner, make sure that the unit rating is the same as delivery mains (electricity, gas oil, or other fuel).
- Observe caution with hot burner components. These are, usually, near to the flame and the fuel pre-heating system, they become hot during the unit operation and will remain hot for some time after the burner has stopped.

When the decision is made to discontinue the use of the burner, the user shall have qualified personnel carry out the following operations:

- a Remove the power supply by disconnecting the power cord from the mains.
- b Disconnect the fuel supply by means of the hand-operated shut-off valve and remove the control handwheels from their spindles.

#### Special warnings

- Make sure that the burner has, on installation, been firmly secured to the appliance, so that the flame is generated inside the appliance firebox.
- Before the burner is started and, thereafter, at least once a year, have qualified personnel perform the following operations:
  - a set the burner fuel flow rate depending on the heat input of the appliance;
  - b set the flow rate of the combustion-supporting air to obtain a combustion efficiency level at least equal to the lower level required by the regulations in force;
  - c check the unit operation for proper combustion, to avoid any harmful or polluting unburnt gases in excess of the limits permitted by the regulations in force;
  - d make sure that control and safety devices are operating properly;
  - e make sure that exhaust ducts intended to discharge the products of combustion are operating properly;
  - f on completion of setting and adjustment operations, make sure that all mechanical locking devices of controls have been duly tightened;
  - g make sure that a copy of the burner use and maintenance instructions is available in the boiler room.
- In case of a burner shut-down, reset the control box by means of the RESET pushbutton. If a second shut-down takes place, call the Technical Service, **without trying to RESET further**.
- The unit shall be operated and serviced by qualified personnel only, in compliance with the regulations in force.

### 3) GENERAL INSTRUCTIONS DEPENDING ON FUEL USED

#### 3a) ELECTRICAL CONNECTION

- For safety reasons the unit must be efficiently earthed and installed as required by current safety regulations.
- It is vital that all safety requirements are met. In case of any doubt, ask for an accurate inspection of electricians by qualified personnel, since the manufacturer cannot be held liable for damages that may be caused by failure to correctly earth the equipment.
- Qualified personnel must inspect the system to make sure that it is adequate to take the maximum power used by the equipment shown on the equipment rating plate. In particular, make sure that the system cable cross section is adequate for the power absorbed by the unit.
- No adaptors, multiple outlet sockets and/or extension cables are permitted to connect the unit to the electric mains.
- An omnipolar switch shall be provided for connection to mains, as required by the current safety regulations.
- The use of any power-operated component implies observance of a few basic rules, for example:
  - do not touch the unit with wet or damp parts of the body and/or with bare feet;
  - do not pull electric cables;

- do not leave the equipment exposed to weather (rain, sun, etc.) unless expressly required to do so;
- do not allow children or inexperienced persons to use equipment;

● The unit input cable shall not be replaced by the user.

In case of damage to the cable, switch off the unit and contact qualified personnel to replace.

When the unit is out of use for some time the electric switch supplying all the power-driven components in the system (i.e. pumps, burner, etc.) should be switched off.

### 3b) FIRING WITH GAS, LIGHT OIL OR OTHER FUELS

#### GENERAL

- The burner shall be installed by qualified personnel and in compliance with regulations and provisions in force; wrong installation can cause injuries to people and animals, or damage to property, for which the manufacturer cannot be held liable.
- Before installation, it is recommended that all the fuel supply system pipes be carefully cleaned inside, to remove foreign matter that might impair the burner operation.
- Before the burner is commissioned, qualified personnel should inspect the following:
  - a the fuel supply system, for proper sealing;
  - b the fuel flow rate, to make sure that it has been set based on the firing rate required of the burner;
  - c the burner firing system, to make sure that it is supplied for the designed fuel type;
  - d the fuel supply pressure, to make sure that it is included in the range shown on the rating plate;
  - e the fuel supply system, to make sure that the system dimensions are adequate to the burner firing rate, and that the system is equipped with all the safety and control devices required by the regulations in force.
- When the burner is to remain idle for some time, the fuel supply tap or taps should be closed.

#### SPECIAL INSTRUCTIONS FOR USING GAS

Have qualified personnel inspect the installation to ensure that:

- a the gas delivery line and train are in compliance with the regulations and provisions in force;
  - b all gas connections are tight;
  - c the boiler room ventilation openings are such that they ensure the air supply flow required by the current regulations, and in any case are sufficient for proper combustion.
- Do not use gas pipes to earth electrical equipment.
  - Never leave the burner connected when not in use. Always shut the gas valve off.
  - In case of prolonged absence of the user, the main gas delivery valve to the burner should be shut off.

#### Precautions if you can smell gas

- a do not operate electric switches, the telephone, or any other item likely to generate sparks;
  - b immediately open doors and windows to create an air flow to purge the room;
  - c close the gas valves;
  - d contact qualified personnel.
- Do not obstruct the ventilation openings of the room where gas appliances are installed, to avoid dangerous conditions such as the development of toxic or explosive mixtures.

## DIRECTIVES AND STANDARDS

### Gas burners

#### European directives:

- Directive 2009/142/EC - Gas Appliances;
- Directive 2006/95/EC on low voltage;
- Directive 2004/108/EC on electromagnetic compatibility

#### Harmonised standards :

- UNI EN 676 (Gas Burners;-EN 55014-1Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus.
- CEI EN 60335-1(Household and similar electrical appliances - Safety. Part 1: General requirements;
- EN 50165 (Electrical equipment of non-electric appliances for household and similar purposes. Safety requirements.
- EN 60335-2-102 (Household and similar electrical appliances. Safety. Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections)

### Light oil burners

#### European directives:

- Directive 2006/95/EC on low voltage;
- Directive 2004/108/EC on electromagnetic compatibility

#### Harmonised standards :

- CEI EN 60335-1(Household and similar electrical appliances - Safety. Part 1: General requirements;
- UNI 267 Automatic forced draught burners for liquid fuels
- EN 55014-1Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus.
- EN 50165 (Electrical equipment of non-electric appliances for household and similar purposes. Safety requirements.

#### National standards :

- UNI 7824: Monobloc nebulizer burners for liquid fuels. Characteristics and test methods

### Heavy oil burners

#### European directives:

- Directive 2006/95/EC on low voltage;
- Directive 2004/108/EC on electromagnetic compatibility

#### Harmonised standards :

- CEI EN 60335-1 Household and similar electrical appliances - SafetyPart 1: General requirements;
- EN 55014-1Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus.
- EN 50165 Electrical equipment of non-electric appliances for household and similar purposes. Safety requirements.

#### National standards :

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### Gas - Light oil burners

#### European directives:

- Directive 2009/142/EC - Gas Appliances;
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- UNI EN 676 Gas Burners
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**National standards :**

-UNI 7824: Monobloc nebulizer burners for liquid fuels. Characteristics and test methods

**Industrial burners**

**European directives:**

- Directive 2009/142/EC - Gas Appliances;

- Directive 2006/95/EC on low voltage;

- Directive 2004/108/EC on electromagnetic compatibility

**Harmonised standards :**

-EN 55014-1 Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus.

-EN 50165 Electrical equipment of non-electric appliances for household and similar purposes. Safety requirements.

-UNI EN 746-2: Industrial thermoprocessing equipment

**Burner data plate**

For the following information, please refer to the data plate:

- burner type and burner model: must be reported in any communication with the supplier
- burner ID (serial number): must be reported in any communication with the supplier
- date of production (year and month)
- information about fuel type and network pressure

Type	--
Model	--
Year	--
S.Number	--
Output	--
Oil Flow	--
Fuel	--
Category	--
Gas Pressure	--
Viscosity	--
El.Supply	--
El.Consump.	--
Fan Motor	--
Protection	--
Drwaing n°	--
P.I.N.	--

**SYMBOLS USED**

 **WARNING!** Failure to observe the warning may result in irreparable damage to the unit or damage to the environment

 **DANGER!** Failure to observe the warning may result in serious injuries or death.

 **WARNING!** Failure to observe the warning may result in electric shock with lethal consequences

## PART I: INSTALLATION

### Burner model identification

Burners are identified by burner type and model. Burner model identification is described as follows.

Type (1)	Model (2)	N. (3)	PR. (4)	S. (5)	*. (6)	A. (6)
(1) BURNER TYPE	<b>RN510 - RN515 - RN520 - RN525</b>					
(2) FUEL	N - Heavy oil, viscosity ≤ 50cSt (7° E) @ 50° C E - Heavy oil, viscosity ≤ 110cSt (15°E) @ 50° C D - Heavy oil, viscosity ≤ 400cSt (50° E) @ 50° C P - Petroleum, viscosity 89cSt (12° E) @ 50° C					
(3) OPERATION (Available versions)	PR - Progressive		MD - Fully modulating			
(4) BLAST TUBE	S - Standard		L - Extended			
(5) DESTINATION COUNTRY	* - see data plate					
(6) BURNER VERSION	A - Standard					

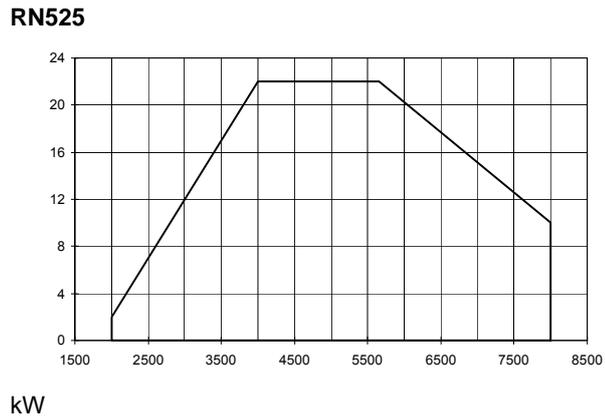
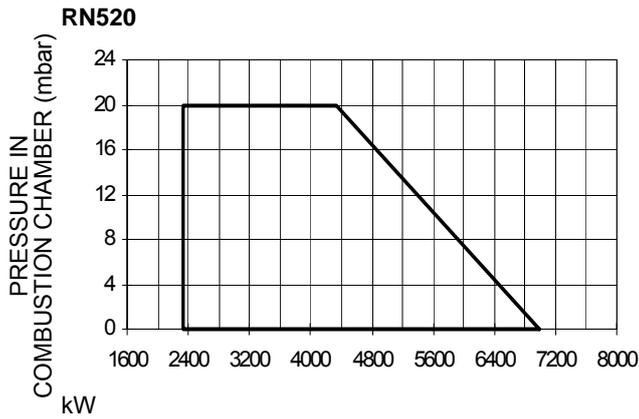
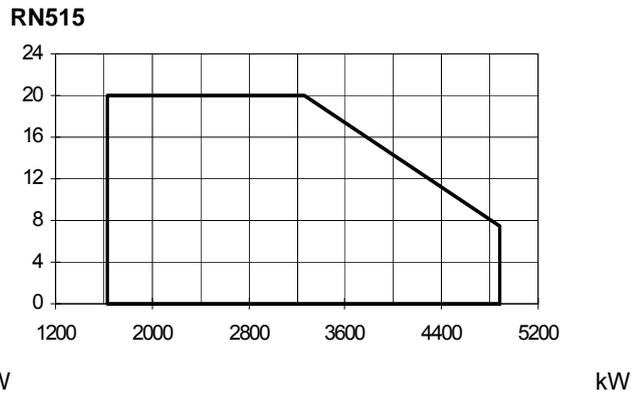
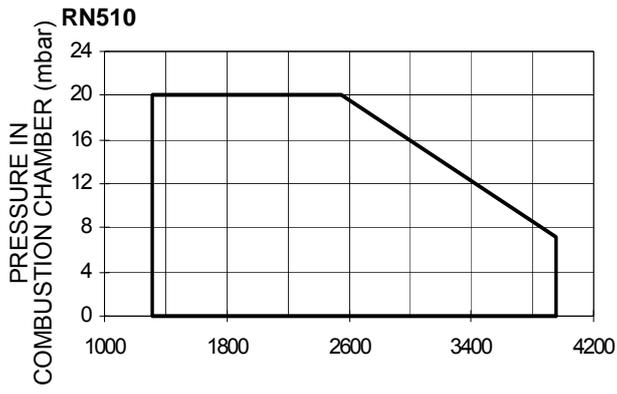
### Technical Specifications

BURNER		RN510	RN515	RN520	RN525
Output	min - max kW	1314 - 3953	1628 - 4884	2326 - 6977	2000 - 8000
Fuel		Heavy oil			
Viscosity		See "Burner model identification" table			
Heavy oil rate	min. - max. kg/h	117 - 352	145 - 435	207 - 622	178 - 713
Oil train inlet pressure	bar	4 max			
Power supply		400V 3N a.c. 50Hz			
Total power consumption (Heavy oil)	kW	33.1	43	59.7	69.2
Total power consumption (Petroleum)	kW	27.1	31	41.7	--
Fan motor	kW	7.5	11	15	18.5
Pump motor	kW	1.1	1.5	2.2	2.2
Pre-heater resistors (heavy oil)	kW	24	30	42	48
Pre-heater resistors (Petroleum)	kW	18	18	24	--
Protection		IP40			
Approx. weight	kg	320	370	415	430
Operation		Progressive - Fully modulating			
Operating temperature	°C	-10 ÷ +50			
Storage Temperature	°C	-20 ÷ +60			
Working service*		Intermittent			

Heavy oil net calorific value (Hi): 40.4 MJ/kg (average value).

NOTE ON THE WORKING SERVICE: for safety reasons, one controlled shutdown must take place every 24 hours of continuous working.

## Performance Curves

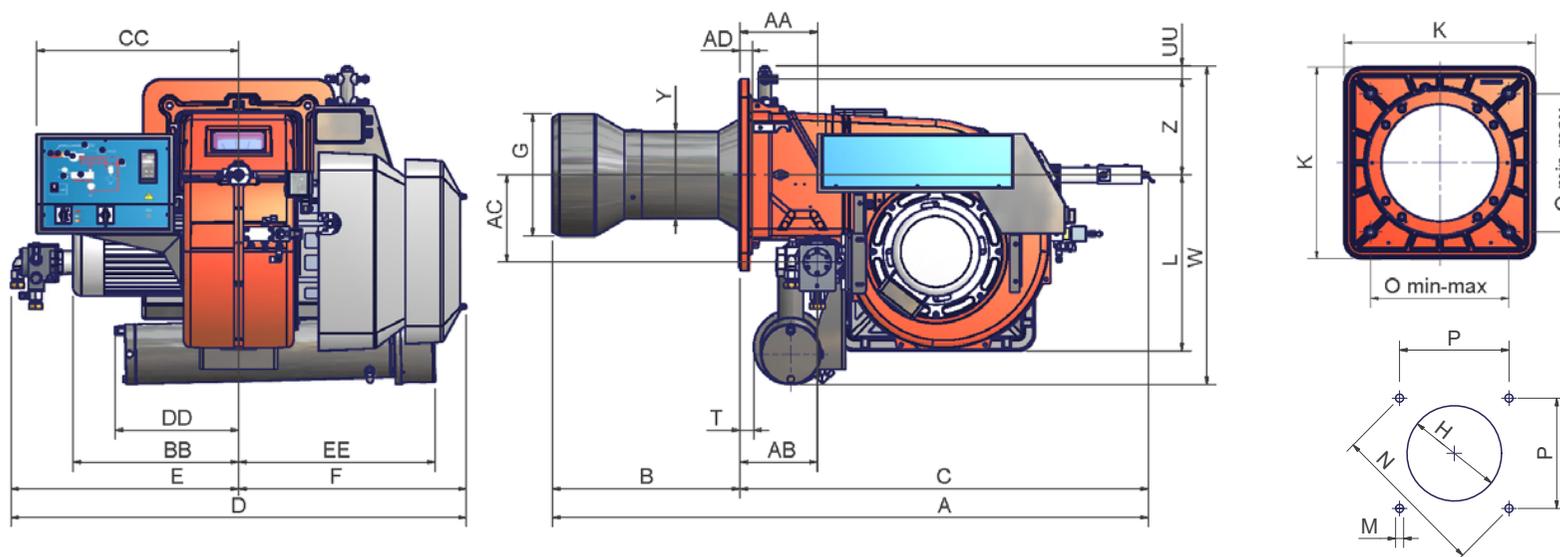


To get the input in kcal/h, multiply value in kW by 860.

Data are referred to standard conditions: atmospheric pressure at 1013mbar, ambient temperature at 15°C

**NOTE:** The performance curve is a diagram that represents the burner performance in the type approval phase or in the laboratory tests, but does not represent the regulation range of the machine. On this diagram the maximum output point is usually reached by adjusting the combustion head to its "MAX" position (see paragraph "Adjusting the combustion head"); the minimum output point is reached setting the combustion head to its "MIN" position. During the first ignition, the combustion head is set in order to find a compromise between the burner output and the generator specifications, that is why the minimum output may be different from the Performance curve minimum.

