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THE JOURNAL OF THE INSTITUTE OF HOSPITAL ENGINEERING

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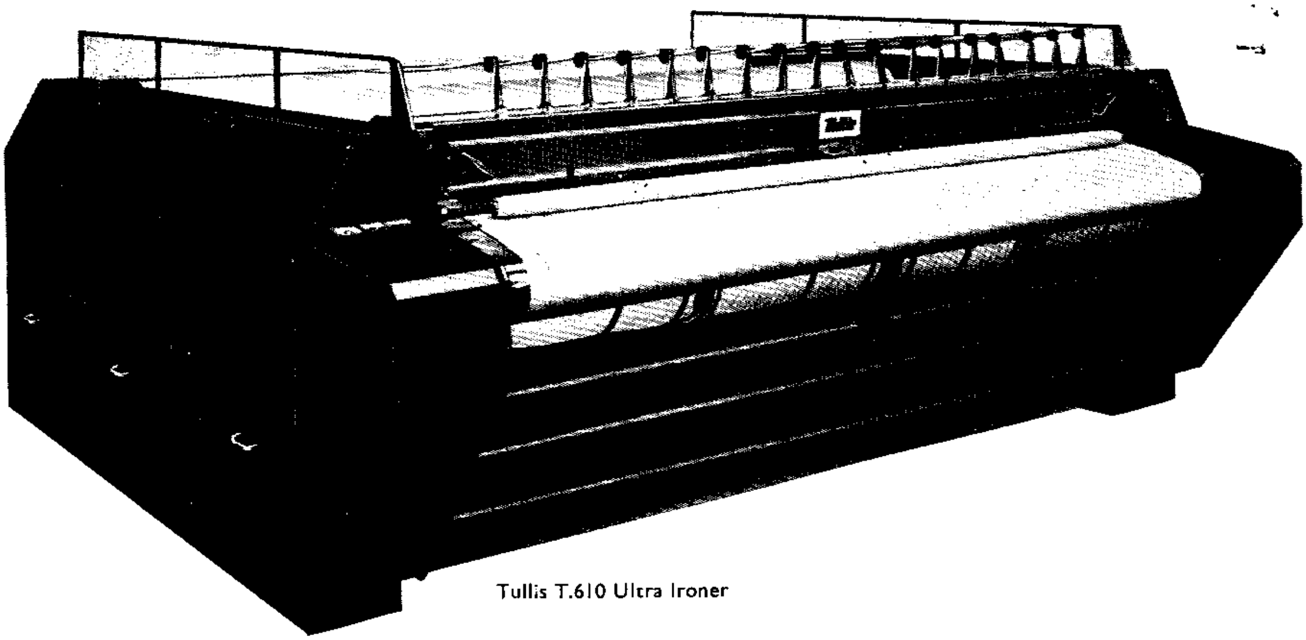

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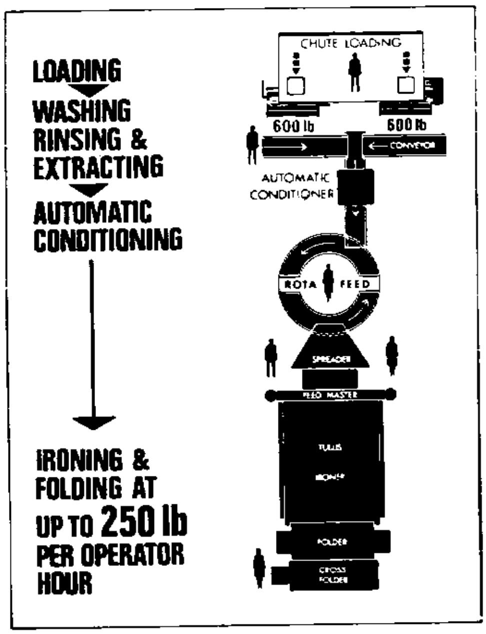

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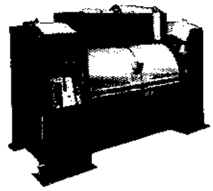

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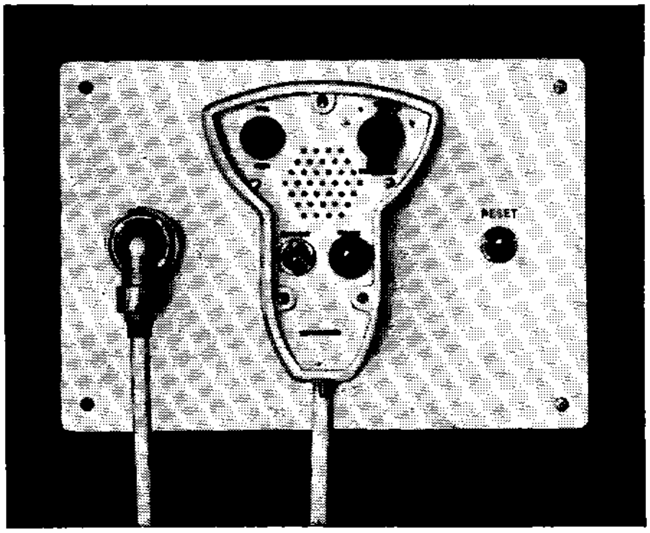

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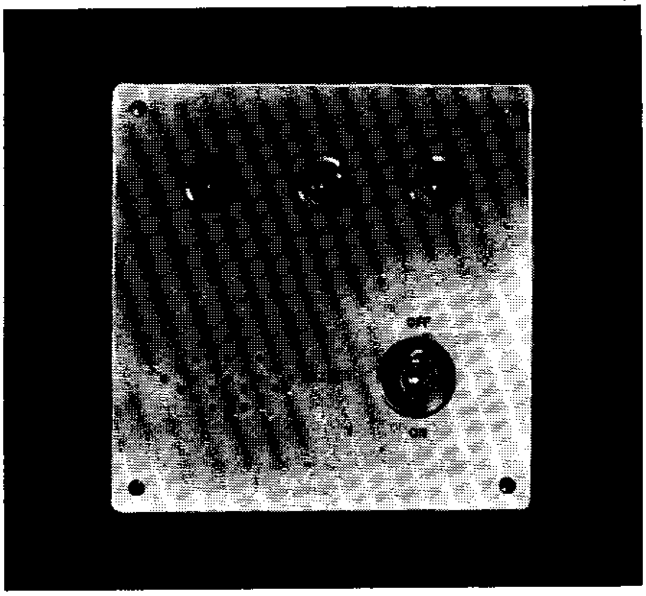

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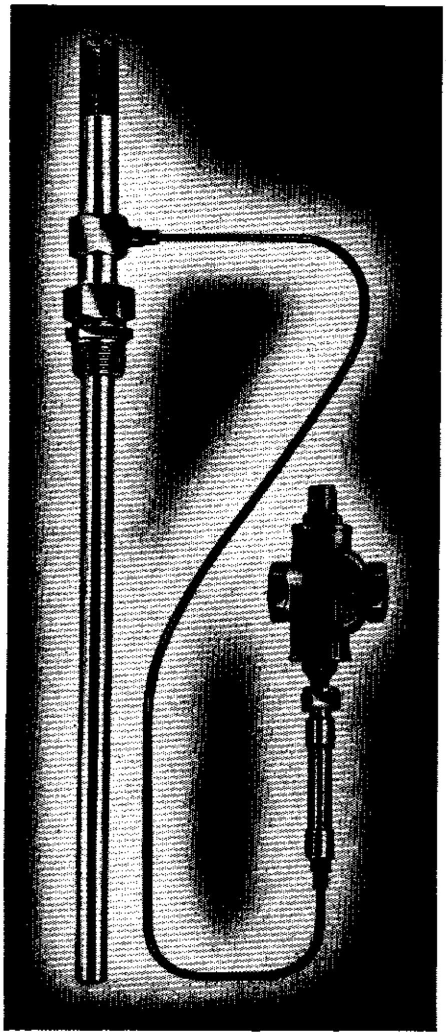

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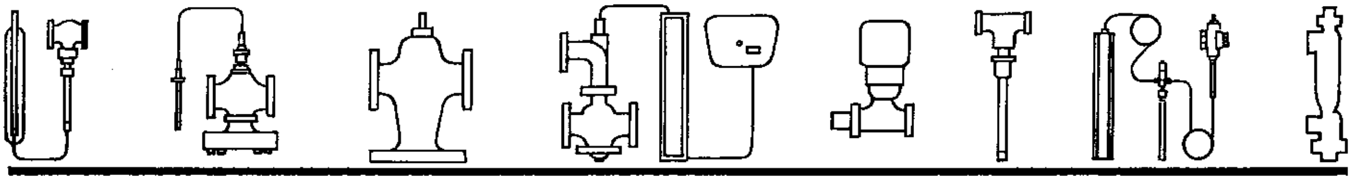

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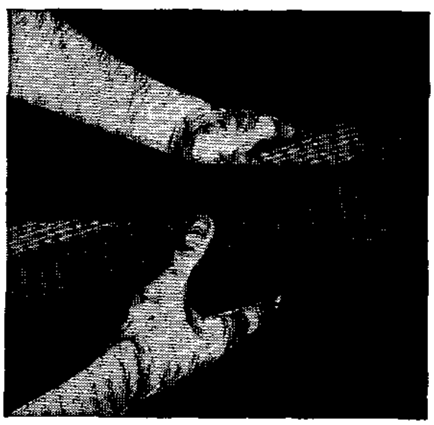
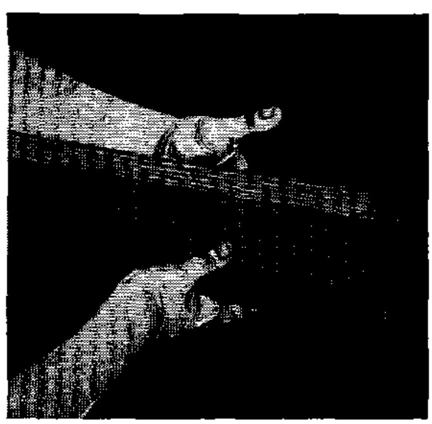
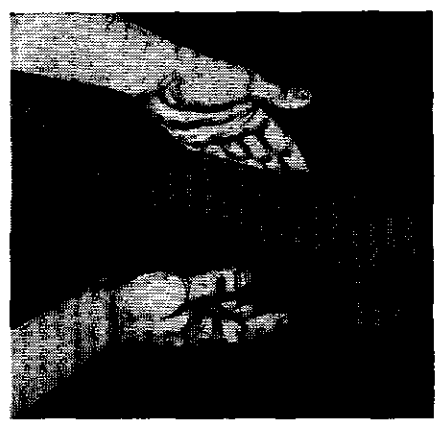

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THE HOSPITAL ENGINEER

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Engineering Considerations in the design of a Haemodialysis /Artificial Kidney Unit

By A. WATSON, C.Eng., M.I.Mech.E., A.M.I.P.E., M.R.S.H.
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THE unit to be described was built by the Manchester Regional Hospital Board at the Withington Hospital of the South Manchester Hospital Management Committee and is designed to treat up to ten patients at any one time, but is versatile enough to be utilised for training people in the use of home "do-it-yourself" artificial kidney machines which are now coming into use. The unit is built to incorporate separate dialysate flow systems, each feeding a separate ward. (See Appendix No. 1.)

In order to appreciate the design of the unit, its proposed way of functioning has to be understood. The patient suffering from kidney failure will firstly have permanent connections made into a vein and an artery in either an arm or leg. These connections are known as "shunts" and are the points from which the patient is connected into the artificial kidney machine. A typical cycle of events will be that the patient will leave his home or work in the evening and will report to the unit, where he will be connected into the artificial kidney machine in an individual ward, each patient being thus isolated from his neighbour in order to reduce the possibility of "cross infection." The treatment will take place overnight: the following morning the patient will be disconnected and will leave the unit to take up his normal routine until the next treatment session. As this treatment normally has to take place at regular intervals, possibly over a number of years, the environment within the unit has been designed to make the patient's stay within the unit as pleasant as possible, so that these regular visits become a matter of routine within his everyday life. T.V. and radio facilities are provided in each ward to help the patient to pass the time.

Introduction

Before considering the pure engineering aspects of this unit, I feel it would be of interest to outline in non-medical terms the principles which govern the design of what is commonly known as the "artificial kidney."

If a fire is not raked regularly to remove the ash and to maintain an adequate supply of air, it will go out. The waste materials, i.e. ash, produced by the burning of fuel will clog up the fire and prevent it from burning properly. Living cells in the human body burn fuel to produce the energy we require for daily life, and the maintenance of body functions. This process, like the fire, produces waste substances some of which are further broken down to yield more energy, but others have to be removed from the body to enable the process of living to continue. If these waste products are allowed to accumulate they produce a rapid deterioration in bodily health and eventually body organisms start to die.

The removal of waste substances is carried out mainly by the kidneys, which eliminate these products into the urine. Kidney function is far more involved than the mere removal of waste. They play a part in controlling the quantity of water excreted from the body; they help to regulate the pH (i.e. level of acidity or alkalinity) and the balance of ions in the blood stream and hence the body fluid as a whole. They also conserve essential substances such as glucose and amino acids.

When the natural kidney fails, the concentration of the body's waste products increases in the blood stream, necessitating the use of a man-made machine to take over the kidneys' essential function of restoring a natural balance within the body.

Basic Principles of the Artificial Kidney

In the human body the kidneys separate out the waste products from the blood stream by virtue of their unique structure. The kidneys contain a large number of tiny ducts called "tubules"; at one end of the tubules is a "knot" of capillaries called the "glomeruli." At the other end the ducts join into a collecting tube down which the waste fluids flow. In the "glomerulus" ultra filtration and dialysis takes place through its semi-permeable membrane wall, along with specific activities of the cells of the tubules, thus eliminating from the blood stream the toxic waste products.

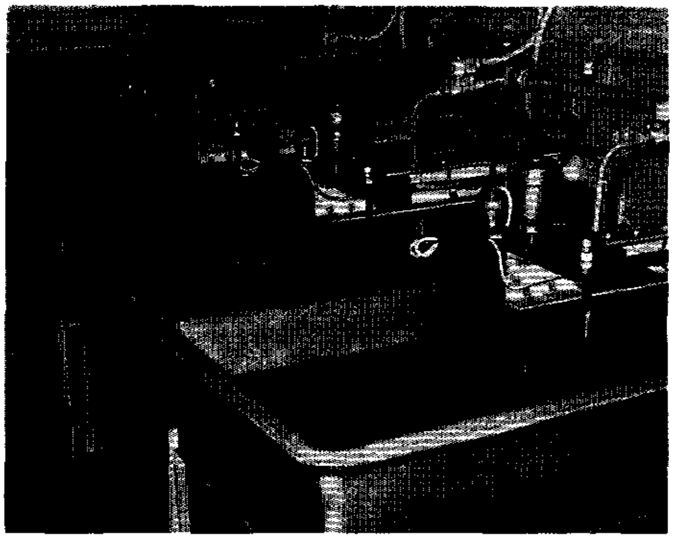


Fig. 1. Mixing Tanks, showing Submersible Pumps, Level Control Probes and Water Controlling Solenoid Valves.

In the artificial kidney, this process is reproduced by letting the patient's blood flow upon one side of a semi-permeable membrane, whilst on the other side there flows a dialysing solution containing only diffusable substances. The membrane is impermeable to blood colloids and substances having large molecular structures. It permits only water and crystalloids to pass through its pores. Energy for this separation and transfer process is obtained from the physical and electro-chemical potentials between the two fluids on either side of the membrane. The direction of flow is determined by the differences in concentration between the two fluids, the final blood concentration being determined by the specific electrolyte concentration in the dialysing solution. Thus, the more abnormal the patient's blood condition, the greater will be the differences in concentration values either side of the membrane, resulting in a more rapid rate of clearance as the electrolytes in the blood diffuse into the dialysing solution. The converse is also possible: by altering the concentration of the electrolytes in the dialysing solution, a deficiency in blood electrolytes could be corrected. In addition to the flow of electrolytes through the membrane, water also is capable of moving in both directions. The direction of flow is determined in this case partially by the differences in hydrostatic pressure. It should finally be pointed out that the pore size of the membrane is such that it does not permit the passage of bacteria.

