

GB Forced draught gas burner

CN 强制通风燃气燃烧器

Two stage operation

两段火运行

Gulliver



CODE - 编码

MODEL - 型号

TYPE - 类型

20023781

RS5D

922T1

INDEX

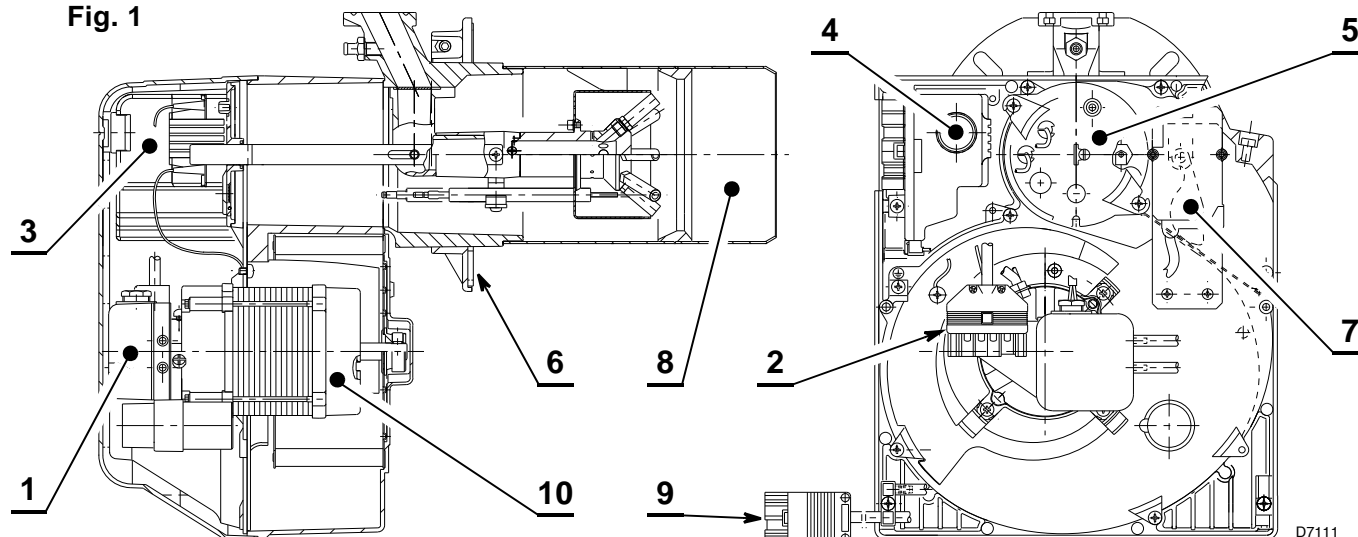
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1. BURNER DESCRIPTION

Two stage gas burner.

- The burner meets protection level of IP 40, EN 60529.
- According to Directives: EMC 89/336/EEC - 2004/108/EC, Low Voltage 73/23/EEC - 2006/95/EC and Machines 98/37/EEC - 2006/42/EC.
- Gas train according to EN 676.
- The burner is approved for intermittent operation as per Directive EN 676.

Fig. 1



- | | |
|-------------------------------------|--|
| 1 – Air pressure switch | 6 – Flange with insulating gasket |
| 2 – 6 pole socket for gas train | 7 – Servomotor |
| 3 – Control box with 7 pole socket | 8 – Blast tube |
| 4 – Reset button with lock-out lamp | 9 – 4 pole socket for 2 nd stage burner |
| 5 – Head holder assembly | 10 – Motor |

1.1 BURNER EQUIPMENT

Flange with insulating gasket	No. 1	Screws and nuts for flange to be fixed to boiler	No. 4
Screw and nut for flange	No. 1	7 pin plug	No. 1
Remote reset connection	No. 1	4 pin plug	No. 1

1.2 ACCESSORIES

SOFTWARE DIAGNOSTIC KIT

A special kit is available that, by an optical link to a PC, shows the burner life together with operating hours, type and number of failures, serial number, etc.

To visualise the diagnostics proceed as follows:

- Connect the kit supplied separately to the control box socket.

Reading of the information begins when the software programme included in the kit starts.

REMOTE RESET KIT

The burner has a remote reset kit (**RS**) consisting of a connection and a push-button operating at a distance of 20 metres max.

In order to install it remove the protective lock-out installed at the factory and insert the lock-out supplied with the burner (see electrical diagram on page 7).

MULTIBLOC ROTATION KIT

There is a special kit available that can be used to install the burner turned 180°, as illustrated on page 5 in position 5 in the section entitled "**3.1 WORKING POSITION**". This kit is designed to ensure the gas train valve works properly. The kit must be installed in conformity with laws and local regulations.

2. TECHNICAL DATA

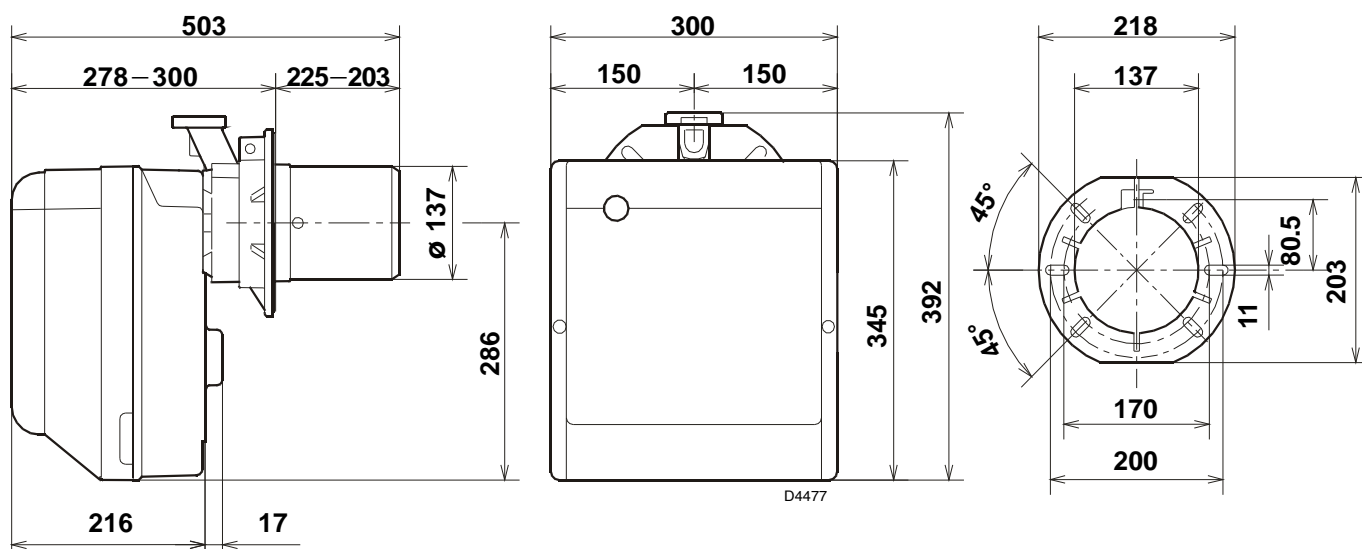
2.1 TECHNICAL DATA

TYPE	922 T1
Thermal power (1)	160/208 - 345 kW – 137.600/178.800 - 296.700 kcal/h
Natural gas (Family 2)	Net heat value: 8 – 12 kWh/Nm ³ = 7000 – 10.340 kcal/Nm ³
	Pressure: min. 20 mbar - max. 100 mbar
Electrical supply	Single phase, 230 V ± 10% ~ 50Hz
Motor	Run current 1.9 A - 2720 rpm - 288 rad/s
Capacitor	8 µF
Ignition transformer	Primary 230 V / 0.2 A – Secondary 8 kV / 12 mA
Absorbed electrical power	0.45 kW
(1) Reference conditions: Temp. 20°C - Barometric pressure 1013 mbar – Altitude 0 m above sea level.	

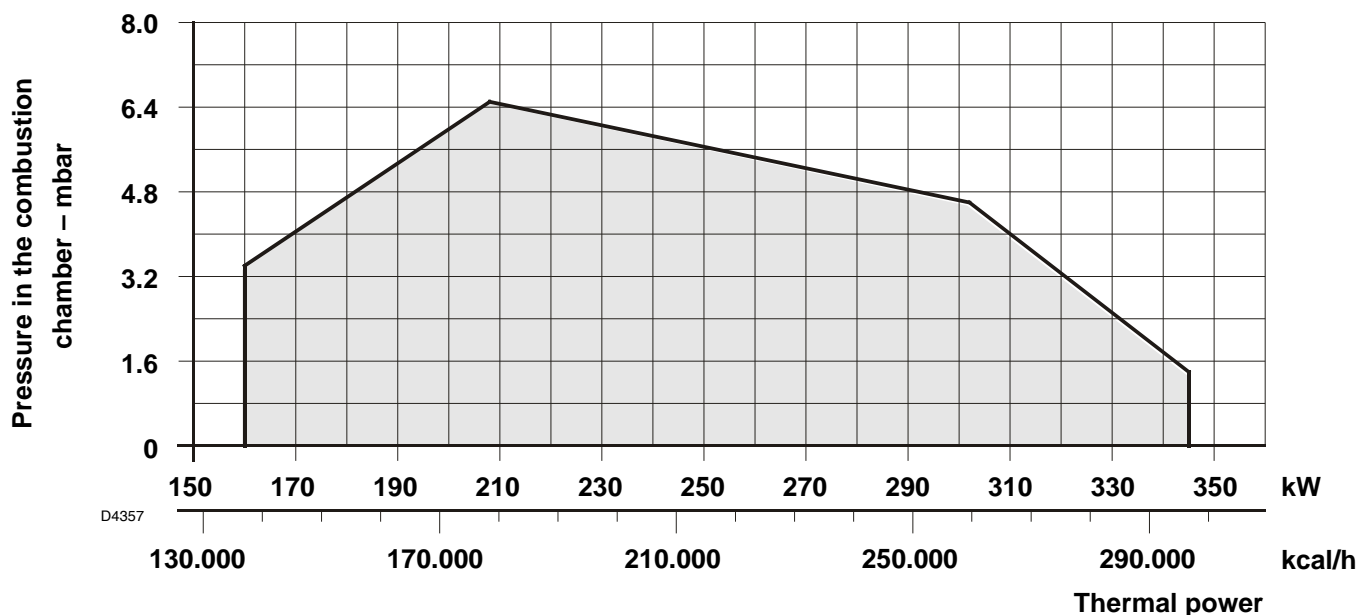
For gas family 3 (LPG) ask for separate kit.

COUNTRY	AT - IT - DK - CH		GB - IE	DE	FR	NL	LU	BE
GAS CATEGORY	II2H3B/P		II2H3P	II2ELL3B/P	II2Er3P	II2L3B/P	II2E3B/P	I2E(R)B, I3P
GAS PRESSURE	G20	H	20	–	–	–	–	–
	G25	L	–	25	20	–	25	25
	G20	E	–	–	20	20/25	–	20/25

2.2 OVERALL DIMENSIONS



2.3 FIRING RATE, (as EN 676)



TEST BOILER

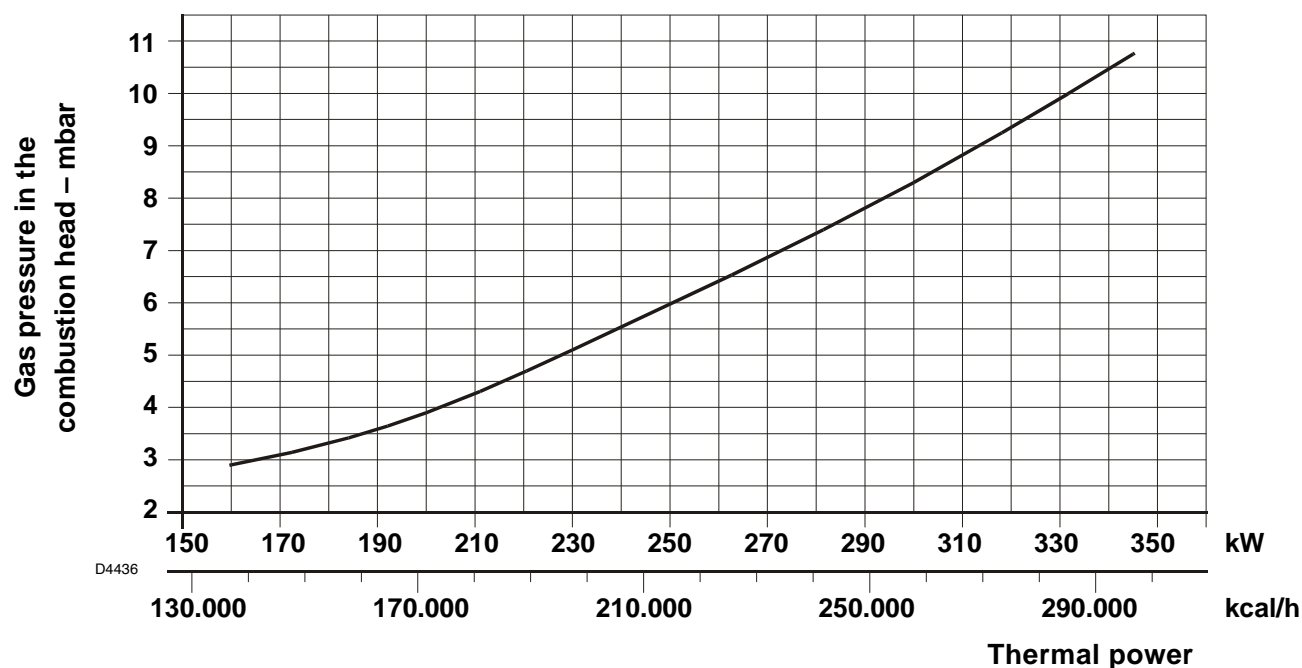
The working field has been defined according to EN 676 standard.

COMMERCIAL BOILERS

The burner-boiler matching is assured if the boiler is according to EN 303 and the combustion chamber dimensions are similar to those shown in the diagram EN 676. For applications where the boiler is not according to EN 303, or where the combustion chamber dimensions differ from those shown in EN 676, please consult the manufacturers.

CORRELATION BETWEEN GAS PRESSURE AND BURNER OUTPUT

To obtain the maximum output, a gas head pressure of 10.7 mbar is measured (**M2**, see chapter 3.5, page 6) with the combustion chamber at 0 mbar using gas G20 with a net heat value of 10 kWh/m³ (8.570 kcal/m³).



3. INSTALLATION

THE BURNER MUST BE INSTALLED IN CONFORMITY WITH LEGISLATION AND LOCAL STANDARDS.

