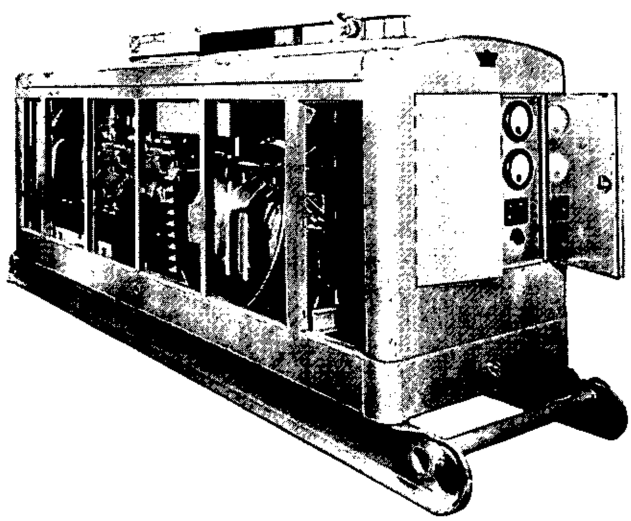
Hospital Engineering

The Journal of the
Institute of Hospital Engineering

Vol. 24 October 1970

Incorporating 'The Hospital Engineer'

HIRE FROM COHENS



PACKAGED GENERATOR SETS

Packaged skid mounted ROLLS ROYCE and FORD diesel engine driven Generating Sets. Wound for 400/440 volts 3 phase 50 cycles supply in the following sizes:- 10KW. 16KW. 24KW. 36KW. 60KW. 90KW. 136KW 180KW. 200KW.

ALSO AVAILABLE

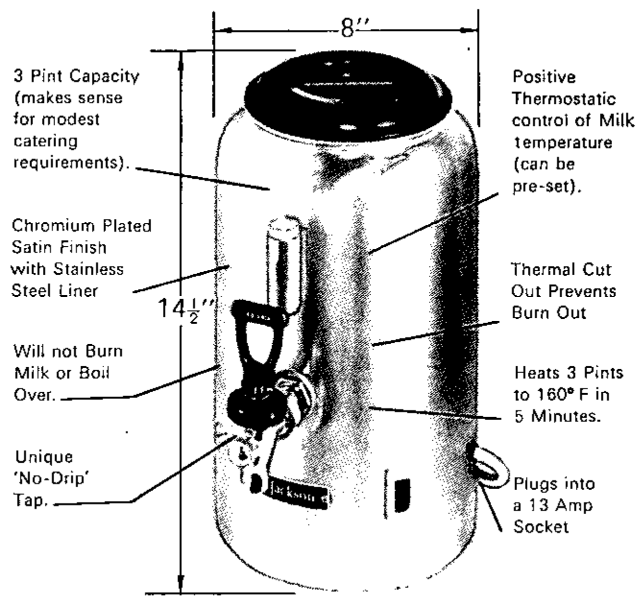
CRANES · BOILERS · WELDERS · COMPRESSORS · FORK LIFT TRUCKS

GEORGE COHEN MACHINERY LTD.

HIRE DIVISION

Wood Lane, London, W1.2. Telephone 01-743 2070 Grams: Omniplant, London.

The Jackson Mini Milk Heater



at £39 isn't it just what you've been looking for?

Jackson Milk Heaters are also available (in 1, 2, 4 or 6 gallon sizes). For full details and literature on the range please use the coupon below.

Please send me full details on the Jackson Mini Milk Heater. ☐ The Full Range of Jackson Milk Heaters. ☐ (Tick where applicable).

Name ....

Firm ....

Address ....

....

Post to :- Jackson Boilers Ltd., Fullerton Park, Elland Road, LEEDS LS11 OHF. Tel. 0532-76673

Jackson Boilers

A Radiation Company

Member of the Catering Equipment Manufacturers Association

'Hospital Engineering'
is published monthly by
Peter Peregrinus Limited,
PO Box 8, Southgate House,
Stevenage, Herts., England
(Member of ESIP)

Individual copies cost 10s.
(postage paid)

The annual subscription is £5

Hospital Engineering Vol. 24 October 1970

Incorporating 'The Hospital Engineer'

The Journal of The Institute of Hospital Engineering

All correspondence relating to the Journal should be addressed to:
Hospital Engineering,
Peter Peregrinus Limited,
PO Box 8,
Southgate House,
Stevenage, Herts., England
Telephone: Stevenage 3311
(s.t.d. 0438 3311)

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

Secretary
J. E. Furness, V.R.D.

Contents

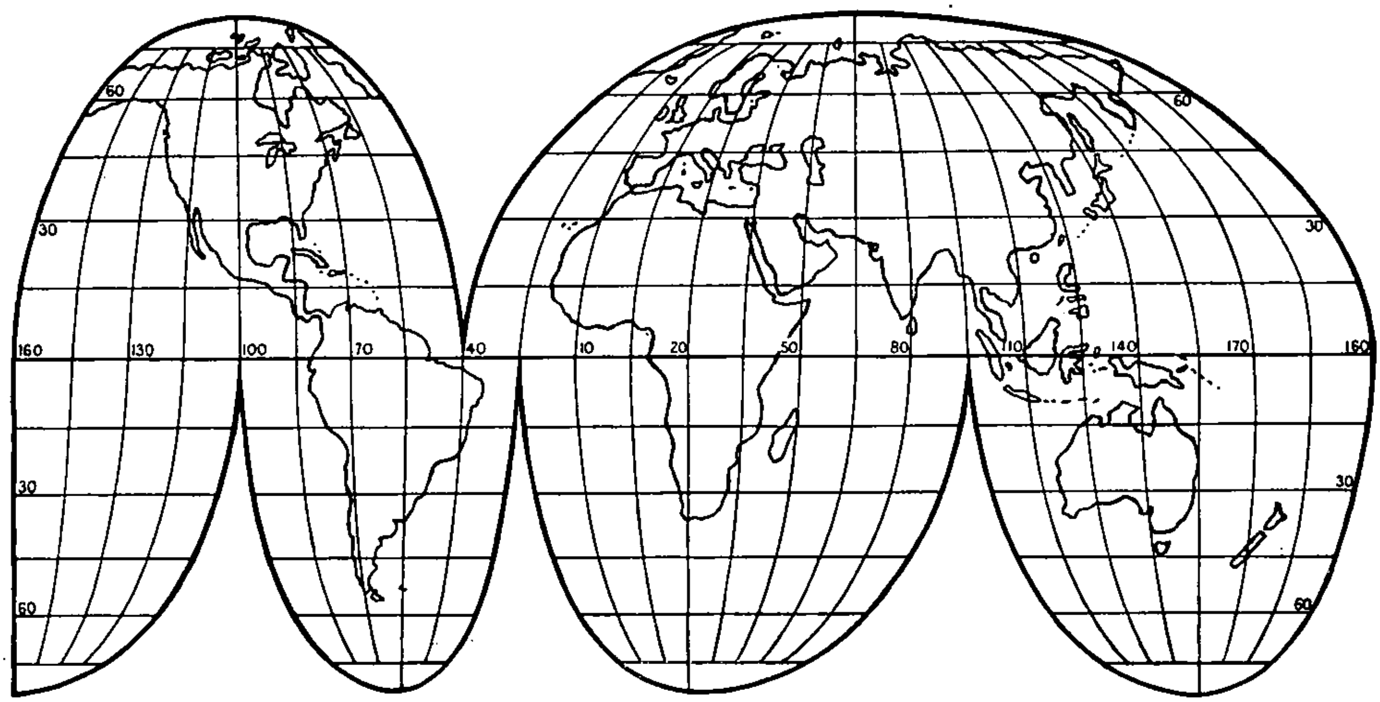
Special Features

News Features

Departments

Encircle HE7 on reply card for further information

Thackray Autoclaves?



ask the users!

