BRISTOL MUNICIPAL OFFICES

THE COUNCIL HOUSE, COLLEGE GREEN

Working Instructions For Engineering Services

Consulting Engineers:
J. ROGER PRESTON & PARTNERS,
15, North Audley Street,
London, W.1.
Phone: Mayfair 1376/9

Contracting Engineers:
ARTHUR SCULL & SON LTD.
3/4, Princes Buildings,
Clifton, Bristol, 8.
Phone: Bristol 36851

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SECTION 1

BRISTOL MUNICIPAL OFFICES

WORKING INSTRUCTIONS

for

ELECTRIC THERMAL STORAGE INSTALLATION

GENERAL DESCRIPTION

The electric thermal storage installation has been designed to use the "Off-peak" supply during hours of the night. The heat generated during this period is used to heat up the water in the six storage vessels. During the day-time the hot water is drawn from the storage vessels, tempered and used in the panel system.

The equipment comprises the following:—

(a) 2 Electrode Boilers.
(b) 2 Boiler Load Control Panels.
(c) 2 Control and Instrument Panels.
(d) 6 Storage Vessels.
(e) 2 Storage/Boiler Pumps.
(f) 1 Sump Pump.
(g) Control Valves and Instruments.
(h) 2 Panel Heating Pumps.
(i) Mixing Valve Station and Thermostat Controller.
(j) Fusible Link Valves.

An expansion tank is provided on the top floor of the Building, and is at atmospheric pressure.

DETAILED DESCRIPTION

(a) Electrode Boilers

The electrode boilers installed have a maximum capacity of 1,500 K.W's, and are designed to work on a 3 phase, 6,600 volt 50 cycle supply. The boiler shell is constructed for a working pressure of 50 lb./sq.in., and has been hydraulically tested to 100 lb./sq.in. The boilers are fitted with water-operated Servo-motor, boiler guard, man-hole, safety valve, flow control and safety thermostats, flow switch, emptying cock and pressure switch.

The high tension electric supply to the boiler is controlled by the oil circuit breakers installed in the Switch Room above the Boiler House. The oil circuit breakers are controlled from the main control panel. The boiler which is required to be operated is selected by means of a rotary switch on the main control panel, and once this switch is in operation the oil circuit breaker will come in automatically at the set conditions of the time switches and various thermostats and other devices. Care must be taken that the temperature in the boiler does not exceed 270°F, and the safety thermostat at the boiler is set at this figure.

The boiler guard is provided with a terminal guard switch which immediately opens the circuit breaker in the event of the terminal guard door being opened.

Important Note:

No work must be done on the top of the boiler, and the terminal guard must not be removed or its access door opened, unless the oil circuit breaker is "locked out" and the isolating switch on boiler top is in the off position. Precautions must be taken to prevent the oil circuit breaker from being put into operation again until the work is finished and the terminal guard re-fixed.

Maintenance Note

A special lubricator has been provided and should be kept full of heavy cylinder oil. This serves to lubricate the stuffing box and servo-motor piston rod on top of the boiler. The method of using the lubricator is first to open the small needle valve, then turn the oil cup in a clockwise direction. This will force oil into the stuffing box. After use, the needle valve should be shut tightly. The oil cup should be filled approximately once a month and the lubricator used every week. The stuffing boxes on top of the boiler should be periodically inspected and re-packed if necessary. Normally no leakage should take place, except perhaps at the central stuffing box: this is provided with a special funnel, and a slight leakage is of no consequence.

HEAVY CYLINDER OIL

When re-packing stuffing boxes, it is necessary to electrically isolate the boiler as indicated in the above note. In addition, the boiler must be hydraulically isolated by closing valves 1 and 5 in the case of boiler No. 1, and 2 and 6 for boiler No. 2. The drain cock on the boiler should be opened to release the pressure, but it is not necessary to empty the boiler completely.

When the re-packing has been completed, the boiler guard should be re-fixed and the boiler re-filled by closing the drain cock and re-opening the valves 1 and 5 or 2 and 6.

The small filters in the supply pipe to the water flow switch must be cleaned every week.

(b) **Boiler Load Control Apparatus**

The output of the electrode boiler is governed by the position of the movable insulating tubes inside the boiler. By raising these tubes the load increases, while lowering them reduces the load. The lowering and raising of the insulating tubes is carried out by the pressure of the water on the top or bottom or the servo-motor piston.

On the instruction drawing, the servo-motor, which is mounted on top of the boiler, is marked 'H,' and the servo-motor piston marked 'X.' The piston is connected to the insulating tubes by a piston rod and star plate. The piston rod passes through the servo-motor cylinder through a gland and to the boiler through a gland on top of the cast iron water outlet bend.

When the boiler load is under automatic control, the valve 3 or 4 should be in the "off" position.

Water is admitted either at 'Z' or 'Y,' depending on whether an increase or decrease of output is called for. There are 4 magnetic valves on the boiler control panel, marked 'L' for lowering the insulating tubes, and 'R' for raising them. The magnetic valves are actuated by the load control relay on the boiler panel on the main control board. The water which operates the servo-motor is obtained from a 200 gallon service tank next to the cold feed and expansion tank on the top floor. If the load control relay calls for an increase in output the water passes through the bottom magnetic valve 'R' to the bottom connection 'Z' of the servo-motor. The pressure causes the piston to rise and the water above the piston is discharged through connection 'Y' via the top magnetic valve 'R' to drain.

If the control relay calls for a decrease in load, the two magnetic valves are closed and those marked 'L' open, thus allowing the water to flow to the top of the servo-motor, and the water in the lower part of the servo-motor to discharge to drain. A $\frac{1}{16}$" orifice disc is fitted in the horizontal part of a fitting of the water supply pipe to the control panel of each boiler; its purpose is to limit the flow of water to the servo piston so increasing the time taken for it to reach the upper position, this should take approximately 7 minutes.

In case of failure of the automatic load control gear, or for testing, the servo-motor piston can be raised or lowered by means of the 4-way valve 3 or 4.

When working on hand-control, it should be remembered that if the boiler is adjusted to a certain load when the temperature of the water in the boiler is low, this load will increase as the temperature rises, although the position of the insulating tubes has not been altered. Therefore, the position of the insulating tubes has to be re-set by hand from time to time in order that the load remains constant.

Maintenance Note:

Dirt collecting in the magnetic valves will interfere with the correct operation of the servo-motor piston movement. If trouble is experienced in this direction, it will be necessary to dismantle the valves and wash them out with water. To dismantle the magnetic valves, the electric supply to the valves should be disconnected, and the unions connecting the valve to the copper pipe lines unscrewed. The valves can then be removed from the panel. The cover, coil and solenoid of the assembly should now be removed and the hexagon unscrewed. The interior of the valve is now accessible for the cleaning operation.

A water isolating valve is provided just above each boiler control panel, and this must be shut whenever it is necessary to do any hydraulic work on the panel.

(c) **Main Boiler Control Panel**

Each boiler is controlled from a separate panel marked "Boiler No. 1" and "Boiler No. 2." Boiler No. 1 Panel contains:

3 Phase Ammeters.
1 High Tension Volt Meter.
1 Load Regulating Relay.
1 Load Control Switch.
1 Emergency Switch.

Pilot Lights for "Boiler Off" and "Boiler On"; water flow failure fault-indicating lights for Out-of-Balance, Excess Load, Excess Temperature, Primary Pump Overload.

Boiler No. 2 Panel contains:

3 Phase Ammeters.
1 Low Tension Volt Meter.
1 Load Regulating Relay.
1 Load Control Switch.
1 Emergency Switch.

Pilot Lights for "Boiler Off" and "Boiler On"; water flow failure fault-indicating lights for Out-of-Balance, Excess Load, Excess Temperature, Primary Pump Overload.

The Ammeters on the Control Panel have been provided to indicate the current to the boiler in each of the three phases. When the green boiler pilot light is on it indicates that the circuit is open, and when the red pilot light is on it shows that it is closed. The control switch enables the boiler to be selected and, provided that the time switch and thermostats are in a position for the boiler to be switched on, will enable the water to be heated by that particular boiler. The emergency switch should be kept in the normal position, except under emergency conditions, as when the switch is placed in the "Off" position, the circuit breaker will open, irrespective of the load which is passing. All other apparatus on the panel is part of the automatic control equipment, which has been designed to:—

(1) Keep the load constant at any required figure within the range of the boiler in spite of the varying conductivity of the water at different temperatures.

(2) Switch off the boiler in the event of:
Circulation of water through the boiler ceasing.
Excessive pressure being developed in the boiler.
The boiler terminal guard access door being opened.
An overload occurring.
The Out-of-Balance between the phases exceeding 15% of the maximum load.
An excess temperature being created in the boiler.
The circulating water pump being overloaded.

(3) Reduce the boiler load to a minimum before the boiler is switched off, on reaching the set temperature of the control thermostats in the vessels, operation of the time switch or operation of the control switch.

(4) Ensure that the electrode insulating shields are brought to a minimum load position when the boiler is switched off either automatically or manually.

(5) Ensure that the boiler cannot be switched on unless the insulating shields are in a minimum load position.