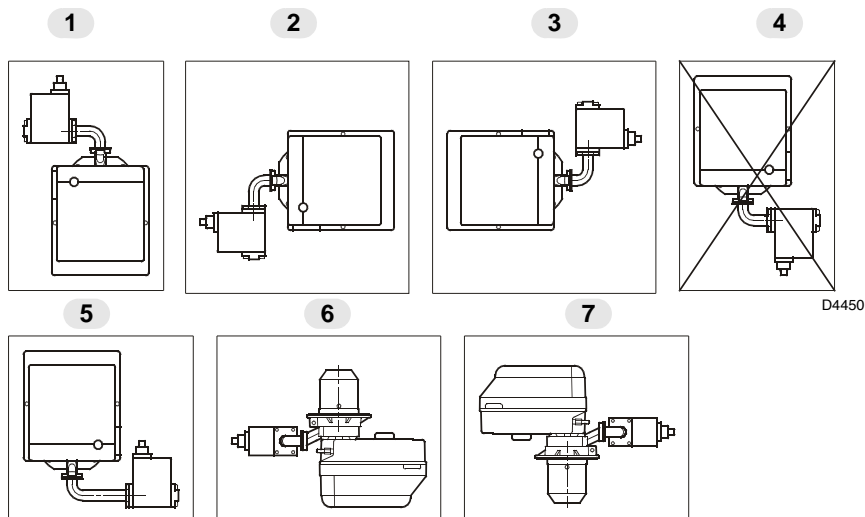
3.1 WORKING POSITION

The burner is designed for operation in position 1 only.

Installation in positions 2, 3, 5, 6, 7 is not recommended as it is likely to hinder the unit's proper operation since air damper closure cannot be guaranteed when the burner is on standby.

Installation in position 5 is only possible using the "MULTIBLOC rotation kit", to be ordered separately.

Installation 4 is prohibited as safety is compromised.



3.2 BOILER FIXING

To fit the burner to the boiler it is necessary to carry out the following:

- Widen, if necessary, the insulating gasket holes (3, fig. 3).
- Fix the flange (5) to the boiler door (1) using four screws (4) and (if necessary) the nuts (2) **interposing the insulating gasket (3)** but keep unloosening one of the two upper screws (4) (see fig. 2).
- Put on the flange (5) the burner combustion head, tighten the flange with the screws (6) and lock the loose screw (4).

N.B.: The burner can be fixed with the variable dimension **(A)** (see fig. 4). Anyway, make sure that the combustion head crosses completely the boiler door thickness.

Fig. 3

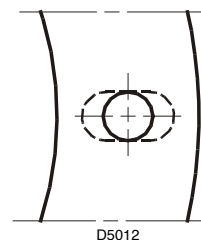


Fig. 2

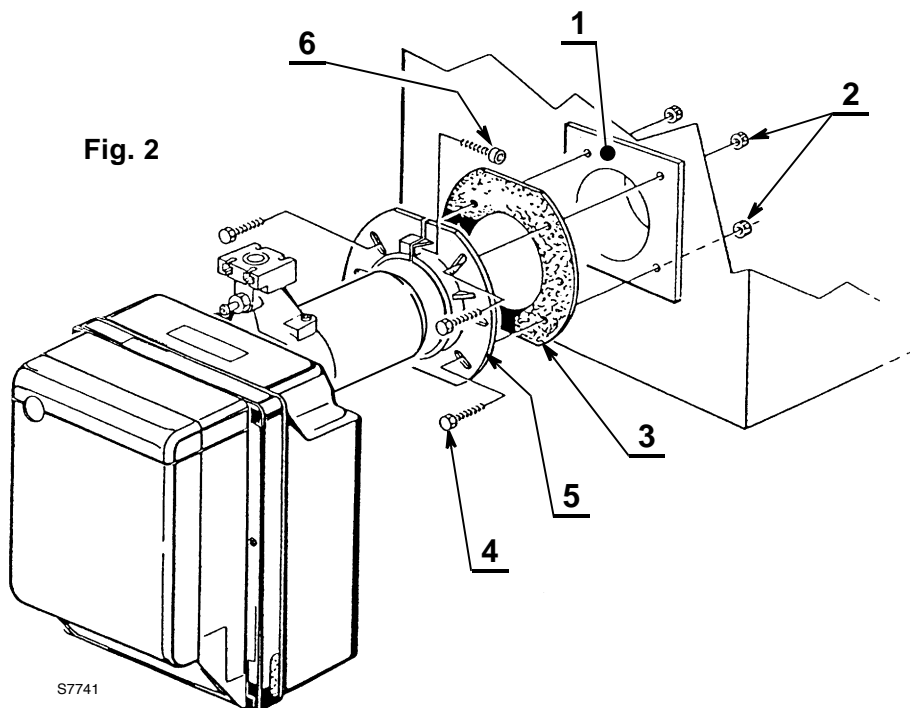
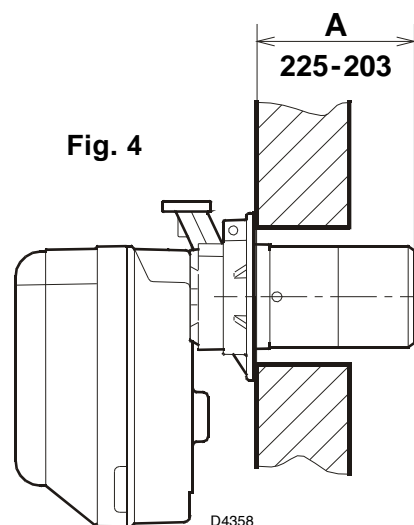


Fig. 4



3.3 GAS TRAIN, (as EN 676)

The gas train is supplied separately, for its adjustment see the enclosed instructions.

GAS TRAIN		CONNECTIONS		USE
TYPE	CODE	INLET	OUTLET	
MB-ZRDLE 410 B01	3970542	Rp 1" 1/4	Flange 3	Natural gas ≤ 200kW and LPG 160 – 345 kW
MB-ZRDLE 412 B01	3970543	Rp 1" 1/4	Flange 3	Natural gas ≤ 300 kW
MB-ZRDLE 415 B01	3970582	Rp 1" 1/2	Flange 3	Natural gas ≥ 300 kW

3.4 GAS TRAIN ELECTRICITY SUPPLY

The gas train's power cables can be fed to the right or left of the burner, as illustrated in figure 5.

Depending on the entry point, the cable clamp with pressure test point (1) and simple cable clamp (2) may need swapping over.

Consequently, you must make sure:

- cable clamp (1) is positioned correctly;
- the tube is positioned correctly so that there are no restrictions likely to impede air flowing to the pressure switch.

WARNING

If necessary, cut the tube to the right size.

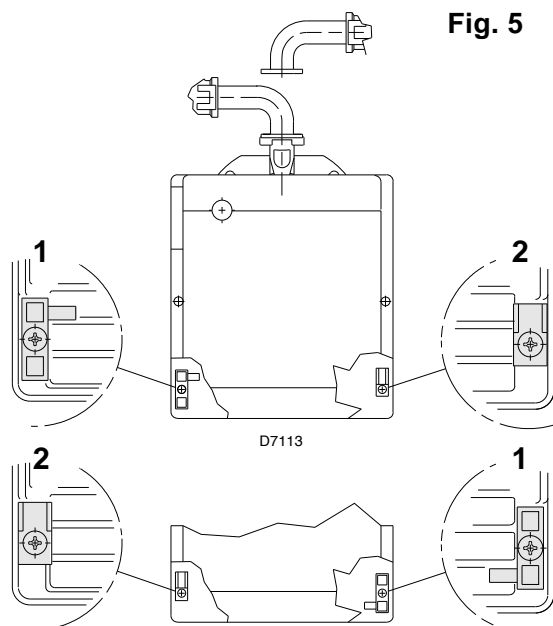


Fig. 5

3.5 GAS FEEDING LINE

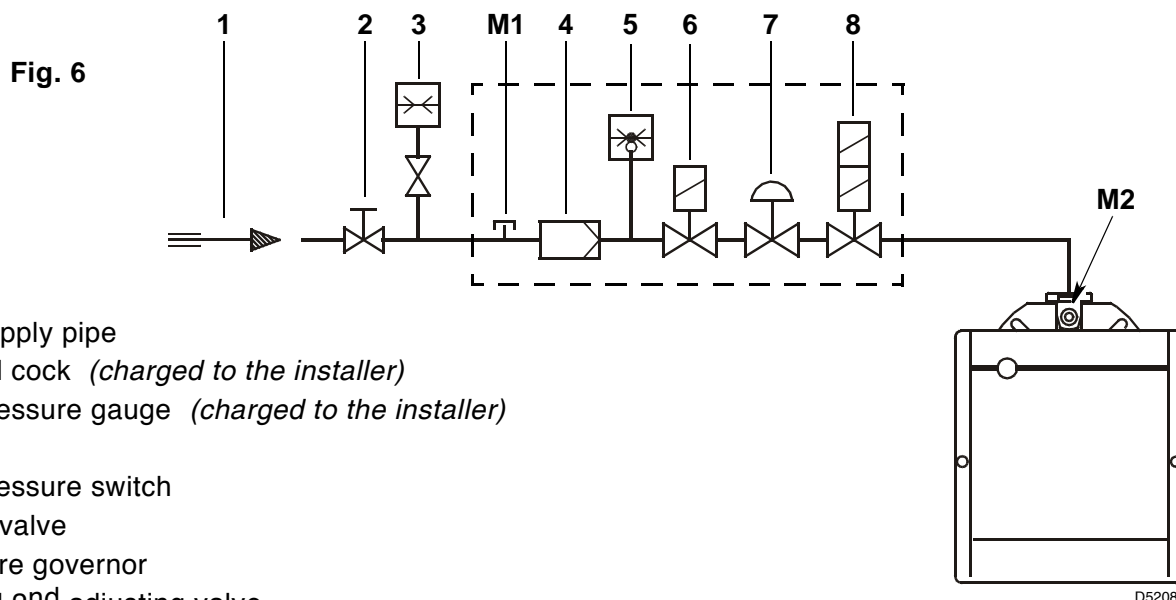
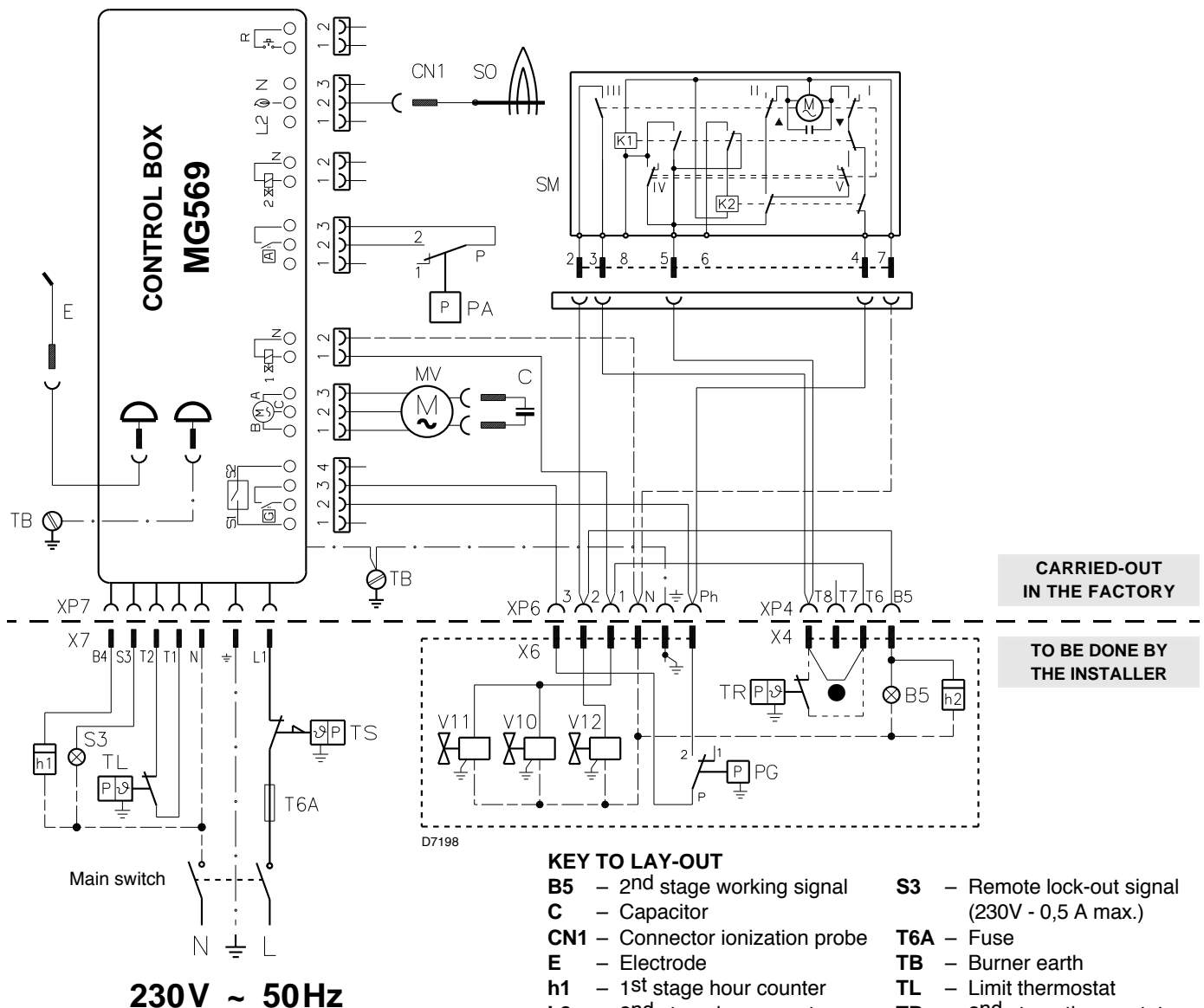


Fig. 6

- 1 – Gas supply pipe
- 2 – Manual cock (*charged to the installer*)
- 3 – Gas pressure gauge (*charged to the installer*)
- 4 – Filter
- 5 – Gas pressure switch
- 6 – Safety valve
- 7 – Pressure governor
- 8 – 1st and 2nd adjusting valve
- M1 – Gas-supply pressure test point
- M2 – Pressure coupling test point

3.6 ELECTRICAL WIRING

3.6.1 STANDARD ELECTRICAL WIRING



ATTENTION:

- Do not swap neutral and phase over, follow the diagram shown carefully and carry out a good earth connection.
- The section of the conductors must be at least 1mm². (Unless requested otherwise by local standards and legislation).
- The electrical wiring carried out by the installer must be in compliance with the rules in force in the country
- Connect the 2nd stage thermostat (TR) to terminals T6 - T8 and remove the bridge.