General Description of Services to a Haemodialysis Unit

The unit to be described was designed for the treatment at any one time of a maximum of ten patients in separate wards. The type of building used was chosen to expedite construction, whilst incorporating the requirements dictated by the positioning of the equipment. To eliminate the possible hazard of failure, a gravity flow system was utilised for dialysate solution; this necessitated the provision of an elevated tank room as indicated in Appendix No. 1.

In order to isolate the domestic cold water services from both the public supply and the rest of the hospital, it was decided to utilise a tank supply system. Tank water feeds all points in the unit, with the exception of fire hydrants and water to the kitchen, which are directly off the mains supply. In order to obtain sufficient "head" for the unit's requirements the tank was mounted on the roof of an adjacent ward block. Its capacity is such that if the feed to the tank ball valve fails, supply to the unit is sufficient for twenty-four hours. The tank itself was coated internally with a non-toxic lining to prevent possible metallic contamination of the water.

Domestic hot water for the unit is provided from a steam-to-water calorifier located in the basement plant room, and is distributed by a pumped system.

In order to assist in the prevention of blood coagulation, a temperature controllable up to 80°F. when the outside ambient is 30° F. was required within each of the wards. To obtain this temperature and at the same time slightly to pressurise these areas, an individual thermostatically controlled fan convector system was built into each ward, each convector having removable, washable filters as standard. All the convectors were fed from a constant temperature low pressure hot water circuit. Heat to the non-clinical areas was provided by conventional radiators. The low pressure hot water for the heating systems was provided by a steam-to-water calorifier served by duplicate circulating pumps and a modulating control system located in the plant room.

The hospital in question is fortunate in having two electric feeders from separate sources of supply. As a result, supply failure is virtually unknown. Stand-by independent electrical generation facilities are available in the hospital boiler house and could be switched to feed the unit if required. When stand-by generation is discussed in relation to such units along with the availability of normal sources of supply, local circumstances must play a large part in deciding the final system to be used.

The Dialysing Process

As stated before in this paper, dialysis is a process of allowing the patient's contaminated blood to flow upon one side of a membrane, with a dialysate solution upon the other side, and thus by a process akin to " osmosis " the impurities leave the blood and go into solution with the dialysate fluid, the clean blood being returned to the patient. This process is illustrated in Diagram No. 1. (See Appendix No. 2.) In the unit being described, the process starts in the high level tank room where the dialysate solution is prepared, a separate system being used for each of the wards. Basically, concentrated dialysate solution is poured into a polyethylene tank, water is then added to give a final volume of 450 litres of solution which is sufficient for one patient session. The water to concentrate ratio is usually about 35 : 1. The concentrate can be either pumped up from the basement bulk store room, measured out in a graduated container prior to pouring into the solution-mixing tank, or delivered in individual containers each holding the exact volume for one tank mix. Water is added to the mixing tanks via a probe-operated, solenoid-controlled valve which shuts off the water supply when it reaches a pre-determined level in the tank, giving the exact 450 litres capacity required. Mixing is carried out by submerged stainless steel bodied pumps to ensure a homogenous mixture. (See Fig. 1). The water solenoid valves are selected from a separate control panel which is equipped with a re-set button. Each mixer pump has its own locally-mounted starter switch for individual tank control.

The process described provides only one type of mix: this can be varied to provide a different pH value or potassium concentration in each of the separate tanks, as required by the physician.

After mixing, the dialysate solution then flows by gravity through ½ in. bore polyethylene pipes to the individual wards, where an all-plastic diaphragm-type ball valve maintains a constant head in a " perspex " tank. This tank also contains a thermostatically-controlled stainless steel heater coil which maintains the solution within the tank at a constant temperature. This is normally about 100°F.

From the " perspex " constant head tank the dialysate solution again flows by gravity through a " rota " type flow meter mounted on the bedside monitor unit, through the artificial kidney and then down the drain to waste.

As mentioned previously, the unit is designed with ten mixing tanks, each serving a separate constant head tank in each ward. In order to facilitate the replacing of the ½ in. lines between these two tanks, 3 in. unplasticised P.V.C. sleeves were permanently installed between the high level tank room and each ward to serve as a guide and container for the ½ in. dialysate lines. (See Figs. 2 and 3.) Thus to replace a ½ in. line, a new length is attached to the end of the one to be re-

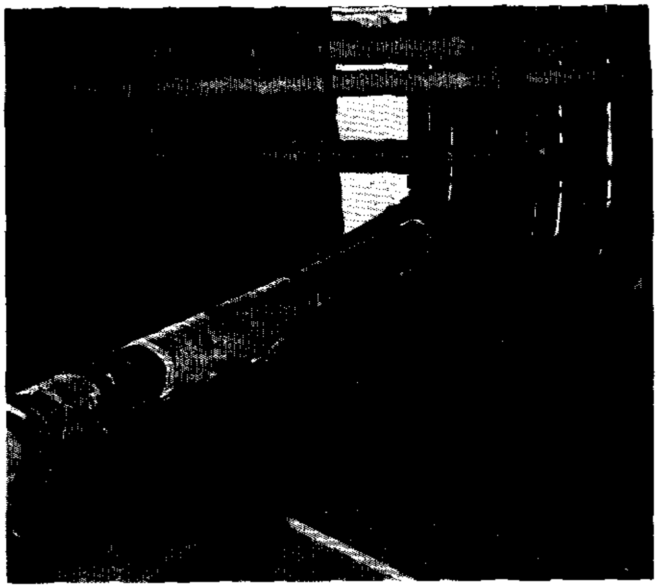
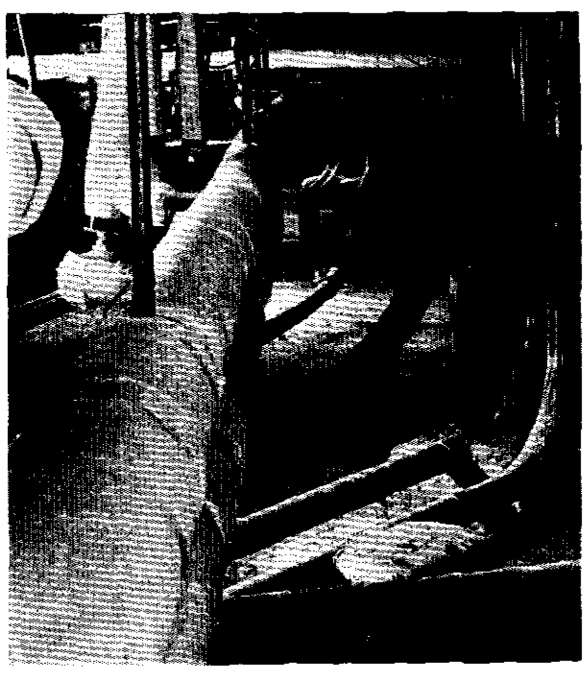


Fig. 2. P.V.C. Sleeves for Dialysate Flow Lines.

placed, the old one is pulled out, drawing the new one into position.

The Dialyser/Artificial Kidney used in this unit is of the type developed by Frederick Kiil in Norway during the second world war. It consists of a number of polypropylene blocks which have been grooved at close intervals, with inter-connecting channels to allow dialysing solution to flow to and from the grooves. The blocks are laid one on top of another and between each adjacent pair two layers of membrane are laid, the groove peaks giving the necessary support for the mem-

Fig. 3. P.V.C. Sleeves rising up to Individual Wards.



branes, which consist of "Cellophane" of 0·001 in. thickness. Blood flows between the membranes, the dialysing solution flows over the outer sides along the grooves, thus providing a large fluid/membrane contact area with low pressure drop against the blood flow. The whole assembly is rigidly clamped together in a frame, making a leak-proof " unit," and is mounted on a tilting trolley to facilitate draining down. (See Fig. 4.)

The efficiency of a dialyser artificial kidney is measured by its " urea " clearance figure, urea being one of the toxic impurities retained in the blood stream when the natural kidney fails. Typical clearance figures are:—

100-300 m.l. per minute when the blood flow rate is 200-400 m.l. per minute.

These figures compare favourably with the maximal rate of 140 m.l. per minute blood flow (renal) from the natural kidney.

The dialysate solution after it leaves the dialyser/kidney contains the toxic impurities which have been removed from the blood of the patient. This contaminated solution cannot be re-used so it is run to waste down the drains within the unit. Each drain is trapped in order to isolate the inlet from the main system.

Monitoring

It is essential that various functions of the patient, along with the flow rate and temperature of the dialysing solution, are constantly monitored during treatment. This is done by the bedside monitor unit (see Fig. 4), which contains the following instruments:—

Blood pressure (Venous) gauge with High and Low Limit variable contact range + or −0 to 250 m.m. of Hg.

Blood pressure (Arterial), details as above.

Dialysis temperature gauge with High and Low Limit variable contacts range 0° to 70°C.

Dialysis Flow Meter " rota " type with control valve and warning device. Range 100 to 700 c.c. per minute.

Blood leak detector warning system.

The blood pressure gauges are actuated by pressure transducers in the blood lines from the patient to the dialysis/artificial kidney. High and low limits are preset on the gauge, thus when the direct reading pointer on the gauge makes contact with either of the pre-set indicators an alarm circuit is activated.

The dialysis solution temperature is similarly treated so that any variation over the pre-set limits activates the alarm system.

The flow meter is of the " rota " type which contains a small " bobbin " within a glass tube, thus by mounting two photo-electric cells across the tube at pre-set levels, the bobbin, if it rises or falls indicating reduced or increased dialysate flow, crosses the light beam and triggers off the alarm circuit.

If the membrane within the dialyser/artificial kidney ruptures, blood will mix with the dialysate solution. To detect this possible fault a spectro-photometric system, sensitive enough to detect a blood/dialysate leak of 1 in 2,000 or better, is mounted in the dialysate drain from the kidney, thus any change in the colour density of the contaminated dialysate solution actuates the warning device (buzzer and light) mounted within the bedside monitor unit.

As the unit being described contains ten separate wards with ten completely independent systems of dialysis flow and monitoring, in order to obtain the required medical supervision it was considered essential that all monitoring alarm systems should be reproduced

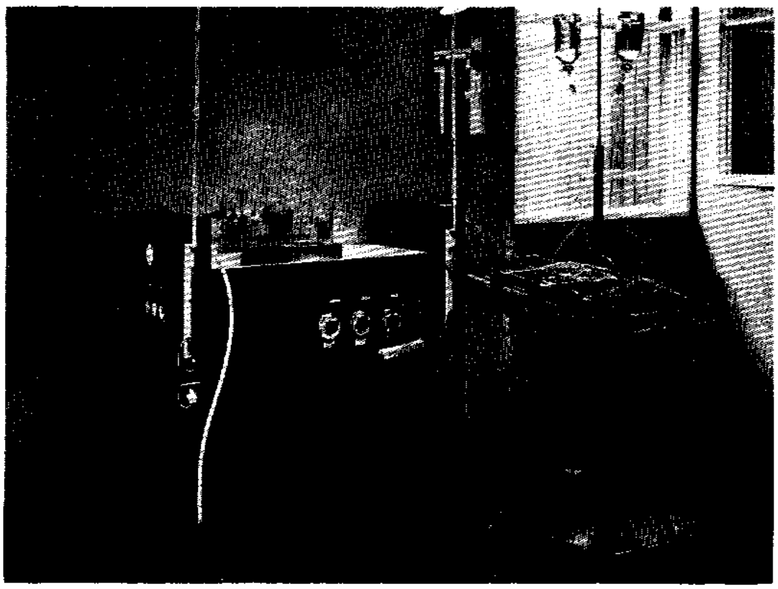


Fig. 4. Header Tank, Prototype Monitor and Kidney on Tilting Trolley.

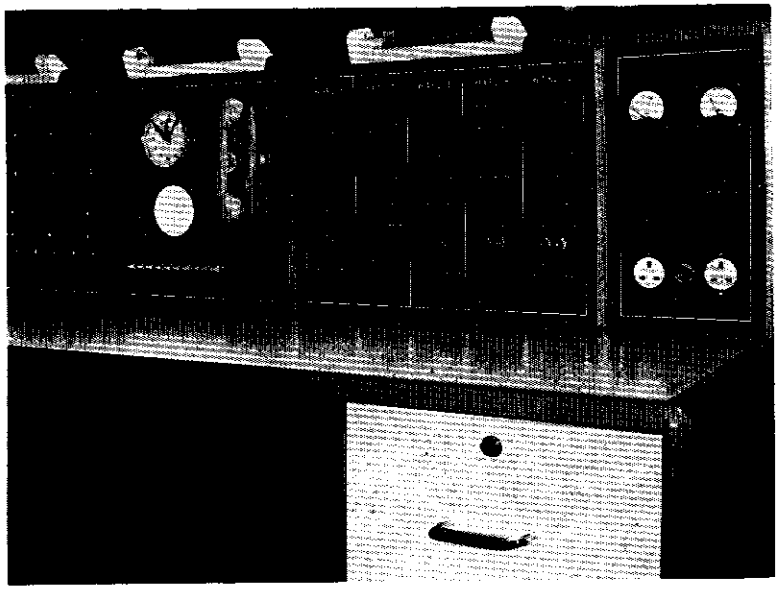
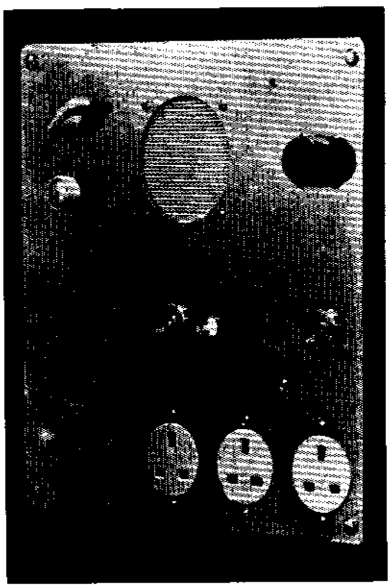


Fig. 5. The Console.

Fig. 6. The Bedhead Unit.



on a centralised master console which forms the " nerve centre " of the whole unit. This enables the nurse on duty at this console to see at a glance how the treatment process is functioning in the ten separate wards. (See Fig. 5.)

As an additional precaution, a set of warning lights actuated by the alarms are mounted above the door of each individual ward, thus if the main console is unattended, the warning lights will be visible to anyone in the corridor area.

The Console and Bed Head Unit

This unit consists of a large desk with a frontage upstand containing twelve separate panels, one for each of the ten wards, a communications panel and a charger panel.

Each ward panel contains green " normal " lights for blood pressures, dialysis flow and temperature, red " alarm " lights for high or low blood pressures, dialysate flow and temperature, white " alarm " light for blood leak detection and an orange light for nurse call and " power-on " indication.

To appreciate fully the facilities on the console, we must refer back to the individual wards. Each ward contains a bedhead unit (see Fig. 6) mounted in the purpose-built rack which houses the monitor unit and also supports the constant head tank in its plastic tray. This bedhead unit contains a socket for television control and a 4-way switch controlling two radio programmes, a special hospital service and television sound.

It also contains the nurse call system whereby the patient depresses a push button which rings a bell on the main console and illuminates a nurse call light on the console and a nurse call light over the door of the ward originating the signal.

It also contains the patient/nurse communications system whereby, upon seeing the patient call signal the nurse on duty at the console can select the ward in question by pressing an appropriately-numbered key and can then speak directly to the patient. After the conversation, the nurse can re-set the call system which has just been used, by means of a re-set button provided on the communications panel.

A charger panel is also built into the console as the signal/alarm system functions from a 24 volt D.C. supply to comply with the Hospital Technical Memorandum No. 8 " Safety Code for Electro-Medical Apparatus." To obtain this 24 volt supply the console contains batteries which are fed by a " floating " trickle charge. The batteries have sufficient capacity to maintain the alarm circuits for a period of eight hours should there be any interruption of normal mains supply. There are three red indicator lights mounted on this panel which show mains failure, charger failure and battery volts low. A test button is also incorporated in the system.

