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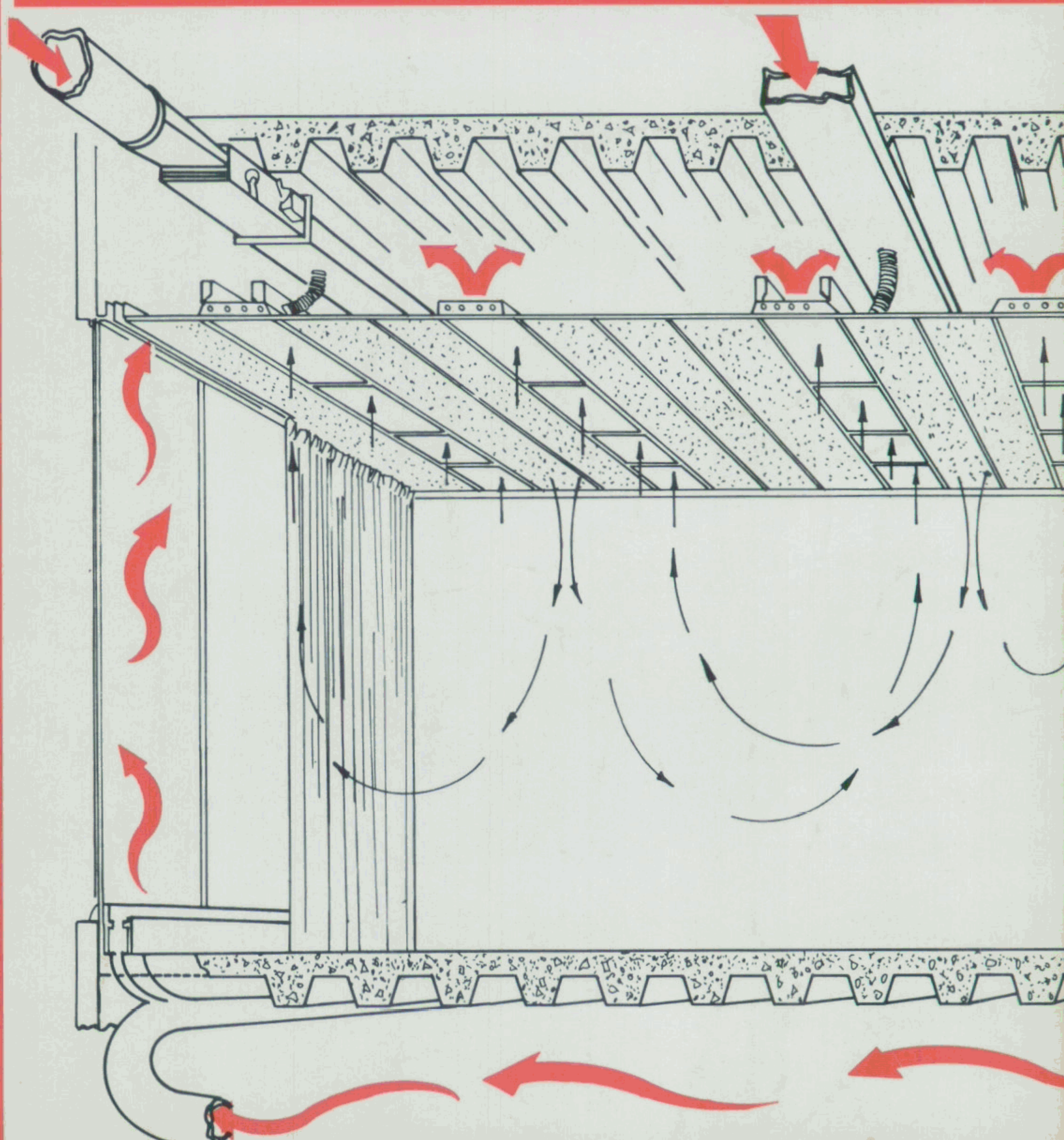
# Hospital Engineering

JULY 1976



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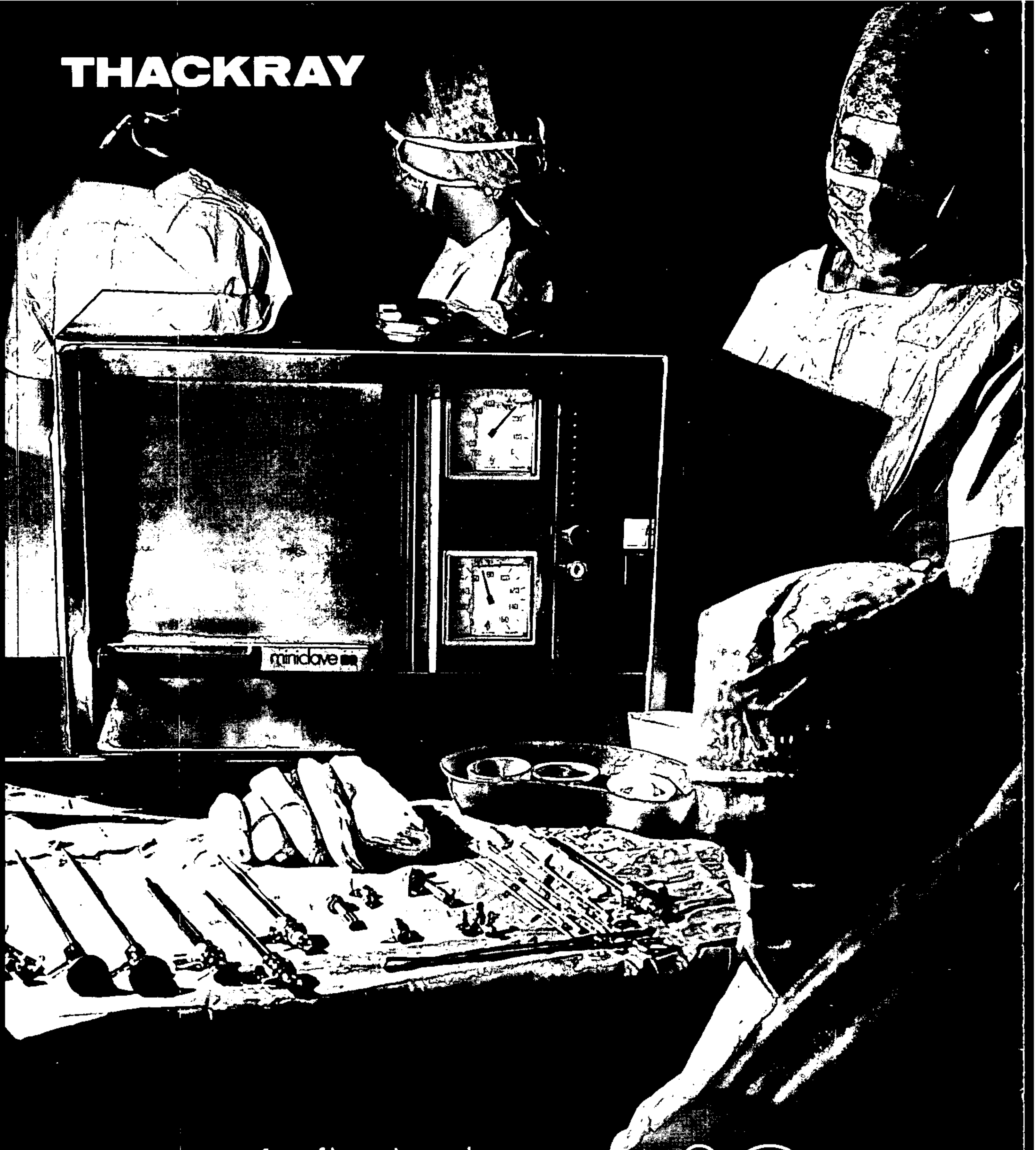


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**Editor**
David Mackin

**Deputy Editor**
Julian Ryder

**Graphics Manager**
M. C. Partridge

*All correspondence relating to the Journal should be addressed to:*
'Hospital Engineering',
Peter Peregrinus Limited,
PO Box 8, Southgate House,
Stevenage, Herts. SG1 1HQ, England
Telephone: Stevenage 3311
(s.t.d. 0438 3311)

**Advertisement Manager**
Barry Weitz,
Advertisement Department,
Peter Peregrinus Limited,
Station House, Nightingale Road,
Hitchin, Herts. SG6 1RJ
Telephone: Hitchin 53331
(s.t.d. 0462 53331)

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The Institute of Hospital Engineering,
20 Landport Terrace,
Southsea, Hants. PO1 2RG, England
Telephone: Portsmouth 23186
(s.t.d. 0705 23186)

**Secretary**
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Hospital Engineering

Vol 30
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# Energy recovery systems for hospital use

by R.G. KENSETT, C.Eng., M.I.Mech.E., M.I.H.V.E., M.Inst.F., A.M.B.I.M., F.I.Hosp.E.

## 1 Introduction

The recent energy crisis has drawn attention to the need to conserve fuel, and an investigation of methods of conserving energy in hospitals has highlighted the waste of valuable resources that is occurring, principally through a lack of heat-recovery systems.

The provision of heat, light and power is currently utilising some 10-12% of the area health authority budgets and a typical breakdown of expenditure is given on Table 1 for an assumed budget of £4·5 million.

From these figures it is apparent that for a typical area health authority a saving of 10% of energy costs would realise some £45 000 per annum. With the rapidly increasing costs of energy supplies, either in manufactured form, such as electricity or gas, in basic form for conversion, such as oil or coal, it will be appreciated that the percentage expenditure and the possible savings can be expected to show very noticeable increases in the next decade.

The energy utilised in the hospital can be considered in two basic forms, namely that which is utili-

Table 1 - Typical annual revenue expenditure

| Total breakdown | | | Breakdown excluding salaries and wages Available expenditure: £1 260 000 | | |
|---|---|---|---|---|---|
| Item | Percentage of Total | Cost | Item | Percentage Revised | Cost |
| Salaries & Wages | 72 | 3 240 000 | Food | 21·4 | 270 000 |
| Food | 6 | 270 000 | Medical Supplies | 14·3 | 180 000 |
| Medical Supplies | 4 | 180 000 | Maintenance | 10·7 | 135 000 |
| Maintenance (Excluding Wages) | 3 | 135 000 | Energy Costs | 35·6 | 450 000 |
| Energy Costs | 10 | 450 000 | Other Items | 18·0 | 225 000 |
| Other Items | 5 | 225 000 | (Energy is the highest single item cost) | | |
| TOTAL | 100 | £4 500 000 | TOTAL | 100 | £1 260 000 |

This Table is taken from MACMILLAN, D.: 'The economic utilation of energy'. Conference on 'Resources for maintenance', September 1972

Mr Kensett is with the Welsh Health Technical Services Organisation, Heron House, 35-43 Newport Road, Cardiff, CF2 1SB, Wales.
This article is based on a paper presented to the Welsh Branch and the London Branch of the Institute.

sed in the form in which it is purchased and that which is converted outside the hospital to some other medium, e.g. boiler plant and electricity. There is, however, a third form which is rarely, if ever, considered and that is the energy that can be recovered after its apparent utilisation, and natural energy (solar or wind energy). The examples that can be readily quoted and appreciated are the heat energy from the incineration of all types of refuse, the recovery of heat from extracted air in ventilation and air-conditioning systems, and the use of such devices as the heat pump to extract solar energy from the heatsink effect of the buildings or in some cases the ground.

This article is concerned with these latter categories of energy utilisation. It is considered that by adopting some, if not all, of the methods to be investigated and commented on a saving of over 10% of the energy costs could be easily achieved.

## 2 Heat recovery from incineration

The recent study into the disposal of hospital waste (DHSS Data Sheets MW 2.2-2.39) has shown that for a typical district general hospital the current rate of waste production is now averaging 6•4 kg/bed/day (14•3 lb) and that this is increasing at a rate of approximately 10% per annum owing to the increasing use of disposal products. It has also been shown in the study referred to that the calorific value of hospital refuse can be expected to average 15 MJ/kg (6200 BThU/lb) and can frequently reach 19•7 MJ/kg (8500 BThU/lb).

Consider a typical district general hospital of 800 beds.

Total waste produced = 800 x 14•3 lb
(800 x 6•48 kg)

Assume that incineratable waste is 72% of the total produced,

then incineratable waste = 8240 lb/day (3745 kg)

Mean Combustion Value (c.v.) of refuse = 7200 BThU/lb
(16 747 kJ/kg)

Maximum heat release from refuse = 8240 x 7200 BThU/day
(374•5 x 16 747 kJ/day)

Consider an oil-fired incinerator with a burning rate of 700 lb/h (5•29 kg/s), then burning period

$= \frac{8240}{700} = 11{\cdot}75$ h

35 sec. oil consumption average = 8•0 gal/h (36•37 kg)

Weight of oil fired = 8 x 8•35 lb
(36•37 x 4•51 kg)

net c.v. of oil = 18 400 BThU/lb
(42 850 kJ/kg)

therefore heat release from oil = 8 x 8•35 x 18400 BThU/h
(36•37 x 4•5 x 42850 kJ/h)

Heat release from refuse = 700 x 7200 BThU/h
(318 x 16 747 kJ/h)

maximum release of heat from process = 6 269 120 BThU/h

efficiency of heat recovery (manufacturer's guarantee figure) = 60%

heat generated $= 6\ 269\ 120 \times \frac{60}{100}$ BThU/h

or 3150lb of steam per hour at 120lbg/in$^2$

Lowest measured c.v. of refuse = 6024 BThU/lb

so the heat generated = 2760 lb of steam per hour at 120 lbg/in$^2$

The system quoted above would assume regular firing of the refuse over the 11•75 h period which could be arranged to coincide with the period of maximum heat demand.

