CONSULTING ENGINEERS.
HEATING & VENTILATION.
TELEPHONE: MUSEUM 8225/6.

J. ROGER PRESTON & PARTNERS

J. ROGER PRESTON,
M.I.MECH.E., F.R.S.I., PP.I.H.V.E., F.I.ARB.
L. COPELAND WATTS, A.C.G.I., M.I.H.V.E.
ADRIA BUCHANAN, M.R.S.I., A.I.H.V.E.

DILKE HOUSE,
MALET STREET,
LONDON, W.C.1.

S P E C I F I C A T I O N of Engineering Work in connection with the proposed Heating, Hot and Cold Water Services and Ventilation at BRISTOL MUNICIPAL BUILDINGS for the LORD MAYOR, ALDERMEN AND BURGESSES of the CITY OF BRISTOL.

9th April 1937.

Definition of Terms.

For the purpose of this specification, the following words and expressions shall have the meaning attached to them:-

The "Architect" shall mean E. Vincent Harris Esq., O.B.E., F.R.I.B.A., 9 Clifford Street, Bond Street, W.1.

The "Quantity Surveyor" shall mean F.J. Clevely Esq., F.S.I., 58 Gordon Square, London, W.C.1.

The "Consulting Engineers" shall mean Messrs. J. Roger Preston & Partners, Dilke House, Malet Street, London, W.C.1.

The "Employers" shall mean the General Building Contractor who shall be appointed to carry out the building work in connection with the main contract.

The "Contractor" shall mean the firm of Engineers who shall be appointed to carry out the work described in this specification

The "Contract Drawings" shall mean the signed copies as follows:-

835/9A. Panel Connections.
835/15A. Thermal Storage Plant.
835/27A. Panel Risers.
835/28A. Basement and Roof.
835/29A. Ground Floor.
835/30A. Upper Ground Floor.
835/31A. First Floor.
835/32A. Second Floor.
835/33A. Third Floor.
835/34A. Fourth Floor.
835/35A. Council Room Fan Chamber.
835/36A. Ground Floor ditto.
835/37A. Conference Room ditto.
835/38A. Layout of Lavs. etc.
835/39A. Panel Details.

All the above drawings dated 20th March 1937.

The "Site" shall mean the New Municipal Buildings, Bristol.

This specification is to be read in conjunction with the General Conditions dated April 1936, which the Contractor will be deemed to have read and which may be seen at the Offices of the Consulting Engineers, and also in conjunction with the conditions of the Main Contract where they apply. Particular attention must be paid to this.

BRIEF DESCRIPTION OF PROPOSED INSTALLATIONS.

Boiler House.

Two electrode water boilers are to be installed in the basement under the tower at the South end of the building, directly below the Transformer Room.

The control panel in connection with these boilers is to be provided alongside the boilers, and also the transformer for the low voltage equipment in connection with the hot water service immersion heaters. The main oil switches, however, are to be erected in the Transformer Room over the boiler house and connected direct to the feeder bus-bars. The primary, secondary and hot water service accelerators are to be installed in the boiler room.

In order to obtain sufficient head room for the boilers, the centre portion of the room will be sunk, the boilers, switchgear and transformer being placed at the low level and the various accelerators being placed at the normal basement level.

From these boilers the primary circulation is to be taken to six storage cylinders situated at ground floor level in a room under the approach road. Connections are to be taken from the primary flow and return mains to each cylinder, all connections being valved so that any cylinder can be isolated. Similarly, the cold feed to the heating is to be connected into each cylinder separately and valved. Also in this room, at the end nearest the boilers, a hot water service storage cylinder is to be provided, heated by means of three banks of immersion heaters, the switchgear controlling these heaters being placed in the boiler house adjacent to the main switchboard.

Heating.

From the storage vessels horizontal mains are to run in the basement and in the trenches under the ground floor of the building. The mains are to be run on the reversed return system so as to give equal travel to all risers. The latter are to be run in casings at the sides of the stanchions as shown on the plans. Two accelerators are to be provided for the heating system. Both are to be electrically driven and one is to be used as a standby to the other. Heating surface is to be provided as shown on the plans in the form of embedded warming panels served by the risers. The coils and connections are to be cast in the floors and the flow riser to each panel is to be valved. The panel control valves are to be fixed in recesses formed in the pipe casings and are to have a special shield giving access to the valve spindle for operating, as shown on detail, Drawing No. 835/39A. At the bottom of each pair of risers, control valves and drain cocks are to be fitted, and at the top an automatic air vent is to be provided on the return, in the roof space or above the flat roof, as the case may be. Provision for expansion is to be made on all risers.

The flow main is to be connected to a three-port mixing valve with thermostatic control of the mixed water temperature, a by-pass from the return main giving the cool water to mix with the high temperature flow from the storage vessels. The secondary pumps are to be connected in the flow main immediately after the mixing valve and before the thermostat controlling the latter.

Heating (cont'd.)

The expansion tank for the heating system is to be a cast iron plate tank and is to be installed in the roof space with a feed pipe connecting to the thermal storage cylinders, an overflow and a ball valve.

A separate circulation is to be run from the high temperature primary flow and return to serve the heater batteries of the three main ventilation plants. An accelerator pump with standby and a three-port mixing valve are to be provided as in the case of the panel heating.

Hot Water Service.

From the thermal storage vessel in the boiler chamber, horizontal mains are to run in the basement and in the trenches under the ground floor of the building. Risers from these mains are to be run in the casings on either side of the stanchions as shown on the plans. From the risers, branches are to be taken to serve all lavatory basins, sinks, etc., as shown on the drawings. The branches are to be brought to within approximately one foot of each fitting or group of fittings and finished with a stop cock with lead-to-iron union for the plumber to connect to the fitting. All the hot water supply arrangements are to comply with the requirements of the Bristol Waterworks Company, and any fees required by them are to be paid by the Contractor. An accelerator is to be fitted on the return of the hot water service system to maintain the circulation, and a standby is to be provided.

Cold Water Service.

From the Water Company's main, a 2 in. service pipe is to be run to two cold water storage tanks, each of 3,500 gallons capacity, fixed in the roof of the building. One of these tanks is to have a $2\frac{1}{2}$ in. outlet with a $2\frac{1}{2}$ in. feed pipe connecting to the hot water service cylinder. The other tank is to have a $2\frac{1}{2}$ in. outlet with a main connection to the cold water service system. Each tank is to be provided with ball valve and overflow. From the service pipe a branch is to be connected to a ball valve in the feed and expansion tank for the heating system. The cold water service mains are to be run in the roof space and connected to drop pipes in casings as shown on the plans. The drop pipes are to run in the stanchion casings or other spaces as indicated, and branches are to be brought to within one foot of the various fittings or groups of fittings; each such branch to be fitted with a stop cock with lead-to-iron union for the plumber to make the connection to the fittings.

All the cold water service equipment is to comply with the requirements of the Bristol Waterworks Company, and any fees required by them are to be paid by the Contractor.

Ventilation <u>Council Chamber and Entrance Hall.</u>

A balanced system of ventilation with inlet and extract is to be provided, with separate fans in fan chamber on roof. The inlet ducts to the entrance hall are to be run in false ceilings at high level on the second floor. The inlet to the Council Chamber is to be run in a false roof space over the Council Chamber. The extract from the entrance hall is to run below the floor of the members' cloakroom on the upper ground floor and that for the Council Chamber is to be brought from under the gallery and run at high level on the first floor.

Ventilation (cont'd.)

Conference and Ante Rooms.

A balanced system of ventilation with inlet and extract is to be provided, with separate fans in fan chamber on roof. The inlet ducts to the Ante Room and the Conference Room are to be run in the false roof space over, as in the case of the Council Chamber, and the extract is to be brought from under the gallery and run at high level on the first floor again as in the case of the Council Chamber.

City Treasurer's Office.

A system of inlet and extract ventilation is to be provided. The inlet and extract fans are to be arranged in the fan chamber on the ground floor and the ducts are to be run in the false ceiling space over the City Treasurer's Office, as shown on the drawings

Lord Mayor's Rooms, Committee Rooms, etc., on First Floor.

A system of extract ventilation is to be provided. A separate extract fan for each wing is to be fixed, one in each of the two main fan chambers.

The extract ducts are to be run in the false ceiling space over the rooms, and vertical uptakes are to be taken on the sides of the stanchions to the roof over the third floor. Thence the ducts are to run to the main fan chamber, as shown on the drawings.

The extract gratings in the ceilings of these rooms are to be arranged to suit the treatment of the ceilings.

Kitchen.

An extract ventilation system is to be provided with a fan in the fan chamber on the roof. The extract ducts in the kitchen are to be formed in a false ceiling space over the whole of the kitchen, with suitable extract grilles or openings over the kitchen apparatus.

Lavatories and Cloakrooms at centre of building, on ground and lower ground floors are to be provided with an extract ventilation system, the extract fan to be placed in fan chamber on ground floor.

Lavatories on Second, Third and Fourth Floors.

The two groups of lavatories (one at each end of the building) are to have separate extract fans arranged in the roof space. The ducts are to run in the vertical shafts which have been arranged to take ductwork and pipes, all as shown on the drawings.

Basement and Boiler Chamber.

A Natural system of ventilation is to be arranged for the boiler chamber, the tank room and the basement stores.

In the boiler chamber a builders' work shaft will be provided by the building contractor from the ceiling level of the boiler chamber to the roof, with suitable outlet louvres. An inlet grille of suitable design is to be

Ventilation (cont'd.)

Basement and Boiler Chamber (cont'd.)

fixed in the boiler chamber at the bottom of this vent shaft. The fresh air inlet is to be through permanent vents in the windows in the tank chamber, which open to the area adjoining.

For the ventilation of the basement stores, three fresh air ducts in builders' work will be provided, running from the area adjoining the tank chamber to ceiling level of the basement stores.

On the opposite side of the basement, two extract grilles are to be provided in the walls of the two staircases. These are to be fixed to frames which will be provided by the building contractor, which are to be of a suitable size for fixing a 24 in. propeller fan in each at a later date should these be required.

A Provisional Sum of £50. 0. 0. (Fifty Pounds) is to be included for the provision of these two propeller fans.

Any partitions which may be erected in the basement will be suitably pierced to permit air circulation in the basement stores.