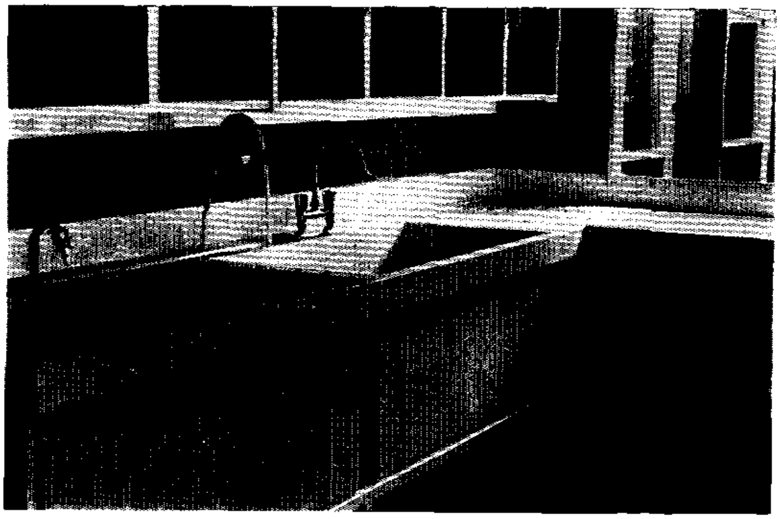


Fig. 7. Kidney Wash Sinks.

The Hydraulic Design of the System

As mentioned previously, the dialysate flow is by gravity for two reasons, firstly to avoid the hazard of pump failure, and secondly to avoid " gassing out " of dissolved gases in solution by the possible reduction in pressure caused by inlet suction on a pumped system. This second point becomes more important when it is remembered that in the constant head tank the temperature of the solution is raised to around 100°F., thus accentuating this problem. If care is not taken in the initial design stages, the problem of air or gas locks in the pipe lines and artificial kidney can cause interruption, or indeed failure, of dialysate supply. When designing the mixing-to-constant header tank pipework system it must be borne in mind that the head available is diminishing as the surface level in the mixing tank falls. Thus, to ensure adequate head when the mixing tank is nearly empty it is advisable to design the system taking the effective head to be the distance between the bottom of the mixing tank and the ball valve inlet on the constant head tank (see Diagram 2A—Appendix No. 3).

In calculating pipe sizes and heads required, the prime consideration is the flow rate. In this instance it is a minimum of 400 to 600 c.c. per minute, this being the flow rate required by the artificial kidney in this application. The orifice in the ball valve feeding the constant head tank should be of low pressure type. When considering layout and design, full use should be made of the maximum head available, as it is far more easy to reduce head than to gain it.

From the constant head tank the dialysate solution goes through a flow meter, mounted on the bedside monitor unit, to the artificial kidney and then down the drain. Thus, sufficient head has to be available from the header tank to supply the 400 to 600 c.c. per minute required through the kidney. Most flow meters are fitted with a needle-type control valve, but unless the pipe line from this valve to the kidney, and the pipes from the kidney to the drain, are sized so that they are always full of solution, much effective head is lost as air locks start to develop in both pipe lines and the artificial kidney itself. These air locks " break " the liquid flow and consequently its head up to that point, resulting in reduced flow and the possibility of failure of supply. A better method appears to be the use of a flow control valve at the end of the drain line, thus the whole system is full of liquid back to the constant head tank, making full use of the available head. (See Diagrams 2B and C —Appendix No. 3.)

Materials of Construction for the Dialysate System

Before considering materials of construction, the condition of the fluid to be handled has to be ascertained. A typical dialysate solution is a mixture of sodium chloride, magnesium chloride, calcium chloride, sodium acetate and dextrose in water at a temperature of up to, say, 100°F. and at pressures up to, say, 5 lbs. p.s.i. The solution itself is highly conductive and so the possibility of electrolytic action between the solution and any metal in contact with it is a real danger, hence the use of plastic materials for tanks, pipe lines and fittings wherever possible.

The mixer tanks in the high level tank room were made from polyethylene and supported in an angle steel frame in order to keep the tank wall thickness to a reasonable limit. The polyethylene used was the pure material without the addition of pigments, etc. This material is ideal for the duty required as it is inert to the dialysate solution being handled at that low temperature. It should be noted, however, that unpigmented polythene is attacked by Ultra Violet light, and suitable precautions may have to be taken to shield any such tanks from direct sunlight.

Tank drains and overflows were constructed from P.V.C. unplasticised pipe and fittings, with solvent welded or mechanical joints as required. As mentioned previously, the sleeves carrying the $\frac{1}{2}$ in. dialysate lines were also constructed from this material.

The $\frac{1}{2}$ in. dialysate pipe lines from mixing tank to constant header tank were run in Low Density Polythene to B.S. 1973:1964 (Type 425) pipe in pure unpigmented material. There are many plastics on the market which could be used for this purpose.

The constant header tanks were fabricated from $\frac{3}{8}$ in. sheet "perspex" with cemented joints mainly for mechanical strength and accurate dimensional control in manufacture. The ball valve in this tank is of the diaphragm type of all-plastic construction, the material used probably being acetal resins.

The flow meter is a glass tube, polypropylene temperature detector pocket, and stainless steel bobbin and valve.

Thus the only pieces of metal equipment in contact with the dialysate solution are the following:—

1. Level control probes in mixer tank. Stainless steel.
2. Mixing pump in mixer tank. „ „
3. Heater coil in constant head tank. „ „
4. Rota flow meter bobbin. „ „
5. Flow control valve to flow meter. „ „
6. Dialysate temperature detector bulb. „ „

In the kidney wash area where the artificial kidneys are dismantled for cleaning, the sinks and draining trays were fabricated from fibre glass reinforced polyester resins. The drains are again in unplasticated P.V.C. These tanks have to withstand a solution of 5% "Milton", i.e. sodium hypochlorite. (See Fig. 7.)

In the basement store room, polyethylene is used for the bulk storage of dialysate concentrate and "Milton." Peristaltic-type pumps are used for the transfer of these liquids from the bulk store to the elevated mixing tank room and to the kidney wash area.

As mentioned under the heading of "Services to a Haemodialysis Unit," cold water is supplied from a non-toxic lined tank at high level. The mains distributing this water were run in unplasticised P.V.C. in sizes over $\frac{3}{4}$ in. using solvent weld joints. The $\frac{1}{2}$ in. and $\frac{3}{4}$ in. run-offs were in copper; the use of this material was kept to a minimum in order to avoid the possibility of copper pick-up in the water.

Laundry

In order to comply with the recommendations of the local "Cross Infection Committee", a 50 lb. capacity washing machine in the existing laundry was set aside for use by the Haemodialysis Unit only. The machine was taken off its automatic control in order that it could be manually operated to boil all soiled linen from the unit for a minimum period of one hour before such linen was allowed to be processed through the laundry in the normal manner.

Mechanical Handling

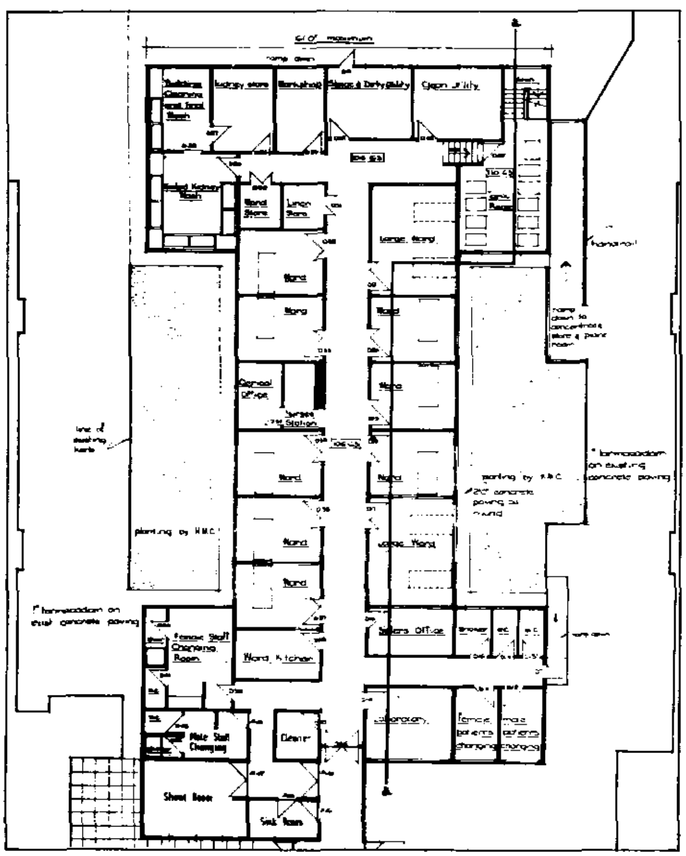
As the techniques in handling the soiled kidneys develop there appears to be the possibility that the artificial kidney will be dismantled whilst completely immersed in "Milton" solution. Thus, a heavy piece of equipment will have to be lifted off its trolley and carefully lowered into a deep sink. This task if performed manually leaves much to be desired. If this dismantling technique is to be employed some mechanical aid will be essential, e.g. a light weight block and tackle mounted on a fixed gantry above each kidney wash sink.

Conclusion

The object of this paper was firstly to describe in simple terms what the unit is trying to do and how the equipment works in achieving this object, and secondly to bring to light some of the problems which were encountered on this project, to enable other people involved in the design of future units of this type to gain some useful information to help them in their task.

The opinions expressed in these pages are personal and not necessarily those of the Manchester Regional Hospital Board. I wish, however, to acknowledge the assistance given by the Regional Engineer, C. G. Daines, and the members of his staff, also H. McMaster, Regional Architect.

APPENDIX No. 1.



APPENDIX No. 2.

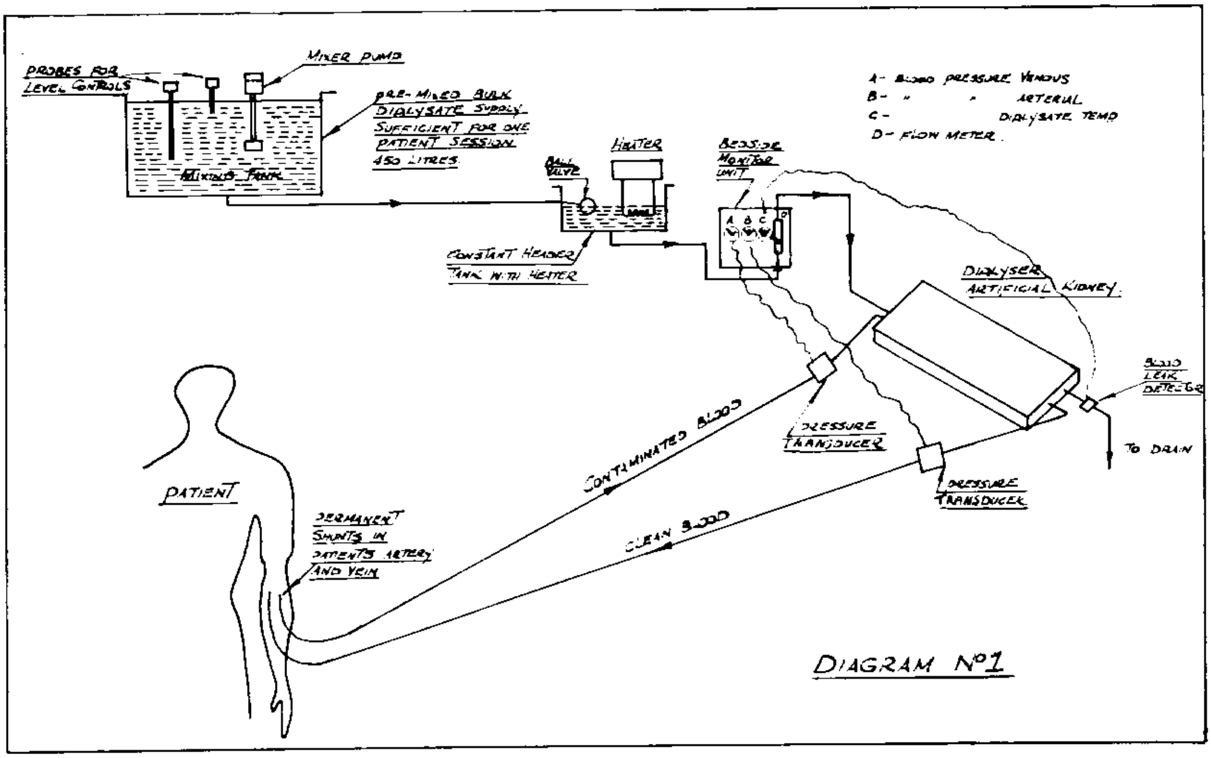


DIAGRAM No 1

APPENDIX No. 3.

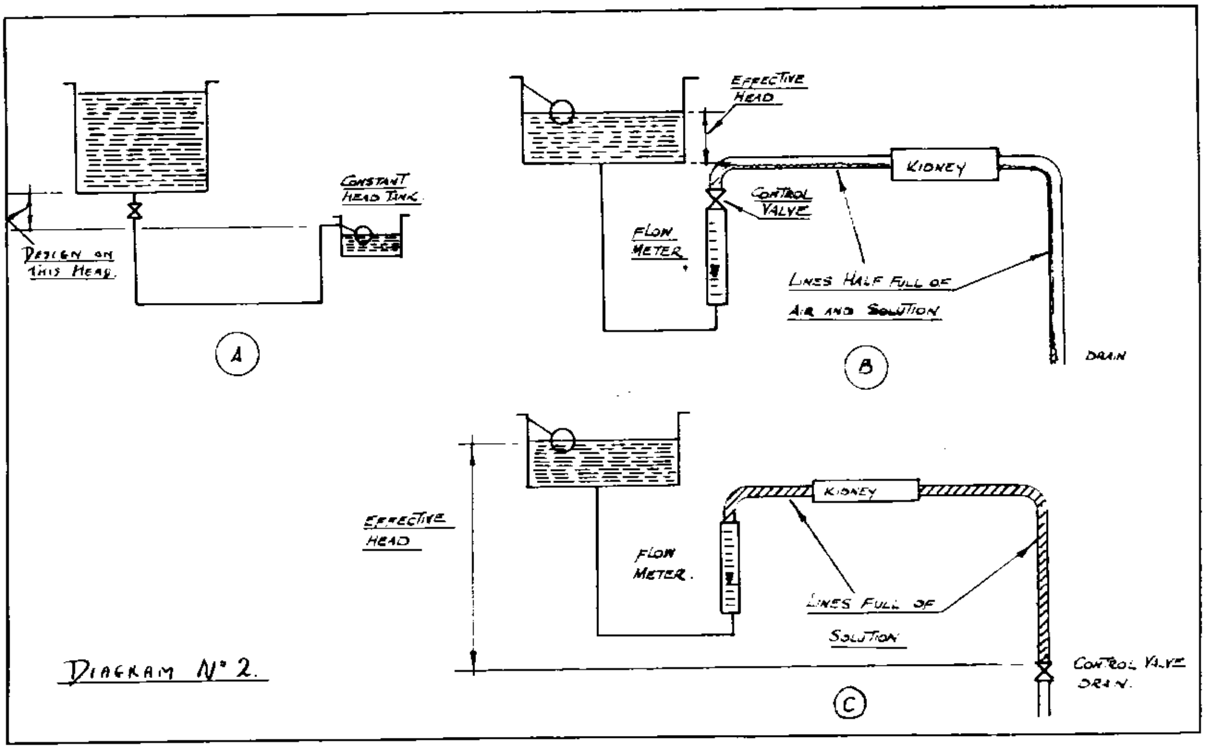


DIAGRAM No 2.

The Protection of Domestic and Industrial Electrical Installations

By J. A. ROBBINS, B.Sc.(Eng.), C.Eng., F.I.Mech.E., F.I.E.E.
J. A. Crabtree & Co., Ltd.