Alternatively, if hot-water production is selected instead of steam production, the hot water produced would be equal to

$$6269120 \times \frac{60}{100} \times \frac{1}{\text{temperature rise}}$$

= 3750 lb for 100°F temperature rise
or 3750 gal/h

The DHSS study group report 'Water consumption in hospitals' states that the anticipated hot-water consumption in the wards would be 34 gal/bed/day. Therefore the hot water produced would be adequate to provide for the needs of the hospital in all departments. Efficient thermal storage vessels would be required as the burning does not take place over the full 24 h, but the cost would be offset by the reduction or elimination of calorifier capacity.

### *Economics*

The cost of the fuel can be eliminated, as incineration would be a requirement of the hospital whether or not waste heat recovery is accepted and the size and type of incinerator would be identical whether the basic or heat-recovery scheme is adopted.

Assume that the steam-raising scheme is adopted:

Average cost of steam generation/1000 lb (453 kg) (DHSS cost returns)
= 59p (but currently estimated at £1•50/1000 lb)

Steam raised at 120 lbg/in$^2$ = 3150 lb/h (142 kg/h)

Time of operation = 11•75 hrs for 7 days
= 82•25 h per week
= 4277 h per year

Therefore the annual saving in direct generation costs = £3•15 x 0•59 x 4277
= £7950 (on estimated current figures £23 850)

This costing assumes there is no reduction made in the capacity of the installed steam-raising plant.

## 3 Heat pipes

Heat pipes offer an efficient method of heat transfer between any types of fluid. The fluids may be similar or dissimilar and may be gaseous or liquid. The transfer may be either from air to air, liquid to liquid, air to liquid or vice-versa. The device is compact, rapidly conducts heat, and will offer a thermal conductivity far greater than any of the current range of metallic heat-conduction devices. The simplified layout of a typical unit is shown in Fig. 1. The heat pipe may be constructed in various shapes and configurations but, for the purpose of describing the design, the straight-pipe standard design has been considered.

Heat transference occurs when a heat source is applied to one end of the pipe which results in vapourisation of the working fluid. The vapour flows by conduction to the opposite end of the tube where the heat is removed in the reservoir. This removal condenses the vapour back into its liquid form and it is returned to the evaporator or heat-source end of the pipe by means of capillary action within the wick, thus completing the cycle. The pumping action of the wick is the part of the device that distinguishes it from other units that transport, evaporate or condense fluids. The action is the result of vapourising of the liquid, which creates voids in the structure of the porous wick. The material of which the wick is constructed has inherent attractive forces, which, when combined with the surface tension of the liquid, fill these voids. The flow is continuous so long as the system process parameters remain unchanged.

Heat pipes therefore operate very efficiently without moving components or any form of external drive. The device may be used to transfer heating or cooling loads in any direction irrespective of gravity. The loads may vary from a few watts to several kilowatts.

An inspection of the salient features of the design will show that it is practical to extract heat from contaminated fluids without affecting the fluid to which the heat is to be transferred.

Research work has shown that one of the main advantages is the ability of the device to handle wide variations in temperature with little or no effect on the efficiency of heat transfer. The units have been shown to operate successfully in the temperature range of -200 to +2000°C.

### Construction

Research work has been undertaken for many years by the International Research & Development Co. Ltd., Fossway, Newcastle-upon-Tyne, which recently published a report on the work to date entitled 'A Status report—heat pipes 1971' by D.A. Reay.

Tests have been carried out using tubular pipes manufactured from copper or stainless steel and special types have been evolved including rotating pipes, flexible pipes with rigid evaporator and condensor sections, and branch pipes in which several evaporators are linked to one condenser. Flatplate heat pipes have also been tested which have the advantage of producing an almost isothermal surface.

Amongst the different types of material used for the wick have been woven cloth, glass fibre, and porous metals, while the working fluids tested have included water, ammonia, halocarbon refrigerants, glycerine, acetone, sodium and lithium bromide (this last fluid is used in absorption refrigeration plant).

### Applications

Current industrial applications have included the cooling of injection-moulding machines and die-casting equipment, stationary and rotating cutting tools, cooling of electronic equipment, including computers, and the cooling of large pieces of electrical equipment. Work is currently in progress on heat removal from such equipment as large bakery ovens.

Future applications of a general nature are likely to fall into four main categories:

*(a)* temperature-variation levelling, to reduce temperature gradients between unevenly heated areas of a body or item of equipment

*(b)* the provision of a constant-heat-flux supply

*(c)* the separation of a heat source and the heat sink

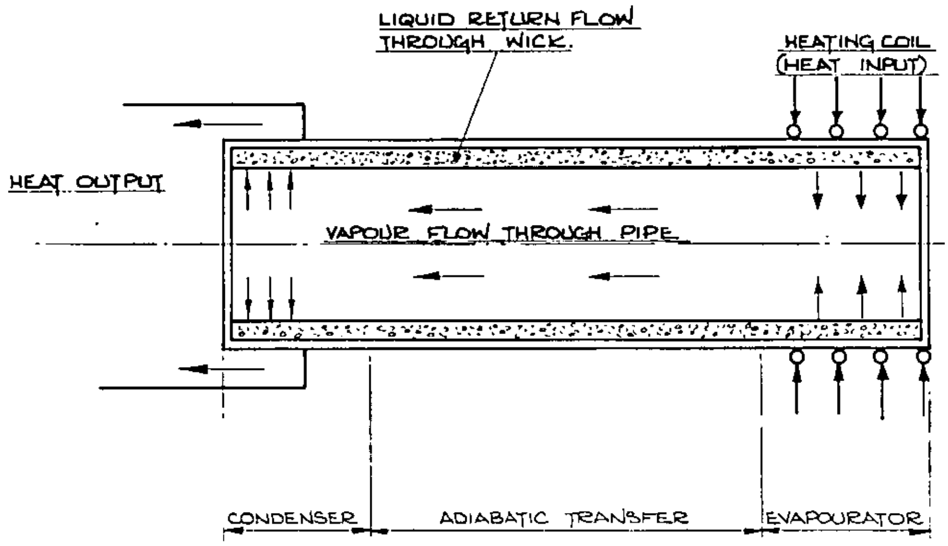



**Fig. 1 Heat pipe**

where heat is to be transferred over distances for remote dissipation

*(d)* as a heat-flux transformer to amplify a low-heat source such as exhaust air to generate high heat such as low-pressure hot water for domestic use and vice-versa.

## 4 Heat recovery in buildings

It will be apparent that the shortage of land has led in recent years to reconsideration of building design. This has resulted in high-rise buildings and has limited the use of natural daylight for illumination. Consideration of the problem will show that, if it is intended to use illumination by natural daylight, the building width must be limited to some 50 ft (15 m). This would comprise two rooms of say 22 ft (6·6 m) width with a central corridor of 6 ft (2 m). This is generally agreed to be the maximum possible width. The use of light wells is not considered practical with buildings of over four stories and some authorities have expressed doubt over this height unless excessively large light wells are provided. It will be readily appreciated that the use of such techniques would result in costly developments and the only satisfactory solution is to permit buildings to spread to make maximum use of the land and to provide artificial lighting. Such a building must have a high continuous level of artificial light and in all probability air conditioning, or at least mechanical ventilation, and under such conditions heat recovery becomes feasible.

It is suggested by many authorities that conventional air-conditioning plant design, such as induction, dual-duct and central-station with multizoning, is no longer suitable for such applications because of the inefficiency at any other condition than the design point. This is primarily because of the need to utilise both heating and cooling which are mixed to achieve the required conditions.

A study conducted by the Electricity Council showed that over a period of three years a conventional plant would never operate at greater than 70% of its installed capacity for other than extremely

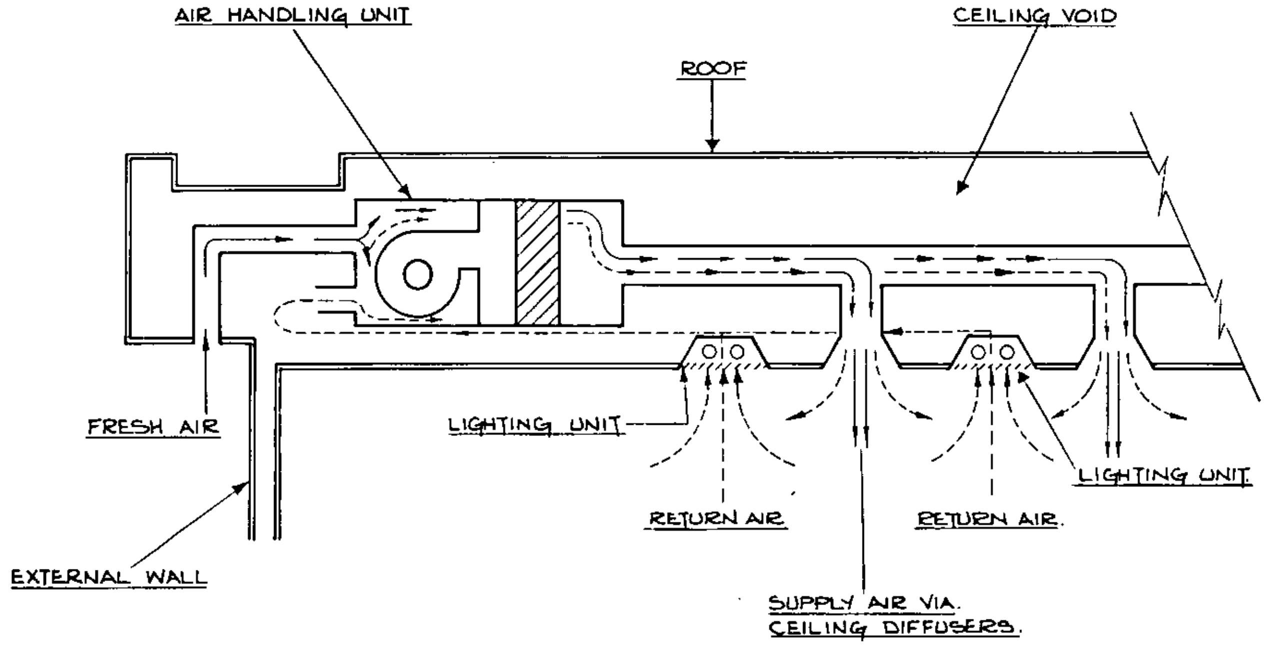



**Fig. 2 Air supply via lighting fittings for heat recovery**

A recent application has been the use of a small pipe in the form of a meat skewer which is inserted in large joints or frozen meals. The transference of heat enables the interior to be cooked at the same rate as the external surfaces. This considerably reduces the cooking time, with the consequent fuel saving and makes the meat far more palatable. Likely applications within the Health Service could include:

*(a)* use with the reconstitution of frozen meals without the need to use special refrigerated air ovens

*(b)* dissipation of heat from high-powered electrical equipment such as X-ray machines and radiotherapy equipment without the necessity to provide mechanical ventilation

*(c)* heat recovery from boiler flue gases, diesel-generator exhaust gas and cooling water. (Heat recovered from these sources could be used to preheat boiler and calorifier feed water or to provide a direct feed of d.h.w.)

*(d)* applications in conjunction with cooking equipment. If the concept of area kitchens providing a precooked frozen-meals service is realised, the heat rejected from the refrigeration process could be used to heat the cooking appliances

*(e)* heat recovery from centralised refrigeration plant. Assume an installed refrigeration capacity of 500 t then the centralised dissipation of heat from cooling towers would be in the order of 124 000 BThU/h (132 000 kJ).

It could be anticipated that the heat recovered would be some 9 kW.

short periods (2-3 days), that for over nine months it would operate at below 50% of capacity, and for six months it would be expected to operate at 25% or less. It is agreed by leading authorities including the Electricity Council, that the preferred system is the 'double-bundle' condenser system, in which the heat extracted by the refrigeration circuit of the system is utilised to provide the required heating before rejection to the cooling tower. Reference should be made to the Study Group 2 report 'Refrigeration services in hospitals Part III' for further details of the recommended forms of refrigeration plant to achieve this result.

Increasing use of air-handling lighting fittings is now being made in commercial buildings and consideration should be given to use of such units in hospitals where, in many departments, the level of lighting can be expected to be much higher than that required for commercial premises. The layout of a typical unit is shown in Fig. 2.

In these units air is extracted from the room via ceiling grilles placed in conjunction with the lighting fittings. The supply air is distributed adjacent to the lighting fitting where it is used to maintain the optimum temperature for maximum light output and efficiency. On average the lighting efficiency is increased by 12%. A typical system offered by Messrs. Barber-Coleman Ltd., is shown in Fig. 3.

In this system, part of the air is circulated over the perimeter zones, where it is used to extract solar-heat gain from windows and walls. It is claimed that, by utilising the system as described, it is possible to show a saving of from 10-15% over the operating costs of a conventional air-conditioning or ventilation system for a building of 10 floors each floor with an area of 13 400 $ft^2$ (1360 $m^2$).

## 5 The thermal wheel

This device which is already in commercial production is illustrated in Fig. 4. In this device a hot fluid is used to heat another fluid. The unit is normally used with a gas and the warm exhaust air or gas is used to preheat incoming air. The recovery rates are very good, and some units have, on test, recovered as much as 93% of the heat available in the exhaust gas.

### *Design of unit*

Heat is transferred by means of a variable-speed rotor driven by an electric motor. The usual speed of rotation is in the order of 20 rev/min but may be as low as 3 rev/min. The unit is similar in design to the Ljundstrom àir heater which is used on almost every nonnuclear power station to extract heat from flue gases to preheat combustion air.