General.

Special precautions are to be taken throughout to ensure silence in operation of all moving machinery, all fans and accelerators being belt driven by means of 'tex-rope' drive, the fans, accelerators and motors being insulated from the structure by special sound-insulating material or anti-vibrators. No metallic continuity between the fans and ducts will be allowed; all such joints to be completed by means of sail cloth.

Special attention must be paid to the construction of the ductwork, and easy bends are to be used throughout with distributing vanes provided in order to ensure an even velocity throughout cross section. In addition, special distributing heads are to be installed in the various rooms to ensure low velocities and equal distribution over the whole face of the outlet gratings.

Provision is also to be made on all branch ducts by means of adjustable dampers so that the whole system can be balanced after erection. These dampers are to be so designed that they can be locked in position after setting.

Special precautions are to be taken throughout the work to ensure neatness.

In general, all pipes and ventilating ducts will be concealed, but in cases such as short branches to taps, etc. where the pipes have to be run on surface, particular attention is to be paid to the way these are run and supported.

All branch circulations on heating and hot water service are to be valved at both flow and return ends, whether these valves are shown on drawings or not, and emptying cocks are to be provided at the lowest points of all such circulations to enable these to be drained when required.

General (cont'd.)

Provision is to be made for venting all high points of heating and hot water service circulations by means of automatic air vessels or open vents, as may be most suitable. Automatic air vessels are to be arranged so that any discharge of water from them will be visible, but will not cause injury or damage to persons or structure.

All heating and hot water service circulations are to be covered, except where otherwise specified. Cold water pipes in roof spaces, etc., are also to be covered. Any pipes run outside are in addition to have the covering finished with a special waterproof coat, as specified.

Electric wiring is to be carried out in accordance with the regulations of the I.E.E. and the local Electricity Supply Company. Galvanised conduit is to be used wherever there is a risk of condensation. Wiring is to be included throughout between the motors and switchgear and in connection with the electrode boilers, the supply to the switchgear being run under another contract.

All pipes passing through walls and floors are to be provided with sleeves, the sleeves to be made from pipe of the same quality as that used for the circulations. Floor plates must also be included for fitting round pipes where they leave floors, walls or ceilings.

BRIEF SUMMARY OF WORK INCLUDED IN CONTRACT.

This list is not necessarily comprehensive, but is intended as an indication of the extent of the contract.

Included.

Supplying and fixing the following:-

Two electrode water boilers with all fittings, mountings and accessories.
High tension circuit breakers.
High tension cable between circuit breakers and heaters.
Transformer.
Low tension main isolating switch and wiring to units and instruments.
Recording instruments.
Primary Pumps.
Motors, switchgear and guards.
Instrument and control panel.
Storage Cylinders with all fittings & mountings.
Modulators, complete with thermostats, rectifiers and wiring.
Secondary Pumps, motors and switchgear for heating and ventilation.
Feed and Expansion Tank with ball valve, overflow, cover, supports, etc.
Cold Water Storage Tanks with ball valves, overflows, covers, supports, etc.
Water Meter and strainer.
Hot Water Service Storage Calorifier with immersion heaters.
Switchgear Control Panel and thermostats for above.
Hot Water Service Accelerators, motors and switchgear.
Altitude Gauges for all accelerators.
Pipes and Fittings.
Valves, keys and labels.
Expansion Loops and Anchors.
Sleeves and Floor Plates.
Vents and overflows.
Automatic Air Vessels, air cocks, etc.
Supports, stays, hangers, etc.
Pipe Coils for embedded panels including ties or other supports, control valves and wall boxes for same.
Drain Cocks.
Thermometer Pockets.
Covering and painting of covering and supports.
Include a P.C. Sum of £40. 0. 0. (Forty Pounds) for Water Co's charges and pipe from water meter to rising mains.
Ventilation Equipment, including air washers, heaters, filters, fans, motors, switchgear, etc., for the various units, with all circulating pumps, tanks, etc.
Distributing ductwork and supports.
Diffusing inlet heads.
Dampers, mid-feathers, baffles and access doors in connection with ducting.
Flexible Connections between fans and trunking.
Silencing Equipment.
Electric Wiring between switchgear and equipment.
Stairs, handrailing, ladders, etc.
Sump Pump.

Included (cont'd.)

Include 2½% for the Builders.

Include Insurance Company's fees in connection with the inspection of heaters, storage vessels, motors, etc.

Include fees required by Water and other Local Authorities.

Include everything to make a complete working installation.

Include for testing plant on completion and for providing unskilled labour to assist the Consulting Engineers to carry out tests.

Include a P.C. sum of £950. 0. 0. (Nine Hundred and Fifty Pounds) for bronze grilles, etc.

Include a Provisional Sum of £50. 0. 0. (Fifty Pounds) for basement extract fans.

Include a Provisional Sum of £2,000. 0. 0. (Two Thousand Pounds) for contingencies, to be spent or not, as may be directed by the Consulting Engineers.

The Contractor will be required to supply to the Consulting Engineers and thereafter amend same to their instructions, fitters' plans to ½ in. scale showing the exact layout of the plant and pipework in the central station and also other layouts considered necessary by the Consulting Engineers. He must also supply any sketches, foundation plans, etc. necessary for the Clerk of Works and Builders on site, and must also arrange to keep the Clerk of Works and Builders' Foreman fully informed as the work proceeds as to all builders' work required, such as holes, chases, trenches, bases for machines, etc.

The Contractor will be required to forward to the Consulting Engineers a report as to the progress of work every fortnight, to be received on each alternate Tuesday. He must also forward monthly a statement showing the position of the contract and authorised extras which may have occurred.

The Contractor must allow for all Engineers' attendance necessary for running such parts of the plant as are workable prior to the completion of the whole contract and also for running the whole of the plant for one month after completion and for instructing the Council's Engineers in the correct use of the apparatus during that time. Framed instructions are to be provided alongside each piece of apparatus requiring same, and in addition, complete printed instructions (i.e., set up in printers' type) are to be provided in accordance with the General Conditions, for the working of the whole equipment.

It is to be understood that the Employers are at liberty to use any part of the installation which the Consulting Engineers may deem suitable for use without in any way relieving the Contractor from responsibility under the terms of the contract.

The Contractor must understand that the period of maintenance commences when the contract as a whole is entirely completed, and not when separate sections are set to work.

Included (cont'd.)

The Contractor is to be responsible for the insurance of the plant as specified in the General Conditions, both during progress of the work and while any part or the whole of the installation is working until the expiration of the period of maintenance.

All drip and drain connections, overflows, safety valve outlets, etc., must be carried to positions where they will be visible but not cause a nuisance or danger, either to persons or structure nearby.

All motors are to be of the supersilent type, suitable for positions in which they are to be fixed, and suitable for the electricity supply.

All running machinery is to be guarded to the satisfaction of the Consulting Engineers and the Insurance Company and to comply with the Home Office requirements.

The Contractor must include for carrying out a preliminary test on the plant and for making all adjustments and balancing which may be necessary and providing unskilled labour to assist the Consulting Engineers in carrying out tests.

All work must proceed as quickly as and in conjunction with the builders' work, and the Contractor must give special attention to the programme of delivery of materials.

The Contractor must include for carrying out the work in accordance with the building progress, even if this takes longer than planned, and no extra will be granted due to this lengthened period or to a rise in prices during the progress of the work.

Proper supervision must be given to the work generally, all necessary visits being made by a responsible member of the staff for this purpose.

The Contractor will be required to pay the whole of his workmen such rates of wages and observe such hours of labour as are recognised by the workmen's Trade Unions.

Not Included.

Builders' work, such as cutting away, making good, building-in brackets, supports, etc.
Painting, except painting of covering, pipe supports and flanges.
Supply and erection of sanitary fittings and lavatory basins.
Concrete bases for electrode water heaters, accelerators, storage vessels, fans, motors, &c.
Trenches and chases in floors or walls.
Drainage work.
Lead safes under cold water tanks, or lagging same against frost.
Electric wiring from intake chamber to main switches.

SPECIFICATION OF MATERIALS TO BE USED.

General.

The names of firms and materials mentioned in the following specification are given as indicating the exact type of article required. The tenderer must quote for these particular makes on the form provided, but it is open for him to put forward alternative makes of material or machines of the same standard, provided these are given at the time of tendering and are accompanied by full specification and alternative prices.

All material must be of British or Empire manufacture unless otherwise specified, and must be in accordance with British Standard Specifications where such exist.

Conditions of Electricity Supply.

Three phase electrical energy will be supplied by the Electricity Department of the City of Bristol at a pressure of 6,350 volts, the frequency being 50 cycles. The power for the heaters will only be available between the hours of 10 p.m. and 7 a.m.

The maximum load on each high voltage heater will be 1,500 kW. The maximum load on the low voltage heater will be 150 kW.

The pump motors and all control gear will be supplied from a separate source (i.e., the transformer room supplying current for the lighting of the building). This supply will be available at all hours. The 3 phase 4 wire supply will be at a pressure of 365 volts and a frequency of 50 cycles.

On the electrical portion, this contract will commence at and include the three oil-immersed circuit breakers and all wiring from these circuit breakers to the equipment is to be included.

In the case of the low tension supplies, a 3 phase, 4 wire supply at a potential of 365 volts and a frequency of 50 cycles, will be laid on to the ironclad isolating switch provided by the Contractor in the boiler chamber. This contract will commence at and include this main isolating switch and also all contactors, starters and switches as hereinafter specified and wiring between these and all other apparatus included in this specification, excluding only the general lighting of the boiler chamber.

The general lighting of the boiler room in the basement and of the storage room on the ground floor is excluded from this contract, but any indicating lamps or visible or audible signalling systems are included.

The available area and head room are indicated on the plans.

The Employers do not bind themselves to accept the lowest or any tender, and reserve the right if they think fit to place the high voltage heating equipment with one firm and to place the low voltage heating equipment with another firm.

Electrical Thermal Storage Equipment. General.

The electrical thermal storage equipment is to comply with the regulations of the Institution of Electrical Engineers (10th edition), numbers 714 (A) to (F) inclusive, 715 (A) and (C) and 1346 (A), (B) and (C). The note following the last-mentioned regulation is also to be treated as a regulation; and where in regulation No. 714 (C) an out-of-balance relay operating at 15% of full load current is stipulated, the closer limit of 10% is to be taken as the maximum permissible. In the same regulation, where it is stated that overload trips shall operate as little as practicable in excess of full load current, a setting of 20% over the full load current is the maximum permissible.