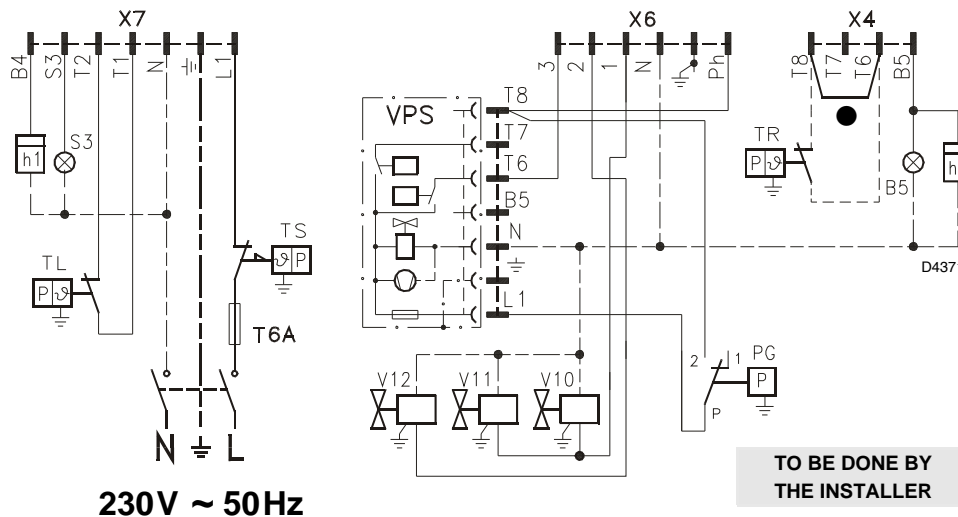
TESTING

- Check the burner has stopped by opening the thermostats.
- Check that the burner is blocked by opening the connector (CN1) inserted in the probe red wire and located outside the control box.

NOTES

The burners have been type-approved for intermittent operation. This means they must stop at least once every 24 hours in order to allow the electrical control box to check its efficiency on start-up. The boiler limit thermostat (TL) normally ensures the burner halts. If this does not happen a time switch halting the burner at least once every 24 hours must be applied in series to limit thermostat (TL).

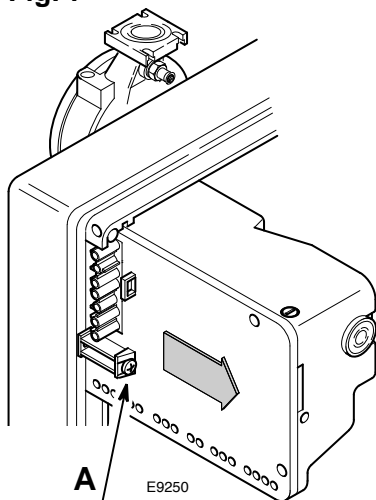
3.7 ELECTRICAL WIRING WITH GAS LEAK CONTROL DEVICE (DUNGS VPS 504)



- KEY TO LAY-OUT**
- B5** – 2nd stage lock-out signal
 - h1** – 1st stage Hour counter
 - h2** – 2nd stage Hour counter
 - PG** – Min. gas pressure switch
 - S3** – Remote lock-out signal
(230V - 0.5 A max.)
 - T6A** – Fuse
 - TL** – Limit thermostat
 - TR** – 2st stage thermostat
 - TS** – Safety thermostat
 - V10** – Safety valve
 - V11** – 1st stage valve
 - V12** – 2st stage valve
 - X4** – 4 pin plug
 - X6** – 6 pin plug
 - X7** – 7 pin plug

- Connect the 2nd stage thermostat (TR) to terminals **T6 - T8** and remove the bridge.

Fig. 7



CONTROL BOX, (see fig. 7)

To remove the control box from the burner it is necessary to:

- disconnect all the connectors, the 7-pin plug, the high voltage cables and the earth wire (**TB**);
- unscrew the bolt (**A**, fig. 7) and pull the control box in the direction of the arrow.

To install the control box it is necessary to:

- screw the bolt (**A**) in at a torque of 1 - 1.2 Nm;
- reconnect all the connectors previously disconnected.

IONIZATION CURRENT

The minimum current necessary for the control box operation is $5\text{ }\mu\text{A}$.

The burner normally supplies a higher current value, so that no check is needed. Anyway, if you want to measure the ionization current, you have to open the connector (**CN1**) (see electrical scheme page 7) fitted on the wire and insert a microammeter.

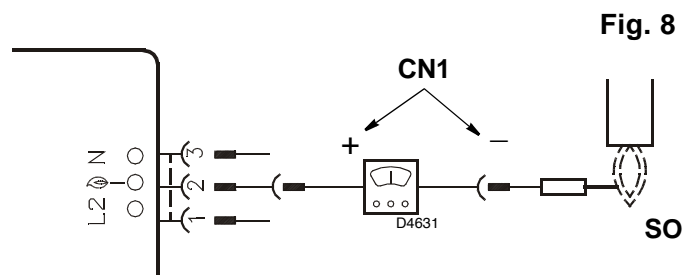


Fig. 8

4. WORKING

FIRING OUTPUT

The firing must occur at reducer output and not higher than 120 kW.

In order to measure the firing output:

- Disconnect the connector (CN1) on the ionization probe cable (see *electrical wiring* at page 7); the burner will fire and then go into lock-out after the safety time (3s) has elapsed.
- Perform 10 firings with consecutive lock-outs.
- On the meter read the total quantity of gas burned. This quantity must be equal to or lower than the quantity here given:

0.10 Nm³ for G20 (natural gas H)

0.10 Nm³ for G25 (natural gas L)

0.03 Nm³ for G31 (LPG).

4.1 COMBUSTION ADJUSTMENT

In conformity with Efficiency Directive 92/42/EEC the application of the burner on the boiler, adjustment and testing must be carried out observing the instruction manual of the boiler, including verification of the CO and CO₂ concentration in the flue gases, their temperatures and the average temperature of the water in the boiler.

To suit the required appliance output, choose the proper setting of the combustion head, and the air damper opening.

The burner leaves the factory set for the minimum output.

4.2 COMBUSTION HEAD SETTING, (see fig. 9)

It depends on the output of the burner and is carried out by rotating clockwise or counterclockwise the setting screw (6) until the set-point marked on the regulating rod (2) is level with the outside plane of the head assembly (1).

In the sketch of fig. 9 the combustion head is set for an output of 230 kW.

The set point 4 marked of the regulating rod is at the same level with the outside plane of the head-assembly as indicated in the diagram.

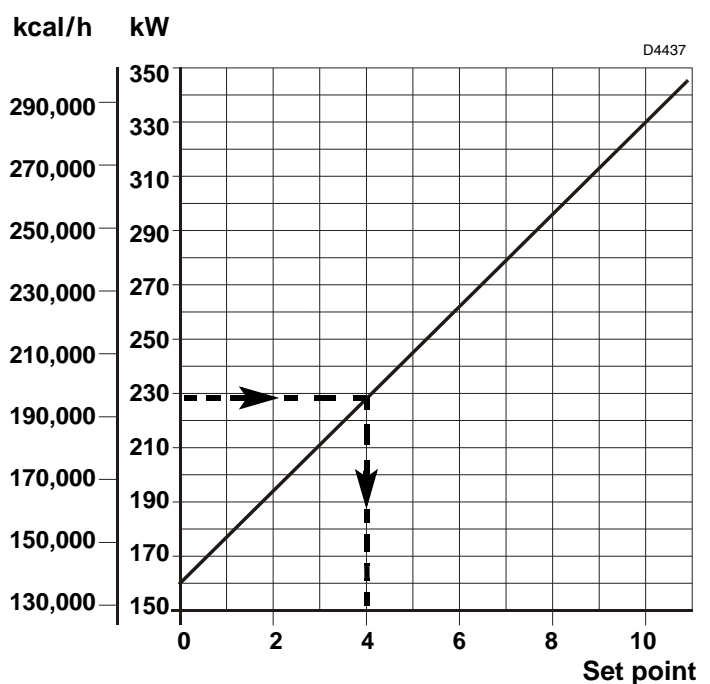
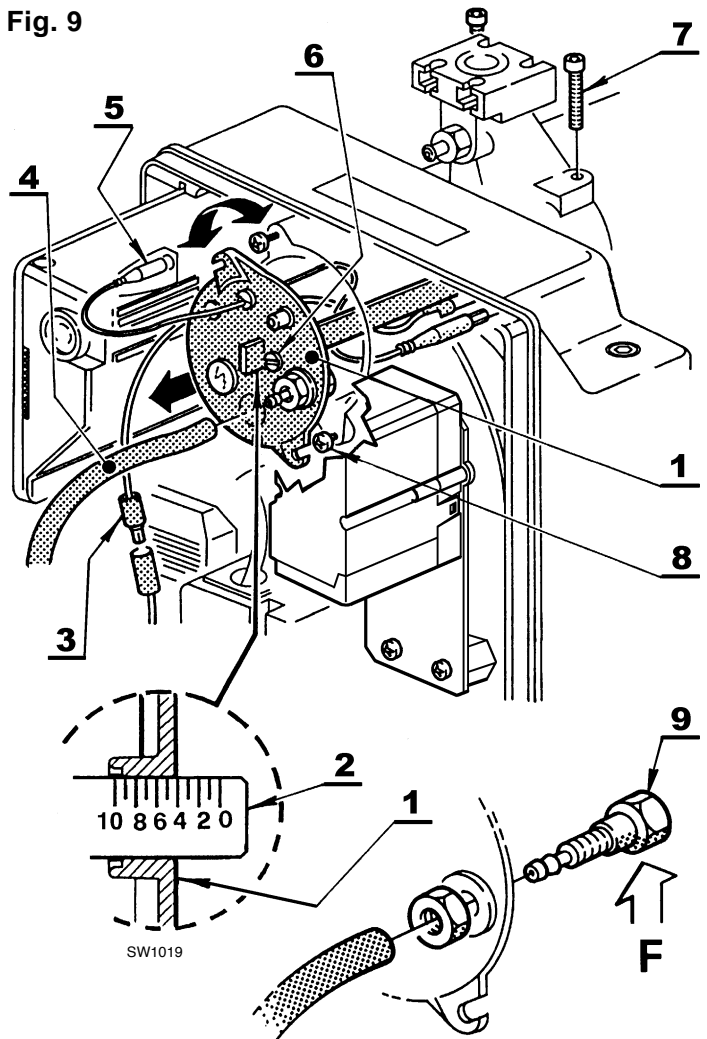
Example:

The burner is installed in a 210 kW boiler. The burner will have to deliver about 230 kW, considering an efficiency of 90%. The diagram indicates, that for this efficiency the adjustment has to be effected on the set-point 4.

NOTE

The diagram is orientative; to assure a good working of the burner, we suggest to adjust the combustion head according to the boiler.

Fig. 9



REMOVING HEAD ASSEMBLY, (see fig. 9, page 9)

To remove the head assembly, carry out the following operations:

Remove the head-holder assembly (1), after taking away the screws (7), disconnect the connections (3 and 5), extract the small tube (4) and loosen the screws (8).

Do not modify the setting position of the bracket-elbow during the disassembly.

REASSEMBLY OF THE HEAD SYSTEM, (see fig. 9, page 9)

Warning

- During the reassembly of the system, tighten the screws (7) completely (*without locking them*); then lock them with a torque wrench setting of 3 - 4 Nm.
- Control that, during the working, there are not gas losses coming from the screws.
- If casually the pressure test point (9) looses, fix correctly and be sure that the hole (F), placed in the external side of the head-assembly (1) turns towards the lower part.

4.3 SETTING OF THE SERVOMOTOR, (see fig. 10)

FIRST STAGE CAM I

By adjusting the micrometric screw, cam I regulates the position of the 1st stage air damper (factory setting reference value 25°).

SECOND STAGE CAM II and III

Cam II regulates the position of the 2nd stage air damper (factory setting reference value 50°, do not exceed 65°).

Cam III is used to open the 2nd stage valve (factory setting reference value 35°).

It must always be at least 15° in front of cam II.

CAM V

Cam V is factory set (factory setting reference value 90°). **Do not modify this setting for any reason.**

ATTENTION

To adjust 1st and 2nd stage output, follow the instructions below:

Output ratio between 1st and 2nd stage must be no more than 1:2.

Example: 2nd stage output required 340 kW;

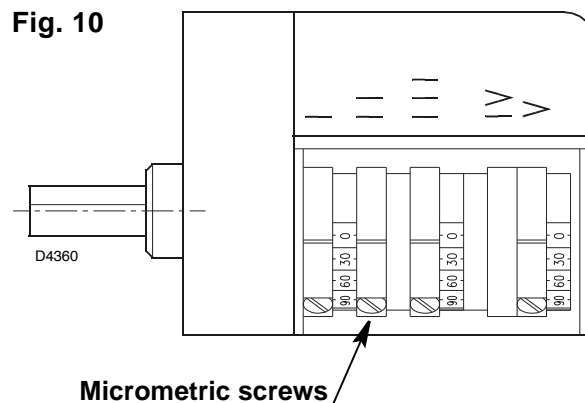
Minimum 1st stage output no less than 170 kW.

Whatever the case, the burner's minimum 1st stage output must not be lower than the value indicated in the operating range.

Example: 2nd stage output required 250 kW;

Minimum 1st stage output no less than 160 kW (minimum in the firing rate page 4).

Fig. 10



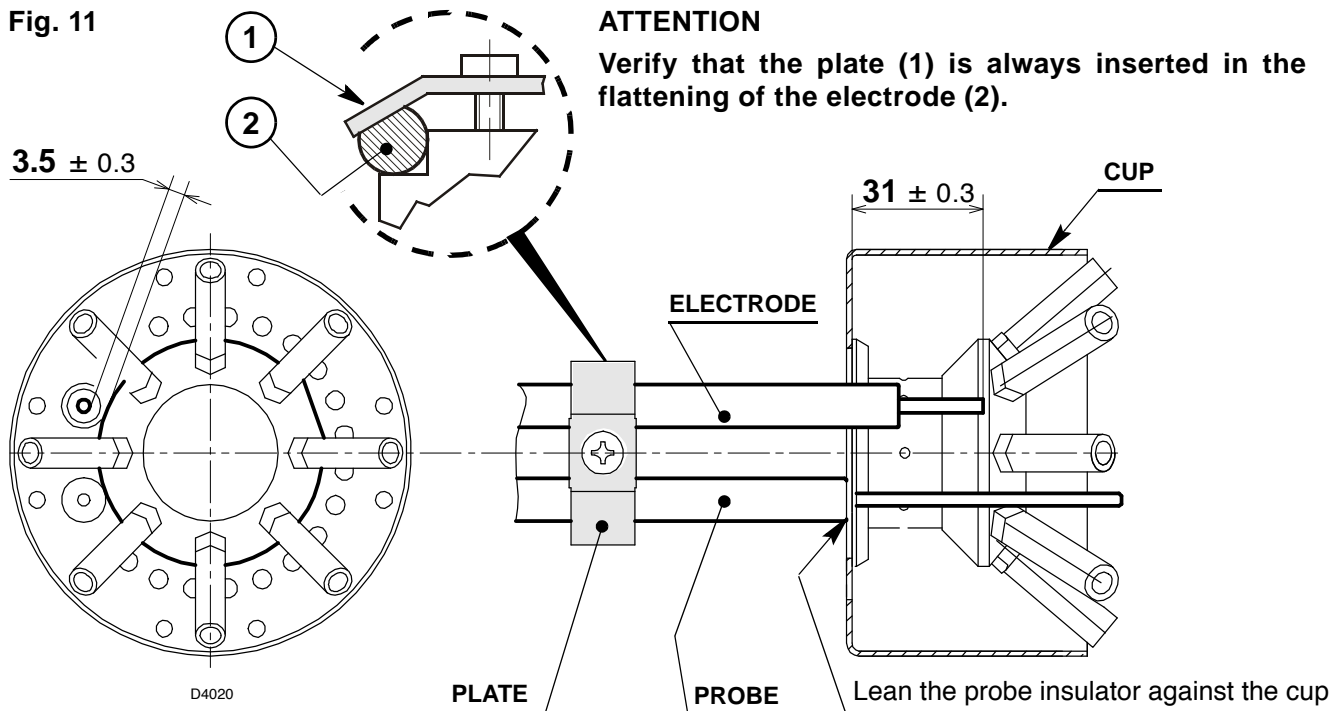
4.4 COMBUSTION CHECK

It is advisable to set the burner according to the type of gas used and following the indications of the table:

EN 676		AIR EXCESS: max. output $\lambda \leq 1.2$ – min. output $\lambda \leq 1.3$			
GAS	Theoretical max. CO ₂ 0 % O ₂	Setting CO ₂ %		CO mg/kWh	NO _x mg/kWh
		$\lambda = 1.2$	$\lambda = 1.3$		
G 20	11.7	9.7	9.0	≤ 100	≤ 170
G 25	11.5	9.5	8.8	≤ 100	≤ 170
G 30	14.0	11.6	10.7	≤ 100	≤ 230
G 31	13.7	11.4	10.5	≤ 100	≤ 230

4.5 PROBE - ELECTRODE POSITIONING, (see fig. 11)

Fig. 11



4.6 AIR PRESSURE SWITCH

Adjust the air pressure switch after having performed all other burner adjustments with the air pressure switch set to the start of the scale.