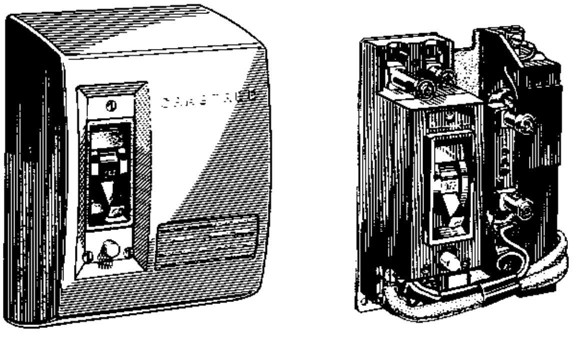
SOME NOTES ON THE PROBLEMS OF EARTH LEAKAGE PROTECTION—PART 2

Ultra-sensitive protection

There is a growing interest in the possibility of using ultra-sensitive current-operated earth-leakage circuit breakers to provide shock risk protection for portable and transportable equipment. On such applications the supply to the equipment is taken through a flexible or trailing cable. Hence there is an ever-present risk that the earth-continuity conductor in the cable may break, or become discontinuous at terminations—so leaving the equipment unprotected as far as earth faults are concerned.

One possible solution to this problem is to use some form of earth-monitoring equipment to establish a continuous check on the integrity of the earth-continuity conductor—isolating the equipment if this conductor becomes discontinuous (see July issue). Alternatively, the equipment can be protected by a current-operated earth-leakage circuit breaker sensitive to earth-leakage currents of the order of 25 mA.

The lower limit of lethal current is usually assumed to be about 50mA. Sustained currents through a victim's body in excess of this value may be lethal: sustained currents less than this value—whilst possibly producing an extremely unpleasant condition of shock—would not normally be directly fatal. If, therefore, the circuit protective device will isolate the equipment effectively instanteously if there is a leakage current to earth of 25 mA or more, it should prevent the user of the equipment receiving a lethal electric shock—even though the earth-continuity conductor had become defective. It must be realised, however, that—in common with other forms of earth-leakage protection—the earth-leakage circuit breaker will not prevent the user getting a shock and possibly a very unpleasant shock. What it will do is ensure that any such shock, due to handling defective or faulty equipment, will not be directly fatal.



Complete unit — Cover removed

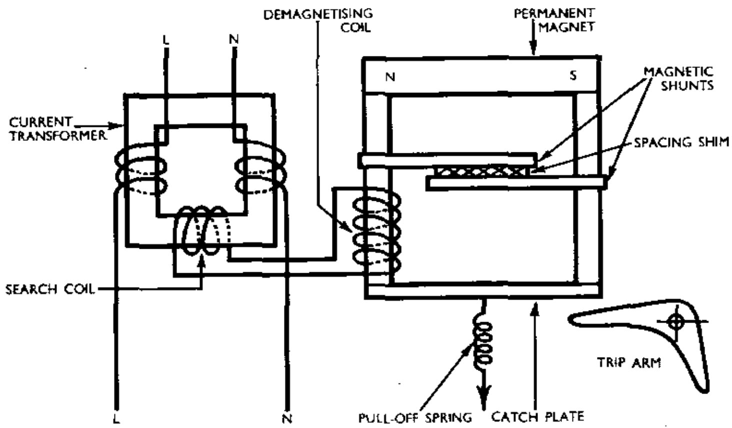
Fig. 9. Single phase 60 amp. current-operated earth-leakage circuit breaker with 25 mA sensitivity.

To achieve this order of sensitivity, it is necessary to amplify in some way the output from the search coil of the current-balance transformer so as to obtain enough power to trip the circuit breaker. One method in common use for this purpose is to use an electronic or solid-state power amplifier—a typical single-phase unit of this type being illustrated at Fig. 9.

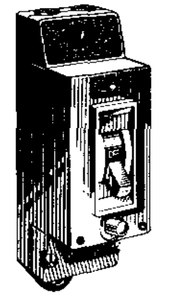
This method has the advantage of providing very adequate power to ensure positive operation of the earth-leakage circuit breaker.

An alternative method, illustrated at Fig. 10, relies on using the output from the transformer search coil to nullify a weak stray magnetic field in a specially designed trip mechanism. The main path for the magnetic flux from the permanent magnet is through the magnetic shunts. The thickness of the spacing shim is so adjusted that only a weak stray magnetic field persists in the remainder of the magnetic circuit—this field having just sufficient force to retain the catch plate against the force of the pull-off spring.

By applying the output from the search coil to the demagnetising coil, a weak signal from the search coil can be arranged to nullify this already weak stray magnetic field—so releasing the catch plate and hence tripping the circuit breaker. Obviously the power available is very limited, and it is a matter of very careful design to ensure that this type of mechanism will give reliable positive operation, and will re-set again positively when the earth-fault condition has been corrected—particularly in dusty or humid conditions. On the other hand, it is claimed as an advantage for this type of mechanism



(*Left*) **Fig. 10.**



(*Right*) **Fig. 11. Double pole 60 amp. voltage-operated earth-leakage circuit breaker.**

that it does not rely on the presence of mains voltage for it to operate.

Voltage-operated earth-leakage circuit breakers

To comply with the requirements of B.S. 842, a voltage-operated earth-leakage circuit breaker must function correctly in conjunction with earth electrodes of resistance value up to a maximum of 500 ohms. In consequence, this type of unit gives complete protection against shock risks under all normal conditions of installation—it is virtually universal in application. (Note: The actual limits of operation as defined by B.S. 842 are that the unit must trip at 24 volts to earth with a 200 ohm earth electrode; 40 volts with a 500 ohm earth electrode.)

Units of the type illustrated at Fig. 11 not only operate within the prescribed 40 volt limit with a 500 ohm earth but, in addition, will operate within the specified voltage limit with considerably higher earth electrode resistances. These units will therefore give full protection under practically all installation conditions likely to be encountered in service.

Voltage-operated earth-leakage circuit breakers are instantaneous in operation: the normal overall operating time of a B.S. 842 unit is less than one cycle. Thus these units clearly fulfil the requirements of the ideal system of shock-risk protection in that they will isolate the circuit immediately dangerous voltages appear on the installation metalwork.

How Voltage-operated Earth-leakage Circuit Breakers are Installed. It cannot be too strongly stressed that the primary function of a voltage-operated earth-leakage circuit breaker is to give protection against the danger of electric shock. This is done by detecting any dangerous voltage rise on installation metalwork. In this respect, the earth-leakage circuit breaker can best be regarded as a voltmeter measuring the potential difference between protected metalwork and earth—disconnecting the power supply when this potential difference reaches a dangerous value. Providing, therefore, that the circuit breaker is so installed that it performs this primary function correctly, then—irrespective of any complications introduced by deliberate or fortuitous parallel earth paths—the installation must be completely protected against shock risk.

To meet this requirement the circuit breaker should be connected as shown at Fig. 12. From this diagram it should be noted that the earth-leakage circuit breaker trip coil is connected between protected metalwork and earth in the same way that a voltmeter would be connected to measure any voltage between metalwork and earth. As a result the trip coil will always detect any voltage rise, even if there are other parallel earth paths on the installation.

It is, however, essential to ensure that the trip coil is not shorted out. To achieve this, I.E.E. Regulations require that the lead from the consumer's earth terminal to terminal "F" on the earth-leakage circuit breaker, and the lead from terminal "E" to the earth electrode shall be insulated. Furthermore the electrode itself must be located outside the effective resistance area of any other earthed metalwork. This requirement is usually met by placing the electrode at least 8 feet from any other earthed metalwork, water mains, etc.

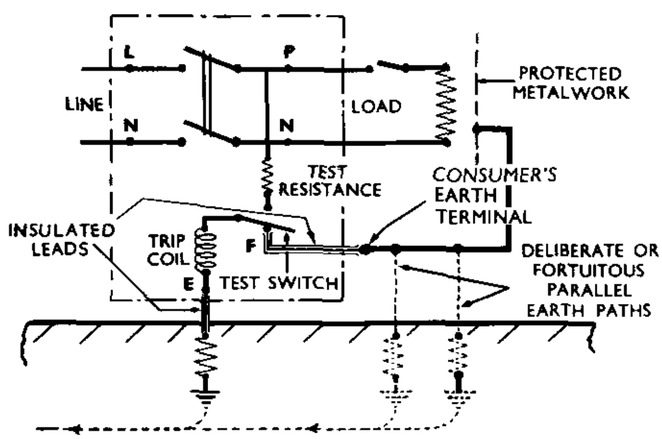


Fig. 12.

If the earth-leakage circuit breaker earth electrode is within the resistance area of any parallel earth electrode attached to the installation metalwork (see Figs. 13 and 14), the earth-leakage circuit breaker trip coil can only detect a portion, V_1, of the total potential difference, V, between this metalwork and earth. Consequently the level of potection afforded may be seriously affected.

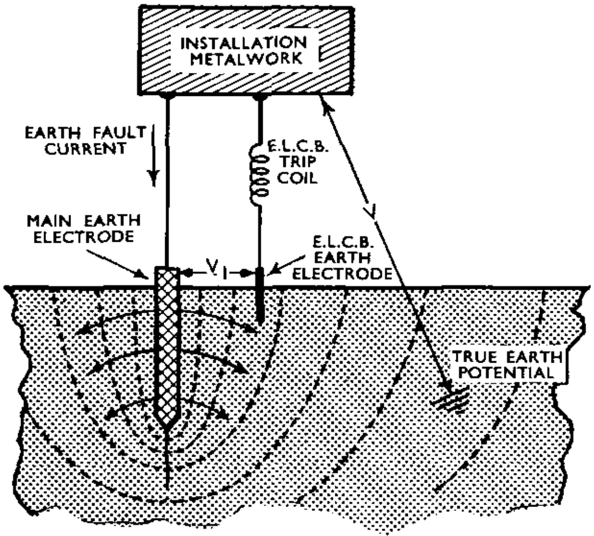


Fig. 13.

The I.E.E. requirement of siting the earth-leakage circuit breaker earth electrode outside the effective resistance area of other earthed metalwork is not normally too difficult to meet in practice. From Fig. 9 it is clear that, with a 6-ft. rod electrode, 90 per cent of the total voltage to earth is dissipated in the first 8 to 10-ft. of soil immediately surrounding the electrode.

The actual tripping voltage limits specified in B.S. 842 are 24 volts to earth, if the earth-leakage circuit breaker earth electrode has a resistance of 200 ohms; and 40 volts if it has a resistance of 500 ohms. Thus, if the earth-leakage circuit breaker earth electrode is so situated that only 80 per cent of the total voltage is detected, anything more than about 30 volts between installation metalwork and earth will still be detected, with an earth electrode resistance of 200 ohms. Even with a 500 ohm electrode, in practice an extremely high figure, anything more than about 50 volts would be reliably detected. This value is still well within the 65 volts safety limit adopted by most of the European countries.

From these figures it is clear that an acceptable level of shock-risk protection will be afforded to the installation, providing the earth-leakage circuit-breaker earth electrode is out of the immediate vicinity of other earthed metalwork: a distance of about 8 to 10 feet should normally be adequate.

In the absence of a power supply to the installation, this requirement may be checked by carrying out two measurements of the installation earth electrode resistance (see Appendix "A"). The first measurement, which should give the true earth electrode resistance of the main installation earth, is made in the normal way, the earth-leakage circuit breaker earth electrode being left unconnected. The resistance should then be measured a second time, using the earth-leakage circuit breaker electrode as the "potential" electrode (see Fig. 13). If the two resistance areas overlap, the second value obtained will be less than the true resistance. Providing the second value obtained exceeds about 85 per cent of the true resistance, the spacing would normally be considered adequate.

When installing a voltage-operated earth-leakage circuit breaker earth electrode, care must be taken to avoid using any metalwork which, in future, may possibly become electrically linked to the installation metalwork, as this would automatically short out the trip coil.

Quite apart from the fact that it would infringe the requirements of the I.E.E. Wiring Regulations, the use of a water pipe as an earth electrode for a voltage-operated earth-leakage circuit breaker is not advisable for this particular reason. Even if the pipe is initially isolated from the installation metalwork, subsequent alterations may well interlink the two circuits and thus invalidate the system of protection by giving rise to the condition shown at Fig. 15. From this diagram it is clear that, as both ends of the trip coil are effectively connected to the water pipe, section XY of the pipe will short out the trip-coil and prevent it functioning.

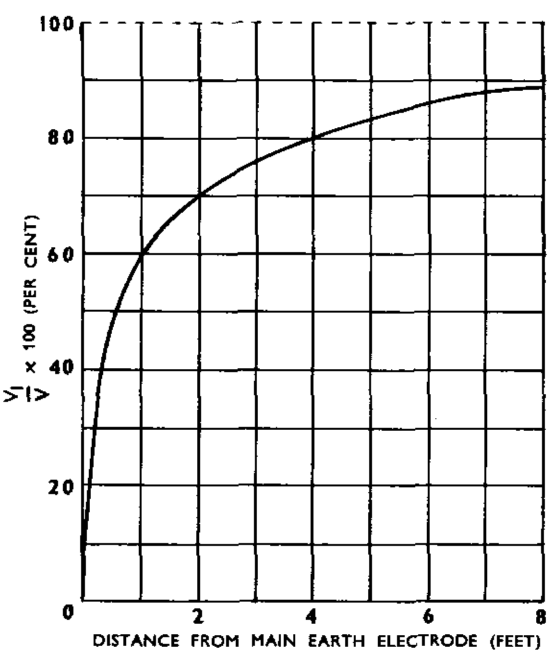


Fig. 14. Voltage gradient in soil surrounding a 6-ft. long × 1-in. diameter electrode.

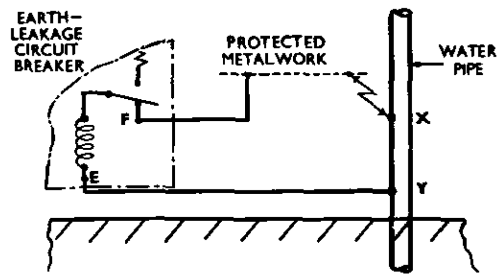


Fig. 15.

The most common cause of this type of condition is the installation of an immersion heater, which more or less automatically ensures that the water system and the installation metalwork are electrically interlinked. Providing, however, that the installation has been carried out correctly, and a *separate earth electrode* has been used for the earth-leakage circuit breaker, the water pipe simply becomes a parallel earth path on the installation. *The circuit breaker trip coil will still measure any voltage appearing between protected metalwork and true earth and will still trip the unit when this voltage reaches a dangerous value.*

How parallel earth paths affect protection

From the foregoing it will be realised that the presence or absence of parallel earth paths, whether deliberate or fortuitous, does not modify the degree of protection against shock. However, the presence of such paths obviously must encourage the flow of somewhat heavier currents in earth fault conditions, thus increasing the risk of fire or, alternatively, the risk of damage to delicate apparatus.

A further point to be noted is that the presence of low-resistance parallel earth paths will reduce the likelihood of the earth-leakage circuit breaker detecting partial earth faults. With a high-resistance earth fault, the current flowing will be small. In consequence, the fault voltage developed across the low-resistance parallel earth will also be small and may not reach a dangerous value. Thus with a high resistance fault there may be no shock risk and so the breaker may not trip, a condition discussed more fully under the heading of "How to Test the Installation" in page 133.

The fact that the breaker does not trip in such conditions is not necessarily a disadvantage: there is one school of thought which recommends the use of a deliberate parallel earth path. Among other things, this effectively prevents any unnecessary tripping of the breaker due to small harmless leakage currents, such as those which may occur when an electric cooker or hotplate is first switched on. With units of the type illustrated at Fig. 11 the operating characteristics have been so chosen as to minimise the possibility of unwanted tripping when no parallel earth path is present. At the same time, if parallel earthing is considered desirable the sensitivity is such that these units are still in every way suitable for this class of installation.