Which, unless you have a few months to spare for globetrotting, is a near impossible task.

Because Thackray Autoclaves are efficiently going about their jobs throughout the world.

In any case you'd only find out what you're about to find out now.

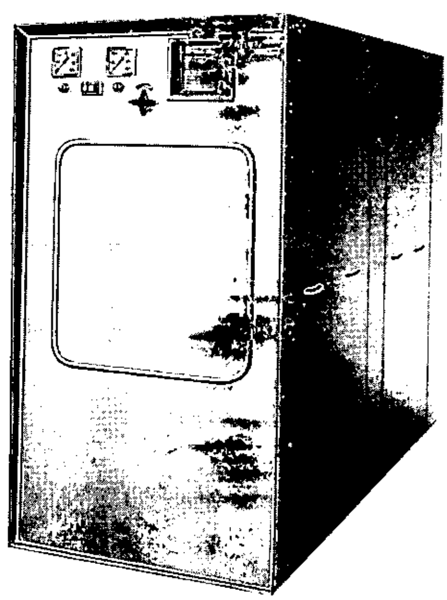
That Thackray make a range of Autoclaves to deal with virtually any sterilising requirement.

That Thackray Autoclaves are clean, functional and modern in design.

That they are coping with the heaviest work-loads quickly and efficiently.

That their routine maintenance is made easy by the accessibility of components.

That their reliability makes major servicing a rarity.



Rapid Cooling Fluids Autoclave for Bottled Solutions

That their well planned controls make for simple operation.

That Thackray Autoclaves feature the "Autoclam" sliding door incorporating a unique principle — probably the most efficient door seal available.

So unless you're planning a world cruise anyway, put away the travel literature and contact Thackray for their literature on the full range of Autoclaves.

CHAS. F.
THACKRAY
LIMITED

P.O. BOX 171, PARK STREET,
LEEDS LS1 1RQ. Tel: 0532 20085
Also at London & Glasgow.

Not the cheapest-but the Best!

Hospital Engineering

Vol. 24
October 1970
Pages 213-232

27th Annual Conference

TOTAL ENERGY

Part 1

by R. MANSER B.Sc.(Eng.), C.Eng., F.I.Mech.E., F.I.E.E.

Total energy is one of the 'in' subjects of the moment. It essentially implies the provision of all energy supplies to a building, or complex of buildings, from a single fuel source. Lecturers are fond of quoting the human body as the first example, but perhaps better for engineers is the car, with petrol as its fuel, a prime mover supplying not only motive power for the car but an electric dynamo or alternator for lighting and auxiliaries, and with waste-heat recovery from the engine jacket for car warming in the winter (plus in the case of the consulting engineer a refrigeration plant in the boot providing cooling for summer use). In the classical sense there are examples going quite a long way back in engineering history involving reciprocating engines and steam turbines used either as back-pressure or passout units. Fairly recently there has been a new technique using gas turbines as prime movers firing into waste-heat boilers.

A major reason for the resurgence of interest in this subject has been the changed relative availabilities of fuels and their costs. In particular, the availability of natural-gas supplies at prices, for bulk users, competitive with heavy oil has caused a marked interest in the dual-fuel engine and, more particularly, in the gas turbine, both of which employ natural gas. In addition, people have been looking again with interest at American practice, since there natural gas has been available in larger quantities for some considerable time, and it is calculated that a third of the total energy requirement of that country is supplied from natural gas.

I propose to treat the subject from the special viewpoint of hospitals which are now on the drawing board, and those which we see as setting the pattern for the future. I will deal first with the special needs of hospitals; secondly with the available techniques, prime movers and fuels; thirdly with the economic case, here dealing with a naturally ventilated 600-bed hospital of the kind currently regarded as a standard district general; and finally with a large deep-planned and air-conditioned hospital of 1200 beds which many would regard as typical of a teaching hospital. Under the final two headings I will first cover the special additional considerations which weigh with the Department when appraising a case, and then attempt to draw some general conclusions as to probabilities without actually stating a policy.

In a review such as this it is relevant, I think, to state that the engineer is still supplying an 'on-demand' service. With the exception perhaps of the laundry and some minor plant items, the only control exercised by the engineer is that made at the design phase when some apportionment of certain loads can be made, particularly if there is significant refrigeration when a choice may have to be made between rotating plant or absorption units. Apart from this, the engineer heats the buildings, and supplies steam for sterilisation and electricity for lighting and medical purposes. As hospitals rely more and more on electricity for patients' treatment the only

Mr. Manser is the Assistant Chief Engineer, UK Department of Health & Social Security

change in the security of the electrical supply must be towards improvement. It is unthinkable for any responsible engineer to plan for a lower degree of security than exists at the moment. Loss or partial loss of heat supplies does not produce such an immediate crisis, but clearly the evacuation of a large hospital due to loss of electricity or heat supply is unthinkable. We can consider the security of each of these on the basis of two criteria: first the immediate or partial loss of electricity or heat, and secondly the maximum length of time that such crisis conditions can be tolerated. For electricity the Department's guidance in essence requires standby supplies to be immediately available to carry the essential electrical demands of the hospital. As previously remarked, there is not such an immediate need to cover for lost heating. The length of time that crisis conditions could be tolerated is, of course, arbitrary, but we consider that this should be measured in hours rather than days even for a major technical calamity. Obviously there is nothing absolute in this judgment, and the loss of heat in summer from a conventional hospital is less calamitous than similar loss in midwinter, but electricity remains a key service. The degree of security of electricity supplies from novel sources will weigh very heavily with the Department when assessing new schemes, and will almost certainly have to be assessed as equal to or better than today's, and also to have been proved in the field.