High Voltage Electrode Water Heaters

Two vertical high voltage electrode water heaters are to be supplied and erected, each rated at 1,500 kW's and capable of raising the temperature of 280 gallons of water per minute 30°F. when working at full rated capacity, the temperature range of the water being 50 - 280°F.

The electrode connections may be arranged either at the top or the bottom, and the shells may be either riveted or welded.

The boilers are to be suitable for a working pressure of 50 lbs. per square inch, and are to be tested to 100 lbs. per square inch hydraulic pressure.

Suitable access to the electrodes and porcelain insulators must be arranged, either by providing an easily removable top to the boiler or by means of manholes in the sides of the boiler in appropriate positions, in order to facilitate inspection and replacement of parts.

The terminals of the electrodes must be enclosed by suitable guards with interlocks to prevent access to the terminals while the supply is on.

The maximum available head room is 16 ft. 0 in., and allowance for dismantling of the heaters is to be included in this height. An eyebolt, or suitable support is to be arranged over heaters for hoisting

The flow and return connections to the storage cylinders are to be valved and interconnected so that each heater can be run separately.

The outlets for safety valves are to be arranged to discharge to a safe position, where steam can be discharged without danger. Drain connections are to be provided.

The following fittings are required on each high voltage heater:-

One 6 in. inlet connection.
One 6 in. outlet connection.
One 3 in. spring loaded safety valve, Hopkinson's Figure No. 501.
One air release valve.
One draw-off valve.
One safety thermostat controlling the switch tripping mechanism.

High Voltage Electrode Water Heaters (cont'd.)

One Negretti & Zambra 4 in. dial mercury-in-steel thermometer, Figure No. 5347.P.
One water flow switch controlling the main switch tripping mechanism, designed to trip the main switch when the water flow through the heater fails.
One altitude gauge.
One excess pressure switch.

The following automatic controls are to be provided:-

(1) The whole of the energy required for the heaters must be under the control of a time switch so as to enable the supply to the electrode heaters to be switched on and off at predetermined hours by means of oil switches, Nos. 1 and 2.

(2) Under normal conditions of working, the supply must further be under the control of a working thermostat, that is, an immersion thermostat inserted in or near the flow from or the return to the boilers and set to limit the temperature of the storage water to a predetermined maximum value.

(3) When the supply is cut off under normal working conditions, either by the working thermostat or by the time switch, the automatic load control must reduce the load to the minimum load position.

(4) When the plant is running, the automatic load control must be capable of maintaining the load on the boiler at within 5% of the predetermined value.

(5) Provision must be made for varying the predetermined setting of the maximum load between limits of 15% and 100% of the maximum boiler output.

(6) The primary pump must be controlled by an automatic contactor associated with the control equipment, so that it starts before and shuts down after the supply is closed or opened to the electrode heater.

In addition, the automatic controls must shut down any boiler by breaking its oil switch when any one of the following fault conditions occurs:-

(a) Instantaneously, should an overload occur on the boiler of 20% or more of the full load phase current.

(b) After a short time delay should an out-of-balance in excess of 10% of the full load phase current occur on the boiler due to breakdown of insulation or any other cause

and instantaneously in the event of:-

(c) Failure of the pump motor or of the supply thereto.

(d) Failure of the water flow through the boiler.

(e) Excess temperature in the boiler above the limit at which it is controlled by the working thermostat.

High Voltage Electrode Water Heaters (cont'd.)

In the event of an emergency shut-down under any of the five foregoing faults, a signal must be given by means of an alarm bell or other audible warning device, and the particular fault which has caused the shut-down must be indicated either on a suitable separate indicator board or on the appropriate relay. In addition, the relay or switch which caused the shut-down must lock out, so as to necessitate rectification of the fault and resetting by hand before the plant will again start up.

Although the emergency shut-down must be instantaneous, except for the short time delay on the out-of-balance relay, i.e., may occur at any setting of the electrode shields, the load must be reduced to a minimum before the supply is again switched on to the boiler when a re-start is made.

While it is open to firms tendering to submit their standard designs of heaters, preference will be given to the design having the greatest flexibility of control and adjustment of load consistent with robustness and simplicity of construction. This adjustment shall be automatic to the extent that when the power is available during the restricted hours of supply, the heater circuits shall be closed under minimum load conditions, and that the normal cutting off of the supply at the end of the restricted period or by the working thermostat (as distinguished from instantaneous emergency tripping) shall be under minimum load conditions.

Provision must be made for varying the predetermined setting of the maximum operating load, in order that the total heating load may be distributed as uniformly as possible over the restricted hours of supply. It is suggested that there should be setting points of the load control, having the following percentage values of the total operating load of the heaters:-

15%, 30%, 45%, 60%, 75%, 87% and 100%.

Conductivity of Local Water Supply.

If the Contractor's standard design is such that it is necessary to increase the conductivity of the water in the heaters by the addition of soluble constituents, then the Contractor shall state in his tender the nature and amount of such soluble constituent to be added, and shall satisfy the Consulting Engineers that it is absolutely stable when used and is non-corrosive in its action upon the shells of the heaters or storage vessels, pipings, radiators, valve bodies, pump casings or impellers or other part of the system provided always that the temperature range and the quantity of soluble constituents added do not exceed the amount stated in the tender by more than 5%. Alternatively, if chemical treatment is unsuitable, the Contractor is to include for the supply and erection of a suitable distillation plant consisting of an L.T. electrode boiler, condenser, tank and feed pump for pumping the makeup into the system, together with all interconnecting piping, switches and safety devices.

Thermal Storage Cylinders.

Six mild steel horizontal storage cylinders, each with a capacity of 9,000 gallons, are to be provided. The internal diameter of the cylinders to be 10 ft. 6 ins. & the overall length approximately 18 ft. The shell is to be $\frac{1}{2}$ in thick, with dished ends of $\frac{5}{8}$ in. thick plates. To be manufactured from Siemens Martin's steel, made by the Open Hearth Process. Longitudinal seams to be lapped and double rivcted and circumferential seams to be single riveted.

Hot Water Storage Calorifier (cont'd.)

exceed 18 watts per square inch of tube surface. The mild steel face plate must be drilled for fixing, by means of at least sixteen 1 in. bolts to the flanged mouthpiece on the storage vessel. Each element to have a "de-loaded" end 4 in. long measured from the face plate. The free ends of the elements in each bank to be suitably braced together and provided with a support adjustable from 9 in. to 12 in. long. The heaters are to be connected for balance between phases on a 365 volt 3 phase 50 cycles supply as mentioned.

The following fittings are required on the low voltage storage vessel,-

One $2\frac{1}{2}$ in. flow connection.
One $1\frac{1}{2}$ in. return connection.
One 1 in. spring loaded safety valve, Hopkinson's Figure No. 5842.
One $\frac{1}{2}$ in. air release valve.
One 2 in. drain valve.
One 4 in. dial Negretti & Zambra mercury-in-steel thermometer, Figure No. 5347.P.
One working thermostat controlling the main switch tripping mechanism.
One $2\frac{1}{2}$ in. cold feed connection.
One safety thermostat controlling the main switch tripping mechanism.
Two Negretti & Zambra brass-cased thermometers, Figure No. 7235.P., with mercury well.

Transformer for Low Voltage Immersion Heater.

This transformer is to be supplied from the 6350 volt bus-bars through No. 3 circuit breaker (referred to later). It is to be mesh connected on the primary side. The pressure across phases on the secondary side is to be 365 volts. The secondary windings to be star connected and the neutral point brought out to a separate terminal. The transformer to be of the oil immersed type with an expansion vessel, and to have the following accessories:-

Trifurcating boxes on both incoming and outgoing leads.
Rollers.
Drain valve.
Oil pressure gauge.
Dial temperature indicator.

The following tappings are required on the high tension side:-

Plus $2\frac{1}{2}\%$ and 5%.
Minus $2\frac{1}{2}\%$.

High and Low Tension Cables.

All power cables from the circuit breakers to the high voltage heaters and from No. 3 circuit breaker to the transformer and low voltage heater, shall be insulated with impregnated paper and lead sheathed.

High and Low Tension Cables (cont'd.)

The sectional areas of the cables are set out below:-

DUTY	KW CAPACITY.	NOMINAL CURRENT AMPS.	CONSTRUCTION OF EACH CORE	AREA OF CONDUCTOR.
Outgoing H.T. cables from Nos.1 & 2 Circuit Breakers to Nos 1 & 2 high voltage heaters	1,500.	137.	37/.064.	0.12 sq. in
Outgoing H.T. cable from No.3 circuit breaker to 150 kW transformer.	150.	13.7.	7/.044.	0.01 " "
L.T. cable from 150 kW. transformer to L.T. switch and thence to 150 kW hot water service heater.	150.	237.	37/.093.	0.25 " "

"Apexior" Coating.

After erection on site, each heater and each storage vessel is to be wire-brushed and painted internally with two coats of "Apexior" and externally with two coats of red Oxide or other approved paint.

Switchgear.

The main circuit breakers will have to be of the same type and arrangement as the other circuit breakers to be supplied by the Bristol Municipal Corporation Electricity Supply Department. The conditions and specification here given comply with the Corporation's requirements, but it is possible that when the order is placed minor variations in type and arrangement may have to be made.

The main circuit breakers shall be of the oil-immersed triple pole, motor-or-solenoid-operated type of the normal carrying capacity set out. The guaranteed rupturing capacity of any H.T. circuit breaker shall not be less than 150,000 kVA.

The main high tension circuit breakers shall be three in number and shall perform the following functions:-

Nos. 1 & 2 shall connect the bus-bars to the high voltage electrode heaters Nos. 1 & 2 respectively.

No. 3 shall connect the bus-bars to the transformer of the low voltage immersion heater.

Switchgear (cont'd.)

NOS. 1 & 2 H.T. CIRCUIT BREAKERS, each controlling one 1,500 kW. high voltage heater.

One low voltage release coil.
Three overload trip coils (instantaneous).

