IDEAL

Concord Super

Modular
Gas Fired Boiler

STELRAD GROUP

December, 1978

Installation & Servicing

ADDENDA: **CONCORD SUPER Modular Gas Fired Boiler**
to

Installation and Servicing Instructions

The following notes should be read before commencement of assembly of the boiler.

A. CAUTION:

CRACKING COULD OCCUR IF THE FLOW AND RETURN MODULE CASTINGS ARE OVERSTRESSED.

When assembling the boiler on site therefore, the following procedure should be adopted to ensure that damage to the flow and return module castings is prevented:

1. Fit the module to the casing but DO NOT TIGHTEN the four fixing bolts.
2. Repeat this procedure for the remaining modules.
3. Assemble the flow and return water manifolds, using the gaskets and bolts provided, and ensure a water-tight joint.
4. Assemble the gas manifold as directed in the Installation and Servicing Instructions.
5. Only when the above procedure has been followed should the four fixing bolts, securing each module to the casing, be tightened.

B.

The details in the Installation ans Servicing Instructions, relating to a required manifold gas pressure of 4.0 in.w.g, refer to those modules to which an Alexander twin solenoid valve is fitted.

For boilers incorporating modules with the Sperryn $\frac{3}{8}$ in. Double Solenoid Valve G.1412/01, the manifold gas pressure is required to be 5.0 in.w.g.

C.

Page 22 Section 4.1 General
Delete the first paragraph and annotations (a), (b), (c) and (d).
Insert 'The boilers are normally despatched to the site as:-
(a) Single packet modules.
(b) Casing and header package'.

Page 22 Section 4.3 Heading should now read 'Assembly of Modules to the Boiler Case'.
The information in paras 4.3.1 and 4.3.2. should be read in the reverse order.

IDEAL CONCORD SUPER
MODULAR GAS FIRED BOILER

CONTENTS

The CONCORD SUPER BOILER

1. Introduction

The gas-fired **Concord Super** Boiler is primarily designed for heating water for central heating of commercial or industrial premises. It can also be used for supplying "domestic" hot water via an indirect system.

Six standard boiler sizes are available, ranging from 50kW (176 600 Btu/h) output up to 300 kW(1 023 600 Btu/h) output rating.

The boiler must be fitted to an open flue system without a draught diverter, and is intended for use on natural gas only.

Each boiler consists essentially of four components:

(a) The insulated boiler case.
(b) The heat exchanger module(s).
(c) The flow and return water headers (if more than one module is used).
(d) The gas header complete with the boiler gas governor.

Fig. 1 illustrates diagrammatically a three module boiler of 150 kW (511 800 Btu/h) output.

A boiler may consist of up to six identical heat exchange modules. Each module incorporates a forced draught burner and its own control system. Only one flue is required, regardless of the number of modules.

2. BOILER SPECIFICATION

2. 1. BOILER DETAILS

2. 1.1. General Description

Fig. 1 illustrates diagrammatically a three module boiler.

The boiler consists of a number (from one to six) of identical heat exchange modules. The heat output from each module is 50 kW (170 600 Btu/h).

The modules are fitted on slide rails within an insulated boiler casing into which the products of combustion of the gas discharge after having given up their heat to the water flowing through the modules. The water flow through the boiler enters the "return" header on the left-hand side of the boiler and then passes through the modules to the "flow" header on the right-hand side. The modules are connected in parallel across the two headers.

It will be seen that the water flows through all the modules all the time. Each module has its own control thermostat and limit thermostat. The control thermostats are adjusted so that as the return water temperature rises the upper module switches off first, then the middle module(s) and lastly the lowest. If the water temperature falls the reverse procedure operates, i.e. the lowest module switches on first, then the middle and lastly the upper. It will be seen therefore that the water flowing through the upper modules is kept warm by the combustion products from lower modules which are firing. There is consequently no loss of efficiency from shut-down modules.

If required, a more sophisticated water temperature control system can be fitted, controlled from temperature measurement of the mixed flow from the boiler, In this way, inside/outside compensation, night setback etc., can be incorporated into the heating system.

A main gas governor is fitted to the boiler. Each module is supplied with gas at constant pressure from the downstream side of this appliance gas governor. A gas service tap is provided at the inlet to each module to isolate the gas supply.

2. 1. 2. The Heat Exchanger Module (Fig.2)

2. 1. 2. 1. Water side of Heat Exchanger

The heat exchange module consists basically of a number of finned copper tubes 1 interconnected between the outer water header 2 and the inner water header 3 . Both headers consist of a cast iron tube plate and a cast iron cover plate. The tube plates and the cover plates have ground mating surfaces and are bolted together. The copper tubes are expanded into the cast iron tube plates. The outer header is bolted to the boiler casing 4 by four bolts. Water flows through the inlet pipe 5 in which the control thermostat pocket 16 is fitted and into the outer header, then through the finned tubes 1 and out through the outlet pipe 6 into which the limit thermostat pocket 7 is fitted. The module inlet pipe 5 is connected to the return header and the module outlet pipe 6 to the flow header illustrated in Fig. 1. The finned tubes are wrapped around with a slotted wrapper 8 which controls the flow of the products of combustion over the fins.

2. 1. 2. 2. Gas Side of the Heat Exchanger

Gas is burned on the surface of a perforated metal cylinder 9 . The hot products of combustion flow outwards through the finned tubes, giving up their heat to the water flowing through the tubes. The cooled exhaust products are then discharged into the insulated boiler casing shown in Fig. 1.
The burner is supplied with a mixture of air and gas in the correct proportions for good combustion by a fan 10 via a connecting duct 11 . Gas at a constant rate is supplied to the inlet of the fan through an injector pipe 12 .

2. 1. 3. The Gas Burner

Each module has its own gas burner which burns a premixture of gas and air. The burner consists of a perforated stainless steel cylinder closed at one end and supplied with a mixture of gas and air at the other end. A stainless steel cone is fitted inside the burner cylinder. A perforated gauze is positioned at the burner entry. The gas burner is concentric with the finned tubes of the heat exchanger as shown in Fig. 2. The pre-mixed gas and air burns just off the surface of the cylinder.

2. 1. 4. Module Gas Supply (Fig.4)

Gas is supplied to each module from the gas header which is situated on the right-hand side of the boiler. The gas pressure in the gas header is controlled by the appliance gas governor (see Fig. 1).

The gas train of each module is illustrated diagrammatically in Fig. 4 and consists of the following items:

(a) a gas service tap 2
(b) a double gas solenoid valve 3
(c) a zero governor
(d) a gas injector pipe

All the above are held in position by two pipe clips which are supported from the cast iron header of the module.

2. 1. 5. Module Combustion Air Supply

Air is supplied to each module by a centrifugal fan. The fan motor has special "long-life" bearings and the motor coil is fitted with a thermal overload switch which will shut off the supply of electric current to the motor if the windings get over-heated.

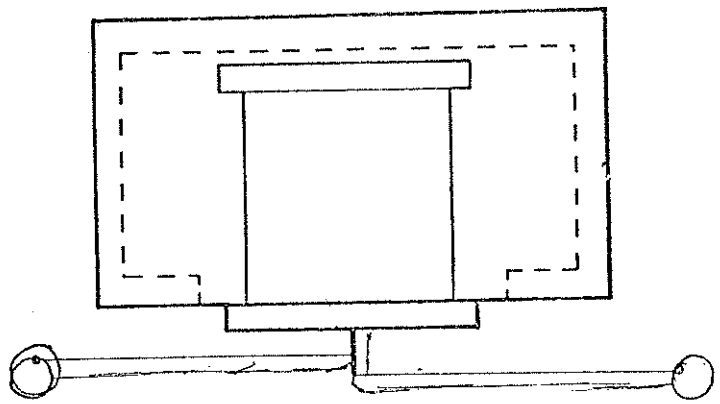
The fan entry is fitted with a gas distribution disc, below which the gas injector pipe is positioned. The shape of the distribution disc ensures good mixing of gas and air in the fan before discharging the mixture into the gas burner.

Module Control System

Each module has its own separate controls. These can be conveniently separated into the electric controls and the gas controls.

