

INSTRUCTION MANUAL



Fulton Boiler Works, (Great Britain) Ltd.

MW
MACHINERY WORLD

SERIES 'E'

GAS FIRED

STEAM BOILER

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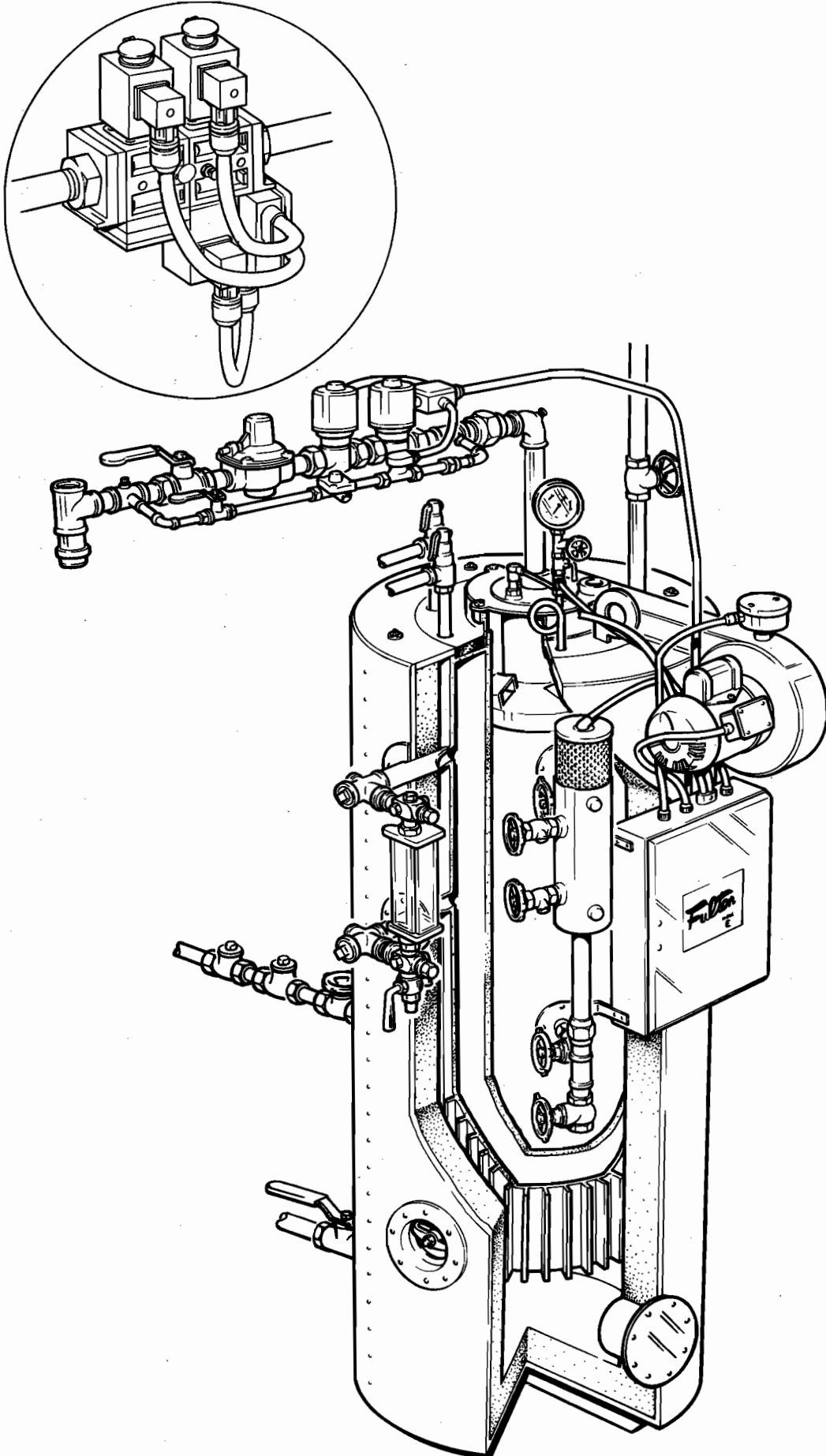


FIG. 1 GAS FIRED STEAM BOILER

INTRODUCTION

SECTION 1

1.1 General (Fig. 1)

The Fulton Series E Gas Fired Steam Boiler is a vertical two pass boiler of simple and efficient design and construction. Every care has been taken in the manufacture of the boiler to ensure that quality and reliability standards are maintained. However, satisfactory performance can only be ensured if the installation recommendations, operating routines and maintenance schedules laid out in this manual are adhered to.

1.2 Technical Data

	BOILER MODEL								
	4E	6E	8E	10E	15E	20E	30E	50E	60E
Performance									
Lbs/Hr (F & A 100°C)	140	210	280	350	525	700	1050	1750	2100
Kgs/Hr (F & A 100°C)	64	96	128	160	240	320	480	800	960
Firing Rates									
Approx. BTU input (000)	170	255	340	424	637	849	1273	2121	2546
Natural Gas 1035 BTU cu.ft. cu.ft./hr cu.m/hr	164 4.64	246 6.97	328 9.29	410 11.61	615 17.42	820 23.22	1230 34.83	2050 58.06	2461 69.70
Electrical Requirements									
Burner Motor hp	1/3	1/3	1/3	1/3	1/3	3/4	3/4	2	2
Burner Motor Output (W)	250	250	250	250	250	550	550	1500	1500
Burner Motor flc 415V	1.1	1.1	1.1	1.1	1.1	1.5	1.5	3.3	3.3
Feed Water Pump flc 415V	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.3	3.3
The full load current (flc) of the feed water pump motor can vary with the type and duty requirements of the pump supplied. The figures quoted above are given as a guide only.									
Miscellaneous									
Water Content (Imp Galls)	12	13	15	20	33	64	141	204	223
Water Content (Litres)	54	59	68	91	150	291	640	927	1022
Approx. Net Weight (lbs)	1500	1540	1590	1785	2130	3135	4480	6728	6944
Approx. Net Weight (Kgs)	680	700	720	810	965	1420	2030	3050	3150
Nat. Gas Head Pipe Size (in.)	3/4	1	1	1	1 1/4	1 1/4	1 1/2	2	2
Required Vertical Clearance (in.) (Floor to Ceiling)	71	81	85	87	93	96	108	112	118
Required Vertical Clearance (mm) (Floor to Ceiling)	1803	2057	2160	2210	2362	2438	2743	2844	2997

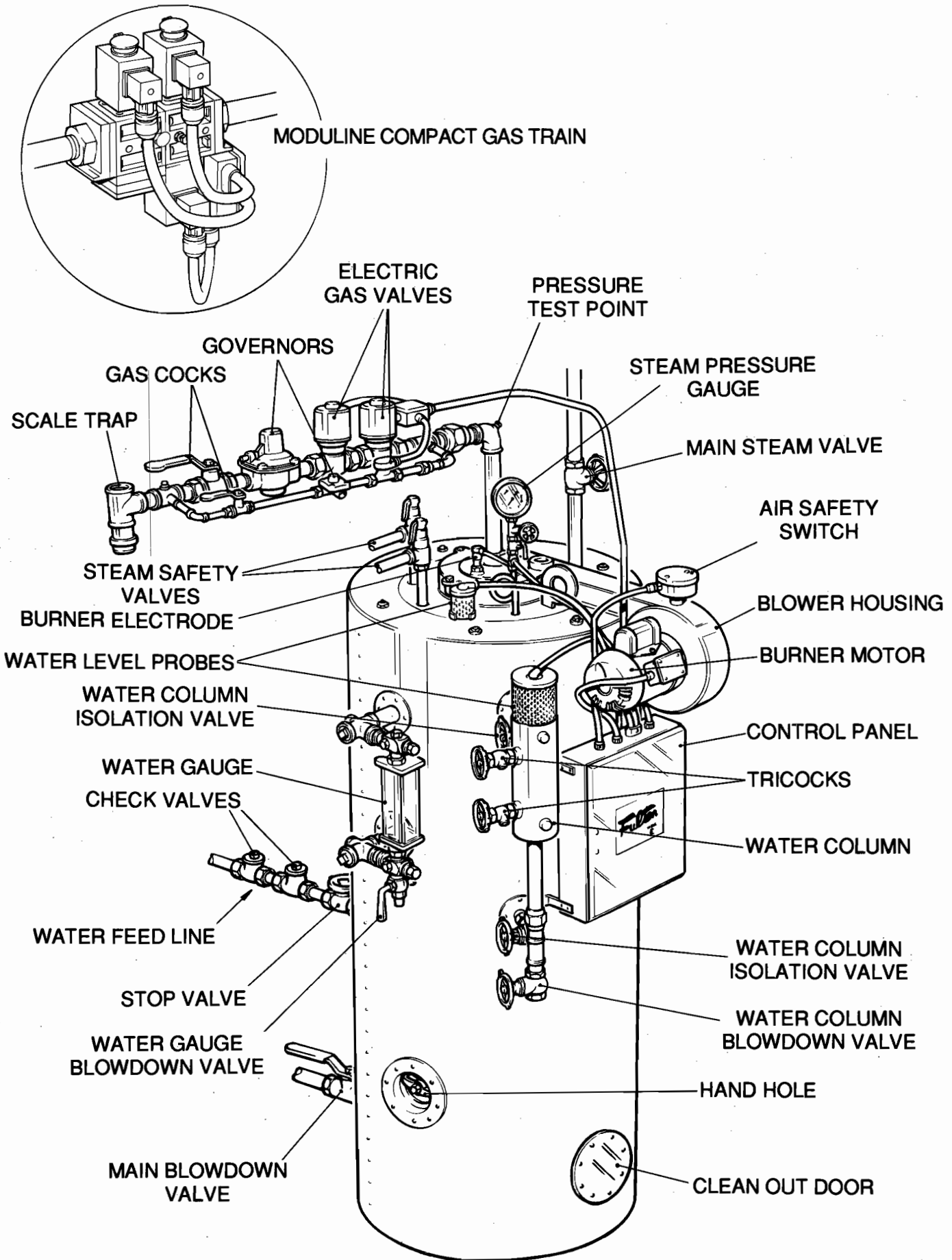


FIG. 2 GENERAL ARRANGEMENT

INSTALLATION

SECTION 2

2.1 General (Figs. 2 and 3)

The installation of a Series E Gas Fired Steam Boiler should be carried out by competent personnel in accordance with all relevant safety regulations. It is the responsibility of the installer to ensure that these regulations are complied with.

The requirements and instructions contained in this Section generally relate to the boilers being installed to operate on Natural or Manufactured Gas. Where the boiler is to operate on L.P. Gas, special reference should be made to Section 2.9 - Gas Supply.

2.2 Siting

The boiler house should be sufficiently large to allow easy and safe access to all parts of the boiler for operational and maintenance purposes. Reference should be made to Section 5 - General Data to ascertain the relevant dimensions and special note taken of the required vertical clearance.

The flooring must be level, laid in a non-combustible material and be of sufficient strength to support the boiler.

2.3 Ventilation

Fuel requires one square inch fresh air intake for 3000 BTU's to burn efficiently. It is essential, therefore, that adequate ventilation is provided to the boiler house to ensure the efficient operation of the boiler.

The following minimum vent sizes are required for the respective boiler size.

BOILER MODEL	VENT SIZE	
	IN ²	CM ²
4E	80	516
6E	90	580
8E	110	710
10E	140	903
15E	220	1420
20E	300	1935
30E	480	3097
50E	720	4645
60E	1080	6968

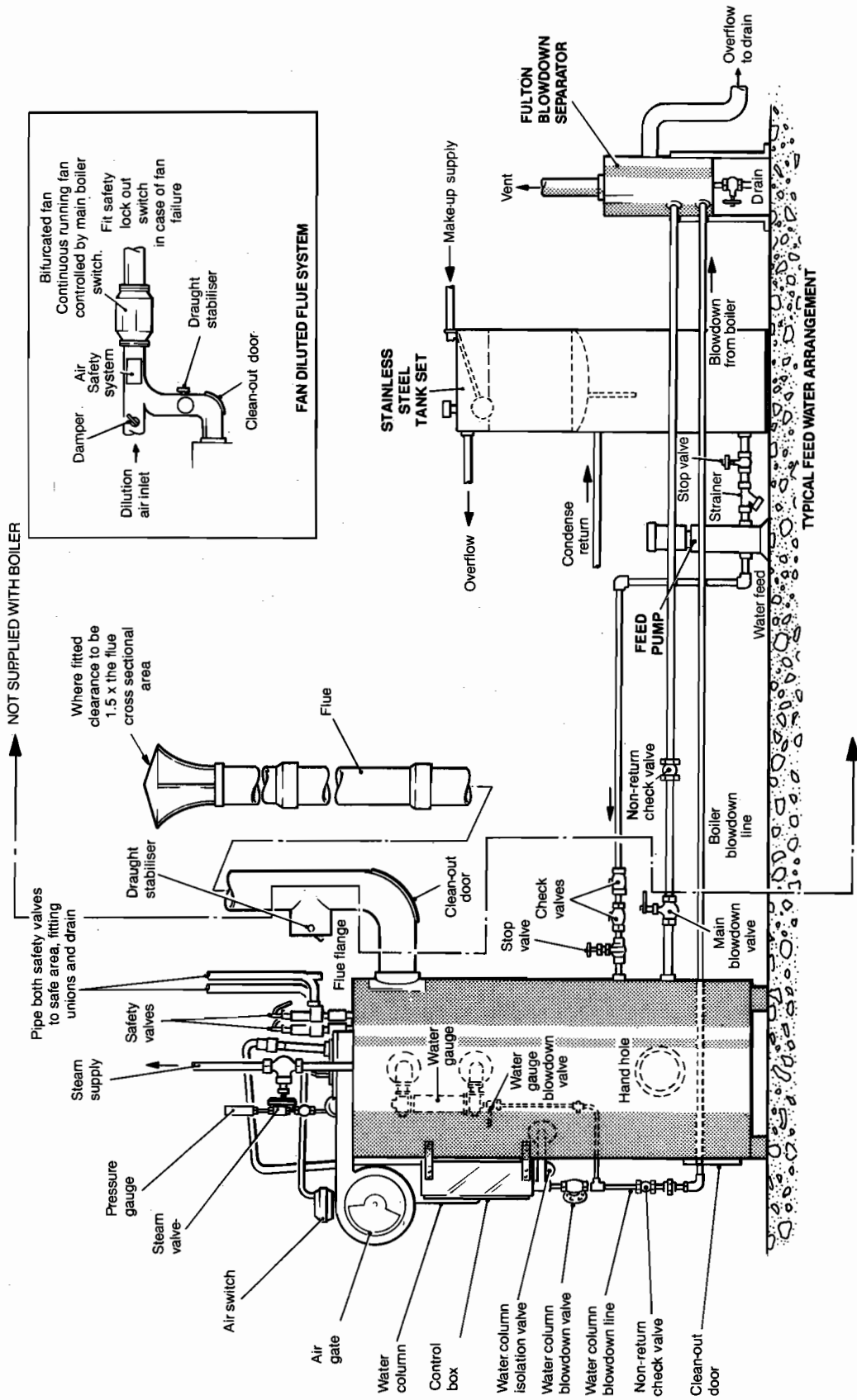


FIG. 3 TYPICAL INSTALLATION ARRANGEMENT

2.4 Flue Outlet

The height and type of flue will generally be subject to local planning regulations and approvals. The following information is intended to provide assistance where the installation of a simple flue is required. Where multi-boiler flues or difficulties are experienced, specialist advice should be obtained.