**Overall dimensions (mm)**



**Boiler recommended boiler drilling template**

	A(S*)	A(L*)	AA	AB	AC	AD	B(S*)	B(L*)	BB	C	CC	D	DD**	E	EE**	F	G	H	K	L	M	N	O	P	T	UU	W	Y	Z
<b>RN510</b>	1502	1682	221	217	246	35	350	530	468	1152	571	1285	349	643	556	642	345	385	540	496	M14	552	390	390	37	36	897	328	270
<b>RN515</b>	1502	1682	145	217	246	35	350	530	508	1152	598	1285	x	643	x	642	384	424	540	496	M14	552	390	390	37	36	802	328	270
<b>RN520</b>	1502	1682	145	207	250	35	350	530	508	1152	598	1285	x	643	x	642	422	472	540	496	M14	552	390	390	37	36	802	328	270
<b>RN525</b>	1502	1682	145	197	275	35	350	530	650	1152	598	1285	x	643	x	642	434	484	540	496	M14	552	390	390	37	78	844	328	270

\*S = measure referred to standard blast tube

\*L = measure referred to extended blast tube

\*\* RN515-520-525: as far as these burners, the oil pumping/pre-heating unit is separate.

## INSTALLING THE BURNER

### Packing

Burners are despatched in wooden crates whose dimensions are:

**RN510-515-520:** 1720 x 1500 x 1210 (L x P x H)

**RN525:** 1800 x 1500 x 1300 (L x P x H)

Packing cases of this kind are affected by humidity and are not suitable for stacking. The following are placed in each packing case:

- burner;
- gasket to be inserted between the burner and the boiler;
- oil flexible hoses;
- oil filter;
- envelope containing this manual.

**RN515-520-525:** as far as these burners, the oil pumping/pre-heating unit is separate.

To get rid of the burner's packing, follow the procedures laid down by current laws on disposal of materials.

### Handling the burner

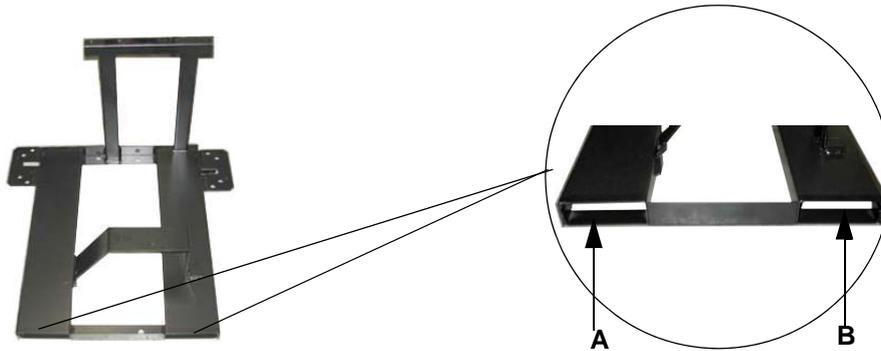


**ATTENTION!** The handling operations must be carried out by specialised and trained personnel. If these operations are not carried out correctly, the residual risk for the burner to overturn and fall down still persists.

To move the burner, use means suitable to support its weight (see paragraph "Technical specifications").

The unpacked burner must be lifted and moved only by means of a fork lift truck.

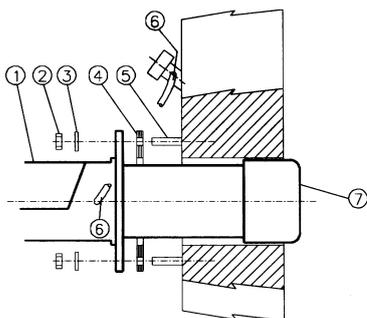
The burner is mounted on a stirrup provided for handling the burner by means of a fork lift truck: the forks must be inserted into the A and B ways. Remove the stirrup only once the burner is installed to the boiler.



### Fitting the burner to the boiler

To install the burner into the boiler, proceed as follows:

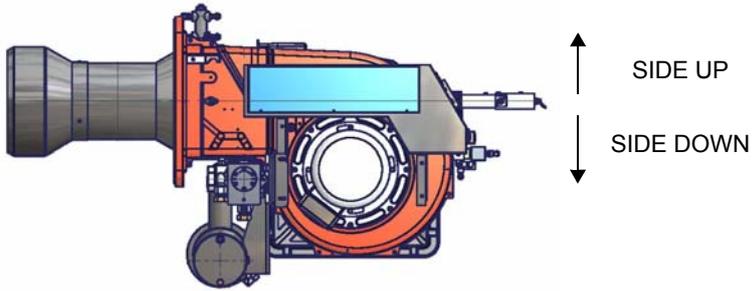
- 1 make a hole on the closing door of the combustion chamber as described on paragraph "Overall dimensions")
- 2 place the burner to the boiler: lift it up and handle it according to the procedure described on paragraph "Handling the burner";
- 3 place the stud bolts (5) on boiler's door, according to the burner drilling template described on paragraph "Overall dimensions";
- 4 fasten the stud bolts;
- 5 place the gasket on the burner flange;
- 6 install the burner into the boiler;
- 7 fix the burner to the stud bolts, by means of the fixing nuts, according to the next picture.
- 8 After fitting the burner to the boiler, ensure that the gap between the blast tube and the refractory lining is sealed with appropriate insulating material (ceramic fibre cord or refractory cement).



#### Keys

- 1 Burner
- 2 Fixing nut
- 3 Washer
- 4 Sealing gasket
- 5 Stud bolt
- 7 Blast tube

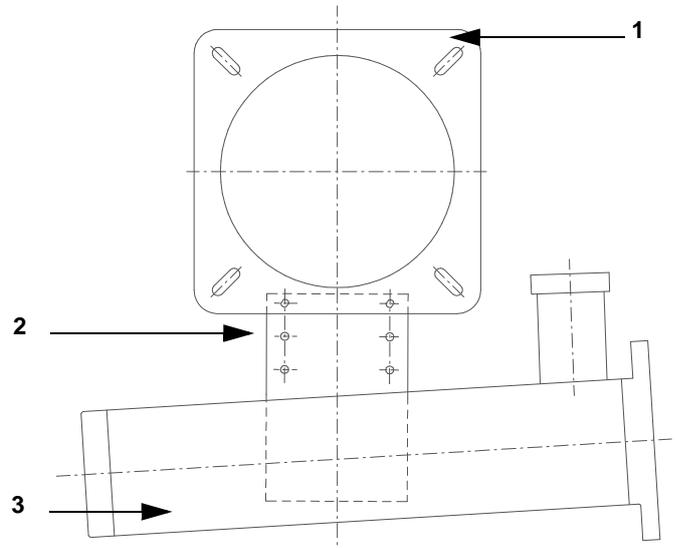
## MOUNTING POSITION



Burner is designed to operate with horizontal flame axis. Set the upper side of the burner flange in a horizontal position, in order to obtain the correct inclination of the pre-heating tank. For different installations, please contact the Technical Department.

### Key

- 1 Burner flange (upper side indicated)
- 2 Bracket
- 3 Pre-heating tank on the burner



## Electrical connections

	<p>Respect the basic safety rules. Make sure of the connection to the earthing system. do not reverse the phase and neutral connections. Fit a differential thermal magnet switch adequate for connection to the mains.</p>
	<p><b>ATTENTION:</b> before executing the electrical connections, pay attention to turn the plant's switch to OFF and be sure that the burner's main switch is in 0 position (OFF) too. Read carefully the chapter "WARNINGS", and the "Electrical connections" section.</p>

	<p><b>WARNING:</b> The burner is provided with an electrical bridge between terminals 6 and 7; when connecting the high/low flame thermostat, remove this bridge before connecting the thermostat.</p>
	<p><b>IMPORTANT:</b> Connecting electrical supply wires to the burner terminal block MA, be sure that the ground wire is longer than phase and neutral ones.</p>
	<p>auxiliary contacts are provided (terminals no. 507 and no. 508 of the MA terminal block) to connect an intervention system (alarm/power supply cutoff) in case of fault of the oil resistor contactor (see Fig. 1- Fig. 2).</p>

To execute the electrical connections, proceed as follows:

- 1 remove the cover from the electrical board, unscrewing the fixing screws;
- 2 execute the electrical connections to the supply terminal board as shown in the following diagrams,
- 3 check the direction of the motor (see next paragraph)
- 4 refit the panel cover

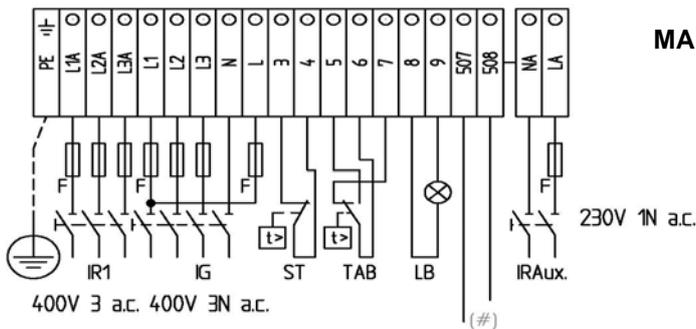


Fig. 1 - Progressive burners

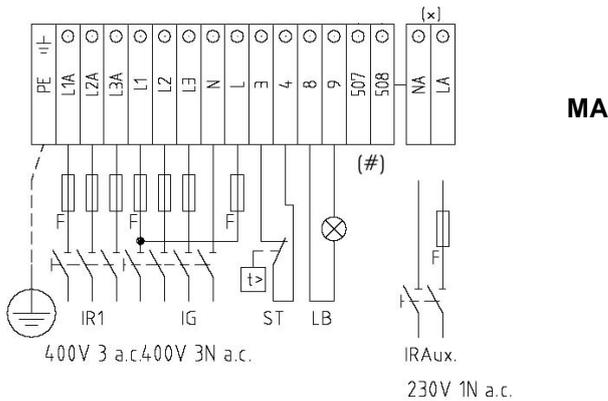


Fig. 2 - Fully modulating burners

### Probes connection

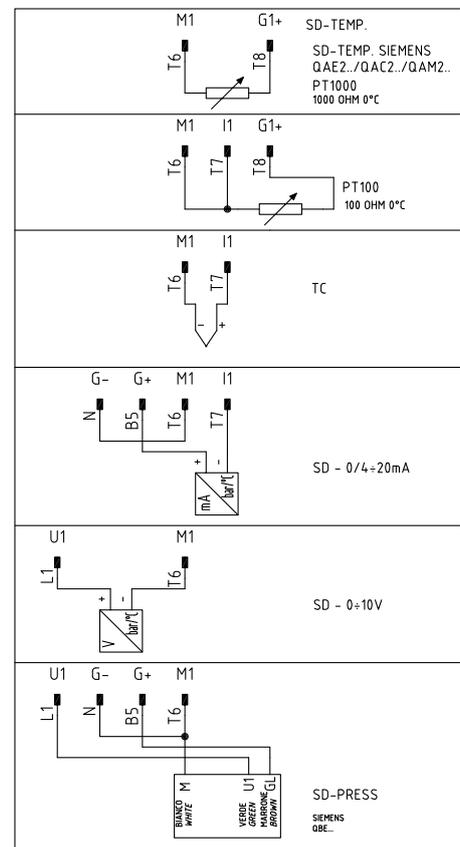


Fig. 3

(#) Free contact for "Faulty heater resistor contactor"

Probes connection oby means of the 7-pins plug (Fig. 4) - see Fig. 3) for connections.



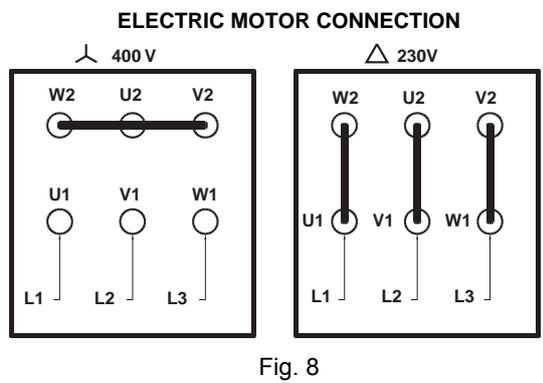
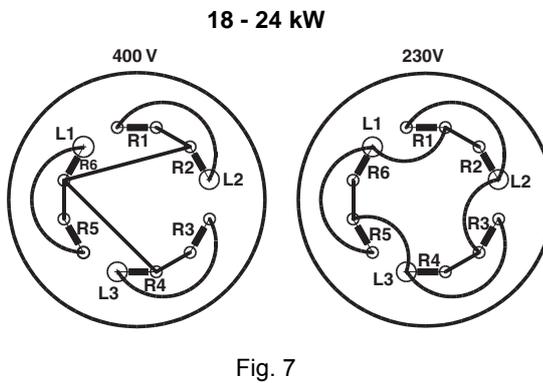
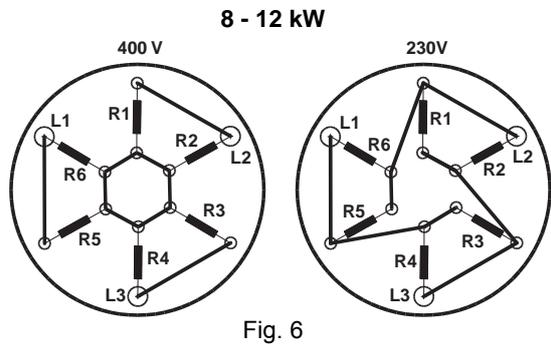
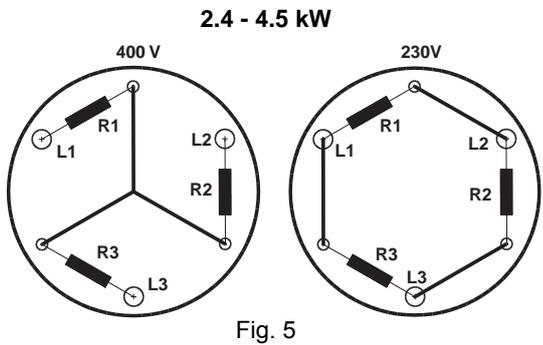
Fig. 4

**RN515-520-525:** As for the connection of the pump-preheating unit, see wiring diagrams.

**Fan and pump motors direction**

Once the electrical connection of the burner is performed, remember to check the rotation of the motor. The motor should rotate in an counterclockwise direction looking at cooling fan. In the event of incorrect rotation reverse the three-phase supply and check again the rotation of the motor.

**Connecting the oil heating resistors**



**Double-pipe and single-pipe system**

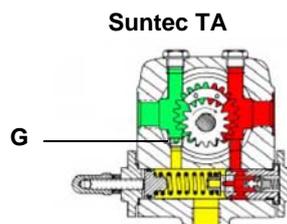
The pumps that are used can be installed both into single-pipe and double-pipe systems.

**Single-pipe system:** a single pipe drives the oil from the tank to the pump's inlet. Then, from the pump, the pressurised oil is driven to the nozzle: a part comes out from the nozzle while the other part goes back to the pump. In this system, the by-pass plug, if provided, must be removed and the optional return port, on the pump's body, must be sealed by steel plug and washer.

**Double-pipe system:** as for the single pipe system, a pipe that connects the tank to the pump's inlet is used besides another pipe that connects the pump's return port to the tank, as well. The excess of oil goes back to the tank: this installation can be considered self-bleeding. If provided, the inside by-pass plug must be installed to avoid air and fuel passing through the pump.

Burners come out from the factory provided for double-stage systems. They can be suited for single-pipe system (recommended in the case of gravity feed) as described before. To change from a 1-pipe system to a 2-pipe-system, insert the by-pass plug **G** (as for ccw-rotation- referring to the pump shaft).

**Caution:** Changing the direction of rotation, all connections on top and side are reversed.



**Bleed**

Bleeding in two-pipe operation is automatic : it is assured by a bleed flat on the piston. In one-pipe operation, the plug of a pressure gauge port must be loosened until the air is evacuated from the system.

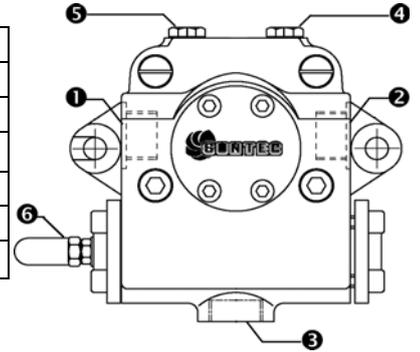
## Oil pumps

**RN510:** SUNTEC TA3

**RN515:** SUNTEC TA4

**RN520 - RN525:** SUNTEC TA5

Suntec TA..	
Oil viscosity	3 ÷ 75 cSt
Oil temperature	0 ÷ 150°C
Min. suction pressure	- 0.45 bar to avoid gasing
Max. suction pressure	5 bar
Max. return pressure	5 bar
Rotation speed	3600 rpm max.