One company is already offering seven models with a volume range from 2000 - 4000 $ft^3$/min (1-20 $m^3$/s). In this particular design the rotor is made up of alternate flat and corrugated axial plates which are made of an inorganic fibrous material. (Some units had these plates manufactured from

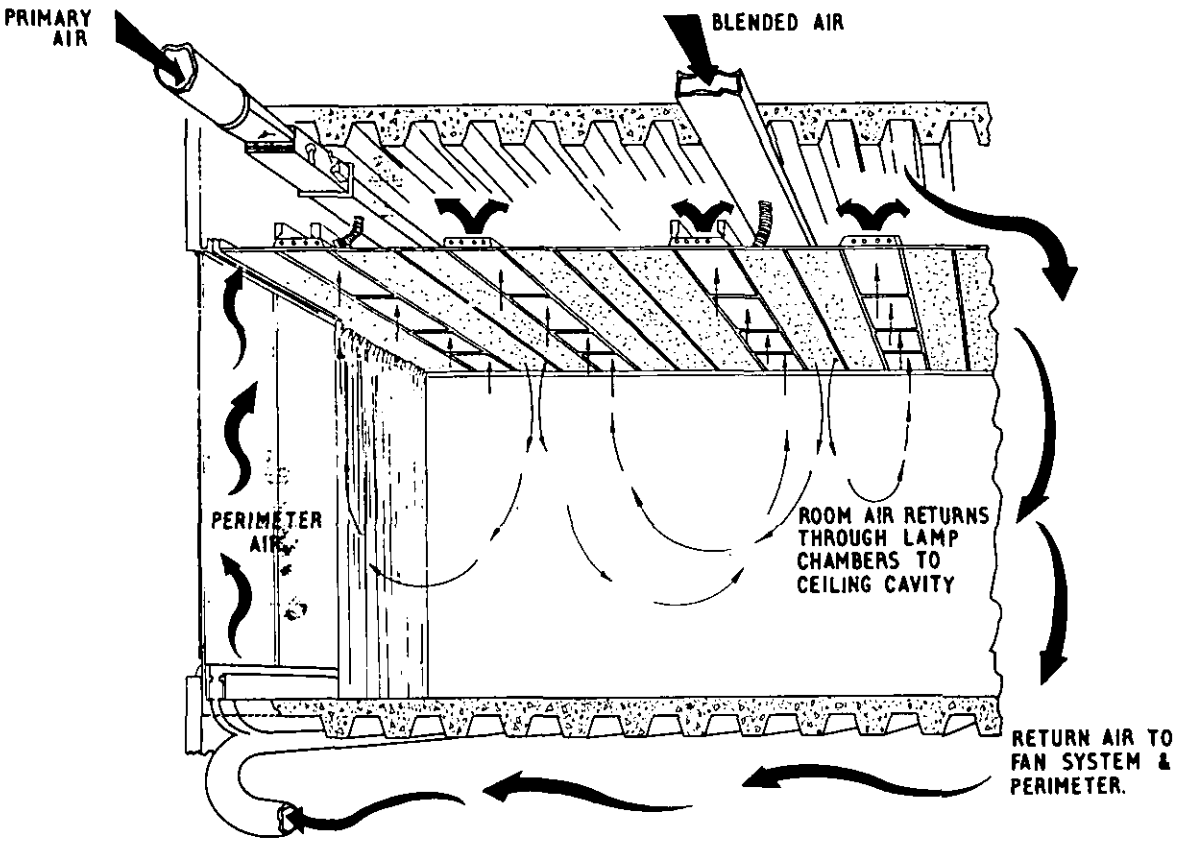



**Fig. 3 Combined heat recovery and distribution system**

asbestos-based material and it was considered that there could be a health hazard.) Investigations carried out in Germany resulted in the recommendations that plastic-coated rotors should be used and that a filter be fitted after the unit to handle the incoming air. It was emphasised that risk from detached asbestos fibres was not great but the recommendations should be followed as a precautionary measure.

These fibrous plates are mounted vertically and will provide a large heat-transfer surface in relation to the volume handled. The transfer distances are short, as the units are shallow in relation to their diameter. As with the rotary air heater the device is divided into two equal sections, one to handle the exhaust gas and the other the incoming air. To obtain the highest heat-transfer rates contraflow is recommended.

In the unit investigated, the rotor was mounted on a horizontal shaft with the hot gases passing through the upper section. In this unit the rotor speed was 5 rev/min. Differing rates of heat recovery and volumes handled may be obtained by variation of rotor speed but this will naturally affect the rate of heat transfer.

Some manufacturers claim that a big advantage of the unit is that heat can be extracted from contaminated gases without contamination being transferred to the incoming air. Tests conducted by the Max von PettenKofer Institute of Munich and by the Hygiene Institute of Heidelberg University have shown that there is a reduction in contamination, which is believed to be the result of the chemical action of the coating containing lithium chloride, or by bactericidal Phsycochemical processes in the humidity and heat exchanges. However, if the recommendation to fit a filter on the incoming air duct and after the unit is adopted, the possibility of contamination transfer will be virtually eliminated.

## *Application of the thermal wheel*

Although the principles have been considered primarily in relation to air, the thermal wheel can be considered in relation to other fluids.

A device based on the thermal-wheel principle has been in use for many years, very successfully, on paper-mill applications. In these mills large quantities of steam are used for drying and previously this vapour was discharged to the atmosphere without the application of any form of heat recovery. The air/steam mixture that was exhausted was near saturation and in consequence only a small amount could be used for air heating. However, by application of the thermal wheel, it has proved possible to recover a high proportion of the heat. When the saturated mixture is passed through the wheel, the majority of the moisture present condenses onto the vanes, which, if these are manufactured from an inert material, does not give rise to any corrosion problems. When cold dry air from outside the building is used for air heating it has been found in practice that this air will absorb a large quantity of water vapour before giving rise to humidity problems.

## *Hospital applications*

An obvious application will be associated with heat recovery from ventilation systems such as extract from laundries. It is doubtful if the system could be applied to operating-theatre air conditioning because, although the risk of contamination is slight, medical opinion is likely to prohibit the use of such equipment.

If a purge system is fitted together with filtration, the exhaust from diesel generators and possibly boilerhouse flues could be used to preheat air.

## *Economics*

As an example of the economics of the system, consider a laundry extract system with a total extract volume of 40000 ft$^3$/min (20 m/s), an extract air temperature of 80°F (26·7°C) and outside air at 35°F (1·7°C).

| | |
|---|---|
| Thus temperature difference | = 45°F (16·1°C) |
| volume of air | = 40000 ft$^3$/min |
| density of air at 80°F and 50% r.h. | = 0·0731 lb/ft$^3$ |

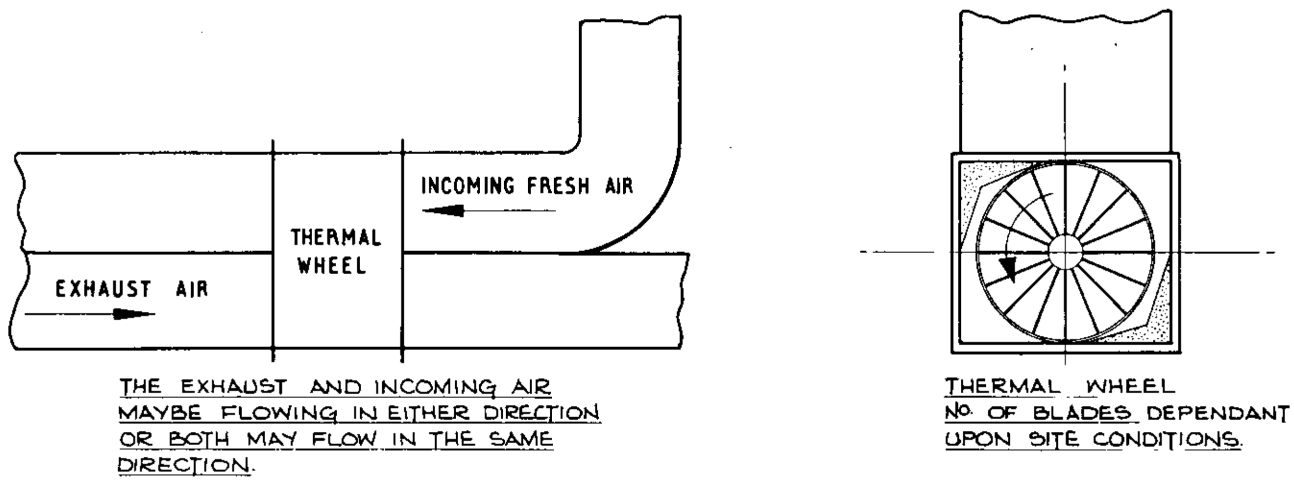



Fig. 4 Thermal wheel

weight of air/minute = 40000 x 0·0731
= 2924 lb
theoretical heat transfer = 2924 x 45
= 131 580 BThU/min
assume 75% practical heat transfer = 98 5000 BThU/min
Volume of air which could be heated = $\frac{98500}{30} \times \frac{1}{0{\cdot}07566}$
= 43 500 ft$^3$/min
(1231 m$^3$/s)

If this heat were provided by low-pressure hot water at 180°F then a heat-transfer efficiency of battery/air of 65%

heat input = 98500 x $\frac{100}{65}$ BThU/min

Standard heating cost (per million British thermal Units) = 59 p

Possible saving per hour = £98500 x $\frac{100}{65}$ x $\frac{0{\cdot}59}{10^6}$ x 60
= £5·38

It should be noted that, owing to recent increases in fuel costs, the generation cost per 100 lb of steam is currently running at £1·50 and the consequent saving would be £15 per hour

## 6 The heat pump

Basically any refrigerating system can be considered a heat pump. In any heat-pump system, heat which is at too low a temperature to be of use is absorbed by the evaporator in the refrigerating system, pumped to higher temperatures in the rejection of heat and the change of state in the refrigerant, and is then rejected from the refrigeration condenser to, in the majority of installations, waste as either heat carried away by air in the case of air-cooled condensers, or heat rejected via the cooling tower in the case of water-cooled condensers. In the heat-pump systems, this heat is recovered and utilised, normally to provide the heat required in the associated air-conditioning plants.

It has the advantage that, while most systems which provide air treatment will consist of two separate sections, one that provides cooling and one that provides heating, the heat pump consists of a single machine and system.

The same compressor, fan and refrigerant coils that provide cooling will also provide the heating required. The economic advantage is said to be in the reduced cost of a single unit as opposed to two separate systems and the reduced running costs obtained from maximum utilisation of the energy input. Commercial units are currently available as production units, in ratings from 2-5 t of refrigeration but larger test installations have been operating for several years. A unit has been operating at the Festival Hall for a number of years and a similar unit is in use at Nuffield College. These units operate using air as the primary source and a diagrammatic layout of the system is shown in Fig. 5. With the Nuffield College unit, which was installed some 12 years ago, the cost per kilowatt output at the time of final testing in 1963 was £73 based on capital charges and the unit cost was 5 p per therm.

The tests conducted showed that the average useful heat output to electric input ratio to be 2·5:1 and at time the advantage showed as high as 5:1. This illustrates the unique advantage of the heat-pump system, in that it will provide more energy that is put into it by virtue of its ability to remove heat from air, water, soil etc. In theory the only energy required by the system is that necessary to pump heat from one section of the plant to another.

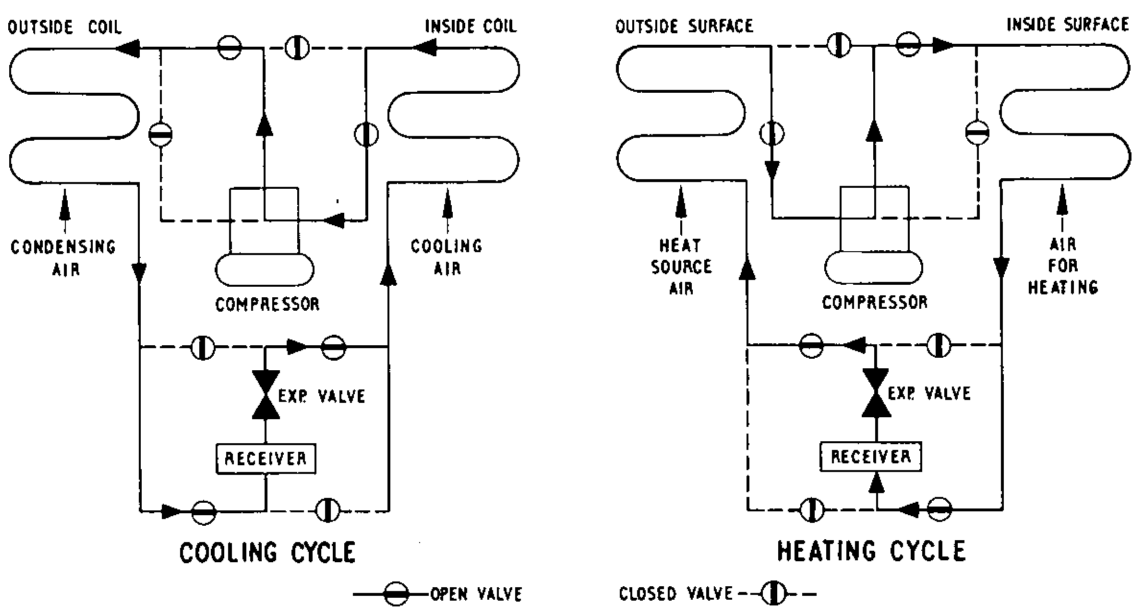



Fig. 5 Reversible heat pump

## 7 Total-energy schemes

The ultimate in energy-conservation schemes will be the total-energy system. Total energy may be defined as the provision of all energy requirements for a building complex from the use of any given basic fuel.