The flue diameter must be the same or larger than the flue flange provided with the boiler, and the outlet should be at least 2 ft. (610 mm) higher than the nearest ridge to avoid down draughts.

The flue standing draught should be from 0.01 in. (0.25 mm) to 0.2 in. (5.08 mm) of water column pressure with the boiler turned off. A draught stabilizer should be fitted at least 2 ft. (610 mm) from the elbow in the vertical position to enable this value to be obtained. Where a chimney cowl is fitted, care should be taken to ensure that the cross sectional area of the outlet is equal to at least 1.5 times the cross sectional area of the flue diameter.

2.5 Water Supply

The quality of the water used in the boiler will affect the life and performance of the boiler. It is strongly recommended that a reputable water treatment concern is consulted prior to commissioning the boiler. The following water conditions represent those which are considered desirable in the boiler.

<i>Total hardness in terms of CaCo3 (mg/L)</i>	<i>Max 2.</i>
<i>Caustic Alkalinity in terms of CaCo3 (mg/L)</i>	<i>350. ppm</i>
<i>Total dissolved solids (mg/L)</i>	<i>2500 ppm</i>
<i>PH value</i>	<i>8 to 10.</i>

Connect the feed water pump to the boiler with 1 in. bore pipe and insert the stop valve and check valves supplied.

2.6 Blowdown Valves

There are three blowdown valves on the boiler; the main valve at the rear of the boiler, the water column blowdown valve and the water gauge blowdown valve. All of these valves must be connected to a blowdown receptacle of approved design. Regulations exist covering such items and care must be taken to ensure compliance with these regulations. If in doubt regarding blowdown arrangements, consult your Fulton agent.

2.7 Main Steam Valve

The main steam stop valve should be inserted in the steam line approximately 12 in. from the top of the boiler

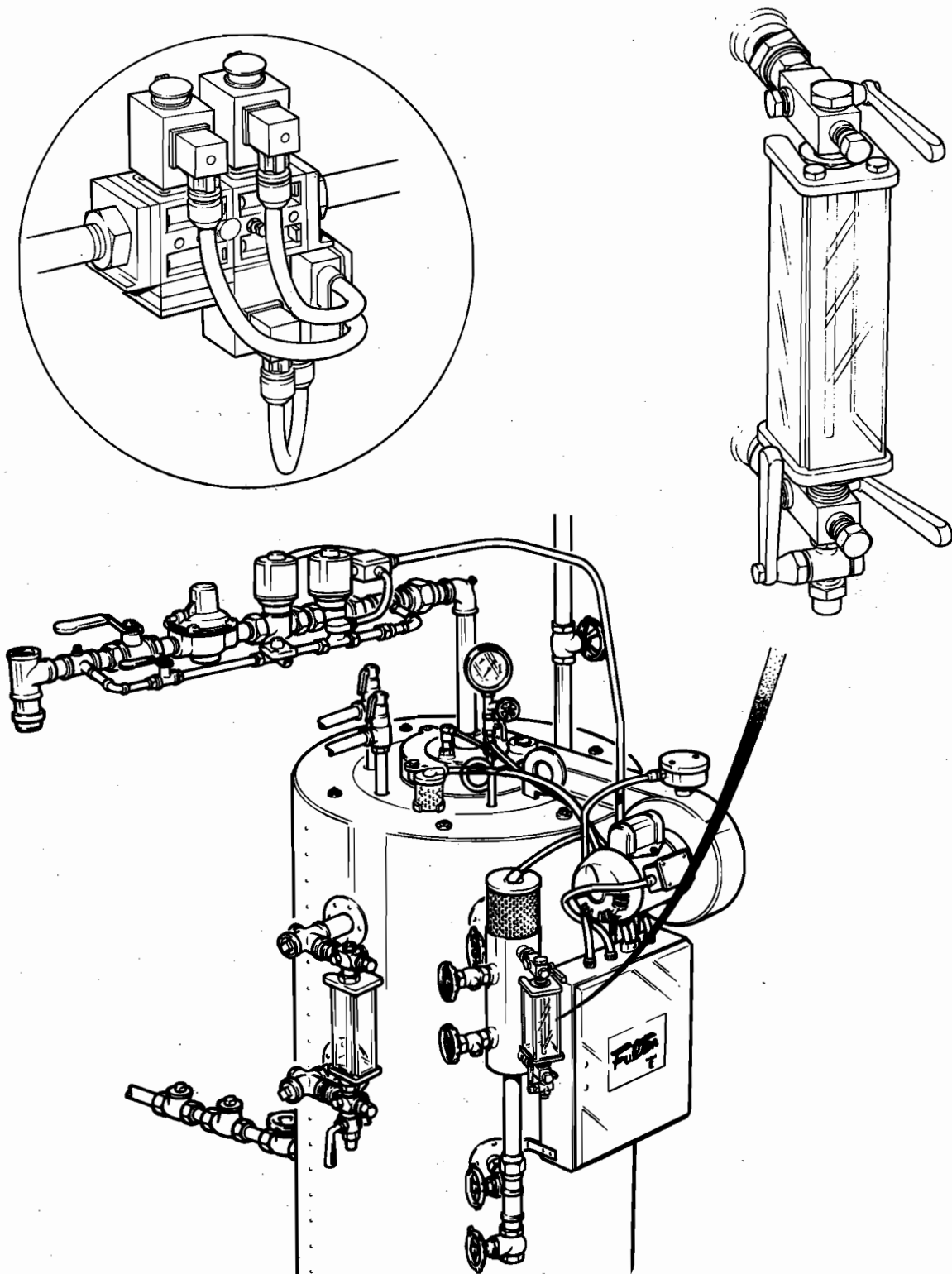


FIG. 4 WATER GAUGE SET AND MODULINE COMPACT GAS TRAIN

2.8 Steam Safety Valves

Mount each of these valves on a standout pipe approximately 6 in. (155 mm) long. The discharge outlets should be piped to a safe discharge point and the piping so arranged that any condensate trapped in the pipework will drain away from the valve.

2.9 Water Gauge Set

Boiler models 4E to 30E are supplied with one complete water gauge set. This gauge should be fitted as illustrated, Fig. 4.

Boiler models 50E and 60E are supplied with two complete water gauge sets. These gauges should be fitted as detailed.

2.10 Gas Supply

Verify that the burner is suitable for the type of gas being supplied.

Refer to Section 5 for the correct size of piping required.

To avoid pressure drops, eliminate all unnecessary bends and elbows in the pipework between the gas meter and the boiler. A scale trap is provided on the gas train and should be used.

Burners suitable for operation on natural and manufactured gas are supplied with gas trains which are fitted with pressure regulating governors. No additional pressure regulating devices should be required.

A minimum pressure of 7 in. (17.5 mb) water column is required at the gas train for natural gas installations and a minimum pressure of 5 in. (12.5 mb) water column is required at the gas train for manufactured gas installations. Burners arranged for operation on L.P. gas are supplied with gas trains which include a pressure regulating governor. It is essential that the MAXIMUM pressure of the gas at the gas train does not exceed 27 in. (67 mb) water column and does not fall below 20 in. (50 mb) water column. To obtain these pressures a pressure regulating device must be fitted to the supply line from the storage tank to the boiler gas train.

2.11 Electrical Requirements

Typical schematic wiring diagrams are included in Section 5 of this manual and the specific diagram relating to the boiler is attached to the inside of the control panel box.

The audible alarm bells supplied must be mounted in a position where they can be heard by a person competent to take the appropriate action should the alarm be activated. Unless otherwise specified, the alarms supply will be mains voltage models.

Unless otherwise specified all models are supplied with burner motors and feed water pump motors arranged for operation on a three phase supply.

The power ratings and requirements are given in Section 1.1 - Technical Data.

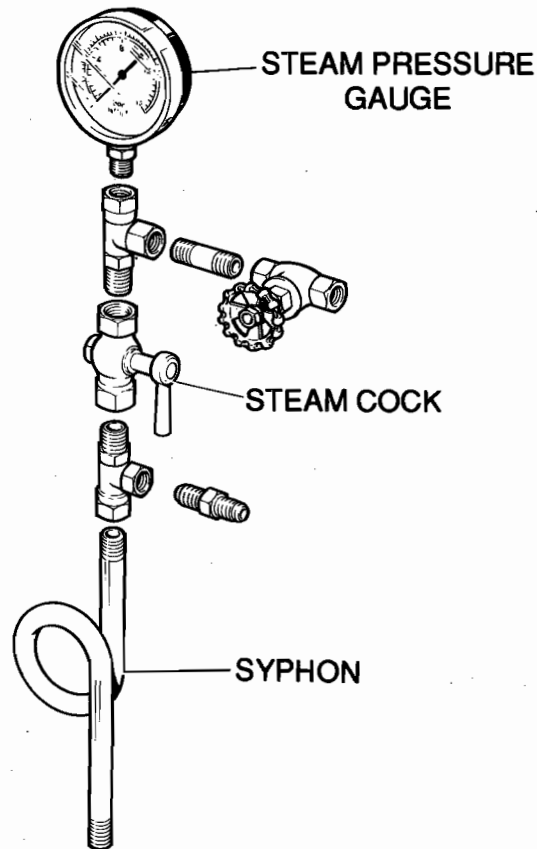


FIG 5 STEAM PRESSURE GAUGE

2.12 Steam Pressure Gauge (Fig. 5)

The steam pressure gauge assembly should be assembled in accordance with the illustration using a sealant on all joints.

Screw the assembly into the top of the boiler and connect the copper tube from the control panel box to the nipple provided on the assembly.

2.13 Commissioning the Boiler (Fig. 6)

We recommend that the commissioning procedures listed below are carried out only by a recognised Fulton agent who will have the necessary experience and testing equipment to ensure that the installation is not only correct, but is operating at maximum efficiency.

INSTALLATION

- (1) Examine the probes in the water column and the boiler shell. Replace any damaged probe.
- (2) Remove the burner and check that the electrodes have not been damaged and that their setting corresponds to the appropriate drawing (refer to Fig. 7). If the burner is fitted with an ultra-violet scanner, remove and check for damage.
- (3) Check that the burner is the correct type for use with the gas being supplied.
- (4) Ensure that all wiring connections are correct and that all terminal screws are tight

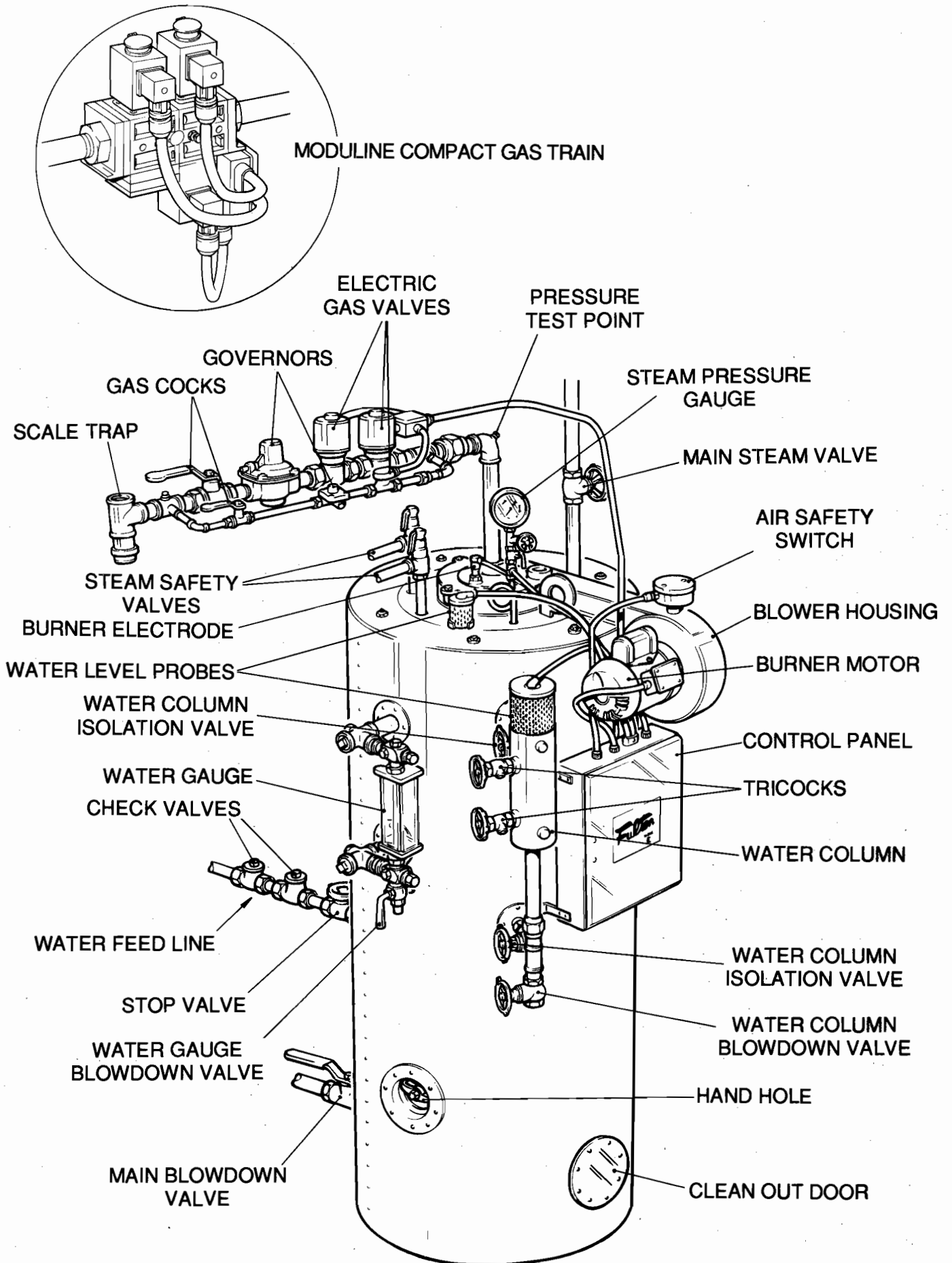


FIG. 6 COMMISSIONING THE BOILER

(5) Insert a micro-ammeter into the meter jack on the burner programmer.

(6) It is assumed that a barometric type draught regulator has been installed in the flue. This should be set for a draught of minus 0.01 to 0.02 in. of water column pressure with the burner off.

(7) Open all valves in the water feed line. Switch on the feed water pump motor and fill the boiler, see Section 3 - Operation. The operation of the pump controls should be checked by using the isolating valves provided to isolate the water column when the pump has filled the boiler to the correct level, i.e. approximately half way in the sight glass. Then open the water column blowdown valve slowly. Avoid creating a vacuum by opening one of the tricocks.

When the water level falls below the level of the "Pump-on" probe, the pump should start. If it does not, then it is probable that the probes are incorrectly connected. Close the blowdown valve and tricock and open the isolation valves.