NO. 3. H.T. CIRCUIT BREAKER, controlling transformer for Low Tension Heaters.

One low voltage release coil.
Three overload trip coils (instantaneous).

Control and Instrument Panel.

The control equipment is to be mounted on a polished slate panel mounted on angle iron framework and framed in a 1 in. wide border of stainless steel.

All indicating and recording instruments are to be of the flush type, and all equipment, including controlling relays and rectifiers for modulators, is to be mounted on this panel.

The following electrical instruments are to be provided together with their current and potential transformers, protecting fuses and connections to the relays:-

On H.T. Panel controlling Nos. 1 & 2 Circuit Breakers, controlling Nos. 1 & 2 High Voltage Heaters:

2 sets of three ammeters (one on each phase) reading from 0 - 300 amps. Space only for time switch to be provided by the Bristol Corporation Electricity Supply Department.
1 Voltmeter, range 0 - 7,000 volts.

On H.T. Panel controlling No.3. Circuit Breaker:

Three ammeters (one on each phase) reading from 0 - 50 amps.

On L.T. Panel No.1, controlling No.3. Low Voltage Heater:

One volt meter reading from 0 - 600 volts.
Three ammeters (one on each phase) reading from 0-300 amps.

On L.T. Panel No.3, controlling 2 primary pumps:

One ammeter with three-way switch to read current in any phase - range 0 - 200 amps.
One voltmeter, range 0 - 600 volts.

The other recording and indicating instruments are as follows, and all wiring run in galvanised screwed conduit is to be included:-

One Graphic Recording Ammeter for each heater.
One flush mounting unbalanced load, 3-phase, 3-wire watt hour meter to be provided for each heater.
Two Negretti & Zambra 4-point Recording Pyrometers Figure No. E.475. All-Mains Resistance Thermometer type range 0 - 500°F. Flush-mounting pattern with chromium-plated fittings. Synchronous motor drive for 210 volts, 50 cycles, 1 phase, A.C. supply. The following are the points of which a temperature record is to be taken by these instruments, Nos. 1-4 on the first and Nos. 5-8 on the second recorder.

Control and Instrument Panel (cont'd.)

(1) Primary flow from electrode water heater.
(2) Primary return to electrode water heater.
(3) Secondary flow to panel heating system.
(4) Secondary return from panel heating system.
(5) Flow from hot water service system.
(6) Return from hot water service system.
(7) Secondary flow to air heaters.
(8) Secondary return from air heaters.

One Negretti & Zambra 30-point electrical resistance thermometer, slide wire type, operating off 210 volts, 50 cycles, 1 phase A.C. supply Flush mounted pattern, scale range 0 - 300°F., with nickel coil bulbs to read the following points:-

	Points.
2 points in each heating storage vessel; total	12.
2 points in H.W.S. storage vessel	2.
1 " " each electrode water heater	2.
City Treasurer's Office, wet and dry bulbs	2.
Council Chamber, 1 wet & 2 dry bulbs	3.
Conference Hall, 1 " " 2 " "	3.
Mayor's Parlour, ... 1 " "	1.
Wash Water temperatures for ventilation plants ...	3.
Outside temperature	1.
Spare	1.
TOTAL POINTS ..	30.

Included on the above panel are to be fitted the following instruments:-

One Ferranti 9 in. dial electric clock, suitable for direct connection to the mains.
Pilot lights for indicating the working of the electrode boiler and primary pump, and the H.W.S. immersion heater controls.

Every instrument is to be labelled to indicate its duty by a suitable brass label painted black, with engraved lettering filled in in white.

Adjacent to the multi-point thermometer an engraved list of the various points must be fixed, this list to match the labels in connection with the various instruments.

The outside bulb is to be fixed at a point to be agreed and must be protected from the weather in an approved manner.

Additional pilot lights to be as follows, each light being labelled to match the instrument labels, and all wiring run in galvanised screwed conduit to conform to the regulatio of the Electricity Department and the I.E.E:-

Control and Instrument Panel (cont'd.)

(1) Secondary (Panel Heating) Pump No.1.
(2) " " " " " 2.
(3) " (Vent. Heater) " " 1.
(4) " " " " " 2.
(5) Hot Water Service ... " " 1.
(6) " " " ... " " 2.
(7) Boiler chamber, tank room & basement extract fan.
(8) " " " " " inlet " No.1.
(9) " " " " " " " 2.
(10) Battery Room Extract Propeller Fan.
(11) Lavatories, Ground & Lower Grd. Floors Extract Fan.
(12) " 2nd, 3rd & 4th Floors Extract Fan No.1.
(13) " " " " " " " No.2.
(14) City Treasurer's Office Inlet Fan.
(15) " " " Extract Fan.
(16) Conference Room and Ante Room Inlet Fan.
(17) " " " " Extract Fan.
(18) Council Chamber and Entrance Hall Inlet Fan.
(19) " " " " Extract Fan.
(20) Kitchen Extract Fan.
(21) City Treasurer's Office Air Washer Pump.
(22) Conference Room and Ante Room Air Washer Pump.
(23) Council Chamber and Entrance Hall Air Washer Pump.

Thermostats and Wiring thereto.

All thermostats to have an extension piece to bring the head of the instrument clear of the lagging on storage vessels and boilers, so as to ensure that the electrical connections and mechanism are kept reasonably cool. The wiring to any such thermostats or other mechanism in positions which may be subject to high temperature from storage vessels, pipes or boilers, is to be insulated with heat-resisting insulation consisting of asbestos and cambric. The remainder of the control wiring may be in V.I.R. cable drawn into conduit.

Test after Setting to Work.

A test of the complete plant after erection and connecting up is to be carried out, and the plant must be demonstrated to be capable of fulfilling all the requirements of this specification.

Heating Primary Pumps.

Two type 'L' low-lift centrifugal pumps by Messrs. F.A. Pullen & Co., each capable of dealing with 280 gallons of water per minute against 25 ft. head when running at 920 R.P.M. and absorbing approximately 3.4 B.H.P. at the pump spindle. Each pump to have cast iron body and cover, cast iron impeller fitted with renewable gunmetal sealing rings, renewable cast iron sealing rings fitted to cover, and steel driving shaft. To be mounted on extended cast iron bed-plate and connected by vee-belt drive to a 'Bull' high torque, supersilent type squirrel cage screen-protected motor with oil ring lubricated sleeve bearings, continuously rated for 5 B.H.P. at 940 R.P.M. on a 365 volts, 3 phase, 50 cycles supply. The pump to be fitted with water-cooled bearing and gland for cooling by outside source of supply. The automatic contactor type starters for the primary pumps to be mounted in the switchgear cubicles associated with the H.T. electrode water heaters which the pumps serve. The water temperature will be 260°F., and the static head 88 ft. of water.

Heating Secondary Circulating Pumps.

Two type 'L' low-lift centrifugal pumps by Messrs. F.A. Pullen & Co., each capable of dealing with 320 gallons of water per minute against 20 ft. head when running at 860 R.P.M. and absorbing approximately 3.1 H.P. at pump spindle. Each pump to have cast iron body and cover, cast iron impeller fitted with renewable gunmetal sealing rings, renewable cast iron sealing rings fitted to cover and steel driving shaft. To be mounted on cast iron bedplate and connected by vee belt drive to a 'Bull' high torque, supersilent type squirrel cage, screen-protected motor with oil ring lubricated bearings, continuously rated for 5 B.H.P. at 925 R.P.M. on a 365 volts, 3 phase, 50 cycles supply. With two 'Brookhirst' Y.H.A.10 air break star-delta starting panel with T.P. isolators and ammeter and suitable belt guard.

Secondary Circulating Pumps for Air Heaters.

Two 4 in. type 'L' low-lift centrifugal pumps as specified above, but capable of dealing with 120 gallons of hot water per minute against a frictional head of 25 ft. when running at 1050 R.P.M., absorbing 1.9 B.H.P. at pump spindle.

Each to be mounted on cast iron baseplate and connected by 'tex-rope' drive to 'Bull' supersilent, screen-protected squirrel cage motor continuously rated for an output of 3 B.H.P. at 925 R.P.M. on 365 volts, 3 phase, 50 cycles supply, mounted on slide rails. Fitted 'Brookhirst' type S.C.A.10 direct-on starting panel with T.P. isolator and ammeter.

Hot Water Service Circulating Pumps.

Two type 'L' $1\frac{1}{2}$ in. centrifugal pumps by Messrs. F.A. Pullen & Co., exactly as above, but for a duty of 10 gallons per minute against a total head of 6 ft. when running at 930 R.P.M., absorbing approximately 0.08 B.H.P. at the pump spindle, and with drive as above from 'Bull' motor exactly as above, but giving an output of $\frac{1}{4}$ B.H.P. at 925 R.P.M. Complete with 'Brookhirst' starter as above.

Sump Pump.

One vertical spindle 4 in. type 'M' centrifugal pump by Messrs. F.A. Pullen & Co., designed to deliver 150 gallons per minute against a 30 ft. head when running at 925 R.P.M. The pump is to have a cast iron impeller and a steel spindle suitable for the depth of the sump (approximately 5 ft. 6 in.) with one intermediate bearing. The shaft is to be direct coupled to a 'Bull' vertical spindle squirrel cage motor continuously rated at 5 B.H.P. when running at 925 R.P.M. The motor to be controlled by a 'Brookhirst' Y.C.A.10 star-delta automatic air-break contactor-type starter, fitted with no-volt and overload releases, T.P. isolating switch and fuses. Provide also one 'Igranic' single-pole float switch complete with 9 ft. of wire rope, copper float counterweight and stops. The starter to have three position switch for hand or automatic operation, with 'off' position.

Test Cocks and Altitude Gauges for Pumps.

Supply and fix on each suction and delivery branch to each pump as near the pump as possible, a $\frac{1}{4}$ in. straight nose brass test cock and an altitude gauge suitable for the particular working head. The latter is to be 4 in. diameter, Figure No. 33A., by Messrs. W.H. Bramall & Co.

Expansion Tank.