With the burner operating at the required power, slowly turn knob clockwise until burner locks out.

Then turn the knob anti-clockwise by about 20% of the set point and subsequently check to see if burner has started correctly. If the burner locks out again, turn the knob anti-clockwise a little bit more.

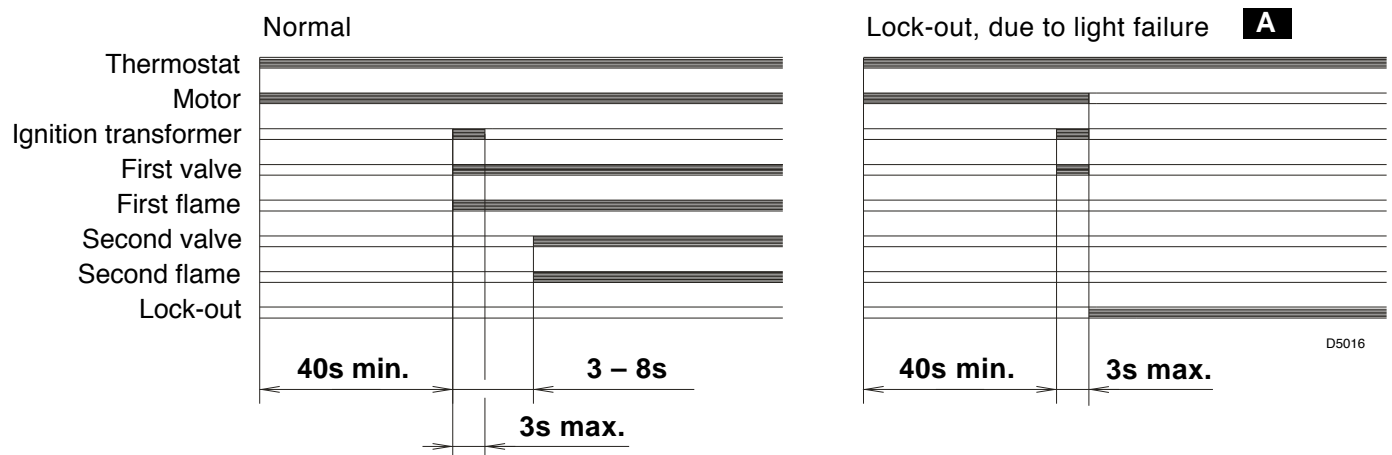
The burner leaves the factory with the pressure switch set at the beginning of the scale.

Attention:

As a rule, the air pressure switch must prevent the air pressure from lowering below 80% of the adjustment value as well as preventing the CO in the fumes from exceeding 1% (10,000 ppm).

To check this, insert a combustion analyser into the chimney, slowly close the fan suction inlet (*for example with cardboard*) and check that the burner locks out, before the CO in the fumes exceeds 1%.

4.7 BURNER START-UP CYCLE



A Lock-out is indicated by a lamp on the control box (4, fig. 1, page 2).

4.8 RE-CYCLE FUNCTION

The control box allows re-cycling, i.e. the complete repetition of the starting programme, for 3 attempts maximum, in the event the flame goes out during operation.

4.9 POST-VENTILATION FUNCTION

Post-ventilation is a function that maintains air ventilation even after the burner is switched off. The burner switches off when the limit thermostat (TL) opens, cutting off the fuel supply to the valves.

To use this function the reset button must be pressed when the limit thermostat is not switched over (**BURNER SWITCHED OFF**).

Post-ventilation time can be set to a maximum of 6 minutes. Proceed as follows:

- Press and hold the reset button for at least 5 seconds till the LED indicator changes to red.
- Set the desired time pressing the button repeatedly: **once = post-ventilation for 1 minute.**
- After 5 seconds the control box automatically shows the minutes set by the red LED flashing:
1 pulse = post-ventilation for 1 minute.

To reset this function, press and hold the button for at least 5 seconds at least, till the LED indicator changes to red then release it without carrying out any operation, then wait for 20 seconds for the burner to start.

If during post-ventilation there is a new request for heat, post-ventilation time is halted and a new operating cycle starts when the limit thermostat (TL) switches over.

The control box leaves the factory with the following setting: **0 minutes = no post-ventilation.**

4.10 CONTROL BOX RESET

To carry out the control box reset, proceed as follows:

- Press the reset button for at least 1 second.
In the event of the burner not restarting it is necessary to check if the limit thermostat (TL) is closed.

5. MAINTENANCE

Disconnect the electric supply to the burner by switching off the main power switch and close the gas shut-off valve before maintaining or checking the system.

The burner requires scheduled maintenance that must be carried out by qualified personnel and in compliance with local legislation.

Scheduled maintenance is vital for the smooth operation of the burner; it avoids waste of fuel and reduces harmful emissions into the atmosphere.

THE FUNDAMENTAL OPERATIONS TO CARRY OUT ARE AS FOLLOWS:

- Check at regular intervals that the holes of the gas head are not obstructed. If they are, clean them with a suitable tool as shown in the figure 12.
- Check there are no occlusions or obstructions in the inlet or return pipes, in the air suction areas and in the combustion product waste pipe.
- Check that the burner and gas train electrical connections are correct.
- Check that the positioning of the air pressure test point (9, fig. 9, page 9) is correct.
- Check that the gas train is suited to the burner capacity, the type of gas used and the network gas pressure.
- Check that the positioning of the combustion head is correct and that it is properly fixed to the boiler.
- Check that the air damper is positioned correctly.
- Check that the ionisation probe and the electrode are positioned correctly (see fig. 11, page 11).

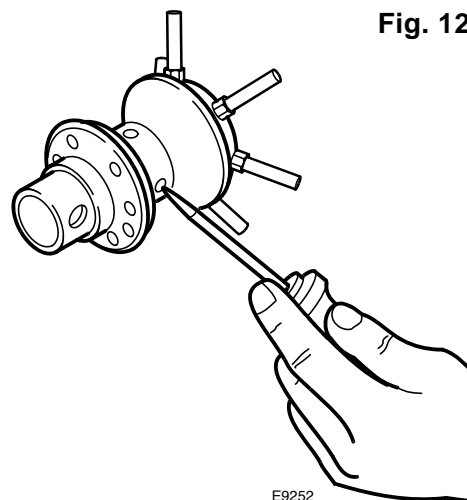


Fig. 12

► Check that the air pressure switch and the gas pressure switch are set correctly.

Leave the burner operating in steady state for approx. ten minutes, checking to ensure that all elements indicated herein have the proper settings for 1st and 2nd stage.

Then carry out the analysis of the combustion by checking:

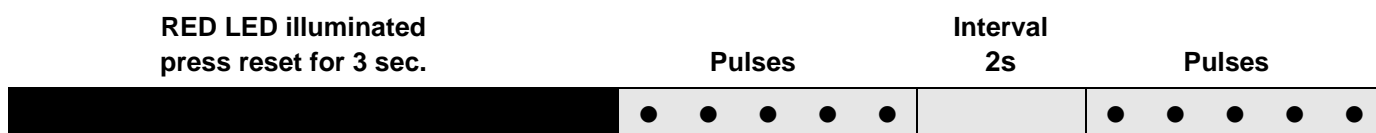
- CO₂ percentage (%); ● CO content (ppm); ● NO_x content (ppm); ● Ionisation current (μA);
- Flue gases temperature at the stack.

5.1 VISUAL DIAGNOSTIC CONTROL BOX

The control box has a diagnostic function that can identify the likely causes of any malfunctions (indicator: **RED LED**).

In order to be able to use this function, press and hold the reset button for at least 3 seconds from when the appliance is made safe (**lock-out**).

The control box sends a sequence of pulses that are repeated at 2-second intervals.



The sequence of pulses issued by the control box identifies the possible types of malfunction, which are listed in the table below.

SIGNAL	PROBABLE CAUSE
2 pulses ● ●	The flame does not stabilise at the end of the safety time: <ul style="list-style-type: none">– faulty ionisation probe;– faulty or soiled gas valves;– neutral/phase exchange;– faulty ignition transformer– poor burner regulation (insufficient gas).
3 pulses ● ● ●	Min. air pressure switch does not close or is already closed before the limit thermostat closed: <ul style="list-style-type: none">– air pressure switch faulty;– air pressure switch incorrectly regulated.
4 pulses ● ● ● ●	Light present in the chamber before the burner's switching on or off: <ul style="list-style-type: none">– presence of a strange light before or after the limit thermostat switching over;– presence of a strange light during pre-ventilation;– presence of a strange light during post-ventilation.
6 pulses ● ● ● ● ● ●	Loss of ventilation air: <ul style="list-style-type: none">– air loss during pre-ventilation;– air loss during and after safety time.
7 pulses ● ● ● ● ● ● ●	Loss of flame during operations: <ul style="list-style-type: none">– poor burner regulation (insufficient gas);– faulty or soiled gas valves;– short circuit between ionisation probe and earth.

ATTENTION To reset the control box after the diagnostics display, press the lockout-reset button.

6. FAULTS / SOLUTIONS

Here below you can find some causes and the possible solutions for some problems that could cause a failure to start or a bad working of the burner.

A fault usually makes the lock-out lamp light which is situated inside the reset button of the control box (4, fig. 1, page 2).

When lock out lamp lights the burner will attempt to light only after pushing the reset button. After this if the burner functions correctly, the lock-out can be attributed to a temporary fault.

If however the lock out continues the cause must be determined and the solution found.

6.1 START-UP PROBLEMS

FAULTS	POSSIBLE CAUSES	SOLUTION
The burner doesn't start when the limit thermostat closes.	Lack of electrical supply.	Check presence of voltage in the L1 - N clamps of the 7 pin plug.
		Check the condition of the fuses.
		Check that safety thermostat is not lock out.
	Lack of gas.	Check the manual cock opening.
		Check that the valves charge over to the opening position and there are not short circuits.
	The gas pressure switch does not close its contact.	Adjust them.
	The connections in the control box are wrongly inserted.	Check and connect all the plugs.
The burner runs normally in the prepurge and ignition cycle and locks out after about 3 seconds.	The air pressure switch is changed over to the operational position.	Replace the pressure switch.
	Phase and neutral connection is inverted.	Invert them.
	The earth connection lacks or is inefficient.	Make the earth connection efficient.
	The ionization probe is earthed or not in contact with the flame, or its wiring to the control box is broken, or there is a fault on its insulation to the earth.	Check the right position and if necessary set it according to the instructions of this manual.
		Reset the electrical connection.
The burner starts with an ignition delay.	Replace the faulty connection.	
	The ignition electrodes is wrongly positioned.	Adjust it according to the instructions of this manual.
	Air output is too high.	Set the air output according to the instructions of this manual.
Burner tends to pull the flame when switching from 1st to 2nd stage.	Valve brake is too close with insufficient gas output.	Adjust it.
	Output ratio between 1 st and 2 nd stage greater than 1:2.	Restore correct maximum ratio of 1:2, making sure 1 st stage output is no less than the operating range's minimum.
	High air excess in 1 st stage.	Restore the correct air excess value (λ min. = 1.3) see section "4.4 combustion control".

FAULTS	POSSIBLE CAUSES	SOLUTION
The burner locks out after the prepurge phase due to flame-failure.	The solenoid valves is passing too little gas.	Check the pressure in the network and/or adjust the solenoid valve according to the instructions of this manual.
	The solenoid valves are defective.	Change them.
	The ignition arc is irregular or has failed.	Check the right insertion of the connectors.
		Check the right position of the electrode according to the instructions of this manual.
	The pipe has not been purged from the air.	Carry out a complete breathing of the line of gas-supply.
The burner locks out during the prepurge phase.	The air pressure switch does not change over to the operational position.	The pressure switch is faulty, change it.
		The air pressure is too low, (the head is bad adjusted).
	The flame exists.	Faulty valves: replace them.
	The pressure test point (9, fig. 9, page 9) is badly positioned.	Place it in the right position according to the instructions on page 9, chapter 4.2.
The burner continues to repeat the starting cycle without going on lock-out.	The gas pressure in the gas-mains lies very close to the value to which the gas pressure switch has been set. The sudden falling-off pressure at the opening of the valve causes the opening of the pressure switch. However this only temporarily, because the valve immediately closes again, so then does the pressure switch, because the pressure builds-up again, causing the cycle to be repeated over and over.	Lower and set the pressure switch.

6.2 OPERATING IRREGULARITIES

FAULTS	POSSIBLE CAUSES	SOLUTION
The burner locks out during operation.	Earth probe.	Check the right position and if necessary set it according to the instructions of this manual.
		Clean or replace the ionization probe.
	The flame disappears 4 times.	Check the gas pressure in the network and/or adjust the solenoid valve according to the instructions of this manual.
	Air pressure switch opening.	The air pressure is too low, (the head is bad adjusted).
		The air pressure switch is faulty, change it.
Burner shut down.	Gas pressure switch opening.	Check the pressure in the network and/or adjust the solenoid valve according to the instructions of this manual.

7. SAFETY WARNINGS

The dimension of the boiler's combustion chamber must respond to specific values, in order to guarantee a combustion with the lowest polluting emissions rate.

The Technical Service Personnel will be glad to give you all the information for a correct matching of this burner to the boiler.

This burner must only be used for the application it was designed for.

The manufacturer accepts no liability within or without the contract for any damage caused to people, animals and property due to installation, adjustment and maintenance errors or to improper use.

7.1 BURNER IDENTIFICATION

The Identification Plate on the product gives the serial number, model and main technical and performance data. If the Identification Plate is tampered with, removed or missing, the product cannot be clearly identified thus making any installation or maintenance work potentially dangerous.