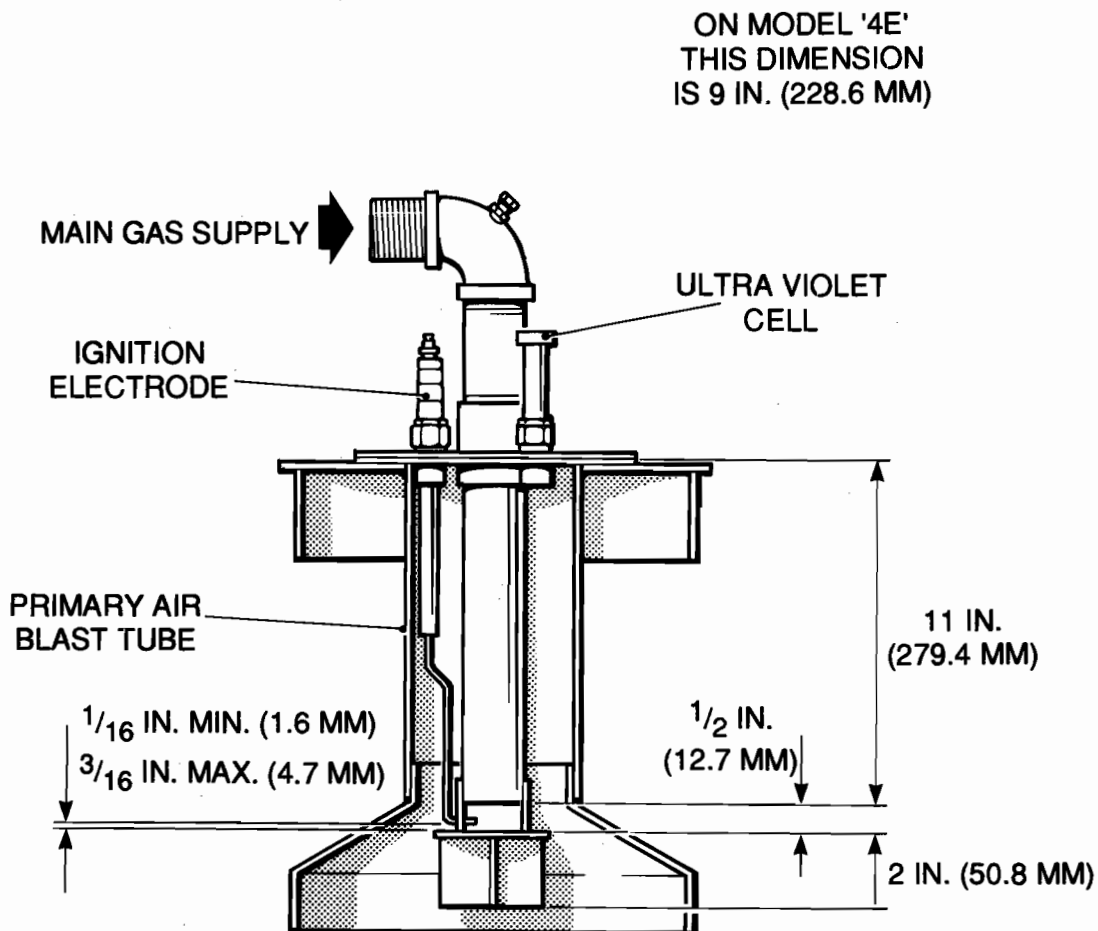


FIG. 7 BURNER ELECTRODE SETTINGS

(8) After purging the gas lines of air, start the burner as detailed in Section 3 - Operation. Check the readings on the micro-ammeter for the pilot and main flames, adjusting the primary air control to obtain the maximum readings.

(9) Adjust the main air control gate to obtain a clean combustion.

(10) Observe the flame through the peephole between the electrodes and adjust the primary air control so that the flame cannot be seen "backing up" the blast tube.

(11) Check the operation of the low water safety controls as detailed in Section 3 - Operation.

(12) Adjust the steam pressure control to suit the boiler application.

If the pressure control is fitted with a differential scale

(a) Set the main scale to the maximum pressure required.

(b) Set the differential scale to give the required pressure differential between the boiler cutting out and restarting. If the pressure control has a fixed differential, i.e. no adjustable differential scale, set the main scale to the maximum pressure required.

2.14 Cleaning Steam Lines and Pressure Vessel

During the first week of boiler operation, clean all oil and dirt from the boiler, the steam line and the condensate return line. To do this, carry out the following procedure:

(1) Disconnect the condensate return pipe from just before the condensate return tank.

(2) Direct the returns to a floor drain or other safe discharge point and make safe.

(3) Leave in this position for one week to allow all impurities to flush through.

(4) Each day drain the boiler completely.

(5) After the week is completed, drain and flush the condensate return tank, removing all installation sediments. Also reconnect the condensate return pipe to the condensate return tank

Installation engineers and operators should observe the following general rules:

2.14.1 Ventilation:

(1) Ensure that there is adequate ventilation in the boiler room. Inefficient ventilation will create a high temperature and cause control knock-out.

(2) Do not keep exhaust fans running with windows, doors and vents closed - this will interfere with the necessary boiler draught.

(3) Do not store chemicals such as perchlorethylene in the boiler house, the fumes may damage the boiler and flue and cause the burner to lock out on flame failure.

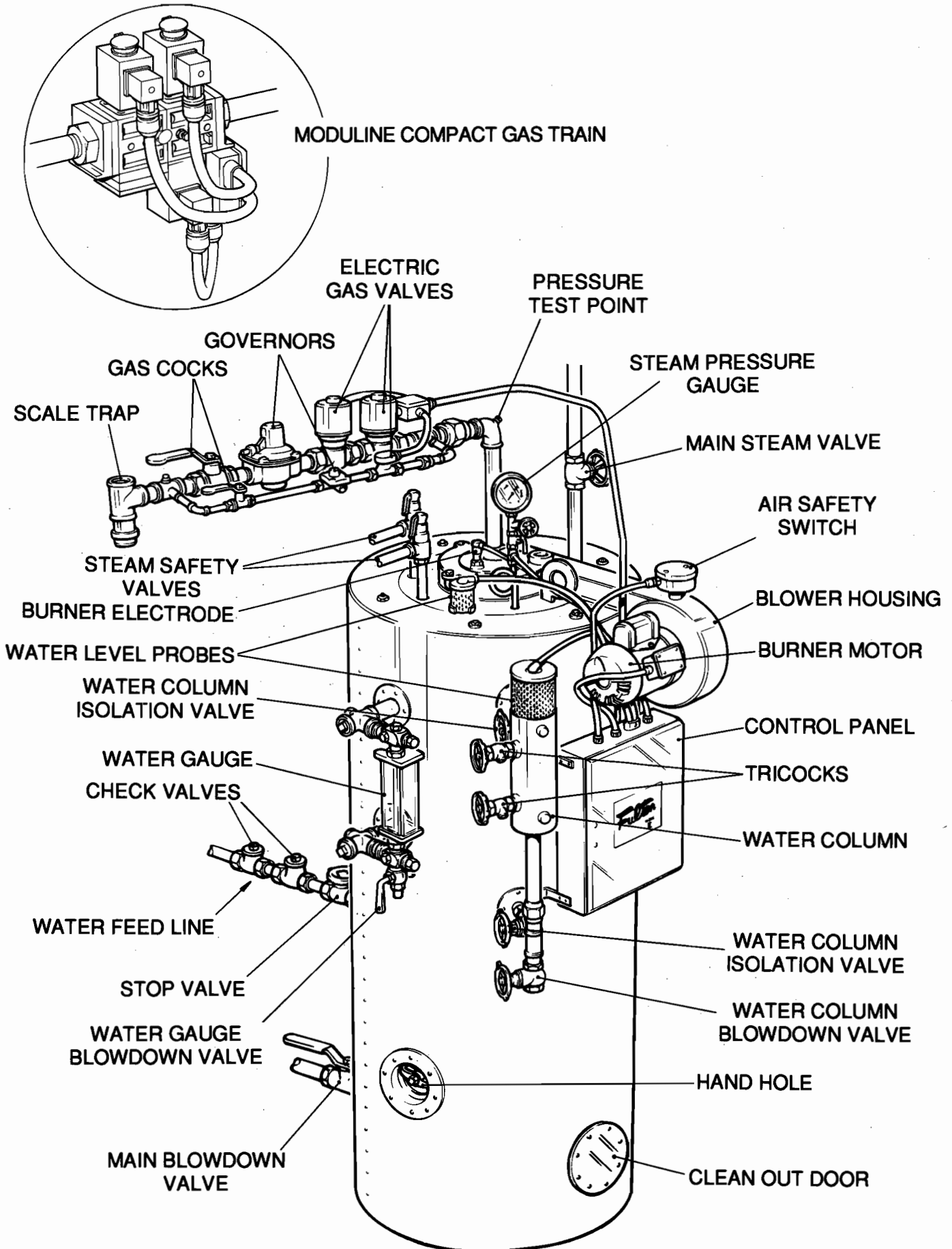


FIG. 6 COMMISSIONING THE BOILER

2.14.2 Boiler Flue:

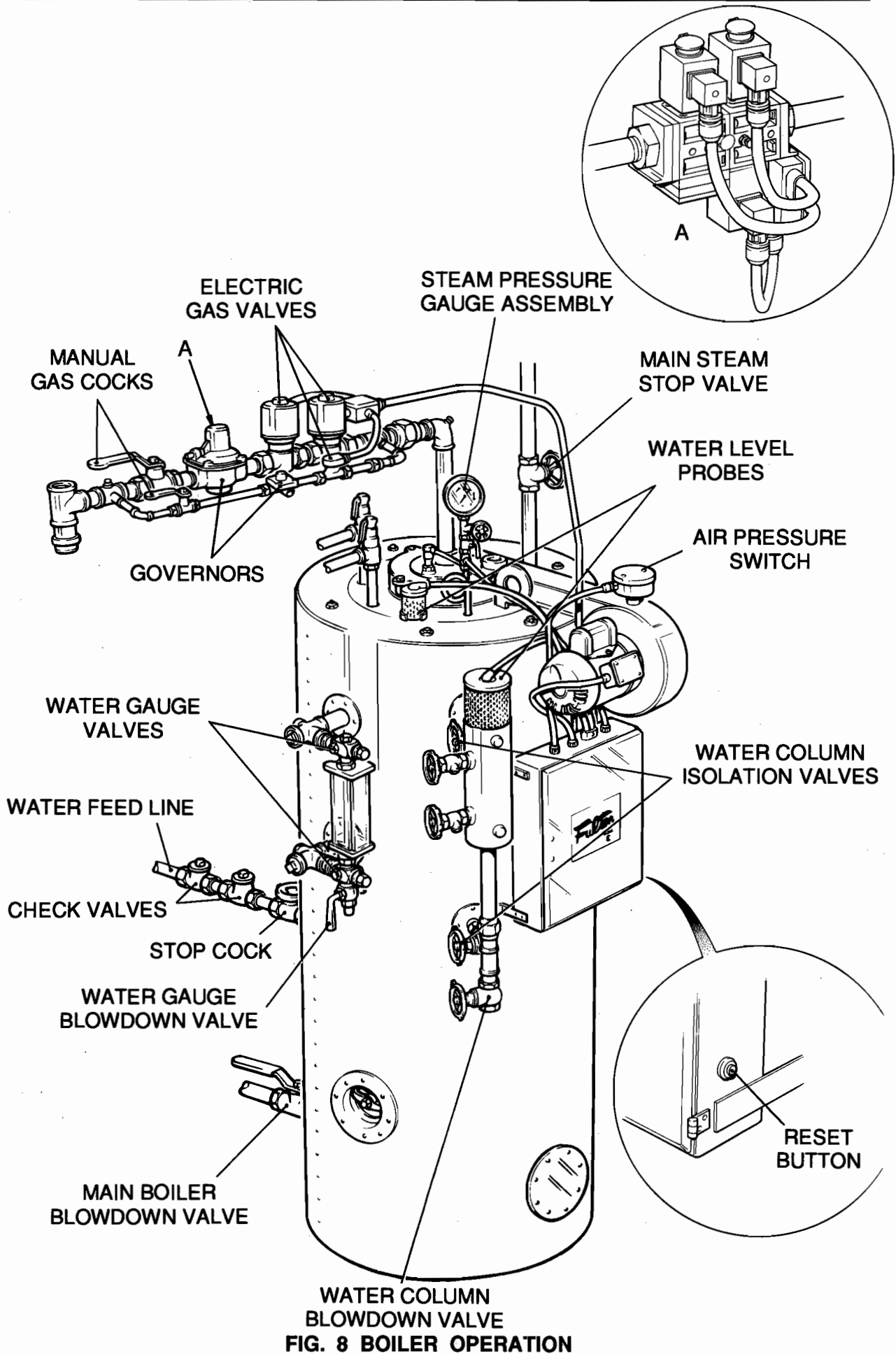
- (1) Avoid fitting 90° elbows wherever possible, otherwise compensation of increased flue diameter may be necessary.
- (2) Make sure that all pipes from the boiler to the main flue are at a rising pitch of 15° min.
- (3) Make sure that the size of the flue is not less than the bore of the flange at the boiler.

2.14.3 Gas Supply:

- (1) Make sure that the piping from the meter is the correct size.
- (2) Make sure that a gas cock is inserted in the gas line between the boiler and the meter.
- (3) Make sure that the scale traps are used.

2.14.4 Plumbing:

- (1) Fit two check valves between the feed water pump and the boiler.
- (2) Ensure that the boiler is washed out after installation and before it is put into service.
- (3) Do not operate the boiler before conducting a water analysis.



SECTION 3

3.1 General (Fig 8)

The following instructions are given for the guidance of the operator in the use of the Series E gas fired boiler and to provide adequate information to ensure that, when the boiler is put into use, it will be done safely and without risk to health.

3.2 Boiler Controls

The following brief description of the controls used on the Series E gas fired boiler is intended to provide the operator with a basic understanding of the operating principles, which is essential for the continued efficient operation of the boiler.

Note: All the controls are of the 'fail-safe' type and are wired in series; failure of any one will automatically shut down the boiler.

For the operational sequence, refer to the wiring diagrams in Section 5 - General Data.

(1) **LOW WATER SAFETY RELAYS and FEEDWATER PUMP RELAYS.** These relays operate in conjunction with probes suspended in the boiler and water column to maintain automatically the level of the water in the boiler and to cut off the burner should the water fall to an unsafe level.

(2) **STEAM PRESSURE CONTROL.** Located in the control panel box and connected to the steam pressure gauge assembly by means of a copper tube. The pressure regulator controls the on/off cycle of the burner, shutting the burner off when maximum pressure is reached and switching on when the steam pressure falls.

(3) **BURNER PROGRAMMER.** This is the main control in the panel box. The programmer in conjunction with a sensing device, either a flame rod or an ultra-violet scanner, 'supervises' the ignition sequence, proves the flame is satisfactory and finally 'monitors' the established flame. Should any fault occur, either during the ignition sequence or during normal running, the programmer will immediately go to 'lock-out' and both main and pilot gas valves will be closed.

(4) **AIR PRESSURE SWITCH.** Mounted on the burner scroll, this switch is operated by the pressure of air entering the burner through the throat of the scroll. absence of air, or insufficient pressure, will prevent the switch completing the circuit thus preventing the burner from operating.