Fig. 1

THREE MODULE BOILER



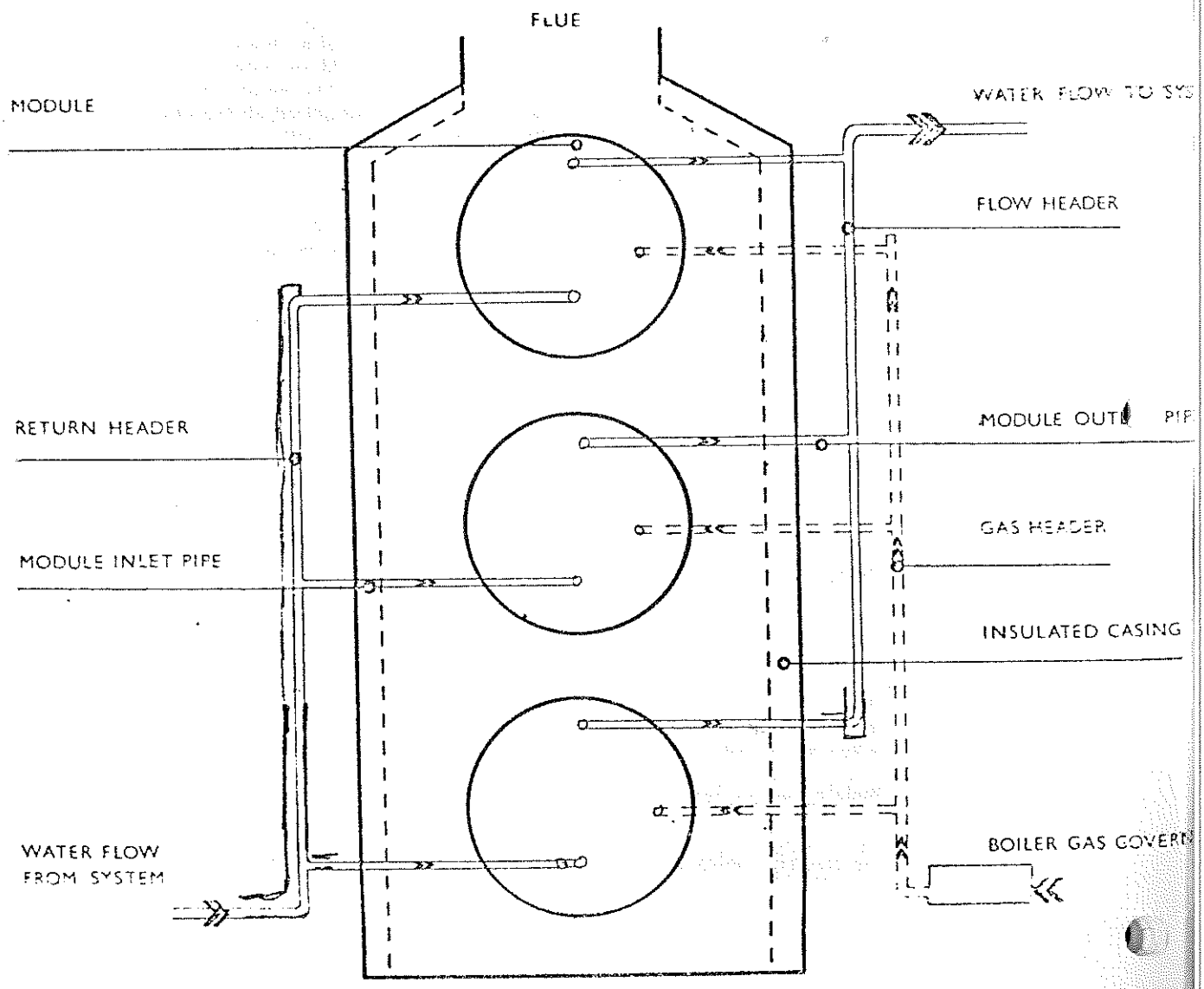
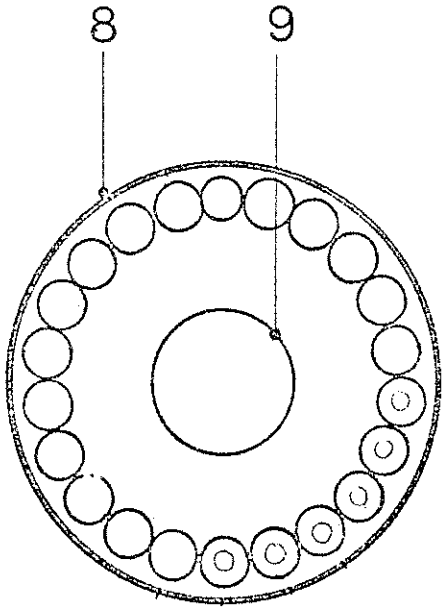
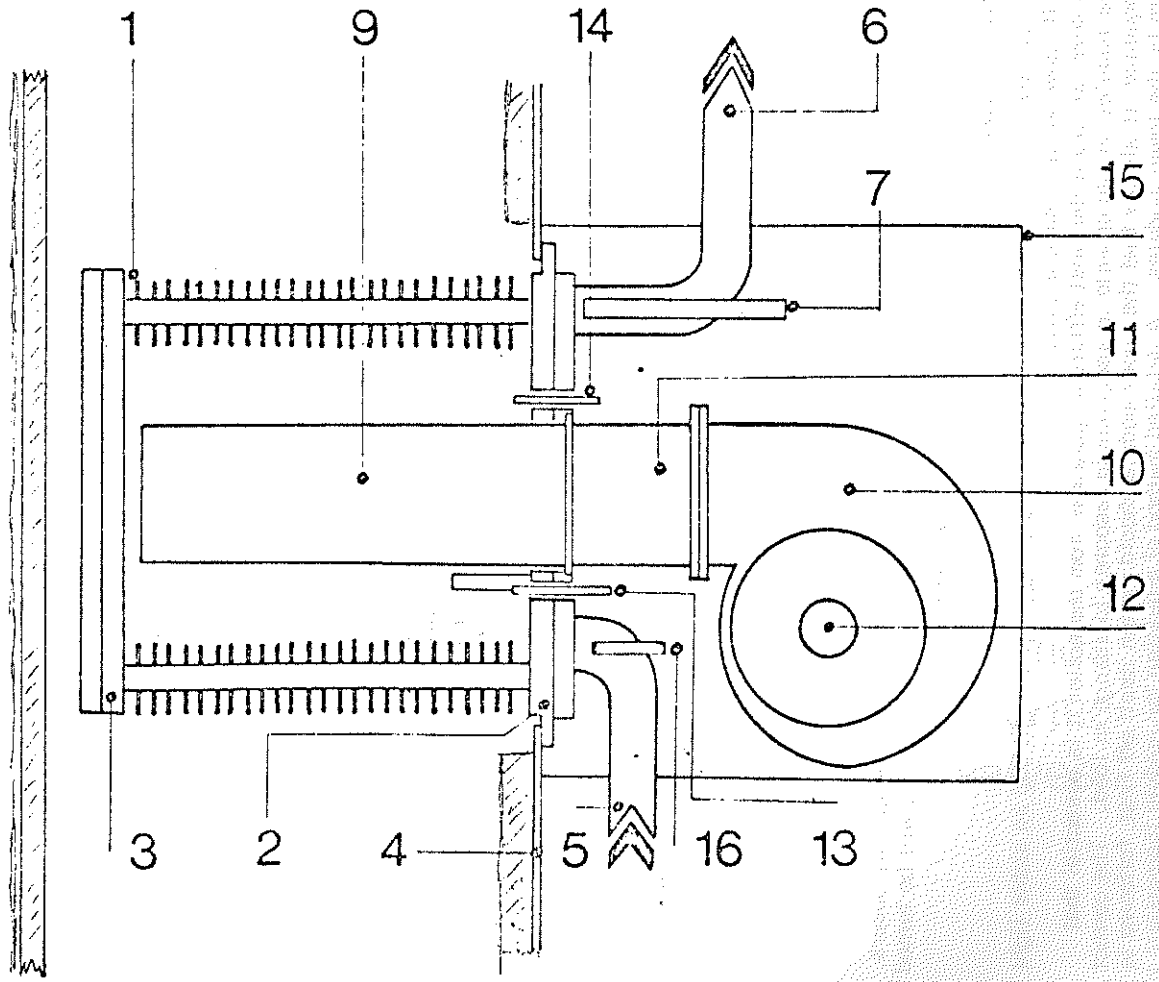


Fig. 2

HEAT EXCHANGE MODULE





2. 1. 6. 1. **Electric Controls of a Module (Figs.2 and 3)**

(a) An electronic sequence controller which also contains the flame monitoring circuits and an integral spark generator.
(b) An adjustable water temperature control thermostat.
(c) A non-adjustable limit thermostat with a manual reset button.
(d) The solenoids of the gas solenoid valves.
(e) An on-off switch.
(f) A green light indicating ''power on''.
(g) A red light indicating a fault condition (lockout).
(h) An amber light indicating that a module is firing.
(i) A spark electrode assembly.
(j) A flame sensing probe.

The sequence controller, the thermostats, the on-off switch and the indicating lights are all mounted on a chassis which is bolted to the top of the fan 10 . The spark electrode assembly 13, and the flame sensing probe 14, are bolted to the front header of the module. (Fig. 2). The limit thermostat bulb is located in the pocket 7 . The control thermostat bulb is located in pocket 16 . The on-off switch and the indicating lamps project through a slot in the module cover 15 and so are accessible when the cover is in position. A wiring diagram of the electric controls is shown in Fig. 3.

2. 1. 6. 2. **Gas Controls of a Module (Fig. 4)**

A diagrammatic layout of the gas controls is shown in Fig. 4. Gas is admitted through the appliance gas governor 1 and then flows to the modules. The gas flow to each module is through the gas service tap 2 , the double solenoid valves 3 , the zero governor 4 to the gas injector 5 . Gas pressure test points are provided at 6 , 7 and 8 . An impulse line 9 gives a pressure signal from the fan discharge to the top of the diaphragm of the zero governor. Another impulse line 10 gives a pressure signal from the boiler casing to the underside of the diaphragm of the zero governor.

Variations in the air quantity delivered by the fan, which can be caused by fan speed variation or by differing back pressures on the fan discharge are signalled through impulse line 9 to the zero governor. A reduction in fan discharge pressure causes the diaphragm to rise throttling the valve 11 and thus reducing the gas flow rate. A stoppage of the fan will cause complete shut-off of valve 11 . Variations in the boiler casing pressure are signalled through impulse line 10 . An increase in casing pressure caused by a partial blocking of the flue,which will affect the air flow from the fan,will cause valve 11 to move towards the closed position. Complete blocking of the flue will close valve 11 completely.

2.1.7 **Module Operation**

It is essential before any module is put into operation that water should be flowing through the boiler. The electric supply should be turned on, followed by the gas supply. A module is put into operation by pressing the on-off switch downwards. The green light will come on, indicating that the power is on to that module. If heat is not required from that module nothing further will happen; the green light will stay on. If heat is required then the following sequence of operations will occur:

(a) The amber light will come on, indicating that the thermostat is not satisfied.
(b) The red light will come on, indicating that the starting sequence has begun.
(c) The fan will start and run for approximately 10 seconds, which purges the combustion chamber of the module.
(d) The spark will be initiated at the spark electrode.
(e) The gas solenoid valve will open.
(f) The gas burner will light.
(g) The flame sensing probe will sense a flame present.
(h) The spark will be shut off.
(i) The red light will go off.