(6) Ensure that the Boiler/Storage Pump in use is normally switched off automatically should the oil circuit breaker trip for any cause.

(For starting up and setting of valves see separate section).

Maintenance

The contacts on the load control relay should be inspected periodically, and if necessary cleaned very carefully by means of carbon tetrachloride by a competent engineer. The relays at the back of the panel should not normally require attention for several years. On no account should any relay be interfered with except by the Service Engineer of the makers of the instruments.

The pilot lamps are 15/20 watt B.C. Pygmy. These can be changed after removing the lamp glass from the front of the instrument panel. The glasses are held in position by a bayonet clip.

(d) **Storage Vessels**

Each storage vessel has two dial type mercury-in-steel thermometers giving the temperature indication at the top and bottom of the vessel. A further thermometer (mercury-in-glass) is provided to enable a reading of the temperature at the centre to be taken. This enables the Attendant to gauge the approximate heat content of the vessels and set the load control relay to a suitable figure when switching on in the evening. The vessels are fitted with internal sparge pipes on the storage flow and heating return. Man-holes, isolating valves, vents and drain cocks are also provided.

In addition a control thermostat is provided at the bottom of the storage vessels, and should be set approximately 20°F lower than the safety thermostat, i.e. at 258°F. If a storage vessel is to be emptied, then its isolating valves 22, 23, 24 and 25 should be closed and its vent and drain cock 26 opened.

Maintenance

The interior of the storage vessels is painted with Apexior compound and whenever a vessel is emptied it is advisable to inspect the condition of this protective coating and re-paint the surface if necessary.

(e) **Storage and Boiler Pumps**

Each boiler is provided with a Storage/Boiler Pump which performs the dual purpose of circulating water through the boiler and water to the storage vessels. The Pumps are selected automatically if the boilers are on automatic control, but on hand control the pumps must be also started by hand. The pumps are provided with isolating valves, the operation of which is indicated on the valve setting chart. The pressure gauges mounted above the pumps enable the pressures on the delivery and suction side to be ascertained. When setting the boiler for operation the cooling water valves, either 11 or 12, must be opened to ensure adequate cooling of the pump bearings. Under no circumstances should these pumps be run with the cooling water shut off.

STEAM CYLINDER OIL FOR THE PUMP GLANDS
& THE WHITE METAL BEARINGS

Maintenance

→ No graphited packings are to be used for re-packing the pumps and the gland units should be pulled up hand-tight only, the slight leakage through the gland being permissible. The oil ring bearings must be kept free and the oil in the bearings should be changed once every three months. Use only best quality light lubricating oil, and see that the oil is kept at the correct level. The pumps must not be run unless they are full of water.

(f) **Sump Pump**

One vertical spindle sump pump is provided over the sump and is operated automatically as soon as the water reaches a pre-determined level. The pump continues to run until the level falls to about 6″ from the bottom of the sump.

(g) **Control Valves and Instruments**

Control valves are provided for isolation and regulation of the various parts of the apparatus, the sequence of operation being dealt with in a further section.

Maintenance

The valve spindle glands should be re-packed periodically with graphited packing, and the glands tightened just sufficiently to prevent leaking past the spindle. When opening a valve the wheel should be turned in an anti-clockwise direction as far as it will go and then slackened in a clockwise direction for half a turn.

(h) **Panel Heating Pumps**

Two pumps are provided for circulating water through the panel heating system, one of these being a stand-by. The pumps have push button automatic starters. When selecting No. 3 pump, valves No. 33 and 35 should be opened, and when selecting No. 4 pump, valves No. 32 and 34 should be opened. It is not necessary to water-cool the panel heating pumps, as they are only dealing with low temperature water and no cooling is provided for. C.T.X.

Maintenance

As for Storage/Boiler Pumps.

(i) **Mixing Valve Station and Thermostat Controller**

The mixing valve station is provided to enable the high temperature water in the storage vessels to be tempered down to that which is required in the panel heating installation. This tempering of the water is normally carried out automatically by the motorised valves 28 and 29. The position of these valves is determined by the controller box to the left of No. 4 pump. With this control, the temperature of the water to the panels will vary inversely to the temperature of the outside air. This enables the utmost economy for the installation as a whole. Manual tempering of the water can be obtained by operating valve No. 31. To isolate the mixing valve, valves No. 27, 30, 32 and 33 must be closed.

For the thermostatic control of the panel heating installation by the controller box referred to above, see description in greater detail under Section 2 concerning the Watford Electric & Manufacturing Co. Ltd. W.P.331 Primostat (Automatic Temperature Control).

Maintenance

The valve spindles should be re-packed with graphited packing and the glands tightened down just sufficiently to stop any leakage of water past the spindles.

Note: No interference is to be allowed to the controller or motorised valve except by the Service Engineer of the manufacturers of the equipment.

(j) **Fusible Link Valves**

The fusible link valves No. 36 and 39 are provided to prevent any high temperature water reaching the panel heating installation. If, for some reason, water at a greater temperature than 130°F finds its ways to these valves, a fusible plug inside the valve will melt and allow a flap to fall. This flap will stop any flow of water to the panels. To isolate valve 36, valves 35 and 37 should be closed, while to isolate valve 39, valves 38 and 40 should be closed. Drains are provided between the two isolation valves to enable the water contained in this length of pipe to be drained in a convenient receptacle.

Maintenance

If a fusible plug melts, the top of the valve should be taken off and the pieces removed. A new fusible plug can be inserted by unscrewing a plug at the bottom of the valve.

TO PUT THE PLANT INTO OPERATION AND SETTING OF THE MAIN VALVES

To Heat Up the Storage Vessels with Boiler on Automatic Control

The general layout of the plant is shown on the accompanying Instruction Drawing, where all the main valves are clearly numbered. The valves must be opened or closed in accordance with this chart.

Ascertain that the installation is filled with water and properly vented, and make sure that the servo-motor is in the lowermost position.

Select the boiler to be used by placing the control switch on the main control panel in the "On" position. The adjustable knob on the load control relay should be set to the desired value of load between 20% and 100% at which the boiler is to be run.

Assuming that the time switch is in the "On" position, the boiler/storage pump should immediately start. When this has run up to speed and changed from star to delta, the oil circuit breaker should come in. This will switch on the red "Boiler On" indicating light on the panel and also above the selected boiler, at the same time extinguishing the green lamp marked "Boiler Off." The servo-motor piston will now begin to rise and the load will be increased until it eventually reaches the value for which the load control relay is set. The magnetic valves R will now close, leaving the servo-motor piston in an intermediate position. As the water in the boiler increases in temperature, so the conductivity increases and it will therefore be found that the load will increase even though the servo-motor piston is stationary. This will cause the load control relay to come into operation and lower the servo-motor piston by means of the valves 'L.' The heated water will be circulated to the storage vessels by the pump in operation, and will gradually take water from the bottom of the vessels, heat in the boiler and replace at the top. There is a bye-pass valve No. 13, which enables water to be circulated from the storage flow to the storage return, thus enabling a considerable quantity of water to flow through the boiler. When the water at the bottom of the storage vessel reaches the set temperature on the control thrmostat, the boiler load will be decreased until the servo-motor piston is in the lower position, whereupon the oil circuit breaker will open.

It will be noticed that there is a slight delay between the time the vessels are satisfied and the opening of the oil circuit breaker, although the load is decreasing during this period. This delay is also occasioned when the time switch switches the boiler off or when the control switch is placed in the "Off" position. The delay is of the order of two or three minutes, but enables the oil circuit breaker to be operated under ideal conditions.

The emergency switch, however, will open the oil circuit breaker immediately, irrespective of the load being taken by the boiler, and although the oil circuit breaker is designed to break on maximum load conditions, burning of the contacts is liable to occur.

Operation No. 1 (Normal)

Automatic Panel Control using No. 3 Pump.
Automatic Boiler Control using No. 1 Boiler.
Rotate control switch on boiler No. 1 Instrument Panel to "On" position, switch No. 1 Boiler Pump Starter to the Auto Position, press start button on No. 3 Panel Pump, check valve openings with Chart.

Operation No. 2

Automatic Panel Control using No. 4 Pump.
Automatic Boiler Control using No. 1 Boiler.
Rotate control switch on Boiler No. 1 Instrument Panel to "On" position, switch No. 1 Boiler Pump Starter to the Auto position, press start button on No. 4 Panel Pump, check valve openings with Chart.

Operation No. 3

Automatic Panel Control using No. 3 Pump.
Automatic Boiler Control using No. 2 Boiler.
Rotate control switch on Boiler No. 2 Instrument Panel to "On" position, switch No. 2 Boiler Pump Starter to the Auto position, press start button on No. 3 Panel Pump, check valve openings with Chart.

Operation No. 4

Automatic Panel Control using No. 4 Pump.
Automatic Boiler Control using No. 2 Boiler.
Rotate control switch on Boiler No. 2 Instrument Panel to "On" position, switch No. 2 Boiler Pump Starter to the Auto position, press start button on No. 3 Panel Pump, check valve openings with Chart.