7.2 BASIC SAFETY RULES

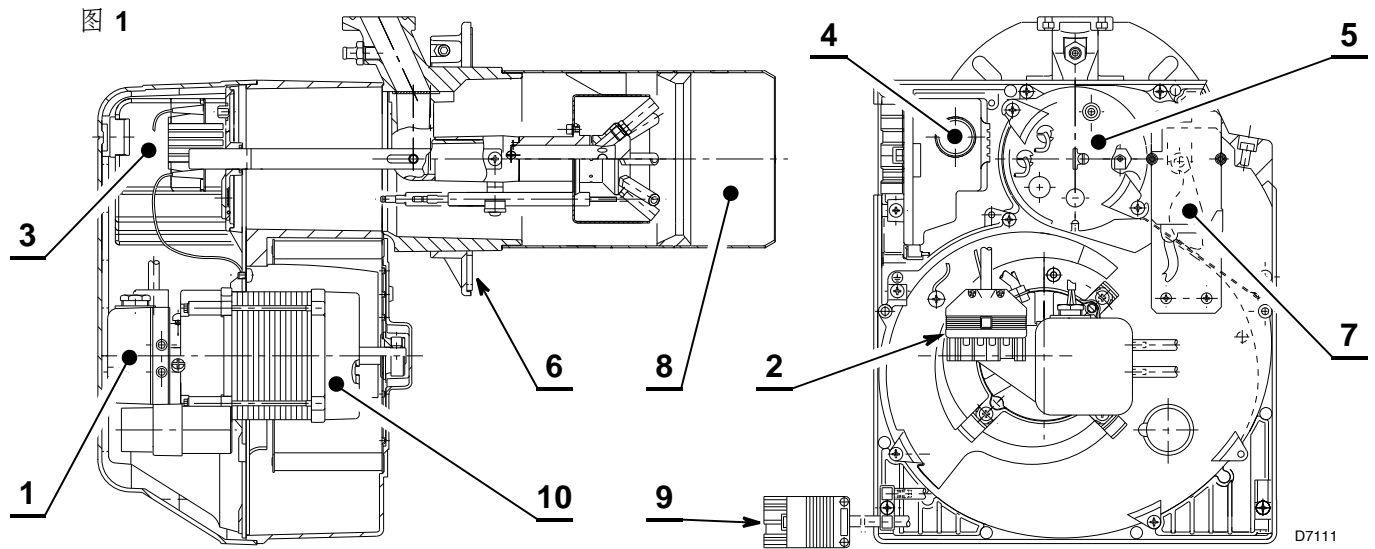
- Children or inexperienced persons must not use the appliance.
- Under no circumstances must the intake grids, dissipation grids and ventilation vents in the installation room be covered up with cloths, paper or any other material.
- Unauthorised persons must not attempt to repair the appliance.
- It is dangerous to pull or twist the electric leads.
- Cleaning operations must not be performed if the appliance is not disconnected from the main power supply.
- Do not clean the burner or its parts with inflammable substances (e.g. petrol, alcohol, etc.). The cover must be cleaned with soapy water.
- Do not place anything on the burner.
- Do not block or reduce the size of the ventilation vents in the installation room.
- Do not leave containers and inflammable products in the installation room.

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1. 燃烧器描述

两段火燃烧器。

- ▶ 燃烧器电气保护等级为 IP 40，符合 EN 60529 标准。
- ▶ 燃烧器符合以下指令：EMC 89/336/EEC - 2004/108/EC，低电压 73/23/EEC - 2006/95/EC 以及机械 98/37/EEC - 2006/42/EC。
- ▶ 燃气阀组符合 EN 676 标准。
- ▶ 本燃烧器符合 EN 676 所规定之间歇式运行。



- | | |
|-----------------|---------------------|
| 1 - 空气压力开关 | 6 - 带隔热垫的法兰 |
| 2 - 燃气阀组用 6 孔插座 | 7 - 伺服电机 |
| 3 - 带 7 孔插座的控制盒 | 8 - 燃烧筒 |
| 4 - 带锁定指示灯的复位键 | 9 - 燃烧器 2 段火用 4 孔插座 |
| 5 - 燃烧头支架组件 | 10 - 电机 |

1.1 燃烧器配置

- | | |
|--------------------------|-------------------------------|
| 带隔热垫的法兰 1 件 | 将法兰安装到锅炉上用螺丝和螺母 4 件 |
| 法兰用螺丝和螺母 1 件 | 7 针插头 1 件 |
| 远程复位组件电气接头 1 件 | 4 针插头 1 件 |

1.2 配件

软件诊断组件

通过红外线与 PC 机相连后，软件可以显示燃烧器寿命、运行时间、故障类型及次数、序列号等信息。

要进行此诊断，请按以下说明操作：

- ▶ 将此组件与控制盒的接口连接。
- 当专用软件开始运行时可以读出相关的信息。

远程复位组件

燃烧器带有一个远程复位组件 (RS)，包括一个电气接头和一个最远操作距离为 20 米的控制按钮。要安装该组件，需将工厂预装的保护性锁定装置取下，装上随燃烧器附带的锁定装置。(见第 7 页电气连接图)。

整体旋转组件

此组件可用于将燃烧器旋转 180° 进行安装，如第 5 页上第 3 章 "3.1 安装位置" 中的位置 5 所示。此组件设计可保证燃气阀组正常工作。此组件的安装必须符合当地的强制性标准。

2. 技术数据

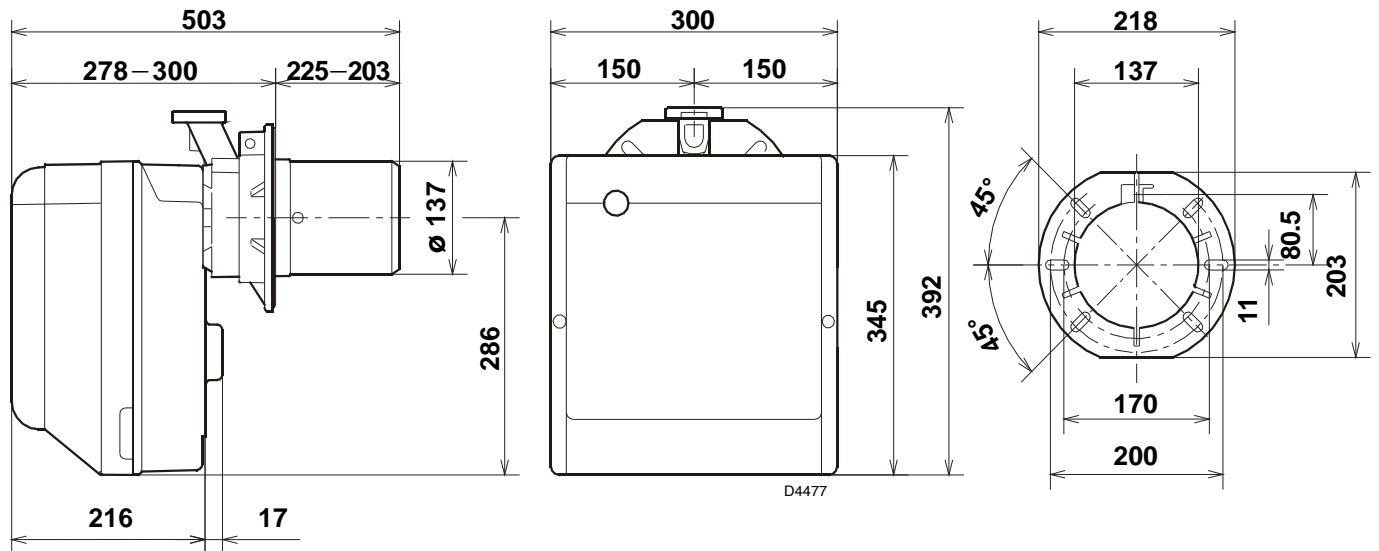
2.1 技术数据

类型	922 T1
热出力 (1)	160/208 - 345 kW - 137.600/178.800 - 296.700 kcal/h
天然气 (2 类)	净热值：8 - 12 kWh/Nm ³ = 7000 - 10.340 kcal/Nm ³
	压力：最小 20 mbar - 最大 100 mbar
电源	单相，230 V ± 10% ~ 50 Hz
电机	运行电流 1.9 A - 2720 rpm - 288 rad/s
电容	8 µF
点火变压器	初级 230 V / 0.2 A - 次级 8 kV / 12 mA
消耗电功率	0.45 kW
(1) 参考条件：温度 20°C - 大气压力 1013 mbar - 海拔高度 0 m。	

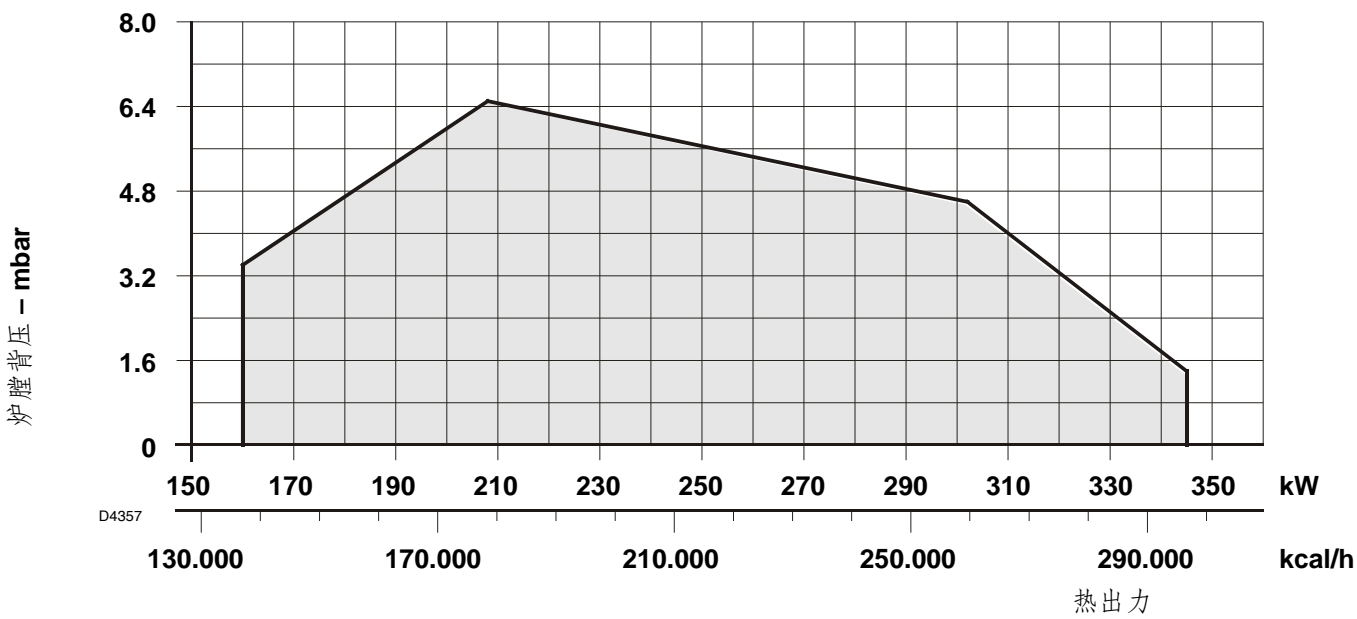
如果使用 3 类燃气 (LPG)，需另配其它组件。

国家			AT - IT - DK - CH	GB - IE	DE	FR	NL	LU	BE
燃气类型			I12H3B/P	I12H3P	I12ELL3B/P	I12Er3P	I12L3B/P	I12E3B/P	I2E(R)B, I3P
燃气压力	G20	H	20	-	-	-	-	-	-
	G25	L	-	25	20	-	25	25	-
	G20	E	-	-	20	20/25	-	-	20/25

2.2 外观尺寸



2.3 出力图, (符合 EN 676 标准)



测试锅炉

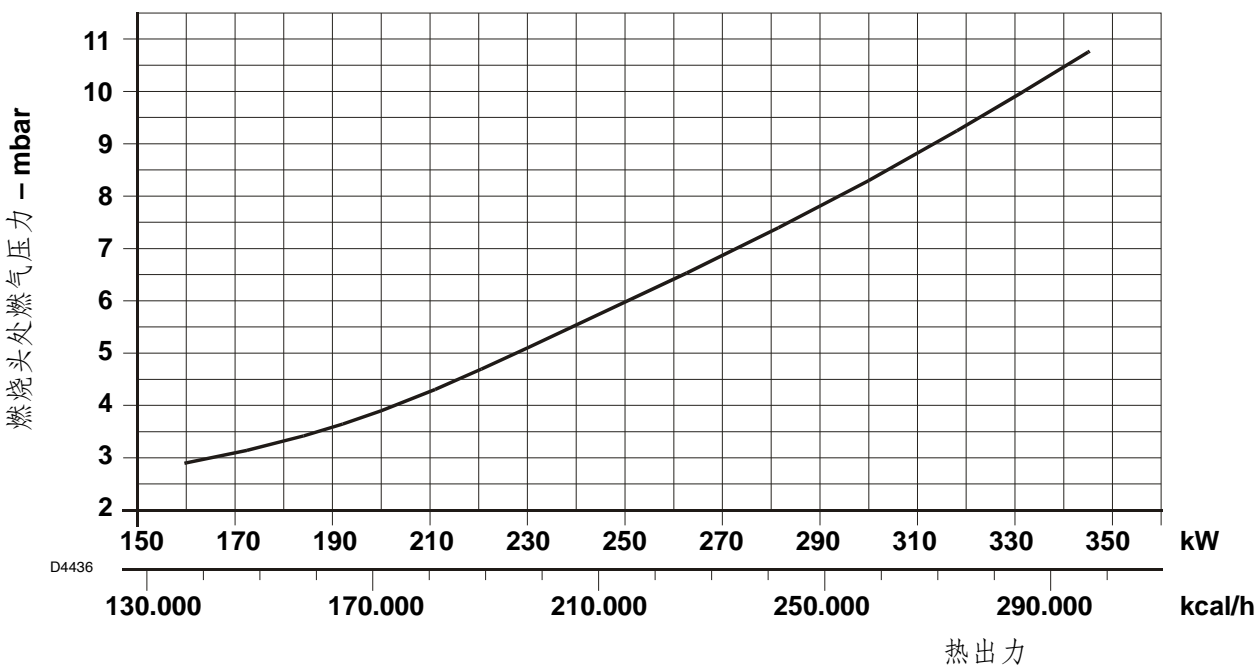
根据 EN 676 标准测定燃烧器出力范围。

商用锅炉

如果锅炉符合 EN 303 标准，炉膛尺寸与 EN 676 图表所示相似，则燃烧器和锅炉相互匹配。如果锅炉不符合 EN 303 标准，炉膛尺寸大大小于 EN 676 所列尺寸，请咨询制造商。

燃气压力与燃烧器出力的对应关系

要获得最大出力，燃烧头处燃气压力值为 10.7 mbar (M2，见图 3.5，页 6)。测试条件：炉膛背压为 0 mbar，使用净热值为 10 kWh/m³ (8.570 kcal/m³) 的燃气 G20。