(5) **GAS HEAD ASSEMBLY.** Consists of pilot and main gas supply lines, each line having a manual gas cock, a governor and electrically powered gas valves. The governors maintain a constant pressure of gas entering the burner and are adjustable. The electrically powered gas valves are controlled by the burner programme.

NOTE

Some models of the Gas Fired Boiler are fitted with a Compact Modular Gas Train, comprising two mechanical valves activated by electrical solenoids, The Start Gas valve has two solenoids fitted identified VS for Start Gas and V1 for Normal Running, the second valve has one solenoid identified V1 and a Gas Regulator fitted.

Adjustments in gas flow are provided for Start Gas by an adjuster located under the cap on solenoid VS and for Normal Running by an external adjuster located on the Gas Regulator.

System pressure can be tested by means of a test point provided in the Start Gas valve.

3.3 Starting the Boiler, All Models (Fig. 8)

Carry out the following procedure on the initial start up of the boiler and on every subsequent occasion when restarting the boiler after a shut down.

- (1) Open the main steam stop valve at the top of the boiler.
- (2) Open all the valves in the water feed line.
- (3) Open the water column isolating valves.
- (4) Open the water gauge valves.
- (5) Close the boiler, water column and gauge glass blowdown valves.
- (6) Switch on the feed water pump motor.

Note: The pump will continue to operate until the water reaches the correct level in the boiler.

3.4 Starting the Burner, Models 4E to 30E (Fig. 8)

Start the burner as follows:

- (1) Open all the valves in the gas mains supply to the boiler.
- (2) Open the manual gas cocks on the Pilot and Main lines of the gas head.
- (3) Open the control panel box and press the button on the burner programmer (this is the control in the middle of the box). Close the control panel box.
- (4) When the boiler has filled with water, and not before, switch on the electrical mains supply to the burner.
- (5) The Low Water alarm will sound and continue to do so until the green Reset button on the side of the panel box is pressed.
- (6) The burner motor will now start and, after a delay of approximately 46 seconds, the burner will fire.
- (7) After the burner has ignited, it will be controlled (through an on/off cycle) by the pressure control in the panel box.
- (8) The Low Water control will shut down the burner immediately the water in the boiler drops to an unsafe level. When this happens, the burner can only be restarted by pressing the green button on the side of the control panel box.

3.5 Starting the Burner, Models 50E and 60E (Fig. 8)

To start the burner, proceed as follows:

- (1) Open all the valves in the main gas mains supply to the boiler.
- (2) Open the manual gas cocks on the Pilot and Main lines of the gas head.
- (3) Open the control panel box and press the Reset button on the burner programmer.
- (4) When the boiler has filled with water, switch on the electrical mains supply to the burner.
- (5) The low water alarm will sound and continue to do so until the green Reset button on the control panel is pressed.
- (6) The burner motor will not start and, after a delay of approximately 45 seconds, the burner will fire (6).

3.6 Setting the Burner for Low Fire/High Fire, Models 50E and 60E (Fig. 9)

The correct settings for low fire/high fire operation are obtained by making adjustments to (1) The two stage solenoid valve (Fig. 9) and (2) The low fire steam pressure switch. Proceed as follows:

- (1) Set the gas input to the boiler for correct input on high fire. This should be done where possible by using the gas meter. Adjust the main air gate and top damper adjustment to obtain optimum combustion conditions.
- (2) Adjust the low fire steam pressure switch to cut out at approximately 15 psi below the setting of the main steam pressure control (See Section 2.12 (12)).
- (3) Adjust the two-stage solenoid valve (Fig. 9) to obtain a low fire gas input of approximately 80% of high fire. Leave the air gate adjustments as for high fire.
- (4) Refer to the adjusting procedure on the two-stage solenoid valve (Fig. 9) for securing.

3.7 Two-Stage Solenoid Valve Adjusting Procedure

Low Fire

- (1) Slacken the cheese-headed screw one turn.
- (2) Rotate the hydraulic brake to set the required gas flow rate.
Volumetric flow rate can be adjusted up to 40%.
Clockwise rotation reduces the gas flow rate.
Counter-clockwise rotation increases the gas flow rate.
- (3) Retighten the cheese-headed screw.

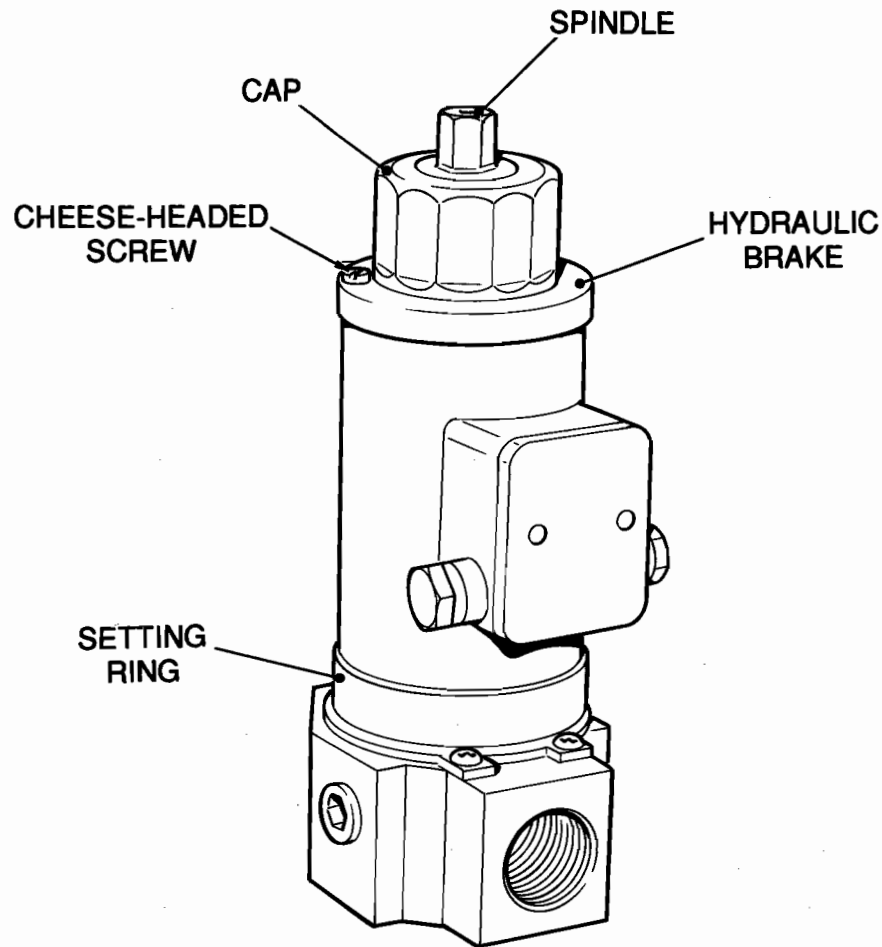


FIG. 9 TWO-STAGE SOLENOID VALVE

High Fire

- (1) Slacken the cheese-headed screw one turn.
- (2) Rotate the setting ring, using a tommy bar in the holes, to set the gas flow rate. Clockwise rotation reduces the gas flow rate. Counter-clockwise rotation increases the gas flow rate.
- (3) Retighten the cheese-headed screw.

Rapid Stroke

- (1) Remove the cap.
- (2) Using the cap in reverse, rotate the setting spindle. Clockwise rotation reduces the rapid stroke. Counter-clockwise rotation increases the rapid stroke.
- (3) Replace the cap.

3.8 Indicator Lights, Models 50E and 60E

Indicator lights are fitted to the control panel as an additional aid to the operator. The meaning and operating sequence of these lights is as follows:

- (1) **BURNER CIRCUIT ON.** Indicates that power is being supplied to the feedwater pump controls. This light should remain on whilst the boiler is operational.
- (2) **PUMP CIRCUIT ON.** Indicates that power is being supplied to the feedwater pump controls. This light should also remain on whilst the boiler is operational.
- (3) **LOW WATER ALARM.** Together with the audible alarm, this light will be energised immediately the burner circuit is switched on. The green Reset button must be pressed to start the burner and cancel this alarm. Should this light or the audible alarm be energised at any other time, a low water condition is indicated. The low water controls cannot be reset until the water in the boiler has been restored to a safe level.
- (4) **PILOT VALVE ENERGISED.** This is a visual indication that the pilot valve has been energised. It does not indicate that the valve is open. Approximately 46 seconds after the burner motor starts, this light will be energised and will remain energised whilst the burner is firing.
- (5) **MAIN VALVES ENERGISED.** This also is a visual indication that the main valves have been energised. This light will come on after approximately 50 seconds of the ignition cycle and will remain on whilst the burner is firing.
- (6) **FLAME FAILURE.** Connected directly to the burner programmer, this light will be energised immediately the programmer goes to the lockout position following flame failure. This light will remain on until the programmer has been reset.
- (7) **HIGH FIRE, LOW FIRE.** These lights provide a visual indication of the operational state of the burner.

3.9 Daily Operating Tests

The following procedure should be carried out by a competent person to ensure the correct functioning of the water level and low water cut-off controls.

THE BOILER MUST NOT BE UNDER STEAM PRESSURE DURING THESE TESTS.

WATER LEVEL LOW WATER SAFETY CONTROLS AND AUDIBLE ALARM:

- (1) Switch on the feed water pump and burner circuits.
- (2) Start the burner.
- (3) Close the bottom water column isolation valve.
- (4) Slowly open the water column blowdown valve and drain the water column.
- (5) As the level falls, the feed water pump will start, the burner will shut down and the alarm will sound.
- (6) Close the blowdown valve and re-open the isolation valve. When the level of water in the column has been restored, restart the burner using the green Start button.

OVER-RIDING LOW WATER CONTROL:

- (1) With the burner firing, close the bottom water column isolating valve.
- (2) Slowly open the boiler blowdown valve. As the level of water in the boiler drops (visible in the gauge), the burner will shut down and the alarm will sound.
- (3) Close the blowdown valve and open the isolating valve. The pump will automatically restore the level of water in the boiler and the burner can be reset.

3.10 Boiler Blowdown Procedure (Fig. 10)

Keep the boiler, water gauge, water column and inter-connecting pipework free from sludge and scale build up by blowing down in the following manner:

- (1) Start the boiler and generate not more than 10psig of steam, then shut off the burner.
- (2) Fully open the boiler blowdown valve for not more than 10 seconds. Close the valve.
- (3) Blow down each arm of the water column in turn by closing one isolation valve at a time and blowing down by opening the water column blowdown valve.
- (4) Blow down the water gauge set by opening the blowdown valve and closing the top and bottom gauge valves B and C in sequence.
- (5) Where a boiler is operating continuously at steam pressure or using water treatment additives, advice should be taken as to the appropriate blowdown procedure.

On completion of the blowdown procedure ensure that all isolation valves are open and all blowdown valves are closed.

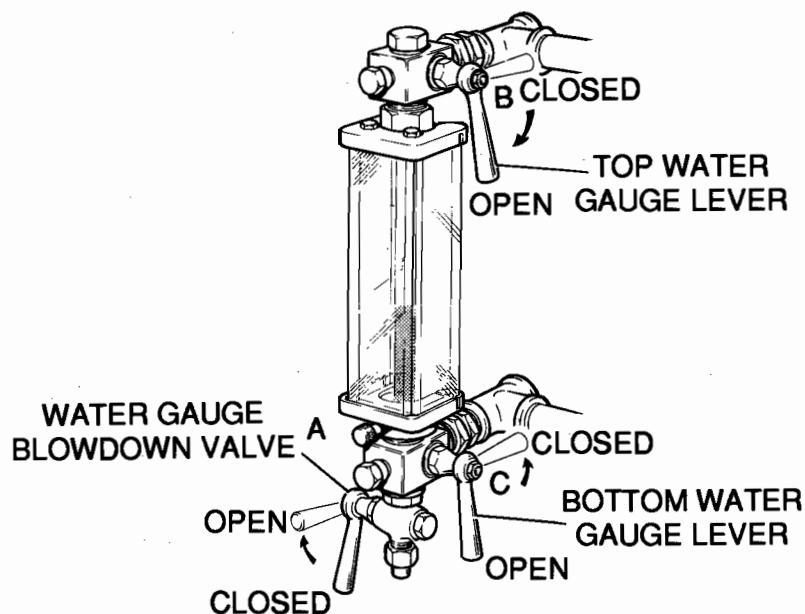


FIG. 10 BLOWDOWN SEQUENCE

	Burner will not Start	Flame Failure	Low Water Alarm	Poor Comb'n	Boiler will not Maintain Press.
Power Supply	X	X			
Gas Supply	X	X		X	X
Refractories				X	
Ignition Electrode	X	X			
Pri Air Adjustment		X		X	
Sec Air Adjustment		X		X	
Transformer	X	X			
Low Water Probes	X		X		
U/V Cell		X			
Low Water Safety Relay	X		X		
Water Level Relay	X		X		
Pressure Control	X				X
Draught				X	
Steam Overload					X
Feedwater Pump	X		X		
Burner Programmer	X	X			
Burner Motor	X	X		X	
Contam. Feedwater			X		
Feedwater Too Hot			X		
Dirty Flues				X	X

FAULT FINDING CHECK LIST

SECTION 4

4.1 General

To ensure the efficiency of the boiler, carry out the regular maintenance instructions detailed below.

If any fault is found during these operations contact your Fulton representative.

Note: It is essential that regular checks are made to ensure that scale build-up is not taking place within the boiler, such checks will ensure that water treatment being applied to the boiler feed water is effective.

The lower hand hole doors should be removed after one month of operation and the interior of the boiler thoroughly examined. If scale or sludge build up is observed the water treatment supplier should be advised.

Subsequent interior examinations should be carried out on a regular basis until satisfactory conditions are observed. Thereafter inspections should be carried out at three monthly intervals.

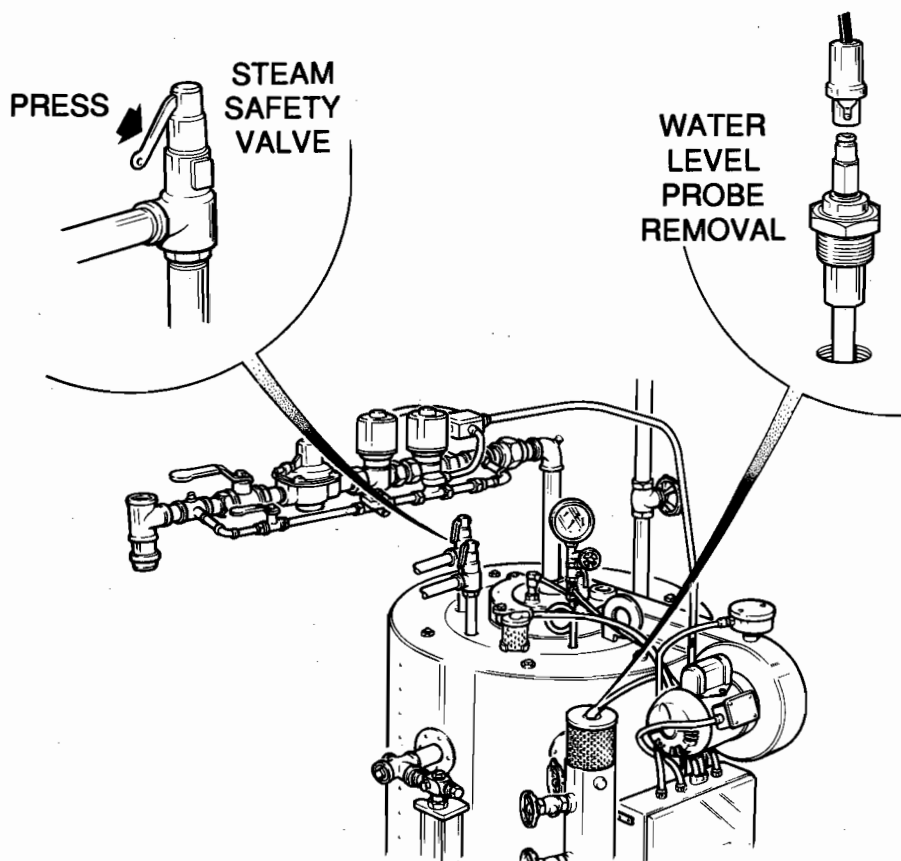


FIG. 11 BOILER MAINTENANCE

4.2 Weekly (Fig. 11)

- (1) Make sure that the pipes from the safety valve outlets are not damaged and that they continue to a safe blow-off point.
- (2) With the boiler under pressure, open the boiler steam safety valves by pressing the relief lever.
- (3) In addition to carrying out the daily operating tests described in Section 3 - Operation, the water level and safety cut-off controls should be tested under operating conditions by interrupting the water feed supply.