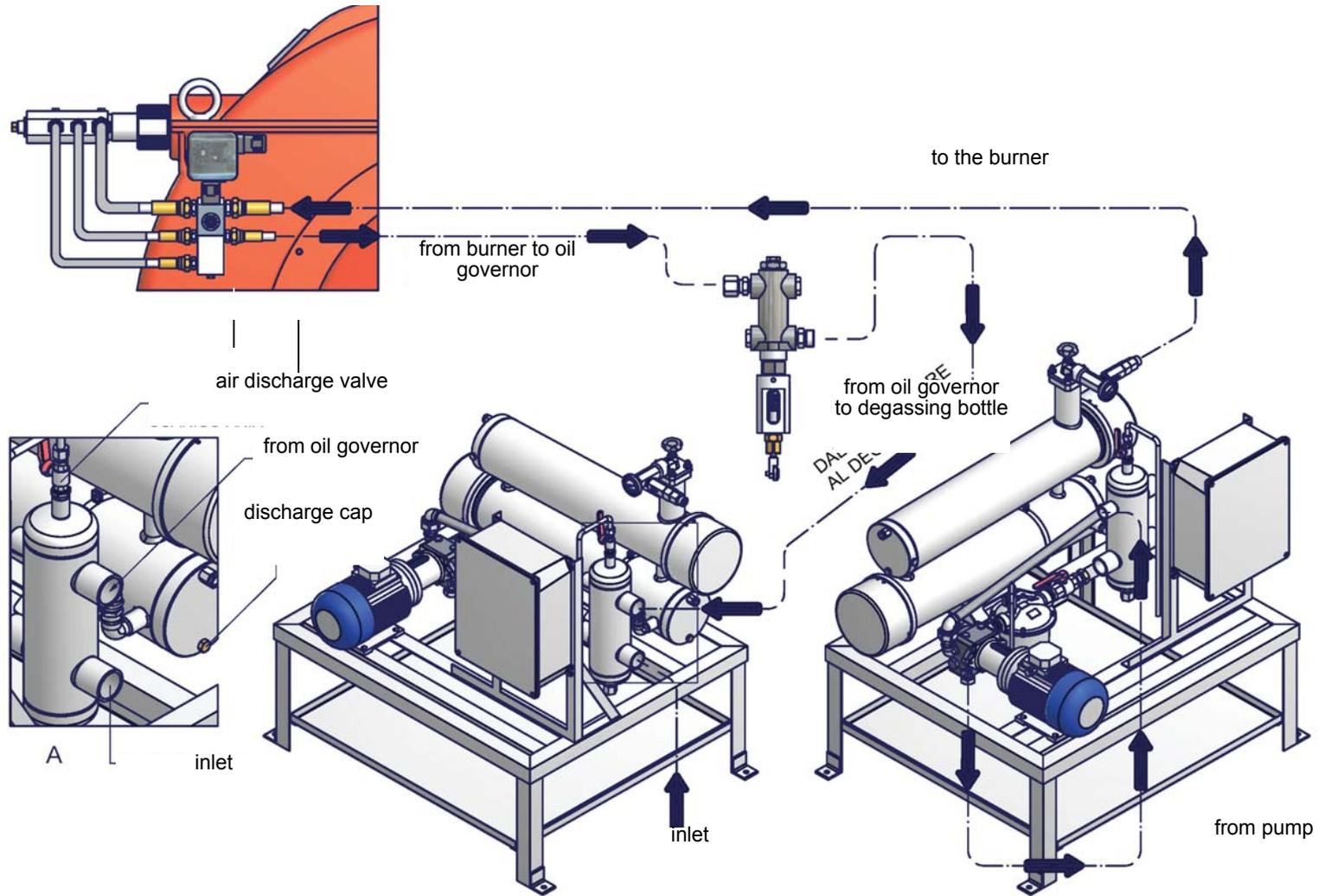
- 1 Inlet G1/2
- 2 To the nozzle G1/2
- 3 Return G1/2
- 4 Pressure gauge port G1/4
- 5 Vacuum gauge port G1/4
- 6 Pressure governor

### About the use of fuel pumps

- Make sure that the by-pass plug is not used in a single pipe installation, because the fuel unit will not function properly and damage to the pump and burner motor could result.
- Do not use fuel with additives to avoid the possible formation over time of compounds which may deposit between the gear teeth, thus obstructing them.
- After filling the tank, wait before starting the burner. This will give any suspended impurities time to deposit on the bottom of the tank, thus avoiding the possibility that they might be sucked into the pump.
- On initial commissioning a "dry" operation is foreseen for a considerable length of time (for example, when there is a long suction line to bleed). To avoid damages inject some lubrication oil into the vacuum inlet.
- Care must be taken when installing the pump not to force the pump shaft along its axis or laterally to avoid excessive wear on the joint, noise and overloading the gears.
- Pipes should not contain air pockets. Rapid attachment joint should therefore be avoided and threaded or mechanical seal junctions preferred. Junction threads, elbow joints and couplings should be sealed with removable component. The number of junctions should be kept to a minimum as they are a possible source of leakage.
- Do not use PTFE tape on the suction and return line pipes to avoid the possibility that particles enter circulation. These could deposit on the pump filter or the nozzle, reducing efficiency. Always use O-Rings or mechanical seal (copper or aluminium gaskets) junctions if possible.
- An external filter should always be installed in the suction line upstream of the fuel unit.

### Burners with separate pre-heating/pumping unit

Follow the scheme in the picture below to connect the burner to the oil pumping unit. The pump sends the oil coming from the tank to the burner. The pressure governor makes the oil reach the nozzle at the required pressure, while the excess of oil goes back to the tank. To change the delivery pressure act on the adjusting screw of the delivery pressure governor.



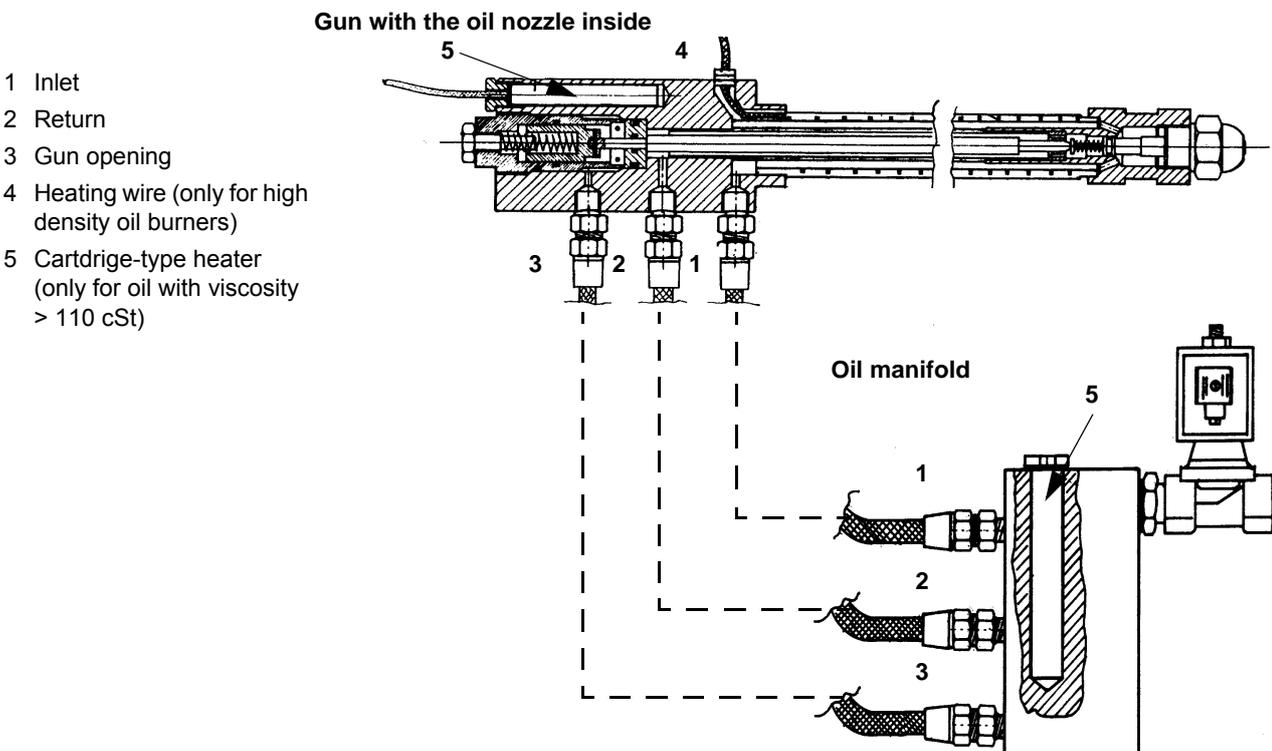
## Connecting the oil flexible hoses

To connect the flexible light oil hoses to the pump, proceed as follows, according to the pump provided:

- 1 remove the closing nuts on the inlet (A) and return (R) connections of the pump;
- 2 screw the rotating nut of the two flexible hoses on the pump **being careful to avoid exchanging the inlet and return lines**: see the arrows marked on the pump that show the inlet and the return (see previous paragraph).



## Connections to the oil gun



## Recommendations to design heavy oil feeding plants

This paragraph is intended to give some suggestions to make feeding plants for heavy oil burners. To get a regular burner operation, it is very important to design the supplying system properly. Here some suggestions will be mentioned to give a brief description.

The term "heavy oil" is generic and summarises several chemical-physical properties, above all viscosity. The excessive viscosity makes the oil impossible to be pumped, so it must be heated to let it flow in the pipeline; because of the low-boiling hydrocarbons and dissolved gases, the oil must be also pressurised. The pressurisation is also necessary to feed the burner pump avoiding its cavitation because of the high suction at the inlet. The supplying system scope is to pump and heat oil.

The oil viscosity is referred in various unit measures; the most common are: °E, cSt, Saybolt and Redwood scales. Table 3 shows the various unit conversions (e.g.: 132 cSt viscosity corresponds to 17.5°E viscosity). The diagram in shows how the heavy oil viscosity changes according to its temperature.

Example: an oil with 22°E viscosity at 50°C once heated to 100°C gets a 3°E viscosity. As far as the pumping capability, it depends on the type of the pump that pushes the oil even if on diagram in a generic limit is quoted at about 100°E, so it is recommended to refer to the specifications of the pump provided. Usually the oil minimum temperature at the oil pump inlet increases as viscosity does, in order to make the oil easy to pump. Referring to the diagram on Fig. 4, it is possible to realise that to pump an oil with 50°E viscosity at 50°C, it must be heated at about 80°C.

---

### **Pipe heating system**

Pipe heating system must be provided, that is a system to heat pipes and plant components to maintain the viscosity in the pumping limits. Higher the oil viscosity and lower the ambient temperature, more necessary the pipe heating system.

### **Inlet minimum pressure of the pump (both for supplying system and burner)**

A very low pressure leads to cavitation (signalled by its peculiar noise): the pump manufacturer declares the minimum value. Therefore, check the pump technical sheets. By increasing the oil temperature, also the minimum inlet pressure at the pump must increase, to avoid the gassification of the oil low-boiling products and the cavitation. The cavitation compromises the burner operation, it causes the pump to break too. The diagram on Fig. 7 roughly shows the inlet pump pressure according to the oil temperature.

### **Pump operating maximum pressure (both for the supplying system and burner)**

Remember that pumps and all the system components through which the oil circulates, feature an upper limit. Always read the technical documentation for each component. Schemes on and are taken from UNI 9248 "liquid fuel feeding lines from tank to burner" standard and show how a feeding line should be designed. For other countries, see related laws in force. The pipe dimensioning, the execution and the winding dimensioning and other constructive details must be provided by the installer.

### **Adjusting the supplying oil ring**

According to the heavy oil viscosity used, in the table below indicative temperature and pressure values to be set are shown.

**Note:** the temperature and pressure range allowed by the supplying ring components must be checked in the specifications table of the components themselves.

HEAVY OIL VISCOSITY AT 50 °C		PIPELINE PRESSURE	PIPELINE TEMPERATURE
cSt (°E)		bar	°C
	< 50 (7)	1- 2	20
> 50 (7)	< 110 (15)	1- 2	50
> 110 (15)	< 400 (50)	1- 2	65

Tab. 1

**Viscosity units conversion table**

Cinematics viscosity Centistokes (cSt)	Engler Degrees (°E)	Saybolt Seconds Universal (SSU)	Saybolt Seconds Furol (SSF)	Redwood Seconds no.1 (Standard)	Redwood Seconds no..2 (Admiralty)
1	1	31	--	29	--
2.56	1.16	35	--	32.1	--
4.3	1.31	40	--	36.2	5.1
7.4	1.58	50	--	44.3	5.83
10.3	1.88	60	--	52.3	6.77
13.1	2.17	70	12.95	60.9	7.6
15.7	2.45	80	13.7	69.2	8.44
18.2	2.73	90	14.44	77.6	9.3
20.6	3.02	100	15.24	85.6	10.12
32.1	4.48	150	19.3	128	14.48
43.2	5.92	200	23.5	170	18.9
54	7.35	250	28	212	23.45
65	8.79	300	32.5	254	28
87.6	11.7	400	41.9	338	37.1
110	14.6	500	51.6	423	46.2
132	17.5	600	61.4	508	55.4
154	20.45	700	71.1	592	64.6
176	23.35	800	81	677	73.8
198	26.3	900	91	762	83
220	29.2	1000	100.7	896	92.1
330	43.8	1500	150	1270	138.2
440	58.4	2000	200	1690	184.2
550	73	2500	250	2120	230
660	87.6	3000	300	2540	276
880	117	4000	400	3380	368
1100	146	5000	500	4230	461
1320	175	6000	600	5080	553
1540	204.5	7000	700	5920	645
1760	233.5	8000	800	6770	737
1980	263	9000	900	7620	829
2200	292	10000	1000	8460	921
3300	438	15000	1500	13700	--
4400	584	20000	2000	18400	--

Tab. 2

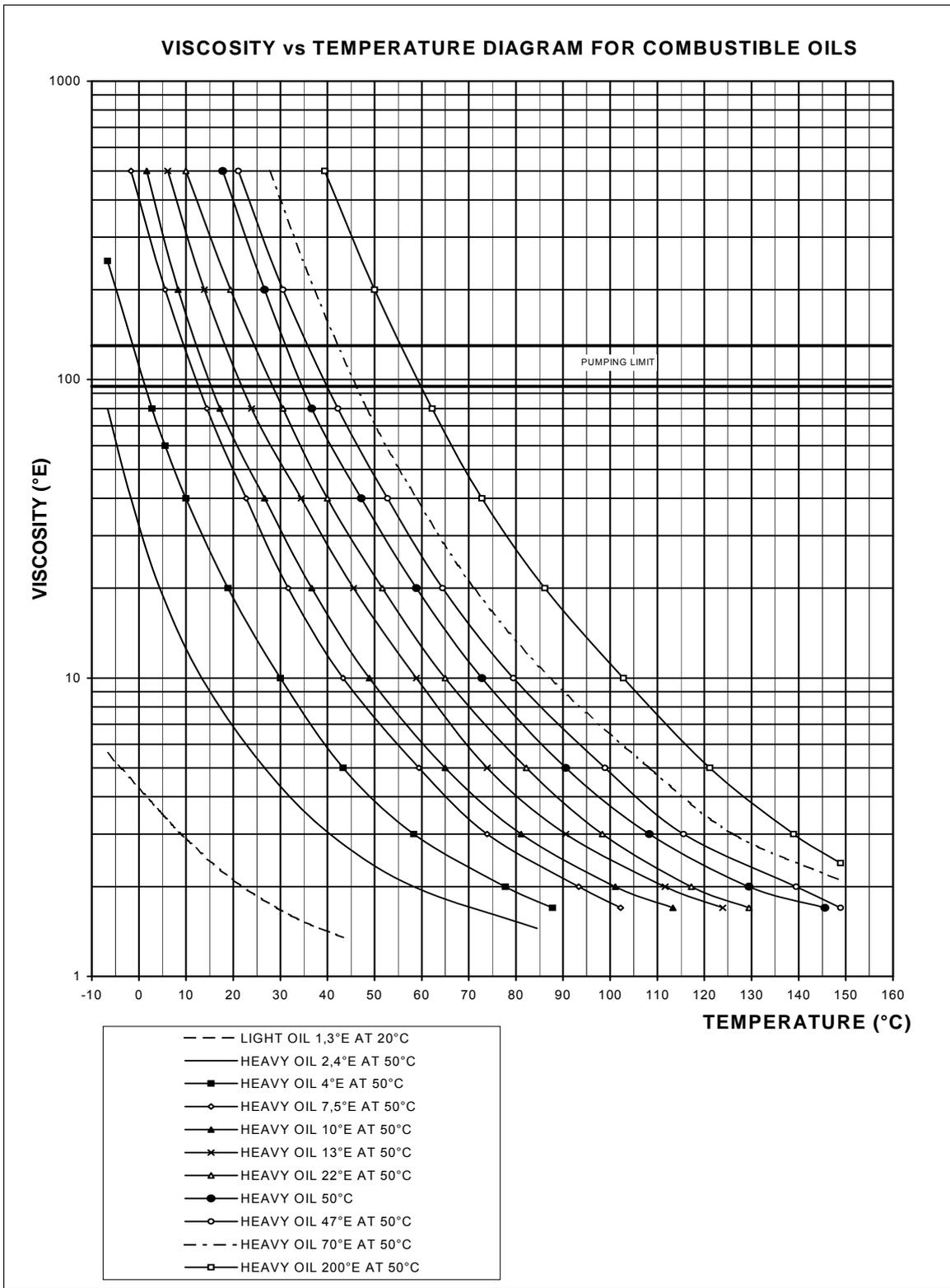


Fig. 9

**Indicative diagram showing the oil temperature at burner pump inlet vs. oil viscosity**

Example: if the oil has a 50°E @ 50°C viscosity, the oil temperature at the pump inlet should be 80°C (see diagram).