If there are no parallel earth paths, the impedance of the trip coil will limit the maximum earth fault current which can flow to about $\frac{1}{2}$ amp. This can only flow for a total time of $\frac{1}{2}$-$\frac{3}{4}$ cycle. Hence, even a direct earth fault is very unlikely to cause any form of permanent damage or create any real fire risk. In addition the breaker will be capable of detecting small leakage currents of the value of 50 mA: often it will open the circuit while the fault is still in the incipient stage. This obviously constitutes a very high level of fire-risk protection.

The function of the test switch

From Fig. 12 it will be noted that a test switch is incorporated in the mechanism. The presence of the switch is a requirement of B.S. 842. This also lays down effective limits for the test resistance, thus ensuring that the test switch not only checks the continuity of the earth path and the operation of the circuit breaker mechanism, but also checks that the operation of the unit is of the correct order of sensitivity.

Even the test switch, however, cannot detect a broken earth continuity conductor. In this respect, the requirement in the I.E.E. Wiring Regulations of insulated leads for the connection from the earth-leakage circuit breaker to the consumer's earth terminal and to the circuit breaker earth electrode has some additional advantages. Whilst the insulation provides additional mechanical protection for the lead, there is also the added advantage that an insulated lead is normally treated with far more respect than a bare lead—the average handyman is not quite so liable to sever or otherwise maltreat it.

This hazard of a broken earth-continuity conductor is not, of course, peculiar to earth-leakage circuit breaker protection: indeed, no other conventional method of protection even checks either the earth electrode or the lead to the earth electrode, quite apart from checking the installation earth continuity. When discussing fixed installations, this point is not necessarily of vital importance: an earth-continuity conductor can usually deteriorate quite seriously before it is useless for voltage-operated protection. When considering the protection of portable appliances—where there is always the risk of breakage of the flexible earth lead—this point assumes far more importance.

Portable tools in industry

Voltage-operated earth-leakage circuit-breaker protection is ideal for the protection of portable tools, due to the inherent feature of instantaneous operation. With any form of fuse protection, the user may be unable to release the portable appliance until the fault current finally blows a fuse, which may take seconds or even minutes.

As a result, the modern tendency on industrial installations is to use voltage-operated earth-leakage circuit breakers for the protection of portable tools,

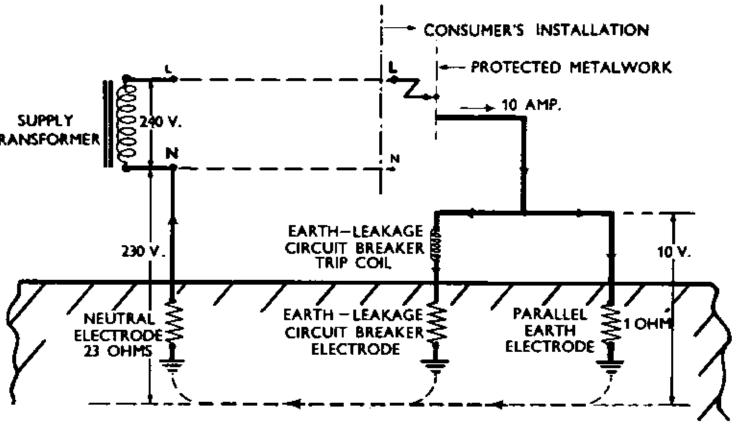


Fig. 16.

often in combination with some form of monitoring circuit for the earth conductor or conductors to the portable equipment.

More recently, interest has also been shown in the possible use, for such applications, of current-operated earth-leakage circuit breakers, sensitive to earth-leakage currents of the order of 25 mA (see page 104, May issue).

How to test the installation

Providing that the unit is correctly connected—i.e., with an insulated earth lead and a separate earth electrode—and providing it operates on the test switch, the breaker is bound to afford full protection to any metalwork correctly bonded to terminal "F." This bonding and the impedance of the earth-continuity conductor should be checked in the usual manner.

It should be noted that flashing from line to earth with a test lamp at socket-outlets, as a final check on the installation, does not test the sensitivity of the circuit breaker—the test switch has already done that.

If the breaker trips, this check has only proved the continuity, but not the impedance, of the earth-continuity conductor. If the lamp lights and the circuit breaker does not trip this merely shows that there is a parallel earth path on the system and hence, due to the relationship of the various circuit constants, the voltage rise on the metalwork is too small to be dangerous.

Fig. 16 shows an extreme example of this condition. The total earth-loop impedance is high, and so the fault current is limited to a value insufficient to blow the fuse. Unfortunately, as there is a very low-resistance parallel earth path at the consumer's end—due possibly to a private piped water supply—most of the fault voltage appears at the transformer earth electrode causing "neutral inversion." Only 10 volts appears between the consumer's metalwork and earth, this being insufficient to trip the breaker.

In this example, the earth-leakage circuit breaker still performs its primary function of ensuring that dangerous voltages do not persist on the installation metalwork, but the presence of the low-resistance parallel earth path prevents the breaker from detecting the 10 amp. fault current flowing steadily to earth. Hence in this particular, and by no means hypothetical instance, the breaker is prevented from performing its subsidiary function of fire risk protection by the low-resistance parallel earth path.

There is, of course, no question of the breaker being at fault because it does not trip under such installation conditions. The real source of the trouble is the 23 ohm neutral earth; and the best corrective measure is to reduce this particular resistance.

Unfortunately, it is not always an economic possibility to improve the supply authority's neutral earth electrode. In any event, this is an element of the earth-loop path over which a contractor normally has no control. Consequently, it usually becomes necessary for the problem to be tackled at the consumer's end, the alternative method of obtaining satisfactory operation being artificially to increase the earth-electrode resistance of the parallel earth path. As this low resistance is almost invariably due to bonding to a metallic water-mains system, the insertion of about three feet of non-metallic piping, at the point where the water mains enter the premises, is usually found, in practice, sufficient to ensure correct operation under such abnormal conditions.

Alternatively, and usually this is a much better solution, current-operated earth-leakage circuit breakers should be used for installations where the resistance of the earth-loop path is relatively low, e.g. below about 40 ohms.

Preferred method of testing

As with current-operated earth-leakage circuit breakers, a practical test should be applied to the installation to confirm that the voltage-operated earth-leakage circuit breaker is correctly performing its protective function. Again, the primary objective is to ensure that a dangerous potential, i.e., in excess of about 40 volts,

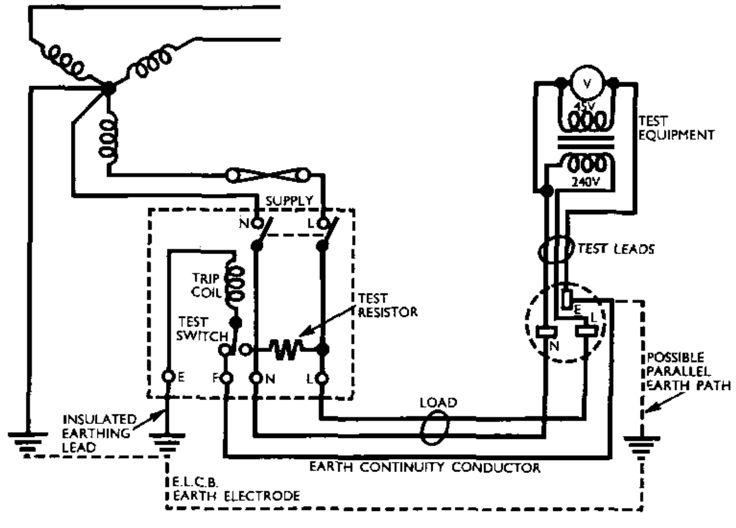


Fig. 17. Method of test for compliance with Regulation E.5 for a typical voltage-operated earth-leakage circuit breaker.

cannot persist on installation metalwork. The 14th Edition of the I.E.E. Wiring Regulations therefore proposes a somewhat similar test for voltage-operated earth-leakage circuit breaker installations to that proposed for current-operation protection.

The use of a 45 volt step-down transformer having a short-time rating of not less than 750 VA is again recommended for this particular test, the test voltage being injected between installation metalwork and neutral (see Fig. 17).

Parts 3 and 4 will be published in consecutive issues. Part 4 will contain the Appendices.

COMPUTER TO MONITOR PATIENTS DURING SURGERY

An Elliott Automation computer is to be connected directly to patients in operating theatres and recovery wards as part of a research project to show how computers can be used to monitor the condition of patients automatically during surgery. It has been ordered by the Medical Research Council for use under the terms of a research grant to Professor J. P. Payne in the Research Department of Anaesthetics at the Royal College of Surgeons in London.

The computer, an Elliott 903, will be used initially in conjunction with experiments in progress in the Research Department of Anaesthetics. It is planned to link it directly to patients in neighbouring hospitals by means of an analogue telephone data link. Feasibility studies of this method of transmission, using a single channel link, have given promising results and a three channel link is being developed in co-operation with the G.P.O.

The computer will monitor the patient's heart-beat, blood pressure, blood circulation, pulse, the rate and volume of breathing, and other conditions. Calculations within the computer, based on these measurements, will enable it to predict any deterioration in the patient's condition at an earlier stage than is possible at present.

The main task of the Research Department of Anaesthetics at the Royal College of Surgeons is the investigation of the biological effects of anaesthetic agents. The computer will enable it to speed-up the turnround of experimental results and release skilled staff from the task of performing routine calculations to do more productive work. A recent four-week experiment with a dental anaesthetic required six months of manual data reduction. The computer would have enabled this job to have been done in one week.

Several of the programmes which the computer will need have already been written by Elliott-Automation as part of the work the Company is doing in developing on-line computer systems for automatic analysis in hospital pathology laboratories.

ANVIL WIN HEREFORD CONTRACT

A contract worth £35,000 for a hospital building at Hereford for the Birmingham Regional Hospital Board has been awarded to the Six/B industrialised building division of Anvil Enterprises Ltd., of Hereford.

The building, which will be linked to the main hospital premises and occupy a total area of 6,500 sq. ft., will comprise a physiotherapy department, including treatment cubicles, specialist rooms, a gymnasium and additional general administration offices.

An important feature of the contract is that it is a "package deal" arrangement whereby Anvil Enterprises Ltd. provided complete architectural designs and mechanical and electrical services to the brief of the Birmingham Regional Hospital Board.

The new hospital block will be built using the Six/B timber frame system with a cedar or tile cladding to the main elevations whilst the gymnasium is built in traditional brick construction, the two methods being used together to best effect.

Architects working with Anvil Enterprises Ltd. on the project are McLennan, Johnson and Blight of Hereford, and the builders, William Powell & Son Ltd., of Hereford. Heating and plumbing services will be provided by W. & R. Edwards and electrical work by C. F. Roberts Ltd., both of Hereford.

The Development of Hyperbaric Therapy

HYPERBARIC oxygen therapy for myocardial infarction can be seen as a logical development of experience in the treatment of other conditions by diffusing high-pressure oxygen into the blood and other body tissues.

If one of the coronary arteries becomes blocked, the heart muscle which it supplies is deprived of oxygen. If this anoxia is not relieved, the muscle dies. If a large amount of muscle is affected, the heart stops, and the patient dies.

A very small infarction may produce no noticeable symptoms, but life or death in the majority of heart attacks will depend on the extent of the infarction, the general condition of the patient and the care and treatment received.

In the majority of cases, the rhythm of the heart is upset, and in severe cases the patient may also suffer from shock.

In hyperbaric oxygen the normal rhythm of the heartbeat is usually restored and shock is quickly relieved. Saturating the blood and tissues with oxygen has been shown greatly to increase the chances of survival until the damage is repaired. The repair process works by normal body mechanisms without any need for surgery or special drugs.

This is the latest development in a story which dates back to the 17th century. Today, hyperbaric oxygen is being used or investigated in almost every branch of medical science.

In 1662, the British physician Henshaw used a compression chamber with increased atmospheric pressure, which he called a "domicilium", for the treatment of chronic illness.

In the mid-19th century, many compression chambers were built, and the medical use of air at pressure up to four atmospheres absolute – four times normal atmospheric pressure – enjoyed something of a vogue.

Hyperbaric treatment went out of favour around the turn of the century, when the trend was away from therapy and towards biological investigation.

Deep sea diving and submarine work was rapidly expanding. The problem of "bends" was encountered – a condition resulting from a large volume of nitrogen being dissolved in the body fluids and characterised by the positions that the victims had to adopt to relieve the pain in their joints caused by the nitrogen coming out of solution. When oxygen-rich mixtures were used, problems of toxicity arose.

Interest became intense again in the 1950's. It became clear that the toxic effects of hyperbaric oxygen could be avoided by using intermittent rather than continuous exposure and the lowest possible pressure needed to achieve the desired result.

In this phase, the Department of Medical Studies of Vickers Research Establishment at Sunninghill, Berkshire, under Dr. Kenneth G. Williams, were in a position to act as innovators in the design of new clinical equipment through their work on the physiology of pressure in submarines and aircraft. Production has been taken up by the new Medical Group of Vickers.

HYPERBARIC OXYGEN TREATMENT FOR THE ACUTE HEART ATTACK

First results achieved at Westminster Hospital, London, indicate that the death rate among patients admitted to hospitals with acute heart attacks can be halved by hyperbaric oxygen therapy.

The treatment has been given in a single-patient bed system using pure oxygen at twice normal atmospheric pressure.

Out of 40 patients suffering from potentially fatal coronary heart attacks – myocardial infarction – 37 recovered in the hyperbaric beds at Westminster. Two of those who died had post-mortem examinations showing thrombosis of both main coronary vessels, which ruled out survival.

The overall death rate among patients with acute myocardial infarction admitted to hospitals is about 30%.

Present day statistics suggest that up to a third of the people in most of the world's urban areas are liable to die from some form of myocardial infarction unless new techniques are employed.

In the Vickers bed, the only one of its kind, the patient can be treated in a sitting or reclining position. The chamber opens to allow the patient to stay in the bed between treatments, eliminating movement which might lead to his condition being harmed.

Proposals for further clinical trials are now being considered by the Ministry of Health.

A range of other hyperbaric oxygen chambers has been developed at Vickers Research Establishment in Berkshire for treatment of such conditions as gas gangrene, poor blood supply in skin grafts and carbon monoxide poisoning. These chambers have been in continuous use since 1959, and about 150 are installed at home and overseas, with a 100% safety record during a total of about 250,000 patient hours of treatment.

Six years' research and development, in co-operation with Westminster Hospital, has gone into the evolution of the hyperbaric bed.

DETAILS OF HYPERBARIC BED SYSTEM

The hyperbaric bed system is designed for patients who cannot lie flat for long periods. They can sit up straight or recline in it on an adjustable backrest at any angle. The whole bed can be tilted head up or head down through an angle of 10° in either direction.

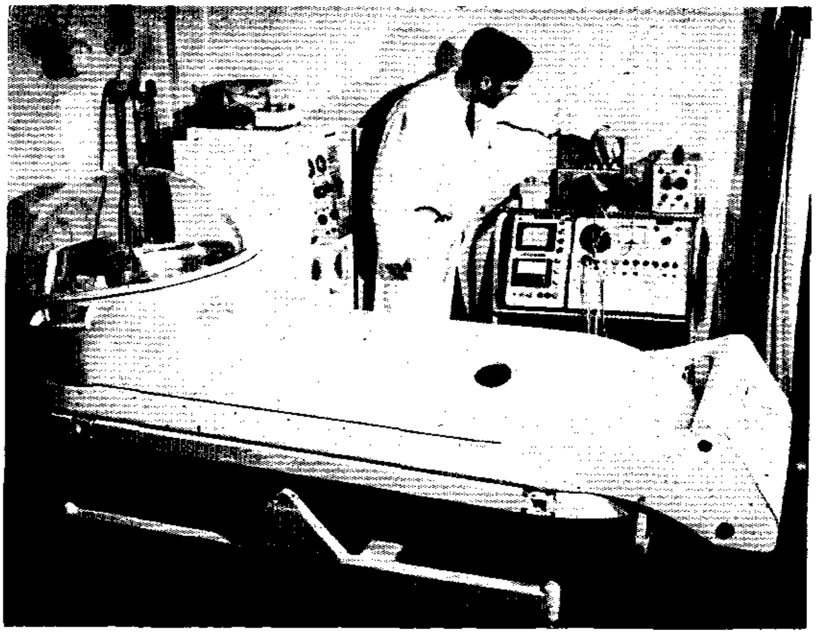
Reclining or upright, the patient has an uninterrupted view of his surroundings and he can be clearly seen. Hospital staff can listen to him through a loudspeaker and can talk to him through a telephone type handset. Radio, TV or taped sound can be relayed to the patient, who can watch TV on a receiver placed outside the chamber.