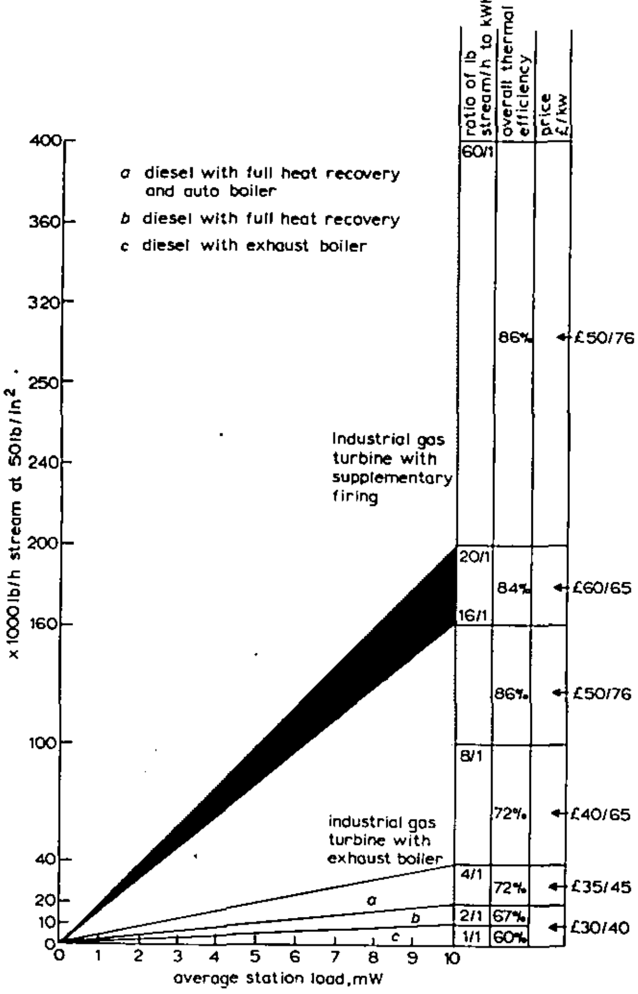


Fig. 1 Capacity of prime movers

Table 1 shows the available techniques for total energy and some of the major parameters which dictate or limit the use of each particular prime mover. Perhaps I should say here that I do not propose to treat cases of peak lopping, partly because not all supply authorities permit it, and partly because it introduces ramifications and permutations which go on almost indefinitely. Therefore one can think in terms of the electricity demand as being the master. That is to say, the prime movers are run to supply the electricity maximum demand, and the waste heat is used to supply the heat requirements for the building complex, topped as necessary. If the waste heat is in excess of the heat demand at any time, accounting for any minor storage capacity, then some heat must be wasted, and the overall efficiency of the system is reduced. If the heat has to be topped up this can, in general, be done at a cost and efficiency comparable with the efficiency of the total energy system. Thus the overall efficiency of the system remains reasonably constant if topping-up heat has to be applied, whereas it falls off sharply if the waste heat available from the prime movers cannot all be utilised. This tells us immediately which of the systems is going to be easier to engineer in real life when the various curves telling us the simultaneous electricity and heat loadings are examined. Clearly the diesel engine with its high prime-mover efficiency, and therefore lower waste-heat availability, is likely to match difficult electricity and heat curves better than the steam turbine which rarely does better than a 16:1 ratio of the power output convertible to electricity to the heat output. Unless the heat requirement of the building complex is always at least 16 times that for electricity then heat must go to waste, with a resulting diminution of efficiency.

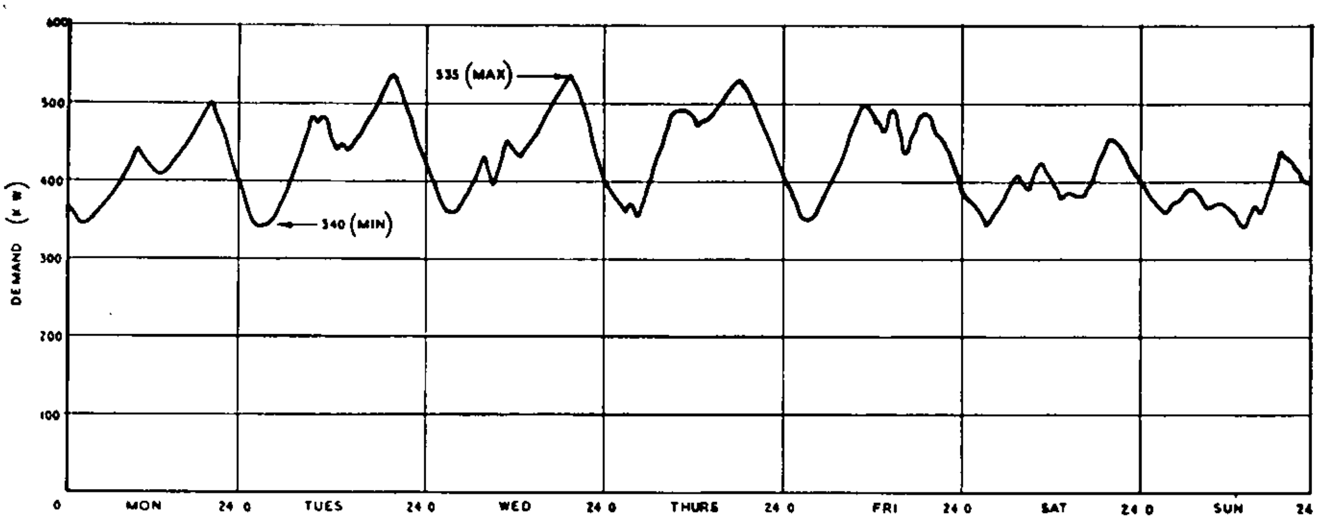
As regards fuel, you will notice that the steam turbine is the only one that can use all primary fuels including coal (and, for that matter, nuclear energy). Unfortunately the power/heat ratio is such that in a modern hospital there are considerable periods of mismatch when recoverable heat has to be turned to waste. The larger diesel engines will run on 3500 s oil, but there is a significant increase in the engineering maintenance involved; such a plant is really a power-station type enterprise. On 35 s oil the diesels become much more a pushbutton job, and this fuel is also suitable for the modern industrial gas turbine. The latter is also very happy on natural gas, which can also be used in the dual-fuel engine and in the spark-ignition engine which is more popular in the US than here. The dual-fuel engine is essentially a gas-fired diesel engine using a small quantity of 35 s oil to initiate combustions. As its name implies, the spark-ignition engine is more like the traditional petrol engine, but as its efficiency and heat recovery are approximately 10% down on those of the dual-fuel engine I do not propose to deal with it here.

Fig. 1 shows much of the information of Table 1, but displays in more elegant fashion two of the key characteristics of the prime movers available to us. First, the high power/heat ratio of the diesel and dual-fuel engines, which means that with electricity as the master demand the amount of waste heat to be recovered is relatively small, and is therefore less likely to overrun the heat demand. The second point is the enormous range of heat, at practically constant efficiency, that can be achieved