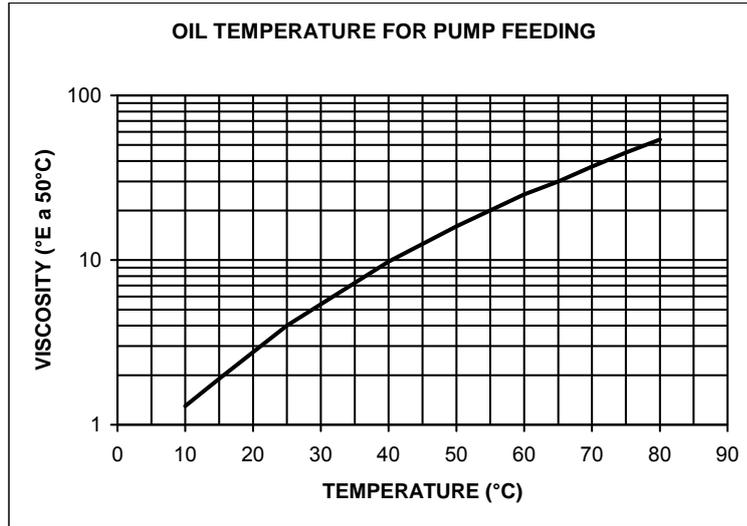


Fig. 10

**Indicative diagram showing the oil pressure according to its temperature**

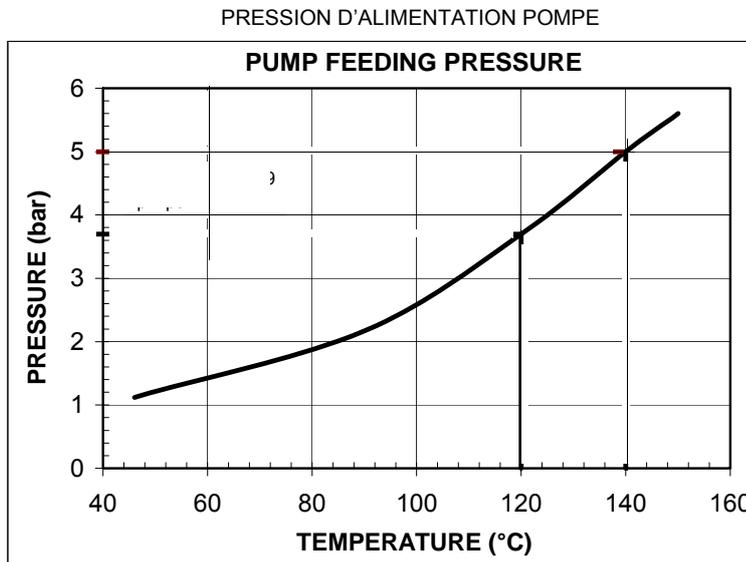


Fig. 11

**Indicative diagram showing the oil atomising temperature according to its viscosity**

Example: if the oil has a 50°E @ 50°C viscosity, the oil atomising temperature should be between 145°C and 160°C (see diagram).

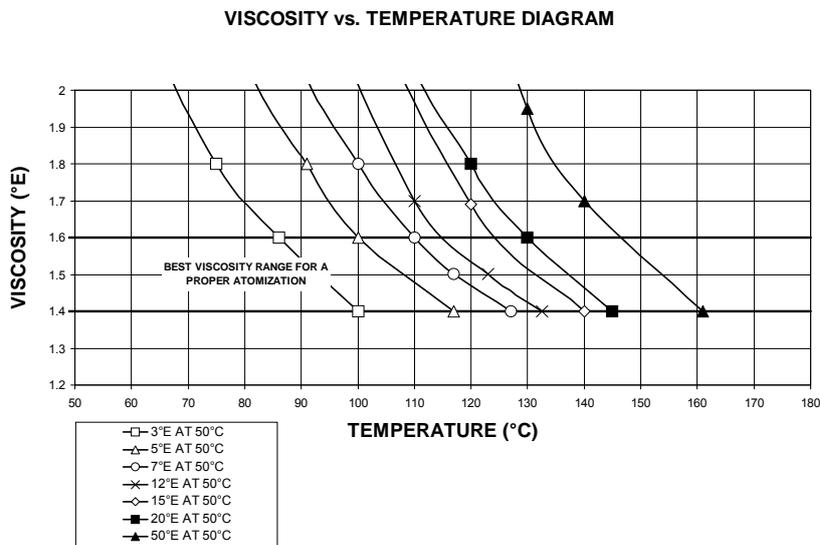


Fig. 12

# HYDRAULIC DIAGRAMS

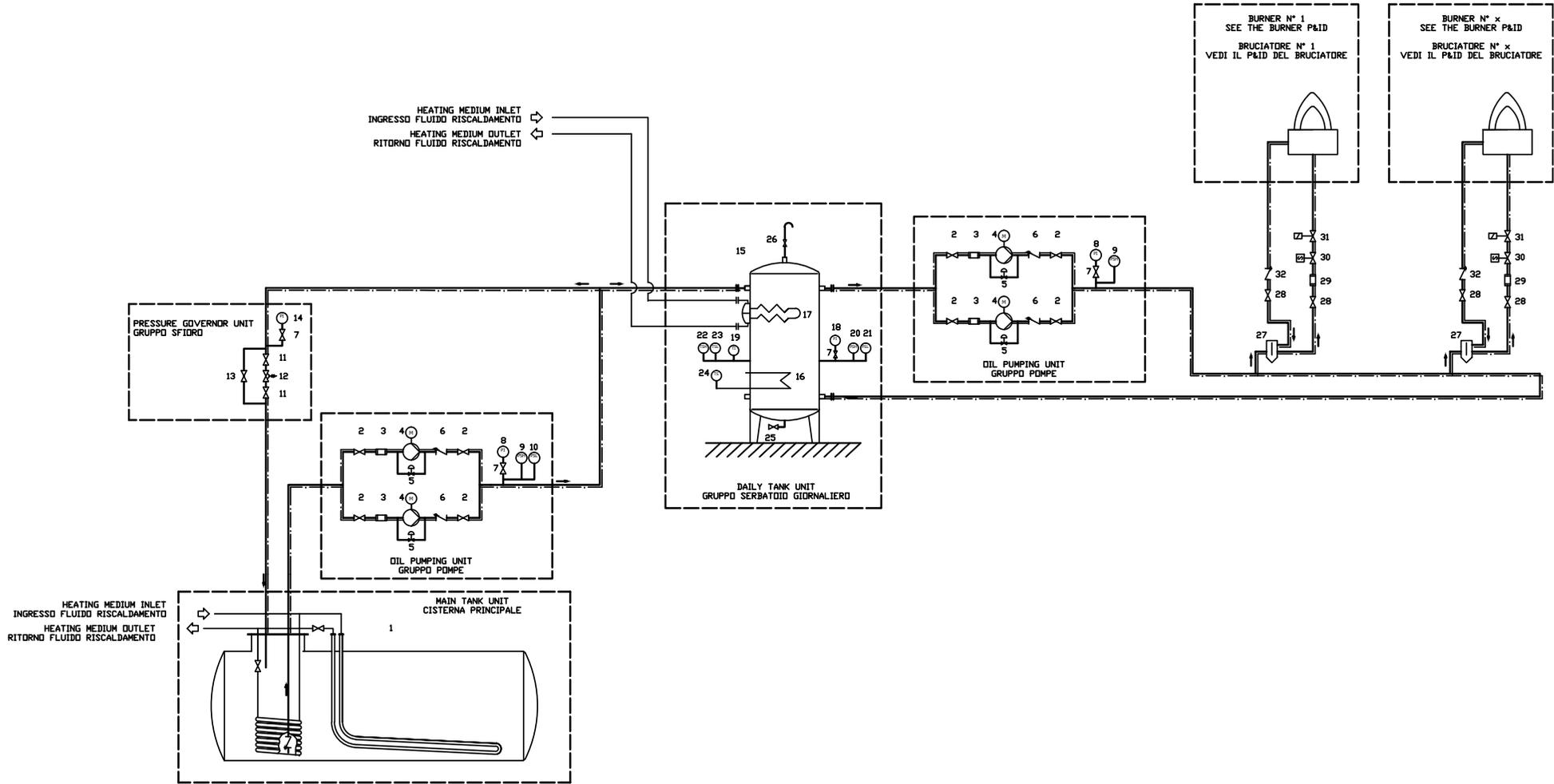


Fig. 13 - 3ID00014 v2 Hydraulic diagram - Two or more burners configuration

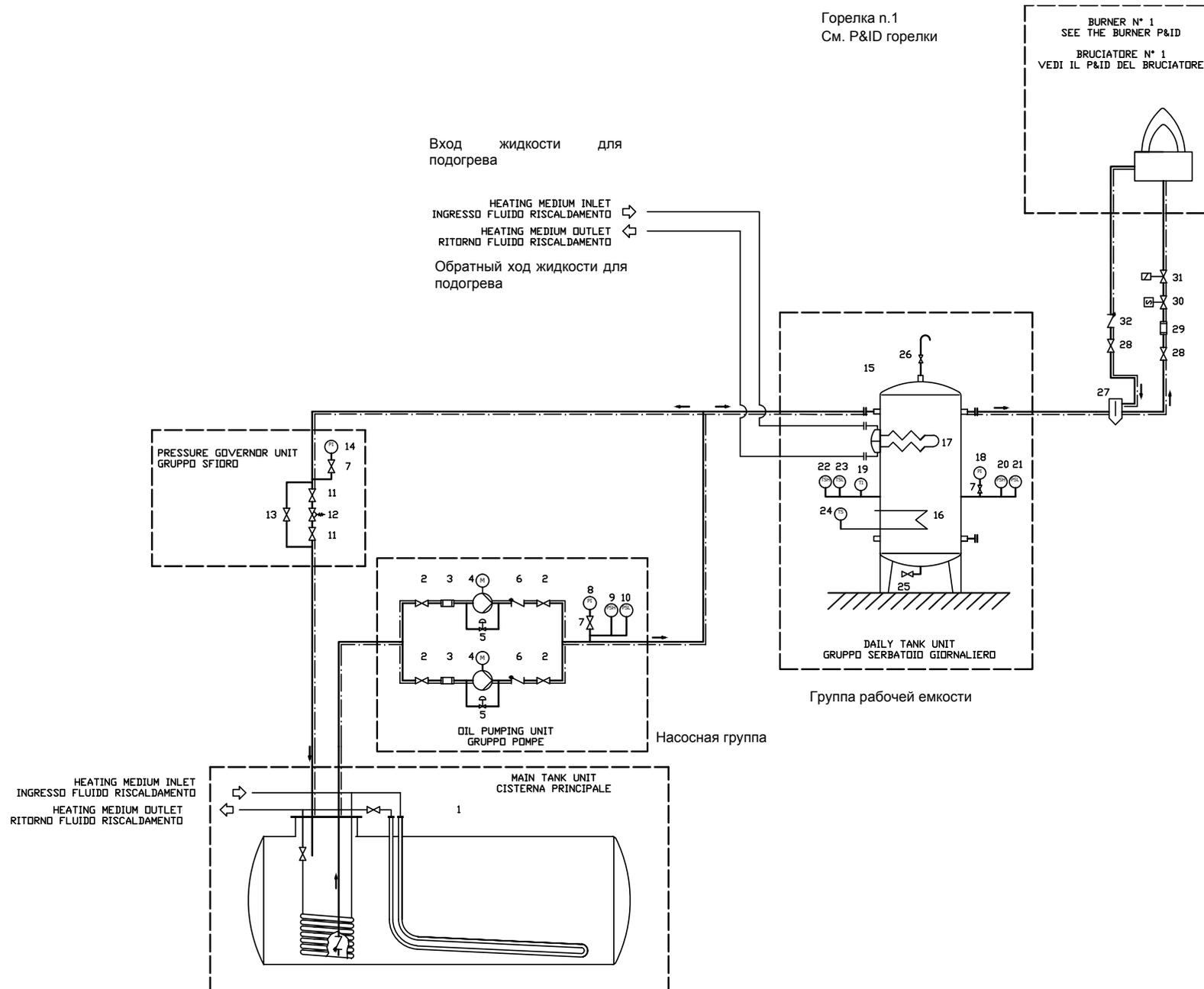


Fig. 14 - 3ID0023 v2 - Hydraulic diagram - Single burner configuration

<b>LEGEND</b>	
<b>POS</b>	<b>OIL TRAIN</b>
1	Main tank
<b>OIL PUMPING UNIT</b>	
2	Manual valve
3	Filter
4	Pump coupled to electrical motor
5	Safety valve
6	One-way valve
7	Manual valve
8	Pressure gauge
9	Maximum pressure switch
10	Minimum pressure switch
<b>PRESSURE GOVERNOR UNIT</b>	
11	Manual valve
12	Pressure governor
13	Needle valve
14	Pressure gauge
<b>DAILY TANK</b>	
15	Daily tank
16	Electrical resistor
17	Heating device
18	Pressure gauge
19	Thermometer
20	High pressure switch
21	Low pressure switch
22	Thermostat (high)
23	Thermostat (low)
24	Thermostat
25	Manual valve
26	Manual valve
<b>TO THE BURNER</b>	
27	Degassing bottle
28	Manual valve
29	Filter (supplied loose with the burner)
30	Solenoid valve
31	Safety valve
31	One-way valve

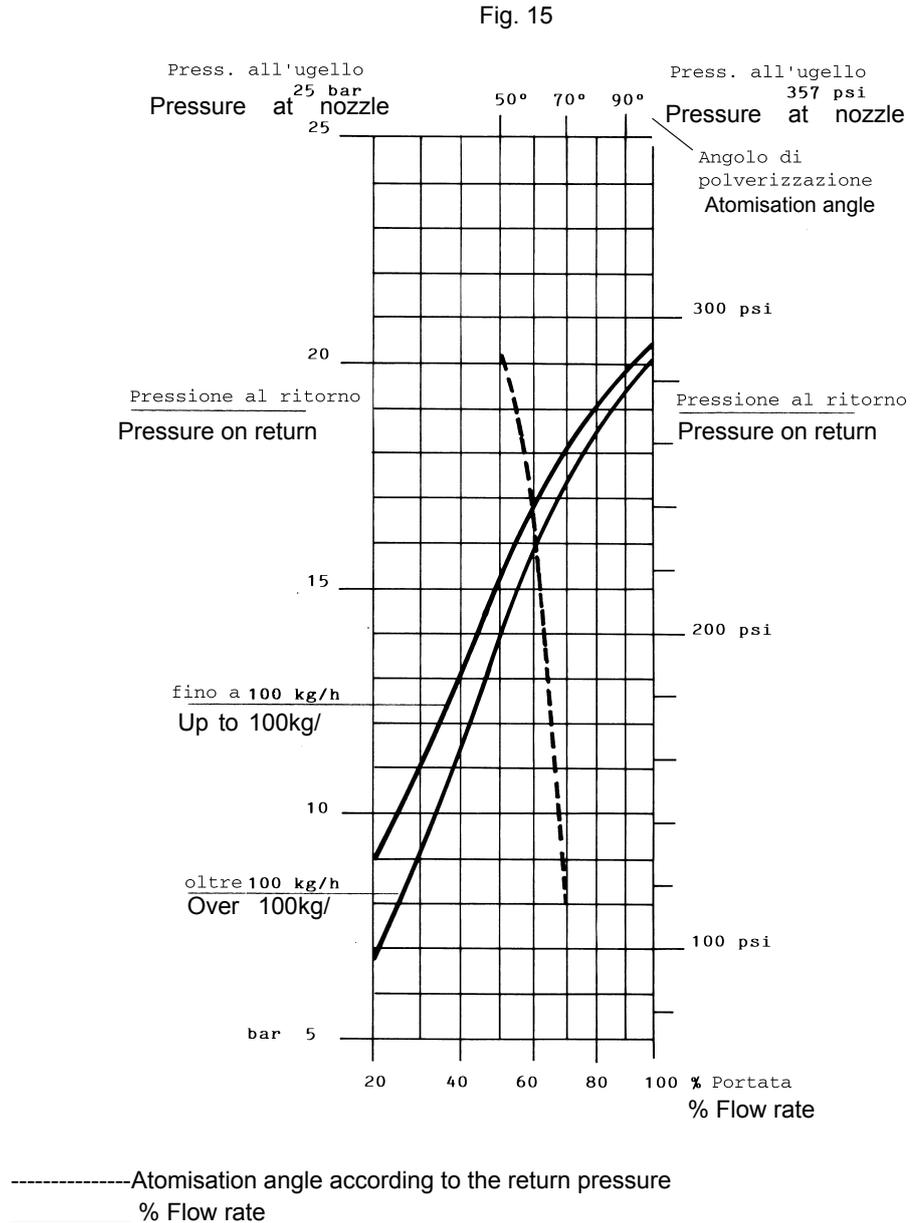
## Adjusting light oil flow rate

The light oil flow rate can be adjusted choosing a by-pass nozzle that suits the boiler/utilisation output and setting the delivery and return pressure values according to the ones quoted on the chart below and the diagram on Fig. 15 (as far as reading the pressure values, see next paragraphs).