Operation No. 5

Hand Mixing of Panel Heating

In an emergency the panel heating can be controlled by hand by removing the large knurled bolt from the link arm of the mixing valve motor, this pulls out and can be used for fixing the position of the mixing valve after adjustment.

Note: In no case is the water to the panel installation to exceed 120 F.

Thermostatic Control of Panel Heating—see Section 2.

SHUTTING DOWN OF PLANT

Electrode Boiler

The electrode boiler normally continues to be in operation until shut down by one of the following devices:—

Time Switch
The time switch is set to prevent the boiler from being switched on during peak load hours. When it opens, the load is gradually decreased and the oil circuit breaker is opened and the boiler/storage pump in operation stopped.

Control Thermostats on Storage Vessels
These should be set for a maximum of 258°F, and when they open the load is again gradually decreased and the boiler and pumps in operation shut down.

Boiler Overload
A 3 phase overload relay is provided, and should it operate, the oil circuit breaker and the starter contactors of the pump motor in operation are opened instantly and a red light is shown on the instrument panel. The automatic controls then bring the servo-motor to its lowermost position. The cause of the overload should be ascertained and the trouble remedied, after which the boiler may be started up again.

Out-of-Balance Relay
This relay operates when the Out-of-Balance current exceeds the permissible value, i.e., 15% of the maximum load. When it operates it shuts down the boiler and pump in operation instantly, and a red light is shown on the instrument panel. The cause of the trouble should be removed before re-starting.

Pump Overloads
The pump motor starters are provided with overload devices in each phase. If the overload device in the starters of the boiler/storage pump operates, the boiler is switched off instantly, and a red light is shown on the instrument panel. The overload re-set on the starter must be operated before the boiler will come in again.

Safety Thermostat
The safety thermostat fitted on the flow bend of the boiler operates on an excessively high temperature being developed in the boiler—it shuts down the plant instantly and a red light is shown on the instrument panel. It is necessary to re-set this thermostat by hand before the boiler can again be put into commission.

Audible Warning
In the event of any of the above faults developing the electric bell is switched on. To silence this whilst the fault is being rectified the small green button on the diversion relay should be pressed. This relay is mounted on the column to the right of the main instrument panel.

Terminal Guard Switch
This will operate if any attempt is made to open the door of the terminal guard whilst the boiler is in operation. The moment the guard switch is opened the oil circuit breaker interrupts the high tension supply.

Excess Pressure Switch
In the event of an excess pressure being developed in the boiler, the plant is shut down instantly, and a red light is shown on the instrument panel.

No-Volt Relay
Failure of the high tension supply to the H.T. circuit breaker will immediately shut down the boiler plant.
In all these cases the servo-motor is brought to the minimum load position, ready for starting up, but the cause of any trouble should be ascertained and removed before attempting to put any boiler on load.

Failure of Low Tension Supply
Should the low tension supply fail, the boiler is again shut down instantly, and when it has been resumed the automatic controls will operate to bring the boiler to minimum load.

Flow Control Thermostat
This thermostat, which is situated below the excess pressure thermostat on the flow bend from the boilers, is designed to control the temperature of the water leaving the boiler. It should be set for a maximum of 258°F. When the water reaches 258°F the control thermostat adjusts the load taken by the boiler to the value required to keep the water leaving at 258°F. Since the load is adjusted by the servo-motor more quickly than the flow control thermostats can respond, the load may vary over a wide range. Should this become excessive or undesirable, the servo-motor can be made to operate more slowly by partially closing the hydraulic isolating valve on the boiler control panel. It should be noted, however, that the fluctuating load will have no detrimental effect on the boiler or associated controls.

TO SHUT DOWN BY HAND

Should it be desired to shut the boiler down before the vessels are fully charged (i.e., when the time switch and the control thermostats are still closed), the control switch on the main boiler instrument panel should be placed in the "Off" position. Immediately this switch is re-positioned the boiler load should start to reduce. It will take five or six minutes for the boiler load to be reduced to the minimum load position, and until that time the oil circuit breaker will still be closed. When the minimum load position has been reached the automatic controls will open the oil circuit breaker.

Venting

The air vents are provided to allow any accumulated air to escape, and should be used periodically. (Although the air vents are of the automatic type, the Lockshield valve must be opened by hand and shut off tight after use). If it is necessary to empty a boiler or storage vessel then the vent cock for that particular vessel should be opened as mentioned in another section.

Drawing Off Water

No water must be drawn from the system except when it is necessary to empty down any vessel or pipework.

If any additional information is required, or if an unusual fault develops which is not mentioned above, please communicate with:—

Sulzer Bros. (London) Ltd.,
31, Bedford Square,
London, W.C.1.
Telephone No.: MUSeum 0702.

VALVE CHART

NORMAL OPERATION

This Chart also applies for valve settings for hand control of installation, except those valves mentioned on the preceding page.

Operation No. 1

Automatic Panel Control using No. 3 Pump.
Automatic Boiler Control using No. 1 Boiler.

Operation No. 2

Automatic Panel Control using No. 4 Pump.
Automatic Boiler Control using No. 1 Boiler.

Operation No. 3

Automatic Panel Control using No. 3 Pump.
Automatic Boiler Control using No. 2 Boiler.

Operation No. 4

Automatic Panel Control using No. 4 Pump.
Automatic Boiler Control using No. 2 Boiler.

Valve No.	Operation Number 1	2	3	4	5	6	7	8	Valve No.	Operation Number 1	2	3	4	5	6	7	8
1	O	O	S	S					21	O	O	O	O				
2	S	S	O	O					22	O	O	O	O				
3	N	N	N	N					23	O	O	O	O				
4	N	N	N	N					24	O	O	O	O				
5	O	O	*	*					25	O	O	O	O				
6	*	*	O	O					26	N	N	N	N				
7	O	O	S	S					27	O	O	O	O				
8	S	S	O	O					28	*	*	*	*				
9	O	O	*	*					29	*	*	*	*				
10	*	*	O	O					30	O	O	O	O				
11	O	O	S	S					31	S	S	S	S				
12	S	S	O	O					32	S	O	S	O				
13	N	N	N	N					33	O	S	O	S				
14	O	O	O	O					34	S	O	S	O				
15	O	O	O	O					35	O	S	O	S				
16	O	O	O	O					36	O	O	O	O				
17	O	O	O	O					37	O	O	O	O				
18	O	O	O	O					38	O	O	O	O				
19	O	O	O	O					39	O	O	O	O				
20	O	O	O	O					40	O	O	O	O				

O—Valve open. S—Valve shut. *—Valve open or shut.
N—Valve in normal position.

SECTION 2

AUTOMATIC TEMPERATURE CONTROL

SPECIFICATION

OF THE W.P.300 RANGE PRIMOSTAT

The page numbers in parentheses refer to the number of the page in our Catalogue W.P.50 upon which may be found a full technical explanation of the item concerned.

As a guide, refer to Leaflet W.P.3003/Fig. 1.

1 AUTO TIMER, which automatically starts up heating installation earlier or later depending upon outside weather conditions. (Page 131).

1 CONTROL SWITCH which can over-ride the automatic temperature control. It has three basic positions:

(a) Auto (giving automatic control).
(b) Raise (over-riding heat increase).
(c) Lower (over-riding heat decrease). (Page 130, para. 4).

1 pair CONTROL CIRCUIT FUSES on main supply.

1 CONTROL CIRCUIT DOUBLE WOUND TRANSFORMER for low voltage supply to the control circuit rectifier(s) and, if required, to valves. (Page 125).

1 CONTROL CIRCUIT RECTIFIER for 24 volt D.C. supply to relays and bridges. (Page 125).

1 RATING SWITCH which enables the installation to be run at ratings other than that dictated by the "TIMER" at any given time. (Page 130, para. 3).

1 AUTOMATIC BOOST which in conjunction with the Auto Timer permits the heating installation after starting to be run at a boost rating until the room temperature level set by the Room Limitation Resistance is attained. (Page 131, under Auto Timer).

1 BRIDGE RESISTANCE NETWORK detecting temperature variations. (Page 125).

1 TIMING MOTOR in conjunction with the patented contact protection circuit mentioned below, tests the temperature sensitive bridge at short intervals for unbalance.

1 GALVONOMETER RELAY sensitive to unbalance currents of only a few micro amperes, is responsible for the initiating signal to the heat control devices through auxiliary D.C. relays. (Page 125).

1 set AUXILIARY D.C. RELAYS which receive the signal from the Galvonometer and appropriately operate heat control devices such as valves, stokers, burners, the electrode shield of an electrode boiler, fan motor contactors, etc. (Page 125).

1 BUILDING CHARACTERISTIC ADJUSTING RESISTANCE, see sheet for setting instructions. (Page 129).

1 ROOM TEMPERATURE LEVEL ADJUSTING RESISTANCE, see sheet for setting instructions. (Page 129).

1 ROOM LIMITATION ADJUSTING RESISTANCE, which may be set to control the upper limit of room temperature. It compensates for the introduction into the heated space of any uncontrollable heat such as solar radiation, large number of occupants, etc. (Page 129, para. 2).