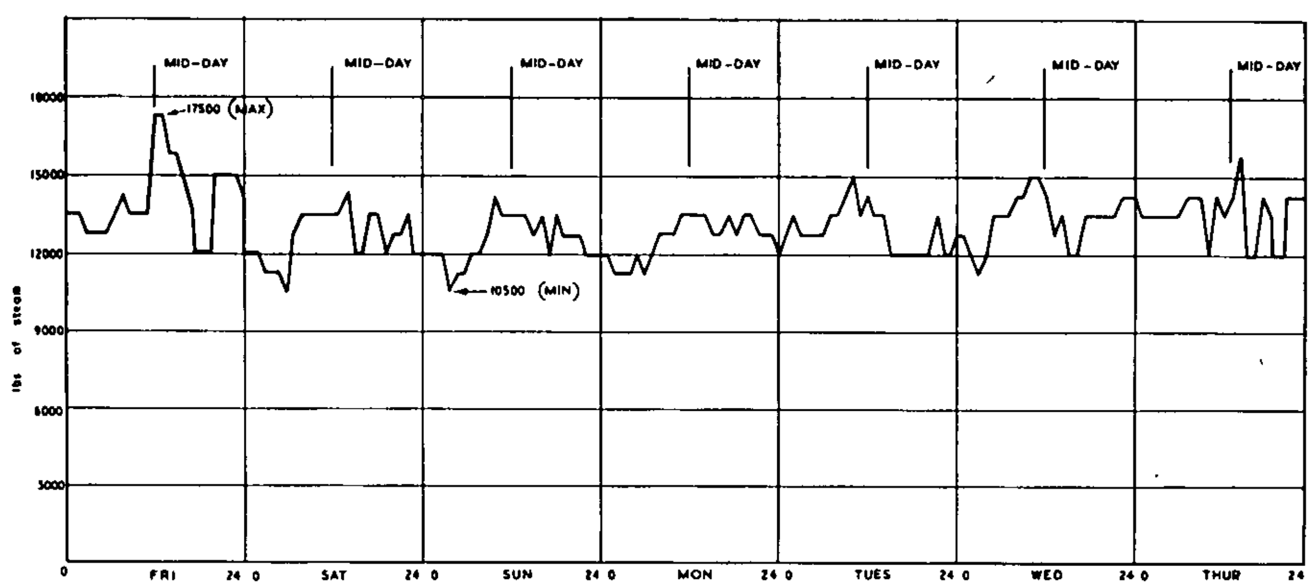
Table 1 Prime movers

Prime Mover	Reciprocating steam	Steam turbine	Diesel	Dual fuel	Spark ignition	Gas turbine
Fuels	Coal Oil Gas	Coal Oil Gas	Oil	Oil Gas	Gas	Oil Gas
Power/heat ratio		1:6	1:1	1:1	1:1	1:3
Prime mover efficiency, %		28-35	38-40	35-40	25-30	15-20
Overall efficiency with heat recovery		75-85	65-75	65-75	60	65-90
Ease of heat recovery	very easy	very easy	complex	complex	complex	easy
Time to start and pick up load	hours/ minutes	hours/ minutes	seconds	seconds	seconds	minutes
Cost, £/kW		60	29-34	38-45	50	45

Fig. 2 Typical winter average hourly demand for 600-bed hospital



(a) Electricity demand



(b) Steam demand

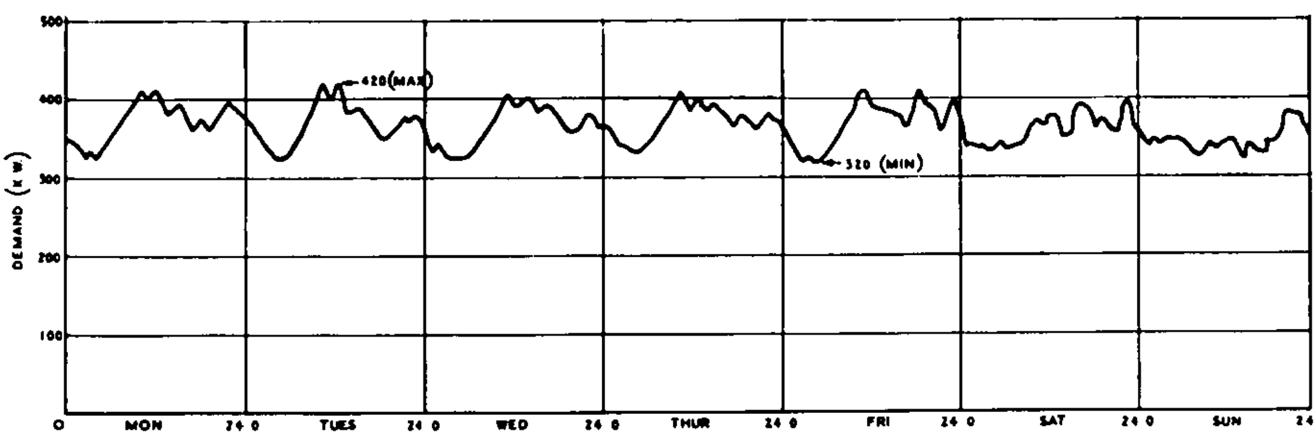
with a gas turbine using supplementary firing. The reason for this is that the gas turbine requires a substantial mass flow of air, and the exhaust is therefore oxygen rich. Given a suitable recovery boiler supplementary firings can be arranged, when the overall efficiency will remain substantially constant over the relatively enormous range of heat output. This slide also displays the narrow useful range of the back-pressure steam turbine.

From now on I will be dealing with the fuel and prime-mover combinations which I am sure your instinct has already lead you to accept. For boilers, either conventional or used for substantial amounts of topping-up heat, either 3500 s oil or natural gas at the bulk-tariff rates will be considered. For diesel engines I will assume only 35 s or 950 s oil since we will not wish to run the sort of power station which involves 3500s oil in diesel engines. For the dual-fuel engine 35s oil and natural gas can be used, and for the gas turbine I shall consider natural gas with 35s oil as a standby fuel when an interuptible tariff is involved.

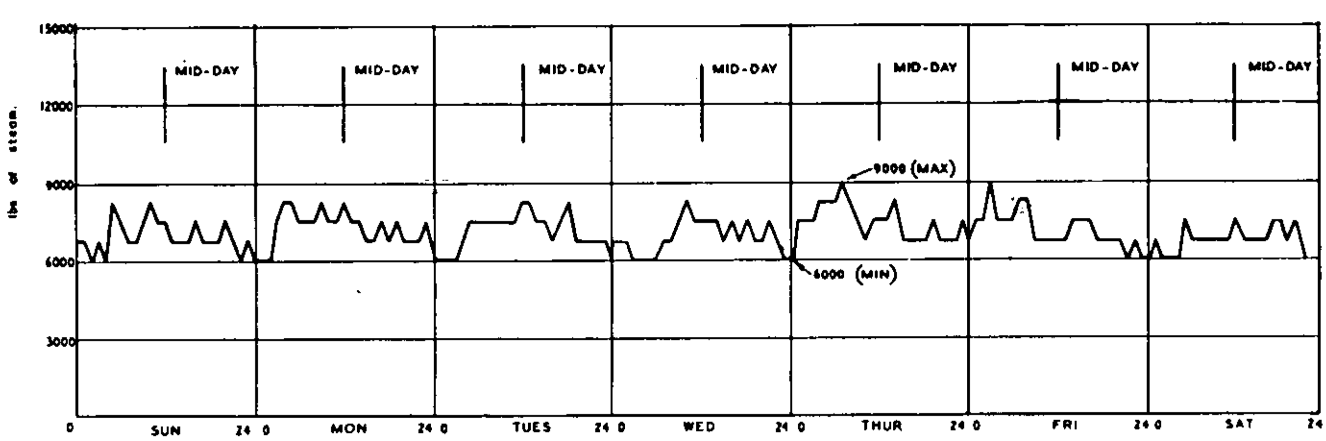
If we assume a modern 600-bed naturally ventilated hospital—a typical modern district general—Figs. 2 and 3 show the essential data for the electrical and steam loadings. (Incidentally, I should perhaps mention the existence of an unpublished paper by Oscar Faber & Partners dealing with this subject. Although all the figures quoted in this paper are original, we have, in the case of this hospital, matched the size with that of the Faber paper so that interested parties can have a more direct comparison between our own views within the Department and those expressed outside.) The key factors here are the two load factors. In particular, an electricity load factor of 0·52 is one that we would consider typical. In fact, it is hardly an exaggeration to say that assuming this figure for the load factor, and the maximum demand as 535 kW, a few manufacturer's catalogues enable a preliminary appraisal of the economic worth of total energy to be made. When commencing a design to fulfil these two criteria we are almost passing preliminary judgment on total energy, and we are also making our first arbitrary judgement on security. This is because from the maximum demand we deduce the plant prime-mover size and number, and it is here that lies a very high proportion of the capital commitment and also much of the decision on the electricity-supply security.