To carry out this test, switch off the power supply to the feedwater pump and lower the water level in the boiler by evaporation. As the level of water falls, the burner should shut down and the alarm sound.

On completion of this test, switch on the power supply to the feedwater pump and check that the water level is restored to normal.

4.3 Monthly (Figs. 12 and 13)

- (1) Blow down the boiler and water column completely.
- (2) Inspect the hand holes in the boiler. If any leakage is evident, the faulty gasket must be renewed. Refer to Fig. 12 and, providing the replacement gasket is a genuine Fulton component, proceed as follows:
 - (a) Using the special tee handle wrench, remove the hand hole assembly as shown on Fig. 10.
 - (b) Remove the old gasket and thoroughly clean the faces on the plate and boiler surface.
 - (c) Fit the hand hole assembly as follow:
 - (i) Place the gasket on the hand hole plate and ensure that it is seating correctly. Do not use any grease, lubricant or adhesive.
 - (ii) Position the plate in the boiler, set the crab and tighten the securing nut sufficiently only to provide a snug fit. Verify the position of the plate in the boiler, then tighten the nut hand tight only. Using the special wrench tighten the nut a further quarter of a turn. **DO NOT OVERTIGHTEN.**
 - (d) If the gasket leaks as the pressure is building up, tighten the securing nut only sufficiently to stop the leakage.
- (3) Clean the sight glass. If any leakage is evident, renew the faulty gasket.

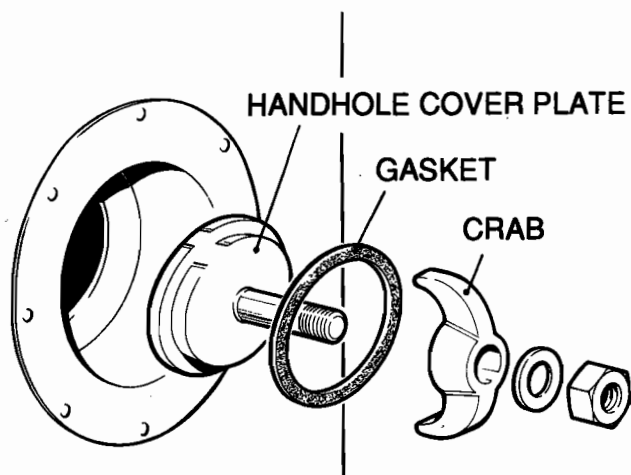


FIG. 12 REMOVAL OF HANDHOLE FITTING

(4) Referring to Fig. 13, disconnect the gas head from the burner by unscrewing the union and removing the burner plate screws. Withdraw the burner assembly and clean the ignition electrodes and reset. If an ultra-violet cell is fitted, check that the lens is clean.

4.4 Three Monthly (Fig. 12)

(1) Drain and isolate the boiler.

(2) Remove the lower hand hole assemblies and inspect the interior of the pressure vessel for scale and sludge build up. (See 4.1).

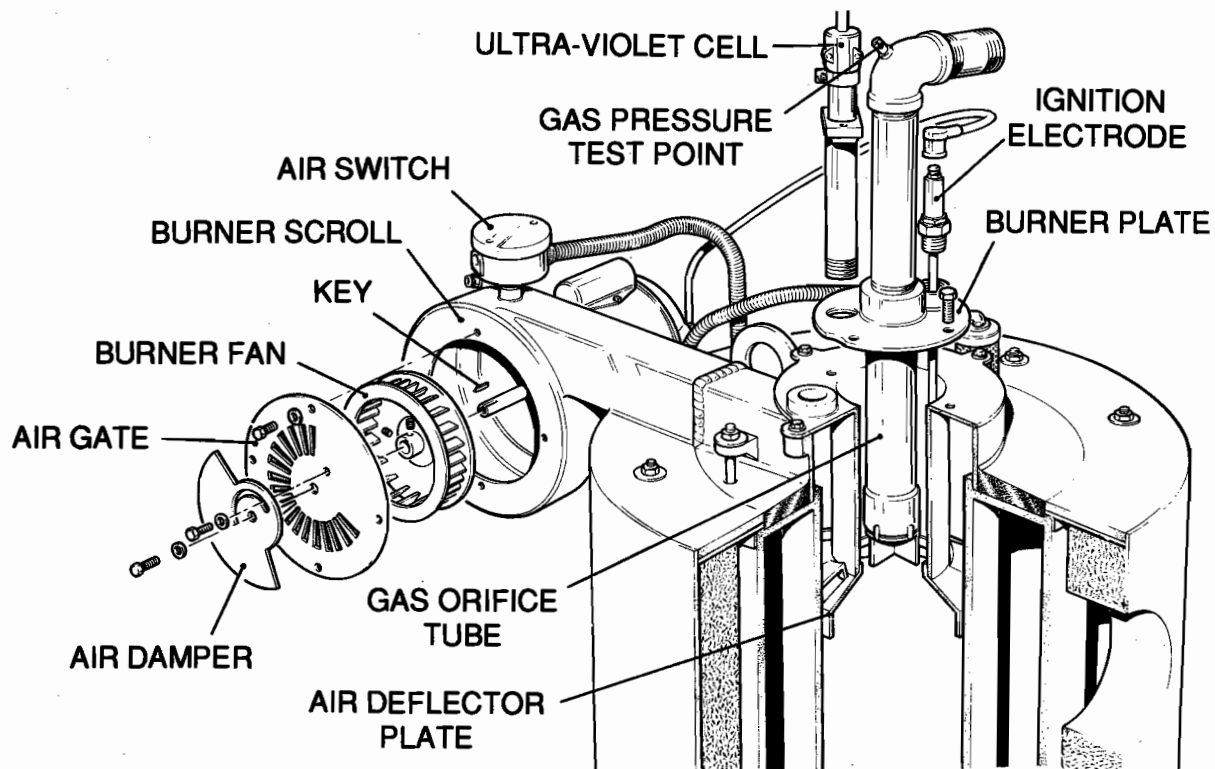


FIG. 13 BURNER ASSEMBLY

4.5 Six Monthly (Fig. 12)

It should be noted that after a Fulton boiler has been in operation for several months, pieces of burned metal will be found in the space at the bottom of the boiler. These pieces of metal are the remains of a light gauge metal form which was used during manufacture for forming the boiler insulation. This is a normal condition and does not affect the efficiency or the life of the boiler in any way.

- (1) Remove the cover plates and clean out door (Fig. 14). Clean out the flue passes. When replacing the cover plates and clean-out door, use furnace cement to ensure a tight seal, thus preventing the escape of hot gases.
- (2) Apply a small quantity of oil to the bearings of the burner motor and the feed water pump motor.
- (3) Drain and flush the feed water tank. Clean any filters in the tank, in the feed water line or in the feed water pump.
- (4) Remove and clean the water electrodes, take care not to crack the porcelain. After replacement, check the operation of the low water cut-off relay and of the feed water pump.
- (5) Remove the air gate and clean the fan.

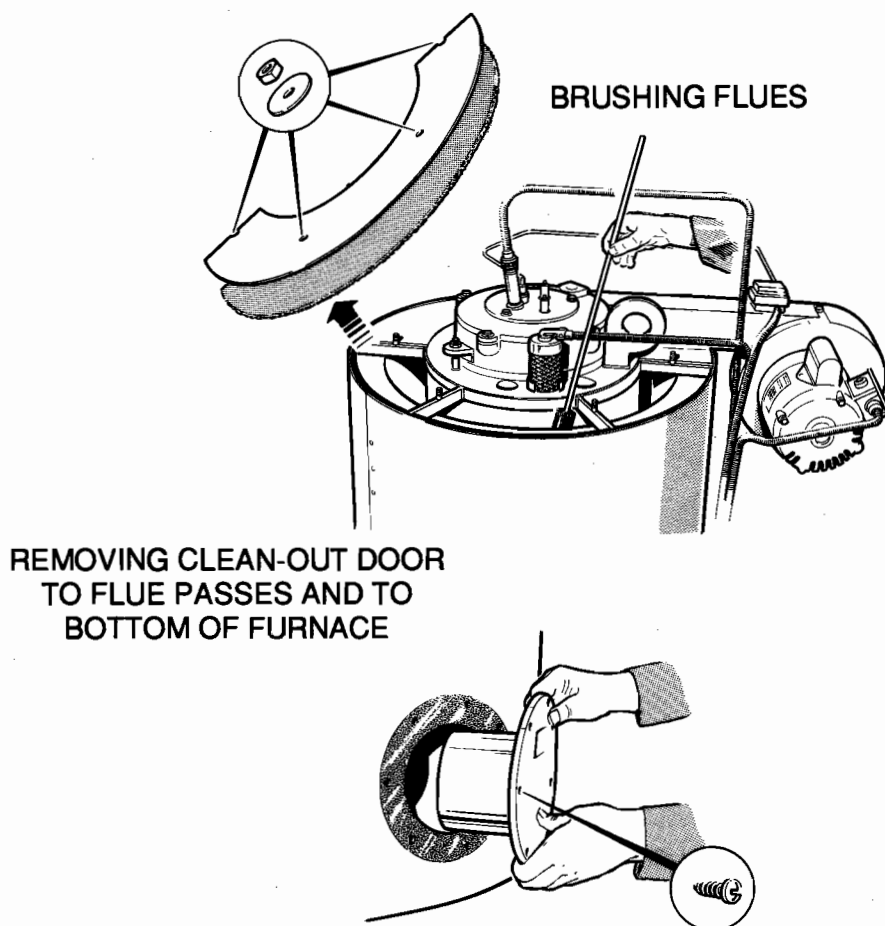


FIG. 14 FLUE CLEANING

SECTION 5

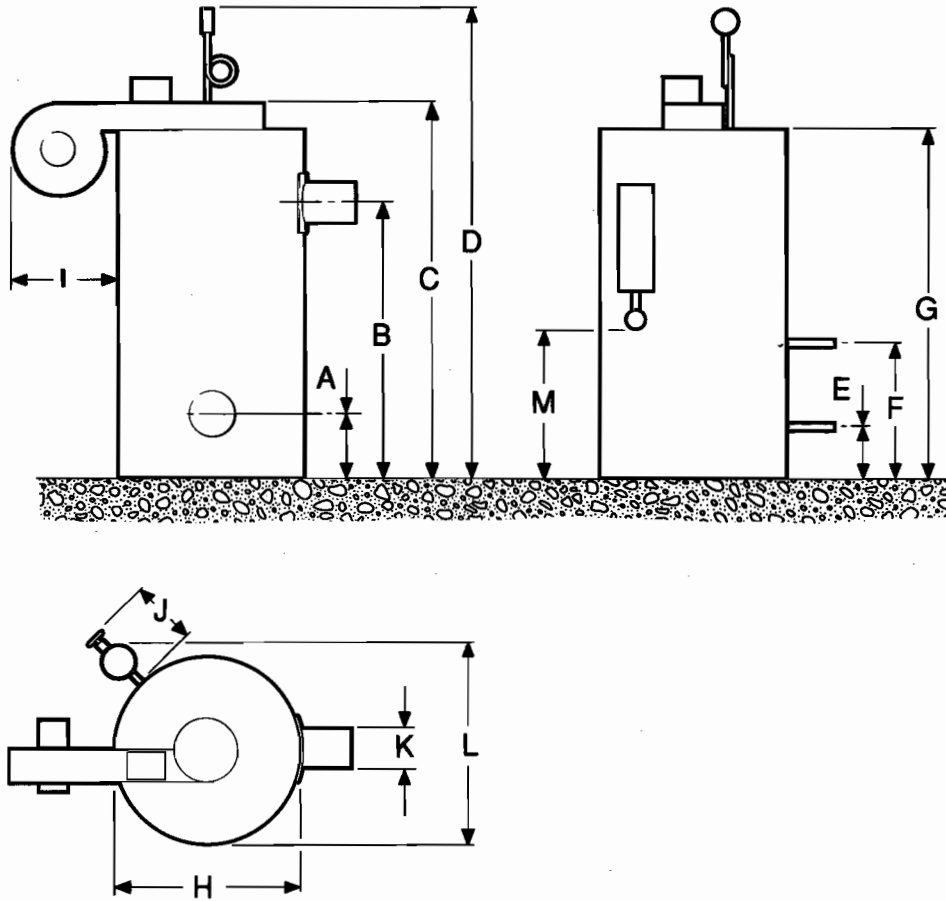


FIG. 15 BOILER DIMENSIONS

	A	B	C	D	E	F	G	H	I	J	K	L	M
4E (in.)	19	41	51	68	15	27	47	26	14	15	6	35	16
4E (mm)	482	1041	1295	1727	381	686	1194	660	356	381	152	889	404
6E (in.)	19	50	60	77	15	33	57	26	14	15	6	35	22
6E (mm)	482	1270	1524	1956	381	838	1448	660	356	381	152	889	559
8E (in.)	19	56	65	82	15	33	62	26	14	15	6	35	26
8E (mm)	482	1422	1651	2083	381	838	1575	660	356	381	152	889	660
10E (in.)	19	57	67	83	15	33	63	28	13	15	6	37	28
10E (mm)	482	1448	1702	2108	381	838	1600	711	330	381	152	940	711
15E (in.)	19	61	72	90	15	33	69	30	12	15	8	41	35
15E (mm)	482	1549	1829	2286	381	838	1753	762	305	381	203	1041	889
20E (in.)	20	64	76	91	16	34	72	38	17	15	10	50	37
20E (mm)	508	1626	1930	2311	406	864	1829	965	432	381	254	1270	940
30E (in.)	20	73	88	103	16	34	83	46	16	14	12	54	47
30E (mm)	508	1854	2235	2616	406	864	2108	1168	406	356	305	1372	1194
50E (in.)	20	74	91	106	16	34	86	55	20	14	12	57	58
50E (mm)	508	1880	2311	2692	406	864	2184	1397	508	356	305	1448	1473
60E (in.)	20	80	97	112	16	34	92	55	20	14	12	57	64
60E (mm)	508	2032	2464	2845	406	864	2337	1397	508	356	305	1448	1625

GENERAL DATA

	BOILER TRIM								
	4E	6E	8E	10E	15E	20E	30E	50E	60E
Steam Safety Valve	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	1 (25)	1 (25)	1.50 (38)	1.50 (38)
Steam Outlet Valve	0.75 (19)	0.75 (19)	0.75 (19)	1 (25)	1.25 (32)	1.50 (38)	2 (51)	3 (76)	3 (76)
Feed Water Stop Valves	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)
Feed Water Check Valve	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)
Boiler Blow Off Valve	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	1.25 (32)	1.25 (32)	1.25 (38)	1.25 (38)
Water Column Blow Off Valve	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)

The following items of trim are supplied with the boiler:-

COMPONENT	QTY.
Main Steam Valve	1
Steam Safety Valve	1 or 2*
Steam Pressure Gauge Assembly	1
Tricocks	2
Boiler Blow Down Valve	1
Water Gauge Set with Glass	1 or 2*
Water Gauge Protector	1 or 2*
Feedwater Check Valve	2
Feedwater Stop Valve	1
Flue Flange and Gasket	1
Draught Stabilizer	1
Alarm Bell	1 or 2*
Flue Brush	1
T Handle Wrench	1

Note:

*Items of trim supplied can vary according to specification.