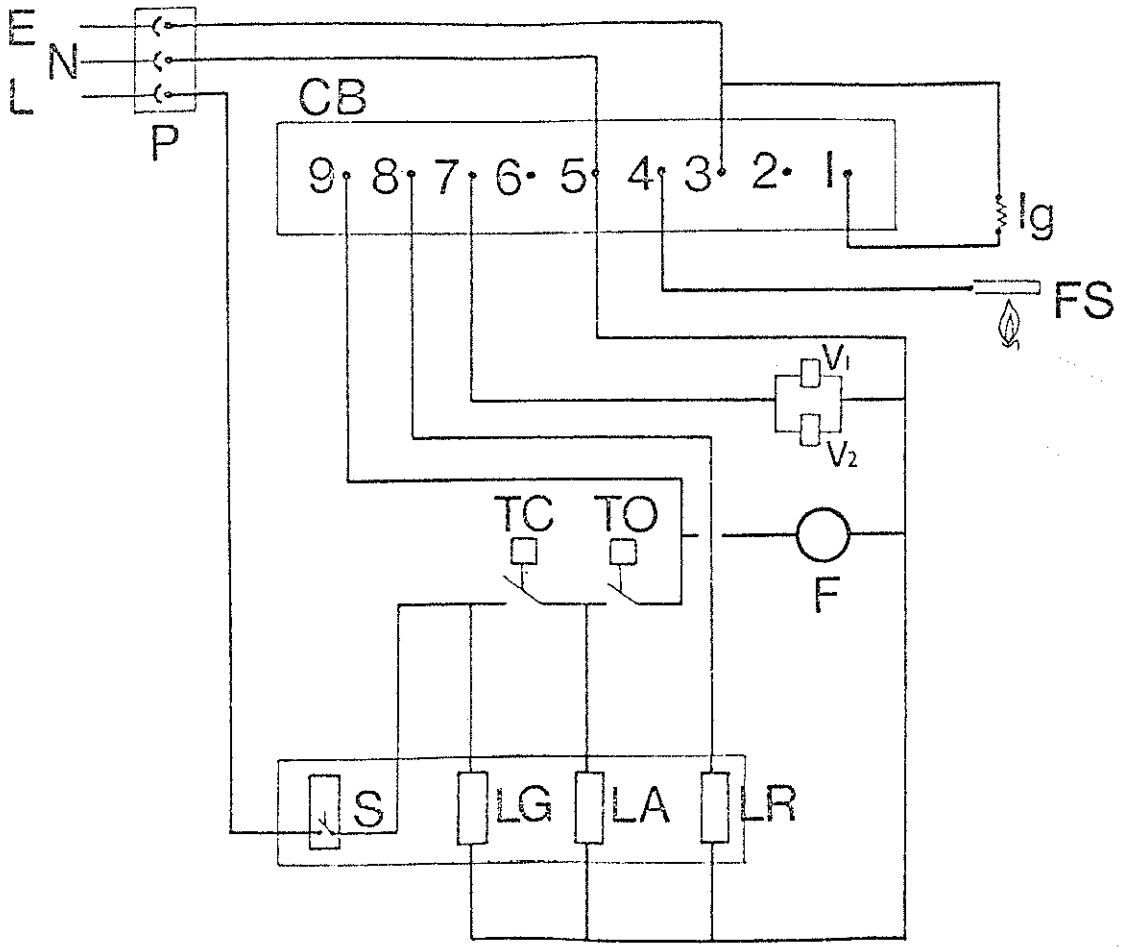
The burner will continue to fire until the thermostat is satisfied. When this occurs, the gas supply will be stopped by the gas solenoid valves and the fan will be turned off. The amber light will go out, the green light will stay on.

2. 1. 8. **Boiler Control**

At full load all the modules will be in operation i.e. a green light and an amber light will show on each module cover.
In order to obtain the most efficient operation from the boiler it is essential that the modules should operate in sequence in response to change in load. The correct sequence is always that the upper module should switch itself off first, followed in turn by the lower modules. A detailed method of adjusting the module thermostats is given in the installation instructions (see para **5. 6. 1).**

Fig.3

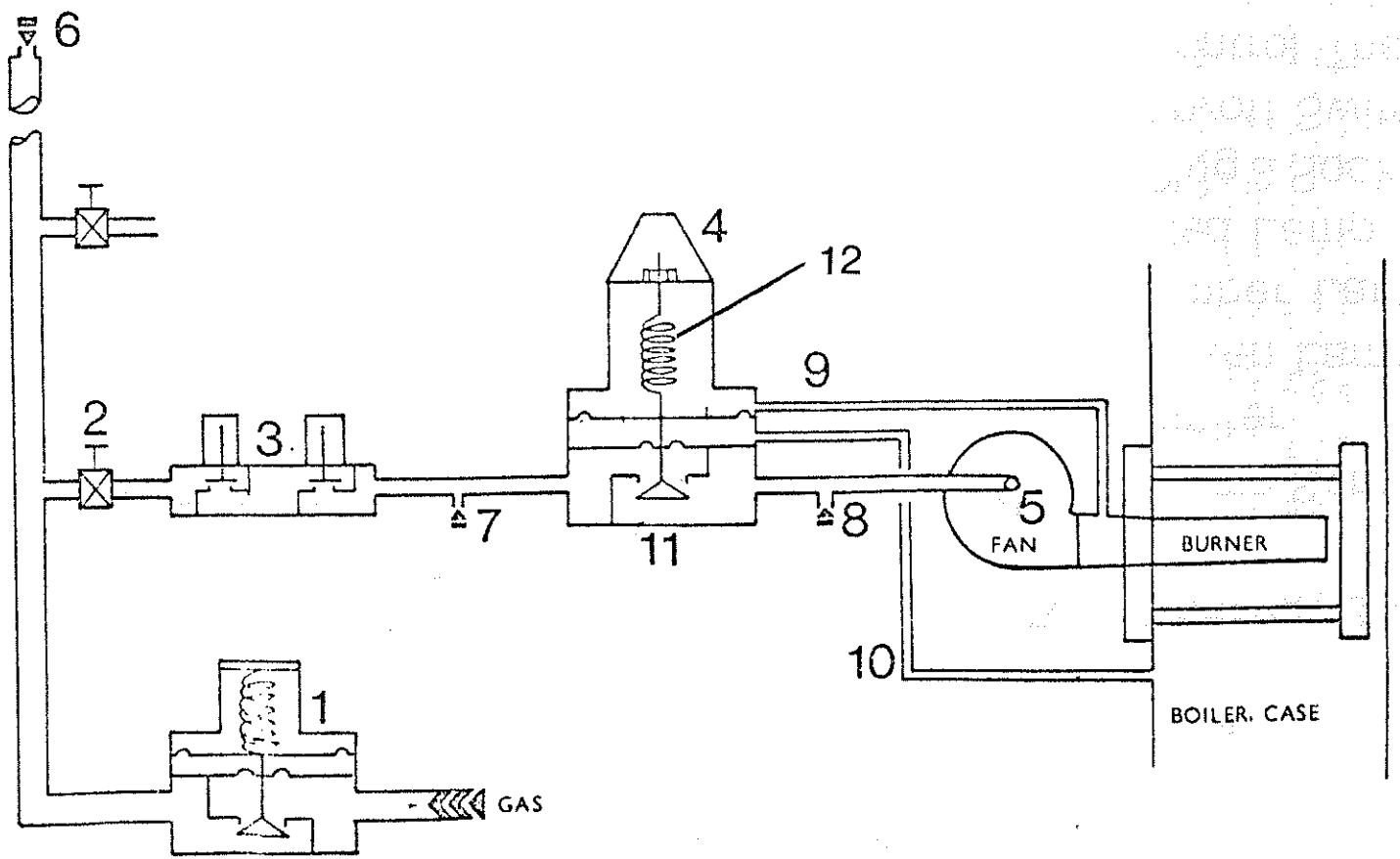
SCHEMATIC WIRING DIAGRAM



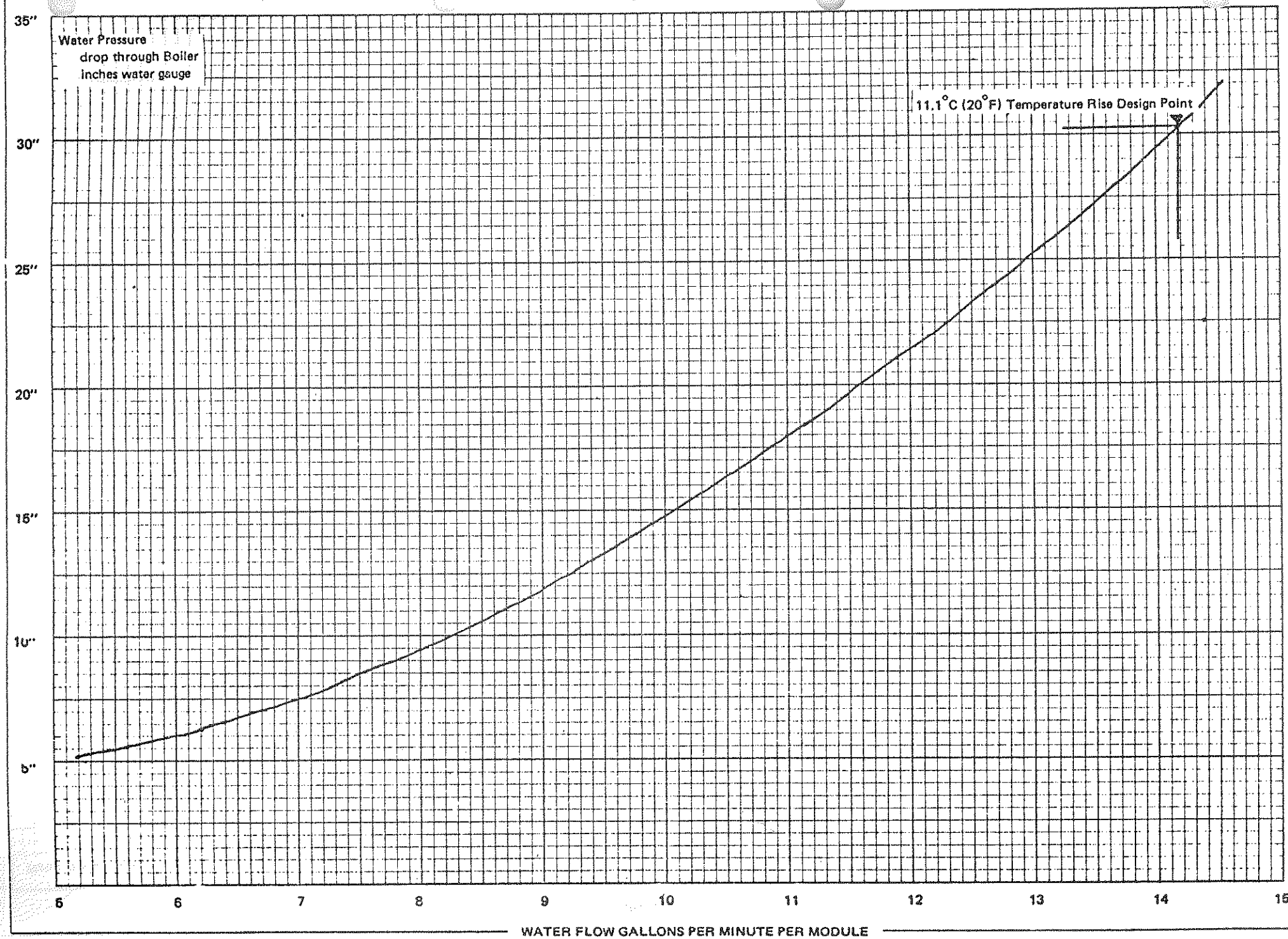
CB	Control Box
F	Fan
FS	Flame Sensor
Ig	Igniter
LG	Green Lamp
LA	Amber Lamp
LR	Red Lamp
P	Plug & Socket
S	on/off Switch
TC	Control Thermos
TO	Overheat Thermo
V_1 & V_2	Solenoid Valves