One standard plate cast iron tank 16 ft. x 12 ft. x 4 ft. of about 4,500 gallons capacity, built up of standard plates $\frac{3}{8}$ in. thick, bolted together with bolts at 6 in. pitch and complete with all necessary $\frac{3}{4}$ in. diameter stay rods. The

Expansion Tank (cont'd.)

tank to be fitted with a 1 in. ball valve with long arm arranged to close at minimum water level and to have 2 in. overflow flanged outlet near top and 2 in. feed connection at bottom. The tank is to be erected by the Makers on a steel grillage consisting of R.S.J's about 18 ft. long. The grillage is to be designed by the makers so that the maximum deflection does not exceed one-thousandth part of the span when the tank is full. The tank is to have a galvanised $\frac{1}{4}$ in. thick mild steel plate cover, complete with hinged access door near the ball valve.

Cold Water Storage Tanks.

Two tanks exactly as above, but each 16 ft. x 10 ft. x 4 ft. deep of about 3,750 gallons capacity. To be fitted with $1\frac{1}{2}$ in. ball valves, 4 in. flanged overflow connections and $2\frac{1}{2}$ in. feed connections.

Tank Gauges.

For showing the level of the water in the two cold water storage tanks in the roof, supply and fix on the instrument panel in the heating chamber two 'Rose' O-H tank water level indicators, type 'A', by Sydney Rose & Co. The main scale is to be calibrated 0-150 ft. head and the secondary scale 0-5 feet.

Pipes and Fittings.

Heating.

The pipe to be used is to be British Standard steel tube of steam quality, of the following weights and thicknesses:-

Size.	Gauge.	Lbs. per Ft.
$\frac{3}{8}$ in.	10.	0.973.
$\frac{1}{2}$ in.	9.	1.403.
1 in.	8.	2.008.
$1\frac{1}{4}$ in.	7.	2.827.
$1\frac{1}{2}$ in.	6.	3.500.
2 in.	6.	4.473.
$2\frac{1}{2}$ in.	5.	6.323.
3 in.	5.	7.483.
4 in.	5.	9.803.
5 in.	5.	12.159.
6 in.	5.	14.609.
7 in.	$\frac{1}{4}$ in.	19.359.
8 in.	$\frac{1}{4}$ in.	22.030.

The above weights are for long random lengths, screwed and with one socket.

All joints are to be welded by the oxy-acetylene process by men experienced in this class of work. The Contractor must satisfy the Consulting Engineers that the welders employed are thoroughly experienced. All butt joints must be properly centred and tees must not have projections into the water-way. The Consulting Engineers will have joints cut out during the progress of the work to check these points, and the Contractor must allow for reinstating these.

All welded pipes must be hydraulically tested to 300 lbs. per square inch, the pressure maintained for at least three hours and all joints well hammered while under pressure. Flanged joints to be tested to same pressure.

Pipes and Fittings (cont'd.)

On the mains in the trenches and in the central station, flanges must be provided to enable pipes to be dismantled easily if required. Flanges are to be jointed with Taylor's rings and are to conform to British Standard Table "F". They must be welded on to the pipes.

Hot and Cold Water Service.

The pipe to be solid drawn copper tube of 'de-oxidised' welding quality of the following thicknesses:-

Inside Diameter.	S.W.G.	Lbs. per Ft.
$\frac{3}{4}$ in.	17	0.38.
$\frac{3}{4}$ in.	16	0.63.
1 in.	15	0.93.
$1\frac{1}{4}$ in.	15	1.15.
$1\frac{1}{2}$ in.	15	1.37.
2 in.	15	1.80.
$2\frac{1}{2}$ in.	14	2.50.
3 in.	13	3.44.

Joints on all pipes are to be made by the bronze-welding process developed by the British Oxygen Co. Ltd., the type of joint to be used being that known as the "Short Bell Butt Joint." The Contractor must adhere rigidly to the recommendations of the manufacturers of the tools and materials used for this work and must furnish certificates issued by the British Oxygen Co. Ltd. to show that the men employed have received adequate tuition in the process.

All copper pipework is to be tested hydraulically to 300 lbs. per square inch.

Bends.

Bends are to be used in preference to round elbows wherever possible.

Sleeves.

Where pipes pass through walls, floors, etc., sleeves must be provided to allow free movement of the pipes, and the Contractor must see that these are cut off properly.

Hangers & Supports.

The Consulting Engineers attach great importance to these, and the Contractor in preparing his tender must give special attention to same. Where expansion will cause movement of the pipes, the hangers and supports must be designed accordingly. In all cases the hangers, supports, etc., must be approved by the Consulting Engineers before being fixed.

Floor and Ceiling Plates.

Where exposed pipes pass through walls, ceilings or floors, hinged malleable floor plates must be used and painted to match the pipe.

Valves.

Up to $2\frac{1}{2}$ in. to be by Messrs. Hattersley (Ormskirk) Ltd., Figure No. 34, lockshield or wheel, or Figure No. 36, flanged. Sizes 3 in. and over to be by Messrs. Hattersley (Ormskirk) Ltd., Figure No. 541, heavy pattern flanged sluice valves tested to 800 ft. head.

Generally, valves within easy reach of the occupants of the offices or of the general public, etc., are to have lockshields, while other valves, e.g., in the boiler chamber, in trenches or casings or in the roof space, are to be wheel valves. In cases where the valves are at high level, extension pieces and bevel gears are to be provided to allow of easy operation from the floor. Four lockshield keys are to be provided for each size of valve.

Ball Valves.

All ball valves are to be Underhayes 'Equilibrium' pattern by Messrs. Firmin & Sons, Ltd., approved by the Bristol Waterworks Company and tapped to receive silencing pipes. All ball valves are to be suitable for the pressure against which they have to work.

Mixing Valves.

General Heating Circuit.

Supply and fix in secondary flow main one 6 in. triple-port Modulator having cast iron body and three Solenoid operated valves suitable for operating on rectified 210 volts A.C., 50 cycles supply. The flanged connections are to be drilled to British Standard Table "D". The modulator is to be complete with 'Westinghouse' metal, or other approved, rectifier, operating relays and M.O.D. type thermostat with three contacts having a stem length of 16½ in. and a temperature range of 60° to 140°F., with an operating differential of ± 5°F.

Ventilation Air Heater Circuit.

Exactly as for panel heating, but 4 in. size and having thermostat, range from 120-200°F.

Safety Limit Valve on Panel Heating

In the 6 in. flow main to the panel heating, on the delivery side of the pump is to be fitted one 6 in. Drayton 'Limit' type 'VT' regulator with thermostatic bulb inserted in the flow main. This is to be arranged to close the flow should the water temperature, owing to failure of the modulator or any other cause, exceed a certain predetermined figure. The regulator is to have an adjusting range of 120°-160°F.

Labels.

All valves in the boiler chamber, in trenches or other situations where the purpose of the valve is not obvious, must be labelled. Labels are to consist of brass plates enamelled black, with engraved lettering filled in with white composition.

Drain Cocks.

To be heavy pattern gunmetal plug cocks, Messrs. Crane's Figure No. D. 344, with loose key and hose connection.

Drain cocks on cylinders, electrode boilers and water storage tanks, as distinct from all other smaller drain cocks which are to be as specified above, are to be Newman-Milliken lubricated plug valves, Figure No. 200M., each complete with suitable operating lever and one box of the appropriate lubricating sticks.

The valves on the cold feeds to the storage cylinders are to be Newman-Milliken lubricated plug valves, Figure No. 200M., each complete with locking plate and suitable padlock and key, and operating handle and one box of the appropriate lubricating sticks.

Panels.

The warming panels are to be of the invisible embedded coil type, consisting of continuous lengths of ½ in. mild steel special bending tube, bent to 6 in. centres and cast in the concrete of the ceilings of the various rooms in the positions shown on the plans. The panel pipes must be bent and the individual coils electrically welded together at works. They are to be hydraulically tested to 500 lbs. per square inch before despatch from works.

Panels (cont'd.)

The floors in which the panels are to be fixed will be concrete floors of hollow tile or other standard construction. The panel coils are to be fixed securely to the shuttering before the floor is cast, and the connections from the panel are to be run to the flow and return risers. Before the pipes are cast in, an hydraulic test is to be carried out on each panel or group of panels. The test pressure to be 300 lbs. per square inch, which pressure is to be maintained for three hours, and the joints well hammered whilst under pressure. The Contractor is to furnish the General Contractor with a full specification for the plastering over the warming panels, including instructions for forming a key for the plaster.

The connections to the panels shall be formed of the same quality pipe as the panel coils themselves, and particular care is to be taken to ensure that the coils lie perfectly flat before they are cast in and that the connections are so run as to prevent the occlusion of air. The control valve to each panel is to be on the flow connection to each coil, and the actual height of the valve above the floor must in every case be settled and agreed with the Consulting Engineers on the site. The valve is to be fitted in a recess with a special gunmetal shroud with face plate to finish on face of wall as shown on Drawing No. 835/10. The return connection to be taken into the return main at a point above the level of the panel

Wherever possible, a stop valve and an air cock are to be fitted at the return end of each panel in order to facilitate venting.

Before ordering any panels, the Contractor is to verify that the sizes given on the plan are in every way suitable for the positions in which they are to be fixed.

The panel control valves are to be $\frac{1}{2}$ in. 'Permaset' gunmetal double-regulating valves supplied by The Associated Metal Supply Co. Ltd.

Air Vessels.

At the top of each vertical return pipe, an automatic air release valve is to be fitted. These are to be by Messrs. Chas. Winn & Co. Ltd., type 'B', with lockshield shut-off valve incorporated in the body. A $\frac{3}{8}$ in. discharge pipe is to be taken from the outlet at the top of the air release valve and run to some convenient point. Where the air valves are fitted in exposed positions, suitable insulation is to be provided. Similar valves are to be employed on the thermal storage vessels and elsewhere where air valves are required.

Anchors.

Anchors specially designed for the positions in which they are to be fitted are to consist of cast iron blocks firmly bolted to a secure foundation and provided with wrought iron straps and bolts for gripping the pipe.

Expansion Bends.

These are to be constructed from pipe of the quality specified above, and where made on site, are to be made by means of a bending machine.

Inlet Fans. Council Chamber.

One No. 70 'Cyclone' SS. centrifugal single inlet fan comprising laminated casing, braced and stiffened with angles, having multivane type impeller mounted on a solid mild steel shaft revolving in two white metal-lined self-aligning ring lubricated bearings, supported on a heavy cast iron stool. This fan to handle 13,500 cubic feet per minute against a resistance head of 0.75 in. W.G., when running at 204 R.P.M.