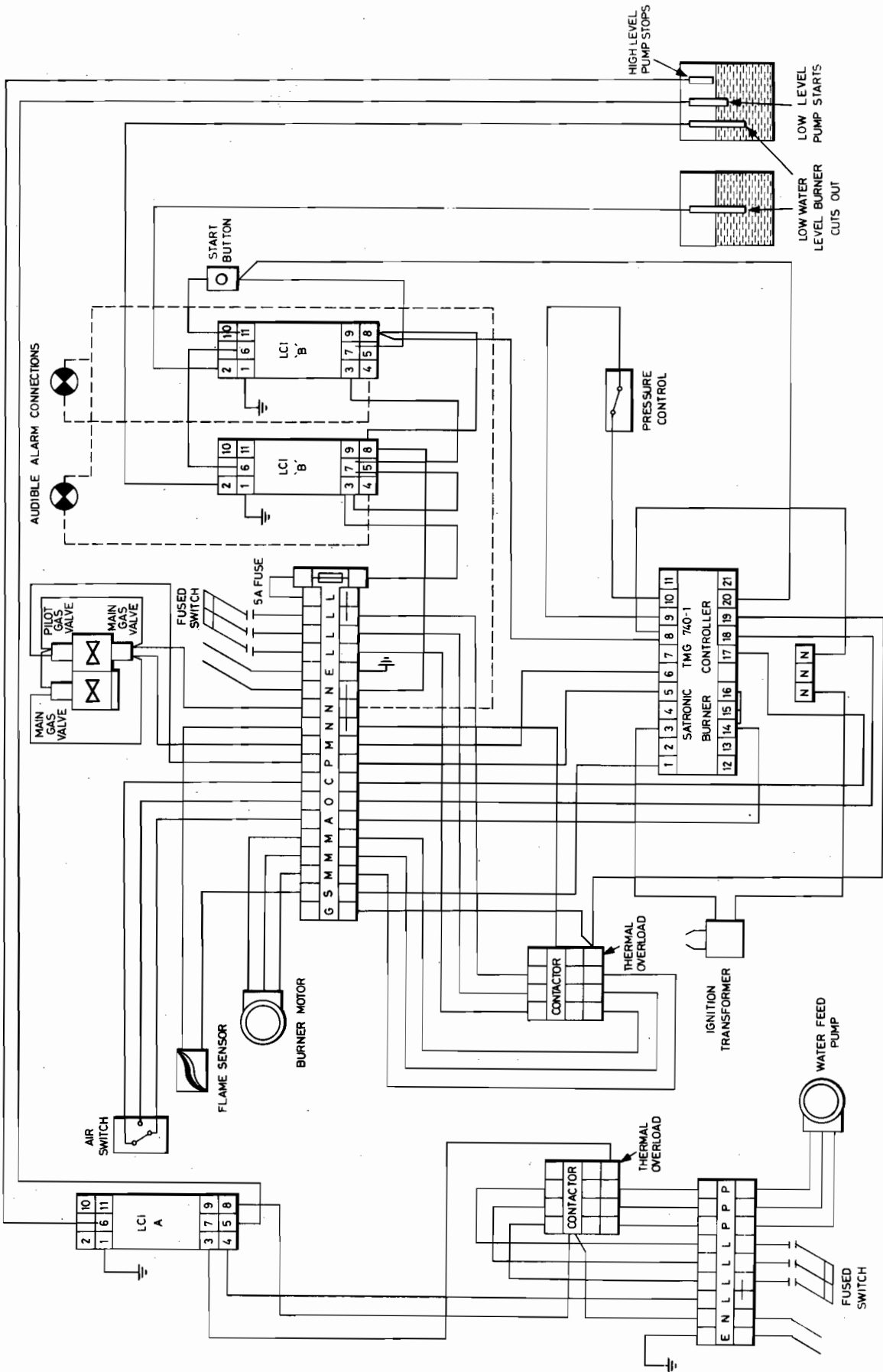
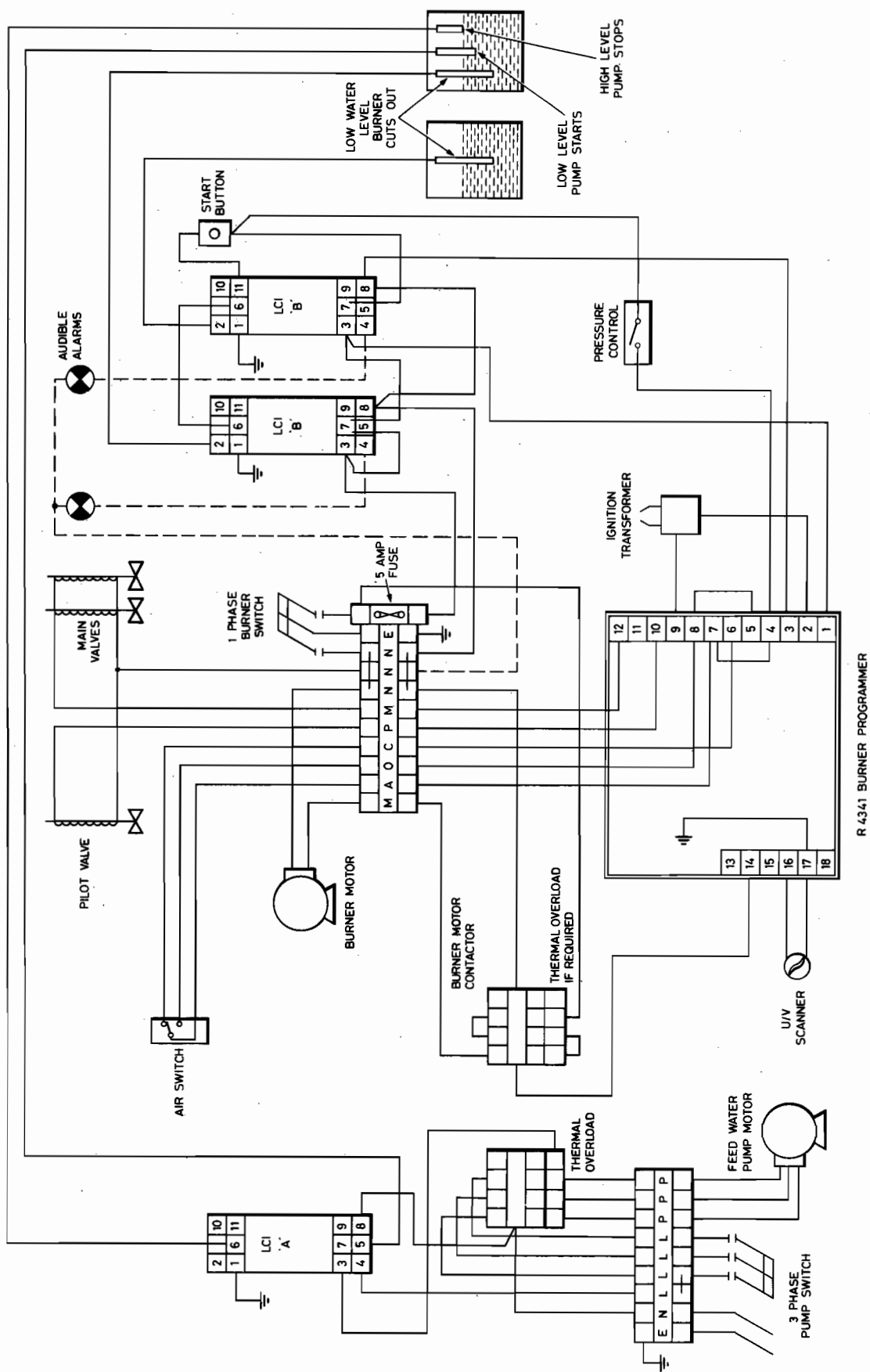
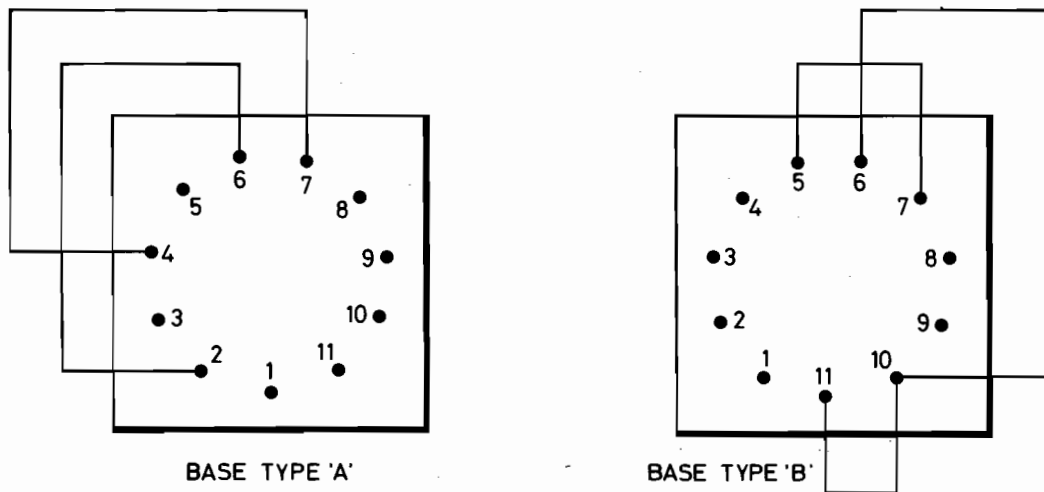
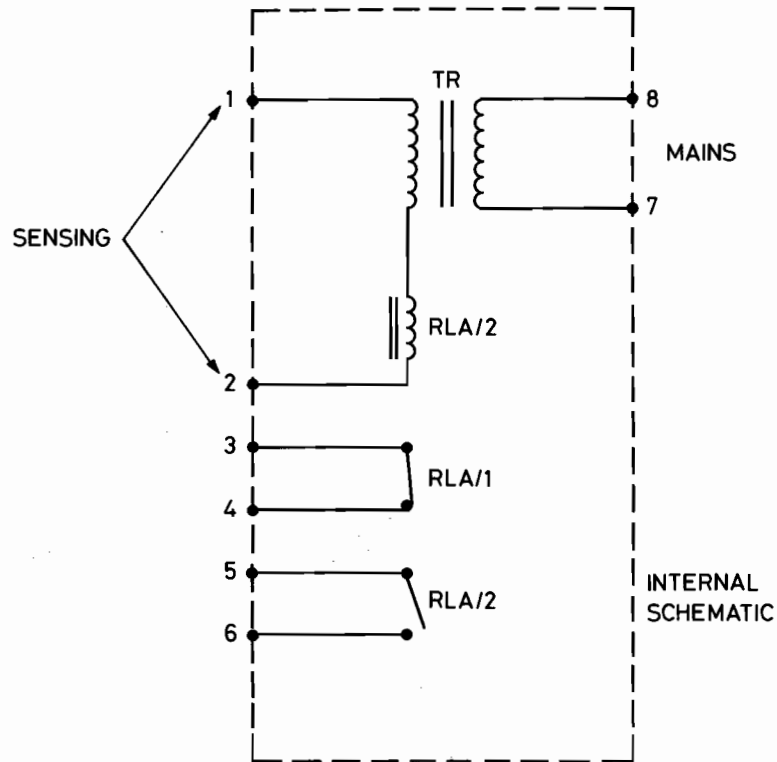


FIG. 16 WIRING DIAGRAM (All models with Satronic burner control)



R 4341 BURNER PROGRAMMER

FIG. 18 WIRING DIAGRAM (All models with Honeywell R4341B Programmer U/V or flame rod operation)



INTERNAL BASE WIRING

FIG. 19 TYPE LC1 LEVEL CONTROLLER

SPARE PARTS**SECTION 6**

When ordering replacement or spare parts ensure you provide all the details given in the spare parts lists, together with the following :-

1. **Boiler number** _____
2. **Boiler type** _____
3. **Type of fuel used** _____
4. **Electrical specification** _____