1 RED INDICATING LAMP, indicates when heat input is being increased.

1† GREEN INDICATING LAMP, indicates when heat input is being decreased.

Terminals are provided on the Primostat for Remote Rating and Frost Protection switches. See External Wiring Diagram.

†Not fitted to On/Off Type Primostats, which have a white lamp indicating supply on.

THE INFINITELY PROGRESSIVE PRIMOSTAT

1. As a guide, reference should be made to the schematic diagram of the mode of control, Leaflet W.P.1006 (Fig. 2).

2. The Primostat, by controlling the output from a heat source inversely as the outside temperature varies, maintains the heated space temperature constant at a required level. The anticipation of the reduction or increase in the amount of heat required to accomplish this as the outside temperature increases or decreases respectively, ensures that under all conditions and consistent with comfort, heat is used with the greatest possible economy.

3. The Primostat, sensitive to outside temperature, regulates the amount of heat required by the fine adjustment between maximum and minimum settings of control devices such as:—

(a) the steam supply valve to a calorifier

(b) the mixing valves in a low or high pressure hot water system

(c) the mixing dampers in a Plenum System

(d) the position of the electrode shield in an Electrode Boiler.

4. The appropriate relation between (a) the Outside Temperature, (b) the heat output from the primary heat source and (c) the required Room Temperature is established by setting the Building Characteristic and Room Temperature dials on the Primostat at positions correct for the particular heating installation. These settings should be carefully determined in the manner shown on Leaflet W.P.1008.

5. Where required as a precautionary measure, an upper limit Thermostat with over-riding control is fitted to ensure that a safe working temperature is not exceeded.

6. By means of the Rating Switch the installation may be run at ratings other than that normally required. In general the switch may be set to enable the system to be run at either of the following ratings:—

(a) Normal Rating, which maintains the Room Temperature at the level normally required during occupancy (65°F).

(b) Reduce Rating, which maintains the Room Temperature at a level approximately 10°F lower than that corresponding to (a) (55°F) (Flow=90°).

(c) Boost Rating, which over-rides any temperature control and permits the heating plant to operate at its maximum rate.

(d) Frost Protection Rating, which permits the installation to maintain a level corresponding to a Room Temperature of 35-45°F, in order to prevent freezing of the water services.

7. Whereas range W.P.200 and W.P.300 Primostats are provided with a Rating Switch giving the above settings, the W.P.100 Range Primostat Rating Switch has only two positions (a) Normal and (b) Reduce. However, by connecting external single pole switches to existing terminals shown in the external diagram, ratings (c) and (d) may be obtained.

8. A brief description of the function of individual items mounted on the Primostat is given in the Specification Leaflet.

9. A detailed discussion of Watford-Pigral Temperature Control may be found in our Catalogue No. W.P.50.

THE ADJUSTMENT OF THE BUILDING CHARACTERISTIC & ROOM TEMPERATURE DIALS

1. The care with which the best setting for these dials is obtained will be a measure of the amount of fuel saved. Time thus spent will repay handsomely.

2. The initial setting of the Building Characteristic and Room Temperature dials requires a knowledge of:

(a) the required Room Temperature (65°F)

(b) the Boiler Flow Temperature necessary to maintain this Room Temperature when the Outside Temperature is 30°F (120-115°F).

3. These figures, which should be obtained from the Heating Engineers responsible for the installation, enable suitable settings for the dials to be extracted from the Calibration Chart on Leaflet W.P.1009 —. If the figure for the Boiler Flow Temperature (b) is not available, it should

normally be taken as 180°F, but for low temperature Panel Heating, 100°F should be taken. An example demonstrating the use of the Calibration Chart is given, together with the Chart, on Leaflet W.P.1009/—.

4. N.B.—The Primostat should be operating at "Normal" rating during any observation period.

5. **Room Temperature Too Low or Too High on Cold Days only**

If it is found eventually that with the dial settings selected, the Room Temperature is too low on **cold days only**, then a higher value for the Flow Temperature should be taken (for example, if 180°F was taken originally, then use 200°F) and the dial settings corresponding to this temperature and the original room temperature should be extracted from the Calibration Chart. On the other hand, if it is found that with the original dial settings, the Room Temperature is too high on **cold days only**, then a lower value for the Flow Temperature should be taken and together with the original Room Temperature, revised dial settings extracted from the Calibration Chart.

6. **Room Temperature Too Low or Too High Generally**

However, if it is observed over a period of varying outside temperatures that the Room Temperatures are generally too low, then a higher value for the required Room Temperature (a) should be taken (for example, if 60°F was taken originally, then use 62°F) and the dial settings corresponding to this temperature and the original Flow Temperature (b) extracted from the Calibration Chart. Conversely, if the Room Temperatures are generally too high over a period of varying outside temperatures, then the Room Temperature should be given a lower value and dial settings corresponding to the temperature and the original Flow Temperature (b) extracted from the Calibration Chart.

7. Once a satisfactory setting has been obtained, the dial positions should be recorded in order that they may be reset in the event of any accidental alteration.

CALIBRATION CHART

T.C. 814

Flow Temperature at 55°F Outside	Flow Temperatures at 30°F Outside											
	135		130		125		120		115		110	
	R.T.	B.C.	R.T.	B.C.	R.T.	B.C.	R.T.	B.C.	R.T.	B.C.	R.T.	B.C.
100	5.3	1.7										
95	6.1	3.7	5.3	1.5								
90	6.5	4.7	6.2	3.2	6.0	2.6	5.0	0.0				
85	6.8	5.7	6.4	3.8	6.6	4.2	5.8	1.6				
80	7.1	6.9	6.8	5.2	6.9	5.3	6.7	3.5	5.5	0.3		
75	7.4	8.3	7.2	6.6	7.2	6.3	7.0	5.0	6.6	3.2	6.1	1.2
70	7.7	10.0	7.5	8.5	7.4	7.5	7.3	7.0	7.1	4.6	6.8	3.1

Note: R.T. Indicates Room Temp. Dial 6.7

B.C. Indicates Building Characteristic Dial 3.5

THE AUTO TIMER

1. **GENERAL**

1.1. The AUTO-TIMER introduces the Outside Temperature as a modifying factor of the Time basis of the control. It is apparent that the time a heating installation takes from starting to attain the required space temperature will depend upon the outside temperature; a longer time being necessary in cold than in mild weather.

1.2. The AUTO-TIMER automatically compensates the starting time according to the outside temperature and gives a late start in mild weather and an early start in cold weather.

In order to ensure a rapid build-up of temperature when starting up in the morning, the Auto-Timer provides for the plant to run under " Boost " conditions, either until the nominal time of starting, when normal control from outside temperature takes over, or when " Room Limitation " is provided, until the room temperature is brought within a few degrees below the required figure, when normal control from outside temperature takes over.

Conversely, the Auto-Timer anticipates the time of shut-down in mild weather and thus utilizes the heat storage of the building to maintain a reasonable temperature until the occupants leave.

1.3. During the night periods of the normal working week, the Auto-Timer operates the system at a " Reduce " rating. Throughout the weekend, it operates the system at a " Frost Protection " rating which maintains a space level of heating corresponding to 35°-45°F.

2. ADJUSTMENTS

2.1. Clock has Lost or Gained Time

The Auto-Timer is driven by a self-starting synchronous motor AND NO ATTEMPT SHOULD BE MADE TO TURN THE DIALS UNLESS THE " PRESS TO SET " BUTTON IS DEPRESSED, thereby disengaging the motor drive. The time and day appear opposite the pointer on the 24-hour clock and day dials. To correct the time, depress the " Set " button and rotate the dials bodily in an ANTI-CLOCKWISE direction by means of a suitable projection such as the knurled screw on the " Stop " dial.

2.2 Stopping and Starting Times of the Heating Installation

2.2.1. Although it is usual to adjust both the " Start " and " Stop " timing discs concurrently, the procedure for each is described separately for the sake of clarity.

2.2.2. The " Stop " disc changes the rating of the installation from " Normal " (i.e. daytime) to " Reduce " (i.e. night-time) level. The time at which this change takes place is automatically modified by the existing outside temperature (See para. 1.2. above).

2.2.3. In order to make any alteration to the " Stop " dial setting, depress the setting button, and rotate the disc in an ANTI-CLOCKWISE direction by means of a suitable projection such as the knurled screw in the actuating arm, so that the time opposite the pointer is between 1400 and 1600 hours; this ensures that the discs are in their most accessible position. Remove the knurled screw, and the " Stop " disc is free to move.

2.2.4. Initially the knurled screw is inserted through the actuating arm into one of a series of holes calibrated in half-hours steps from 1630 to 2000 hours. These times correspond to the time at which the building concerned becomes unoccupied, and normally the knurled screw is inserted through the arm into the hole that is so marked. For example, if the occupants leave at 1730 hours, then the screw is inserted through the clearance hole in the arm into the hole marked 1730 hours, and screwed tight. Two points must be watched:—

(a) After the knurled screw is removed, the " Start " disc directly beneath the " Stop " disc is also free to move. The " Start " disc should be securely held between the finger and thumb of the left hand whilst the " Stop " disc is being moved (unless of course the starting time is also being altered, when the " Stop " disc is removed altogether, see para. 2.2.6.).