NOZZLE	DELIVERY PRESSURE bar	RETURN PRESSURE MAX. bar	RETURN PRESSURE MIN. bar
FLUIDICS WR2/UNI-GAS M3	25	19 - 20	7 - 9 (indicative values)

DIMENSIONS	FLOW RATE kg/h	
	Min	Max
40	13	40
50	16	50
60	20	60
70	23	70
80	26	80
90	30	90
100	33	100
115	38	115
130	43	130
145	48	145
160	53	160
180	59	180
200	66	200
225	74	225
250	82	250
275	91	275
300	99	300
330	109	330
360	119	360
400	132	400
450	148	450
500	165	500
550	181	550
600	198	600
650	214	650
700	231	700
750	250	750
800	267	800

Tab. 3



## Oil thermostat adjustment

Progressive and fully modulating oil burners are equipped with electronic multi-thermostat Danfoss MCX, whose operation is con-

trolled by thyristor. (for details refer to the attached technical documentation)



Fig. 16 - Danfoss MCX

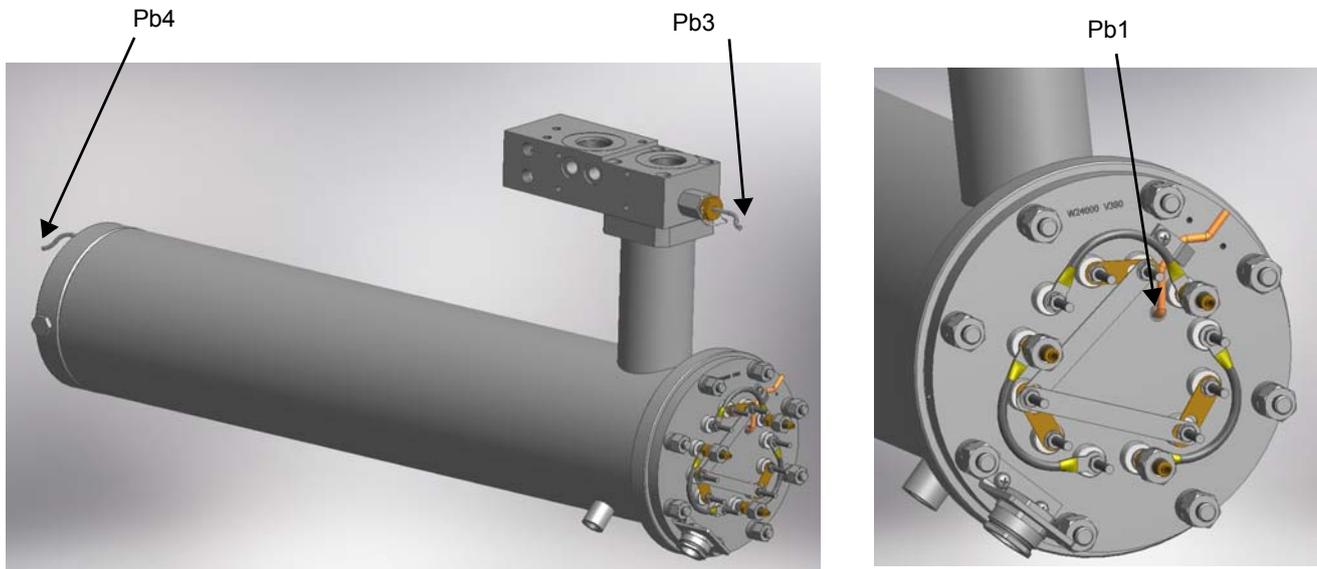


Fig. 17 - Probe connections (Danfoss MCX)

Menu path			Oil viscosity at 50 °C according to the letter shown in the burner model				
			P	N	E	D	H
			89 cSt	< 50 cSt	> 50 cSt < 110 cSt	> 110 cSt < 400 cSt	> 400 cSt < 4000 cSt
			12 °E	< 7°E	> 7 °E < 15 °E	> 15 °E < 50 °E	> 50 °E < 530 °E
Par							
rEG	Pb1	tr	Oil heater temperature probe				
	Pb2	tCl	Plant consent temperature probe (when installed)				
	Pb3	Oil	oil heater output temperature probe (PID regulation);				
		SP0	Set-point oil heater with oil pump stopped (stand-by)				
	Pb4	tcn	Oil heater consent temperature probe				
		trS	Safety temperature tank resistors (manual reset)				
			20 °C	70 °C	70 °C	70 °C	---
			60-70 °C	110-120 °C	120-130 °C	130-140 °C	140-150 °C
			45 °C	120 °C	130 °C	140 °C	150 °C
			40 °C	100 °C	100 °C	110 °C	120 °C
			120 °C	190-200 °C	190-200 °C	190-200 °C	190-200 °C

The above temperature values are suggested and refer to a plant designed according to the prescriptions in the burner user manual. The suggested values can change in reference to the fuel oil specifications.

#### Burners equipped with double tank

All thermostats are located inside the control panel. To set the temperature use a small screwdriver.

Such temperature must be set during burner operation, checking temperature in the thermometer mounted on the pre-heating tank. We suggest a thermometer with scale up to 200° C.

Adjust this thermostat to the correct value according to the viscosity-temperature diagram and check the temperature by using a thermometer with a scale of up to 200° C mounted on the pre-heating tank.

**Safety resistors thermostat TRS:** it is factory preset and sealed. Don not modify it!

When the set temperature is exceeded, check the reason and reset it by means of the push button PR

**Resistor thermostat TR:** check the best atomising oil temperature and set it on TR.

**Thermostat TCN** (it gives the enabling signal to the oil N.C. valve): set TCN at about 20° less than TR.

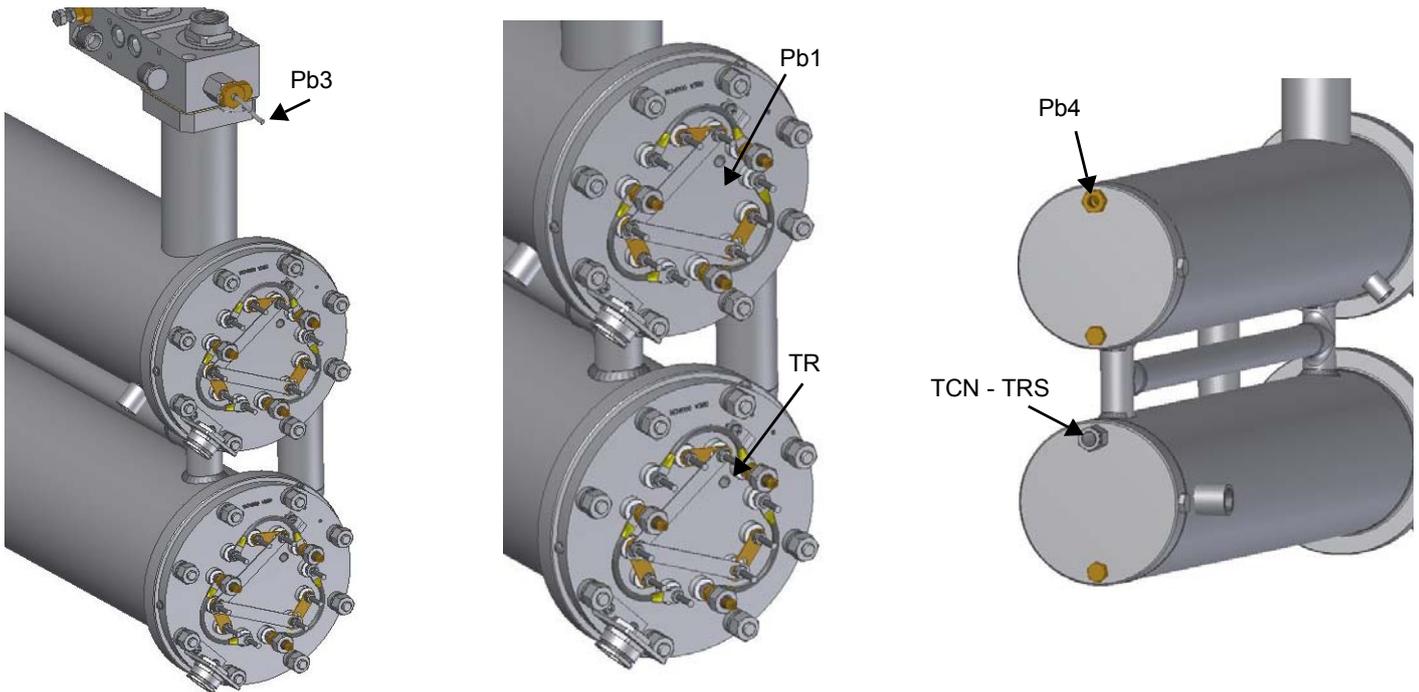
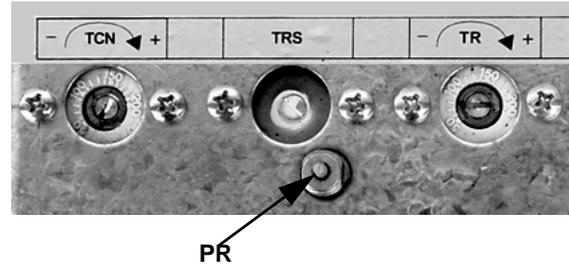


Fig. 18 - Probe connections (Danfoss MCX)

## ADJUSTING AIR AND FUEL RATE



**ATTENTION:** before starting the burner up, be sure that the manual cutoff valves are open. Be sure that the mains switch is closed.

**ATTENTION:** During commissioning operations, do not let the burner operate with insufficient air flow (danger of formation of carbon monoxide); if this should happen, make the fuel decrease slowly until the normal combustion values are achieved.



Before starting up the burner, make sure that the return pipe to the tank is not obstructed. Any obstruction would cause the pump seal to break.



**IMPORTANT!** the combustion air excess must be adjusted according to the values in the following chart.

Recommended combustion parameters		
Fuel	Recommended (%) CO <sub>2</sub>	Recommended (%) O <sub>2</sub>
Heavy oil ≤ 50cSt (7° E) @ 50° C	11 ÷ 12	4.2 ÷ 6.2
Heavy oil ≥ 50cSt (7° E) @ 50° C	11 ÷ 12.5	4.7 ÷ 6.7

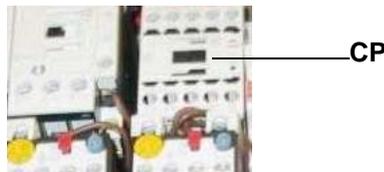
### Adjustments - brief description

- Adjust the air and oil flow rates at the maximum output (“high flame”) first, by means of the air damper and the adjusting cam respectively.
- Check that the combustion parameters are in the suggested limits.
- Then, adjust the combustion values corresponding to the points between maximum and minimum: set the shape of the adjusting cam foil. The adjusting cam sets the air/fuel ratio in those points, regulating the opening-closing of the fuel governor.
- Now set the low flame output, acting on the low flame microswitch of the actuator in order to avoid the low flame output increasing too much or the flues temperature getting too low to cause condensation in the chimney.

Now, adjust the burner according to the actuator model provided.

### Oil Flow Rate Settings by means of Berger STM30../Siemens SQM40.. actuator

- 1 Check the fan motor rotation.
- 2 Prime the oil pump acting on the related contactor (**CP** - see next picture): check the pump motor rotation (see “Fan and pump motors direction” on page 11) and keep pressing for some seconds until the oil circuit is charged;



- 3 bleed the air from the **M** pressure gauge port (Fig. 17) by loosening the cap without removing it, then release the solenoid starter.

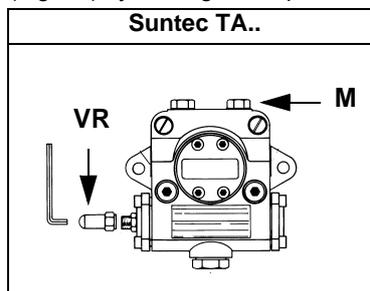
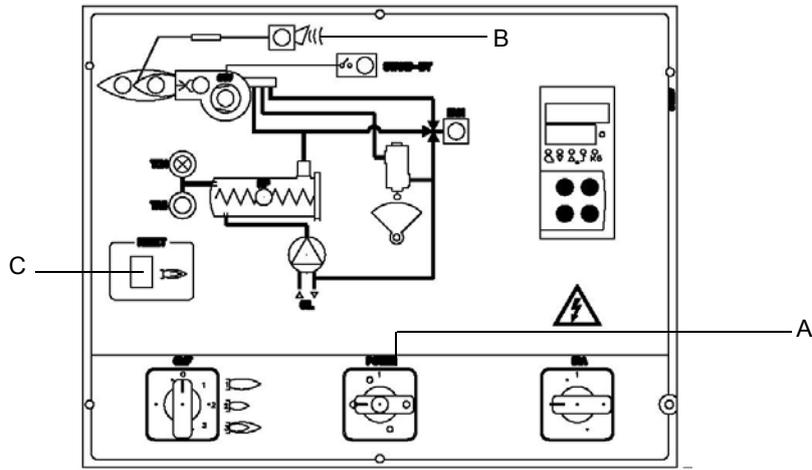
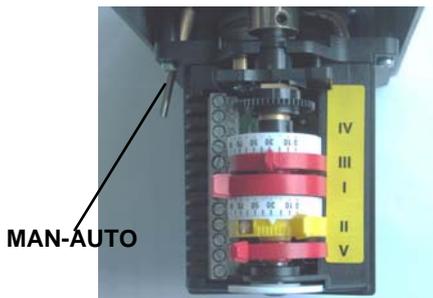


Fig. 19

- 4 Before starting the burner up, drive the high flame actuator microswitch matching the low flame one (in order to let the burner operate at the lowest output) to safely achieve the high flame stage.
- 5 Turn the burner on by means of its main switch **A** (see next picture): if the burner locks (LED **B** on in the control panel) press the RESET button (**C**) on the control panel - see chapter “OPERATION”.



- 6 Start the burner up by means of the thermostat series and wait until the pre-purge phase comes to end and that burner starts up;
- 7 drive the burner to high flame stage, by means of the thermostat **TAB** (high/low flame thermostat - see Wiring diagrams), as far as fully-modulating burners, see related paragraph.
- 8 Then move progressively the microswitch to higher values until it reaches the high flame position; always check the combustion values (see next steps).