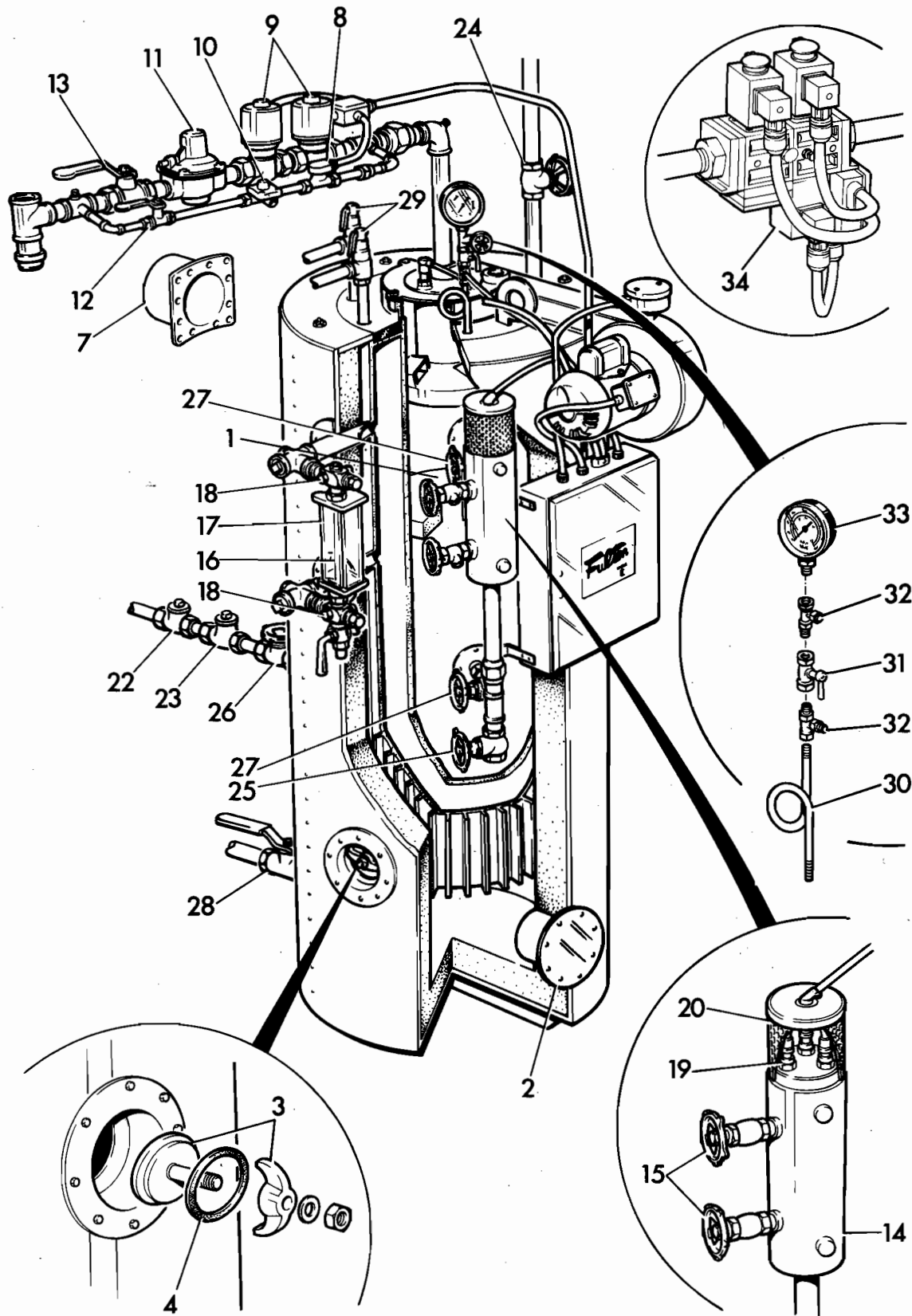


FIG. 20 BOILER SPARE PARTS

ITEM NO.	PART NO.	DESCRIPTION	REMARKS
1	10001	Refractory, furnace, 10 in.	Models 6E - 15E
	10002	Refractory, furnace 15 in.	Models 20E - 30E
	10003	Refractory, furnace 22 in.	Models 50E - 60E
2	10006	Boiler, cleanout plug, round	
3	10009	Handhole door, assembly, 16 in.	Models 4E - 8E
	10010	Handhole door, assembly, 18 in.	Models 10E
	10011	Handhole door, assembly, 20 in.	Models 15E
	10012	Handhole door, assembly 28 in.	Models 20E
	10013	Handhole door, assembly 34 in.	Models 30E
	10014	Handhole door, assembly 41 in.	Models 50E - 60E
	4	10017	Handhole door, gasket
5	10021	Flue brush, 6 in.	Models 4E - 20E
	10022	Flue brush, 8 in.	Models 30E - 60E
6	10023	Handhole door, tee wrench	
7	10119	Aluminium flue flange, 6 in.	Models 4E - 10E
	10120	Aluminium flue flange, 8 in.	Models 15E
	10121	Aluminium flue flange, 10 in.	Models 20E
	10122	Aluminium flue flange, 12 in.	Models 30E
	10123	Aluminium flue flange, 12 in.	Models 50E - 60E
8	10296	Valve, pilot gas, 1/2 in.	
9	10301	Valve, main gas, 1 in.	Models 4E - 10E
	10302	Valve, main gas, 1 1/2 in. slow opening	Models 30E
	10303	Valve, main gas, 1 1/2 in. fast opening	Models 15E - 30E
	10305	Valve, main gas, 2 in.	Models 50E - 60E
	10307	Valve, main gas, 2 in.	Models 50E - 60E
10	10308	Governor, pilot gas, 1/2 in.	Models 4E - 30E
	10309	Governor, pilot gas, 3/4 in.	Models 50E - 60E
11	10310	Governor, main gas, 1 in.	Models 4E - 10E
	10312	Governor, main gas, 1 1/4 in.	Models 15E - 20E
	10314	Governor, main gas, 1 1/2 in.	Models 30E
	10317	Governor, main gas, 2 in.	Models 50E
	10316	Governor, main gas, 2 in.	Model 60E
12	10549	Stop cock, pilot gas, 1/2 in.	
13	10551	Stop cock, main gas, 1 in.	Models 4E - 10E
	10552	Stop cock, main gas, 1 1/4 in.	Models 15E - 20E
	10553	Stop cock, main gas, 1 1/2 in.	Models 30E
	10554	Stop cock, main gas, 2 in.	Models 50E - 60E
14	10403	Casting, water bottle	
15	10404	Tri-cock	

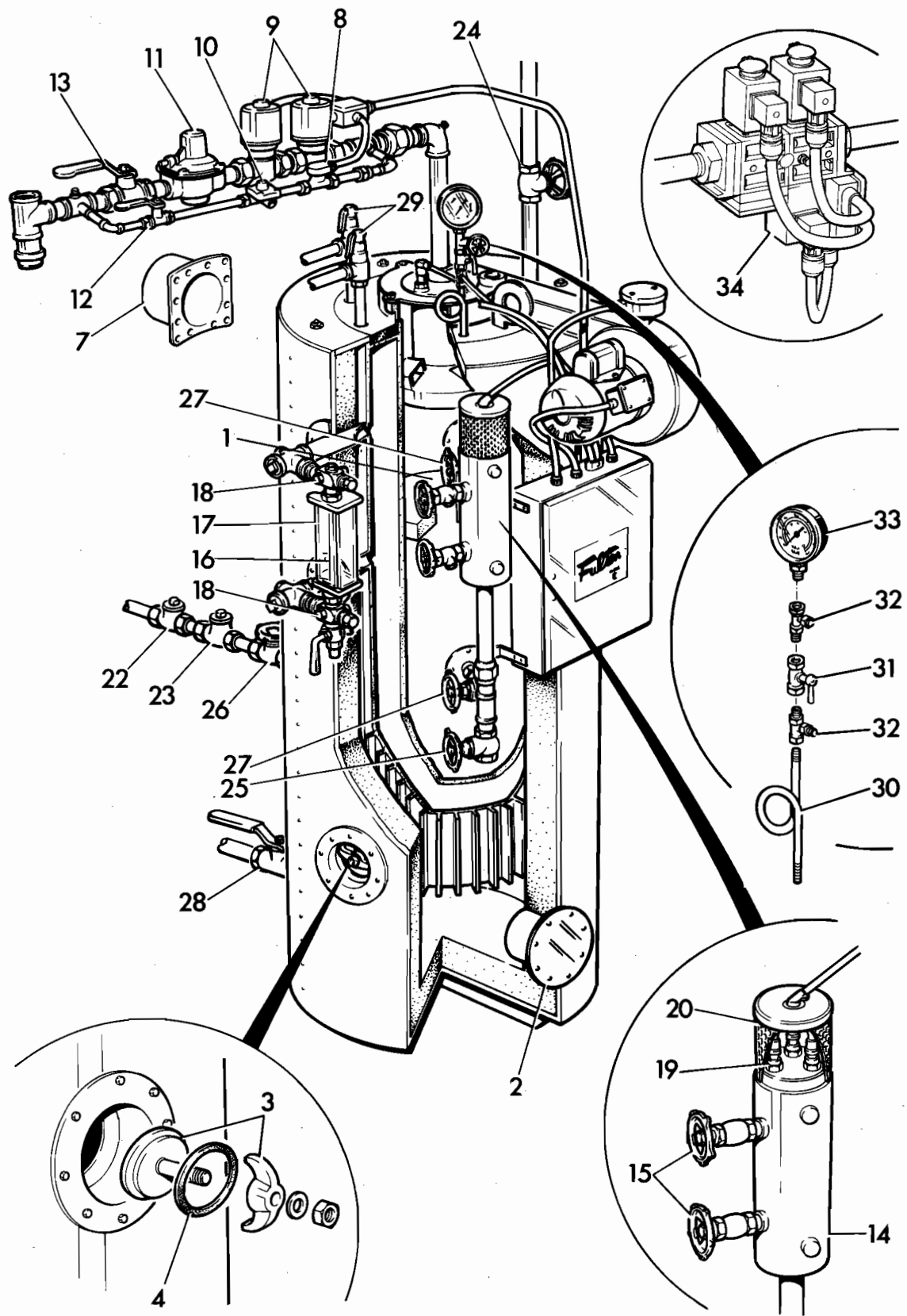


FIG. 20 BOILER SPARE PARTS

ITEM NO.	PART NO.	DESCRIPTION	REMARKS
16	10405	Glass, water-gauge, 1/2 in. x 9 1/4 in.	
17	10411	Protector, water gauge	
18	10414	Gauge, water level, light pattern	
19	10417	Probe, low water level, shell 15 3/4 in.	
	10418	Probe, water pump off 7 in.	
	10419	Probe, water pump on 8 3/4 in.	
	10420	Probe, low water level, bottle 10 1/2 in.	
20	99E9370	Basket, water column	
21	11311	Control panel box	
22	10532	Valve, check, lift type, 1 in.	
23	10533	Valve, check, vee-reg type 1 in.	
24	10535	Valve, steam stop, 3/4 in.	Models 4E - 8E
	10536	Valve, steam stop, 1 in.	Model 10E
	10537	Valve, steam stop, 1 1/4 in.	Model 15E
	10538	Valve, steam stop, 1 1/2 in.	Model 20E
	10539	Valve, steam stop, 2 in.	Model 30E
	10540	Valve, steam stop, 3 in.	Model 50E - 60E
25	10535	Valve, water column blowdown, 3/4 in.	
26	10536	Valve, water feed stop, 1 in.	
27	10536	Valve, water column isolating, 1 in.	
28	10551	Valve, main boiler blowdown, 1 in.	Models 4E - 15E
	10552	Valve, main boiler blowdown, 1 1/4 in.	Models 20E - 60E
29	10558	Valve, safety, Fig. 3376 3/4 in. set to 125 psi	Models 4E - 15E
	10559	Valve, safety, Fig. 3376 3/4 in. set to 155 psi	Models 4E - 15E
	10560	Valve, safety, Fig. 3376 1 in. set to 125 psi	Models 20E - 30E
	10561	Valve, safety, Fig. 3376 1 in. set to 155 psi	Models 20E - 30E
	10562	Valve, safety, Fig. 3376 1 1/2 in. set to 155 psi	Models 50E - 60E
30	10564	Gauge, pigtail syphon	
31	10548	Valve, pressure gauge isolating, 1/4 in.	
32	10565	Gauge, syphon tee, 1/4 in.	
33	10566	Gauge, pressure, 4 in. 0-250 psi	Models 4E - 30E
	10567	Gauge, pressure, 6 in. 0-300 psi	Models 50E - 60E
34	11405	Gas unit, moduline, 1 in., 240V	Models 4E - 15E
	11428	Gas unit, moduline, 1 1/2 in., 240V	Models 20E - 30E