3. 安装

燃烧器的安装必须符合当地强制标准。

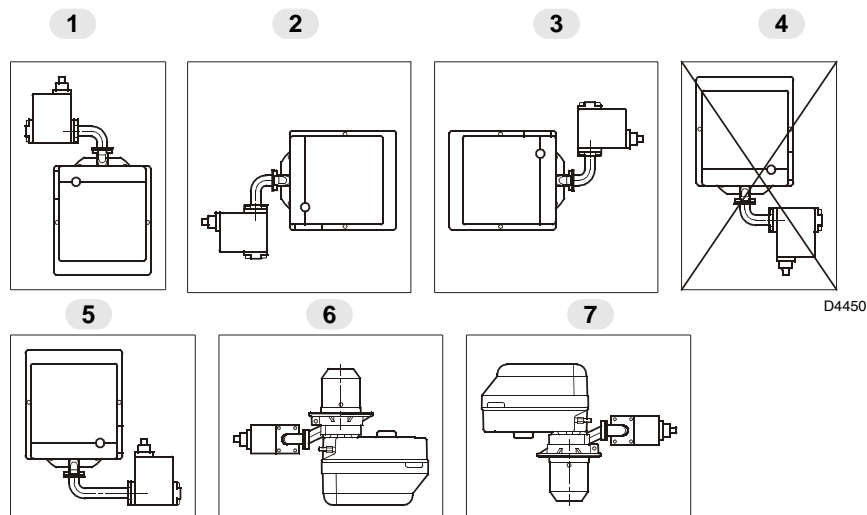
3.1 安装位置

燃烧器只能安装于位置 **1**。

不建议将燃烧器安装在位置 **2, 3, 5, 6, 7**。安装于上述位置有可能妨碍燃烧器的正常运行，因为这些位置不能保证在燃烧器待机时风门挡板完全关闭。

如使用“整体旋转组件”，可将燃烧器安装于位置 **5**。此组件为单独订购组件。

禁止将燃烧器安装于位置 **4**，此位置无法保证燃烧器运行的安全性。



3.2 燃烧器安装

将燃烧器安装到锅炉上，应按照以下步骤进行：

- 如必要，可将隔热垫上的开孔 (**3**, 图 3) 加大。
- 使用 4 个螺丝 (**4**) 以及螺母 (**2**) (如必要) 将法兰 (**5**) 安装到锅炉炉门 (**1**) 上并插入隔热垫 (**3**)，但要保留最上面两个螺丝 (**4**) 中的一个不拧紧 (见图 2)。
- 将燃烧头穿过法兰 (**5**)，用螺丝 (**6**) 将法兰拧紧，并将松动的螺丝 (**4**) 锁紧。

注意：燃烧器适合安装于不同尺寸的锅炉 (**A**) (见图 4)。但要确保燃烧头完全穿过锅炉炉门。

图 3

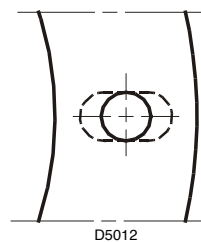


图 2

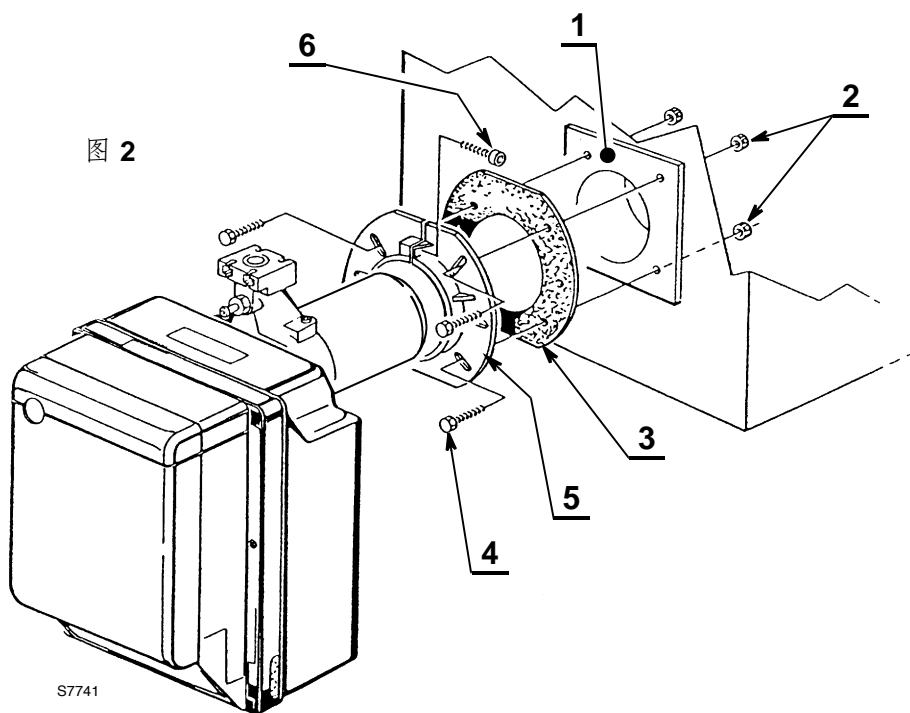
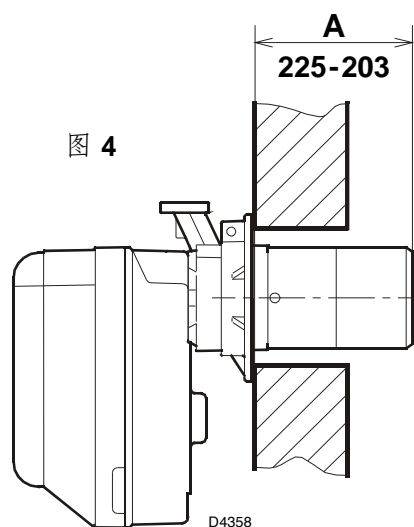


图 4



3.3 燃气阀组 , (符合 EN 676 标准)

燃气阀组单独提供，其安装、调试参见随附手册。

燃气阀组		连接		应用
型号	编码	进口	出口	
MB-ZRDLE 410 B01	3970542	Rp 1" 1/4	法兰 3	天然气 ≤ 200kW 和 LPG 160 – 345 kW
MB-ZRDLE 412 B01	3970543	Rp 1" 1/4	法兰 3	天然气 ≤ 300 kW
MB-ZRDLE 415 B01	3970582	Rp 1" 1/2	法兰 3	天然气 ≥ 300 kW

3.4 燃气阀组电源

燃气阀组电源线可以从燃烧器右侧或左侧连接，如图 5 所示。
根据进线位置，将带压力测试点 (1) 的电缆夹与不带压力测试点的电缆夹 (2) 互换位置。

之后，必须确认以下两点：

- 电缆夹 (1) 的位置正确；
- 测压管的位置正确，不会阻止空气到达压力开关处。

注意

如果需要，可将测压管截取至适当长度。

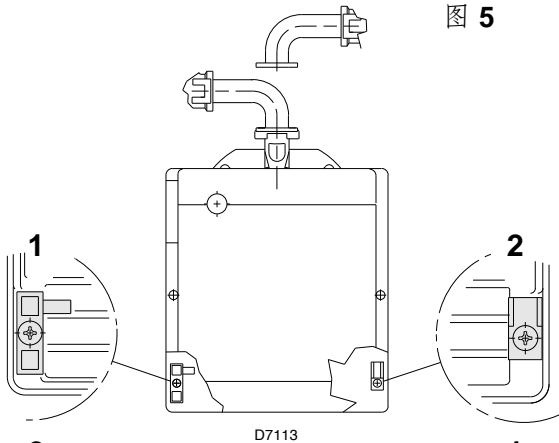
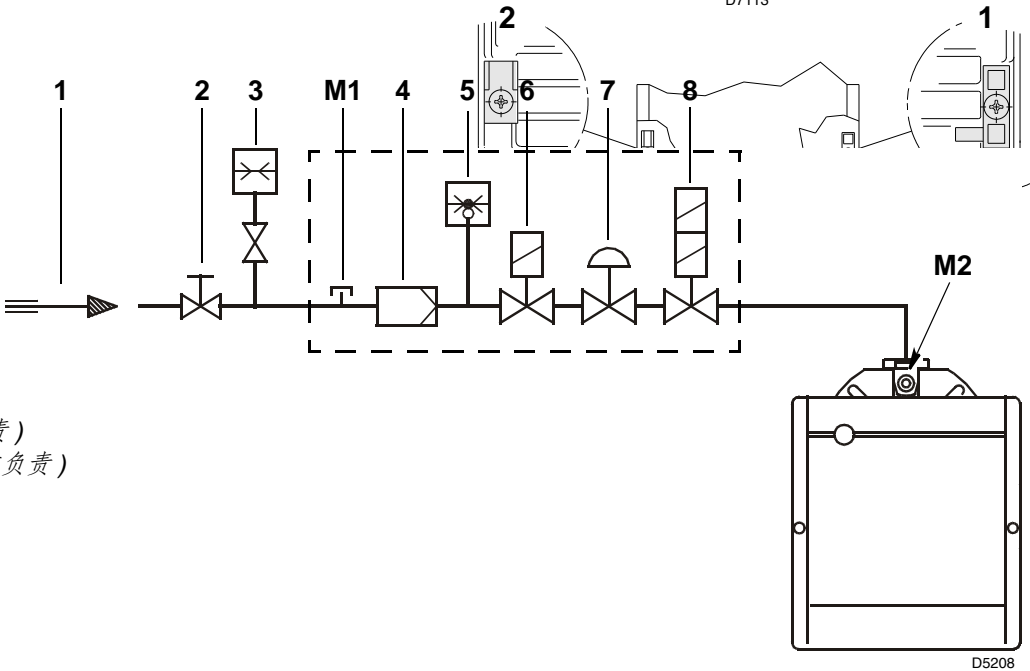


图 5

3.5 燃气管路

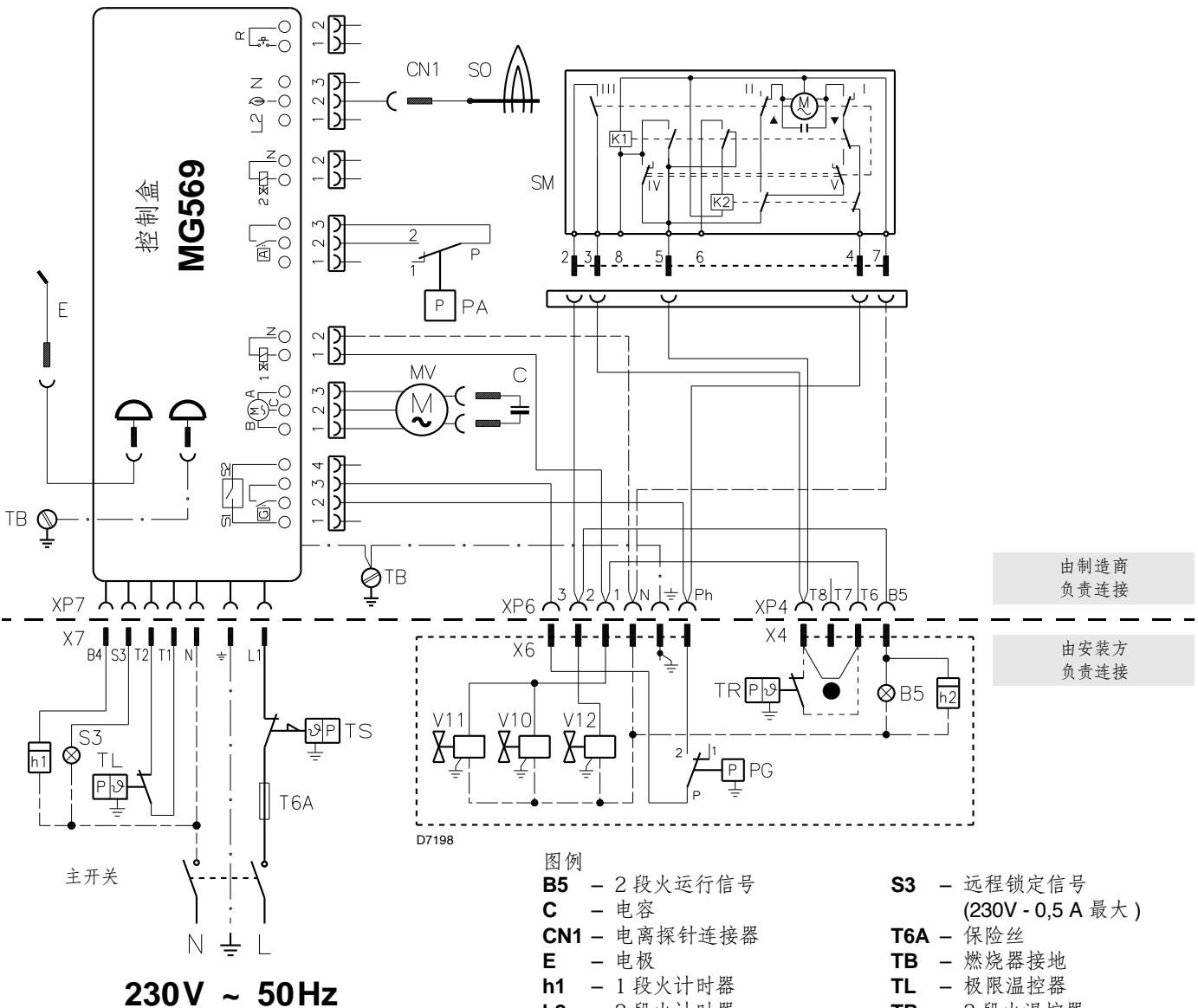
图 6



- 1 燃气供应管路
- 2 - 手动阀 (由安装方负责)
- 3 - 燃气压力计 (由安装方负责)
- 4 - 过滤器
- 5 - 燃气压力开关
- 6 - 安全阀
- 7 - 调压器
- 8 - 1 段火及 2 段火调节阀
- M1 - 燃气供应压力测试点
- M2 - 燃烧头处压力测试点

3.6 电气连接

3.6.1 标准电气连接



A 注意事项：

- ▶ 不得将零线-相线接反，认真按照电气接线图进行电气连接，保证良好的接地性。
- ▶ 导线截面积必须至少为 1mm²。(当地强制性要求有其它规定的除外)。
- ▶ 安装方进行电气连接时必须符合当地的强制要求。
- 将 2 段火温控器 (TR) 连接到接线端子 T6 - T8，并拆除短接线。