(b) Whatever setting is attempted, on no account should the final position of the discs be such that either the radial edge of the " Stop " disc projects beyond the ramp on the " Start " disc, or the radial edge of the " Start " disc projects beyond the " Stop " disc ramp.

2.2.5. **The " Start " Disc** changes the rating of the installation back from " Reduce " (i.e. night-time) to " Normal " (i.e. daytime) level. The time of this change is automatically modified by the existing outside temperature. (See para. 1.2. above).

2.2.6. In order to expose and make any setting alterations to the " Start " disc which is directly beneath the " Stop " disc, proceed as in para. 2.2.3. and as before, remove the knurled screw, and carefully noting its existing setting, slide the " Stop " disc from under the " Day " disc in a left to right direction. The " Start " disc is then free to move.

2.2.7. Initially the knurled screw is inserted through the actuating arm and the " Stop " disc, and screws into one of a series of holes calibrated in half hour steps from 0600 to 0930 hours. These times correspond to the time at which the building concerned becomes occupied, and normally the knurled screw is inserted through the arm " Stop " disc into the hole corresponding to that time. For example, if the building becomes occupied at 0830 hours, then the screw is inserted through the actuating arm and the hole required in the " Stop " disc (in the previous example it was the 1730 hours hole) and screwed into the " Start " disc hole marked 0830 hours. Again, the point stressed in para. 2.2.4 (b) should be watched.

2.3. Heating Installation Reduces Input Too Early or Too Late

2.3.1. If after carrying out the settings described in para. 2.2.2. et seq., it is found that the heating reduces either too early or too late, which means that the room temperature is either too low when the occupants leave, or remains too high for some time after their departure, then, provided that **the estimated change in the stopping time is not more than plus or minus half an hour,** an adjustment may be carried out by removing the knurled screw and advancing or retarding the " Stop " dial **one step only** from the normal setting and reinserting the screw. For example, if the occupants leave at 17.30 hours, and the room temperature is as a rule still high at 1830 hours, the " Stop " dial setting may be moved from 1730 hours to 1700 hours. Conversely, if the room temperature is generally too low at time of the occupants' departure, the " Stop " dial setting may be moved from 1730 hours to 1800 hours. The two points, para. 2.2.4. (a) and (b), must again be watched. Should the discrepancy be somewhat more than half an hour, details of the closing time required and the observed discrepancy should be forwarded to us, when we will supply a new disc with a modified ramp.

2.4. Heating Installation Starts Too Early or Too Late

2.4.1. If, after carrying out the settings described in para. 2.2.5. et seq., it is found that the heating plant is starting either too early or too late, which means that the required room temperature is either attained too soon before the occupants arrive or is not at its required level when they arrive, then, provided that **the estimated change in the starting time is not more than plus or minus half an hour,** an adjustment can be made by removing the knurled screw, and taking care not to move the " Stop " dial, advance or retard the " Stop " disc one step only from its normal setting and reinserting the screw. For example, if the normal occupation time is 0830 hours and the room temperature is generally at its required level at 0800 hours then the " Start " disc may be moved one step and the screw reinserted into the 0900 hours setting. Conversely, if the room temperature is generally too low at the occupation time, the " Start " disc may be moved one step and the screw reinserted into the 0800 hours setting. Attention is again drawn to the point stressed in para. 2.2.4. (b). Should the discrepancy in the starting time be somewhat more than plus or minus half an hour, details of the starting time required and the observed discrepancy should be forwarded to us when we will supply a " Start " disc with a modified ramp.

2.5. Weekend Frost Protection Rating Disc

2.5.1. The Auto-Timer is provided with either a 5 or 5½ day week disc. This is the innermost disc of all on the driving shaft and its ramp operates the system throughout the weekend at a room temperature of 35°-45°F corresponding to a Frost Protection Rating. That is to say, the heating system only operates when the temperature falls below 45°F.

2.5.2. If it is desired to change the disc from either a 5 day to 5½ day working week, or vice versa, then on application to us, we will supply an alternative disc.

2.5.3. To remove the existing disc, depress the " Setting " button and turn the dials in an ANTI-CLOCKWISE direction by means of a suitable projection such as the knurled screw, until the weekend ramp is at the bottom. Unscrew the countersunk screw which is midway along the ramp, and then the innermost disc, being slotted, may be slid from underneath in a left to right direction. The replacement disc can then be placed into position and the countersunk screw reinserted and screwed tight.

2.5.4. Adjustment to the times at which the " Frost Protection " rating commences or ceases may be made by removing the countersunk screw and turning the disc in the appropriate direction, i.e. anti-clockwise to advance and clockwise to retard the commencing time. The minimum variation obtainable is 2 hours and it should be noted that the " Commencing " and " Ceasing " times are **not** independent, i.e. if the " Commencing " time is advanced by two hours, the " Ceasing " time is retarded by two hours, and vice versa.

TYPICAL STARTING TROUBLES AND THEIR REMEDY

Symptom	Fault	Remedy
1. Primostat fails to start.	(a) Lack of Electrical Supply. (b) The connection between the G1 terminal on the external detector box and the G1 terminal on the Primostat is not made.	(a) Check fuses and supply. If in order then (b) Check continuity between the points mentioned and make good any disconnection. Ascertain that all connections are soldered at those points shown as such on the external wiring diagram.
2. The Primostat continues to call for an increase in heat input, indicated by the red lamp, regardless of an increase in room temperature beyond the required level.	One or more of the following connections are not made:— (a) The connection between the negative terminal of the immersion detector and the negative terminal on the Primostat. (b) The connection between the positive terminal on the external detector junction box and the positive terminal on the Primostat. (c) The connection between G2 on the immersion detector and G2 on the Primostat. (d) The immersion detector open-circuited between its negative and G2 terminals.	(a) (b) (c). Check the continuity between the points mentioned and make good any disconnection. Ascertain that all connections are soldered at those points shown as such on the external wiring diagram. (d) Check for continuity and if faulty, report to us.
3. The Primostat calls for a **decrease** in heat input, indicated by the green light when it is obvious that an **increase** is required.	One or more of the following connections are not made:— (a) The connection between the positive terminal on the immersion detector and the positive terminal on the Primostat. (b) The connection between the negative terminal on the external detector junction box and the negative terminal on the Primostat. (c) The external detector open-circuited internally between its negative and G1 terminals.	(a) (b) Check for continuity between the points mentioned and make good any disconnections. Check soldering as in (2). (c) Check for continuity and if faulty, report to us.

If the fault is not traced, switch off the Primostat and communicate with us (Phone No. Watford 28201). It is not advisable to undertake any adjustments or alterations within the Primostat itself.

INSTALLATION INSTRUCTIONS FOR THE ROOM TEMPERATURE DETECTOR

1. The Detector is designed for use indoors and is sensitive to ambient temperature. It is also responsive to radiant heat.

2. The Detector should be mounted about 7 or 8 feet from the ground level.

3. The Detector should not be mounted where it may be influenced by electric lamps, radiators, processes or apparatus giving off heat.

4. The Detector should not be subject to direct rays of sunshine.

5. Where a drawing showing the approximate location of the Detector(s) is supplied for the installation, it should be followed as closely as possible.

6. The Detector is suitable for wall mounting and is supplied with a wooden base which can be cut away to take conduit.

7. Wiring connections should be made in accordance with the external wiring diagram supplied. Solder all connections carefully.

If any additional information is required, please communicate with the manufacturers:—

Watford Electric & Manufacturing Co. Ltd.,
Whippendale Road,
Watford, Herts.
Telephone No. Watford 28201.

SECTION 3

VENTILATION SYSTEMS

NORTH PAVILION—ROOF SPACE

VENTILATION PLANT FOR END LAVATORIES—DRAWING No. C.2157/18

DESCRIPTION

A system of Extract Ventilation is provided with a fan arranged in the roof space. The duct-work is run in the vertical shafts passing up through the building adjacent to the entrances to these lavatories on successive floors. The lavatories served are those on the 2nd, 3rd and 4th floors, together with the Members Cloakroom on the 1st floor next to the North Pavilion at the Park Street end of the building. Extract grilles are positioned on the face of the walls, on the side nearest to the Lift, and from these branch ducts are taken to connect into the vertical extract ducts in the shafts, rising right up into the roof spaces to join up and be taken into the fan suction. From the Extract fan the discharge duct is taken out to drop down the shaft in one corner of the Pavilion, to an outlet grille in the external wall of the shaft below the level of the Pavilion Dome.

EQUIPMENT

1 — No. 30SS Extract Fan for 2,500 C.F.M. against 0.625 ins. W.G. with ½ H.P. Bull Motor — **Maker**—Matthews & Yates Ltd.

1 — S.C.A. Pedestal mounted type 945 starter for Extract Fan, with Pilot Lighting — **Maker**—Brookhirst Switchgear Ltd.

Indicated on Control and Instrument Panel:—

Pilot light for running of Extract Fan.