The old rules were probably as good as any for a secure supply; i.e. there should be a sufficient number of sets to have one down on maintenance and one down on involuntary outage. The next step is to allow for a stand-by supply from an outside electricity source, and then to make a purely arbitrary decision on the number and size of sets to be used for normal running. The natural load growth must also be considered, and here, regrettably, I must say that we are very much in a quandary, since the generation of hospitals now being built has not been in existence long enough to display any meaningful natural growth, and in the older hospitals we have the greatest difficulty in separating load increases due to updating from

Fig. 3 Typical summer average hourly demand for 600-bed hospital



(a) Electricity demand



(b) Steam demand

Table 2 Capital cost: conventional system, 600-bed hospital

Assume the use of four boilers, each 6000 lb/h (fourth boiler as standby). Installed cost: oil fuel, less chimneys and builders work, 4 at £8500	£34 000
Electrical intake: comprising three 250 kVA transformers, switchgear, cabling and jointing ..	£4500
Standby generator (200 kW)	£1000
Contribution to Electricity Board for electricity service	£600
Builders' work for engineering plant	£2000
Total	£50 100

Table 3 Capital cost: dual-fuel system, 600-bed hospital

Assume three 300 kW engine/alternator sets, excluding waste-heat recovery, switchgear etc., at £13 200 each	£39 600
Four 5000 lb/h supplementary boilers using gas burners	£27 600
Three 1500 lb/h heat exchangers	£4500
Oil storage (35 s) for emergency and interruptable-supply use	£1600
Contribution to Gas Board for gas service ..	£600
Insulation and ventilation of plant room	£1500
Builders' work associated with engineering plant..	£2300
Total	£77 700
Additional accommodation for plant	£10 000

Table 4 Capital cost: diesel plant, 600-bed hospital

Assume three 300 kW engine/alternators	£39 600
Assume four 5000 lb/h supplementary boilers ..	£27 600
Three heat-recovery heat exchangers; 1500 lb/h each	£4500
Oil storage	£3600
Insulation and ventilation of plant room	£1500
Builders' work associated with engineering plant..	£2600
Total	£84 400
Additional accommodation for plant	£10 000

Table 5 Capital cost: gas-turbine plant, 600-bed hospital

Assume three 320 kW sets excluding waste-heat recovery at £17 000 each	£51 000
Three heat recovery/auxiliary firing boilers (9000 lb/h each)	£33 750
Oil storage for emergency use and interruptable gas tariff	£1300
Ducts and flues	£2000
Insulation and ventilation of plant room	£1200
Builders' work associated with engineering plant..	£2000
Contribution to Gas Board for gas service ..	£600
Total	£91 850
Additional accommodation for plant	£5000
Above figures are without standby supplies.	
If a 200 kW diesel set is added at a capital cost of £9000 for set and £500 for accommodation, totals become	£100 850
Additional accommodation for plant	£5500

Table 6 Operating cost: conventional system, 600-bed hospital

$1{\cdot}05\times10^6$ therm of heat produced by heavy oil (3500 s) at 4·5d (assuming 75% conversion efficiency) $1{\cdot}05\times10^6\times\frac{100}{75} = 1{\cdot}4\times10^6$ therm at 4·5d/therm	£26 200
Electricity $2{\cdot}43\times10^6$ kWh at 1·67d/kWh	
$\frac{2{\cdot}43\times10^6\times1{\cdot}67}{240}$	£16,900
Maintenance costs (2% capital)	£680
Operating labout (five shift staff)	£5300
Total	£49 080

Table 7 Operating cost: dual-fuel system, 600-bed hospital

Total energy heat = $1{\cdot}05\times10^6$ therm

$$\text{Electricity} = \frac{2{\cdot}43\times10^6\times3412}{10^5} = 82\,800 \text{ therm}$$

Total energy = $(1{\cdot}05+0{\cdot}0828)\times10^6 = 1{\cdot}133\times10^6$ therm

Assuming 92% of energy is produced by natural gas at 5d/therm and 8% produced by 35 s oil (7d/therm) in pilot system. Conversion efficiency 70%

Gas $\frac{1{\cdot}133\times10^6\times0{\cdot}92\times5}{240}\times\frac{100}{70}$	£31 010
Oil $\frac{1{\cdot}133\times10^6\times0{\cdot}08\times7}{240}\times\frac{100}{70}$	£3020
Lubricating oil at 6s/gal	£1732
Maintenance (£600 in steam plant: 3% capital on engines £1200)	£1800
Operating labour (five shift engineers + two day fitters)	£10 000
Total	£47 562

Table 8 Operating cost: diesel plant, 600-bed hospital

Total energy = $(1{\cdot}05+0{\cdot}0828)\times10^6$ therm

Diesel fuel at 7d/therm and converted at 60%

$$1{\cdot}133\times10^6\times\frac{100}{68} = 1{\cdot}667\times10^6 \text{ therm}$$

$1{\cdot}667\times10^6$ therm at 7d/therm = $\frac{1{\cdot}667\times10^6\times7}{240}$	£48 700
Lubricating oil at 6s/gal	£1732
Maintenance	£1800
Operating labour	£10 000
Total	£62 232

Table 9 Operating cost: gas-turbine plant, 600-bed hospital

Total energy $(1{\cdot}05+0{\cdot}0828)\times10^6$ therm $= 1{\cdot}133\times10^6$ therm

Natural gas used and connected at 65% efficiency overall to provide $1{\cdot}133\times10^6$ therm

$$1{\cdot}133\times10^6\times\frac{100}{65} = 1{\cdot}74\times10^6 \text{ therm}$$

$1{\cdot}74\times10^6$ therm at 5d/therm	£36 250
Maintenance (1·5% capital)	£1250
Operation (assume identical with conventional plant)	£5300
Total	£42 800

the true natural growth rate due to the changing pattern of treatment. However, there is some evidence for a figure of 5% per annum.

A final complication is that, whereas there are fairly well recognised rules for the overhaul of diesel engines, the modern industrial gas turbine has built up an enviable reputation for very long running periods with very small maintenance demands. Thus on an installation such as the well publicised Players' project, where eight turbines are used well matched to the process involved, the company may well look forward to the predicted security of supply and costs. Unfortunately the smaller prospective maximum demands of the modern hospital mean that fewer gas turbines of reasonable size can be used so that the security question looms much larger.

The first task of the designer, then, is to look at the maximum demand and to assess the number of sets required. I have taken the above demand to warrant three sets of about 300 kW each; i.e. two sets running will carry the maximum demand with a nominal allowance for growth, and an extra set down on breakdown will still leave 300 kW, which should cover the emergency supply. For the gas-turbine alternative the nearest available size has also been assumed, but here we have a further worry. A gas turbine will not run up and pick up full load as quickly as a diesel set, and the time taken is embarrassing by hospital standards. It is recommended, therefore, that an arrangement of three 300+kW gas turbines should be covered by an extra diesel set for emergency use. As an alternative it may be backed up by an emergency supply from the public authority. The effect of this will become apparent in later calculations.