Berger STM30



MAN-AUTO

Siemens SQM40

**Actuator cams**

- I High flame
- II Stand-by and Ignition
- III Low flame

- 9 the nozzle supply pressure is already factory-set and must not be changed. Only if necessary, adjust the supply pressure as follows (see related paragraph); insert a pressure gauge into the port shown on Fig. 18 and act on on the pump adjusting screw **VR** (see Fig. 17) as to get the nozzle pressure at 25bar (see diagram on page 22).

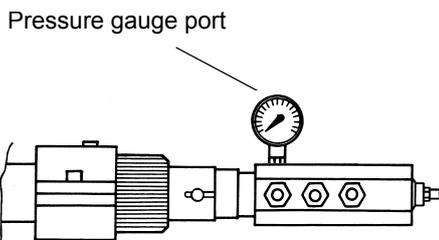


Fig. 20

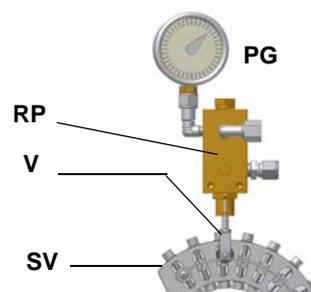
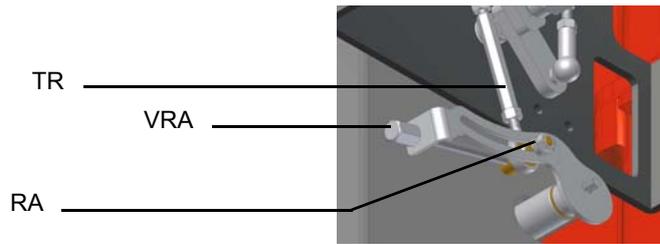


Fig. 22

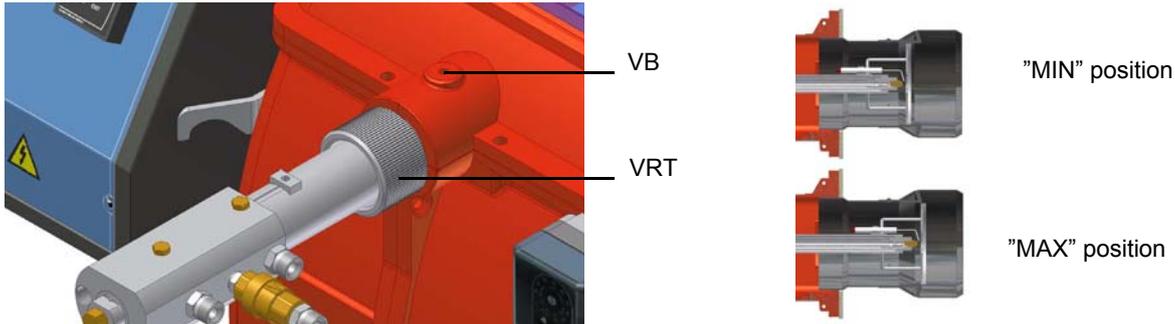
- 10 in order to get the maximum oil flow rate, adjust the pressure (reading its value on the **PG** pressure gauge): checking always the combustion parameters, the adjustment is to be performed by means of the **SV** adjusting cam screw **V** (see picture) when the cam has reached the high flame position.
- 11 To adjust the **air flow rate in the high flame stage**, loose the **RA** nut and screw **VRA** as to get the desired air flow rate: moving the rod **TR** towards the air damper shaft, the air damper opens and consequently the air flow rate increases, moving it far from the

shaft the air damper closes and the air flow rate decreases.

**Note:** once the procedure is performed, be sure that the blocking nut RA is fasten. Do not change the position of the air damper rods.

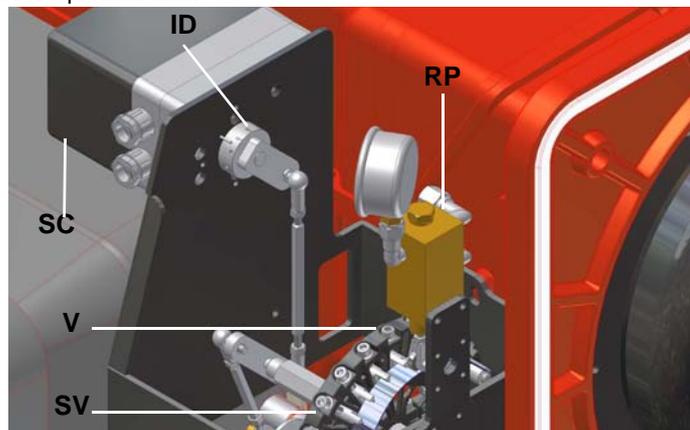


12 If necessary, change the combustion head position: to let the burner operate at a lower output, loose the **VB** screw and move progressively back the combustion head towards the MIN position, by turning clockwise the **VRT** ring nut. Fasten **VB** screw when the adjustment is accomplished.



**Attention!** if it is necessary to change the head position, repeat the air and gas adjustments described above.

- 13 as for the point-to-point regulation in order to set the cam foil shape, move the low flame microswitch (cam III) a little lower than the maximum position (90°);
- 14 set the **TAB** thermostat to the minimum in order that the actuator moves progressively towards the low flame position (as for fully-modulating burners, refer to the related paragraph);
- 15 move cam III towards the minimum to make the actuator move towards the low flame until the two bearings find the adjusting screw that refers to a lower position: screw **V** to increase the rate, unscrew to decrease, in order to get the pressure as showed on diagram on Fig. 15, according to the requested rate.



- 16 Move again cam III towards the minimum to meet the next screw on the adjusting cam and repeat the previous step; go on this way as to reach the desired low flame point.
- 17 The low flame position must never match the ignition position that is why cam III must be set 20°- 30° more than the ignition position.
- 18 Turn the burner off; then start it up again. If the adjustment is not correct, repeat the previous steps.

### Calibration of air pressure switch

To calibrate the air pressure switch, proceed as follows:

- Remove the transparent plastic cap.
- Once air and heavy oil setting have been accomplished, startup the burner.
- During the pre-purge phase of the operation, turn slowly the adjusting ring nut **VR** in the clockwise direction until the burner lockout, then read the value on the pressure switch scale and set it to a value reduced by 15%.
- Repeat the ignition cycle of the burner and check it runs properly.
- Refit the transparent plastic cover on the pressure switch.

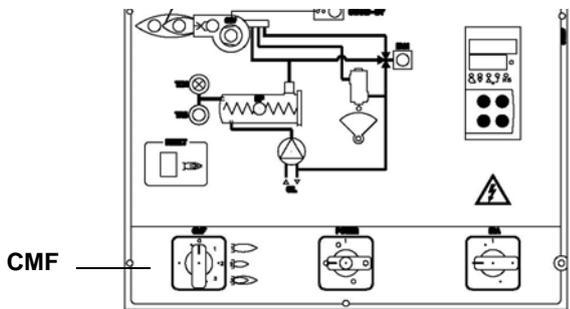


### Fully-modulating burners

To adjust the fully-modulating burners, use the **CMF** switch on the burner control panel (see next picture), instead of the **TAB** thermostat as described on the previous paragraphs about the progressive burners. Go on adjusting the burner as described before, paying attention to use the CMF switch instead of **TAB**.

The **CMF** position sets the operating stages: to drive the burner to the high-flame stage, set CMF=1; to drive it to the low-flame stage, set CMF=2.

To move the adjusting cam set CMF=1 or 2 and then CMF=0.



- CMF = 0 stop at the current position
- CMF = 1 high flame operation
- CMF = 2 low flame operation
- CMF = 3 automatic operation

**Oil circuit**

The fuel is pushed into the pump 1 to the nozzle 3 at the delivery pressure set by the pressure governor. The solenoid valve 2 stops the fuel immission into the combustion chamber. The fuel flow rate that is not burnt goes back to the tank through the return circuit. The spill-back nozzle is feeded at constant pressure, while the return line pressure is adjusted by means of the pressure governor controlled by an actuator coupled to an adjusting cam. The fuel amount to be burnt is adjusted by means of the burner actuator according to the adjustments set (see prevoius paragraph).

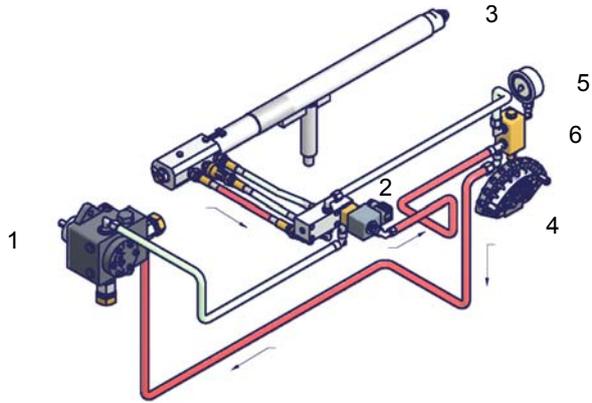


Fig. 23 - Stand-by

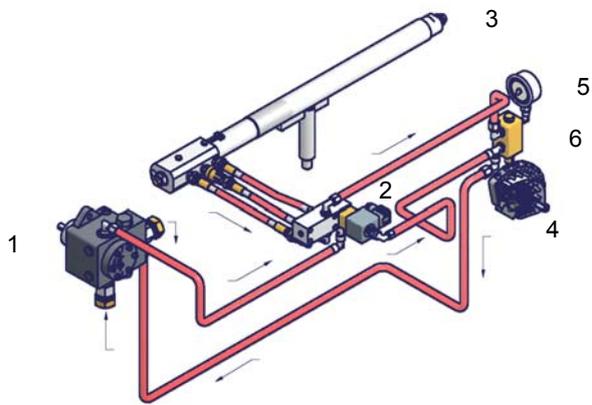


Fig. 24 - Prepurge

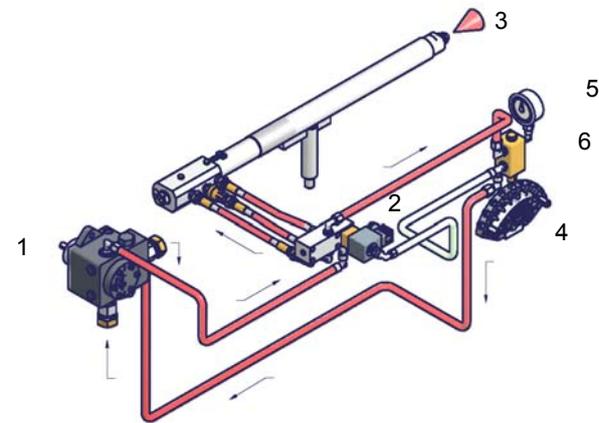


Fig. 25 - Low flame

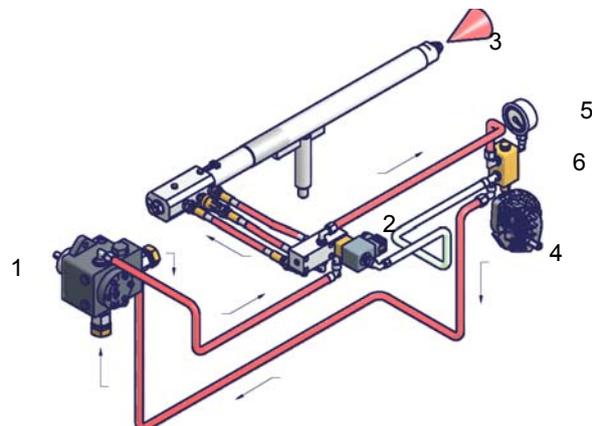


Fig. 26 - High flame

**Key**

- 1 Oil pump
- 2 Oil solenoid valve
- 3 Nozzle
- 4 Adjusting cam
- 5 Pressure gauge
- 6 Pressure governor

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## PART II: OPERATION

### LIMITATIONS OF USE

THE BURNER IS AN APPLIANCE DESIGNED AND CONSTRUCTED TO OPERATE ONLY AFTER BEING CORRECTLY CONNECTED TO A HEAT GENERATOR (E.G. BOILER, HOT AIR GENERATOR, FURNACE, ETC.), ANY OTHER USE IS TO BE CONSIDERED IMPROPER AND THEREFORE DANGEROUS.

THE USER MUST GUARANTEE THE CORRECT FITTING OF THE APPLIANCE, ENTRUSTING THE INSTALLATION OF IT TO QUALIFIED PERSONNEL AND HAVING THE FIRST COMMISSIONING OF IT CARRIED OUT BY A SERVICE CENTRE AUTHORIZED BY THE COMPANY MANUFACTURING THE BURNER.

A FUNDAMENTAL FACTOR IN THIS RESPECT IS THE ELECTRICAL CONNECTION TO THE GENERATOR'S CONTROL AND SAFETY UNITS (CONTROL THERMOSTAT, SAFETY, ETC.) WHICH GUARANTEES CORRECT AND SAFE FUNCTIONING OF THE BURNER.

THEREFORE, ANY OPERATION OF THE APPLIANCE MUST BE PREVENTED WHICH DEPARTS FROM THE INSTALLATION OPERATIONS OR WHICH HAPPENS AFTER TOTAL OR PARTIAL TAMPERING WITH THESE (E.G. DISCONNECTION, EVEN PARTIAL, OF THE ELECTRICAL LEADS, OPENING THE GENERATOR DOOR, DISMANTLING OF PART OF THE BURNER).

NEVER OPEN OR DISMANTLE ANY COMPONENT OF THE MACHINE.

OPERATE ONLY THE MAIN SWITCH, WHICH THROUGH ITS EASY ACCESSIBILITY AND RAPIDITY OF OPERATION ALSO FUNCTIONS AS AN EMERGENCY SWITCH, AND ON THE RESET BUTTON.

IN CASE OF A BURNER SHUT-DOWN, RESET THE CONTROL BOX BY MEANS OF THE RESET PUSHBUTTON. IF A SECOND SHUT-DOWN TAKES PLACE, CALL THE TECHNICAL SERVICE, WITHOUT TRYING TO RESET FURTHER.

**WARNING:** DURING NORMAL OPERATION THE PARTS OF THE BURNER NEAREST TO THE GENERATOR (COUPLING FLANGE) CAN BECOME VERY HOT, AVOID TOUCHING THEM SO AS NOT TO GET BURNT.

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## OPERATION



**ATTENTION:** before starting the burner up, be sure that the manual cutoff valves are open and check that the pressure upstream the gas train complies the value quoted on paragraph "Technical specifications".

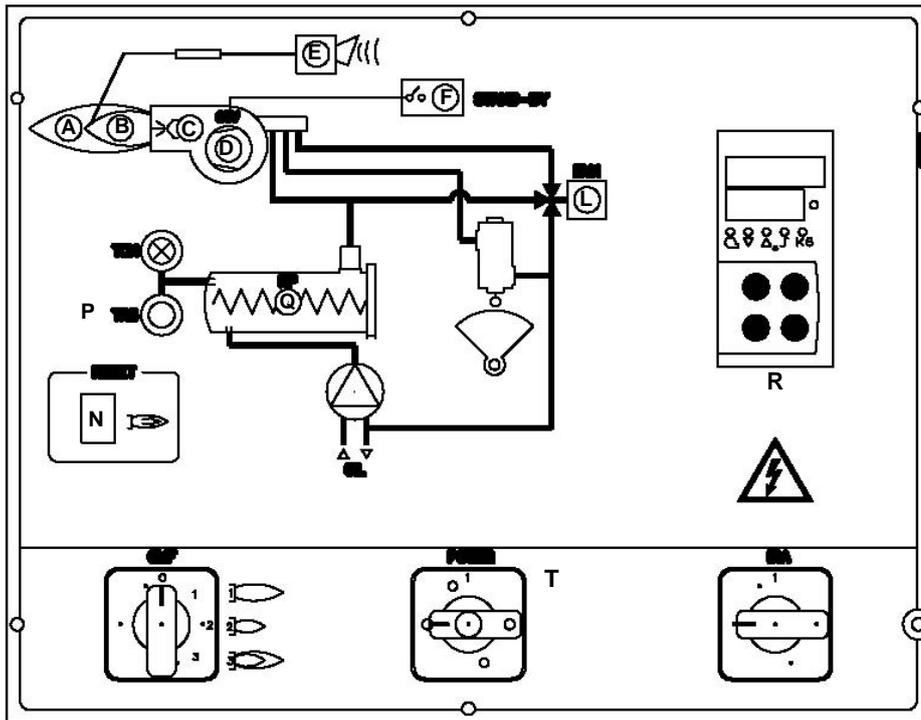
**N.B. be sure the cutoff valves on the delivery and return pipes are OPEN.**

- Turn the burner on by means of its main switch **A** (see next pictures).
- Check that the burner is not locked (LED **E** lights up); if so, reset it by pressing the reset button **N**.
- Check that the series of thermostats (or pressure switches) enable the burner to start up.
- At the beginning of the start-up cycle the servo control drives the air damper to the maximum opening, the fan motor starts and the pre-purge phase begins. During the pre-purge phase the complete opening of the air damper is signalled by the indicator light **F** on the front panel.
- At the end of the pre-purge the ignition transformer is energised (signalled by the indicator light **C** on the panel). Two seconds later, the oil valve opens and the ignition transformer is de-energized (light **C** off).