The patient can be nursed on the bed, so that heart cases can be given hyperbaric therapy without the need for them to be moved between treatments. When opened the structure "yawns" with a 3 ft. 8 in. opening at the head end.

A special "surgical" version of the hyperbaric bed system has post-operative surgical nursing and support facilities.

The bed structure has a steel base with semi-circular head and foot ends. It is centrally pivoted on a sub-chassis with four sprung castors. A jacking system controls the tilt of the bed.

The top section of the bed is mounted on the base by a hinge and counterbalance system. To reduce weight this section is manufactured from double skinned light alloy sheets with ribs and stiffeners and rigid foam filling.



The Vickers Hyperbaric Oxygen Bed closed and in operation.

The top section merges into a turret at the head end which is capped by a plastic dome. There are also two plastic observation portholes near the foot end.

The top and bottom sections of the bed are locked together by a castellated locking ring. The ring is moved electrically but an emergency handle is provided in case there should be a power failure.

Pneumatic and electrical connections are provided in the bed for support facilities and for monitoring, cardiac and brain function, blood pressure, temperature and so on.

The bed is connected by a short length of trunking to a recirculation console, which conditions the gas circulating in the system.

Carbon dioxide, odours and moisture are removed and the operator can adjust temperature and humidity to suit the comfort of individual patients. The percentage of carbon dioxide is continuously monitored.

The maximum working pressure of the system is two atmospheres absolute. Operation of the bed is semi-automatic. Compression and decompression rates are selected by the operator and the required treatment pressure can be preset. The pressure can be held at any intermediate figure. The gas conditioning operates at all times. There is an emergency decompression system and a warning system which indicates failure in supplies, or other conditions which need correcting action.

The bed and recirculation console are manufactured under Lloyds Register of Shipping (Non-Marine Department) Surveillance and every one is subjected to a pressure test witnessed by Lloyds, before receiving its certificate. The metal structure of the bed is subjected to a 30 pounds per square inch gauge hydraulic test, the plastic dome to 75 p.s.i.g. and the plastic and fibreglass parts in the console to 100 p.s.i.g.

The hyperbaric oxygen bed system, which costs £6,250, is manufactured at the South Marston Works of the Engineering Group of Vickers, and assembled at the Medical Group's Works at Basingstoke.

SAFETY PRECAUTIONS IN THE HYPERBARIC BED AND OTHER HYPERBARIC CHAMBERS

Hazards associated with the use of hyperbaric oxygen chambers have received much attention in the past, and thorough care has been taken to eliminate all possible risk.

There are five ways in which fire may be started in a vessel filled with air or oxygen. All are specifically countered.

1. A static spark – is prevented by high humidity in the Vickers chambers. As an added precaution, fabrics of man-made fibre are not allowed inside, and it is recommended that all other fabrics should be flame-proofed.
2. A mechanical spark from metallic impact or abrasion – cannot occur provided that the usual precautions in oxygen treatment are observed.
3. Electrical spark from a breakdown of insulation, or overheating – cannot occur because the only electric wires entering the chamber are for the intercommunication system, which is "self-energising" and incapable of starting a fire.
4. Chemical reaction, as between oxygen and oil or grease – the use of oil or grease is prohibited.
5. Match or cigarette lighter – as with an ordinary oxygen tent, patients cannot take such articles in.

OTHER USES OF THE EQUIPMENT

Radiotherapy

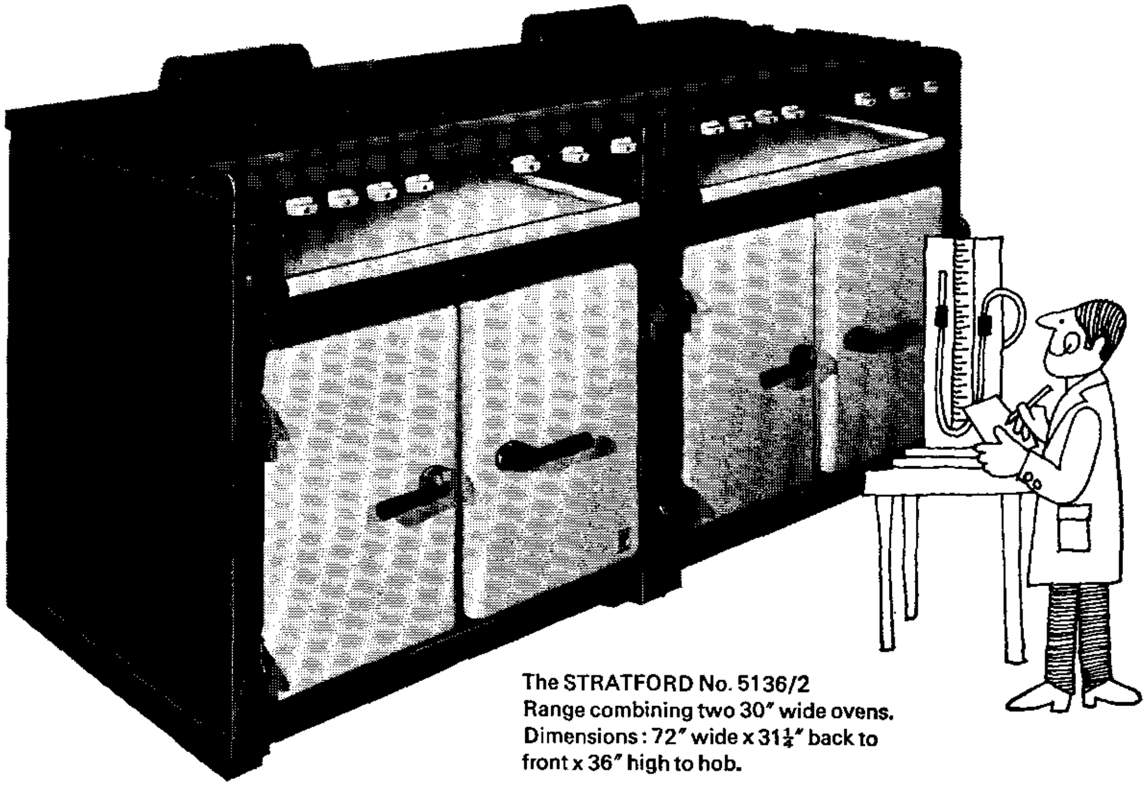
Cells near the centre of a tumour often have a poor blood supply, with low oxygen tension. Their sensitivity to radiation is reduced as a result, so that they are liable to escape the effects of radiation and survive to form a nucleus of further tumour growth. Treatment in a hyperbaric oxygen chamber has been found to raise the oxygen tension and radio sensitivity of these cells – so making radiotherapy more effective.

Carbon Monoxide Poisoning

In carbon monoxide poisoning, the blood is deprived of its normal oxygen-carrying capacity and death from asphyxia

Continued on page 143

You don't need a laboratory to measure the Radiation quality in a Stratford Range



The STRATFORD No. 5136/2
Range combining two 30" wide ovens.
Dimensions: 72" wide x 31½" back to front x 36" high to hob.

Instruments could prove the impressive technical performance of the Stratford range in actual figures. But there's more to Radiation quality than you can measure this way. For instance Stratford ranges are exceptionally solid; they are built for continuous heavy duty to *provide a constant and high output* standard of cooking, and designed for easy cleaning inside and out. Take a closer look at the generous specification:

ALL MODELS HAVE: Robust vitreous enamelled cast iron and angle iron framework, with vitreous enamelled sheet steel panels and linings. Top bars and burners vitreous enamelled black. 1" thick fibre-glass and foil insulation; front-reading Regulo control. Drilled *ring boiling burners with specially* designed venturi for maximum flame stability; safety taps. All burners, bars and oven fittings are quickly and easily removable for cleaning and maintenance.

RADIATION QUALITY reflects the substantial resources of the company in manufacturing facilities, experienced staff and investment in research.

Radiation catering equipment is designed for a long, busy life, high performance, and ease of cleaning and maintenance.

It is backed by a technical advisory service second to none.

Radiation gas appliances may readily be converted to operate on Natural Gas.

We'll be glad to let you have fuller information or we'll send one of our specialists to discuss anything from a single unit to a complete integrated kitchen installation. Please write or phone:

RADIATION CATERING EQUIPMENT LTD

(FOR GAS, ELECTRICITY, STEAM AND BOTTLED GAS)

Palatine Works, Warrington, Lancs. Telephone: Warrington 32172 & 30015
255 North Circular Road, London NW10. Telephone: 01-459 1234

A RADIATION COMPANY

LAING WIN £5M. GLASGOW CONTRACT

THE Scottish Western Regional Hospital Board has placed a £5-million contract with John Laing Construction Ltd. to build a hospital complex three miles from the centre of Glasgow. Occupying some 25 acres of the grounds of the existing Gartnavel Royal Hospital, this will be the first of a number of new district general hospitals in the region. Work will start this month and is expected to last for 3½ years.

The project was designed by Keppie, Henderson and Partners, Architects, in association with T. D. W. Astorga, D.A.,Dip.T.P., A.R.I.B.A., Regional Architect, Western Regional Hospital Board. Gartnavel District General Hospital will serve community needs in the north-west of the city.

The 400 ft. long, 11-storey high first phase of the hospital provides for 576 beds in an eight-storey block rising from a three-storey podium. The podium will house out-patient, diagnostic and therapeutic facilities and administrative departments on the ground floor. Seven operating theatres and a central supplies' department will be on the lower ground floor, and the dining room, kitchen and staff changing facilities on the upper ground floor.

Nursing and medical residences and the nurses' training school will be located in a separate section of the site to the west of the main building. The residential area has been designed as an estate of flats and homes for some 330 hospital staff and students and will comprise 15 blocks of two and four storeys.

In the main hall of the hospital will be a hotel-type reception office where brief particulars will be recorded from patients being admitted. There will also be a postal sorting office, a newspaper/confectionery shop and a hairdressing salon. Off the hall will be a restaurant for beverages and snacks, with the latest type of vending machines giving round-the-clock service with hot or cold snacks.

All bed areas will have w.c.s, washing facilities and showers immediately adjacent to them and pleasant sitting rooms nearby to encourage early ambulation and promote well being of patients and serve the convenience of staff. Patients will be accommodated in rooms containing not more than four beds, and about one-fifth of all patients will have single rooms.

The out-patient department will cater for about 70,000 patients each year. Here, a high standard of privacy has been aimed at to preserve the dignity of the patient. Most patients will undress as necessary and be examined and treated in one room only, thus avoiding the discomfort of a small cubicle or movement from one room to another while partially clothed.

There will be a day ward enabling patients to spend several hours in hospital in comfortable conditions while examinations are carried out, which might otherwise require their admission to hospital overnight or perhaps for several days.

A large department for physiotherapy and occupational therapy is planned to encourage early rehabilitation and return to useful employment or activity of all types of patient. This will include gymnasia, a range of treatment cubicles, workshops and a domestic section in which treatment can be given to about 50 patients simultaneously.

Patients will select their meals from a menu and, in the kitchen, this will be assembled on a tray which will keep the food warm during its journey to the ward areas. The arrangements for serving meals may include its distribution by trained waitresses, thus relieving nursing staff of one of their present time-consuming but not essential duties.

The foundations throughout the main building will be on piles. The structural frame of the tower block will be precast concrete and the podium *in situ* concrete. Heating throughout the project will be by low and medium-pressure hot water to radiators and convectors.

The consulting engineers are: Ove Arup and Partners, Glasgow (civil and structural); Ramsay and Primrose, Glasgow (electrical and mechanical); Donald Smith, Seymour and Rooley, Glasgow (heating and ventilating). The engineering aspect of the project has been designed in association with A. Gilmour, M.I.Mech.E., M.I.E.E., A.M.I.W.E., Regional Engineer, Western Regional Hospital Board. The quantity surveyors are John Dansken and Purdie, Glasgow.

RECORD ORDERS FOR THERMALITE
Extensive use in two big hospitals

AN ORDER for 150,000 yards super of Thermalite lightweight aerated concrete building blocks is in process of delivery to the new Northwick Park Hospital, Harrow, Middlesex, which is being built by Messrs. Trollope & Colls Ltd.

This order is one of the largest received by Thermalite Ytong Ltd. and represents over a month's production at their London factory at West Thurrock, Essex, one of the eight Thermalite factories in Great Britain. It also represents the amount of Thermalite that would be needed to provide thermal insulation for 1,500 homes.

Thermalite blocks are being used mainly for internal partitions, because of their lightweight and workability, and in parts for external walls for thermal insulation at Harrow. Deliveries have been underway for some time and will continue for about three years, during which time the hospital buildings, which are for the North-West Metropolitan Regional Hospital Board, and the Medical Research Council, will be erected in three phases.

The hospital, designed by Llewelyn-Davies, Weeks Forestier-Walker and Bor, for the Board and the M.R.C., will provide the full range of normal medical services and facilities for medical research. It is being erected on a site which is approximately half a mile long by a quarter of a mile wide and all buildings will be interconnected by tunnels or covered ways. They will include a ward block, nine storeys high, of three wings. The main operating theatres will be housed in one large low rise block of three storeys.

Another "month's production" order for Thermalite in various sizes has been received for the £14m. contract for the erection of a main teaching hospital for the new University Hospital of Wales in Cardiff. The hospital has been designed by S. W. Milburn & Partners, Cardiff, for The United Cardiff Hospitals and the Welsh National School of Medicine and is being built by F. G. Minter Ltd.

Thermalite is being used for internal partitions for its all round serviceability, in the main hospital buildings and in the residential blocks, all of which are of reinforced concrete construction. The contract will be completed in early 1971 and it is anticipated that the hospital will be in full operation by the end of 1972.

B.S.I. News

Abstracts of information supplied by the British Standards Institution

BRITISH STANDARDS YEARBOOK 1968

The 1968 edition of the *B.S.I. Yearbook* is now available. It includes lists and summaries of some 5,000 British Standards, Codes of Practice, handbooks and special issues, including a number of important publications giving guidance on the change to metric. The British Standards in metric terms are identified in accordance with the system of code letters now adopted in the B.S.I. News lists. The *Yearbook* also gives information on B.S.I.'s information, sales, testing and other services.

Free copies of the *Yearbook* are being distributed to all B.S.I. subscribers, who may purchase further copies at the usual discount.

Non-subscribers can buy copies at the full price of 15s. (plus postage and packing 3s.).

NEW BRITISH STANDARDS

B.S. 4312 : 1968 Flanged steel screw-down stop valves and stop and check valves for general purposes 8s.

Ratings, classification, design and construction, materials, dimensions, testing and marking requirements for cast or forged flanged carbon steel outside screw globe and angle stop and stop and check valves from 1½ in. to 12 in. nominal size. (SBN: 580 00139 3)

B.S. 4318 : 1968 Recommendations for preferred metric basic sizes for engineering 5s.

Contains a list of preferred metric basic sizes for engineering from 1 mm. to 300 mm. Guidance is also given on the choice of sizes larger than 300 mm. (SBN: 580 00174 1)

NEW CODES OF PRACTICE

B.S. 142 : 1968 Slating and tiling 15s.

Expands information on materials, divides application of clay and concrete plain and single-lap tiling into two sections and considers problem of condensation. Provides tables dealing with relationship of lap and pitch for slates and recommends batten sizes for both slates and tiles. Makes recommendations regarding safety and general precautions during work on roofs. Includes an appendix giving data for the calculation of thermal insulation. (SBN: 580 00173 3)

CP 299 : 1968 Sprayed asbestos insulation 7s.