MAINTENANCE OF EQUIPMENT

Extract Fan — See Matthews & Yates Ltd. Leaflet No. FM/SS Second Edition and No. 00.U/01 for Bull Motors.

Motor Control Gear — See Brookhirst Switchgear Ltd. Leaflets. Components 3002/1. 3031/1. 3015.2002/1. Spares 672.698/1.682/1.719.

DRAWINGS

Relevant drawings to this Ventilation System:—

C. 2157/18
C. 2157/49
C. 2157/50
C. 2157/51
C. 2157/52
C. 2157/53

SOUTH PAVILION—ROOF SPACE

VENTILATION FOR END LAVATORIES — DRAWING No. C.2157/14

DESCRIPTION

A system of Extract Ventilation is provided with a fan arranged in the roof space. The duct-work is run in the vertical shafts passing up through the building adjacent to the entrance to these lavatories on successive floors. The lavatories served are those on the 2nd, 3rd and 4th floors, together with the Members Cloakroom on the 1st floor next to the South Pavilion, at the Cathedral end of the building. Extract grilles are positioned on the face of the walls on the side nearest to the lift, and from these branch ducts are taken to connect into the vertical extract ducts in the shafts, rising right up into the roof space to join up and be taken into the fan suction. From the extract fan the discharge duct is taken out to drop down the shaft in one corner of the Pavilion, to an outlet grille, in the external wall of the shaft below the level of the Pavilion Dome.

EQUIPMENT

1 — No. 30SS Extract Fan for 2,500 C.F.M. against 0.625 ins. W.G. with ½ H.P. Bull Motor
— Maker—Matthews & Yates Ltd.

1 — S.C.A. Pedestal mounted type 945 starter for Extract Fan, with Pilot Lighting
— Maker—Brookhirst Switchgear Ltd.

Indicated on Control and Instrument Panel:—

Pilot light for running of Extract Fan.

MAINTENANCE OF EQUIPMENT

Extract Fan — See Matthews & Yates Ltd. Leaflet No. FM/SS Second Edition and No. 00.U/01 for Bull Motors.

Motor Control Gear — See Brookhirst Switchgear Ltd. Leaflets. Components 3002/1, 3031/1, 3015.2002/1. Spares 672,698/1,682/1,719.

DRAWINGS

Relevant drawings to this Ventilation System:—

C. 2157/14
C. 2157 49
C. 2157/50
C. 2157/51
C. 2157/52
C 2157/53

NORTH TOWER—FOURTH FLOOR

VENTILATION PLANT ROOM FOR COUNCIL CHAMBER — DRAWING No. C.2157/26

DESCRIPTION

Balanced System of Ventilation with Inlet and Extract ductwork to Council Chamber and Entrance Hall on 1st floor level. Lesser rooms connected to the extract ductwork—Telephone Booths for Press Room 1st Floor, and Film Store 3rd Floor. Connected to inlet ductwork—Archivist's Store 2nd Floor.

Inlet ductwork to Council Chamber, drops from inlet fan in Plant Room down to 3rd Floor level, and enters false roof space over Council Chamber at this level. Air enters Room through apertures concealed in feature of ceiling. Inlet ductwork to Entrance Hall continues from main droppers and passes at high level through Gallery on 2nd Floor slab. Air enters Hall through 'Stylovent' diffusers used as light fittings in right and left hand Vestibules.

Extract duct work from Council Chamber connects to grilles under seating, and passes in the false ceiling over the City Treasurer's Office, to the Gallery between Upper Ground and 1st Floors. Thence to the North Tower to pass vertically up to the extract fan in the roof space of Tower.

Extract ductwork from Entrance Hall is taken to below false floor of Members Cloakrooms on Upper Ground Floor, to rise to high level in the Gallery between Upper ground, and 1st Floors, and then join with that from the Council Chamber.

Adjustable dampers are provided in all main branch ducts, near position where branches are taken off.

For position of temperature recording points, and feed tank for wet and dry bulb thermometer unit on wall of Tower at 2nd Floor level—see drawings Nos. C.2157/20 and /7.

EQUIPMENT

1 — Primary Air Heater 6′ 0″ wide x 5′ 0″ high for hot water operation with flow 180°F and return 150°F to raise 13,500 c.f.m. from 30°F to 60°F. 2½″ F & R. Connections. — **Maker**—Matthews & Yates Ltd.

1 — Secondary air heater do. do. to raise 13,500 c.f.m. from 50°F to 70°F. 2½″ F & R. Connections. — **Maker**—Matthews & Yates Ltd.

1 — 6′ 0″ long x 6′ 0″ wide x 5′ 0″ high air washer to handle 13,500 c.f.m. — **Maker**—J. Gardner & Co. Ltd.

1 — Air washer pump with 5 h.p. motor. — **Maker**—F. A. Pullen & Co. Ltd.

1 — 16 cell fabric Air Filter 7′ 4″ x 7′ 4″. — **Maker**—J. Jeffreys & Co. Ltd.

1 — No. 70 S.S. inlet fan for 13,500 c.f.m. against 0.75 ins. W.G. with 4 h.p. Bull motor. — **Maker**—Matthews & Yates Ltd.

1 — S.C.A. Pedestal mounted type 945 starter for inlet fan, with pilot lighting.

1 — do. do. for extract fan.

Interlocking contacts provided on the stator switches to ensure the motor cannot be started until the motor regulator is in low speed position and all resistance is in circuit.

1 — Double speed regulator for inlet and extract fans. Speed reduction of 50% against fan load, and the two regulators operated by the one handle to ensure speed of both fans varied simultaneously.

Inlet fan stator switch having interlocking contacts and sequence isolation, so that the extract fan cannot be started up until inlet fan is running.
— **Maker**—Brookhirst Switchgear Ltd.

1 — Four pole isolator switch for both inlet and extract fans. — Maker—Brookhirst Switchgear Ltd.

1 — Type YHA, Size 2A starter for air washer, pump motor with pilot lighting. — Maker—Brookhirst Switchgear Ltd.

1 — No. 50 S.S.D.I.D.W. extract fan for 13,500 c.f.m. against 0.5 ins. W.G. with 3 h.p. Bull motor. — Maker—Matthews & Yates Ltd.

1 — 2" PMSX modulating valve, on flow main to secondary air heater battery, controlled through a response regulator unit on wall of Plant Chamber, by a QXP room thermostat at Public Gallery end of Council Chamber. — Maker—The Rheostatic Co. Ltd.

1 — Type FS/105P Rigid stem dial thermometer for recording air temperature leaving primary air heater, and entering air washer. — Maker—Negretti & Zambra Ltd.

1 — do. do. for recording air temperature leaving secondary air heater and entering fan for distribution. — Maker—Negretti & Zambra Ltd.

1 — Distance reading electric dry bulb immersion thermometer, in air washer pump delivery pipework, to record wash water temperature on Control and Instrument Panel in Boiler House.

Also indicated on Control and Instrument Panel:—

Readings for 1 wet and 2 dry bulb temperatures. Pilot lights for running of inlet fan and extract fan, and air washer pump.

MAINTENANCE OF EQUIPMENT

Air Heaters—See Matthews & Yates Ltd. Leaflet No. 138/6.

Air Washer—See J. Gardner & Co. Ltd. Instruction Sheet.

Air Washer Pump—See Fredk. A. Pullen & Co. Ltd. Leaflet No. A203.

Air Filter—See J. Jeffreys & Co. Ltd. Instruction Sheet and Drawing No. 1126/2.

Inlet and Extract Fans—See Matthews & Yates Ltd. Leaflet No. FM/SS Second Edition and No. 00.U/01 for Bull Motors.

Motor Control Gear—See Brookhirst Switchgear Ltd. Leaflets. Components 3002/1,3031/1, 3015,2002/1,713,3013. Spares 672, 698/1,682/1, 719,636,680.

Modulating Valve and Room Thermostat—See Rheostatic Co. Ltd. Leaflets No. 200X and 244, Issue 1.

DRAWINGS

Relevant drawings to this Ventilation System:—

C. 2157/6
C. 2157/7
C. 2157/20
C. 2157/26
C. 2157/28
C. 2157/44
C. 2157/45
C. 2157/46
C. 2157/49
C. 2157/50
C. 2157/51
C. 2157/52
C. 2157/53
C. 2157/55

SOUTH TOWER—FOURTH FLOOR

VENTILATION PLANT ROOM FOR CONFERENCE ROOM—DRAWING No. C.2157/27

DESCRIPTION

Balanced System of Ventilation with Inlet and Extract ductwork to Conference Room on 1st Floor level. Also connected to the Extract ductwork—Waiter's Room 3rd Floor.

Inlet ductwork to Conference Room, drops from Inlet fan in Plant Room down to 3rd Floor level, and enters false roof space over Conference Room at this level. Air enters room through apertures concealed in feature of ceiling.