The burner is now into operation, the servocontrol begins the opening, after few seconds the burner goes to two stages operation and eventually switches to the high flame operation, depending on the needs of the plant (light **A**, on) or continues with low flame operation (light **B**, on).

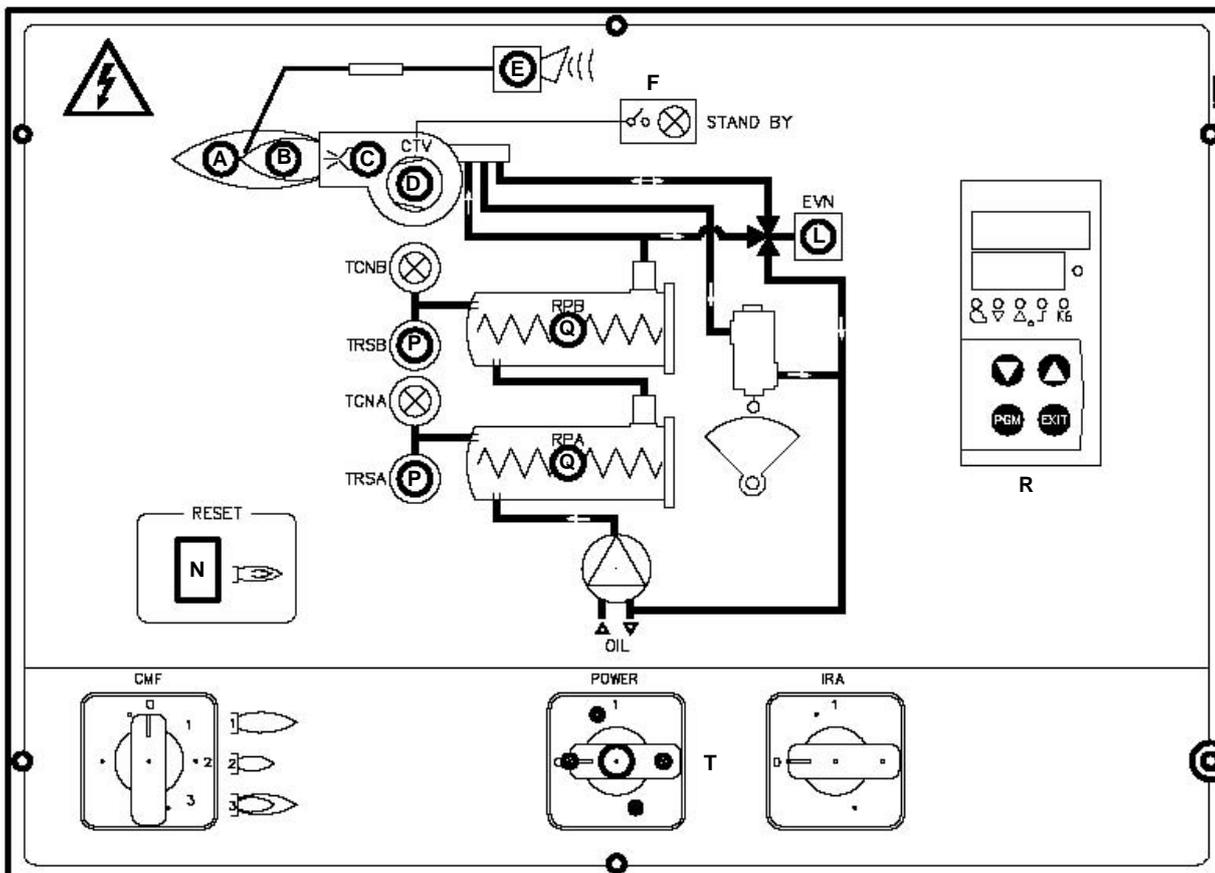
As far as fully-modulating burners, see the Siemens RWF40 burner modulator manual.

**Control panel**  
RN510



- A High flame lamp
- B Low flame lamp
- C Ignition transformer operation
- CMF Manual operation switch  
0= Off      1= High flame  
2= Low flame    3= Automatic
- D Fan motor thermal cutout intervention
- E Burner lockout
- F Burner in stand-by
- IRA Auxiliary resistors wswitch
- L Heavy oil solenoid lamp operation
- N Control box reset pushbutton
- P Heating resistors safety thermostat
- Q Pre-heating tank
- R Modulator
- T Main switch

**RN515 - RN520 - RN525**



## PART III: MAINTENANCE

At least once a year carry out the maintenance operations listed below. In the case of seasonal servicing, it is recommended to carry out the maintenance at the end of each heating season; in the case of continuous operation the maintenance is carried out every 6 months.



**WARNING: ALL OPERATIONS ON THE BURNER MUST BE CARRIED OUT WITH THE MAINS DISCONNECTED AND THE FUEL MANUAL CUTOFF VALVES CLOSED!**

**ATTENTION: READ CAREFULLY THE "WARNINGS" CHAPTER AT THE BEGINNING OF THIS MANUAL.**

### ROUTINE MAINTENANCE

- Clean and examine the oil filter cartridge and replace it if necessary.
- Examine the condition of the oil flexible tubing and check for possible leaks.
- Check and clean if necessary the oil heaters and the tank, according to the fuel type and its use; remove the heaters flange fixing nuts and remove the heaters from the tank: clean by using steam or solvents and not metallic things.
- Clean and examine the filter inside the oil pump. Filter must be thoroughly cleaned at least once in a season to ensure correct working of the fuel unit. To remove the filter, unscrew the four screws on the cover. When reassemble, make sure that the filter is mounted with the feet toward the pump body. If the gasket between cover and pump housing should be damaged, it must be replaced. An external filter should always be installed in the suction line upstream of the fuel unit.
- Remove and clean the combustion head (page 35).
- Examine and clean the ignition electrodes, adjust and replace if necessary (see page 35).
- Examine and clean the detection probe, adjust and replace if necessary (see page 36).
- Examine the detection current (see page 36).
- Remove and clean (page 36) the heavy oil nozzle (**Important: use solvents for cleaning, not metallic tools**) and at the end of the maintenance procedures, after replacing the burner, turn it on and check the shape of the flame; if in doubt replace the nozzle. Where the burner is used intensively it is recommended to replace the nozzle as a preventive measure, at the begin of the operating season.
- Clean and grease joints and rotating parts.

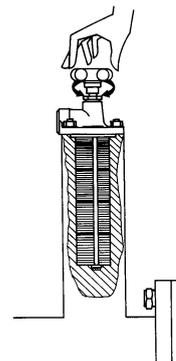
**IMPORTANT: Remove the combustion head before checking the ignition electrodes.**



**CAUTION: avoid the contact of steam, solvent and other liquids with the electric terminals of the resistor. On flanged heaters, replace the seal gasket before refitting it. Periodic inspections must be carried out to determine the frequency of cleaning.**

### Self-cleaning filter

Fitted only on high viscosity oil burners. Periodically turn the knob to clean the filter.



## Removing the combustion head

- Remove the cover H.
- Slide the photoresistor out of its housing.
- Unscrew the oil connections E (Fig. 28) connecting the flexible pipes to the gun L and remove the whole assembly as shown in Fig. 28-Fig. 29.
- clean the combustion head by means of a vacuum cleaner; to scrape off the scale use a metallic brush.

Note: to replace the combustion head reverse the procedure described above.

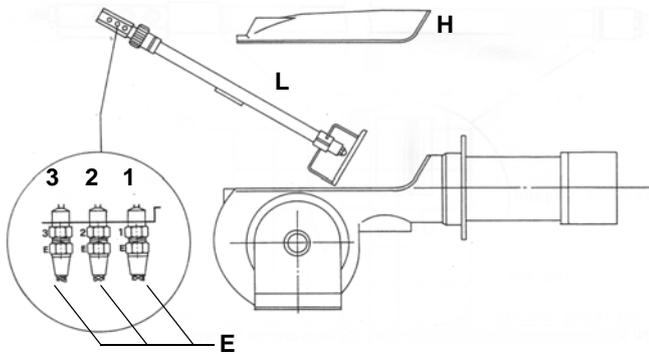


Fig. 27

### Key

- 1 Inlet
- 2 Return
- 3 Lance opening
- 4 Heating wire (only on high density oil burners)
- 5 Cartridge-type heater
- H Cover
- L Oil lance
- E Oil piping connections

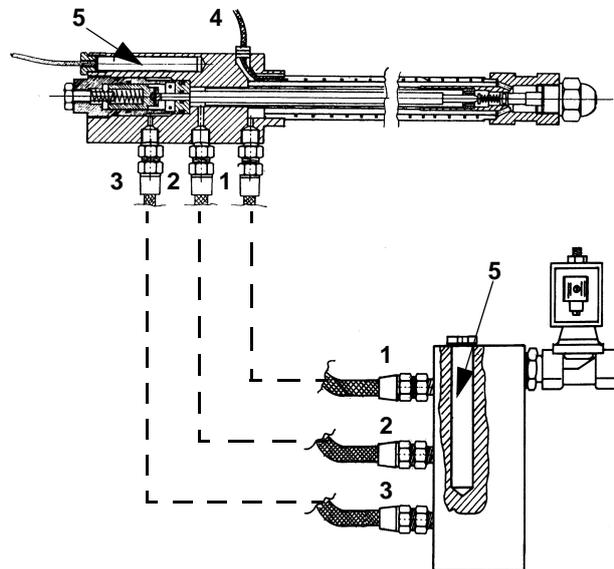


Fig. 28

## Removing the oil gun, replacing the nozzle and the electrodes



**ATTENTION:** avoid the electrodes to get in touch with metallic parts (blast tube, head, etc.), otherwise the boiler operation would be compromised. Check the electrodes position after any intervention on the combustion head.

To remove the oil gun, proceed as follows:

- 1 remove the combustion head as described on the previous paragraph;
- 2 loosen the **VL** screw and remove the oil gun and the electrodes: check the oil gun, replace it if necessary;
- 3 after removing the oil gun, unscrew the nozzle and replace it if necessary;
- 4 in order to replace the electrodes, unscrew the **VE** fixing screws and remove them: place the new electrodes being careful to observe the measures showed on pag.: reassemble following the reversed procedure.

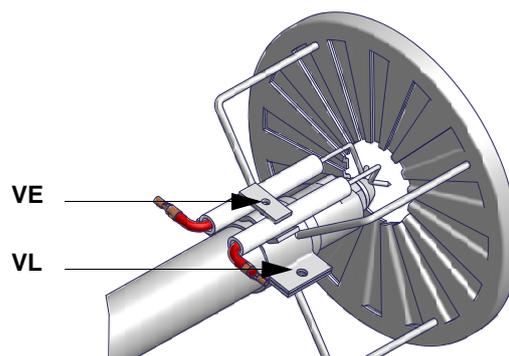


Fig. 29

### Nozzle and ignition electrodes correct position

Place the nozzle according to the combustion head; unscrew **VB** and move the combustion head. Check the ignition electrodes at the end of the procedure.

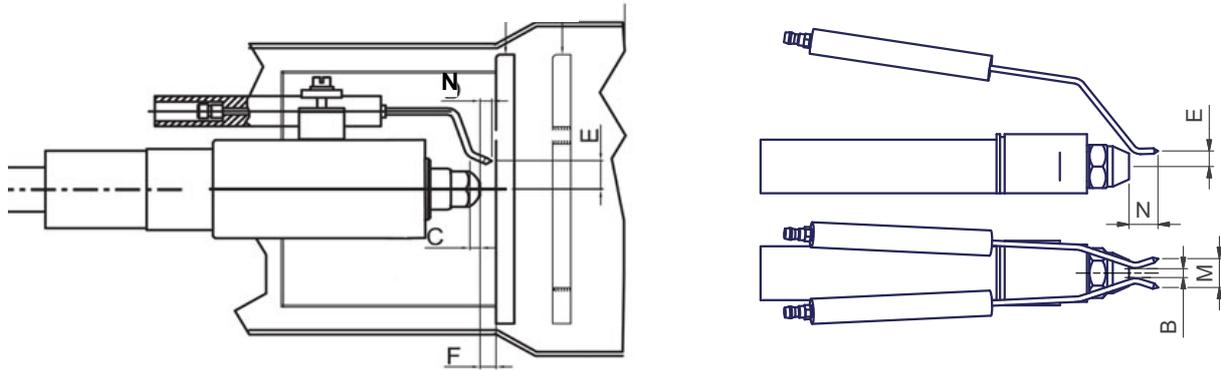


Fig. 30

B	C	M	N	E	F
3 ÷ 5 mm	3 ÷ 4 mm	10 ÷ 15 mm	10 mm	13 mm	8 mm

### Checking the detection current

To check the flame intensity signal, follow the diagram shown on the next picture. If the measured value is lower than the suggested one, check the photoresistor position, the electrical contacts. Replace the photoresistor if necessary.

Siemens LAL2.. control box	
Minimum detection current @ 230V	8 $\mu$ A
Maximum detection current without flame	0.8 $\mu$ A
Maximum detection current	35 $\mu$ A

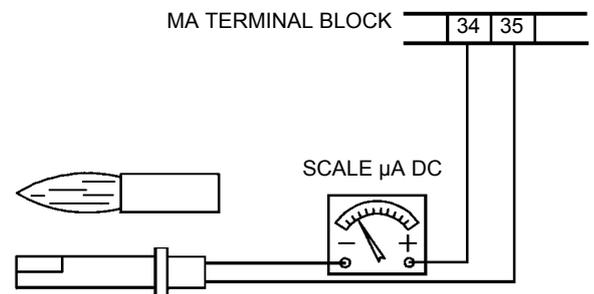


Fig. 31

### Cleaning and replacing the detection photoresistor

To clean/replace the photoresistive detector, remove it from its slot. To clean the photoresistor, use a clean cloth, not cleaning sprays.

### Seasonal stop

To stop the burner in the seasonal stop, proceed as follows:

- 1 turn the burner main switch to 0 (Off position)
- 2 disconnect the power mains
- 3 close the fuel valve of the supply line

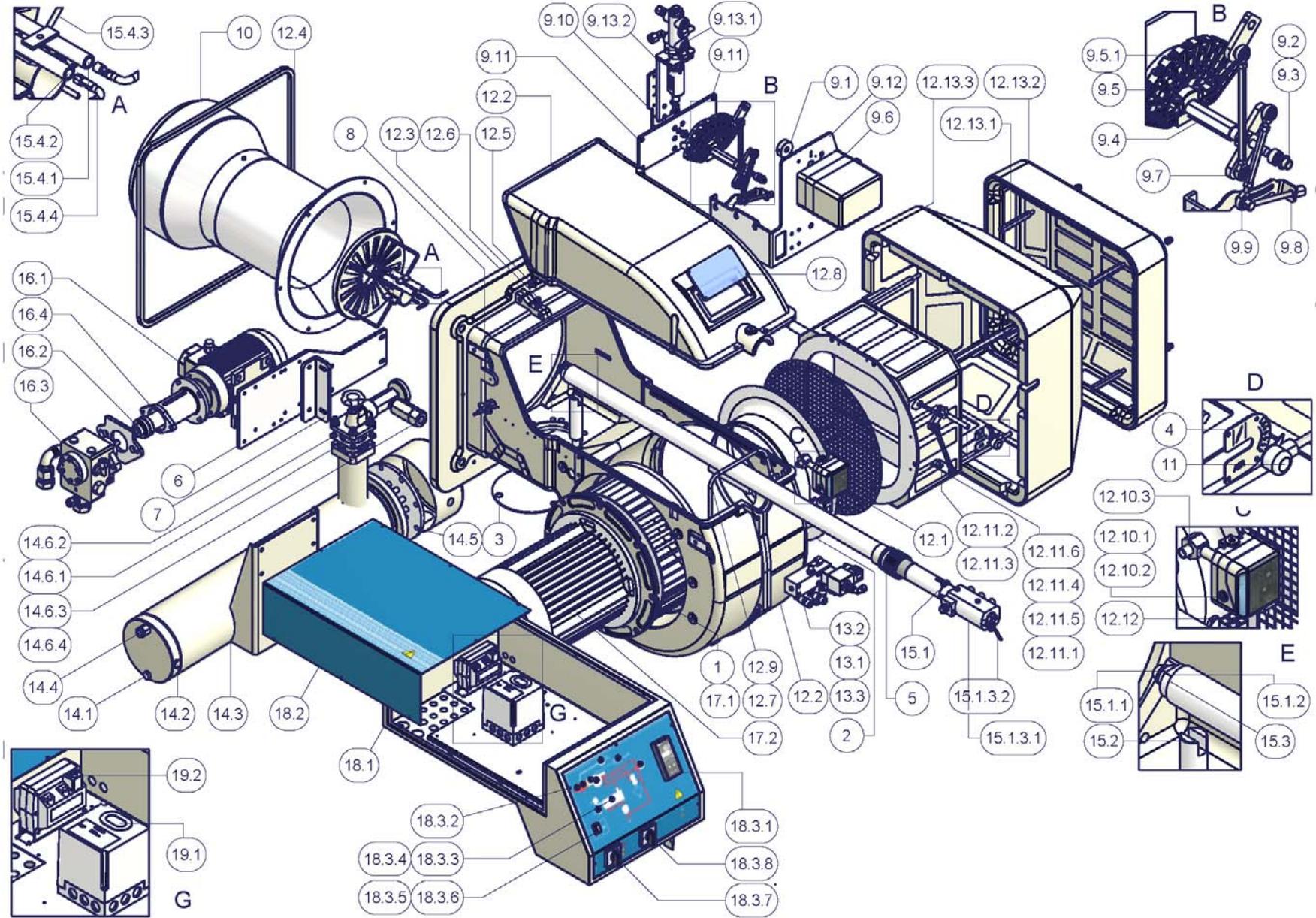
### Burner disposal

In case of disposal, follow the instructions according to the laws in force in your country about the "Disposal of materials".