The greatest advantage of the system is the increase in overall operating efficiency. With standard energy systems, electricity is brought in from supply authorities and steam is generated in a boiler plant burning any given basic fuel and is then converted to low-temperature or high-temperature hot water as required. The standard system will offer a maximum overall system efficiency of 30-40%. With the total-energy system, in which all forms of heat energy are recovered from the basic generator, the efficiency, proven on test, will be 78-80%. This increase in overall efficiency provides the economic advantage for the scheme. As would be expected, the capital costs will be increased over conventional schemes, but the design selected and the sitting of hospital buildings could be considerably influenced by the use of a total-energy scheme.

Provided that the basic fuel supply can be assured, the total-energy scheme will ensure security of the electrical supply and other energy requirements. Schemes may be designed with either steam turbines, gas turbines or diesel engines as the prime mover for the generator.

*Research by commercial organisations has shown* that, as a guide to the choice of prime mover, the following can be applied, where the steam requirement of between 100-15 lb per kilowatt of electrical power is typical the steam turbine is the most suitable prime mover.

Where the steam requirement is 15-3 lb per kilowatt of electrical power consumed, the gas turbine is preferred, and where the heat demand is equivalent to below 3 lb of steam per kilowatt the diesel of dual-fuel engine is most efficient.

As will be appreciated, the current energy demands in a modern district general hospital would be in the order of 25-30 lb of steam and 2-2·5 kW per bed. These demands will, of course, vary according to the number and type of auxiliary departments attached to the complex. These could include the area laundry, central sterile-supplies department and, in the near future, area kitchens producing the food requirements for a frozen-meal service.

It is agreed, however, that where the steam requirement increases the electrical demand will increase approximately in the same proportion.

Thus it can be expected that the ratio will always lie in the region 10-12 lb of steam per kilowatt which would indicate that the gas turbine is the preferred prime mover. The ratios quoted are based on research and operating experience both in United Kingdom and overseas, principally in the USA. The scheme that will be considered in detail is therefore the use of a gas turbine as the prime mover.

### *Gas-turbine Scheme*

The open-cycle gas turbine will normally operate at a *comparatively low efficiency, with the efficiency un*likely to exceed 25%. The remainder of the energy input would be lost in the exhaust gas unless waste-heat recovery is incorporated.

The overall thermal efficiency that can be obtained will depend on the final temperature of the

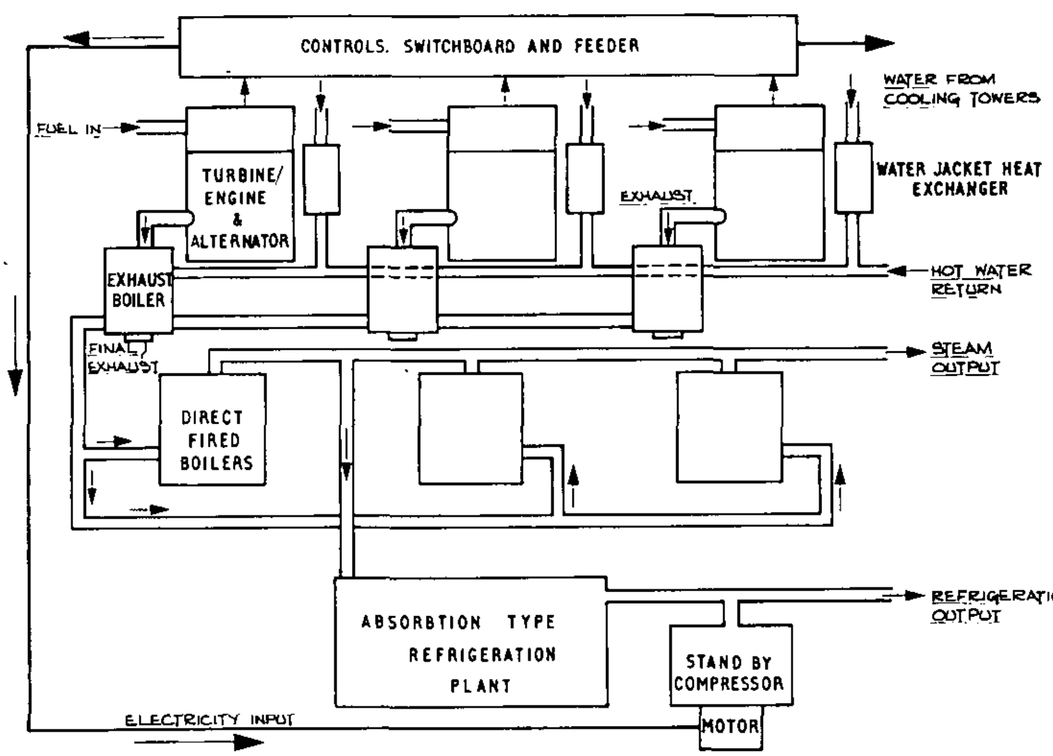



**Fig. 6 Hospital total-energy plant**

exhaust gas after heat recovery and it will be apparent that the lower this temperature the higher will be the efficiency.

With a turbine fired on natural gas the exhaust temperature will be of the order of 800-850°F (425-455°C) and, compared with exhaust from a diesel engine, very clean. Research has shown that a heat recovery of about 10 000 BThU per kilowatt generated can be expected. It has also been stated that, because of the excess oxygen present in turbine exhausts, which has been preheated to the exhaust-gas temperature, it is possible to burn additional fuel very efficiently and increase the recoverable heat to around 35 000 BThU per kilowatt generated. This will increase the overall efficiency of the plant to approaching 90%.

Fig. 6 illustrates a typical system, suitable for hospital use, with a basic gas-turbine prime mover.

A big major disadvantage of the gas turbine is its poor part load efficiency and performance but this can be overcome by following standard hospital practice with boiler plant and using a multi-unit installation. This proposal would also assist in providing the required degree of standby plant.

A further problem that can arise is the balancing of the electrical load against the heat requirements.

Taking an average running load as equivalent to 25 lb of steam per bed and a 2 kW electrical load, then, with heat recovery at 10000 BThU per kilowatt recovered heat would be equivalent to 20000 BThU, say 16·5 lb of steam at 120 lbg/in$^2$, but by auxiliary burning utilising the excess oxygen present the heat equivalent could be adjusted accordingly. A further point that should be considered to make maximum use of the energy and increase the overall efficiency to approaching the optimum of 90% would be the use of absorbtion refrigeration plant to produce chilled water for air-conditioning applications. At present the loading is in the order of 0·25 t per bed, with a required heat input of 19 000 BThU/T.

## *Heat balance*

Consider an 800-bed district general hospital with the following energy demands:

25 lb of steam per bed
0·25 t of refrigeration per bed
2 kW of electrical load per bed

Then the heat demand or its equivalent will be as follows:

| | |
|---|---|
| steam | = 25 x 800 = 20 000 lb/h |
| refrigeration | = 0·25 x 800 = 200 t/h |
| electricity | = 2·0 x 800 = 1600 kW |

## *Heat Utilisation*

| | |
|---|---|
| heat load | = 20000 (at 120 lbg/in$^2$) x 1193 |
| | = 23 860 000 BThU/h |
| refrigeration load | = 200 x 19000 |
| | = 3 800 000 BThU/h |
| total heat load | = 27 600 000 BThU/h |
| but electrical demand | = 1600 kW |

therefore heat to be recovered per kilowatt generated = 17 250 BThU

However, without auxiliary firing and operating standard efficiency, heat recovered is 10 000 BThU/kW and with operation at optimum efficiency using auxiliary fuel, the heat recovered is 30 000 BThU/kW.

To achieve a complete heat balance the following options may be considered:

*(a)* with auxiliary fuel and recovering 30 000 kW generate $\frac{27\ 600\ 000}{30\ 000}$ or 920 kW and buy in the remainder of 680 kW

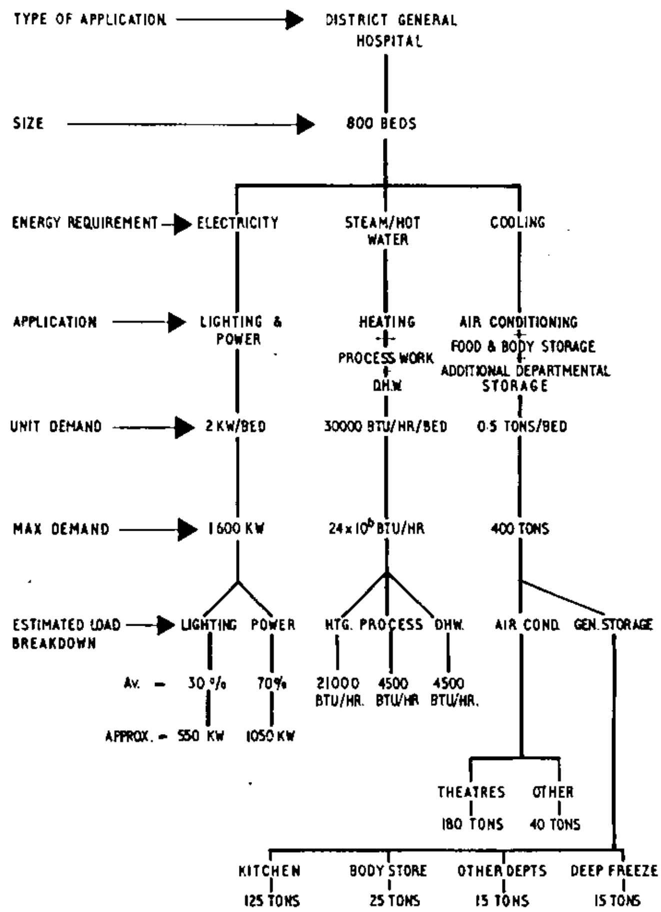



**Fig. 7 Energy pattern**

*(b)* eliminate the auxiliary fuel and operate at 10 000 BThU/kW and generate $\frac{27\ 600\ 000}{10\ 000}$ or 2760 kW and by use of electric heating, electrically powered steam generators etc. reduce the heat demand until a balance is reached

*(c)* reduce the degree of auxiliary firing until the recovery rate per kilowatt matches the electrical demand.

## *Economics of Selection*

From the point of supply security and revenue costs option *(a)* can be eliminated, but capital costs of this option will be considerably reduced.

Option *(b)* in its energy-balance condition is obviously the most economical as regards revenue costs, but the high-cost capital items such as the prime mover, generator and switchgear will be almost double the costs of a balanced scheme. Option *(c)* therefore offers the most economical solution.

It is very difficult to cost accurately the possibilities considered without extensive work and the production of a complex and not readily understood report. The main problems are that certain basic equipment must be provided such as some site generation, heat generating plant and refrigeration equipment, and it is difficult to obtain general agreement on the basic costs to be allocated to each scheme, particularly as it is often found that it is possible to provide different forms of plant for a given duty with the heat-recovery system. The example may be quoted of refrigeration plant. As stated the heat-recovery scheme could be combined with an absorbtion unit, whereeas, if an electric motor was used as the drive, it is most probable that a screw or rotary compressor system would otherwise be selected for this duty, because of the reduced space required.

The approximate cost of providing the gas turbine as the primary drive, together with the auxiliary equipment, will be £45 per kilowatt, the waste-heat boiler costs will be £1·25 per 1000 BThU/h output and absorbtion-refrigeration-plant cost will be in the order £85 per tonne of refrigeration.

It is obviously essential to consider each case on its merits, to make a decision as to the required breakdown of plant capacity to ensure economic operation and adequate standby and to complete a present-worth calculation for possibilities considered before reaching a decision on the plant to use and the economics of utilising a heat-recovery system.

## 8 Conclusions

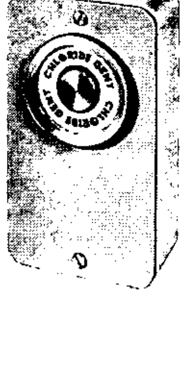
As was indicated earlier the energy costs given here were based on 1971-2 costings and do not in consequence reflect the rapid increase in fuel costs which occurred during the latter part of 1973 and early 1974 and which were averaging out at 10% of the total budget, which, for a typical area health authority would be in the order of £450 000. It is considered likely that the 1973-4 costings will increase the percentage to at least 12% and probably higher, which would indicate an annual charge of some £550 000. It will be appreciated that, by adopting some or all of the methods described in this article, a saving of 10% of the energy costs or some £45 000 could be readily achieved. The adoption of the total-energy concept may not be so readily accepted, and it is understood that a saving of at least 14% would be required to make the scheme economically acceptable. On 1970-71 costings it was reported that this figure could be achieved on the larger hospital projects and with the increased fuel costs commented on the figure can, in the present economic situation, be exceeded.

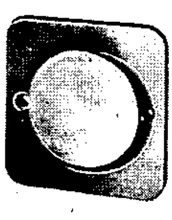
# Product news

### Magnetic door holder

A magnetic door holder for fire-stop doors has been introduced by Chloride Gent Ltd. of Leicester. The holder - *code 4302* - can be used in conjunction with fire-alarm systems so that when an alarm is initiated, the fire-stop doors will close automatically. The object of closing the doors is to reduce lateral draughts, smoke dispersion and the speed of fire spread. The door holders are available in surface-or flush-mounting versions and can be skirting or wall mounted, or alternatively bracketed to the floor or ceiling. Models are available for operation on 200/250 V a.c. or 24 V d.c. The surface-mounting door holder has dimensions 137 x 72 x 45mm. The flush-mounting plate increases the first two dimensions to 152 and 92 mm, respectively.