Fig.4

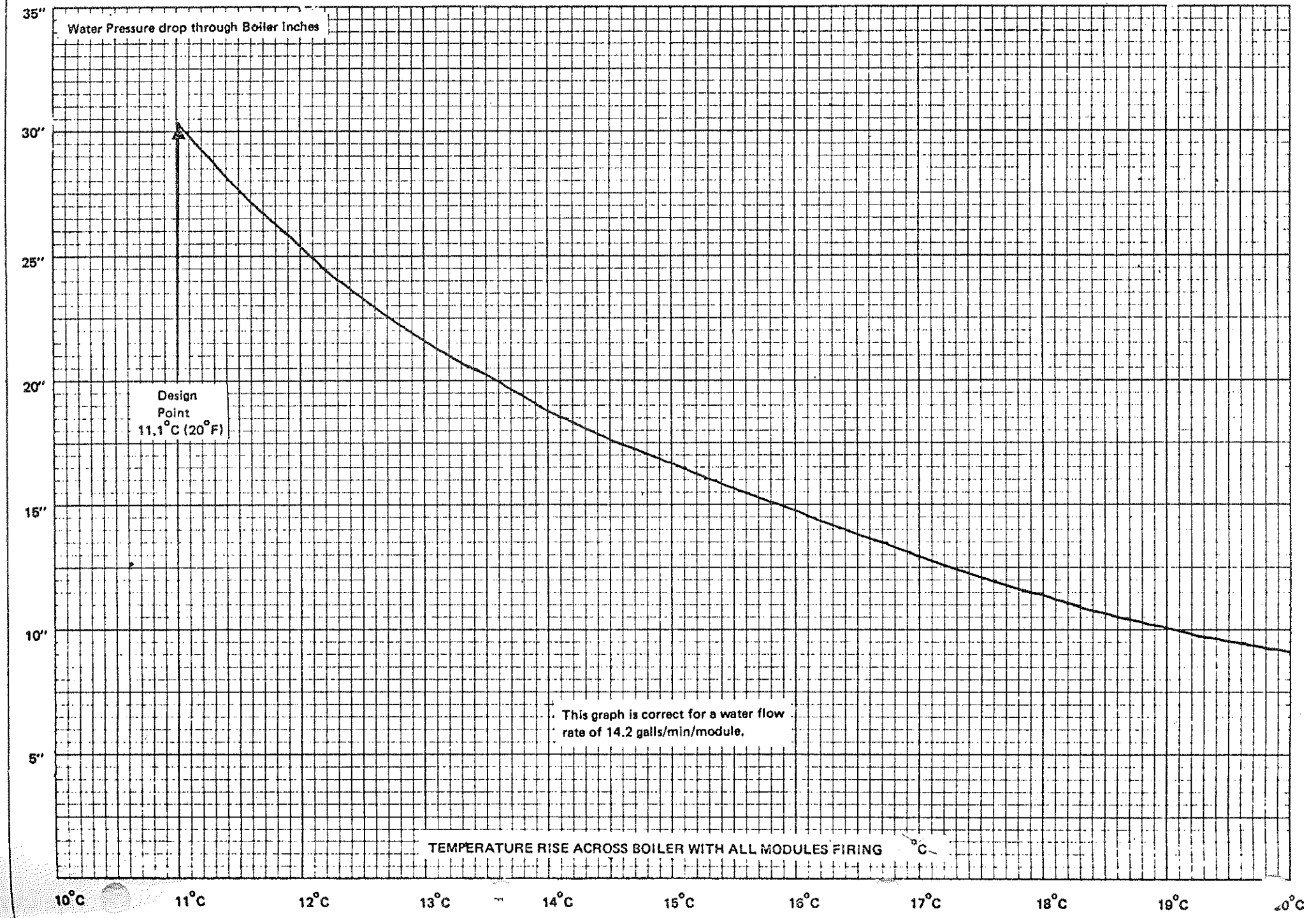
MODULE GAS SUPPLY



GRAPH I


35"
30"
25"
20"
15"
10"
5"
Water Pressure
drop through Boiler
inches water gauge
11.1°C (20°F) Temperature Rise Design Point
5
6
7
8
9
10
11
12
13
14
15
WATER FLOW GALLONS PER MINUTE PER MODULE

GRAPH II


Water Pressure drop through Boiler Inches
35"
30"
25"
20"
15"
10"
5"
Design Point 11.1°C (20°F)
This graph is correct for a water flow rate of 14.2 galls/min/module.
TEMPERATURE RISE ACROSS BOILER WITH ALL MODULES FIRING °C
10°C
11°C
12°C
13°C
14°C
15°C
16°C
17°C
18°C
19°C
20°C

2.2. BOILER DATA

2.2.1. Boiler Ratings

Table I lists the boiler output ratings and the corresponding gas input required.

2.2.2. Dimensions and Weights

Table II lists the dimensions and weights of the various sizes of the boiler.

2.2.3. Hydraulic Resistance

The water pressure drop through the boiler is given in two graphs. Graph 1 is a plot of the boiler water pressure drop against water flow per module. This graph is applicable to all sizes of boiler, because the modules are connected in parallel. Graph 2 is a plot of the boiler water pressure drop against the water temperature rise if all the modules are firing. This graph is also applicable to all sizes of boiler.

2.2.4. Water Content

Each module contains 3.5 litre (0.75 gal) of water.

TABLE I

Boiler Output		Gas Input			
kW	Btu/h	kW	Btu/h	ft^3/h	m^3/h
50	170 600	58.8	200 705	194	5.49
100	341 200	117.6	401 411	388	10.98
150	511 800	176.5	602 218	582	16.48
200	682 400	235.3	802 823	776	21.96
250	853 000	294.1	1 003 529	969	27.45
300	1 023 600	352.9	1 204 095	1 163	32.94

TABLE II

Boiler Casing Dimensions

Boiler Output	Height		Width (2)		Depth (1)	
kW	mm	in	mm	in	mm	in
50	772	30	600	24	350	14
100	1190	47	600	24	350	14
150	1610	64	600	24	350	14
200	1450	57	1070	42	350	14
250	1815	71.5	1070	42	350	14
300	1975	78	1070	42	350	14

(1) This depth is increased by 260 mm (10 in) when module covers are in place.

(2) This width is increased by 180 mm (7 in) in size range 50 to 150 kW, by 210 mm (8.5 in) in size range 200 to 300 kW to allow for flow and return pipework.

Boiler Weights

Output kW	Rating Btu	Wt of Case kg	Wt of Case lb	Wt of Modules kg	Wt of Modules lb	Wt of Headers kg	Wt of Headers lb	Total Wt kg	Total Wt lb
50	170 600	16	35	41	90	-	-	57	125
100	341 200	36	79	82	180	9	20	127	279
150	511 800	56	123	123	271	14	31	193	425
200	682 400	73	160	164	361	16	35	253	556
250	853 000	90	198	205	451	18	40	313	689
300	1 023 600	90	198	246	541	18	40	354	778

Each module weighs 41 kg (90 lb)

3. INSTALLATION REQUIREMENTS

3.1 SINGLE MODULE BOILER INSTALLATION (One module fitted inside boiler casing, i.e. 50 kW Model only)

3.1.1 General

The installation of the boiler must be in accordance with the Gas Safety Regulations, Building Regulations, I.E.E. Regulations and Regional Water By-Laws. It should also be in accordance with B.S. Codes of Practice and the British Gas Publication specified below and any relevant requirements of the local Gas Region and the Local Authority.

3.1.2 Location

The position chosen for the boiler should permit the provision of a satisfactory flue and an adequate air supply. It should also provide adequate space for servicing and air circulation. Where installation of the boiler will be in an unusual position, special procedures may be necessary and B.S. 5376:2 gives detailed guidance on this aspect.

Any cupboard or compartment used to enclose the boiler must be designed and constructed specifically for this purpose. An existing cupboard or compartment may be used provided that it is modified for the purpose. Details of the essential features of cupboard/compartment design are given in B.S. 5376:2.

The boiler must **NOT** be installed in a bathroom or bedroom.

3.1.3 Connection to Gas Supply

The gas installation should be in accordance with C.P. 331:3. The following notes are intended to give general guidance:
The meter to be used must be of adequate capacity to meet the total gas load, i.e. boiler plus other gas appliances installed.
Ensure that the pipework from the meter to the appliance is of adequate size. Do not use pipe of smaller size than the appliance gas connection.
Test the complete installation for soundness as described in the above code.

3.1.4 Fluing

Detailed recommendations for fluing are given in B.S. 5440:1. The following notes are intended to give general guidance.

3.1.4.1

The boiler must be fitted to an open-flue system. A draught diverter must not be fitted in the system. The cross-sectional area of the flue serving the boiler must not be less than the area of the boiler flue outlet.

Materials used for the flue system should be mechanically robust, resistant to internal and external corrosion, non-combustible and durable under the conditions to which they are likely to be subjected.

Flue pipes should be constructed from one of the following materials:

(a) aluminised or stainless steel
(b) aluminium
(c) cast iron - acid-resistant vitreous enamel lined,
or (d) sheet metal - acid-resistant enamel lined.

If double walled flue pipe is used it should be of a type acceptable to British Gas.

Where a chimney is to be used it should be composed of or lined with a non-porous acid resisting material. (Chimneys lined with salt-glazed earthenware pipes are acceptable if the pipes comply with B.S. 540).

A flue pipe, constructed from one of the materials in (a) to (d) above, should form the initial connection to lined chimneys. Alternatively a chimney may be lined with a stainless steel flexible flue liner or any other liner acceptable to British Gas. (The number of joints in a liner must be kept to a minimum).

The following points are of particular importance:

(1) The route of the flue to the point of termination should be as direct as possible. Resistance in the form of change of direction should be kept to a minimum. Sharp bends and horizontal runs must not be used.

(2) Facilities should be made for disconnecting the flue pipe for inspection and servicing requirements. Bends with removable covers should be fitted for inspection and cleaning purposes where considered appropriate.

(3) Because of the very high efficiency of the boiler it is almost certain that condensation in the flue will occur. Provision must therefore be made for condensate to flow freely to a point at which it can be released, preferably into a gully. The condensate pipe from the flue to the disposal point should be of non-corrodible material of not less than 22 mm (¾ in) diameter.

(4) The inital length of the flue pipe from the appliance should be preferably vertical for at least 600 mm (2ft) and should preferably be internal.

(5) If a draught stabiliser is to be fitted in the flue, means should be provided to ensure that the gas will not flow to the burner if the draught stabiliser malfunctions.

(6) Flue pipes and fittings must not be closer than 25 mm (1 in) to combustible material, and where passing through a combustible partition such as a ceiling or roof, must be enclosed in a non-combustible sleeve providing an annular space of at least 25 mm (1 in). Spaces around flue pipes passing through walls of flues should be sealed against the passage of smoke or flame.