The fan is to be provided with grooved pulley and driven through suitable 'tex-rope' drive by a 'Bull' 4 B.H.P. screen-ventilated, supersilent, slip-ring motor fitted with ring-oiled bearings. This motor to run at 950 R.P.M. and to be wound for an A.C. supply of 365 volts, 3 phase, 50 cycles and mounted on slide rails.

The motor to be controlled by a 'Brookhirst' type S.C.A.10 circuit breaker consisting of a floor fixing iron case containing:-

A triple pole electrically-operated stator contactor, with no-volt release.

Three Solenoid overload trips with oil dash-pot time lags.

A triple pole isolating switch enclosed in a separate compartment and interlocking with the doors to prevent contact with live parts.

A moving iron ammeter mounted on top of the case.

A control switch marked "start" and "stop" fitted on the side of the case.

Interlocking contacts to be provided on the stator switches to ensure that the motor cannot start until the rotor regulator (specified below) is in the low speed position and all resistance is in circuit.

Further, the inlet fan stator switch is to have interlocking contacts and sequence isolation, so that the corresponding extract fan cannot be started up until the inlet fan is running.

In a separate case suitable for floor mounting, two rotor regulators, one for the inlet and one for the extract fans, are to be provided. The resistance is to be designed to give a speed reduction of 50% against fan load. The two regulators are to be operated by the one handle to ensure that the speed of both inlet and extract fans are varied simultaneously.

Conference Room.

One No. 70 'Cyclone' SS. fan to handle 14,500 cu. ft. of air per minute against 0.75 in. W.G., when running at 207 R.P.M., driven through 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 4 B.H.P., controlled by a 'Brookhirst' starter, all as described above, with speed regulation and interlocking contacts, etc., to ensure that the extract fan cannot start until this fan is running.

Inlet Fans (cont'd.)

City Treasurer's Office.

One No. 50 'Cyclone' SS. fan of alternative handing design, built up to arrangement 3, to handle 6,500 cubic feet per minute against 0.5 in. W.G., when running at 243 R.P.M., developing 1.5 B.H.P., all as described above. The motor to be controlled by a 'Brookhirst' type S.C.A.10 direct-on starting panel with no-volt and three overload releases, isolator and ammeter, with interlocking contacts to ensure that the extract fan cannot be started up until the inlet fan is running. No speed regulation required.

Extract Fans.

Council Chamber.

One No. 70 'Cyclone' SS. fan, to handle 13,500 c.f.m. against 0.5 in. W.G. when running at 176 R.P.M., driven through 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 3 B.H.P., controlled by a 'Brookhirst' starter, all as described above for the inlet fan, and having a rotor regulator mounted in the same case as the regulator for the inlet fan.

Conference Room.

One No. 70 'Cyclone' SS. fan to handle 14,500 c.f.m. against 0.5 in. W.G., when running at 179 R.P.M., driven through 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 3 B.H.P., controlled by a 'Brookhirst' starter, all as described above.

City Treasurer's Office.

One No. 45 'Cyclone' SS. fan of alternative handing design, built up to arrangement 3, to handle 5,000 c.f.m. against 0.5 in. W.G., when running at 263 R.P.M., driven through 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 1.5 B.H.P., controlled by a 'Brookhirst' S.C.A.10 starter all as described above for the City Treasurer's Office inlet fan, with the interlocking arrangements as mentioned.

Lord Mayor's Rooms, etc.

One No. 45 'Cyclone' SS. fan of alternative handing design, built up to arrangement 3; to handle 5,000 cubic feet per minute against 0.5 in. water gauge, when running at 263 R.P.M; driven through a 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 1.5 B.H.P., controlled by a 'Brookhirst' S.C.A.10 starter, all as described above, including 50% speed regulation.

Committee Rooms.

One No. 45 'Cyclone' SS. fan, exactly as above.

Lavatories.

Three No. 30 'Cyclone' SS. fans, each of alternative handing design, built up to arrangement 3, to handle 2,000 c.f.m. against 0.5 in. W.G., when running at 386 R.P.M., driven through 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 0.5 B.H.P., controlled by a 'Brookhirst' S.C.A.10 starter, all as described above, but without interlocks to any other starter.

Extract Fans (cont'd.)

Kitchen.

One No. 45 'Cyclone' SS. fan of alternative handing design, built up to arrangement 3, to handle 5,000 c.f.m., against 0.375 in. W.G., when running at 240 R.P.M., driven through 'tex-rope' drive by a 'Bull' motor running at 950 R.P.M., developing 1 B.H.P., controlled by a 'Brookhirst' S.C.A.10 starter, all as described above. The casing and impeller of this fan are to be heavily galvanised after manufacture and the scroll is to be fitted with a cleaning door and drain pad.

All the above fans to be specially designed for silent running and to be manufactured by Messrs. Matthews & Yates, Ltd.

Propeller Fan.

Battery Room Extract.

One 12 in. 'Streamline' propeller fan comprising runner constructed in teak with Barronia nuts and bolts, mounted on a stainless steel shaft running in a cast iron tube fitted with grease lubricated ball bearings, direct driven by a totally enclosed motor as described above. The motor to be arranged externally to the cast iron tube and bracketed thereon. The fan to be designed to handle 350 c.f.m. against 0.125 in. W.G., when running at 900 R.P.M.

The above fan to be designed for silent running, and to be complete with 'Brookhirst' S.C.A.10 triple pole contactor starter with no-volt and three overload releases and isolator.

The fan to be manufactured by Messrs. Jas. Keith & Blackman Co. Ltd.

Air Washer Plants.

Council Chamber.

One mist type air washer designed for a duty of 13,500 c.f.m. The washer to be 5 ft. high x 6 ft. wide x 6 ft. long, constructed from 1/16th in. galvanised sheet steel plates, braced and stiffened with angles and tees and provided with a glazed water-tight inspection door fitted in the side of the casing. The tank is to be 14½ in. deep, constructed from ⅛ in. plate with all joints welded, and treated with 'Riccol.'

The washer is to be fitted with one bank of spray nozzles of the angle type mounted on galvanised wrought iron standpipe and galvanised wrought iron header. A battery of eliminator and scrubber plates to be fitted inside the washer, these to be of copper, as also must be the spacing strips and supports. The washer is to have the following fittings:-

One electric water-tight bulkhead light fitting.
One ball valve.
One overflow and drain connection, arranged to discharge over a hopper head so that the flow is visible.
One weir strainer across tank.
One circular gauze suction strainer.
One pot strainer.
Flexible connections to pump.

Air Washer Plants (cont'd.)

For circulating the water for the above washer, provide and fix one 1½ in. type 'M' medium-lift centrifugal pump made by Messrs. F.A. Pullen & Co. Ltd., of suitable capacity for the washer, mounted on a cast iron bed-plate and direct-driven through a flexible coupling by a 2 B.H.P. 'Bull' screen-ventilated, supersilent squirrel cage motor with ring oiled bearings and controlled by a 'Brookhirst' Y.H.A.10 hand-operated, star-delta starter having no-volt and three overload releases, with isolator and ammeter.

Conference Room.

One washer plant 6 ft. high x 6 ft. wide x 6 ft. long, designed for a duty of 14,500 c.f.m., all as described above.

City Treasurer's Office.

One washer plant 4 ft. high x 4 ft. wide x 5 ft. long, designed for a duty of 6,500 c.f.m., all as described above.

The above washers to be manufactured by Messrs. J. Gardner & Co. Ltd.

Air Heaters. Council Chamber.

Primary and secondary heater batteries are to be provided of the same cross-sectional area as the washer. Each heater to have a mild steel casing flanged, with angles, and arranged to bolt direct to the inlet and outlet of the washer respectively. The heaters are to be spirally wound copper gilled tube designed to work with hot water having a flow temperature of 180°F., and a return temperature of 150°F. The pre-heater is to consist of one row of tubes and is to be capable of raising 13,500 c.f.m. from 30°F. to 60°F. The secondary heater is also to have one row of tubes and is to be capable of raising 13,500 c.f.m. from 50° to 70°F.

Conference Room.

Primary and secondary heater batteries, all as described above, but designed for 14,500 c.f.m.

City Treasurer's Office.

Primary and secondary heater batteries, all as described above, but designed for 6,500 c.f.m.

The above heaters to be by Messrs. Matthews & Yates, Ltd

Heater Controls.

In the air discharge from each of the above air washing and heater units, temperature regulators are to be fitted to control the air temperature by diaphragm-controlled valve on flow pipe to secondary heater. These controls are to be relay-operated type with thermo relay. They are to be capable of maintaining the air temperature within limits of ± 1½°F. of any predetermined temperature.

The controls are to be complete with reducing valves, copper piping and water connection to supply and drain, and the control dial is to be marked in degrees fahrenheit; manufactured by The British Arca Regulators, Ltd.

Heater Controls (cont'd.)

Fit in each washer plant two thermometers, Figure No. FS/105P., by Messrs. Negretti & Zambra, one in the space after the preheater and before the sprays and one in the duct after the secondary heater.

Air Filters. Council Chamber.

On the outlet side of the heater battery, after the air washer, i.e., adjacent to the suction eye of the fan, is to be fixed a dry fabric type air filter made by Messrs. J. Jeffreys & Co. Ltd., consisting of sixteen units built up into a battery on an angle-and-tee-iron framework. The whole to be enclosed in a suitable galvanised mild steel casing with change-section pieces to connect to heater battery and fan. Doors to be provided into the duct on the inlet and outlet side of filter in order to give easy access for removal of the filtering elements for cleaning. Each unit is to consist of a cast iron frame 22 in. x 22 in. with five removable fabric bags supported by a galvanised mild steel framework. The units to be arranged in a battery four units wide by four units high.

Conference Room.

The inlet plant is to be equipped with one dry fabric air filter, all exactly as described above.

City Treasurer's Office.

On the outlet side of the heater battery, after the air washer, i.e., adjacent to the suction eye of the fan, is to be fixed a dry fabric type air filter made by Messrs. J. Jeffreys, Ltd., consisting of nine units built up into a battery three units high x three units wide. Otherwise, exactly as the filters for the Council Chamber and Conference Room described above.