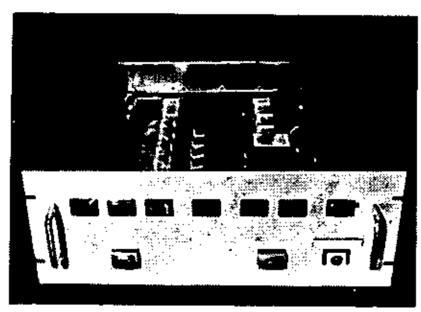
*Chloride Gent Ltd., Faraday Works, Temple Road, Leicester LE5 4JF*





### Gas-leak alarm

A gas-detection alarm and shutdown system for gas-fired boiler rooms, the *R005 series*, has been introduced by Hazard Controls Ltd. At first gas alarm condition, typically 20% of the lower explosive limit (l.e.l.), the unit will sound an external alarm with an oscillating tone. At the second alarm condition, typically 50% of l.e.l., the alarm changes to a steady tone and at the same time the unit operates a relay to shutdown the gas boosters. After a time delay from booster shut down, the *R005* will isolate the electrical supply to a slam-shut solenoid valve.



The unit will also accept an input from one or more manually operated emergency break-glass pushes. Provision is made for an alarm in the event of a fault condition; and for ease of maintenance, a key switch override facility is incorporated.

*Hazard Control Ltd., 61 High Street, Barnet, Herts EN5 5UR*

## Radiant panels
These panels are claimed to offer high outputs compared with conventional panels. Two types are available, denoted *style A* and *style B1*. *Style A* has an exposed coil and is suitable for applications where heat is required from both faces of the panel. *Style B1* has an insulated back and is suitable for applications where heat is required from one face only. Both styles are available in two sizes, 15H and 25H, and are designed for horizontal mounting, i.e. longest side horizontal. Panels for vertical applications i.e. longest side vertical, can be supplied as specials.

The panels are suitable for hot-water and steam systems and are tested to 34·5 bars g (500 $lbs/in^2$ g) for working pressures up to 10·3 bars g (150 $lbs/in^2$ g).
*F.H. Biddle Ltd., 16 Upper Grosvenor Street, London W1X OBQ*

## Fixed-height bed
An illustrated colour leaflet fully describing the *Ellison Consort '75* fixed-height DHSS-contract-approved hospital bed, has been published by Ellison Hospital Equipment Ltd. Details of this, and the *Consort 75 RB* with its rising backrest and retractable mattress, are included. A table of general information deals with measurements, specification and colour finishes.
*Ellison Hospital Equipment Ltd. (C75), Wellhead Lane, Perry Barr, Birmingham B42 2TD*

## Wall covering
Acalor International Ltd. has introduced *Wardkote*, a sprayed skin for application to walls and ceilings to help create clean conditions. It is intended for use in wards etc., not in operating theatres, sterilising rooms etc. where aseptic conditions are essential. *Wardkote* consists of two main materials; a prespray material based on synthetic latices and a main film material.
*Alacor International Ltd., 6/10 Crompton Way, Crawley, Sussex RH10 2QR*

## Control system
The OSC11 optimum-start control system is designed for use in small buildings such as health clinics. The system, which can be used with all types of heating and ventilating installations, consists of a control unit and inside and outside detectors. The control unit comprises a synchronous-motor timeswitch, with a 72 h spring reserve against power failure, an electronic comparison circuit and output relays.

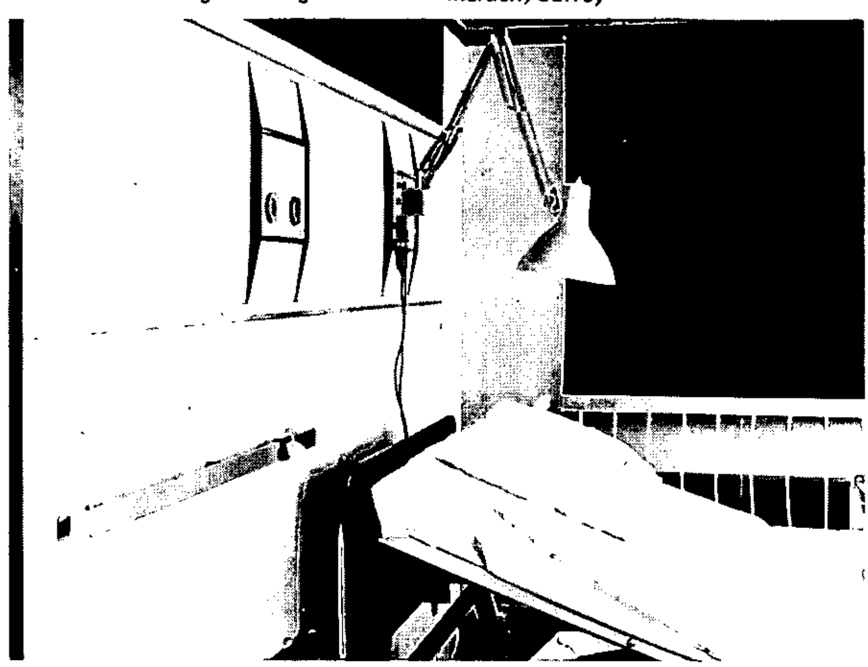
A 2-position switch provides automatic or night-prolong operation. The timeswitch can give a variety of programmes, allowing facilities such as 'early on', 'early off' or 'late off' to be selected.

*Landis & Gyr-Billman, Victoria Road, North Acton, London W3 6XS*

## Generating-set leaflets
Five 8-page full-colour leaflets are being produced by Auto Diesels Braby Ltd. They describe the complete range of diesel-driven generating sets and ground power units produced by the company. The first of this series describes the sets rated from 120 - 700 kVA.
*Auto Diesels Braby Ltd., Cowley Mill Road, Uxbridge, Middx. UB8 2QG*

# Product news

## Partitioning
A section of glazed partitioning incorporating all hospital bedhead services with a flush finish and yet giving immediate access has been developed by Clifford Partitioning Co. Ltd. in conjunction with Medishield (Harlow) Ltd. Available in modules of 2·4 m, with or without glazing, the system accomodates 300 mm wide service ducts which can be installed at any convenient point to enable services to be dropped from the ceiling void. Single side services may be installed in 150 mm wide wall, while the back-to-back installation is possible within a 225 mm width. Fire resistance is to a minimum of 0·5 h fire check and surface spread of flame to class O.
*Clifford Partitioning Co. Ltd., New Malden, Surrey*



# Unfortunately, yesterday's more easily solved than

As your catering budget shrinks, your problems begin to grow.

These problems can only be solved by forward planning and an efficient catering system. Your Electricity Board and the people at the Electric Catering Centre can help.

If you are considering leasing or investing capital in new equipment they can provide information on the best choice. Also on how to maintain it to protect your investment, and on how staff training can ensure its optimum use.

They can introduce you to catering systems that take account of everything from menu analysis to washing-up. And they know how to fit a refrigerator, freezer, boiling-top, fryer, griddle, Bain-Marie, work-top and eye-level grill into a compact modular 10-foot run.

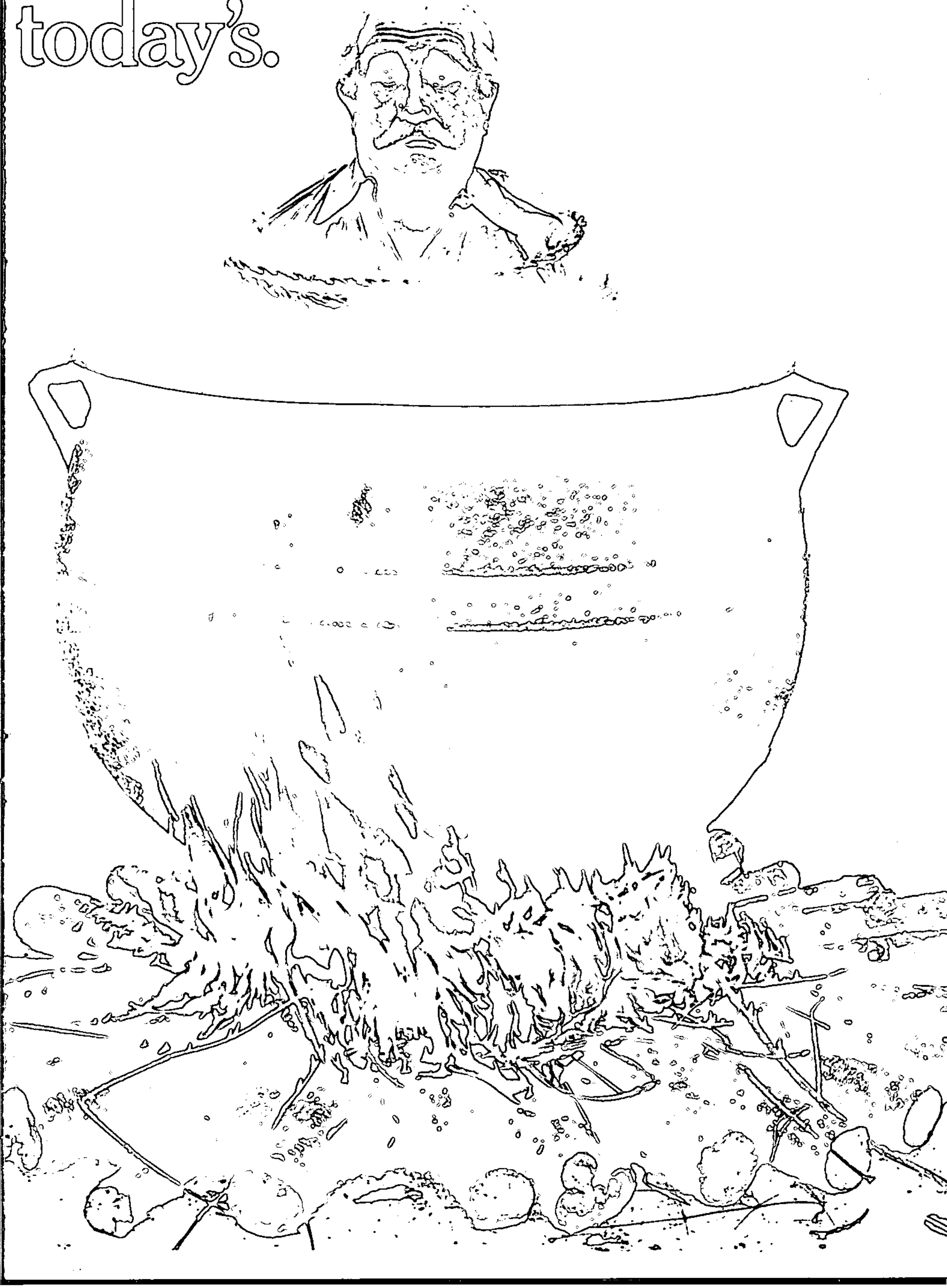
One of these proven systems could exactly match your needs and budget. If it doesn't, they'll sit down and work out one that does.

Their advice is free. And it's available through your Electricity Board or the Electric Catering Centre, 45 St. Martin's Lane, London WC2N 4EJ. Tel: 01-836 7337.

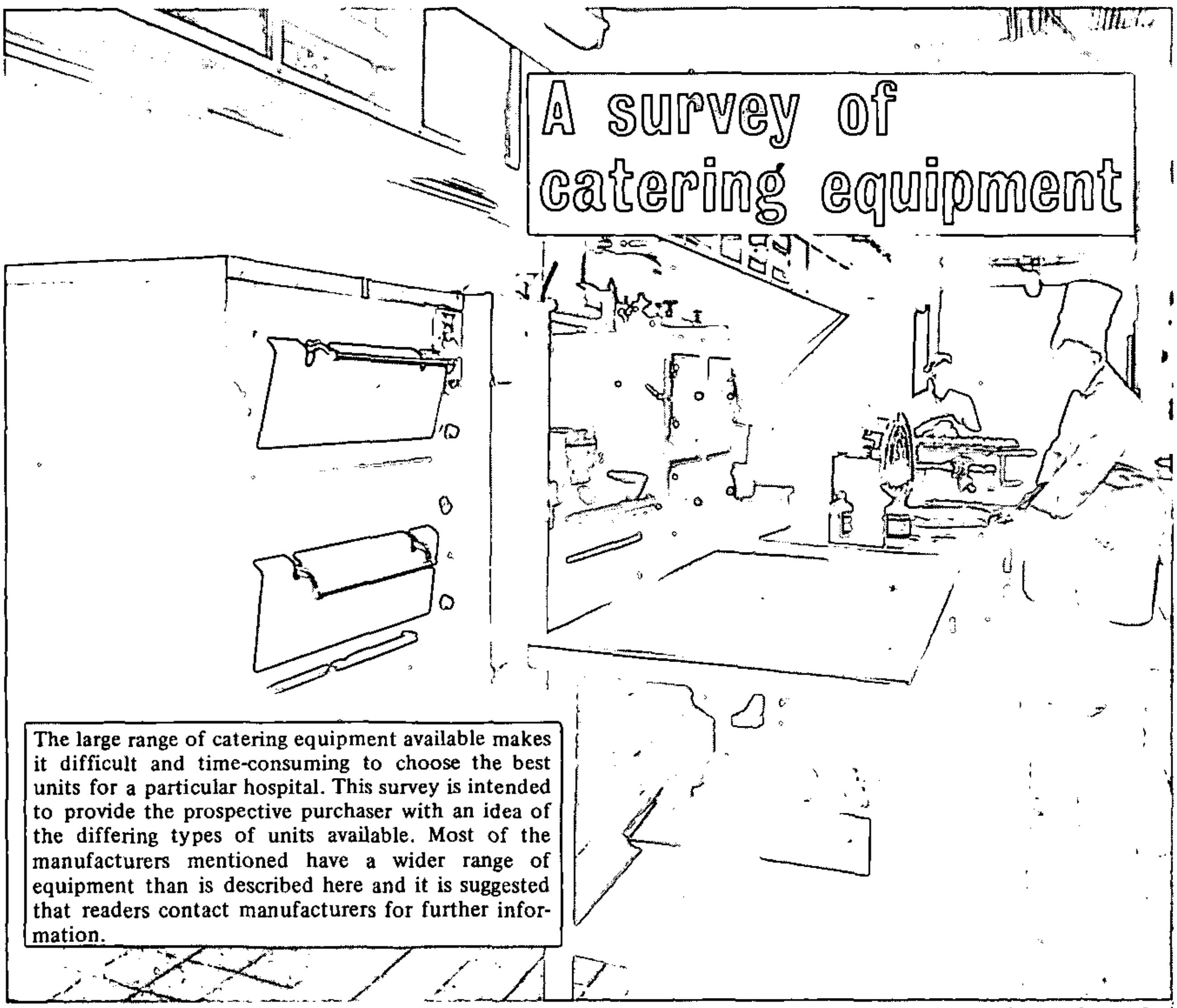
**CATERELECTRIC**

*The Electricity Council, England and Wales.*

catering problems were today's.