Reviewing the calculations briefly, we have made 60-year calculations because this is our normal write-off period for buildings, and we have allowed a consistent 20-year period for plant replacement. The purists may quarrel, but this is sufficiently near to put the matter in perspective. The maintenance figures quoted have in the main been drawn from both our own experience and that of manufacturers, but the operating labour does repre-

Table 10 *Summary of costs, 600-bed hospital*

Item	Cost	Remarks	Present worth
	£		£
Conventional			
Heavy fuel oil (3500 s)			
Capital (1) building	—		—
(2) plant	50 100	p.w. factor 1·17	58 617
Operational	49 080	p.w. factor 9·967	489 180
		(equivalent annual value = £54 961)	547 797
Dual fuel (gas)			
Capital (1) building	10 000	p.w. factor = 1·0	10 000
(2) plant	77 100	p.w. factor = 1·17	90 207
Operational	47 562	p.w. factor = 9·967	474 050
		(equivalent annual value = £57 615)	574 257
Diesel (35 s oil)			
Capital (1) building	10 000	p.w. factor = 1·0	10 000
(2) plant	84 400	p.w. factor = 1·17	98 748
Operational	62 232	p.w. factor = 9·967	620 272
		(equivalent annual value = £73 143)	729 020
Gas turbine (gas)			
Capital (1) building	5 000	p.w. factor = 1·0	5 000
(2) plant	91 850	p.w. factor = 1·17	107 464
Operational	42 800	p.w. factor = 9·967	426 587
		(equivalent annual value = £54 083)	539 051
with diesel standby			
Capital (1) building	5 500	p.w. factor = 1·0	5 500
(2) plant	100 850	p.w. factor = 1·17	117 994
Operational	42 800	p.w. factor = 9·967	426 587
		(equivalant annual value = £55 190)	550 081

Assumptions:
interest rate 10%
life of all plant taken as 20 years
life of all buildings taken as 60 years
life of project taken as 60 years

sent our own view. For the conventional installation this can hardly be debated, and for the gas turbine we have in fact allowed for very low labour costs in line with the satisfactory record of these prime movers to date. It is, I think, only in the diesel generator and dual-fuel engine that our assessment might be considered high in comparison with some other opinions, but quite frankly we would not wish to run a diesel power station with the level of staffing that some people have been advocating, even though we are aware of unmanned stations giving satisfactory service in other situations.

In the conventional system of Table 2 we have allowed for 6000 lb/h boilers, a reasonable intake substation and a 200 kW standby generator, giving a total capital cost of just over £50000.

In the dual-fuel engine alternative of Table 3 we have allowed for three 300 kW sets, four 5000 lb/h boilers, three 15000 lb/h heat exchangers, oil storage and associated equipment, giving a total capital cost of £77700 plus £10000 for extra accommodation.

A diesel plant, (Table 4,) is very similar, giving a total capital of £84400 plus £10000 for accommodation.

The gas-turbine alternative shown in Table 5 uses three 320 kW sets which are standard, giving a total capital of £91850. The plant accommodation is only £5000 extra because these sets have such light foundation requirements by comparison with the heavy foundations of diesel or dual-fuel engines.

Tables 6–9 show the operating costs. For the conventional plant (Table 6,) we have allowed for five shift engineers. For the dual-fuel engine (Table 7,) we have made allowance for the natural gas, the 35s oil needed for combustion, lubricating oil (significant, but not always allowed for), a maintenance allowance of £600 for the steam plant and 3% of the capital on the engines. For the operating labour we have allowed for five shift engineers and two day fitters. The diesel engine, (Table 8,) is much the same.

The gas-turbine alternative is shown in Table 9. The assumed maintenance is 1·5% of capital cost, and the operational staff required has been assumed to be similar to a conventional plant.

Table 10 gives the overall assessed economic case based on natural gas at 5d/Btu, 35s oil at 7d/Btu and 3500s oil at 4·5d/Btu. These figures are as advantageous as any actual tariffs, and probably better than most. The right-hand column of the Table shows the present worth; i.e. the present value of the installation plus its running costs over the whole period of 60 years.

The figures show that the gas-turbine total-energy scheme comes out practically the lowest before the diesel standby set is included, but if the 200 kW diesel is put in then the present worth becomes higher than the conventional installation costs. It is difficult to make a generalised comment on the cost of arranging a standby outside supply, as this would probably be cheap if not used. If, however, a charge were incurred, probably a maximum-demand charge, then the cost would probably exceed that of the 200 kW diesel.

I do not think it proper to draw deductions to the last pound, but I would limit the economic conclusions (and I must stress that this is the economic conclusion only) to stating that the best total-energy scheme can be shown to be very close to the conventional system, and so might, in a specially selected case, be made equal or even lower. On the straight figures, however, there is obviously no overriding economic case for a total-energy scheme in a 600-bed naturally ventilated hospital.

Part 2 of this paper will be published in the November issue of Hospital Engineering.

Paging in hospitals

BY P. COLES, C.Eng., M.I.E.E.

Introduction

With the growth of sophistication of paging systems it is becoming increasingly difficult to distinguish between the different systems available, and to weigh up their advantages or shortcomings.

Of the three parts of the paging system—transmitter, encoder and receiver—it is the receiver which has to meet conditions which are not generally found in any other field of electronics. There are products which have to be highly miniaturised, and others which have to withstand rough handling, but it is difficult to think of any other field in which the above two requirements have to be combined with extremely low power consumption and a very high degree of reliability.

Mr. Coles is Head of Development, Multitone Electric Co. Ltd.

Receivers

If we compare on-site paging receivers with radiotelephones, one is immediately aware of a totally different order of battery life. Almost all radiotelephones run on chargeable cells and have a life between charges of around 10 h. This obviously would be totally unacceptable in a paging receiver. When disposable cells are used a battery life of many weeks is expected, and where rechargeable cells are employed, a working cycle between charges of a week should be aimed at. In addition, the decoding circuits of the receiver must not malfunction or miss a call in conditions of high electrical background noise. The call must be loud enough to hear in noisy conditions, but soft enough to avoid being a nuisance in quiet surroundings. Clearly a paging receiver is not an easy animal to design and produce.

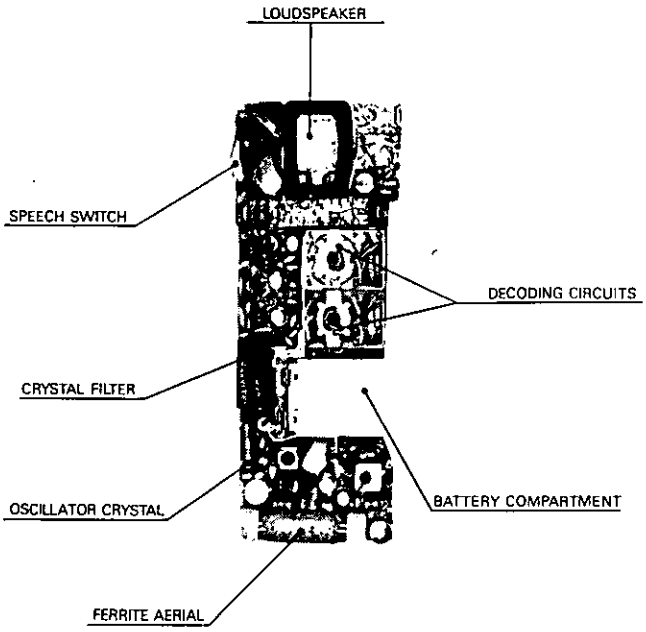


Fig. 1 Chassis of Multitone RA60 receiver

As is widely known, the Post Office specification to which all radio paging receivers must now conform relates sensitivity to selectivity. The more sensitive the receiver the more selective it must be. In this way the receiver is automatically protected from interference from adjacent systems on adjacent frequencies. This offers no protection, of course, against adjacent systems on the same frequency.

Fig. 1 shows the chassis of the Multitone RA60 receiver. Speech on the 27 MHz and 31·75 MHz frequency bands is only allowed to hospitals, and only for emergency use. Since nonhospital installations are not allowed speech, the Post Office specification deals only with selectivity for call and not for speech. The only practical way of ensuring equal protection from interference on call and speech is to use a multielement crystal filter. This type of filter, the use of which is mandatory in all radiotelephone equipment, also ensures higher selectivity, and hence higher permissable sensitivity for speech and call than can be achieved by other means. This crystal filter should not be confused with the oscillator crystal which serves an entirely different purpose.