(7) If the flue pipe passes through a room or internal space other than that in which the appliance is installed, the pipe should be shielded. Shielding should be spaced 25 mm (1 in) from the flue pipe.

Termination

The flue should terminate in accordance with the relevant recommendations given in B.S. 5440:1.
The flue must be fitted with a terminal, preferably one which has been tested and found satisfactory by British Gas.
The terminal must not be installed within 600 mm (2ft) of an openable window, air vent or other ventilation opening.

3.1.4.3 **Flue Design Calculations**

For design calculations on flue sizings the following should be used:

(a) Gas exit temperature from boiler - 135°C (275°F)
(b) CO_2 content of flue gases - 9.5%
(c) Volume of flue gas is 0.021 m^3/s. (44.5ft^3/min) at S.T.P.

3.1.5 **Air Supply**

Detailed recommendations for air supply are given in B.S. 5440:2.
The following notes are intended to give general guidance.
The room in which the boiler is installed must be provided with a permanent air vent. This vent should be either direct to the outside air or to an adjacent room which itself has a permanent vent of at least the same size direct to the outside air.
The basic minimum effective area requirement of the permanent air vent, which is based on the rated **input** of the boiler, is as follows:

4.4 cm^2 per kW in excess of 7 kW (1 in^2 per 5000 Btu/h in excess of 25 000 Btu/h).

The actual minimum effective area of the permanent air vent is therefore:

230 cm^2 (37 in^2).

If the appliance is to be installed in a purpose-made cupboard or compartment air vents are required in the cupboard or compartment at high and low level which may communicate with a room or direct to outside air. The latter is preferable.

The basic minimum requirement of cupboard/compartment air vents, which are based upon the rated **input** of the boiler, are as follows:

Position of air vent	Air from room	Air direct from outside
High Level	9 cm^2 per kW (2 in^2 per 5 000 Btu/h)	4.5 cm^2 per kW 1 in^2 per 5 000 Btu/h)
Low Level	18cm^2 per kW ($4in^2$ per 5 000 Btu/h)	9cm^2 per kW $2in^2$ per 5 000 Btu/h)

The actual minimum effective areas of the air vents required in the cupboard or compartment are therefore:

Position of air vent	Air from room	Air direct from outside
High level	520cm^2 (80in^2)	260cm^2 (40in^2)
Low level	1040cm^2 (160in^2)	520cm^2 (80in^2)

Note: Both air vents must communicate with the same room or must both be on the same wall to outside air.

Should cupboard or compartment air vents be open to a room, the room must itself be provided with a permanent air vent as previously specified.

3.1.6. Water Circulation Systems

The central heating system should be in accordance with the relevant recommendations of B.S.537612 and the British Gas publication entitled "Material and Installation Specifications for Domestic Heating and Hot Water''.

The domestic hot water system (where applicable) should be in accordance with the relevant recommendations of CP 342:1 or 2 (whichever is applicable) and the above mentioned British Gas publication.

Water circulation systems must incorporate a pump as the boiler is not suitable for natural circulation. It is recommended that a water flow switch be fitted in the system to protect against pump failure.

3.1.7. Electrical Supply

External wiring must be in accordance with the I.E.E. Regulations. This is a Class 1 appliance suitable for connection to a 240 volt single phase A.C. supply of 50 Hz frequency. For wiring instructions see Electrical Connections (para IV.8)

THIS APPLIANCE MUST BE EARTHED

3.2. MULTI-MODULE BOILER INSTALLATION (Two or more modules fitted inside boiler casing i.e. 100 - 300 kW Models).

3.2.1. General

The installation of the boiler(s) must be in accordance with the Gas Safety Regulations, Building Regulations, I.E.E. Regulations and Regional Water Regulations. It should be in accordance also with B.S. Codes of Practice and British Gas Publications as specified below and any relevant requirements of the local gas region and the local authority.

3.2.2. Location

The position chosen for the boiler(s) should permit the provision of a satisfactory flue system and an adequate air supply. It should also provide adequate space for servicing and air circulation.
Detailed recommendations regarding boiler position are given in CP 332:3.

3.2.3. Connection to Gas Supply

3.2.3.1. Gas Service Pipes

The local Gas Region should be consulted at the installation planning stage, in order to establish the availability of an adequate supply of gas. A service pipe should not be used without prior consultation with the local Gas Region.

3.2.3.2. Meters

A gas meter should be connected to the service pipe by the local Gas Region or local Gas Region contractor. An existing meter should be checked by the Gas Region to ensure that the meter is adequate to deal with the rate of gas supply required.

3.2.3.3. Gas Installation Pipes

Installation pipes should be fitted in accordance with CP 331:3. Ensure that the pipework from the meter to the boiler(s) is of adequate size. Do not use pipes of smaller size than the boiler gas connection. Test the complete installation for soundness as described in the above Code. Further guidance for connection to gas supply is given in CP 332:3

3.2.4. Fluing

Detailed recommendations for fluing are given in the British Gas Publication "Technical notes on the design of flues for non-domestic boilers". Reference should also be made to CP 332:3 where applicable.
The following notes are intended for guidance only:

3.2.4.1. Flue

Each boiler should be fitted with its own individual open flue system. A draught diverter must not be fitted in the system. The cross-sectional area of the flue serving the boiler must not be less than the area of the boiler flue outlet.
A fan dilution system may be used. It must be designed by a competent engineer to conform with British Gas Data Sheet No. 24.
Materials used for the flue system should be mechanically robust, resistant to internal and external corrosion, non-combustible, and durable under the conditions to which they are likely to be subjected.
Flue pipes and fittings should be constructed from one of the following materials (see B.S. 715 and B.S. 835):

(a) aluminised or stainless steel
(b) aluminium
(c) cast iron - acid-resistant vitreous enamel lined
(d) sheet metal - acid-resistant vitreous enamel lined.

If double walled flue pipe is used it should be of a type acceptable to British Gas.
In order to minimise condensation the use of a double walled flue or insulation e.g. lagging applied to the external surface of the flue pipe, is recommended.
Provision must be made for condensate to flow freely to a point at which it can be released, preferably into a gully. The condensate pipe from the flue to the disposal point should be of non-corrodible material of not less than 22 mm (¾ in) diameter.

Facilities should be made for disconnecting the flue pipe from the boiler for inspection and servicing purposes. Bends with removable covers should be fitted for inspection and cleaning purposes when considered appropriate. If a draught stabiliser is to be fitted in the flue means should be provided to ensure that gas will not flow to the burners if the draught stabiliser malfunctions.
The flue system should ensure safe and efficient operation of the boiler to which it is attached, protect it from wind effects and disperse the products of combustion to the external air.

3.2.4.2. Termination

The flue should terminate in a freely exposed position above roof level and should be so situated as to prevent the products of combustion entering any opening in a building in such concentration as to be prejudicial to health or a nuisance.

3.2.4.3. Flue Design Calculation

For design calculations on flue sizing and heights the following figures should be used:

(a) Gas exit temperature 135°C (275°F)
(b) CO_2 content of exhaust gas 9.5%
(c) Flue gas volume per module is .021 m^3/s. (44.5 ft^3/min) at STP

The boiler is designed to give its nominal output with a balance condition i.e. no suction or pressure at the boiler exit. Precautions have been taken in the burner design to compensate for variations in suction or pressure within the boiler case. This compensation ensures that the CO_2 and the CO/CO_2 ratio remains virtually constant independent of casing pressure. However the output of the modules varies with casing pressure. This variation is a 2.4% increase in output for a suction increase of 1 mm w.g. This corresponds to a 1.5% increase in output for each 10 metre height of flue. If a very high flue is necessary to suit particular buildings, then a draught stabiliser should be used.

3.2.5. Air Supply

Multi-module boiler installations up to 730 kW (2 500 000 Btu/h) input

Detailed recommendations for air supply are given in CP 332:3.

Multi-module boiler installations in excess of 730 kW (2 500 000 Btu/h) input

Detailed recommendations for air supply are given in the British Gas Publication "Guidance for boiler installations in excess of 2 000 000 Btu/h (586kW) output."

The following notes are intended to give general guidance only. In all cases there should be provision for an adequate supply of air for both combustion and general ventilation.

3.2.5.1. Air Supply by Natural Ventilation

There should be suitable openings communicating directly with the outside air at high level and at low level. Where communication with the outside air is possible only by means of high level openings, ducting down to floor level for the lower opening(s) should be used. Openings should be provided preferably on all four sides, but at least on two sides of exposed boiler houses. All openings should have negligible resistance and be so sited that they cannot be easily blocked or flooded. Grilles or louvres should be so designed that high velocity air streams do not occur within the space housing the boiler. The air space requirements stated overleaf are based on the rated input of the boiler(s) and are equivalent to those specified in the British Gas Guidance Notes as mentioned above. (Note: The above documents specify requirements in terms of output rating).

The basic minimum effective area requirements of the openings are as follows:

Total input rating of modules	Position of opening	Air direct from outside
Up to 730 kW (2 500 000 Btu/h)	High Level	4.5cm^2 per kW (1in^2 per 5 000 Btu/h)
	Low Level	9cm^2 per kW (2in^2 per 5 000 Btu/h)
730 to 1320 kW (2 500 000 to 4 500 000 Btu/h)	High Level	3 300cm^2 (500in^2)
	Low Level	6 600cm^2 (1 000in^2)
Above 1320 kW (4 500 000 Btu/h)	High Level	2.5cm^2 per kW (1in^2 per 9 000 Btu/h)
	Low Level	5cm^2 per kW (2in^2 per 9 000 Btu/h).

The actual minimum effective areas of the openings required are therefore:

Total Number of Modules installed	Position of opening	Air direct from outside
2 to 12	High Level	260cm^2 per module (40in^2 per module)
	Low Level	520cm^2 per module (80in^2 per module
13 to 22	High Level	3,300cm^2 per module (500in^2 per module)
	Low Level	6,600cm^2 per module (1,000in^2 per module)
23 and above	High Level	145cm^2 per module (22in^2 per module)
	Low Level	290cm^2 per module (44in^2 per module)

3.2.5.2. Air Supply by Mechanical Ventilation

The supply of air to a space housing a boiler by mechanical means should be by mechanical inlet with natural or mechanical extraction. Mechanical extract ventilation with natural inlet must not be used.
Where a mechanical inlet and a mechanical extract system is applied, the design extraction rate should not exceed one-third of the design inlet rate. The requirements for air supply by mechanical ventilation are given in CP 332:3 and the British Gas Guidance Notes mentioned above.

Note: For mechanical ventilation systems an automatic control should be provided to cut off the gas supply to the boiler(s) in the event of failure of air flow in either inlet or extraction fans.