# A survey of catering equipment



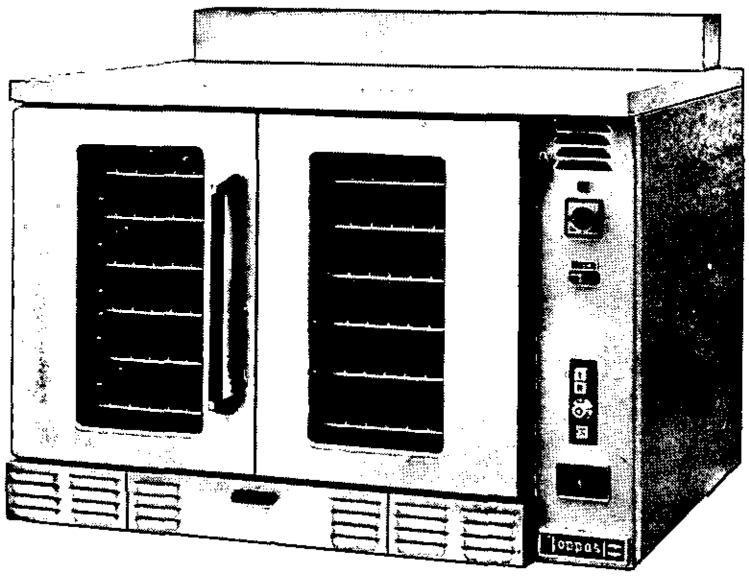
The large range of catering equipment available makes it difficult and time-consuming to choose the best units for a particular hospital. This survey is intended to provide the prospective purchaser with an idea of the differing types of units available. Most of the manufacturers mentioned have a wider range of equipment than is described here and it is suggested that readers contact manufacturers for further information.

*Addenbrooke's Hospital, Cambridge (photo: British Gas)*

## CONVECTION OVENS

| Manufacturer | Model | Fuel | Dimensions height mm | width mm | depth mm | Cubic capacity and electric loading |
|---|---|---|---|---|---|---|
| G.F.E. Bartlett, Maylands Avenue, Hemel Hempstead, Herts. | E7G1 | gas | 1575 | 1120 | 1170 | 0·28 $m^3$ single deck |
| | E7E1 | electric | 1575 | 1120 | 1170 | 0·28 $m^3$ single deck |
| | E9G | gas | 1740 | 990 | 770 | double deck |
| | E9E | electric | 1740 | 990 | 770 | 15 kW double deck |
| | other models available | | | | | |
| Benham & Son Ltd., 307 Merton Road, London SW18 | EFCO 200 | gas and electric | 1740 | 670 | 910 | 10·5 kW single deck |
| | EFCO 320 | gas and electric | 1740 | 900 | 990 | 21 kW single deck |
| Falcon Catering Equipment Ltd., Fourth Way, Wembley, Middx. | G1103 | gas | 850 | 900 | 770 | 0·12 $m^3$ single deck +6 - burner top |

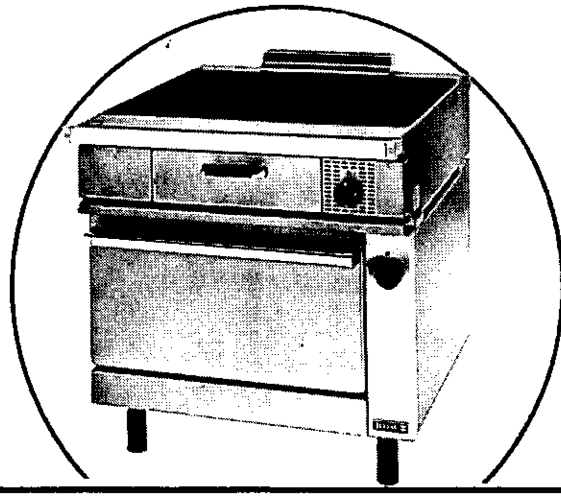
| Manufacturer | Model | Fuel | Dimensions height mm | width mm | depth mm | Cubic capacity and electric loading |
|---|---|---|---|---|---|---|
| Frialator International, | V10 | gas | 1575 | 965 | 1067 | single deck |
| 384 Finchley Road, | V20 | gas | 1753 | 965 | 1067 | double deck |
| London NW2 | V15 | electric | 1575 | 965 | 1067 | 11 kW single deck |
| | V25 | electric | 1753 | 965 | 1067 | 22 kW double deck |
| Garland Catering Equipment, | Blodgett | | | | | |
| Stone Close, | FAIDO | gas | 1753 | 965 | 940 | single deck |
| West Drayton, | GZL 20 | gas | 2083 | 965 | 1118 | double deck |
| Middx. | electric and other models available | | | | | |
| Moorwood Vulcan Ltd., | V007 | electric | 1488 | 1100 | 900 | 12•5 kW single deck |
| PO Box 16, | TAG7 | gas | 1438 | 1068 | 915 | single deck |
| Ecclesfield, | FDA | | | | | |
| Sheffield | | | | | | |
| | also available as 2-tier | | | | | |
| J. Stott & Son., PO Box 9, Vernon Works, Royton, Nr. Oldham, Lancs. | Straithaire | gas and electric | 419 | 914 | 756 | 4•5 kW per single deck oven |
| | also available in double- and treble-deck versions | | | | | |
| Oliver Toms Ltd., | Chefaire | | | | | |
| 222, Kensal Road, | Mk 111 | gas | 1485 | 835 | 875 | single deck |
| London W10 | | | | | | |
| Zoppas Catering Equipment Ltd., | 210 72 700 | gas | 1540 | 1000 | 1000 | single deck |
| 2 Crampton Road, | 210 776 42 | electric | 1540 | 1000 | 1000 | 12•8 kW single deck |
| Penge, London SE20 | | | | | | |




Zoppas gas convection oven

## RANGES

| Manufacturer | Model | Fuel | Dimensions height | width | depth | Oven | Tops |
|---|---|---|---|---|---|---|---|
| | | | mm | mm | mm | | |
| Benham & Sons, 307 Merton Road, London SW 18 | Mark IVa cuisine | gas | 870 | 921 | 953 | 1 | solid |
| | | | | | | 1 | four burners |
| | | | | | | 1 | six burners |
| | heavy duty | | | | | 1 | half griddle and two burners |
| | | | | | | 1 | griddle |
| | Meta 600 series medium duty | gas | 860 | 600 | 700 | 1 | four burners |
| | | | | | | 1 | two burners and half solid |
| | Meta 900 series medium duty | gas | 860 | 900 | 700 | 1 | six burners |
| | | | | | | 1 | four burners and half solid |
| | Portman type A | electric | 920 | 1040 | 810 | 6kW | 2 x 4·25 kW solid and 2 x 1·8 kW radiant |
| | Portman type B | electric | 920 | 1040 | 810 | 6kW | 3 x 4·25 kW solid |
| Corsair Heating & Catering Ltd., Dawes Court Works, High Street, Esher | CH16 | electric | 863 | 914 | 761 | 4·8 kW | 6 x 2·5 kW solid |
| | | | | | | 4·8 kW | 6 x 2·75 kW solid |
| Falcon Catering Equipment Ltd., Fourth Way, Wembley, Middx. | G1004U heavy duty | gas | 850 | 900 | 850 | 1 | four burners |
| | | | | | | 1 | solid |
| | G1104U medium duty | gas | 850 | 900 | 770 | 1 | six burners |
| | | | | | | 1 | solid |
| | G1109U medium duty | gas | 1505 | 900 | 770 | 1 | six burners |
| | | | | | | 1 | solid |
| | E1109 Heavy duty | electric | 910 | 900 | 815 | 5·2 kW | 3 x 3·5 kW solid |
| | | | | | | | 2 x 3·5 kW solid and 2 x 2 kW radiant |
| Frialator International, 384 Finchley Road, London NW2 | 136 heavy duty | gas | 914 | 813 | 914 | 1 | solid |
| | | | | | | 1 | fry tops |
| | | | | | | 1 | four burners |
| Moorwood Vulcan Ltd., PO Box 16, off Green Lane, Ecclesfield, Sheffield | Restaurant range medium duty 36 L-67 | gas | 927 | 914 | 775 | 1 | six burners or |
| | | | | | | 1 | two solid + griddle |



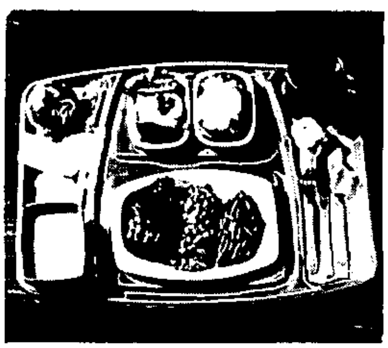
Zoppas solid-top range

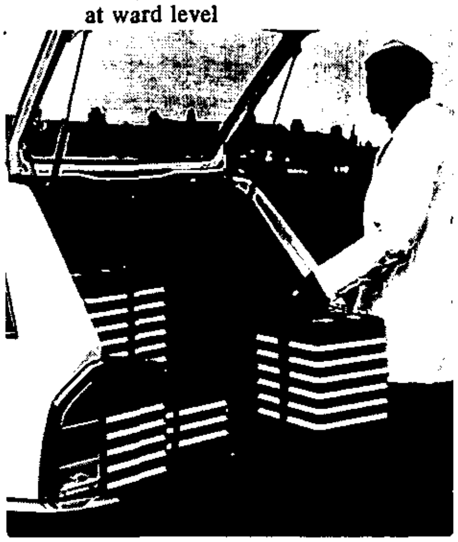
| Manufacturer | Model | Fuel | Dimensions height mm | width mm | depth mm | Oven | Tops |
|---|---|---|---|---|---|---|---|
| Moorwood Vulcan Ltd., (continued) | 60 L-67 | gas | 927 | 1524 | 775 | 2<br>2 | ten burners or<br>two solid + four burners and griddle |
| | 260L-67 | gas | 927 | 1594 | 775 | 2 | six burners + grill and griddle |
| | heavy duty | | | | | | |
| | 3645 A | gas | 864 | 864 | 927 | 1 | four burners |
| | 3845 A | gas | 864 | 864 | 978 | 1 | four burners |
| | 3630 A | gas | 864 | 864 | 927 | 1 | solid top |
| | 3830 A | gas | 864 | 864 | 978 | 1 | solid top |
| Smith & Welstood (GG) Ltd., Esse Works, 9, Staplehurst Road, London, SE13 | 635/SU | gas | 850 | 900 | 750 | 1 | solid |
| | 635/OU heavy duty | gas | 850 | 900 | 750 | 1 | four burners |
| J Stotts & Son., PO Box 9, Vernon Works, Royton, Nr. Oldham, Lancs | M 5031 | gas | 850 | 870 | 770 | 1 | six burners |
| | MCH 16 medium duty | electric | 762 | 914 | 864 | 1 | six plates<br>total loading 17·2 kW |
| | Strathearn heavy duty | gas | 864 | 914 | 927 | 1<br>1<br>1 | four burners<br>two burners + fry top<br>solid top |
| T I Catering Equipment Ltd., Fullerton Park, Ellerton Road, Leeds | Gold Choice 1050 E medium duty | electric | 920 | 1060 | 830 | 6 kW | 6 x 2 kW radiant rings |
| Zoppas Catering, Equipment Ltd., 2, Crampton Road, Penge, London SE20 | heavy duty | | | | | | |
| | 21 444 660 | gas | 860 | 840 | 950 | 1 | four burners |
| | 21 339 680 | gas | 860 | 840 | 950 | 1 | solid top |
| | medium duty | | | | | | |
| | 21 645 240 | electric | 860 | 840 | 950 | 1 | four plates<br>total loading 17·5 kW |

Note: in most cases the ovens and tops mentioned here can be supplied as separate units, and the ovens as 2-tier units.