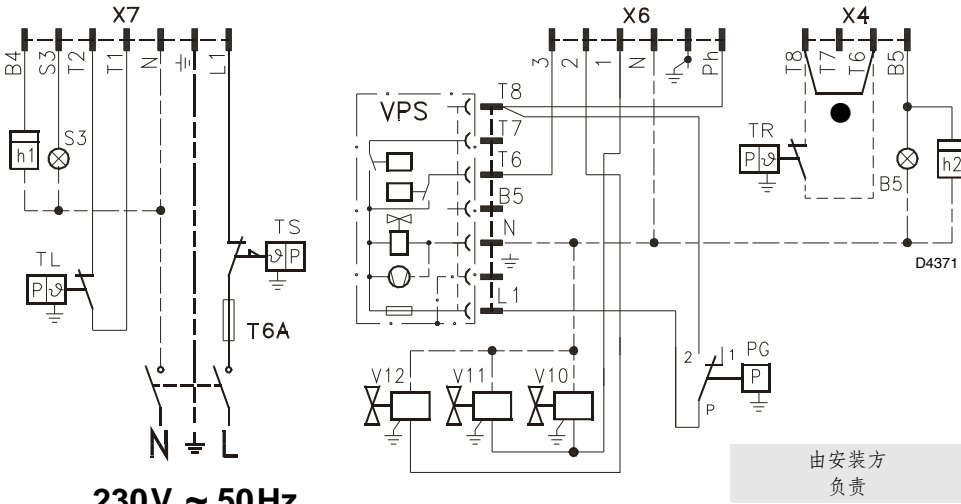
测试

- ▶ 断开温控开关，检查燃烧器是否停机。
- ▶ 断开控制盒外离子探针的红色电缆的连接器 (CN1)，检查燃烧器是否锁定。

注意

燃烧器为间歇式运行，即必须每 24 小时至少停机一次，以检查电气控制盒在启动时的有效性。一般情况下，锅炉的极限温控器 (TL) 可以保证燃烧器按时停机。否则，应在极限温控器 (TL) 上串联一个可以使燃烧器至少每 24 小时停机一次的开关。

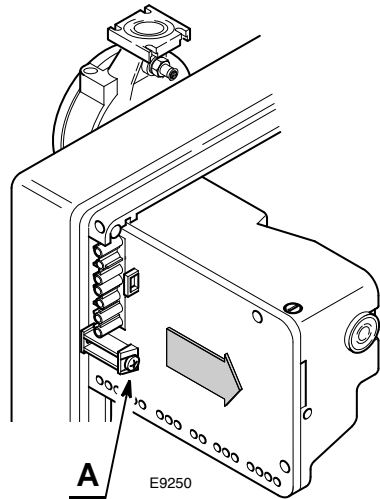
3.7 带燃气泄漏检测装置的电气连接 (DUNGS VPS 504)



- 图例
- B5 - 2 段火锁定信号
 - h1 - 1 段火计时器
 - h2 - 2 段火计时器
 - PG - 最低燃气压力开关
 - S3 - 远程锁定信号 (230V - 0.5 A 最大)
 - T6A - 保险丝
 - TL - 极限温控器
 - TR - 2 段火温控器
 - TS - 安全温控器
 - V10 - 安全阀
 - V11 - 1 段火阀
 - V12 - 2 段火阀
 - X4 - 4 针插头
 - X6 - 6 针插头
 - X7 - 7 针插头

- 将 2 段火温控器 (TR) 连接到接线端子 T6 - T8，并拆除短接线。

图 7



- 控制盒，(见图 7)
- 按如下步骤从燃烧器上拆下控制盒：
- 将所有连接器、7 针插头、高压电缆及地线 (TB) 连接断开；
 - 拆下螺栓 (A，图 7)，将控制盒按箭头方向拉出。
- 安装控制盒需按以下说明进行：
- 将力矩扳手的力矩调至 1 - 1.2 Nm，拧紧螺栓 (A) ；
 - 将之前所有断开的连接重新连接上。

离子电流

控制盒运行所需的最小电流为 5 μ A。
通常情况下，燃烧器提供的电流更大，所以一般不需检查此项。但如果想测量离子电流，必须断开电缆上的连接器 (CN1)(见电气连接图第 7 页)，在其中加装一个微安计。

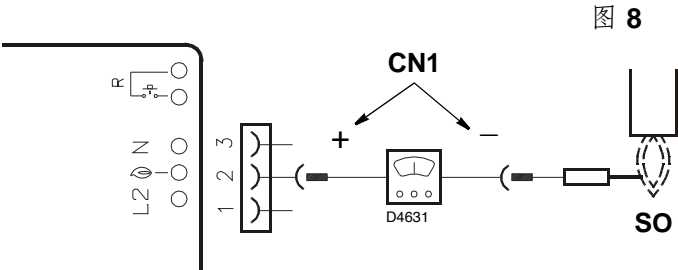


图 8

4. 运行

点火出力

点火出力必须尽量较低，不得高于 **120 kW**。

要测量点火出力：

- 断开电离探针电缆上的连接器(CN1) (见电气连接图 7)；燃烧器点火，3 秒安全时间之后进入锁定状态。
- 重复“点火 - 锁定”操作 10 次。
- 在流量计上读出所消耗的全部燃气量。此耗气量必须小于等于以下所列耗气量：
0.10 Nm³ 使用 G20 (天然气 H)
0.10 Nm³ 使用 G25 (天然气 L)
0.03 Nm³ 使用 G31 (LPG)。

4.1 燃烧调节

锅炉上的燃烧器必须符合效率指令 92/42/EEC，其调试和测试必须按照锅炉操作手册进行，包括烟气中 CO 及 CO₂ 的含量、温度以及锅炉内的平均水温。

要满足所需出力要求，请选择适合的燃烧头及风门挡板开启度的设置。

燃烧器出厂时设置为最小出力。

4.2 燃烧头设置，(见图 9)

根据燃烧器出力来设置燃烧头。顺时针或逆时针旋转调节螺丝(6)直至调节杆(2)上所标示的刻度与燃烧头组件(1)外部的平面对齐。

图 9 中所示为燃烧器出力为 230 kW 时，燃烧头的设置。

调节杆所标示的刻度 4 与燃烧头组件外部的平面对齐，如图。

举例：

燃烧器安装于功率为 210 kW 的锅炉上。

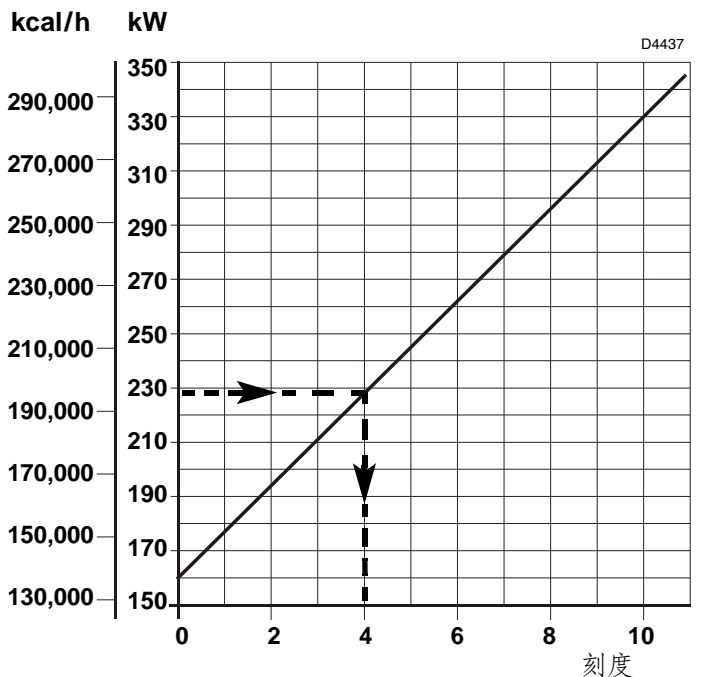
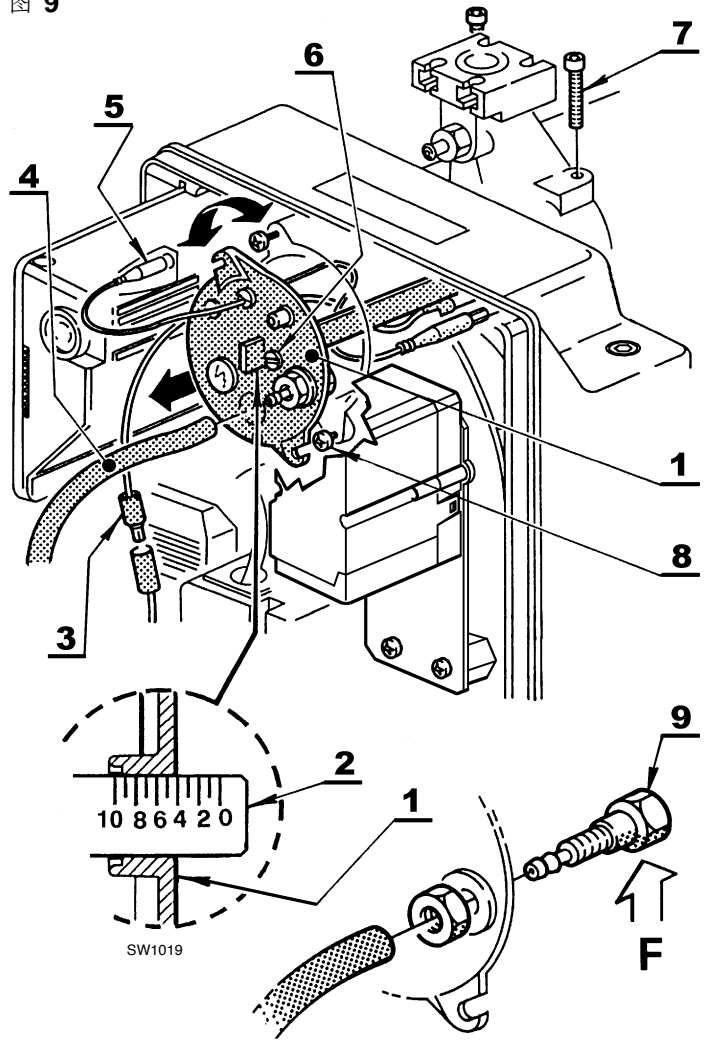
燃烧器出力为 230 kW，效率为 90%。

如图，燃烧头应设置在刻度 4 处。

注意

此图只作为参考，要保证燃烧器的良好运行，建议根据具体应用来调整燃烧头。

图 9



取下燃烧头组件，（见图 9，页 9）

按下列步骤取下燃烧头组件：
拆下螺丝 (7)，断开连接 (3 和 5)，取出导管 (4)，拧松螺丝 (8) 然后取下燃烧头支架 (1)，。
在拆卸过程中不要改变组件 (1) 上的设置点。

重新安装燃烧头组件，（见图 9，页 9）

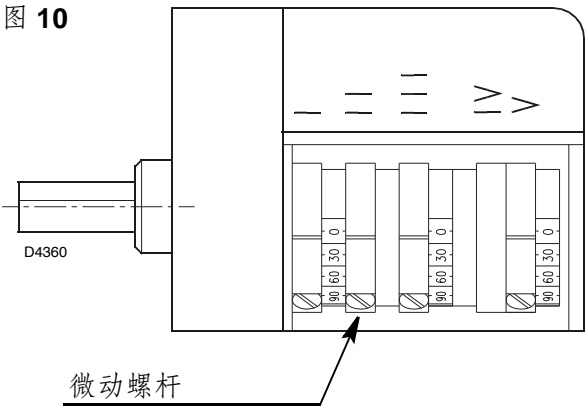
- 警告
- 在重新安装燃烧头组件的过程中，上紧螺丝 (7)(不要锁紧) ；然后将力矩扳手的力矩调整为 **3 - 4 Nm**，将螺丝锁紧。
 - 检查在操作过程中，螺丝处是否有燃气泄漏。
 - 如果压力测试点处 (9) 的连接松动，将其固定好并确保燃烧头组件 (1) 内部的小孔 (F) 朝下。

4.3 伺服电机设置 (见图 10)

1 段火 凸轮 I
通过调节微动螺杆，凸轮 I 可调整 1 段火出力时的风门挡板位置 (工厂设置的凸轮角度为 25°)。

2 段火 凸轮 II 和 III
凸轮 II 调整 2 段火时风门挡板位置 (工厂设置角度为 50°，不得超过 65°)。
凸轮 III 用来开启 2 段火阀 (工厂设置角度为 35°)。
位于凸轮 II 前面时，角度不得小于 15°。

凸轮 V
凸轮 V 位置由工厂设置 (工厂设置值为 90°) 。不得对此设置进行任何更改。



注意事项

- 要调整 1 段火和 2 段火的出力，需按照以下操作说明进行：
- 1 段火和 2 段火的出力比不得高于 **1:2**。
- 举例： 2 段火所需出力为 **340 kW** ；
 1 段火最小出力不得低于 **170 kW**。
- 但任何情况下，燃烧器 1 段火最低出力不得低于燃烧器出力范围的最小值。
- 举例： 2 段火所需出力为 **250kW** ；
 1 段火最小出力不得低于 **160 kW** (燃烧器最小出力范围见第 4 页出力图) 。

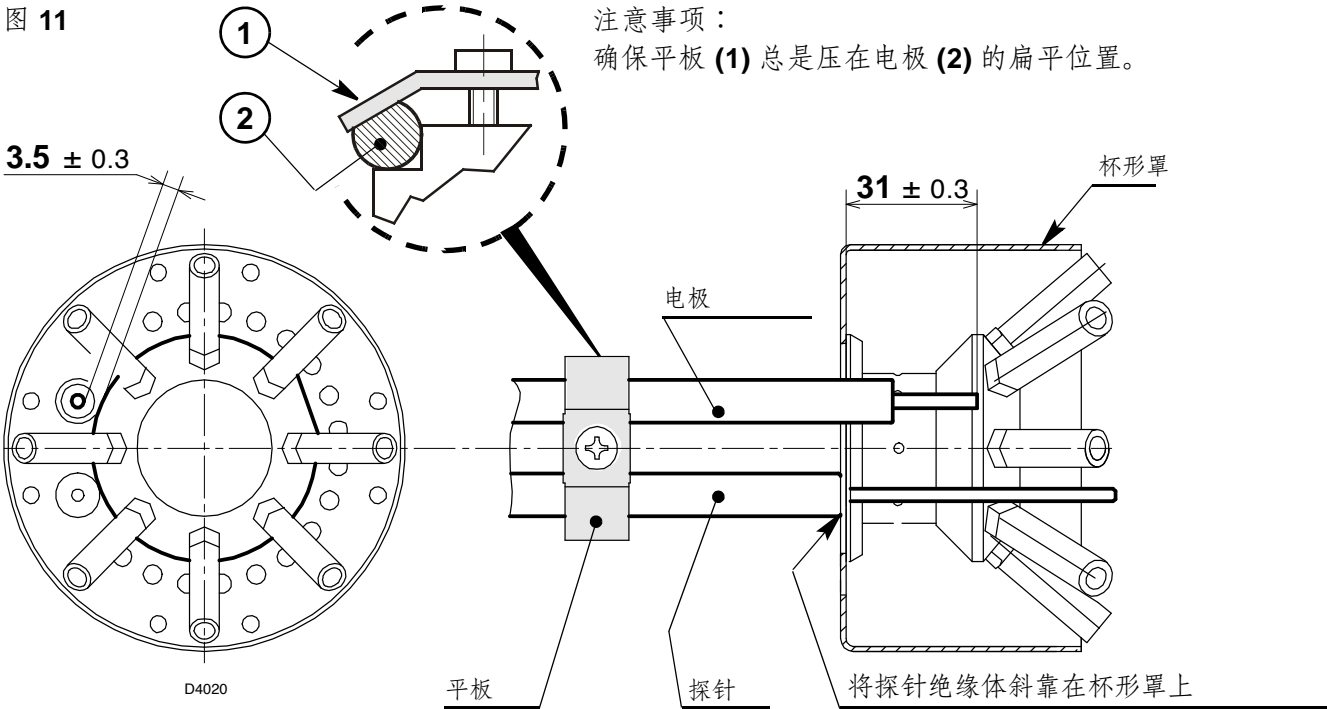
4.4 燃烧检查

建议根据所使用的燃气类型及下表所列参数设置燃烧器：

EN 676		过量空气：最大出力 $\lambda \leq 1.2$ – 最小出力 $\lambda \leq 1.3$			
燃气	CO ₂ 最大理论值 0 % O ₂	设定 CO ₂ %		CO mg/kWh	NO _x mg/kWh
		$\lambda = 1.2$	$\lambda = 1.3$		
G 20	11.7	9.7	9.0	≤ 100	≤ 170
G 25	11.5	9.5	8.8	≤ 100	≤ 170
G 30	14.0	11.6	10.7	≤ 100	≤ 230
G 31	13.7	11.4	10.5	≤ 100	≤ 230