Application of insulation, complying with B.S. 3590, to various types of internal surfaces. Describes equipment used and indicates essential factors in determining density, thickness, surface texture and finish. (SBN: 580 00192 X)

LOW-LEAD PAINTS

A new British Standard relating to the permissible limit of lead in low-lead paints has been published by B.S.I. at the request of the Paintmakers' Association, with the object of assisting the implementation of an agreement between the Ministry of Health and the Association on cautionary labelling.

In accordance with this agreement manufacturers have undertaken to label paint products "Do not apply on surfaces which might be chewed by children" for all paints containing more than 1% (with a tolerance of +0·5%) of lead or containing known toxic compounds of other metals. The new standard—B.S. 4310 *Permissible limit of lead in low-lead paints and similar materials*—relates only to lead content, and provides for paints containing less than the upper limit of 1·5% to be identified as "low-lead paints"—which are thus likely to be suitable for painting surfaces liable to be chewed by children. A paint identified as complying with B.S. 4310 may, nevertheless, contain a known toxic compound of some metal other than lead, and in this case it should bear a cautionary label to this effect.

It should be noted that in the special case of paint used on children's toys the permissible limits of toxic metals are covered in the *Toys (Safety) Regulations* 1967. These are to be extended this year to impose upper limits on the content of a wide range of toxic metals. The same limits will be incorporated in a revised edition of B.S. 3443 *Code of safety requirements for children's toys and playthings.*

There are two appendices to B.S. 4310. One gives a reference method for the determination of lead in the range of 0·2% to 2% of lead; the other a rapid method for the detection of lead and approximate indication of the amount in the range 1·0% to 1·5% of lead.

(B.S. 4310, price 5s.)

RADIATION WARNING SYMBOL

With the increasing use of ionizing radiation in applications—as, for example, medical and industrial radiography—and in the generation of such radiation during nuclear research, in nuclear power stations, and by radioactive substances, a need arose for a distinctive symbol to indicate the actual or potential presence of ionizing radiation, and the first edition of a British Standard, B.S. 3510, for this purpose was published in 1962.

A recently revised edition of B.S. 3510 *A basic symbol to denote the actual or potential presence of ionizing radiation* brings the standard into agreement with I.S.O. Recommendation R 361.* It concentrates on specifying the basic symbol to denote ionizing radiation. A number of ancillary recommendations which were included in the earlier edition, but which have since proved to be irrelevant, have been removed, among them the "skull and crossbones" symbol.

(B.S. 3510, price 4s.)

*R361 *Basic ionizing radiation symbol.*

OIL-BURNING AIR-HEATERS

A new British Standard—B.S. 4256: 1967 *Oil-burning air-heaters*—has just been published in three parts. It will help to ensure that these appliances are safe and will give good service, though compliance is not of course a guarantee of either. Conditions of use vary greatly, and unflued heaters of this general type must be used only where there is adequate ventilation; expert advice should be obtained before installation.

Part 1—*Non-domestic, transportable fan-assisted heaters*—specifies the construction, operation, performance, and safety requirements for both flued and unflued heaters of this type.

Part 2—*Fixed, flued, fan-assisted heaters*—specifies construction, operation, performance, and safety requirements for heaters of this type.

Part 3—*Fixed, flued, convector heaters*—specifies construction, operation, performance, and safety requirements for heaters of this type.

These heaters are all designed to be used with distillate oils such as kerosine (paraffin), gas oil and domestic fuel oil.

PACKAGED VENTILATION UNITS FOR CLEAN AIR AND CONTROLLED TEMPERATURE

Ventilation Equipment and Conditioning Ltd., offer the "Vequip" range of 20-Packaged Ventilation units which provide positive pressure filtered air, at a controlled temperature.

Where the intake air could be contaminated with an odour or fume, the Company recommend the use of the models which contain special activated carbon filter elements designed to remove such contaminants.

The standard units are finished in a stove enamel light blue/grey. Sizes vary according to the duty required and the rated output.

Standard models are available to handle from 200 c.f.m. to 4,000 c.f.m. All controls and component parts are easily accessible from the front, and simplicity in their removal is a feature of these units.

Filtration efficiencies can be varied to suit requirements in the range of 95-99.98% efficiency down to 5-0.5 micron. The activated carbon filter element, when fitted, operates in the submicron range and removes trace elements of fume and odour molecules.

Double deflection grilles are a standard feature enabling correct air entry without draught, and recirculation facilities are provided for by means of a hand set damper, which controls the infinitely variable intake/recirculation ratio.

Further information is available from Berrymede Road, Acton Green, London, W.4.

NEW GENERATOR HAS MULTIPLE USES

A versatile, new generating set that has a multiplicity of uses, is announced by **G. & M. Power Plant Co. Ltd.,** Whitehouse Road, Ipswich, Suffolk.

The generator, the RDP Dieselite, is powered by a four-cylinder diesel engine of lightweight construction with radiator cooling and employing the latest 'Onan' static excited alternator. Models are available in ratings of 8, 10, 12.5 and 15 kW, operating at 120 or 240 AC, either independently or simultaneously.

Compact in design—overall length is between 43 in. and $47\frac{1}{2}$ in. and weight from 825 lbs. to 915 lbs.—the generator has been developed for a wide range of industrial applications as well as hospitals, for automatic operation in times of mains failure.

NEW LOW COST STEEL CENTRAL HEATING TUBE

Tube Products Ltd., a TI Company of P.O. Box 13, Popes Lane, Oldbury, Warley, Worcs., have launched a new low cost tin/zinc coated mild steel tube specifically developed for close circuit central heating systems. Known as Tru-Wel central heating tube, it will be of considerable interest to those concerned with central heating installations in hospitals, clinics, nursing homes, surgeries and other medical establishments.

Approximately half the price of thin-walled copper tube, Tru-Wel tube offers substantial savings wherever it is used —as much as £20 on an average domestic central heating installation.

Custom-made for the job and conforming fully to British Standard Specification 4182: 1967 for coated mild steel tubes for small bore central heating systems, the tin-zinc coating applied to the tube positively assists the making of soldered joints and gives a smooth, light-grey, corrosion-resistant finish which provides an excellent key for painting.

The new tube can be cut, bent and joined using all the conventional techniques and equipment employed when handling copper tube.

Tru-Wel central heating tube is available in five nominal bore sizes—$\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ in.—and is supplied in 20 ft. lengths.

A NEW ADVANCE IN AIR FILTRATION

Vokes Ltd., Air Filter Division, Henley Park, Guildford, Surrey, introduce an entirely new filter material.

Designed specifically for air filtration requirements, Vee-Glass E.C.M.P. is made from 100% continuous glass filament by a process controlled by electronic programming techniques to produce a media pattern of bonded, continuous filaments in interlocked strata of graduated density.

Vokes, with complete flexible control over their process are able, virtually, to dial a media pattern to suit the most specialised requirements and they have, for the introduction of this new product, chosen four basic media patterns to suit a wide range of application.

VG2 combines in one integral material, both primary and fine filtration for general air conditioning, heating and ventilating applications; this two-stage filtration is Vokes' standard media. It is available as disposable panels in a wide range of popular sizes.

It is in the automatic filter application that the most important Vee-Glass feature, the integral laminate of re-orientated filament is seen to advantage.

A feature of Vee-Glass is that all the benefits of this purpose-designed material can be introduced to applications where filters of odd sizes and shapes are required.

All grades of Vee-Glass comply with the latest and most stringent fire-proofing standards.

CONTENTS GAUGE INDICATES DEPTHS IN PERCENTAGES

A new style remote indicating, pneumatically actuated tank contents gauge, designed to enable zero depth settings to be adjusted on site, has been introduced by the **Eurogauge Co. Ltd.,** East Grinstead, Sussex. Called the EG 161 Universal, the gauge is suitable for checking liquid levels varying from 1 to 3 metres in industrial and domestic gas-oil storage tanks.

An unusual feature of the gauge is a dial plate calibrated to show depth readings in percentages. Where required, however, additional plates can be supplied for applications on which it is considered more convenient to read-off contents in quantities.

The new gauge is a 'square' unit, and is normally supplied to suit metric dimensions. Continuous readings are obtained with only the minimum operation of its built-in pump, and the gauge has a pressure safety device designed to prevent damage to the measuring element. Adjustment is also available to accommodate a range of specific gravities from 0·74 to 1·00 and for this purpose a separate chart is provided with each instrument.

NEW RANGE OF PHOTO-ELECTRIC SWITCHES

A comprehensive range of industrial photo electric switches is now in production under the trade name "Phototect". Features include ON-OFF, or OFF-ON switching, with or without time delay; also, units with built in counters and for feeding directly into solid state systems. Operational distances up to 30 feet. All units can be used on 110, 240 or 440V., —5%+15%, 50 or 60 cy., without alteration, and are solid state except for the output relay when used. Further information from **The Donovan Electrical Co. Ltd.,** Electronics Division, Birmingham, 33.

ILLUMINATED NEOPRENE SOCKET

An improved version of the Briticent 5 amp. 4 way fused neoprene socket outlet is now available incorporating a robust, long life, neon indicator lamp, mounted in a neoprene shock proof housing, to give the added safety factor of a visual indication that the sockets are "live". The sockets are mounted in "ring main" fashion within the neoprene case and are protected by a 10 amp. fuse and the 5 amp. unit is now of a similar design to the existing 4 way, 13 amp. unit. It is priced at 54s. net trade.

Further details from **British Central Electrical Co., Ltd.,** 16/26 Banner Street, London, E.C.1.

⅜-in. FLOOR SCREEDS IN ONE OPERATION

The use of powder and water mix underlayments to provide a hard, smooth floor surfacing and levelling screed on which a final floor covering can be laid, can now be widely adopted. Hitherto, when required to exceed a screed depth of more than $\frac{3}{16}$ in. it has been necessary to combine the material with a filler.

With Ardit G6, a new powder and water mix product introduced in April 1968 by Ardex Surfaces Ltd., as an additional product to Ardit Z8, it is possible to lay a floor screed to a depth of ⅜ in. in a single application, and over if a filler is employed. The material is easy to mix and apply and provides a hard, smooth, level surface on most types of sub-floor. After being laid, it dries and hardens very rapidly and can normally be walked upon after only an hour. The fixing of floorcoverings can commence in a matter of hours after screeding.

Further information from **Ardex Surfaces Ltd.,** Rediffusion House, 8–12, Camden High Street, London, N.W.1.

NEW MODEL IN THE TBL ROOMSTAT RANGE

An addition to the TBL range of room thermostats has been announced by **Teddington Autocontrols,** Windmill Road, Sunbury-on-Thames, Middlesex, the British Thermostat Company's main subsidiary.

The new model (Type BD/6) has been designed specifically for use with warm air domestic central heating systems, where it is desirable to alter the temperature setting frequently. For this purpose a direct action set point control knob is used with a three start thread giving quicker adjustment.

The Teddington TBL Roomstat range on which this version is based employs a spring loaded bellows operating a snap action micro switch. This system provides maximum sensitivity to changes in temperature and the setting of the instrument can be seen from the position of the pointer on the range scale. The unit is designed to carry a maximum load of 20 A (200/250 V.) non inductive and 3 A (inductive) at 0·6 P.F.

For warm air applications, fine control is obtained by the introduction of an anticipator heater into the thermostat. In operation, this anticipator obtains a closer control of the room temperature by causing the sensing element to "anticipate" the rising room temperature and switch off the thermostat with a minimum of space temperature change. The anticipator is for use in installations where space temperature variations could otherwise be as much as 5–10°F. before sufficient heat has been passed to or dissipated from the sensing element before the switch operates.

PEGSON/WEDA INTRODUCE A SMALL SUBMERSIBLE PUMP

Pegson Ltd., Coalville, Leicestershire, one of the Bentley group of companies, have introduced a new and adaptable lightweight submersible pump. Designated for L.100 pump, the unit is suitable for continuous operation in a space as small as an 8 in. bore pipe and has a maximum rating of 82 gallons per min. with a total head of 43 ft.

Key features of the L.100 are the chrome steel impeller, built-in motor protection, integral starter and the minimal maintenance requirements. Motor variations are available to suit supplies of 415 volts, 3 phase, 50 cycles; 240 volts, single phase, 50 cycles; or 110 volts, single phase, 50 cycles. Complete with 33 ft. of cable, it is listed at less than £100.

"HELMSMAN" INDUSTRIAL LOCKERS

This is the largest locker in the "Helmsman" range, which has been specially designed by **W. B. Bawn & Co. Ltd.,** where it is necessary to have the personal and working clothes separated, and to take advantage of the cloakroom heating facilities.

It is available either as double or single compartment units. both 7 ft. high and 20 in. deep and either 20 in. or 12 in. wide, The former has a central partition divider.

The lockers have a sloping top which is louvred, and louvres are also placed at the top of the door, and on the air input duct which is formed in the base of the locker.

Locking is by espagnolette bolt with lock (1800 differs) and the finish is anti-rust treated with choice of five standard colours. Seats and stands are available as optional extras.

Further information from Byron Works, Blackhorse Lane, Walthamstow, E.17.

THE 25th ANNUAL CONFERENCE

The 25th Annual Conference was held in the City Hall, Sheffield, on 29th, 30th and 31st May, 1968.

The proceedings began with an Official Welcome by the Lord Mayor of Sheffield, Alderman Mrs. Patience Sheard, J.P., and the Conference was then opened by Mr. L. G. Northcroft, O.B.E., B.Sc., C.Eng., M.I.Mech.E., President of the Institute.

During the Conference a wide range of Papers of a very high standard were given and it is hoped to publish some of these in the Journal. The Institute is much indebted to all the speakers for making the Conference so rewarding.

THE ANNUAL DINNER

The Annual Dinner was held on the evening of 29th May and among the guests were the Lord Mayor and the Lady Mayoress, Mr. C. Copple (Assistant Chief Engineer, Ministry of Health), Mr. A. Wotherspoon (Assistant Chief Engineer, Scottish Development Department) and Mrs. Wotherspoon, Mr. P. H. Beahan (Regional Training Officer, Sheffield R.H.B.) and Mrs. Beahan, and Mr. E. R. Haynes and Mr. V. Franco (both of the Ministry of Health).

The President and Mrs. Northcroft welcomed the guests.

Mr. A. R. White (Regional Engineer, Leeds R.H.B.) proposed the toast "The Lord Mayor and the City of Sheffield" and spoke of his pleasure in so doing, particularly as the Lord Mayor was so familiar with work in the Hospital sphere. He said the Lord Mayor was a member of the Sheffield R.H.B., Chairman of the Health Committee of the Municipal Corporation, a member of the Central Health Services Council, and she had always been deeply interested in services for the elderly and the welfare of the handicapped. Mr. White spoke, too, of the Lord Mayor's tremendous contribution in the reduction of atmospheric pollution and to the great strides which the City of Sheffield had made in this direction and, also, in the fields of housing and city centre development.

The Lord Mayor, replying, commenced by congratulating the organisers for bringing the Conference to Sheffield and spoke of the many attractions the City had to offer, not least of which were the tremendous rebuilding schemes, completed and in hand. The Lord Mayor spoke of the University, which had an engineering department of international reputation and a most distinguished medical school and referred, also, to the fact that it was Sheffield which gave its name to the largest Regional Hospital Board in the country and of the massive rebuilding programme in which the Board was engaged. The hospital engineer was involved in every aspect of the creation of the complex machine known as a hospital and mentioned the wide range of duties and responsibilities which are the lot of the engineer at hospital level. The Lord Mayor concluded by expressing the hope that those attending the Conference might find time to enjoy the magnificent countryside and historic houses in the surrounding area.

Mr. C. Copple proposed the toast of the Institute of Hospital Engineering. He began by referring to the grant of Incorporation on 1st January, 1967, when the Institute took over from the old Institution of Hospital Engineers. Following Incorporation, the membership had been broadened to appeal to the many who had some sort of involvement in Hospital Engineering. Mr. Copple spoke of how the Institute had so strongly encouraged training in management and said that the Institute catered probably better than any other body in this way for the hospital engineer and spoke of the Ministry's indebtedness in this connection and, also, for the "platform" which was provided by the Institute's Journal.