## TROUBLESHOOTING

CAUSES/TROUBLES	DOES NOT START UP	CONTINUES PRE-PURGUE	BURNER STARTS UP WITH COLD OIL	DOES NOT IGNITE AND GOES TO SHUT DOWN	DOES NOT PASS TO HIGH FLAME	GOES TO SHUT DOWN DURING OPERATION	GOES OFF AND REPEATS THE CYCLE DURING OPERATION
MAIN SWITCH OFF	●						
LINE FUSES BLOWN	●						
MAXIMUM THERMOSTAT MALFUNCTION	●						
FAN THERMAL CUTOUT TRIPPED	●						
AUXILIARY FUSE BLOWN	●						
OIL RESISTOR FAULTY	●		●				
OIL ENABLING THERMOSTAT TRIPPED	●		●				
CONTROL UNIT MALFUNCTION	●	●		●	●	●	●
AIR SERVOCONTROL MALFUNCTION					●		
CIRCUIT ENABLING THERMOSTAT		●			●		
SMOKY FLAME						●	●
IGNITION TRANSFORMER FAULTY				●			
IGNITION ELECTRODES WRONGLY POSITIONED				●			
DIRTY NOZZLE				●		●	
FAULTY OIL VALVE				●			●
FAULTY OR DIRTY PHOTORESISTOR							●
FAULTY RESISTOR THERMOSTAT	●						
FAULTY HIGH-LOW FLAME THERMOSTAT					●		
ACTUATOR CAM NOT CALIBRATED					●		
LOW OIL PRESSURE				●		●	●





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## **WIRING DIAGRAMS**

Refer to the attached wiring diagrams.

### **WARNING**

- 1 - Electrical supply 230V 50Hz 1 a.c./400V 50Hz 3N a.c.
- 2 - Do not reverse phase with neutral
- 3 - Ensure burner is properly earthed

**SIEMENS LAL.. CONTROL BOX**

**Use**

- Control and supervision of oil atomization burners
- For burners of medium to high capacity
- For intermittent operation (at least one controlled shutdown every 24 hours)
- Universally applicable for multistage or modulating burners

**Housing and plug-in base**

- Made of impact-proof and heat-resistance black plastic
- Lockout reset button with viewing window; located behind it:
- Lockout warning lamp
- Lockout indicator coupled to the spindle of the sequence switch and visible in the transparent lockout reset button
- uses easy-to-remember symbols to indicate the type of fault and the point in time lockout occurred

Base and plug-in section of the LAL... are designed such that only burner controls of the LAL... family can be plugged in.

- 24 connection terminals
- Auxiliary terminals «31» and «32»
- 3 earth terminals terminating in a lug for earthing the burner
- 3 neutral conductor terminals prewired to terminal 2
- 14 knockout holes for cable entry by means of cable glands
- 8 at the side
- 6 in the bottom of the base
- 6 lateral threaded knockout holes for cable entry glands Pg11 or M20

**Operation**

Flame detector and flame simulation test are made automatically during burner off times and the prepurge time «t1». If loss of flame occurs during operation, the burner control will initiate lockout. If automatic repetition of the startup sequence is required, the clearly marked wire link on the plug-in section of the LAL... must be cut away.

**Pre-conditions for burner startup**

- Burner control is not in the lockout position
- Sequence switch is in its start position (with LAL2 voltage is present at terminals 11 and 12.
- Air damper is closed; end switch «z» for the CLOSED position must feed power from terminal 11 to terminal 8.
- Contact of the limit thermostat or pressure switch «W» and the contacts of any other switching devices in the control loop between terminals 4 and 5 must be closed e.g. a control contact for the oil preheater's temperature
- Normally closed contact of the air pressure switch must be closed.

**Startup sequence**

Start command by «R»:

- «R» closes the start control loop between terminals 4 and 5
- The sequence switch starts to run
- Only prepurging, fan motor at terminal 6 receives power
- Pre- and postpurging, fan motor or flue gas fan at terminal 7 receives power on completion of «t7»
- On completion of «t16», the control command for opening the air damper is delivered via terminal 9
- Terminal 8 receives no power during the positioning time
- The sequence switch continues to run only after the air damper has fully closed.

t1 Prepurge time with air damper fully open:

- The correct functioning of the flame supervision circuit is checked during «t1»
- The burner control will initiate lockout if correct functioning is not ensured.

With LAL2:

Shortly after the beginning of «t1», the air pressure switch must change over from terminal 13 to terminal 14 otherwise, the burner control will initiate lockout start of the air pressure check.

t3 Short preignition time:

«Z» must be connected to terminal 16, release of fuel via terminal 18.

t3' Long preignition time: «Z» connected to terminal 15.

t3n Postignition time:

- «Z» must be connected to terminal 15

- With short preignition, «Z» remains on until «TSA» has elapsed connection to terminal 16.

t4 Interval «BV1 – BV2» or «BV1 - LR»: On completion of «t4», voltage is present at terminal 19. The voltage is required to power «BV2» connected to auxiliary switch «v» in the actuator.

t5 Interval: On completion of «t5», terminal 20 receives power. At the same time, control outputs 9 to 11 and input 8 are galvanically separated from the LAL...’s control section.

LAL... is now protected against reverse voltages from the load control circuit. With the release of «LR» at terminal 20, the startup sequence of the LAL... ends. After a few idle steps (steps with no contact position changes), the sequence switch switches itself off.

B Operating position of the burner

B-C Burner operation: during burner operation, «LR» drives the air damper to the nominal load or low-fire position, depending on heat demand; the release of the nominal load takes place via auxiliary switch «v» in the actuator and in the event of loss of flame during operation, the LAL... will initiate lockout. For automatic start repetition, the clearly marked wire link «B» on the plugin section of the LAL... must be cut away.

C Controlled shutdown: in the case of controlled shutdown, «BV...» will immediately be closed. At the same time, the sequence switch is started to program «t6»

C-D Sequence switch travels to start position «A»

t6 Postpurge time: fan «M2» connected to terminal 7. Shortly after the start of «t6», terminal 10 receives power and the air damper is driven to the MIN position. Full closing of the air damper starts only shortly before «t6» has elapsed initiated by the control signal at terminal 11. During the following burner off time, terminal 11 is live.

t13 Permissible afterburn time: during «t13», the flame signal input may still receive a flame signal.

D-A End of control program: start position

As soon as the sequence switch has reached the start position – having thereby switched itself off – the flame detector and flame simulation test will start again.

During burner off times, the flame supervision circuit is live.

**Lockout and indication of the stop position**

Whenever a fault occurs, the sequence switch stops and with it the lockout indicator. The symbol appearing above the reading mark indicates the type of fault:

◀ No start. One of the contacts is not closed (also refer to «Preconditions for burner startup»):

Extraneous light:

Lockout during or after completion of the control program

Examples: nonextinguished flame, leaking fuel valves faulty flame supervision circuit.

▲ Interruption of startup. No OPEN signal at terminal 8 from the changeover end switch «a». Terminals 6, 7 and 15 are live until fault has been corrected

P Lockout. No air pressure indication at the beginning of the air pressure check. Air pressure failure after the air pressure check.

■ Defect in the flame supervision circuit.

▼ Interruption of the startup sequence. No positioning signal at terminal 8 from the auxiliary switch «m» for the low-fire position. Terminals 6, 7 and 15 are live until fault has been corrected.

1 Lockout. No flame signal at the end of the safety time.

| Flame signal has been lost during operation.

A Consenso all'avviamento (ad esempio tramite il termostato o il pressostato R dell'impianto)

B Operating position of the burner

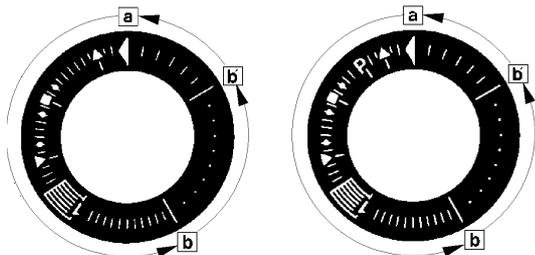
B-C Burner operation: during burner operation, «LR» drives the air damper to the nominal load or low-fire position, depending on heat demand; the release of the nominal load takes place via auxiliary switch «v» in the actuator and in the event of loss of flame during operation, the LAL... will initiate lockout. For automatic start repetition, the clearly marked wire link «B» on the plugin section of the LAL... must be cut away.

C Controlled shutdown: in the case of controlled shutdown, «BV...» will immediately be closed. At the same time, the sequence switch is started to program «t6»

C-D Sequence switch travels to start position «A».

During burner off times, the flame supervision circuit is live.

**Lockout indication**



- a-b Startup sequence
- b-b' Idle step (with no contact confirmation)
- b(b')-a Postpurge program

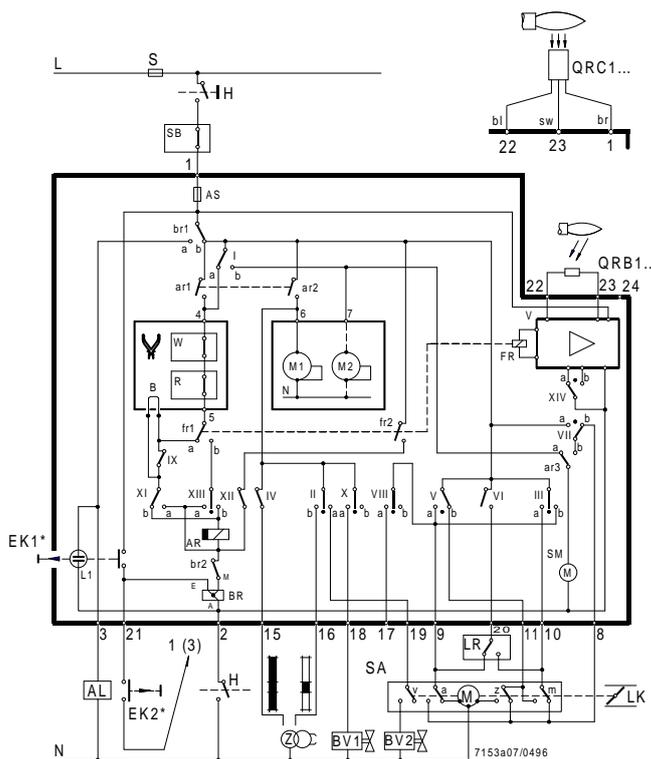
Burner control can immediately be reset after lockout:  
 Do not press the lockout reset button for more than 10 seconds  
 The sequence switch always travels to the start position first  
 After resetting  
 After rectification of a fault that led to shutdown  
 After each power failure  
 During this period of time, power is only fed to terminals 7 and 9...11.  
 Then, the LAL... will program a new burner startup sequence

**Specifications**

- Power supply AC 230 V -15 / +10 %
- for LAL2... on request AC 100 V -15 %...AC 110 V +10 %
- Frequency 50 Hz -6 %...60 Hz +6 %
- Absorption AC 3.5 VA
- Mounting position optional
- Protection IP 40
- Perm. input current at terminal 1 AC 5 A max., 20 A peak
- Perm. current rating of control terminals 3, 6, 7, 9...11, 15...20

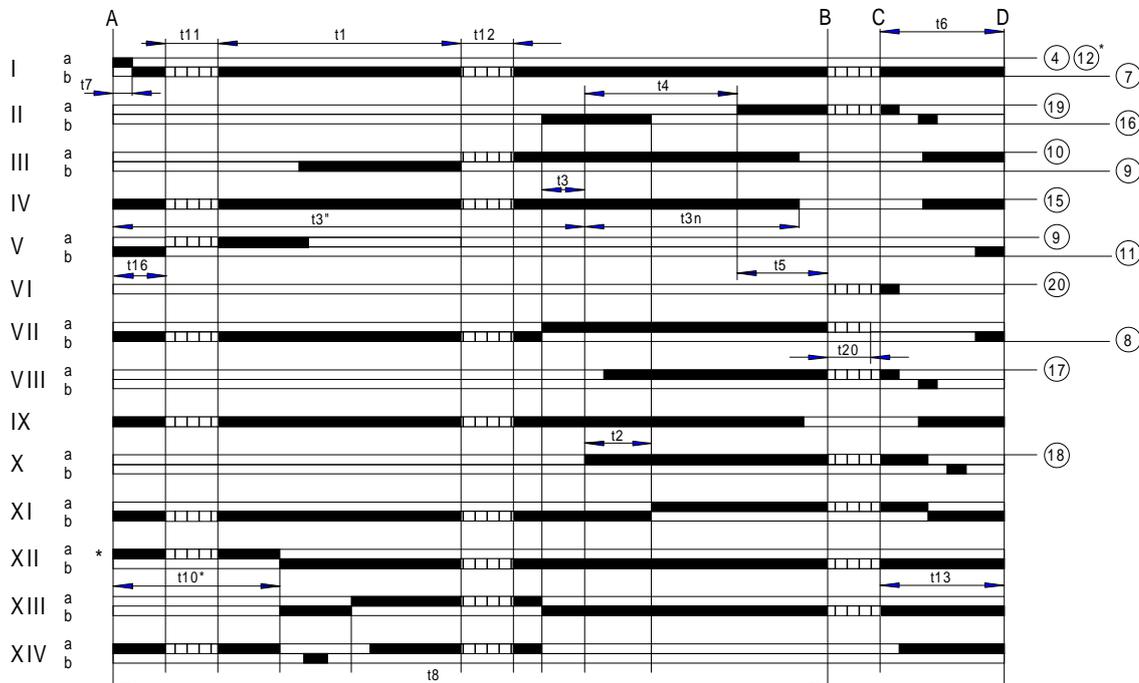
Internal fuse  
 External fuse  
 Weight

4 A max., 20 A peak  
 T6,3H250V according to IEC 127  
 max. 10 A  
 Device 1000 g  
 Plug-in base 165 g



**Sequence diagram**

**Control output at terminal**



**Lockout position indication**

**Key**

- t1 Prepurge time with air damper fully open
- t2 Safety time
- t3 Preignition time, short («Z» connected to terminal 16)

- T3' Preignition time, long («Z» connected to terminal 15)
- t3n Postignition time («Z» connected to terminal 15)
- t4 Interval between voltage at terminals 18 and 19 («BV1-BV2»)
- t5 Interval between voltage at terminals 19 and 20 («BV2» load controller)

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t6	Postpurge time (with «M2»)
t7	Interval between start command and voltage at terminal 7 (start delay time for «M2»)
t8	Duration of startup sequence (excluding «t11» and «t12»)
t10	Interval from startup to the beginning of the air pressure check
t11	Air damper running time to the OPEN position
t12	Air damper running time to the low-fire position (MIN)
t13	Permissible afterburn time
t16	Interval to the OPEN command for the air damper
t20	For self-shutdown of the sequence switch

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Note: specifications and data subject to change. Errors and omissions exceptd.