4.5 探针电极位置 (见图 11)

图 11



4.6 空气压力开关

在空气压力开关设置于起始位置情况下完成上述所有调试后，进行空气压力开关调整。当燃烧器以最小出力运行时，以顺时针方向缓慢转动旋钮直至燃烧器锁定。接着，将旋钮向逆时针方向旋转至设置值的 20%，查看燃烧器启动是否正常。如果燃烧器再次锁定，则将旋钮继续沿逆时针方向小幅转动。

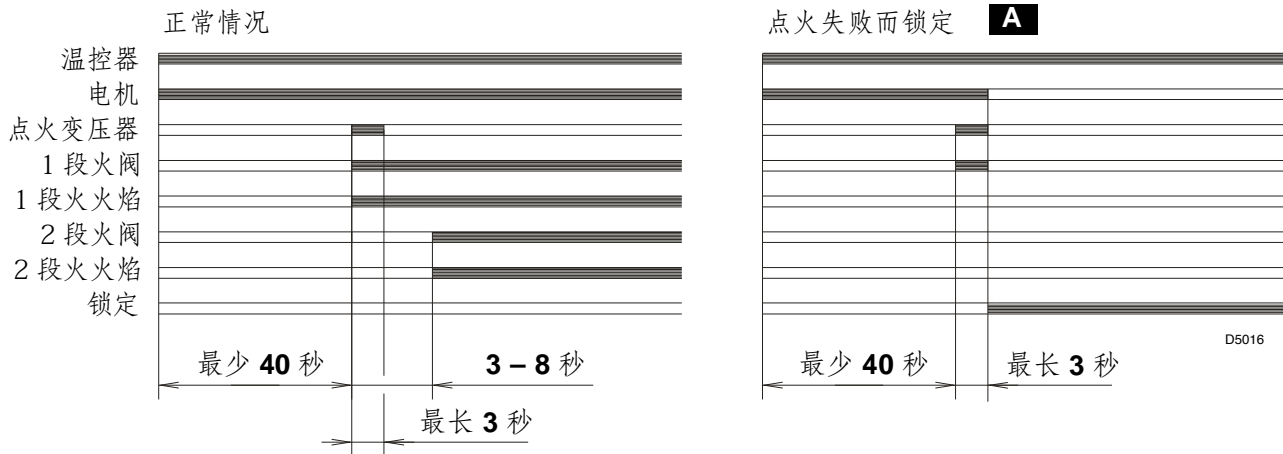
燃烧器出厂时，压力开关置于起始位置。

注意事项：

按照标准，空气压力开关必须保证空气压力不得低于设定值的 80%，以确保烟气中的 CO 排放量不超过 1% (10,000 ppm)。

要检测此项目，需将一个烟气分析仪插入烟囱处，缓慢关闭风机进风口（如使用纸板遮挡），检查确认烟气中 CO 排放量超过 1% 时燃烧器是否锁定。

4.7 燃烧器启动循环



A 控制盒指示灯会显示锁定状态 (4, 图 1, 页 2)。

4.8 循环功能

控制盒具有循环功能，例如：燃烧器运行时火焰熄灭，控制盒可以完全自动重复启动程序，最多重复 3 次。

4.9 后吹扫功能

后吹扫功能指燃烧器停机后仍保持通风的一种功能。当极限温控器 (TL) 断开时，燃烧器停机，停止供应燃料。要使用这一功能，必须在极限温控器断开 (燃烧器停机) 前按下复位键。

后吹扫的时间最长可设定为 6 分钟。按以下步骤操作：

- 按住复位键保持至少 5 秒直至 LED 指示灯变为红色。
- 通过重复按下按钮设定所需时间：按一次按钮 = 后吹扫持续 1 分钟。
- 5 秒钟后，控制盒通过红色 LED 灯的闪烁自动显示所设定的时间：
闪烁 1 次 = 后吹扫持续 1 分钟。

要消除此功能，按下并按住该按钮至少 5 秒钟，直至 LED 指示灯变为红色，然后松开按钮，不再进行任何操作，等待 20 秒钟至燃烧器启动。

如在后吹扫时，如有新的加热需求，后吹扫会暂停，极限温控器 (TL) 闭合，开始新一轮的启动周期。

工厂预设控制盒状态为：0 分钟 = 无后吹扫。

4.10 控制盒复位

要复位控制盒，请按照以下说明进行：

- 按下复位键至少 1 秒。
- 如果燃烧器没有重新启动，则需检查极限温控器 (TL) 是否闭合。

5. 维护

在维护和检修整个系统前，切断燃烧器主电源开关，关闭燃气截止阀。

燃烧器需定期由具有资质的技术人员进行检修，并符合当地的强制性规范。

定期检修可保证燃烧器的良好性能，避免燃料的过度消耗以及增加污染物的排放。

所需执行的基本操作如下：

- 定期检查确认燃烧头上的燃气孔没有任何堵塞。如有堵塞，请如图 12 所示，用适当工具清除。
- 检查确认空气进气区及燃烧烟气排放管路的进口及出口上没有任何堵塞。
- 检查确认燃烧器及燃气阀组的电气连接正确。
- 检查确认空气压力测试点 (9，图 9，页 9) 位置正确。
- 检查确认所选燃气阀组与燃烧器型号、燃气类型以及管路燃气压力相匹配。
- 检查确认燃烧头位置正确，且正确安装于锅炉上。
- 检查确认风门挡板位置正确。
- 检查确认离子探针及电极位置正确 (见图 11，页 11)。
- 检查确认空气压力开关以及燃气压力开关设置正确。

使燃烧器连续稳定运行 10 分钟以便检查 1 段火及 2 段火运行时操作手册中所列所有部件的设置正确。

随后执行下列燃烧状态检查，以了解：

- CO₂ 比例 (%);
- CO 排放量 (ppm);
- NO_x 排放量 (ppm);
- 离子电流 (μA);
- 烟囱处的排烟温度。

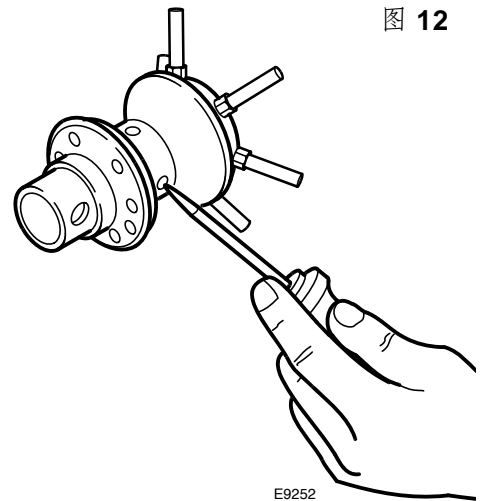
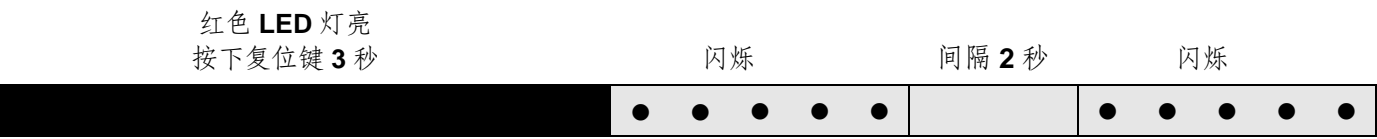


图 12

E9252

5.1 控制盒的可视诊断

控制盒具有故障自诊断功能，能识别可能的故障原因（指示器：红色 LED 灯）。
要使用这一功能，须等燃烧器进入安全状态（锁定）之后再按下复位按钮 3 秒。松开按钮后，红色 LED 灯会闪烁。
控制盒每隔 2 秒会重复连续闪烁 N 次。



控制盒发出的闪烁信号可以帮助判断可能的故障类型，列表如下。

信号	可能的原因
闪烁 2 次 ● ●	安全时间结束后，火焰仍不稳定： - 电离探针故障； - 燃气阀故障或脏； - 零线 / 相线接反； - 点火变压器故障 - 燃烧器调整不当（燃气不足）。
闪烁 3 次 ● ● ●	最低空气压力开关不闭合，或在极限温控器闭合前已闭合： - 空气压力开关故障； - 空气压力开关调整不当。
闪烁 4 次 ● ● ● ●	燃烧器启动或停机前炉膛内有光： - 极限温控器闭合前或闭合后，有非正常光； - 在预吹扫阶段有非正常光； - 在后吹扫阶段有非正常光。
闪烁 6 次 ● ● ● ● ● ●	检测不到风压： - 预吹扫时检测不到风压； - 安全时间后检测不到风压。
闪烁 7 次 ● ● ● ● ● ● ●	运行过程中火焰熄灭： - 燃烧器调整不当（燃气不足）； - 燃气阀故障或脏； - 因电离探针接地而造成短路。

注意事项

诊断显示后，要复位控制盒，需按下锁定 - 复位按钮。

6. 故障 / 解决方案

以下所列造成燃烧器启动和运行故障可能的原因及其解决方法。

如果燃烧器出现故障，则位于控制盒复位键内的红色锁定指示灯会亮 (4, 图 1, 页 2)。

当锁定指示灯亮起，按下复位按钮后，燃烧器才会尝试点火。点火之后，如果燃烧器工作正常，则锁定可能是由于暂时的故障造成的。

但如果锁定状态持续，必须确定原因并找到其解决方案。

6.1 启动故障

故障	可能的原因	解决方案
极限温控器闭合时燃烧器不启动。	无电源。	检查 7 针插头处 L1-N 间的电压。
		检查保险丝状态。
		确保安全温控器未断开。
	燃气不足。	确保手动阀打开。
		检查确认阀门位于开启位置，没有发生短路。
	燃气压力开关未闭合其接触器。	调整。
	控制盒电气连接错误。	检查并连接所有插头。
在预吹扫阶段及点火周期内，燃烧器运行正常，但 3 秒后出现锁定。	空气压力开关处于运行位置。	更换。
	相线和零线接反。	将其互换位置。
	无接地连接或接地不良。	保证接地性良好。
	离子探针接地，或未与火焰接触，或与控制盒之间的电线连接断开，或其绝缘接地故障。	检查确认探针的正确位置，如必要，根据操作手册进行设置。
		恢复电气连接。
燃烧器启动时出现点火延迟。	更换损坏的电缆。	
	点火电极位置不当。	根据操作手册调整其位置。
	空气过量。	根据操作手册设定空气量。
燃烧器从 1 段火向 2 段火转换时，火焰状态不稳定。	阀门开度不足导致燃气量不足。	调整。
	1 段火和 2 段火的出力比大于 1:2。	恢复正确的最大比例 1:2，确认 1 段火出力不低于运行出力范围的最小值。
预吹扫阶段结束后，未出现火焰，燃烧器锁定。	1 段火时空气过多。	恢复正确的过量空气系数 (λ 最小 = 1.3)，见“4.4 燃烧检查”。
	电磁阀通过燃气量过少。	检查管路中的压力并 / 或根据操作手册调整电磁阀。
	电磁阀故障。	更换。
	点火电弧不稳定或没有火花。	检查确认连接器插入是否正确。
		根据手册检查确认电极位置是否正确。
预吹扫阶段，燃烧器锁定。	管路中仍有空气未排净。	将燃气供应管路中的空气完全排净。
	空气压力开关未转换至运行位置。	压力开关故障，更换。
		空气压力过低 (燃烧头调节不当)。
	产生火焰。	阀门故障：更换。
预吹扫阶段，燃烧器锁定。	压力测试点 (9, 图 9, 页 9) 调整不当。	将其置于正确位置，参见操作手册页 9, 章 4.2。

故障	可能的原因	解决方案
燃烧器未进入锁定状态，不断重复启动周期。	燃气阀组中的燃气压力与燃气压力开关的设定值非常接近。 打开阀门时产生的压力突降会导致压力开关断开。 但这种情况只是暂时的，因为阀门会立即再次闭合，因此压力开关也会随即闭合，因为压力重新恢复，使得此过程不断重复。	调低并设定最低燃气压力开关。

6.2 运行故障

故障	可能的原因	解决方案
燃烧器运行时锁定。	探针接地。	检查其正确位置，如必要，可根据操作手册设定。
		清洁或更换离子探针。
	火焰熄灭 4 次。	检查管路中的压力并 / 或根据操作手册调整电磁阀。
		风压过低（燃烧头调整不当）。
燃烧器停机。	空气压力开关断开。	空气压力开关故障，更换。
		检查管路中的压力并 / 或根据操作手册调整电磁阀。

7. 安全警告

为保证燃烧的污染排放最低，锅炉燃烧室的尺寸必须达到一个特定值。
因此建议用户在为锅炉选配此型号燃烧器之前咨询我公司技术支持部。

此燃烧器必须且只能用于专为其设计的用途。

由于燃烧器的错误安装及调试、非正常使用、未按产品所附技术手册操作以及无操作资质人员操作产品所造成的任何人、畜及财产损失，本产品制造商不承担任何责任。

7.1 燃烧器标识

产品上的标识铭牌列出了其序列号、机型以及主要的技术及性能参数。产品因铭牌被涂改、移除或是丢失而无法识别的，会对其安装及维护造成潜在危险。

7.2 基本安全规程

- 儿童及非专业人士禁止使用该设备。
- 在任何情况下，禁止使用布、纸及其它任何材料堵塞设备安装室的进气格栅、排气格栅及通风孔。
- 非认证人员不得对设备进行维护维修。
- 抽拉及缠绕电线危险！
- 对设备的清洗必须在主电源断开之后进行。
- 不得用易燃物（如汽油、酒精等）清洁燃烧器及其部件。设备外盖必须用肥皂水清洗。
- 不得在燃烧器上放置物品。
- 不得堵塞设备安装室内通风孔或缩小其尺寸。
- 不得将各类容器及易燃物遗留于设备安装室内。



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