## FOOD SERVICE SYSTEMS

| Manufacturer | Model | Type | Average load for 300 beds | Ancillary Equipment |
|---|---|---|---|---|
| C.H. Blackburn & Co Ltd., Stellex Works, Calne, Wilts. | Heatrex | heat store base, stainless-steel cover | 30-40 kW | 23 cm ceramic plates; conveyor or tray slide; mobile bain maries; heated mobile self-levelling dispensers for plates, covers, bases and bowls; trays; tray trolleys |
| Electrolux (Commercial Equipment Ltd.), Porters Wood, Valley Road, St. Albans, Herts. | Helitherm | semi insulated tray | 30-40 kW | square or oblong ceramic plates; insulated bowls; conveyor; mobile bain maries; heated plate dispensers; container carts; tray cabinets for 20/40 completed trays |
| Falcon Catering Equipment Ltd., Fourth Way Wembly, Middx. | Ganymede | heat store base, stainless-steel cover | 30-40 kW | 23 cm ceramic plates; conveyor; mobile bain maries; heated self-levelling dispensers for plates, bowls, bases and covers; trays; tray trolleys |
| Grundy (Teddington) Ltd., Somerset Road, Teddington, Middx. | Grundy-Finessa | heat store base, stainless-steel cover | 30-40 kW | 23 cm ceramic plate, tray conveyor; mobile bain maries; heated self-levelling dispensers for plates, bowls, bases and covers; tray trolleys |
| Regethermic UK Ltd., Devonshire House, 2 Devonshire Gardens, Chiswick, London W4 | Regethermic | cooked chilled food, reconstituted at ward level | 5·4 kW per 20 bed unit | bulk aluminium, ceramic, or disposable dishes; 10-20 portions; individual ceramic plates; stainless-steel covers; conveyor belt; mobile trolleys; accelerated chiller for cooked food (Foster); infrared cabinets for reheating meals on wards; mobile carts |
| Temp-Rite International Ltd., Bristol Road, Greenford, Middx. | Temp-Rite Trays | fully insulated tray | 15 kW | optional conveyor or table; disposable or ceramic dishes; mobile bain maries; trolleys; stack carriers; straps |



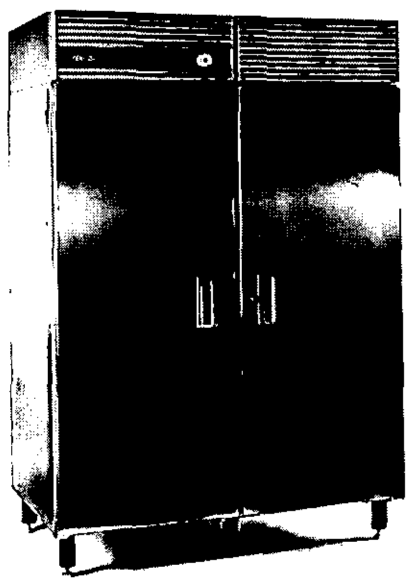


Temp-Rite meals service trays

| Manufacturer | Model | Type | Average load for 300 beds | Ancillary Equipment |
|---|---|---|---|---|
| Temp-Rite International Ltd. (continued) | Temp Tainer | fully insulated bulk food container | nil | half- or full-size gastronorm pans or aluminium foil liners |
| Zoppas Catering Equipment Ltd., 2 Crampton Road, Penge, London SE20 | Dieta | heat store base, stainless-steel cover | 30-40 kW | conveyor belt; mobile wet bains marie; heated self-levelling dispensers for plates, bases and covers; trays; tray trolley; special 'Dieta' ceramic plate |

REFRIGERATORS AND FREEZERS

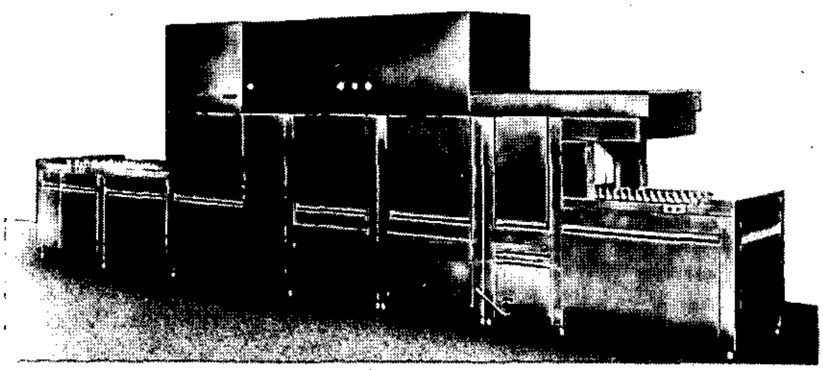
| Manufacturer | Model | | Dimensions height | width | depth | Cubic capacity |
|---|---|---|---|---|---|---|
| | | | mm | mm | mm | $m^3$ |
| Foster Refrigeration Ltd., | GH-20-T | fridge | 2110 | 724 | 746 | 0·57 |
| Old Meadow Road, | GH-45-T | fridge | 2110 | 1450 | 746 | 1·30 |
| Kings Lynn, Norfolk | GL 20 ADT | freezer | 2110 | 724 | 746 | 0·57 |
| | GL 45 ADT | freezer | 2110 | 1450 | 746 | 1·30 |
| | | other models available | | | | |
| Sadia Aerofreeze Ltd., | H220 | fridge | 2022 | 775 | 819 | 0·60 |
| High Street, Yiewsley, | L220 | freezer | 2022 | 775 | 819 | 0·56 |
| West Drayton, Middx. | | | | | | |
| | | other models available | | | | |
| Zoppas Catering Equipment Ltd., | 43 411 811 | fridge | 2000 | 700 | 800 | 0·68 |
| 2, Crampton Road, | 43 412 811 | fridge | 2000 | 1400 | 800 | 1·36 |
| Penge, London SE20 | 43 413 811 | freezer | 2000 | 700 | 800 | 0·68 |
| | 43 513 811 | freezer | 2000 | 1400 | 800 | 1·36 |
| | | other models available | | | | |



Zoppas refrigerator

## DISHWASHERS

| Manufacturer | Model | Type | Fuel | Dimensions (Exterior) height | width | depth | Output per hour |
|---|---|---|---|---|---|---|---|
| | | | | mm | mm | mm | |
| Crypto Peerless Ltd., | KP1500 | S | any | | | | |
| Kings Norton, | 1LR | C | any | 1626 | 651 | 1473 | 194 racks |
| Birmingham | 2LR | C | any | 2642 | 651 | 1473 | 240 racks |
| | F2LR | F | any | 5232 | 651 | 1473 | - |
| | F1LR | F | any | 4216 | 651 | 1473 | - |
| Dawson MMP Ltd., | AA | SA | any | 1495 | 765 | 673 | 55 racks |
| Abbey Works, | BPF | C | any | 1524 | 1808 | 685 | 6000 pieces |
| Waltham Cross, | CAPF | C | any | 1498 | 800 | | 10 000 pieces |
| Herts. | CAR | R | any | 4268 | 1537 | | 10 000 pieces |
| | Deluge | F | any | 6096 | 1320 | | 6300 pieces |
| | Plongette | | E | 2028 | 2388 | 1791 | panwash |
| Hobart Manufacturing Co. Ltd., | LE4C | SA | any | 651 | 648 | 1276 | 45 racks |
| Hobart Corner, | AME & AMEC | SA | any | 651 | 648 | 1276 | 55 racks |
| New Southgate, | CS183 | C | any | 1498 | 635 | 1830 | 150 racks |
| London N11 | CCS239 | C | any | 1498 | 635 | 2390 | 220 racks |
| | FT3E-521 | F | E or S | 1680 | 796 | 5210 | 5 ft per min. |
| | CD-A-1(1-B-2) | | E or S | 1520 | 1680 | 540 | condenser and energy feedback unit |



Stierlen BTM 5000 with heat-recovery pump

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Turmix (GB) Ltd., Stierlen Dishwashers | KM500 | SA | E | 850 | 604 | 585 | 700-1000 plates |
| Turmix (GB) Ltd., | BTM5000 | F | E | 7140 | | | 5000 plates |
| Turmix House, | SPW750 and 1000 | | | | | | heat-recovery pump can be fitted to a number of machines in the BTM series |
| Zoppas Catering Equipment Ltd., | 60 042 240 | S | E | 600 | 750 | 1380 | 760 plates |
| 2 Crampton Road, | 60 050 740 | S | E | 670 | 760 | 1400 | 1000 plates |
| Penge, London SE20 | 60 047 170 | C | E or S | 1500 | 690 | 1430 | 1300/2000 plates |
| | 60 150 840 | F | E or S | 5400 | 830 | 1480 | 2650/4000 plates |

All manufacturers make other models

Key

| | | | |
|---|---|---|---|
| | R rotary | S steam | E electric |
| S stationary | SA semiautomatic | F flight | C conveyor |

# HE Book news

**IEE medical electronics monographs 13-17** edited by D.W. Hill and B.W. Watson
Peter Peregrinus Ltd., 1975, 182pp., £8.50

In line with the policy adopted for the previous two volumes this third work contains a broad spectrum of subjects of current interest and practical importance in medical electronics and instrumentation.

The authors have produced a well written book of some half-dozen monographs covering a variety of subjects that are of interest to a wide range of people involved in the field of medical electronics.

The illustrations included are clear and easily understood and the use of mathematical formulas is kept to a minimum without missing out any necessary information. A comprehensive list of references is given at the end of each section for readers who require more technical detail on a particular subject.

This book will be a valuable source of reference to doctors, physicists, engineers and technicians.

**An introduction to heat pumps** by John A. Sumner
Prism Press, 1976, 55pp., £1.25 (paper), £3.50 (cloth)

*An introduction to heat pumps* explains very clearly and most fully the basic principles behind the operation of heat pumps, and the manner in which they can be used, by answering a number of very simple questions.

It is interesting to recall that in January 1975, *The Times* published a letter by the author, John A. Sumner, in which he described the operation of the heat pump he installed in his house in 1960. The letter at that time provoked a considerable number of inquiries. What is a heat pump? How does it work? What will it save in fuel and money? Where can I get one? This book not only aims to answer all these questions concisely, but it succeeds in doing so in a most down to earth and informative way.

Admittedly the book, even in paperback, is rather expensive, but one's interest is immediately raised on reading the 'contents' page, the chapters being listed in the following order: What is a heat pump?; Why should I use a heat pump?; What is the 'efficiency' of a heat pump?; What types of heat pump are available?; How should I choose a heat pump?; How can I obtain ambient heat?; Can I use a heat pump on 'off peak' electricity rates?; How would you design an efficient heat pump?; What should a heat pump cost?; What guarantees can I expect?; What life can I expect of my heat pump?; Can I use a heat pump with my existing heating system?; Where can I acquire a heat pump?; Definitions of 'efficiencies'.

In simple terms, a most interesting book.

**Handbook of environmental control. Volume 5—Hospital and health care facilities** by Conrad P. Straub
CRC Press (Ohio, USA), 1975, £28

In contrast to the first four volumes of the *CRC Handbook of environmental control*, which were concerned primarily with the macroenvironment - air, water, and land (solid wastes—this fifth volume is concerned with the microenvironment—hospital and health care facilities. As in the previous volumes selected, relevant data have been well collected and tabulated. The data presented provide information on the hospital environment, indicating microbiologic aspects, disinfection and cleaning techniques, ventilation, toxic agents, radiological health, noise, safety, food hygiene, solid wastes, liquid wastes, and water supply.

The information in this volume should be of considerable use to works officers, administrators, environmental practitioners, medical staff, nurses, engineers, building officers, laboratory personnel and others concerned with the basic principles of environmental health and safety in hospitals, health centres and healthcare facilities. It is most satisfactory to read a book of this nature which is designed in a logical sequence.

R.G. Smith

# SYMPOSIUM

## Secure units for abnormal offenders

As a result of recommendations made by the Butler Committee on abnormal offenders the National Health Service is required to provide units that can offer security. The Department of Health & Social Security has emphasised the urgency for these units in the consultative document 'Priorities for health and personal social services in England' by making special finance available for them. The operational policies for these units are currently being debated, and architects and engineers are also debating the way in which these policies can best be accommodated.

The Institute of Hospital Engineering hopes to help the design professions and those responsible for the maintenance of the units reach conclusions about desirable solutions at a symposium to be held on the 20th October 1976 at the Institution of Mechanical Engineers in London, at which it is intended that the discussions will be led by a doctor, an architect and an Engineer.

Members please note that the leaflet giving full details of the symposium and incorporating an application form will be distributed in the September issue of *Hospital Engineering*.

# 9th ANNUAL GENERAL MEETING

The 9th Annual General Meeting of the Institute was held at the Royal Hotel, Norwich, on the 30th April 1976, where the President F.H. Howorth presided.

### Council report and financial accounts

The President proposed that, with the consent of the meeting, the report of the auditors be taken as read. This was agreed unanimously.

The President proposed, seconded by B.G.B. Lucas, that the report of council and the audited accounts of the Institute for the year ended the 31st December 1975 be received and adopted. This was also carried unanimously.

### Elections to Council

The President confirmed that, in accordance with the Articles of Association, the following members of Council would retire at the conclusion of the meeting:

K.W. Ashton
  area member, Midlands
J.W. Barnes
  area member, Southern and South West
J. Cadenhead
  area member, Scotland
K.J. Eatwell
  general member
W. Carr
  nominated member

The President announced that the following, being the sole nominees in their respective categories, were elected to Council unopposed:

K.W. Ashton
  area member, Midlands
J.W. Barnes
  area member, Southern and South West
J. Cadenhead
  area member, Scotland
W. Carr
  Nominated member

The President then called upon the Secretary to open the sealed envelope containing the auditors letter giving the result of the ballot for the election of a general member of Council, which sealed letter revealed that K.J. Eatwell was the successful candidate.

### Special business

The President moved, on behalf of Council, the following special resolution: 'That the Articles of Association be altered by deleting from Article 97 the words 'four months' and substituting therefor the words 'five months'. J.R. Harrison seconded and the resolution was carried unanimously.

### President's remarks

The President spoke of how he had enjoyed his first year of office. Mr. Howorth said the year had been marked with an element of sadness with the ending of the courses staged at the University of Keele by the Institue. To fill the gap left by the cessation of these courses, Council had staged additional 1-day symposia at various venues. These had been extremely well supported, were obviously popular and clearly met a need and Council would continue this policy for the immediate future. Mr. Howorth referred to the writing of technical papers and the value to be obtained from such an exercise, quite apart from the information disseminated in this way, and called for renewed efforts to increase the flow of papers and articles for publication in the Institute journal.

The President concluded by thanking members of Council for their considerable efforts and contribution during the year.

### Vote of thanks

B.G.B. Lucas spoke of the responsibilities placed upon a president and of how much Mr. Howorth had given to the office during his first year. These sentiments were warmly received by all present.