3.2.6. Water Circulation Systems

The water circulation system should be installed in accordance with the requirements of the appropriate authorities and insurance company.
Water circulation systems must incorporate a pump as the boiler(s) is not suitable for natural circulation. It is recommended that a water flow switch be fitted in the system to protect against pump failure.

3.2.7. Electrical Supply

External wiring must be in accordance with the I.E.E. Regulations
This is a Class 1 Appliance suitable for connection to a 240 volt single phase A.C. supply of 50 Hz frequency.
For wiring instructions see 'Electrical Connections' para 4.8.

THIS APPLIANCE MUST BE EARTHED

4. INSTALLATION INSTRUCTIONS

4.1. General

Normally the boiler(s) will be despatched to site completely assembled. The weights and dimensions of the boilers are given in Table II.
If access to the boiler house is difficult, the unit may easily be broken down into its main component parts, which are as follows (see Fig I):

(a) The boiler case
(b) The heat exchanger modules
(c) The flow and return water headers
(d) The gas header complete with the boiler gas governor.

The boiler case can be located in its correct position and the unit assembled. From Table II it will be seen that the heaviest single component is the case, but even for the largest boiler in the range, the 300 kW model, this only weighs 90 kg (198 lb) which can be carried by two men.

4.2. Foundation Details

There are no special foundation requirements, apart from a firm, level and incombustible floor. No special precautions need to be taken with regard to the effect of the temperature on the foundations. The bottom of the boiler case will not rise above 80°C. The boiler feet should be packed with shims to take up any irregularities in the floor.

4.3. Dismantling & Reassembling of the Main Boiler Components

The following paragraphs 4.3.1. and 4.3.2. can be ignored if site conditions allow the boiler to be positioned without stripping.

4.3.1. Removing Modules from Boiler Case

(a) Remove the module cover by undoing the 6 mm hexagon set screws and sliding the covers off.
(b) Release the 1½ in. union nuts connecting the module inlet and outlet pipes from the flow and return headers.
(c) Remove the flow and return headers.
(d) Release the ½ in.union nuts connecting the gas header to each module and remove the gas header complete with the main governor.
(e) Unbolt the four 10 mm set screws holding the module to the casing being careful not to disturb the asbestos rope seal which is glued to the casing.
(f) Slide each module out on its runners.

4.3.2. Reassembly of Modules in Boiler Case

The boiler case can then be placed in position and the boiler reassembled in the reverse order to the sequence above.

4.4. Water Connections and Water Flow Rate

The flow header, i.e. heated water, is always on the right-hand side of the boiler and the return header on the left-hand side.
The flow and return header to the boiler should be adequately supported and allowance made for pipework expansion. No strain should be put on the boiler flow and return headers. Drainage of the boiler takes place down the return header and a drain point should be incorporated at the lowest point of the return system. If isolation valves are fitted in the flow and return pipes to the boiler then a safety valve set at 65 psi should be fitted on the boiler side of the isolation valves.
The design heat output of each module is 50 kW (170 600 Btu) which at a temperature rise of 11.1°C (20° F) needs a water flow of 3877 kg (8530 lb) per hour. This is approximately 1.07 l/s (14.2 gal/min).

The water flow through the boiler will correspond to the number of modules in the boiler, i.e. a three module boiler will handle 3 x 3.21 l/s (14.2 gal/min). The water flow through the boiler should not fall below a third of the design flow, otherwise nucleate boiling may occur on the tubes of the heat exchanger. It is recommended that a water flow switch be incorporated in the water circuit to protect the boiler against pump failure. The flow switch should be set at approximately one-third flow requirement.
The water pressure drop through each module is 75 mbar (30 in.w.g) at the design flow rate of 1.07 l/s (14.29 gpm) per module.
Because the modules are connected in parallel this pressure drop remains constant independent of the size of the boiler. Graphs 1 and 2 show the influence of water flow against pressure drop and rise in temperature.
The design operating pressure of the boiler is 4.5 bar (65 lb/in^2).

4.5 Condensate Drainage

A ½ in.BSP pipe is welded to the right-hand side of the boiler. This pipe should be connected to a drain via an open gully. Normally condensation will only occur within the boiler when the return water temperature is below the water dew point, which is approximately 55°C. Therefore condensation will only occur when the system is warming up.

4.6 Connection of Boilers to the Flue System

The design of the flue has been covered in sections 3.1.4.1. and 3.2.4. The flue pipe should be of the same nominal bore as the boiler spigot. The spigot diameter is sufficiently large to accommodate an insulated double wall flue pipe. Any gap remaining between the flue pipe and the spigot should be sealed with asbestos rope.

4.7. Gas Connections

The gas supply pipe should be adequately sized to pass the required amount of gas for the boiler. The gas pressure at the inlet of the boiler governor should not be less than 15 mbar (6 in.w.g).The gas supply pipe should be adequately supported so that no strain is imposed on the boiler governor.

4.8. Electrical Connections

The electrical connnection to each module is through a three-pin socket which is supplied with each module. The corresponding plug is fitted to the control system chassis. A flexible lead should be wired to the socket so that it can be disconnected from the module when servicing is required.
The electrical load taken by each module is 30 Watt. The electrical supply must be fused accordingly at 3 amp.

5. COMMISSIONING & TESTING

5.1. Electrical Isolation

Turn off the electrical supply to the boiler and isolate all the modules from the electrical supply by withdrawing the electrical sockets from the left-hand side of the module cover.

5.2. Filling the Boiler with Water

It is preferable to fill the boiler with water by admitting the water to the return header; by this method the air is forced from the tubes in the heat exchanger modules. An air bleed can conveniently be fitted at the top of the flow header.

5.3. Water Circulation

Switch on the pump motor and check that the water is circulating. If the advised water flow switch is fitted in the system, check that it is operating satisfactorily, i.e. that no flow condition removes the electrical supply from the boiler.

5.4. Gas Supply & Gas Tightness

Turn off the gas taps to isolate the module(s) from the gas header. Connect a manometer tube (a U-tube gauge) to the gas tapping point at the top of the gas header (shown in Fig. 4 as point 6).
Turn on the main gas service tap which is located upstream of the main boiler governor.
Bleed air from the gas pipes; this can conveniently be done by undoing the upper module gas service tap union connection. When the air has been bled from the system the union should be tightened.
A note of the reading of the gas pressure shown on the manometer should now be taken. The main gas service tap should be turned off. The gas pressure is now trapped in the header and the pressure shown on the manometer should not fall; otherwise there is a leak. If a leak is found it should be traced and sealed. If there is no leak, then the main gas service tap should be turned on.

5.5. Testing Each Module

Each module should be checked separately in the following manner:

5.5.1. Prefiring Check

Remove the module cover by undoing the two six mm hexagon bolts.
Check that the gas service tap is in the off position.
Plug in the electrical socket to the module to be commissioned.
Turn the module control thermostat to the off position.
Turn off the on-off switch on the module by pressing upwards.
Turn on the electrical supply to the boiler.
Turn on the on-off switch on the module by pressing downwards.
The green light should now be on, indicating that power is on to the module under test.
Turn the module control thermostat to the on position.
The following sequence of events will now occur:

(a) The amber light and the red light will come on.
(b) The fan will start and run for approximately 9 seconds before:-
(c) The ignition spark will be heard from inside the module.
(d) The spark will continue for approximately 9 seconds and then will go off.
(e) The amber and red lights will stay on and the fan will continue to run.
(f) Turn the on-off switch to the off position and all the lights will go out.

5.5.2. Firing Check

Turn on the gas service tap to the module being fired.

Turn on the on-off switch; the following sequence of events will now occur:

(a) The green, red and amber lights will come on.
(b) The fan will start and run for approximately 9 seconds.
(c) The ignition spark will be heard.
(d) The gas valves will open and the burner will light.
(e) The red light will go off, the green and amber lights staying on.
(f) Check the reading on the manometer and adjust the main boiler governor until it indicates a pressure of 10 mbar (4 in.w.g.).
(g) Turn off the module on-off switch.

5.5.3. Fault Condition

If the burner does not fire, the following sequence of events will occur following (d) in 5.5.2. above:

(e) The gas valves will stay open for approximately 9 seconds, the spark will continue for the same length of time.
(f) The gas valves will close and the spark go off.
(g) The red light, the amber light and the green light will stay on.

Another attempt to light can now be made by turning the on-off switch off and then on again. The sequence outlined above in para. 5.2.2. (a) to (e) will then re-occur.

The most likely reasons for the burner failing to light on first commissioning are either that air is still present in the gas lines or that gas pressure is too low. Corrective action should be taken either by repurging the gas lines or adjusting the main boiler governor until the manometer reads 10 mbar (4 in.w.g.) with the gas valves open.
If the burner still does not fire, the fault-finding instructions should be consulted.

5.5.4. Safety Checks

5.5.4.1. Flame Sensing Probe

(a) Re-establish the flame as outlined in para. 5.5.2.
(b) Remove the lead from the flame sensing probe.
(c) The burner should stop firing within one second.
(d) One attempt will be made to relight and then the burner will go to "lock-out", the red light staying on as well as the green and amber lights.
(e) If the above check is satisfactory, replace the lead to the flame-sensing probe. If the check is not satisfactory, the control box should be replaced.

5.5.4.2. Control Thermostats

After the boiler has been running for some time and the water temperature has risen, check that the operation of the control thermostat is satisfactory. When the thermostat is satisfied it should turn the modules off, the amber light going off and leaving the green light on.

5.6. Testing the Boiler

After each module has been tested as outlined above, they can all be switched on. With all the modules firing the gas pressure at the gas header should again be checked, and if necessary adjusted to 10 mbar (4 in.w.g) with all the modules firing.

5.6.1. Controlling Boiler Water Temperature

The thermostat bulbs of the controlling thermostat are in the return pipe to each module.
The design temperature rise of each module is 11.1°C (20°F) if the correct amount of water is flowing through the modules.
The thermostat dial is marked Low to High and has four graduation marks in between. The approximate corresponding temperatures are as follows:

Low	1	2	3	4	High
57°C	63°C	68°C	74°C	79°C	85°C

The thermostats should be so adjusted that the lowest module in the boiler case operates for the greatest length of time.
Fig. No. 5 shows the approximate settings to obtain a mixed flow temperature of 80°C if the water flow rate through the boiler is correct.
If the water flow rate is below design then all the above settings should be reduced, but they should be kept in the same order. If the water flow rate is above design, then the settings should be increased but kept in the same order.