Importance of the sensitivity of the receiver

Great importance is now attached to sensitivity. This is demonstrated by the fact that the latest Multitone receiver (type RA60) is 35 times more sensitive than receiver types manufactured four years ago. It is, of course, useful to be able to pick up the signal a long way from the hospital, but this advantage is not the main reason why sensitivity is important. In fact, the more sensitive the receiver, the more reliable will be the system as a whole. As the first 'bloom of youth' wears off, a sensitive receiver will go on functioning perfectly, whereas if it were less sensitive, it would have had to be sent in for repair. With highly sensitive receivers there are virtually no blind spots, and only one transmitter need be used even on very large installations. This not only reduces cost but also increases reliability. A good receiver, therefore, is a sensitive one, which in turn means a selective one. The RA60 receiver, as supplied to the UK market, has a sensitivity of 14 μV/m, and a selectivity which permits it to be twice as sensitive.

However high the performance of the r.f. sections of the receiver, the unit will be of little use without high-reliability decoding. The use of all-electronic circuits is to be preferred to electromechanical frequency-selection units on the grounds of long-term reliability. It is very important from the manufacturer's point of view that the decoding circuits should be easily inserted into the main circuit board of the receiver, otherwise each receiver code number is an individually manufactured unit. Plug-in decoding circuits also assist the user inasmuch as additional receivers of specified call numbers may be added to an existing system at short notice.

Power supplies

In the interests of low running costs and convenience in use, a receiver should be designed with the lowest power consumption consistent with a high level of performance. When the power consumption level has been decided, it is necessary to decide whether disposable or rechargeable cells should be used. One of the disadvantages of rechargeable systems is that if a charging cycle is missed the receiver is out of use until recharging is complete. This disadvantage may be overcome by arranging that the cells are easily removable and replacement charged cells available.

Built-in accumulators reduce the reliability of the system, for it is not possible to rely on users to have them recharged regularly. Once the accumulator has been allowed to run down, the receiver must be taken out of service while being charged.

Quality of manufacturing and design

It is most important to examine the chassis of the receiver to asses the quality of design and manufacture, for reliability greatly depends on this. A well designed and cleanly made chassis can be spotted quite easily, as this at least does not require any specialised knowledge.

Encoders

When choosing a system it is essential to make sure that the encoder proposed has sufficient capacity for the growth in the number of receivers in the foreseeable future, and that it has satisfactory facilities for group-call operation and any other facilities that may be required, such as telephone coupling.

∗ Members Diary ∗

INSTITUTE OF HOSPITAL ENGINEERING 1971 ANNUAL CONFERENCE

The 1971 Annual Conference will be held in Bristol, at the Royal Hotel, on Tuesday, Wednesday and Thursday, the 22nd–24th June. The Conference Dinner will be held on the Wednesday evening, also at the Royal Hotel, and, of course, distinguished guests will be invited to this. It is hoped to hold a general domestic meeting for members of the Institute during the afternoon of the first day.

Full details of the entire programme will be published and circulated to members in due course.

NEW FACES

Mr. P. J. Chapman, recently assistant engineer, North Middlesex Hospital, is now hospital engineer at the Prince of Wales Hospital, Tottenham Group HMC.

Mr. D. Griffiths, Associate Member, has been appointed Deputy Group Engineer to the South-West Wales HMC, at Carmarthen. He comes from Llanelly Hospital, where he was hospital engineer.

Mr. R. R. Hosie, the new assistant engineer at North Middlesex Hospital, has transferred from St. Michael's Hospital, Enfield.

Mr. J. Jeffrey has been appointed assistant engineer at Hemlington Hospital, Middlesborough. He has joined the hospital service from the local Borough Engineer's department.

Mr. F. Rust has moved from the post of senior assistant engineer, Whittington Hospital, to be hospital engineer at Highlands Hospital, London N21.

Mr. D. R. Wilson, an Associate Member, and Honorary Secretary of the Southern Branch of the Institute, has been appointed Group Engineer, St. James' HMC, Portsmouth.

∗ Among the Branches ∗

MIDLAND BRANCH

The branch has recently published its programme for meetings until March 1971. An interesting variety of topics is included; e.g. 'Liquid-oxygen installations', Deep-freeze catering', 'Lift controls' and 'Fire-fighting installations'.

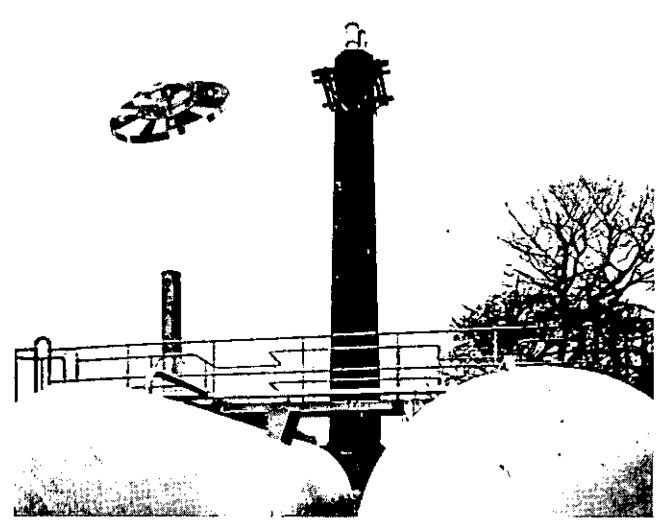
SOUTH-WESTERN BRANCH

Meeting at Glenside Hospital, Bristol, the Branch spent an evening hearing about mineral-insulated cables from two representatives of Pyrotenax Ltd. A brief introduction of the history of m.i. cables, from their invention in France to their present-day widespread use, was followed by a half-hour film on the manufacturing processes involved, and then a demonstration was given of the special tools required for their use. A question-and-answer session concluded a most interesting evening.

SOUTHERN BRANCH

The branch recently visited the CEGB generating station at Fawley, where a very interesting tour was conducted by the Senior Administration Engineer. Starting with a general view of the site, members continued to the 400 kV substation for a detailed description of the circuit-breaker systems used. The entire substation is housed as a protection against the salt sea air. The party then proceeded to the main control building for a talk and some slides illustrating the construction of the station, which were followed by a question time. Next in the tour was the main generator and boiler house, where, as the station was not fully commissioned, it was possible to see boilers, turbines and generators at various stages of completion. Finally, members were taken to the actual control room, where the amount and complexity of monitoring equipment was really too much to absorb in the short time remaining. Apparently there are two computer rooms, and eventually the control and loading requirements will all be computerised. All in all, this was a most interesting and instructive tour.

Clippings

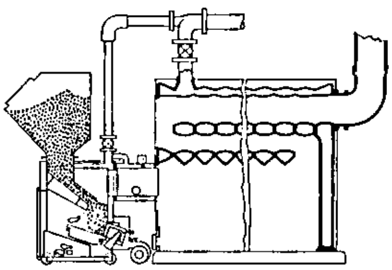


The recent spate of u.f.o. sightings in and around Upshire seemed to centre very close to the recently modernised Regional Health Centre, a fact not encouraging patients' speedy recovery, except in the juvenile male e.n.t. ward. One can only presume that the frequent sightings through the West Ward windows was purely fortuitous, and devoid of any alien significance, though it is possible that the boiler-house chimney, undergoing reconstruction at the time, may have appeared weapon-like to any controlling intelligence

Did you know that coal, mechanically stoked, is 'smokeless'? The Gas Industry is closing down its coal-based gas works so production of gas coke will drop. But do not let this leave you in the cold next winter. Take advantage of the situation and convert to automatically stoked coal.