The speaker referred to the setting up of a residential training centre by the Ministry and emphasised the importance of fault diagnosis, to which the training centre would devote much study. He stressed, too, the real need for the constant feed back of information from hospital engineers to the Ministry.

Mr. Copple concluded by saying that even when the National Training Centre had become established, the functions of the Ministry and of the Institute would complement each other within the overall training needs.

The President of the Institute replied to this toast and said:

"Mr. Copple, I was desperately afraid you were going to start talking about feed back, because I am; but before I do that I would like to make a few points about the Institute as it is now and as it should be in several years' time.

"This is a small gathering—it is unrepresentative, because in the Institute of Hospital Engineering there should be five categories of people. There should be the private consultants who are responsible for carrying out major engineering designs in the hospital world; there should be the engineers of the Ministry who are responsible for that same object and Regional Board engineers; there should be the hospital engineer (and you may think that at that point I have said the lot); but there should be the manufacturers of equipment for the Hospital Service.

"It has been my privilege over the last generation to travel the world at frequent intervals and I have spoken to hospital engineers in many parts of the world and certainly all over the English speaking Commonwealth. These engineers have exactly the same problems as you have and they are meeting with the same resistance and difficulties. They also must have a proper part in the Institute of Hospital Engineering.

"When you consider these five categories of people you will realise that your present size and your present thinking does not begin to cover the subject at all. Why is it necessary to have a special body of engineers? Surely, as everybody says, there are already too many institutes and institutions, why have another one? I would refer you to your own programme for this Conference. (The subjects for discussion were 'Environmental Engineering', 'Applied Tribology', 'Medical Electronics', 'Recent developments in Oil-fired Hot Water Steam Boilers' and 'Radiation Protection'.) Where else would you find an engineering body that is vitally interested in the assortment of subjects which are going to be discussed in these three days? There are certain parts of it which will properly form the subject for this institution or that institution. It is quite impossible to find an institution in the world which will concern itself with all the subjects we are going to discuss. It is a great pity, because obviously there is greater strength in a larger institute; but nevertheless from these five categories that I have mentioned there are enough hospital engineers to make this a very powerful organisation indeed if the fact is realised by all the parties concerned.

"What have people to gain? I know that it is easy to say that you do not join bodies of this kind for gain. You join them to see what you can give; but by and large you do also join because of what you can gain from it and all of these five categories can gain. They can gain because hospital engineering is the worst conducted process industry in the world. It is not often thought that medicine and the engineering behind medicine is a process industry. The process operators, instead of being the brewers or the manufacturers of textiles, are the medical staff, operating (in its wider sense) on the human frame in one form or another as a raw material. The engineering behind this particular process industry is conducted in a way which would be absolutely incomprehensible if it was being run as a commercial organisation. You have different responsibilities for engineering. You have the process people telling the engineers what they want regardless of whether it is right engineering or not: like the brewers, like the textile manufacturers, they will tell you it is because such and such a thing has got to be done this way and the engineer has no choice. This attitude is changing, as it is changing in all the process industries as they are becoming more and more scientific and as they are becoming less and less rule of thumb. When an industry begins to develop technically it produces untried engineering methods and it tells the new designers whether their untried methods are satisfactory or not. At the present moment there is no way in which feed back goes all the way up to the medical people or to the consulting engineer or to the Ministry. There is no organised way.

"I maintain that the object of the Institute of Hospital Engineering should be to provide a two-way traffic, a platform for the engineer and the medical staff to find out what the result is of the things that they want doing, whether they work or not; to find a way of getting the hospital engineer who is given equipment that is not quite right and so alters it, to find a way for him to tell the people that matter what he is doing to make the things work. This is what I mean by feed back right through the hospital industry and this, I think, seems to be the prime object of drawing into the Institute completely these five categories of people. Throughout the world there are people who are saying where can I get this information.

"You must not start this Institute by thinking parochially—you have got to enlarge this view point to cover the world. People want co-operation to happen. The Ministry want to hear what is happening at the grass roots of hospital engineering from the hospital engineer. Now, not only is it necessary for the Institute to strengthen itself in numbers, but it is necessary for the branches of the Institute to be live centres of discussion. Not only is this necessary but it is imperative in any training scheme which takes place, either through the Ministry or with the help of the Institute. It is most important that any training scheme or national conference is a two-way traffic, not from them to you but altogether in discussion and in detailed informed discussion. I believe that this Institute has an enormous part to play throughout the hospital engineering world and Mr. Copple, sir, I thank you for proposing our toast."

Mr. H. A. Adams, M.B.E., Chairman of Committees of the Institute, proposed the toast of "Our Guests and Visitors," and Mr. A. Wotherspoon (Assistant Chief Engineer, Scottish Development Department) responded.

INTER-REGIONAL TRAINING SCHEME FOR POTENTIAL GROUP AND HOSPITAL ENGINEERS

This scheme, first reported in the February 1968 issue of THE HOSPITAL ENGINEER, becan with an introductory course in Mansfield on 10th June.

As a result of the nation-wide advertisements, direct enquiries to all Regional Boards and Boards of Governors, and a special announcement in the March issue of THE HOSPITAL ENGINEER, 90 applications were received from which 30 candidates were selected for interview by a selection panel drawn from the three organising Regions—Birmingham, Leeds and Sheffield.

Finally, twelve candidates were selected for training and are being sponsored by the Regions in which they elected to do their practical training. These are: Birmingham 4; Leeds 4; Liverpool 1; Manchester 1; Sheffield 2.

The twelve month course is made up broadly as follows:—

Introductory Course	1 week
Technical Lectures	7 weeks
Management Courses	3 weeks
Review Courses	1 week

Special Practical Courses at Cardington for:—

Boiler House Practice	2 weeks
Air Conditioning	2 weeks
Electrical Installations	2 weeks
Diesel Generators	2 weeks

Practical training attachments at selected hospitals in the respective Regions are arranged in conjunction with the above courses and occupy about 29 weeks.

The course finishes on 9th June, 1969.

SOUTHERN BRANCH

The 128th meeting of the Southern Branch was held on 25th May, 1968, at Coldeast Hospital, Sarisbury Green.

The meeting was opened by Mr. W. A. J. Whiffen, Chairman of the Branch, who gave a talk on Basic Air Conditioning Theory and the use of Psychrometric Charts.

The construction and general layout of air conditioning plants was first discussed, taking into account filtering, preheating, washing and the necessary air changes involved. From this followed the use of the Psychrometric Chart and how the requisite temperature and relative humidity could be worked out in conjunction with the automatic controls fitted on the plant.

Diagrams and charts were produced and explained, and the talk closed with a discussion period.

At the business meeting which followed, copies of the brochure "Going Metric – First Stages" were distributed to members.

Mr. H. Fothergill, who had been succeeded by Mr. R. G. Smith as an Area Member of Council, was thanked and applauded for his past service over eight years as a Member of Council. He, in turn, thanked all concerned for the support that he had been given. It was agreed to invite Mr. Smith to attend the September meeting of the Branch.

Mr. Fothergill stressed the importance of attending th Annual Conference. Strength in numbers was of great moment and facilities were open to members to obtain leave of absence from H.M.Cs.

The Chairman gave a résumé of the papers read at the Oxford Five Branch Meeting and stressed their quality. This subject was discussed at length.

JOINT SCOTTISH BRANCHES

It has been announced by Mr. J. Cadenhead, Hon. Secretary of the Glasgow Branch, that a joint Scottish Branches Conference will be held on October 3rd, 4th and 5th, 1968.

Detailed arrangements are being worked upon and will be published in these pages as soon as they have been completed.

PERSONAL

Mr. G. D. Ashley has been appointed a Hospital Engineer with Chesterfield H.M.C.

Mr. T. Button has been appointed Hospital Engineer at St. Woolos Hospital, Newport. He was an Assistant Engineer at St. David's Hospital, Cardiff.

Mr. T. Casey has been appointed Hospital Engineer to Herts and Essex Hospital, Bishops Stortford. He was an Assistant Engineer at Princess Alexandra Hospital, Harlow.

Mr. W. L. Gilbert has been appointed Hospital Engineer at Wexham Park Hospital, Slough.

Mr. P. Kernahan has been appointed Group Engineer to the Isle of Wight H.M.C.

Mr. W. G. Richards has been appointed Group Engineer to the Welsh Border H.M.C.

Mr. A. Gilmour has retired as Regional Engineer to the Western R.H.B., Scotland. He is succeeded by Mr. K. W. Wilson who was previously Deputy Regional Engineer to the Newcastle R.H.B.

(Continued from page 136)

results. In hyperbaric oxygen chambers, enough oxygen has been dissolved in the blood plasma to maintain life and speed recovery.

Neonatal Asphyxia

Treatment in a hyperbaric chamber has been proved to be effective in resuscitating a new-born infant which fails to breathe spontaneously. The time between birth and first respiration should not be more than four minutes. While it is not always possible to obtain the services of an anaesthetist within that time, a nurse can begin treatment in a neonatal hyperbaric chamber without any delay.

Shock

This may result from loss of blood, injury or other causes including coronary occlusion. It results in a lack of blood for effective circulation. By saturating the blood with oxygen, hyperbaric treatment has been shown to counteract the effect of anoxia in the brain and other tissues and relieve the work load on the heart. It helps to improve the blood circulation and quickly restores the patient to a state in which further treatment can be given.

Plastic Surgery

Hyperbaric oxygen has been of great value in preserving a graft with an inadequate blood supply until a sufficient supply of blood is established through natural processes.

Burns

Here, hyperbaric oxygen treatment has stimulated healing, reduced infection and helped to prevent the death of tissue which has been injured but not destroyed.

Infections

Hyperbaric oxygen has revolutionised the treatment of gas gangrene, a frequently fatal infection which, in the recent past, has resulted in the closing of operating theatres at hospitals because of outbreaks among patients.

The new treatment has been effective both in limbs and in the pelvic condition which was previously almost always fatal. With it, recovery is now quite normal, and the once-common amputations should no longer be necessary.

Not only has human suffering been relieved; stays in hospital have been shortened.

Thrombosis, Embolus and Spasm of Blood Vessels

When a blood vessel is blocked by a blood clot, a gas bubble, a fragment of tissue or muscular spasm, the tissue supplied by the blood vessel is deprived of oxygen and deteriorates rapidly unless the condition is relieved. While hyperbaric oxygen does not usually cure the underlying conditions, it has been shown to maintain the tissues in good condition until corrective action such as surgery can be carried out.

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SITUATIONS VACANT

BURNLEY AND DISTRICT
HOSPITAL MANAGEMENT COMMITTEE

ASSISTANT ENGINEERS (Three)

to assist the Group Engineer in the operation and planned maintenance of the engineering or electrical services.

Candidates must have completed an apprenticeship in mechanical or electrical engineering or acquired thorough practical training in hospital or similar engineering services and hold the Ordinary National Certificate in Engineering or an equivalent qualification approved by the Minister of Health.

Salary—£917 rising to £1,270 per annum (additional increments above the minimum may be awarded for relevant experience).

Application forms and details obtainable from the Group Secretary, Burnley General Hospital. Closing date for applications 26th July, 1968.

EAST BIRMINGHAM HOSPITAL
MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER

Salary £1,570 to £1,805.

For job description and application form apply to Group Secretary, 45 Bordesley Green East, Birmingham, 9.

Closing date for applications 22nd July, 1968.

THE HOSPITAL FOR SICK CHILDREN
GREAT ORMOND STREET, LONDON, W.C.1.

HOSPITAL ENGINEER

Applications are invited for a new post of Hospital Engineer. The successful applicant will be directly responsible to the Group Engineer for all engineering services and planned maintenance of Great Ormond Street and its country branch hospital at Tadworth, Surrey, and have some responsibility for services in the Institute of Child Health, a postgraduate medical school of the University of London.

Preference will be given to applicants with a Higher National Certificate or Higher National Diploma in mechanical or electrical engineering with endorsements in Industrial Organisation and Management. Minimum qualifications should include one of the following or an approved equivalent:—

(i) City and Guilds Mechanical Engineering Technicians Certificate (Part II) which must include Plant Maintenance and Works Service; or
(ii) City and Guilds Certificate in Plant Engineering; or
(iii) Ministry of Transport First Class Certificate of Competency if it includes an Ordinary National Certificate.

Salary will be on the scale £1,292-£1,500 p.a. plus London Weighting of £75 p.a., increasing on 1st September 1968 to £1,370-£1,600 p.a. plus London Weighting.

Applications naming two referees should be sent to the House Governor by 10th August, 1968.

DEPUTY CHIEF ENGINEER for large Teaching Hospital. Preferably a corporate member of the Institute of Electrical Engineers, the successful candidate would be required to take charge of the electrical requirements of new work and undertake reports and investigations. He may also have some overall authority at high level for general maintenance but the details of his responsibilities could be worked out to suit his particular needs. Salary scale £1,825-£2,162. Write to the House Governor, The London Hospital, E.1.

ST. HELENA GROUP HOSPITAL
MANAGEMENT COMMITTEE, COLCHESTER

Applications are invited for the post of DEPUTY GROUP ENGINEER. The successful applicant will also act as HOSPITAL ENGINEER OF NOTLEY HOSPITAL, near Braintree, where he will be based and will have responsibilities throughout the Group. Experience is required in the management of mechanical and electrical engineering plant and in the control and deployment of staff. Applicants must be qualified in accordance with P.T.B. Circular 191. Further particulars available on request.

Salary scale:—£1,370 to £1,605 per annum plus £200 for special responsibilities.

An unfurnished house can be made available if required.

Applications, stating age, qualifications and experience with the names of three referees to the Group Secretary, St. Helena Group Hospital Management Committee, 14, Pope's Lane, Colchester, Essex, not later than 27th July.

ST. JAMES' HOSPITAL MANAGEMENT COMMITTEE
PORTSMOUTH

Applications are invited for the post of HOSPITAL ENGINEER at St. James' Hospital, Portsmouth (950 psychiatric beds) which will become vacant on 1st October, 1968, following retirement of present holder. Candidates must have a sound knowledge of steam-raising plant, heating and domestic hot water services; have served an apprenticeship in mechanical or electrical engineering and possess:—

(a) Higher National Certificate or Higher National Diploma in Mechanical Engineering with endorsements in Industrial Organisation and Management and Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course; OR
(b) Higher National Certificate or Higher National Diploma in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S.III or O2 level, or with endorsement in) Applied Heat and Applied Mechanics, provided he has suitable practical experience in mechanical engineering; OR
(c) City and Guilds Mechanical Engineering Technicians Full Technological Certificate (Part III) which must include Plant Maintenance and Works Service.

The successful candidate will be directly responsible to the Group Engineer for the engineering services. A semi-detached house is available within the hospital estate. Salary scale £1,270 p.a. rising by annual increments to £1,500 p.a. plus a special units responsibility allowance of £25 p.a.

For application forms and further details please apply to the Group Secretary, St. James' Hospital, Portsmouth.

LEA CASTLE HOSPITAL
NR. KIDDERMINSTER

ASSISTANT ENGINEER required. Candidates must hold the O.N.C. in mechanical or electrical engineering or similar qualifications recognised by the Ministry of Health. Housing accommodation available at a reasonable rental.

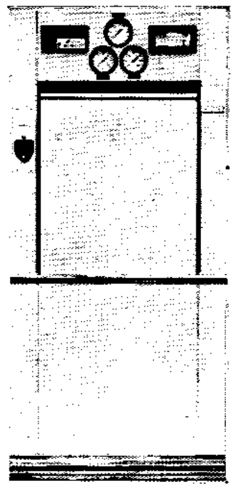
Salary scale £917 rising to £1,192 per annum.

Applications to Hospital Secretary.

MISCELLANEOUS

Stethoscopes, Headphones and Pillowphones—For all Repairs and Accessories—Workshops for the Disabled, Northern Road, Cosham, Portsmouth. Telephone: Cosham 76533.

CIRCULATING PUMPS and Steam Turbines. Complete units, electric and steam, spares and service. TURNEY TURBINES Ltd., 67 Station Road, Harrow. Tel.: 1355 and 3449.



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