Extract ductwork from Conference Room connects at high level on 1st floor level to the tops of Builders' ducts, on the sides adjacent to the Entrance Hall and Servery. At the foot of these Builders' ducts, Extract Grilles are fitted under the stone seating. This Extract ductwork splits into two, one range passing back through the false ceiling of the Entrance Hall Vestibule and Servery on 1st Floor, and the other range in the false ceiling of the Kitchen 2nd Floor, both to rise vertically in the void at the back of the Tower to the Extract Fan in the roof space. Joining this ductwork at 3rd Floor level is the Extract from the Waiters' Room. On the external wall of the Conference Room, grilles are fitted to the bottom of Builders' ducts taken up at the sides of the windows, to the false ceiling over at 3rd Floor level. The Extracts are then taken through the Builders' ducts in the false ceiling, to connect to the main extract at the back of the Tower.

Also in this Plant Room is installed the Extract Fan for the ventilation of the Kitchen 2nd Floor, and Servery 1st Floor. Air is extracted from the Servery through a hood connected to a Builders' duct, in turn connected to a metal duct passing through the false ceiling over the Kitchen 2nd Floor. Extract from the Kitchen is through grilles under the Canopy into the false ceiling. From the false ceiling an Extract duct is joined to that from the Servery, and taken up to connect to the Kitchen Extract Fan. The discharge from this fan is taken out through the back wall of the South Tower to atmosphere.

Adjustable dampers are provided in the Kitchen Extract ducts and Waiters' Room duct. For position of Temperature Recording Points, and Feed Tank for Wet and Dry Bulb Thermometer Unit in Extract Duct in Gallery 2nd Floor level—See Drawings Nos. C.2157/20 and /7.

EQUIPMENT

1 — Primary Air Heater 6′ 0″ wide x 6′ 0″ high for hot water operation with flow 180°F and return 150°F to raise 14,500 C.F.M. from 30°F to 60°F. 2½″ F & R. Connections.	— **Maker**—Matthews & Yates Ltd.
1 — Secondary Air Heater do. do. to raise 14,500 C.F.M. from 50°F to 70°F. 2½″ F & R. Connections.	— **Maker**—Matthews & Yates Ltd.
1 — 6′ 0″ long x 6′ 0″ wide x 6′ 0″ high air washer to handle 14,500 C.F.M.	— **Maker**—J. Gardner & Co. Ltd.
1 — Air washer pump with 5 h.p. motor.	— **Maker**—F. A. Pullen & Co. Ltd.
1 — 16 cell fabric Air Filter 7′ 4″ x 7′ 4″.	— **Maker**—J. Jeffreys & Co. Ltd.
1 — No. 70 S.S. Inlet Fan for 14,500 C.F.M. against 0.75 ins. W.G. with 4 h.p. Bull motor.	— **Maker**—Matthews & Yates Ltd.
1 — S.C.A. Pedestal mounted type 945 starter for inlet fan, with pilot lighting.	Interlocking contacts provided on the stator switches to ensure the motor cannot be started until the rotor regulator is in low speed position and all resistance is in circuit.
1 — do. do. for Extract Fan.	Inlet fan stator switch having interlocking contacts and sequence isolation, so that the Extract fan cannot be started up until inlet fan is running. — **Maker**—Brookhirst Switchgear Ltd.
1 — Double speed regulator for inlet and extract fans. Speed reduction of 50% against fan load, and the two regulators operated by the one handle to ensure speed of both fans varied simultaneously.	

1 — Four pole isolator switch for both inlet and extract fans. — Maker—Brookhirst Switchgear Ltd.

1 — Type YHA, Size 2A starter for air washer, pump motor with pilot lighting. — Maker—Brookhirst Switchgear Ltd.

1 — No. 55 S.S.D.I.D.W. Extract fan for 14,500 c.f.m. against 0.5 ins. W.G. with 3 h.p. Bull motor. — Maker—Matthews & Yates Ltd.

1 — 2" PMSX Modulating valve, on flow main to secondary air heater battery, controlled through a Response regulator unit on wall of Plant Chamber by a QXP room thermostat under centre of stone seat on South side of the second doorway into Conference Room. — Maker—The Rheostatic Co. Ltd.

1 — Type FS/105P Rigid stem dial thermometer for recording air temperature leaving primary air heater, and entering air washer. — Maker—Negretti & Zambra Ltd.

1 — do. do. for recording air temperature leaving secondary air heater and entering fan for distribution. — Maker—Negretti & Zambra Ltd.

1 — Distance Reading electric dry bulb Immersion Thermometer in air washer pump delivery pipework to record wash water temperature on Control and Instrument Panel in Boiler House.

1 — No. 45 S.S. Extract Fan for Kitchen for 5,000 C.F.M. against 0.375 ins. W.G. with 1½ H.P. Bull Motor. — Maker—Matthews & Yates Ltd.

1 — S.C.A. Pedestal mounted type 945 starter for Kitchen Extract Fan, with pilot lighting. — Maker—Brookhirst Switchgear Ltd.

Also indicated on Control and Instrument Panel:—

Readings for 1 wet and 2 dry bulb temperatures.
Pilot lights for running of inlet fan, extract fan, kitchen extract fan, and air washer pump.

MAINTENANCE OF EQUIPMENT

Air Heaters—See Matthews & Yates Ltd. Leafllet No. 138/6.

Air Washer—See J. Gardner & Co. Ltd. Instruction Sheet.

Air Washer Pump—See Fredk. A. Pullen & Co. Ltd. Leaflet No. A203.

Air Filter—See J. Jeffreys & Co. Ltd. Instruction Sheet and Drawing No. 1126/2.

Inlet and Extract Fans—See Matthews & Yates Ltd. Leaflet No. FM/SS Second Edition and No. 00.U/01 for Bull Motors.

Motor Control Gear—See Brookhirst Switchgear Ltd. Leaflets. Components 3002/1, 3031/1, 3015,2002/1, 713,3013. Spares 672,698/1, 682/1, 719, 636, 680.

Modulating Valve and Room Thermostat—See Rheostatic Co. Ltd. Leaflets No. 200X and 244, Issue 1.

DRAWINGS

Relevant drawings to this Ventilation System:—

C. 2157/7
C. 2157/20
C. 2157/27
C. 2157/48
C. 2157/49
C. 2157/50
C. 2157/51
C. 2157/52
C. 2157/53
C. 2157/55

CENTRAL POSITION — GROUND FLOOR

VENTILATION PLANT ROOM FOR CITY TREASURER'S OFFICE—DRAWING No. C.2157/11

DESCRIPTION

System of Ventilation with Inlet and Extract ductwork to City Treasurer's Offices on Ground Floor level. Also connected to the plenum Inlet ductwork of this system—branch ducts taken to supply fresh air to Interview Room, Strong Room, and Writing Room, all being on Ground Floor. The Fresh Air Inlet to the Plenum Plant for the City Treasurer's Office is brought through Builders' duct from the open area at ground level below front access roadway facing College Green, into the Plant Room. The Plenum inlet duct passes from the fan up into the false floor on Upper Ground Floor, then to gallery at high level adjacent to City Treasurer's Office. The inlet duct then branches right and left splitting into a series of short ducts, fitted with outlets behind a continuous Builders' grille, at high level in City Treasurer's Office. Extracts are taken from grilles at low level under window sills on the far side of City Treasurer's Office, and up through vertical Builders' ducts into horizontal metal ducts in the false ceiling over the City Treasurer's Office. Thence extract air is taken into common duct in gallery returning to the Extract Fan in the Plant Room in the same manner as inlet duct is brought in. The discharge is then through Builders' duct into open area similar to that for the fresh air inlet.

The same Plant Room houses the Extract Fan set serving the Extract Ventilation System for the Central Lavatories 3F and 4M on Upper Ground Floor, and 1M and 2F on Ground Floor.

The ductwork runs are shown on drawings Nos. C.2157/44 and /47. Adjustable dampers are provided in the ductwork runs at the main branches.

For position of Temperature Recording Points, and Feed Tank for wet and dry bulb Thermometer Unit in Extract Duct in Gallery at high level adjacent to City Treasurer's Office—See Drawings Nos. C.2157/20 and /7.

EQUIPMENT

1 — Primary Air Heater 4′ 0″ wide x 4′ 0″ high for hot water operation with flow 180°F and return 150°F to raise 6,500 C.F.M. from 30°F to 60°F. 2″ F & R. Connections. — **Maker**—Matthews & Yates Ltd.

1 — Secondary Air Heater do. do. to raise 6,500 C.F.M. from 50°F to 70°F. 2″ F & R. Connections. — **Maker**—Matthews & Yates Ltd.

1 — 5′ 0″ long x 4′ 0″ wide x 4′ 0″ high Air Washer to handle 6,500 C.F.M. — **Maker**—J. Gardner & Co. Ltd.

1 — Air Washer Pump with 4 H.P. Motor. — **Maker**—F. A. Pullen & Co. Ltd.

1 — 9 cell Fabric Air Filter 5′ 6″ x 5′ 6″. — **Maker**—J. Jeffreys & Co. Ltd.

1 — No. 50SS Inlet Fan for 6,500 C.F.M. against 0.5″ W.G. with 1½ H.P. Bull motor. — **Maker**—Matthews & Yates Ltd.

1 — S.C.A. Pedestal mounted type 945 starter for inlet fan with pilot lighting.