One complete set (i.e., five) of spare filter bags for one unit of the battery is to be supplied with each of the above batteries.

Silencing Devices.

All precautions to avoid transmission of noise from moving machinery to the structure are to be included by the Contractor.

All fans, accelerators and pumps to be mounted on 'Coresil' pads at least 2½ in. thick, and the concrete foundations supporting fans and pumps are also to be isolated similarly from the structure by 'Coresil' pads. The foundations of all motors are similarly to be insulated by 'Coresil' pads, and in addition, special anti-vibrator pads complete with belt reaction brackets are to be provided under the slide rails. These sound prevention devices to be provided by Messrs. Christie & Grey, Ltd., and installed to their instructions.

Connections from fans tc ducting or structure to be made by means of heavy sail cloth to avoid direct metallic connection.

All pumps and accelerators to have flexible connections (both suction and delivery) to prevent transmission of noise along the pipe lines.

Silencing Devices (cont'd.)

All propeller fans to be bedded on resilient cork pads, and the bolts to be provided with rubber sleeves and rubber washers under the steel washers so that there is nowhere metal-to-metal contact.

Isolating Switches.

The switchgear controlling the fans for the three main plants, viz., Council Chamber, Conference Room and City Treasurer's Office, is to be erected in the fan room containing the washer plants, the switchgear controlling the associated extract fan being placed alongside the appropriate inlet fan control. Adjacent to the extract fans so controlled 4-pole isolator switches must be provided so that when work is being carried out on these fans the motor cannot be started from the switchgear. The fourth pole is to be connected with the trip coil on the inlet fan so that this cannot be started while the extract fan is isolated.

All wiring is to be carried out between the fan motors and the control gear, as specified previously.

Trunking.

All metal trunking is to be well constructed from galvanised steel sheets, the joints being lapped in the direction of the air stream, closely riveted and treated with jointing material to make air-tight.

Where the longest side of the duct is 4 ft. 6 in. or over, the metal to be 14 S.W.G; where the longest side is under 4 ft. 6 in., but over 2 ft., the metal to be 16 S.W.G; where the longest side is under 2 ft., the metal to be 18 S.W.G.

All trunking of large section to be well stiffened with galvanised iron flats or angles at suitable intervals.

Supports to be well designed to suit their position and of ample strength for the work to be done.

Special attention is to be paid to the stream-lining of the trunking where changes of section and/or direction occur. These must take place gradually and guide vanes or baffles must be included to prevent eddying and loss of efficiency.

Access and cleaning doors must be provided to all ducts at suitable intervals. They must be substantially made with galvanised frames and must be air-tight when closed.

Special distribution heads are to be provided for all inlets and extracts; these are to be designed to give an even velocity over the whole face of the grille, guide vanes and diffusers being arranged to obtain this.

Grilles on Ventilation System.

(a) Council Chamber, Conference Room and Ante Room.

On the inlet system no grilles are to be provided. The air is introduced through openings in the plasterwork ceiling and special regulating distribution heads are to be supplied.

On the extract system, a bronze grille 18 in. wide x 41 ft. long, in, say, 10 sections, is to be provided under each of the galleries as shown on the drawings.

Grilles on Ventilation System (cont'd.)

(b) City Treasurer's Office.

On the inlets, special air inlet arrangements are to be made to suit the decoration of the ceiling and/or the lighting fittings.

On the extract system, four bronze grilles of the sizes indicated on the drawings are to be provided and fixed on the face of the columns in which the extract ducts are run.

(c) Lord Mayor's Rooms and Committee Rooms.

Bronze extract grilles are to be arranged in the ceiling. The total area of the grilles is to be as shown on the drawings, but the actual dimensions are to be settled to suit the treatment of the ceilings.

(d) Entrance Hall.

On the inlet system, six special bronze grilles are to be provided and fixed in the frieze above the cornice, as indicated on the drawings. On the extract system twelve special bronze grilles are to be provided and fixed on the face of the columns where the extract ducts are run, as shown on the plans.

(e) Lavatories.

Bronze grilles of the sizes shown on the drawings are to be fixed where indicated on the drawings.

(f) Kitchen.

Grilles, connections, hoods, etc., will have to be provided to suit the arrangement of the cooking apparatus.

(g) Boiler House, Tank Chamber and Basement.

Bronze grilles of the sizes indicated are to be provided and fixed where shown on the plans.

To cover the cost of all the foregoing grilles, etc., a P.C. sum of £950. 0. 0. (Nine Hundred and Fifty Pounds) is to be included.

Acid-proof Trunking.

The trunking to be used in conjunction with the acid-proof fan for extracting from the battery room is to be asbestos-cement piping jointed in cement. The piping is to be treated internally with three coats of 'Keragel' acid-resisting paint.

Dampers.

Adjustable dampers are to be provided on all branch ducts for balancing and control. They are to be butterfly pattern, provided with a quadrant and locking device for fixing permanently when the correct setting is obtained. The balancing of the systems and setting all dampers is to be included by the Contractor.

Covering.

The Contractor will be expected to pay particular care to the question of covering, which must be a really neat and efficient first-class job. Each pipe must be covered separately, and the Contractor must, when fixing pipes that

Covering (cont'd.)

will later be covered, see that ample room is left between pipes and wall or other pipes, so that the covering can be applied easily, e.g., a pipe to be covered should be fixed with a clearance of at least 2½ in. from the wall, or, say, 4 in. clear from any other pipe which is also to be covered. The question of expansion should also be borne in mind when fixing pipes which will be covered later.

The storage vessels for the heating and hot water service and the boilers to have a covering consisting of three-ply asbestos paper applied to the shell of the vessel, 4 in. cork in slabs applied in two layers each 2 in. thick, with all joints staggered, slabs securely wired in place, finished with a skim of Portland Cement and the whole enclosed in 22g. blue planished steel casing.

All air vessels and air pipes in roof spaces are to be covered. All such covering to be 85% Magnesia composition applied to a thickness of 1 in., reinforced with galvanised wire mesh and finished with a ½ in. thick coat of hard-setting compound, trowelled to a smooth finish and painted two coats.

All the high temperature pipework in the boiler chamber and tank room to be insulated with 1½ ins. thick 85% Magnesia compound reinforced with galvanised wire netting, and finally enclosed in 24 S.W.G. blue planished steel sheet secured with self-tapping screws and stainless steel bands.

All the low temperature heating and hot water service pipework in the boiler chamber and tank room to be as above, but with 1½ ins. thick 85% Magnesia.

All flanged joints and valve bodies, etc., to be covered with blue planished steel boxes with hinges and brass pin fasteners and lined with 85% Magnesia composition ¾ in. thick.

In the building generally, including pipe in trenches or ducts, the heating and hot water supply pipework to be covered with 1½ ins. thick 85% Magnesia composition, reinforced with galvanised wire netting and finished with a ½ in. thick coat of hard-setting compound, trowelled to a smooth finish and painted two coats.

Cold water pipes, where liable to freezing, e.g., in roof spaces, are to be covered with sectional covering.

The heating pipes in the basement, where they serve to warm the basement, are to be left uncovered.

All covering, when finished, to have two coats of approved waterproof paint. Pipe supports, flanges and other ironwork to be painted two coats black bitumastic paint at the same time.

Any outside pipework is to be covered, and, in addition, to be finished with plastic bitumen waterproof covering of ⅛ in. nominal thickness.

Covering (cont'd.)

The Consulting Engineers attach considerable importance to the question of covering. Very particular consideration must be given to this, both as regards the suitability for fixing in the different positions and its neatness and efficiency, and all these points will be given due attention in considering the tender. The efficiency is of the utmost importance, particularly for the mains in the ducts. The efficiency guaranteed must be definitely stated and the tolerances required. (The efficiency must in no case be less than 85%, so that the heat loss from a covered pipe is not more than 15% of that lost from an uncovered pipe). If required by the Consulting Engineers, a sample of the proposed covering shall be selected on site, after the whole of the material has been delivered, and sent to the National Physical Laboratory for testing, and the Contractor must include in his tender for this test, for all expenses in connection with same and for a man visiting the National Physical Laboratory to cover a short length of pipe for testing purposes. The test must be carried out in accordance with the usual practice of the National Physical Laboratory, using steam at a pressure of 100 lbs. per square inch inside the pipes, the surrounding air temperature being between the limits of 50° to 60°F.

A separate price is to be given with a full description of the covering proposed in the various positions and the name of the firm supplying same. It is pointed out that the Employers reserve to themselves the right to order another firm's covering instead of that included by the successful tenderer for the general contract.

Insurance Inspection.

The following equipment is to be inspected by The Municipal Mutual Insurance, Ltd., 25/27 Old Queen St., S.W.1. in accordance with the service specified against each item and the fees paid by the Contractor:-

Electrode boilers to be inspected under Service 'A'.
Thermal storage cylinders under Service 'B'.
Hot water service calorifier under Service 'B'.
All electric motors under Service 'C'.
Oil-immersed circuit breakers under Service 'C'.
Transformer under Service 'C'.

Electric Wiring.

In addition to all the wiring in connection with the electrode boilers which is specified previously, the wiring between all motors and the controlling switchgear is to be included in this contract. Wiring is to be run in solid drawn galvanised screwed conduit properly connected to the switchgear and provided with flexible metallic hosing for joining to the terminal box on the motor from the conduit to allow movement on the slide rails. V.I.R. cable of suitable cross section is to be run in the conduit, the whole of the wiring to be in accordance with the I.E.E. regulations and to the satisfaction of the Bristol Municipal Corporation Supply Department.

Guards.

All belts, pulleys and moving parts are to be properly guarded to the satisfaction of the Factory Inspector. Guards are to consist of $\frac{1}{2}$ in. square wire mesh made from 12 S.W.G. wire galvanised after manufacture, properly stayed and supported and provided with hinged access doors with padlocks where required.

Stairs, Handrailing, Ladders, &c.

Five steel stairs, two from the higher level of the boiler chamber to the lower floor, one from the boiler chamber to the tank chamber, and one in each of the main fan chambers, of the widths and lengths shown on the drawings, are to be supplied and erected. They are to be formed with Steelway 'Prominedge' stair treads with the necessary steel stringers, supports, etc.