## Northcroft Silver Medal

The Northcroft Silver Medal for 1975 has been awarded to George Tuson for his paper 'The art of public speaking' which appeared in the July 1975 issue of *Hospital Engineering.*

George Tuson is with the Wessex Regional Health Authority and is well known throughout the hospital service particularly, perhaps, through his contributions as a tutor on the Keele Courses over the years.

# HE Institute news

It is intended that the presentation of the award will be made by the donor, L.G. Northcroft, Past President of the Institute, at one of the major functions of the Institute during the year.

## BRANCH OFFICERS

The following Branch Officers have been elected for the forthcoming year:

Midlands branch

Chairman: R. Watson
Vice Chairman: R.J. Chatwin
Honorary Secretary: R.G. Taylor, 55 Chichester Drive, Quinton, Birmingham B32 1BG

Southern Branch

Chairman: P.W. Webb
Vice Chairman: N.P. McNeill
Honorary Secretary: D.R. Wilson, 5 Orchard Gardens, Fordingbridge, Hants.

## WEST OF SCOTLAND BRANCH

On the 22nd April 1976 a large turnout of the membership attended the last meeting of the session to hear A. Peters and T. Terry talk on maintenance management in the reorganised service. The speakers, both of whom are area maintenance managers in Scotland, outlined the problems associated with their areas, the Argyll & Clyde Health Board and the Lanarkshire Health Board, respectively, and discussed how they saw the role of the area maintenance manager.

A major problem with these areas was the disproportionate spread of population from one district where the density could be 1000 or more per square kilometre to another, where the density was as low as 7 per square kilometre. The extra workload resulting from the takeover of local authority clinics and premises has been considerable, but this was being met by a combination of direct labour and contract labour, with specialised experts being available from key points.

When the building/engineering management structure for the areas under discussion was being established, a volume of 90000m$^3$ was used as the criteria for defining an engineering unit, with a slightly higher volume for a building unit. The resultant structure was comparable with the existing engineering organisation but there were likely to be problems when staffing the proposed building structure.

Communications and the transportation of personnel was a problem in the sparsely populated areas, where the health boards were responsible for water supplies from their own dams and electricity supplies from their own generators. The provision of radio telephones for key personnel was going ahead in the medical field to improve communications but with more vehicles and caravans being used as mobile clinics, the problems of maintaining the communications network and a dispersed vehicle fleet became more acute.

After a short break for coffee, the speakers answered a variety of questions from branch members on lines of communication through the organisation, multidisciplinary tradesmen, storage of materials in remote areas, accountability for expenditure of public money on maintenance, whether the professional engineer was also a professional manager and the relationships between the area maintenance manager and personnel and other specialist departments.

The Chairman reluctantly called question time to an end by proposing a vote of thanks to the speakers and the meeting closed shortly afterwards with a vote of thanks to the Chair.

## SOUTHERN BRANCH

The branch has arranged the following meetings:

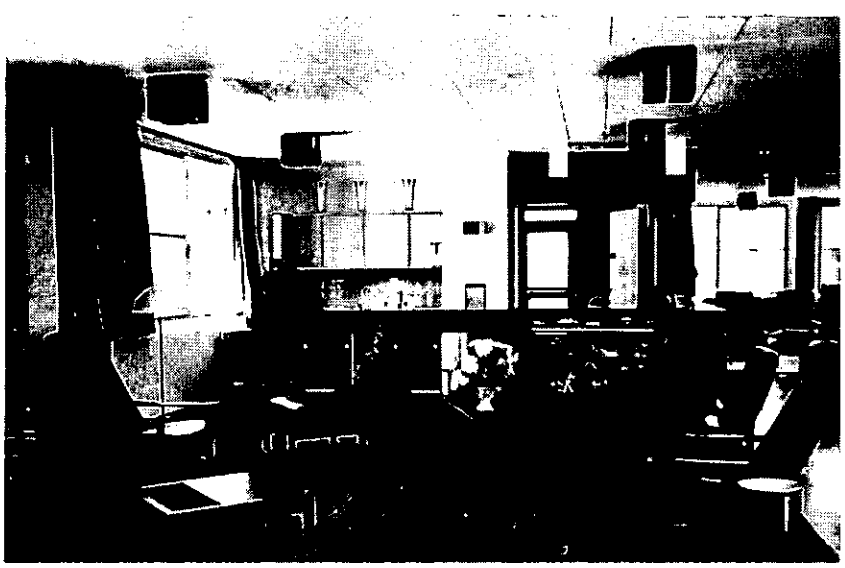
| | | |
|---|---|---|
| **1976** | | |
| 21st July | Southampton University Hospital | Committee Meeting |
| 18th September | Queen Alexandra Hospital, Portsmouth | Visit to IBM Havant |
| 13th November | Christchurh Hospital | 'Gas turbines' by Cmdr. Bradshaw, R.N. |
| **1977** | | |
| 8th January | Royal Hampshire County Hospital, Winchester | 'Steam utilisation and energy conservation' by Spirax Sarco |
| 12th March | Southampton University Hospital | 'Development of radio therapy equipment' by Mr. Orchard, Principal Physicist, Wessex Radiotherapy Centre |

## HE News

# New care unit

Her Majesty Queen Elizabeth the Queen Mother officially opened Cynthia Spencer House, a continuing-care unit at Mansfield Hospital, Northampton, on 5th May 1976. The single-storey building has a floor area of 800 m$^2$ and stands in the same complex as the Mansfield Hospital Young Disabled Unit. The interior layout provides four open-plan 5-bed wards, five 1-bed rooms, specially equipped bathrooms and w.c.s, a consultants room, a treatment room, an overnight-stay room, pantry and kitchen facilities, large day-rooms areas and internal garden courtyards.

The building was designed for the National Society for Cancer Relief by the Regional Architects Department of the Oxford Regional Health Authority and CED Building Services were the main contractors. It is one of five in England and Scotland which the Society is having built using the 'Oxford method' of industrialised building.



# Conference on public purchasing

Cost effectiveness in public purchasing is the theme of a 1-day regional conference organised by the Institute of Purchasing & Supply. The conference is being held at the Saxon Inn, Huddersfield on July 15th, 1976.

Sessions will include:

Resource management in local-authority supplies
*Speaker*: S. Swallow, director of supplies, Greater London Council

The interface between the DHSS and other public bodies
*Speaker*: G.E. John, director, health-service supply branch, DHSS.

Public procurement and the national interest
*Speaker*: H. Leadbeater, controller of supplies, Property Services Agency, DOE.

Problems of tendering
*Speaker*: M.J. Miller, managing director, Blakdale - NSE Ltd.

Councillor J. Megahy, a lecturer in economics at Leeds University, will deliver the opening address and further information may be obtained from Mrs. C. Moalong, Institute of Purchasing & Supply, York House, Westminster Bridge Road, London SE1 7UT.

# Classified Advertisements

OFFICIAL APPOINTMENTS
SITUATIONS VACANT
COURSES, EQUIPMENT ETC.

To place an advertisement in this section, please write or telephone:
Classified Advertisement Department, *HOSPITAL ENGINEERING*
Peter Peregrinus Ltd.
Station House, Nightingale Road,
Hitchin, Herts. SG5 1RJ, England
Telephone: Hitchin (s.t.d. 0462) 53331, ext. 283

## APPOINTMENTS AND SITUATIONS VACANT

EALING, HAMMERSMITH AND HOUNSLOW AREA HEALTH AUTHORITY (TEACHING)

**EALING HEALTH DISTRICT**

### HOSPITAL ENGINEER

to be responsible to the District Works Officer for the Engineering services at St. Bernard's Hospital, Southall, Middx. (1600 beds approximately).

Salary scale - Basic £3615 - £4140 + Earnings supplement £312
London Weighting £312
Bonus 15% of basic
£108 special responsibility allowance.

In addition to having served an Engineering Apprenticeship applicants must have a sound knowledge of mechanical and electrical plant and experience of its maintenance, and possess an appropriate qualification.

Application form and job description obtainable from District Personnel Office, St. Bernard's Hospital, Southall, Middx. UB1 3EU. Tel: 01-574 8141 Ext. 106.

Closing date for applications: 16th July 1976

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LANCASHIRE AREA HEALTH AUTHORITY
BLACKBURN DISTRICT
QUEEN'S PARK HOSPITAL

ASSISTANT ENGINEER

Due to the promotion of the present holder a vacancy exists for an engineer wishing to start a career in hospital engineering.

Duties will primarily be concerned with assisting a Hospital Engineer in the day to day maintenance and the operation of engineering plant in Health Service properties within the District. The post will be based initially at Queens's Park Hospital, but the successful applicant may be required to work in other units within the District.

Qualifications: ONC in Mechanical or Electrical Engineering or an equivalent approved qualification.

Salary : £3063 - £3507 per annum.

Application forms and job description available from the District Personnel Officer, Health District Central Offices, Queen's Park Hospital, Blackburn.

Closing date 12th July, 1976

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**DORSET AREA HEALTH AUTHORITY**

EAST DORSET HEALTH CARE DISTRICT
POOLE GENERAL HOSPITAL, LONGFLEET ROAD, POOLE, DORSET, BH15 2JB

### ASSISTANT ENGINEER (ELECTRICAL)

Applications are invited for the post of Assistant Engineer (Electrical) to be directly responsible to the Hospital Engineer for the efficient operation and maintenance of all engineering plant and services within the Hospital and associated units.

Applicants must have served a recognised apprenticeship, preferably in electrical engineering and be qualified at least to ONC standard or equivalent. Salary on the scale £3063-£3507 per annum.

Application forms and job descriptions from the Sector Personnel Officer.

Closing date 14 days after the appearance of this advertisement.

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EALING, HAMMERSMITH AND HOUNSLOW AREA HEALTH AUTHORITY (TEACHING)

**SOUTH HAMMERSMITH HEALTH DISTRICT (T)**

**Charing Cross Hospital**

### ASSISTANT BUILDING OFFICER £3009 - £3414

Applicants must have relevant experience in the building industry, the supervision of staff, and should hold an Ordinary National Certificate in Building or equivalent qualification.

The person appointed will assist in the supervision of a wide range of maintenance tasks in the District. The duties will include general maintenance responsibilities and preparation of drawings and specifications.

Informal visits to the Department may be arranged through the District Building Officer, Mr. John Bullen (tel: 01-741 0517) and closing date for return of completed application forms is the 12th July 1976.

**Job descriptions and application forms are available from Heather Dann, District Personnel Department, Charing Cross Hospital, Fulham Palace Road, London, W6 8RF (Tel: 01-748 2040 ext. 2997).**

## CLASSIFIED ADVERTISEMENTS *continued from previous page*

### APPOINTMENTS AND SITUATIONS VACANT

SOUTH WEST THAMES
REGIONAL HEALTH AUTHORITY

# SITE ENGINEER I

**£4680–£5940**

**+ £312 London Weighting**
**ST. GEORGE'S TEACHING HOSPITAL**

An experienced engineer is required as member of the team set up to supervise the installation of the mechanical services to this new teaching hospital complex. This is a multi-million pounds project and only those capable of meeting the challenge of this post should apply.

Applicants must have wide practical experience and a good knowledge of engineering standards and formal testing procedures.

Qualifications:
Apprenticeship, plus Ordinary National Certificate (Mechanical) with 5 years' experience as a Clerk of Works or Supervisor, or Apprenticeship with 10 years' experience as Clerk of Works or Supervisor.

Application form from Personnel Officer (S2), 40 Eastbourne Terrace, London W2 3QR. Completed forms to be returned by the 23rd July.

THE CITY AND EAST LONDON
AREA HEALTH AUTHORITY
(TEACHING)
ASSISTANT ENGINEER–WORKS DEPT.

Applications are invited for the post of Assistant Engineer based at Area headquarters. Initially, duties will involve assisting with a programme of project work and, depending on the candidate's ability and experience, these will include the management of certain projects. At a later stage, the duties will become more concerned with the implementation of the principles of Estate Management.

Candidates must have completed an apprenticeship or have otherwise acquired a thorough practical training. Minimum qualification is O.N.C. or equivalent; a higher qualification will be an advantage.

Salary scale: £3375 to £3819 inclusive

For further information please ring the Area Works Officer, telephone 01-253-3020 Ext. 341. Application form and job description available from the Area Personnel Department, The City and East London Area Health Authority (T), Addison House, 32/43, Chart Street, London, N1 6EF. Closing date: 23rd July 1976.

**Sex Discrimination Act**

No appointment advertisement which indicates or can reasonably be understood as indicating an intention to discriminate on grounds of sex (e.g. by inviting applications only from males or only from females) may be accepted, unless

(1) the appointment is for the purpose of a private household or
(2) it is in business employing less than six persons or
(3) it is otherwise excepted from the requirements of the Sex Discrimination Act

A statement must be made at the time the advertisement is placed saying which of the exceptions in the Act is considered to apply.

HEREFORD
HEALTH DISTRICT

# SECTOR ENGINEER

**required for Central Sector**

Applications are invited for the above vacancy from suitably qualified personnel already employed within the National Health Service in England and Wales.

The successful candidate will be responsible for the engineering maintenance of the County Hospital (362 beds); General Hospital (143 beds); Victoria Eye Hospital (25 beds); Tupsley Hospital (32 beds); 2 Clinics, associated staff houses, Headquarters Offices and the Ambulance Station; together with other technical duties on a District-wide bases as required by the District Engineer.

Salary £4371 per annum rising by annual increments to £5262 per annum.

Further details together with application forms and job description may be obtained from the District Works Officer, 24. St James Road, Hereford.

Completed application forms to be returned by the 23rd July 1976.

### EQUIPMENT

STEAM PACKAGED
**Boilers**
2,000–25,000 lb/hr.
Short and long term hire available throughout the United Kingdom.

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