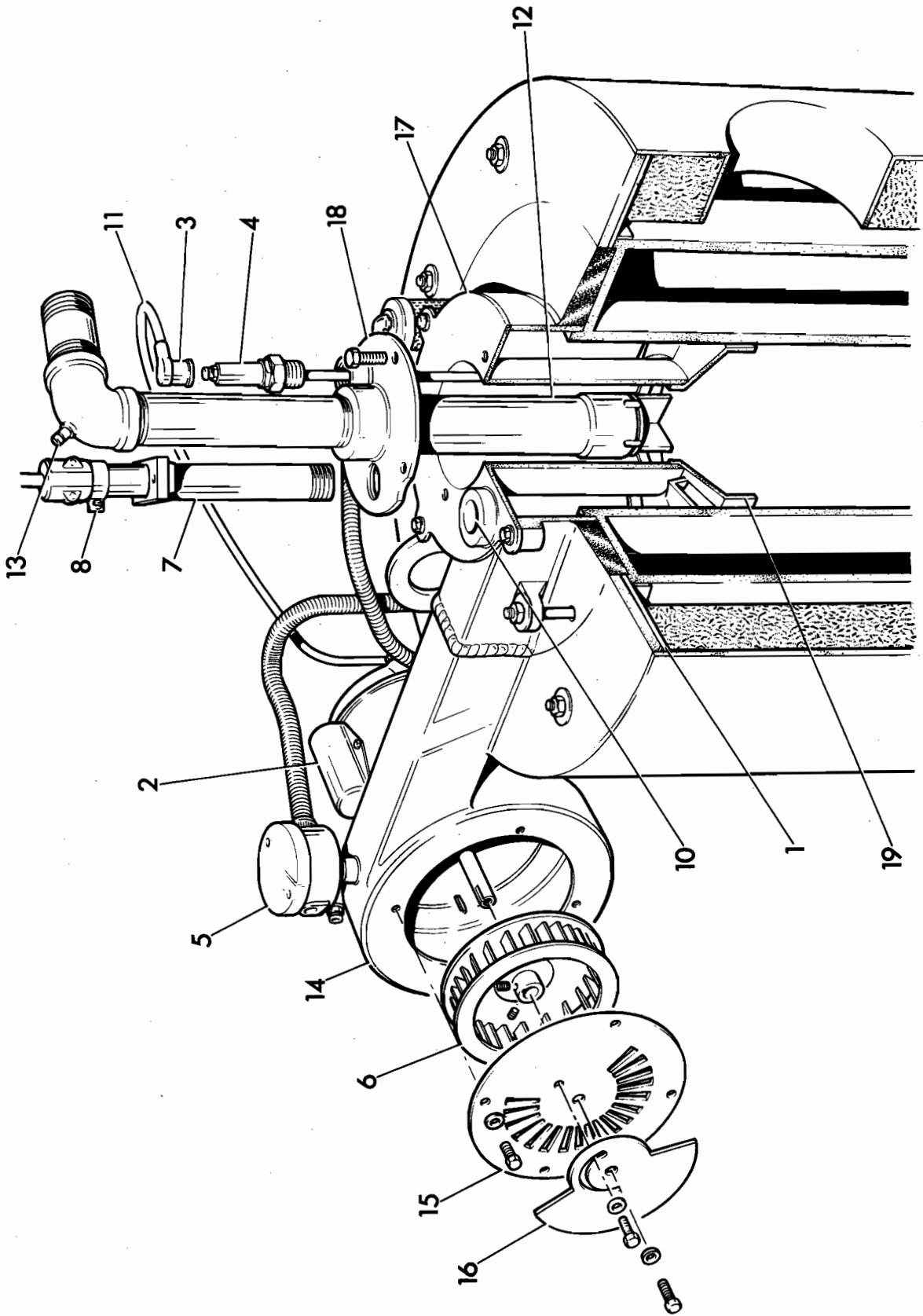


FIG. 21 BURNER ASSEMBLY SPARE PARTS

ITEM NO.	PART NO.	DESCRIPTION	REMARKS
1	11232	Gasket, flue cover plate, 6 in. wide	Models 4E - 8E
	11233	Gasket, flue cover plate, 6 in. wide	Model 10E
	11234	Gasket, flue cover plate, 6 in. wide	Model 15E
	11235	Gasket, flue cover plate, 8 in. wide	Model 20E
	11236	Gasket, flue cover plate, 8 in. wide	Model 30E
	11237	Gasket, flue cover plate, 8 in. wide	Models 50E - 60E
	10135	Gasket material Kaowool roll 6 in. x 22 ft	
	10136	Gasket material Kaowool roll 8 in. x 22 ft	
2	10241	Motor, burner, 1/3 HP, 250W, 240V, 1 Ph	Models 4 E - 15E
	10247	Motor, burner, 1/3 HP, 250W, 380/415, 3 Ph	Models 4E - 15E
	10242	Motor, burner, 3/4 HP, 550W, 240V, 1 Ph	Models 20E - 30E
	10248	Motor, burner, 3/4 HP, 550W, 380/415V, 3 Ph	Models 20E - 30E
	050E9451	Motor, burner, 2 HP, 1.5 kW, 240V, 1 Ph	Models 50E - 60E
	050E9450	Motor, burner, 2 HP, 1.5 kW, 415V, 3 Ph	Models 50E - 60E
3	10249	Electrode, Angle Rajah	
4	10251	Ignition electrode, gas, I18	
5	10270	Air switch	
6	10271	Burner fan, 6 1/4 in. x 1 1/2 in.	Models 4E - 8E
	10272	Burner fan, 7 in. x 1 1/2 in.	Model 10E
	10274	Burner fan, 8 3/8 in. x 1 1/2 in.	Model 15E
	10273	Burner fan, 7 1/2 in. x 1 1/2 in.	Model 20E
	10276	Burner fan, 8 3/8 in. x 2 in.	Model 30E
	10278	Burner fan, 9 3/16 in. x 2 1/2 in.	Model 50E
	10277	Burner fan, 10 in. x 2 1/2 in.	Model 60E
7	10293	Sensor, adaptor, Satronic type	Models 6E - 30E
8	10292	Sensor, Satronic U/V UVZ780	Models 6E - 30E
	10289	Sensor, Honeywell, U/V C7027A	Models 4E, 50E and 60E
9	10318	Eyeglass, spring	
10	10319	Eyeglass, Pyrex	
	10977	Eyeglass, washer	
11	10321	Wire, ignition cable	
12	10987	Tube, orifice, nat. gas 1 in. x 5/16 in.	Model 4E
	10330	Tube, orifice, nat. gas 1 in. x 3.8 in.	Model 6E
	10332	Tube, orifice, nat. gas 1 in. x 7/16 in.	Model 8E
	10334	Tube, orifice, nat. gas 1 in. x 1/2 in.	Model 10E
	10340	Tube, orifice, nat. gas 1 1/4 in. x 39/64 in.	Model 15E
	10342	Tube, orifice, nat. gas 1 1/4 in. x 21/32 in.	Model 20E

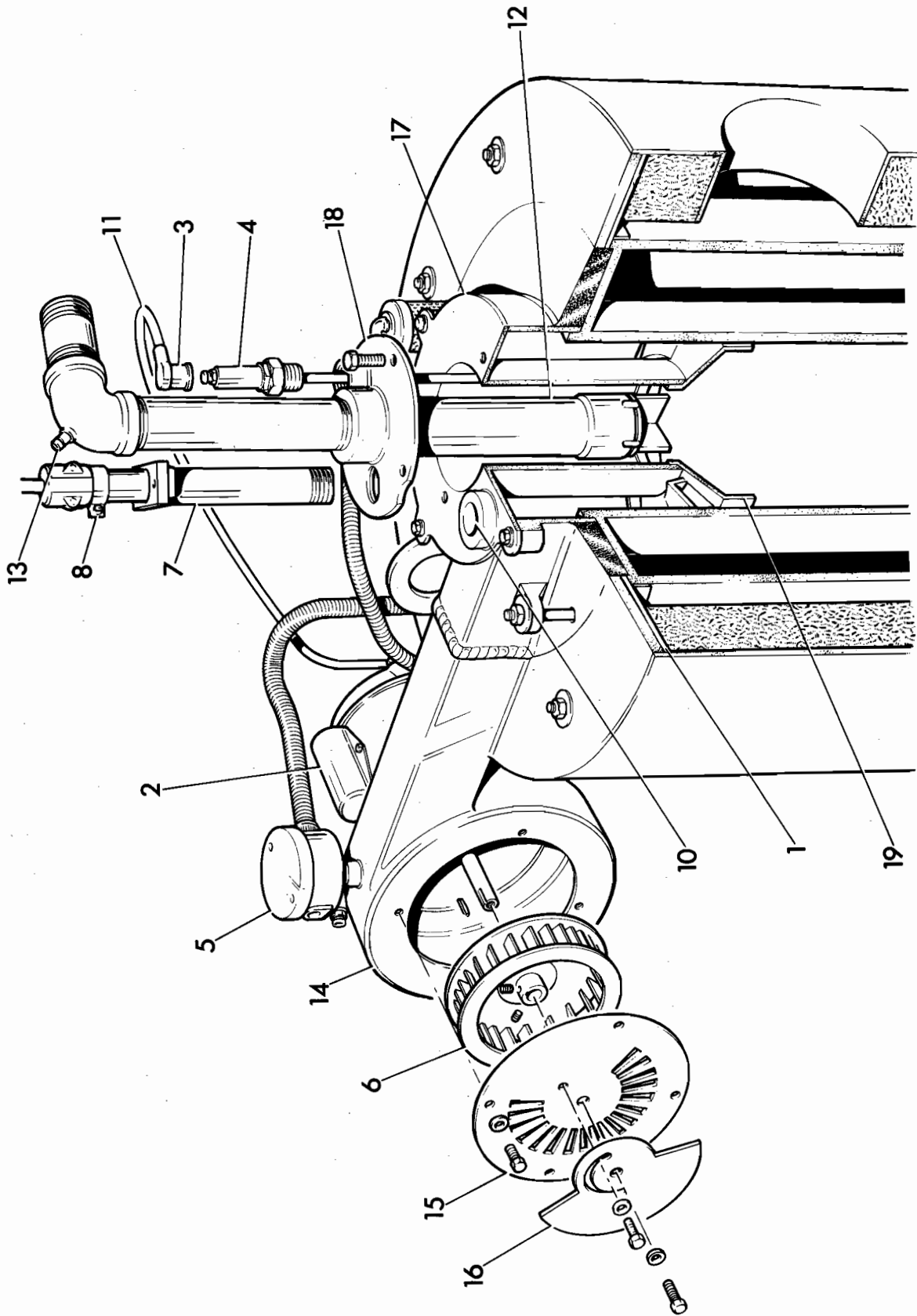
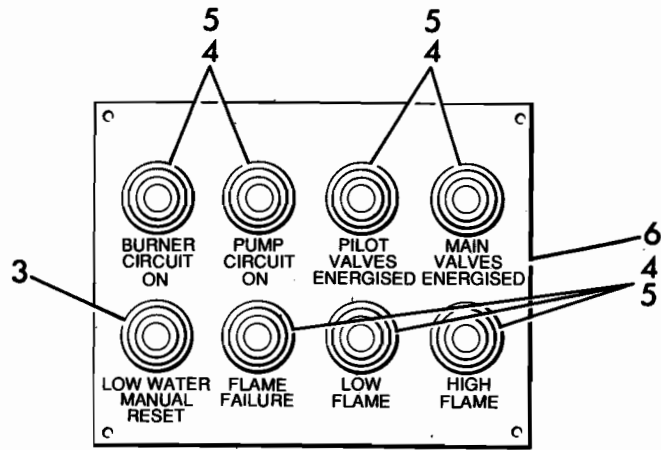


FIG. 21 BURNER ASSEMBLY SPARE PARTS

ITEM NO.	PART NO.	DESCRIPTION	REMARKS
	10344	Tube, orifice, nat. gas 1 1/2 in. x 7/8 in.	Model 30E
	10346	Tube, orifice, nat. gas 1 1/2 in. x 1 1/16 in.	Model 50E
	10348	Tube, orifice, nat. gas 1 1/2 in. x 1 1/32 in.	Model 60E
13	10350	Nipple, pressure test 1/8 in.	
14	10365	Burner scroll	Model 4E
	10366	Burner scroll	Models 6E - 15E
	10367	Burner scroll	Models 20E - 30E
	10368	Burner scroll	Models 50E - 60E
15	10376	Air gate	Models 4E - 15E
	10377	Air gate	Models 20E - 30E
	10378	Air gate	Models 50E - 60E
16	10379	Air damper	Models 4E - 15E
	10380	Air damper	Models 20E - 30E
	10381	Air damper	Models 50E - 60E
17	11300	Burner top plate	Models 6E - 15E
	11301	Burner top plate	Models 20E - 30E
	11299	Burner top plate	Models 50E - 60E
18	010EG430	Burner plate	Models 6E - 10E
	015EG430	Burner plate	Models 15E - 20E
	030EG430	Burner plate	Model 30E
	050EG430	Burner plate	Models 50E - 60E
19	11305	Air deflector plate	Models 6E - 15E
	11306	Air deflector plate	Models 20E - 30E
	11307	Air deflector plate	Models 50E - 60E



CONTROL PANEL INDICATOR LIGHTS

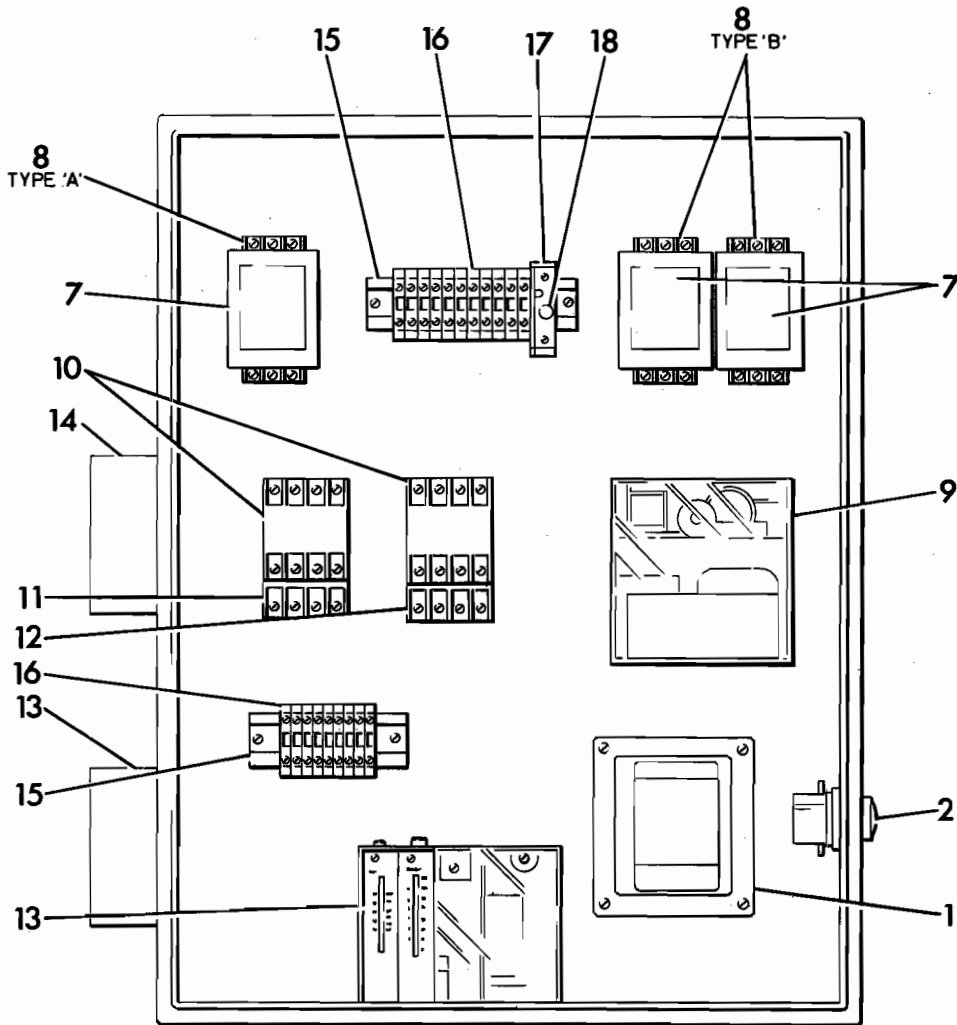


FIG. 22 CONTROL PANEL SPARE PARTS

ITEM NO.	PART NO.	DESCRIPTION	REMARKS
1	10237	Ignition transformer, 1-pole, 240V	
2	10443	Push start button	Models 4E-30E
3	10444	Push start button, neon ac16	Models 50E-60E
4	10450	Lamp indicator	Models 50E-60E
5	10445	Lamp bulb neon AC16	Models 50E-60E
6	10466	Facia panel, gas	Models 50E-60E
7	10468	Relay, water level, LC1	
8	10471	Relay, water level, base, type 'B'	
	10470	Relay, water level, base, type 'A'	
9	10486	Programmer, Satronic, TMG 740-2	Models 6E-30E
	11344	Base, Satronic programmer, 5-720G	Models 6E-30E
	10476	Programmer, Honeywell, R4341B	Models 4E, 50E, 60E
	10477	Base, Honeywell programmer, Q641A	Models 4E, 50E, 60E
10	10488	Contactactor, CI9 240/1/50	
11	10498	Thermal overload, TI16 0.85-1.3A	Models 4E-15E
	10499	Thermal overload, TI16 1.2-1.9A	Models 20E-30E
	10501	Thermal overload, TI16 2.7-4.2A	Models 50E-60E
12	10500	Thermal overload, TI16 1.8-2.8A	Models 4E-30E
	10501	Thermal overload, TI16 2.7-4.2A	Models 50E-60E
13	10508	Pressure control, L404F1300	Models 4E-60E
14	10509	Pressure control L404F1227	Models 50E-60E
15	10510	Rail, terminal	
16	10511	Terminal block, SAK4	
17	10520	Terminal block, fused	
18	10525	Terminal fuse, 5 amp	

Material & Workmanship Warranty



5 Year Warranty

On the Fulton Boiler Pressure Vessel

Fulton Boiler Works (Great Britain) Ltd will repair or replace FoB factory any Fulton pressure vessel which within five (5) years of the date of delivery is found to be defective in workmanship; or material, provided this equipment is operated and maintained by the buyer for the purpose for which it was designed and in accordance with the Manufacturer's Handbook. This Warranty does not cover damage or failures that can be attributed to corrosion, scale or dirt accumulation or to low water conditions. This Warranty is good only in the United Kingdom of Great Britain and Northern Ireland. This Warranty does not include labour or delivery charges of any kind.

 **Fulton**

Fulton Boiler Works (Great Britain) Ltd

General Warranty

The Fulton general Guarantee is given in lieu of and in exclusion of any warranty, expressed or implied, statutory or otherwise, as to the state, condition, performance, quality or fitness of the goods. Save thereunder we shall be under no obligation or liability of any kind to you in regard to the goods. In the case of new goods manufactured and supplied by us we will make good any defect developing therein under proper use within 12 months of delivery, provided that after investigation in our sole discretion we are satisfied that the defect arose from faulty design, materials or workmanship and from no

other cause whatsoever. Defective goods or parts must be returned to us as soon as possible after discovery of the defect. Costs of carriage and of detaching and incorporating parts will be borne by you. In all cases at the termination of such 12 months all liability on our part will cease. No liability whatsoever is to be incurred by us in respect of gauge or sight-glasses, packing glands or electric motors or any goods or accessories not of our manufacture. But so far as we are able, we shall let you have the benefit of any guarantee or warranty given to us in respect thereof.