1 — do. do. for Extract Fan.

Inlet fan stator switch having interlocking contacts and sequence isolation, so that the Extract Fan cannot be started up until inlet fan is running. — **Maker**—Brookhirst Switchgear Ltd.

1 — Four Pole Isolator Switch for both Inlet and Extract Fans. — **Maker**—Brookhirst Switchgear Ltd.

1 — Type YHA Size 2A Starter for Air Washer Pump Motor. with pilot lighting. — **Maker**—Brookhirst Switchgear Ltd.

1 — No. 45 SS Extract Fan for 5,000 C.F.M. against 0.5 ins. W.G. with 1½ H.P. Bull motor. — **Maker**—Matthews & Yates Ltd.

1 — 2" PMSX Modulating Valve on flow main to Secondary Air Heater Battery, controlled through a Response Regulator Unit on wall of Plant Chamber, by a QXP Room Thermostat on centre of wall between the windows on the far side of the City Treasurer's Office. — **Maker**—The Rheostatic Co. Ltd.

1 — Type FS/105P Rigid Stem Dial Thermometer for recording air temperature leaving Primary Air Heater, and entering Air Washer. — **Maker**—Negretti & Zambra Ltd.

1 — do. do. for recording air temperature leaving Secondary Air Heater and entering fan for distribution. — **Maker**—Negretti & Zambra Ltd.

1 — Distance Reading Electric Dry Bulb Immersion Thermometer in Air Washer Pump delivery pipework, to record wash water temperature on Control and Instrument Panel in Boiler House.

1 — No. 30 SS Extract Fan for Central Lavatories for 2,000 C.F.M. against 0.5 ins. W.G. with ½ H.P. Bull motor. — **Maker**—Matthews & Yates Ltd.

1 — S.C.A. Pedestal mounted type 945 Starter for Central Lavatories Extract Fan, with pilot lighting. — **Maker**—Brookhirst Switchgear Ltd.

Also indicated on Control and Instrument Panel:—

Readings for 1 wet and 1 dry Bulb Temperatures.

Pilot Lights for running of Inlet Fan, Extract Fan, Central Lavatories, Ground Floor and Upper Ground Floor Extract Fan, and Air Washer Pump.

MAINTENANCE OF EQUIPMENT

Air Heaters—See Matthews & Yates Ltd. Leaflet No. 138 6.

Air Washer—See J. Gardner & Co. Ltd. Instruction Sheet.

Air Washer Pump—See Fredk. A. Pullen & Co. Ltd. Leaflet No. A203.

Air Filter—See J. Jeffreys & Co. Ltd. Instruction Sheet and Drawing No. 1126/1.

Inlet and Both Extract Fans—See Matthews & Yates Ltd. Leaflet No. FM/SS Second Edition and No. 00.U/01 for Bull motor.

Motor Control Gear—See Brookhirst Switchgear Ltd. Leaflets. Components 3002/1, 3031/1, 3015, 2002/1, 3013. Spares 672, 698/1, 682 1, 719.680.

Modulating Valve and Room Thermostat—See Rheostatic Co. Ltd. Leaflets No. 200X and 244. Issue 1.

DRAWINGS

Relevant drawings to this Ventilation System:—

C. 2157/6
C. 2157/7
C. 2157/11
C. 2157/20
C. 2157/44
C. 2157/47

SOUTH END—BASEMENT

AIR CONDITIONING PLANT ROOM FOR ARCHIVES DEPARTMENT—DRAWING No. C.2157/39/40/41/43 (Composite)

DESCRIPTION

A complete Air Conditioning System is provided in the Basement for this Department, with Fresh Air Inlet, Warm Air Supply, and Recirculated Air ductwork leading from the special Plant Room alongside the conditioned room. Fresh air is brought into the plant from ductwork connection to a Builders' fresh air shaft situated behind the partition wall in the Archives Room. The fresh air inlet duct connects to a suction box, to which is also connected the recirculated air duct, before passing through inter-coupled dampers into the inlet to the capillary air washer.

Also before the dampers, and from the suction box, a by-pass damper controlled branch duct is taken to the outlet side of the air washer. The water pumped through the air washer, is chilled and kept to a low temperature by a Freon refrigeration plant, and the whole plant is controlled by a system of electrical automatic equipment.

The sequence of operation is as follows:—

When the air circulating fan is energised, the electrical supply to the control equipment is made. Provided the limit switch on the 3-way mixing valve is made, the refrigerating machinery will then be subject to the dictates of the immersion thermostat in the line from the water cooler. This thermostat operates both the air-cooled condenser and compressor, but must not control the washer pump.

The sequence of control is as follows:—

An electrical proportioning damper control unit is fitted to the by-pass and washer dampers, and a three-way proportioning valve is fitted on the chilled water and re-circulated water lines. These units are controlled in sequence by a double potentiometer dewpoint thermostat, with the sensitive element positioned after the washer. A humidistat positioned in the return air duct would re-set the dew point controller in the case of a fluctuation in relative humidity. The dry bulb temperature would be measured by a thermostat placed in the return air duct controlling a proportioning valve in the heating flow to heater battery.

After leaving the air washer, the air passes through the heater battery and is delivered along the inlet ducting by the centrifugal fan, into the Archives Department via 8 supply air grilles each with adjustable dampers. Inside the Archives Department 4 12" dia. propeller fans suitably arranged at high level, agitate the air within the room to ensure even condition and distribution throughout. On the far side of the room, 6 recirculation air grilles, each with adjustable dampers, are fixed to the partition wall, and connect with branch ducts into the main recirculation ductwork back to the Plant Room. The air is then re-conditioned in the correct proportion, as dictated by the automatic controls, and again circulated to the Archives Department.

The plant is required for continuous operation throughout the year, and the internal design conditions for the Archives is to maintain 60°F dry bulb and 60% relative humidity, when the outside summer condition is at 85°F dry bulb and 50% relative humidity, and outside winter condition is at 30°F dry bulb and 100% relative humidity.

EQUIPMENT

1 — Complete Refrigeration Plant, duty to cool 15 gallons of water per minute from 45°F to 41°F, representing a total heat extraction of 36,000 BTU's per hour. — **Maker**—Alfred Porter & Co. Ltd.

(a) **Compressor**—One triple cylinder reciprocating single acting, enclosed type Freon 12 compressor, with 2½" bore and 3" stroke and running at 350 R.P.M. driven by "V" rope drive from a 4 H.P. motor.

(b) **Condenser**—One air-cooled condenser assembly, comprising a battery of copper tube with inlet and outlet headers, and sheet metal casing. The liquid receiver situated beneath the battery. Condenser assembly incorporates a propeller fan with fractional H.P. motor.

(c) **Evaporator**—One shell and tube water cooler with oil recovery still provided, and oil drain line to compressor unit. Liquid and suction connections each with stop valves.

(d) **Starters**—One direct on triple pole automatic contactor, for remote automatic control of the condenser. One direct on triple pole automatic contactor, for automatic control of compressor.

(e) **Oil Separator**—One oil separator fitted in the discharge line between the compressor and condenser. Unit comprising steel drum housing filtering media, hot gas inlet and outlet connections, positive oil return line float valve.

(f) **Controls and Safety Devices**—For automatic control of the plant:—

1. High pressure float valve.
2. Adjustable differential type thermostat.
3. Pressure operated water switch.
4. Automatic suction pressure regulator.
5. Oil recovery heat exchange unit.
6. Filter/Dryer Unit.
7. Hand set high pressure cut-out.
8. Low pressure cut-out.

1 — Single Inlet Centrifugal Fan duty 2,240 C.F.M. with 1 H.P. Bull motor. — Maker—Fan Equipment Corp. Ltd.

1 — Starter for Fan Motor D-on-line type with extra contactor to which electrical supply for the control system is wired.

1 — Size 130 Capillary Ball Washer having 3-cells high x 1 cell wide, for 2,240 C.F.M. — Maker—Fan Equipment Corp. Ltd.

1 — Air washer circulating pump for duty 15 gallon per minute with Bull motor. — Maker—Fan Equipment Corp. Ltd.

1 — Direct-on-line starter for pump motor.

1 — Air Heater Battery to raise 2,240 C.F.M. from 56½°F to 62½°F when supplied with hot water at 180°F flow, and 150°F return. ½" F & R. connections. — Maker—Spiro-Gills Ltd.

1 — Chilled Water Surge Tank 100 gallons 63" x 24" diam.

1 — Chilled water circulating pump for duty 15 gallons per minute with Bull motor, in pipeline to evaporator. — Maker—Rhodes, Brydon & Youatt Ltd.

AUTOMATIC CONTROLS

(a) 1 — Model 2B electric proportioning damper Control Unit with final shaft movement of 180°.

(b) 1 — Model ZA electric proportioning 3-way mixing valve size 1¼". Valve handles 15 gallons per minute, and has additional limit switch to break electrical circuit to compressor and evaporator.

(c) 1 — Model ZD.2 dewpoint thermostat, operating at 46°F, with fine throttling range for sequential control of two units (a) and (b). — Maker—Teddington Industrial Equipment Ltd.