5.6.2. High Limit Thermostat

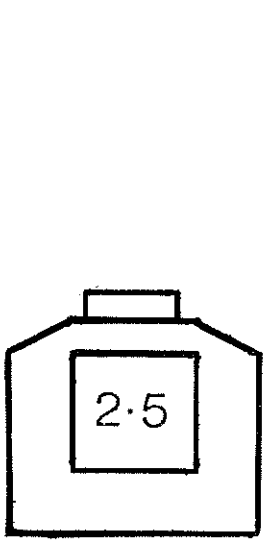
The high limit thermostat which is located in the flow pipe of each module has a fixed setting of 97°C. If this temperature is exceeded then the limit thermostat will trip, the green button will pop out, the burner will stop firing and the amber light will go out. The limit thermostat is reset by pushing in the green button on the thermostat.
If the water flow rate through the modules is correct, then even when the control thermostat setting is at maximum, i.e. 85°C, the 11° temperature rise through the module should not cause the limit thermostat to trip. However, if the water flow rate is below design there is a possibility that tripping will occur. If this should happen the control thermostats should be set back until the high limit thermostat does not trip out.

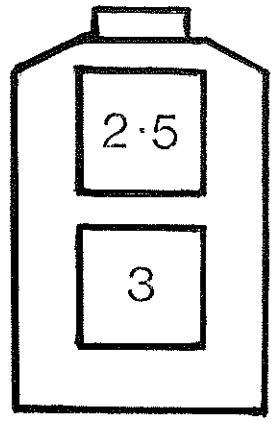
5.7. Module Covers

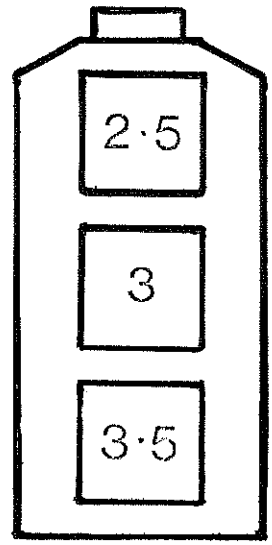
The module covers should be replaced after the boiler water temperature has been adjusted.

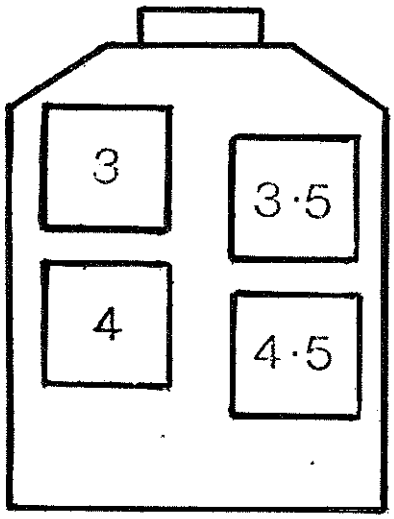
Fig.5

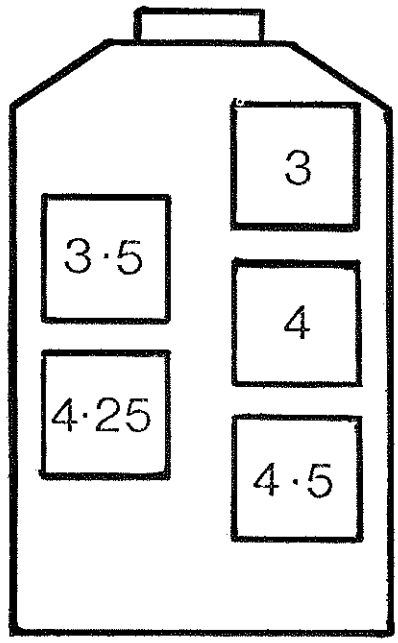
Thermostat Settings

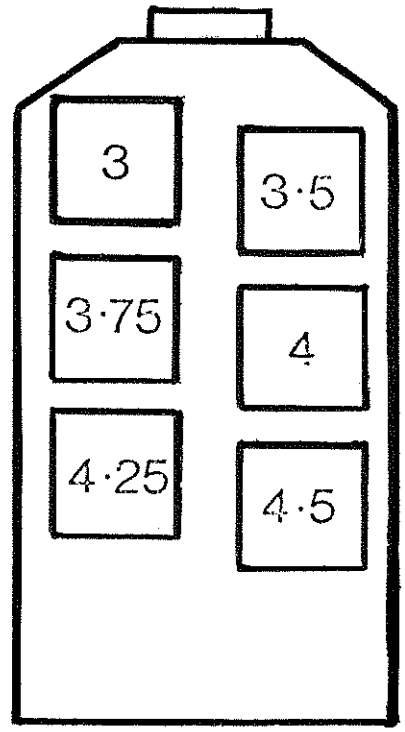












Approximate settings of control thermostats to give a mixed flow temperature of 80°C.

Note these settings only apply if the correct water flow rate is passing through the boiler.

6. SERVICING INSTRUCTIONS

6.1. General

Annual and biennial servicing is recommended and the procedures are given below.

ALWAYS ISOLATE THE ELECTRICITY SUPPLY TO THE BOILER BEFORE COMMENCING ANY SERVICING PROCEDURE OR ANY EXCHANGE OF COMPONENTS. THEN TURN OFF THE GAS SERVICE TAP TO THE MODULE BEING SERVICED.

6.2. Annual Service

6.2.1. Removing Module Cover

(a) Withdraw the electric socket from the module.
(b) Unscrew the two module cover retaining bolts (6 mm).

6.2.2. Removing the Fan Assembly and Control Chassis

(a) Disconnect the lead to the spark electrode.
(b) Disconnect the lead to the flame sensing probe.
(c) Disconnect the two leads and the earth leads from the gas solenoid valves.
(d) Undo the governor end of the impulse line which goes to the top of the diaphragm of the zero governor.
(e) Remove the two 4 mm screws which retain the clip securing the gas injector pipe to its support bracket.
(f) Remove the three 8 mm nuts holding the fan assembly to the module.
(g) Withdraw the fan assembly from the module, being careful to withdraw the thermostat bulbs from their pockets.
(h) The burner can now be withdrawn from the module.

6.2.3. Cleaning the Burner

(a) Unscrew the two 4 mm nuts from the studs which retain the and remove the gauze.
(b) Withdraw the air distribution cone from inside the burner.
(c) Lightly brush the inside and outside of the burner.
(d) Lightly brush the burner gauze.

6.2.4. Reassembly of the Burner

The burner can now be reassembled.

(a) Push the air distribution cone right into the burner.
(b) Replace the burner gauze and tighten up the screw.
(c) Replace the burner in the module.

6.2.5. Cleaning the Fan

(a) Remove the gas distribution disc from the fan intake.
(b) Inspect the fan blades and if necessary lightly brush to remove any accumulation of dirt.
(c) Replace the gas distribution disc (see Fig. 6 for correct position).

6.2.6. Removal of Spark Electrode Assembly

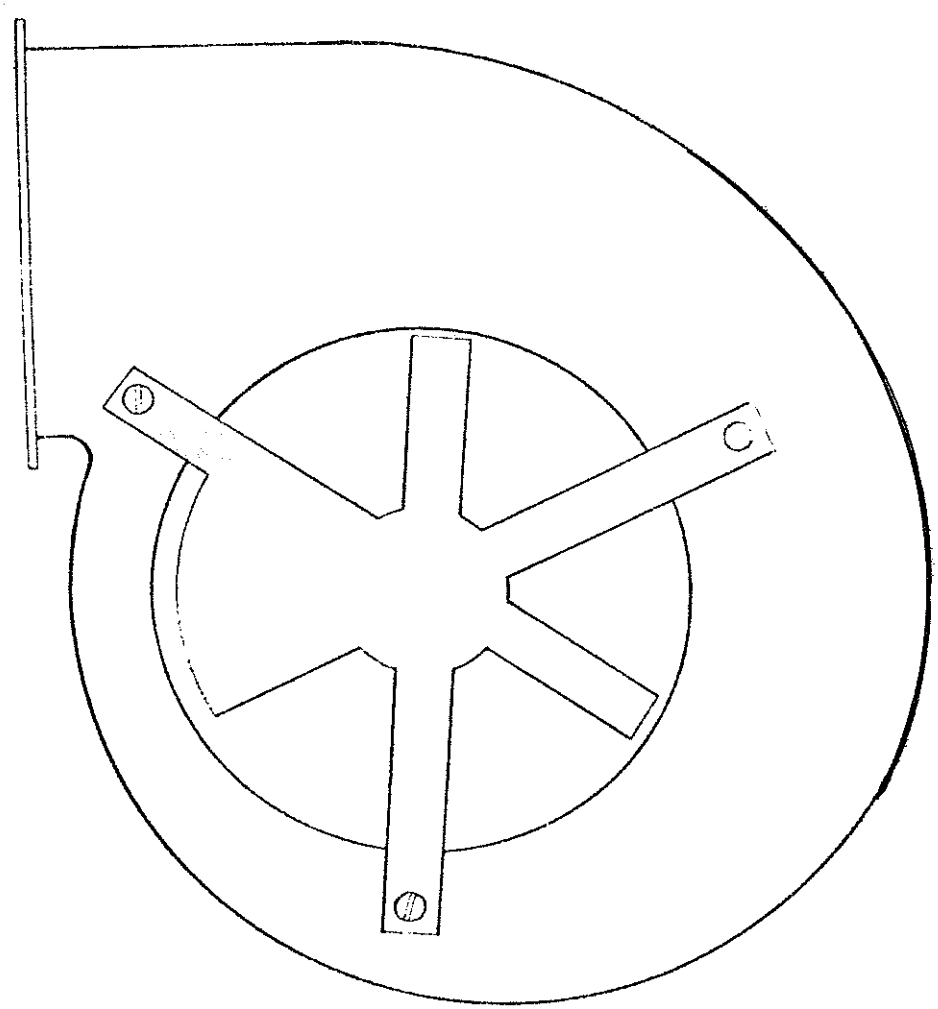
(a) Unscrew to two 4 mm nuts from the studs which retain the spark assembly in position.
(b) Withdraw the spark assembly and inspect. If the spark electrode is reduced in diameter it should be replaced. Check that the spark gap is set to 4 mm.

6.2.7. Reassembly of Spark Electrode Assembly

(a) Refit the spark electrode assembly to the module.
(b) Replace the 4 mm nuts.

Fig. 6

LOCATION OF GAS DISTRIBUTION DISC ON FAN INTAKE



6.2.8. **Removal of the Flame Sensing Probe**

(a) Undo the 4 mm nut which secures the flame sensing probe in position.
(b) Withdraw the flame sensing probe and inspect. If the probe is reduced in diameter or is not straight it should be replaced.

6.2.9. **Reassembly of the Flame Sensing Probe**

Replace in position and tighten up the 4 mm nut.