All stairs to have handrails on both sides, these being of the double rail pattern. Also, a handrail on three sides above the lower portion of the boiler chamber floor, as shown on the drawing, is to be provided. The standards are to be of forged steel 36 ins. high, with two $2\frac{1}{4}$ in. diameter balls for handrails $1\frac{5}{8}$ ins. o.d; the shanks to be $1\frac{1}{2}$ ins. diameter at the bottom and $1\frac{1}{4}$ ins. diameter at the top. The handrailing to be tubular type $1\frac{5}{8}$ ins. o.d. with internal screwed nipples giving flush joints.

The fixing for all handrails and ladders to be suitable for the positionsin which they are to be fixed.

Exact dimensions of the stairs, etc. required are to be obtained from the site before their manufacture is commenced and working drawings must be submitted for approval.

All the above to be supplied and erected by Messrs. Steelway, Ltd.

Painting.

In addition to the painting of the covered pipework and of the storage cylinders, etc., the Contractor will be required to carry out the following:-

All steelwork in the boiler chamber, tank room and basement, including steel stairs, hangers, brackets, handrailing, all machines such as pumps and motors, all iron cylinder cradles, switchgear supports, etc., must be painted two coats of waterproof paint. The priming coat to be Messrs. Lewis Berger & Sons, Ltd's 'Promeum' Primer and the finishing coat 'Promeum' finishing paint, either battleship grey or other approved colour, as shall be directed later.

The cold water and expansion tanks, all exposed pipework, all fans and associated equipment, to be painted as above.

All steelwork in trenches or voids under floor is to be painted two coats of bitumastic black paint as a rust preventative.

Before carrying out this painting, all steel or iron work must be scraped, wire brushed and cleaned so as to be free from oil and rust. Cost of painting to be included with each item.

INSTRUCTIONS FOR TENDERING.

All material must be of British or Empire manufacture, unless otherwise specified, and must be in accordance with British Standard Specifications where such exist.

The tender must be based on the material of the make specified, but it is open for the tenderer to put forward alternative makes at the time of tendering providing full particulars of same and alternative prices are given. If these are not put forward at the time of tendering the Consulting Engineers will not undertake to consider same afterwards. Any such material of alternative make must be of British or Empire manufacture and in accordance with British Standard Specifications where such exist.

The tenderer must give full particulars of any special piece of apparatus he proposes to use where such is not specified.

The plans and specifications must be returned direct to Messrs. J. Roger Preston & Partners, Dilke House, Malet Street, London, W.C.1, at the same time as the tender is despatched, and no tender will be considered where this is not done.

All tenders must be submitted on the form provided and must be accompanied by a letter giving all further particulars asked for. The tenderer must fill in the Schedule of Prices attached to the Form of Tender at the time of tendering.

Sealed tenders, endorsed "New Municipal Buildings, Bristol - Tender for Heating, etc.," must be sent in to E. Vincent Harris Esq., O.B.E., F.R.I.B.A., 9 Clifford Street, Bond Street, W.1, to be received not later than 12 noon on

The lowest or any tender will not necessarily be accepted, and the acceptance of any tender will be subject to the consent of the Ministry of Health. No compensation will be made for the preparation of any tender. The right is also reserved to place the order for different sections of the work with different firms, although it is unlikely that this will be done.

The Contractor will be required to sign the usual contract.

The order for this work will be placed through the General Building Contractor, for whom the usual 2½% discount must be included. This discount must be included proportionately in each item.

Terms of payment will be the same as those for the General Contractor.

It is understood that the engineering work must proceed as quickly as and in conjunction with the builders' work.

The tender must be divided up as set out in the accompanying Details of Tender.

FORM OF TENDER.

Name of Tenderer_____

Address of Tenderer_____

E. Vincent Harris Esq., O.B.E., F.R.I.B.A.,
9 Clifford Street,
Bond Street,
London, W.1.

Date_____

Dear Sir,

re Bristol Municipal Buildings.

We hereby undertake to execute the work proposed to be carried out at the above in accordance with the General Conditions dated April 1936, plans and specification prepared by your Consulting Engineers, Messrs. J. Roger Preston & Partners, and in accordance with the conditions of the Main Contract, where they apply, for the sum of

_____pounds

s. d. £. s. d.

This sum is made up as follows:-

Items.		£.	s.	d.
1 - 4.	Heating System			
5 & 6.	Hot Water Supply System			
7 & 8.	Cold Water Supply			
9 - 16.	Ventilation			
17 - 20.	Covering			
21.	P.C. Item for Grilles	950.	0.	0.
22.	Provisional Sum for Basement Extract Fans	50.	0.	0.
23.	Provisional Sum for Contingencies	2,000.	0.	0.

The above prices are made up as detailed on the attached sheets.

The covering we propose will be carried out by Messrs._____

_____and its specificatio
and full particulars are given on the accompanying sheet, together with all other information asked for.

We undertake to carry out the work in_____weeks from the date of receiving the order to proceed, or in accordance with the progress of the building work.

FORM OF TENDER.
(cont'd.)

With reference to the General Conditions, should any extra work or variation be required not in the form of supplementary estimates, and not capable of being priced on the accompanying schedule, which we have duly completed and signed, we undertake to carry out this work at nett cost of material and labour plus _____% to cover establishment charges and profit, the nett cost of labour being based on Trade Union rates.

The whole of the work will be carried out in the best possible manner and to the entire satisfaction of the Consulting Engineers.

Yours faithfully,

DETAILS OF TENDER.

The following are Details of the prices given in our tender:-

		£. s. d.	£. s. d.
1.	Thermal storage heating plant in boiler chamber, including boilers, cylinders, pumps, primary and secondary pipework and all switchgear		
2.	Feed and expansion tank and cold feed to boiler chamber ...		
3.	Heating outside boiler chamber..		
4.	Sump pump and connecting pipework		
5.	Hot water service plant in boiler chamber, including cylinder, pipework, pumps, immersion heaters and all switchgear ...		
6.	Hot water service outside boiler chamber		
7.	Main cold water storage tanks and cold water feed to H.W.S. cylinder		
8.	Cold water service from tanks in roof		
9.	Ventilation of Council Chamber..		
10.	Ventilation of Conference Room..		
11.	Ventilation of City Treasurer's Office		
12.	Lavatories Extract Ventilation..		
13.	Kitchen Extract Ventilation ...		
14.	Lord Mayor's Rooms, &c. Extract Ventilation		
15.	Committee Rooms Extract Ventilation		
16.	Ventilation of boiler house and battery room		
	Carried forward		

DETAILS OF TENDER (cont'd.)

		£. s. d.	£. s. d.
	Brought forward		
17.	Covering in connection with Item No.1.		
18.	Covering for heating outside boiler chamber (Item No. 3.) ...		
19.	Covering in connection with Item No. 5.		
20.	Covering for H.W.S. outside boiler chamber (Item No. 6.)		
21.	P.C. Item for Grilles		950. 0. 0.
22.	Provisional Sum for Basement extract fans		50. 0. 0.
23.	Provisional Sum for Contingencies..		2,000. 0. 0.
	TOTAL		

Signed_____

Date_____

SCHEDULE OF PRICES.

The following schedule of prices must be completed by the Tenderer and all the various materials must be of the same quality as that described in the specification. The rates are to be the gross prices and are to include delivery of the material on to the site and fixing, together with all establishment charges and profit. The price of the piping per foot run must include all the necessary supports. In the event of any variations being required they are to be priced in accordance with the following schedule:-

	½"	¾"	1"	1¼"	1½"	2"	2½"
Red steam pipe, per ft. run, including supports ...							
Butt weld in R.S. pipe ...							
Branch weld in R.S. pipe ..							
Pair of flanges welded on to R.S. pipes & complete with nuts & bolts & joint made.							
Long sweep flanged bend, complete with counter flanges welded on straight pipe, nuts & bolts & joint made							
Flanged sweep tee, ditto.							
Malleable straight union ..							
Malleable bend							
Malleable elbow							
Malleable tee							
Fireset in R.S. pipe ...							
Flanged gate valve, fixed complete	-	-	-	-	-		
Screwed gate valve, ditto..							-
Copper pipe per ft. run, including supports ...							
Bend in copper pipe ...							
Straight weld in copper pipe							
Branch weld in copper pipe.							
G.M. straight union (compression joint) ...							
G.M. elbow ditto ...							
G.M. tee ditto ...							
Sleeves							
Floor Plates							

SCHEDULE OF PRICES.
(cont'd.)

	3"	4"	5"	6"	7"	8"
Red steam pipe, per ft. run, including supports ...						
Butt weld in R.S. pipe ...						
Branch weld in R.S. pipe ..						
Pair of flanges welded on to R.S. pipes and complete with nuts & bolts and joint made						
Long sweep flanged bend complete with counter flanges welded on straight pipe, nuts & bolts & joint made						
Flanged sweep tee, ditto ..						
Malleable straight union ..						
Malleable bend						
Malleable elbow						
Malleable tee						
Fireset in R.S. pipe ...						
Flanged gate valve, fixed complete						
Plastic covering 1½ in. thick, finished planished steel.						
Plastic covering 1½ in. thick, finished planished steel.						
Plastic covering 1 in. thick, finished ½ in. hard cement and painted two coats ..						
Plastic covering 1½ in. thick, finished ½ in. hard cement and painted two coats ..						
Sectional Covering, 85% Magnesia 1 in., wrapped spirally with canvas and painted two coats ...						

SCHEDULE OF PRICES
(cont'd.)

	½"	¾"	1"	1¼"	1½"	2"	2½"
Plastic covering 1¼ in. thick, finished planished steel.							
Plastic covering 1½ in. thick, finished planished steel.							
Plastic covering 1 in. thick, finished ½ in. hard cement and painted two coats ...							
Plastic covering 1¼ in. thick finished ½ in. hard cement and painted two coats ...							
Sectional Covering, 85% Magnesia 1 in., wrapped spirally with canvas and painted two coats ...							

Cork covering on cylinders, finished planished steel, per square foot ... ...

Panel Control Valves, ½ in., fixed ... ...

Valve shield for above, fixed .....

Panel Surface, per square foot of ceiling area, measured 3 in. beyond centres of extreme pipes on either side ... ...

Panel Pipe, per foot run for panel coils and connections, ½ in. ... ...

Signed_____ Date_____