6.2.10. **Cleaning the Impulse Lines**

The impulse line 9 (Fig. 4) which is attached to the fan assembly should be blown through to check if it is clear.
The other impulse line 10 (Fig. 4) which signals boiler casing pressure to the underside of the zero governor diaphragm should also be disconnected and blown through to check that it is clear.

6.2.11. **Reassembly of the Fan Assembly and Control Chassis**

The fan assembly should be fitted back into the module in the reverse procedure to that given in 6.2.2. above. If the cork gasket which seals the fan assembly to the burner is damaged it must be replaced. Care must be taken not to over-tighten the 8 mm nuts, or damage to the casting may result.

6.3. **Biennial Service**

6.3.1. **Cleaning of the Heat Transfer Surface**

(a) Repeat the annual service as detailed above, i.e.

6.2.1. Remove module cover.
6.2.2. Remove fan assembly.
6.2.3. Remove the burner.
6.2.6. Remove electrode assembly.
6.2.8. Remove the flame sensing probe.

(b) Isolate the boiler from the flow and return water pipes.
(c) Drain down the boiler. Each module contains 3.5 litre (0.75 gal) of water.
(d) Release the 1½ in.union nuts connecting the modules to the return and flow headers.
(e) Release the ½ in. union nuts connecting the gas inlet manifold to the modules.
(f) Remove the four 10 mm studs holding the module into the boiler casing.
(g) Pull out the module and place on the bench.
(h) Unscrew the two stainless steel screws holding the slotted wrapper over the finned tube. Remove the wrapper.
(i) The finned flue-ways will now be revealed. These should be brushed thoroughly until clean.

6.3.2. **Zero Governor**

It is advisable to strip and inspect the zero governor at the biennial service. If there is any sign of deterioration of the main or secondary diaphragms or the valve bob 'O' rings these should be replaced. The setting of the zero governor will be disturbed during this service. It should be reset in accordance with the instructions given in para. 8.2.5.2.

6.3.3. **Reassembly of the Module**

(a) The reverse procedure to the above should be adopted. Care should be taken that the slots in the wrapper are in line with the highest point of the fins on the finned tubes.
(b) It will probably be more convenient to complete the assembly as detailed in 6.2.4., 6.2.7, 6.2.9. and 6.2.10 on the bench before the module is replaced in the boiler case.

6.3.4. **Cleaning the Module Waterways**

This should only be necessary if a considerable amount of make up water has been used in the system.

(a) Remove the module from the boiler case as detailed in 6.3.1.
(b) Remove the gas controls assembly by releasing the pipe clips holding the solenoid valves and the zero governor in position.
(c) The twelve 8 mm bolts and the centre 8 mm bolt which hold the inner cover plate to the inner tube plate should be removed. The plates can now be separated.
(d) The waterways will now be revealed. If it is found that the tubes are scaled or partially blocked, then the outer cover plate should be unbolted from the outer tube plate by unscrewing the twelve 8 mm bolts from the outside and the six 8 mm bolts from the inside of this assembly.
(e) The tubes can now be cleaned right through and also the water passages in the headers cleaned.

6.3.5. **Reassembly of the Module**

In general the reverse procedure to that outlined above should be followed. Attention should be paid to the following:

(a) New gaskets between the mating flanges should be used if the old ones show signs of damage.
(b) Care should be taken that the triangular lugs on the cover plates are placed in line with the corresponding lugs on the header castings.
(c) A thin coating of grease should be applied to the gaskets before assembly.
(d) When bolting the surfaces together the bolts should be tightened evenly. A torque of 35ft/lbf should not be exceeded.
(e) Reassembly can then continue as listed in 6.3.3.

7. FAULT FINDING

Diagnosis and rectification of fault conditions are given in the following paragraphs. Fig. 3 should be consulted.
The lamp indications on each module are a guide to any malfunctioning.
The module covers should not be removed except by a qualified technician. Live terminals can be exposed inside the cover.

7.1. Electric Supply

With the ON-OFF switch on each module pushed to the ON position, the green light on the front of the module(s) should be alight.
If the green light does not come on, check

(a) The time clock (if fitted) is adjusted to be calling for the boiler to be on.
(b) That the electricity supply is satisfactory and that the fuse has not blown.
(c) that the plug and sockets on each individual module are making a good connection.

If all the above are satisfactory, then either the module ON-OFF switch or the green lamp is faulty. Replace if necessary.

7.2. The Burner does not attempt to start

7.2.1. Thermostat Failure

The correct sequence of operation of the burner has been given in paras. 2.1.7. and 5.5.2.
If the green light is ON and the control thermostat is calling for heat, both the red and the amber lights should come on and the starting sequence should commence.

7.2.1.1. Control Thermostat Failure

If the amber light does not come on, then either

(a) The return water temperature is above the set point of the control thermostat, or
(b) The control thermostat has failed. This can be checked by shorting across the terminals of the control thermostat. If it is faulty it should be replaced.

7.2.1.2. Overheat Thermostat Trip

If the amber light comes on but not the red light, then the overheat thermostat has tripped, in which case it should be reset by pushing the green button which protrudes from the thermostat cover plate. The overheat thermostat will trip if the control thermostat is set too high, or is faulty, or the water flow through the module is too low.

7.2.2. Control Box Failure

If the red light still does not come on after the thermostats have been checked, then either there is a loose connection at terminal 9, or the control box is faulty. Before changing the control box, check that there is voltage between terminals 9 and 5 with the control box unplugged, and that the contacts between the control box and the control box base are satisfactory.

7.2.3. Fan Failure

When the green light, the amber light and the red light come on, indicating the start of the sequence, the fan will be heard to start. If the fan does not start this is due either to

(a) A faulty connection between the fan and the control box base: check terminals 9 and 5 (Fig. 3), or
(b) A fan motor failure, or
(c) A foreign body jammed in the fan blades.

The procedure laid down in para. 6.2.2. should be followed and the fan assembly removed. The control chassis can now be removed from the fan and the fan motor and fan runner withdrawn from the fan housing. The fan runner is fixed to the motor shaft by an allen screw. A new motor can then be installed. Care must be taken to position the runner on the motor shaft so that it does not foul the fan housing.

7.2.4. Ignition Failure

7.2.4.1. Ignition Transformer Failure

After the fan has completed its prepurge period of approximately 9 seconds the ignition spark should be heard from within the module. If this is not heard the igniter lead should be removed from the plug and with **the gas turned off,** the ignition coil can be tested by holding the lead approximately 4 mm from a convenient earth when a spark should be seen to occur after the fan prepurge time. If there is no spark, check the connection to terminal 1 (Fig. 3). If this is satisfactory, then the ignition transformer has failed and the control box (which contains the ignition transformer) must be replaced.

7.2.4.2. Igniter Failure

If a satisfactory spark is obtained from the ignition lead then the igniter assembly should be removed from the module. The lead should be reconnected to the plug and the igniter casting placed on a convenient earth. The sequence can now be started again. A spark should be seen between the electrode and the earth probe. If the spark is tracking to earth anywhere else but across the spark gap, the igniter assembly should be replaced.
Do not forget to turn on the gas before carrying out the rest of the procedure.

7.2.5. Gas Supply Failure

It has now been established that

(a) The electricity supply is satisfactory - para. 7.1.
(b) The thermostats are satisfactory - para. 7.2.1.
(c) The fan is satisfactory - para. 7.2.3.
(d) The ignition is satisfactory - para. 7.2.4.

If the burner does not light it is necessary to investigate the gas train.

7.2.5.1. Solenoid Valve Failure

If the burner fails to ignite it is now necessary to check that

(a) The gas supply to the modules is satisfactory. A manometer should be connected to the gas manifold test point (6 in Fig 4). With no modules running this pressure will be of the order of 15 mbar (6 in.w.g) to 22 mbar (9 in.w.g).

When the starting sequence has switched on the ignition and the gas valves opened this pressure should drop to 10 mbar (4 in.w.g). If it does not drop at all this indicates that the gas valves have not opened. In a multi-module installation when other modules are running the manometer should be connected to test point 7 (Fig. 4) when a reading of approximately 7.5 mbar (3 in.w.g) should be obtained. If no pressure occurs at point 7, the gas valves are not opening.

(b) The output from the control box should next be checked. The leads should be removed from the solenoid valves and connected to a voltmeter (the output from the control box is rectified 240 volts A.C.). A voltage reading should be obtained at the same time as the ignition spark is heard. If no reading is obtained then check the leads to control box terminal 7. If the leads are satisfactory the control box must be replaced. If a voltage reading is obtained and no gas pressure is read at test point 7 then the solenoid valves are failing to open and must be replaced.

7.2.5.2. Zero Governor Failure

The zero governor operation is shown diagrammatically in Fig. 4. Its operation can be checked by connecting both limbs of a manometer across test points 7 and 8 (Fig. 4). The difference between these pressures should be approximately 5.5 mbar (2.2 in.w.g) when the gas manifold pressure is 10 mbar (4 in.w.g). If the pressure difference is higher than this then there is insufficient gas being supplied to the burner, and if it is less than this then there is too much gas going to the burner. The amount of gas can be adjusted by altering the tension of spring 12. Increasing the tension by screwing down the lock-nuts reduces the amount of gas and vice versa. If, however, the burner should have been functioning satisfactorily it is necessary to check that the impulse lines 9 and 10 are not blocked; these should be removed and blown through. Impulse line 10 has a bend inside the boiler casing and its removal can only be accomplished by unscrewing the whole fitting from the casing.
The pressure from the fan which is transmitted by impulse line 9 should be approximately 0.92 mbar (0.38 in.w.g).
If it is found to be impossible to adjust the zero governor to give the requisite 5.5 mbar (2,2 in.w.g) pressure drop across it, then the governor must be replaced.

7.2.6. Flame Sensing Failure

If a flame is not established at the end of the flame proving sequence then the red lamp will not go off and the burner will lock out. It is possible however, that a flame is being established and that either the flame sensing probe has failed or the detection circuit in the control box has failed. In order to prove this it is necessary to remove the lead from the flame sensing probe and connect a D.C. micro-ammeter between the lead and the probe. The reading on the meter should be between 6 and 8 microamps D.C. If the reading is satisfactory and the burner goes to lock-out then the control box has failed and must be replaced. If the reading is not satisfactory the flame sensing probe must be removed from the module and examined. If it is damaged it must be replaced.

STELRAD GROUP Limited
PO Box 103, National Avenue
Kingston upon Hull.
North Humberside. HU5 4JN
Telephone: 0482 492251
Telex: 527032
H.0192(1) 12/78 Printed in England

IDEAL boilers