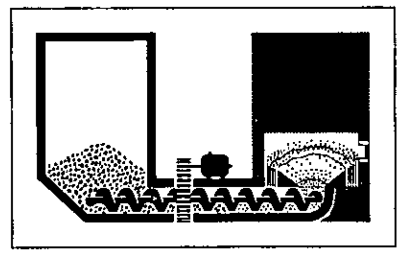
* You can buy it for half the price of the coke you use now.
* Mechanically stoked, your boiler efficiency will be 50% more than it is on handfired coke.
* Your heating standards will go up because the fire will be automatically controlled. This means a guaranteed prompt start after the weekend and in the mornings.
* Less storage is required and coal can be delivered much more easily than coke.
* It will give your present boilers a new longer lease of life. Other fuels with high operating temperatures cause quick deterioration in old boilers and mean expensive replacement. With solid fuel you can keep them happy and comfortable for years to come.
* Conversion to coal is swift and uncomplicated: many heating plants can be changed over in a weekend.
* The NCB will give you supply contracts as a special assurance of regular supplies in the future.

Some of the ways to convert from Coke to Coal

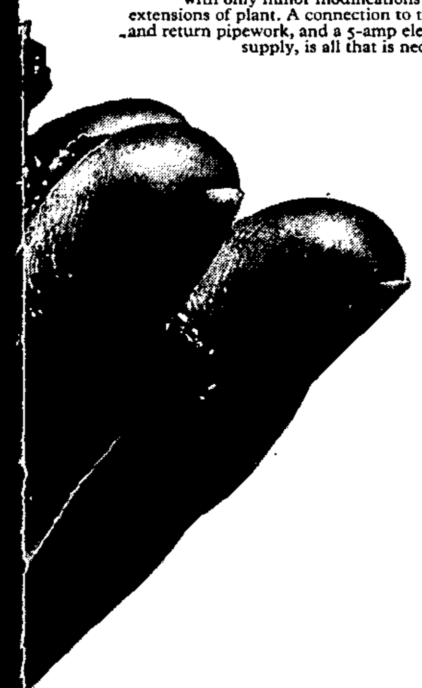


Pre-burner. Using the gravity feed principle, this newly-developed unit enables existing sectional boilers to switch from coke to coal with only minor modifications and no extensions of plant. A connection to the flow and return pipework, and a 5-amp electricity supply, is all that is necessary.

Gravity Feed. A fuel hopper automatically feeds fuel to the firebed, where air is forced in to provide almost total combustion. Removal of the small amount of clinker left by this method, and re-filling of the hopper, takes only a few minutes each day. For large installations, automatic hoppers are available.



Underfeed. This method permits the use of the cheapest grades of coal, fired smokelessly. A rotating screw feeds the fuel into the firebed from below. Forced air pushes the volatile gases through the firebed for virtually total combustion. Labour requirements are less—with automatic control available to reduce them further.



NCB

When you're making a change, coal is a change for the better.

For further information, write to or telephone your local NCB Regional Office (the address is in the telephone directory).

For some months Hospital Engineering has been featuring the continuing discussions resulting from the report of the Woodbine Parish Committee on Hospital Building Maintenance. This month the formal exchanges cease with the Institute's comments on the report, and the comments of the Regional Engineers Association, below.

Reaction to the deliberations has been sharp at the higher appointment levels, but, as seems the case with all 'political' discussion, the majority of those that will be affected by any change in the system seem indifferent. Perhaps only a few realise that their whole future career could be reshaped, or is everyone really content for the Institute Council to speak for him?

Last word on Woodbine Parish?

The Institute of Hospital Engineering

The Institute was invited to make both written and oral submissions to the Woodbine Parish Committee, and now the report has been published would like to offer the following comments, which it is hoped will be constructive and helpful.

The Institute would like to congratulate the members of the Committee on the production and presentation of a report which, apart from its astute observation of the subject under discussion, provides much useful data which will be of considerable value to those currently responsible for providing a maintenance service in hospitals.

Paragraph 1.4 We are in agreement with the conclusions of the Committee in respect of the need for integrated maintenance organisation in the Hospital Service. This endorses the opinion put forward in the Institute's written and oral evidence. However, we shall comment later on how this conclusion conflicts with recommendations elsewhere in the report.

1.5 We note the reference to comparison of remuneration between group engineer and building supervisor. Although we recognise the need for revaluation of remuneration for building supervisors, we do not consider that there is valid reason for comparison in this instance. Furthermore we have always understood that such comparisons are not recognised by the Whitley Councils when negotiating conditions of service for differing groups of employees. We consider that revaluation of remuneration for all staffs should be based on the job analysis, degree of responsibility and job evaluation.

3.1.2 The Committee's observations and comment are strongly supported by the Institute.

3.2.1 The Institute is generally in agreement with the observations of the Committee, particularly those concerning the need for effective estate management, and the importance of the maintenance function in relation to the standard of care and treatment of patients.

3.2.4, 3.2.5 Group engineers are fully aware of the need for sound estate management in the hospital service, and many already have the responsibility of formulating policy and organising implementation. In our opinion, it is unlikely that worthwhile progress will be made until there is true appreciation of the importance of the maintenance function at all levels within the hospital service, and the consequent provision of a realistic financial allocation to meet its needs.

3.2.7 The report refers to the need for a clear definition of professional and technical responsibility, authority and accountability for maintenance at all levels in the hospital service.

3.2.8 The Institute considers that, at whatever level in the present or future health-service structure maintenance is controlled, its management should be in the hands of those with expertise in the maintenance and operation of engineering and building services. We would suggest that at the present time professional expertise in this field is not concentrated at RHBs, but at HMCs and Governing Boards. In this respect, the report tends to ignore its own evidence that at present there are 91 chartered engineers employed as group engineers, and the number is increasing annually.

3.2.9 The report refers to the conflict between delegation of responsibility and the continuing need for accountability, and suggests that the long-term and some midterm proposals will lessen the conflict. The Institute considers that where conflict exists it is primarily for the following reasons:

HMCs continue the policy of a divided maintenance function.

HMCs do not follow the advice and guidance given by the Department on the maintenance function and on the duties and responsibilities of those officers employed to manage it.

Both the Department and RHBs tend to fragment responsibility for certain specialist aspects of maintenance, rather than channel and concentrate all maintenance and operation functions in one integrated organisation at HMC level, where the work and the ultimate responsibility for its implementation must be discharged.

The Institute is aware that there are HMCs (e.g. Coventry, East Birmingham and mid-Worcestershire) which, having experienced the weaknesses of a divided and fragmented maintenance function, have encouraged the organisation of a fully integrated maintenance and operation service. It is significant that in this sort of management structure and working environment the conflict previously referred to does not exist, and many of the recommendations contained in the report have already been implemented, including some elements of estate management. As far as we are aware, none of the HMCs referred to were visited by the Committee's Executive Investigator.

The report emphasises the need for, and recommends, fully integrated maintenance organisations as a part of long-term objectives. It is apparent that the immediate and midterm proposals will involve considerable expenditure, particularly in connection with additional staff. The Institute considers that the priority at the present time is to continue and accelerate the Department's present policy of collecting data to evaluate the needs of hospital-engineering maintenance, and to extend its application to the whole maintenance function. We consider that there is an immediate need to implement full integration of all aspects of maintenance at HMC level, whenever the opportunity presents itself. By so doing, the Committee's long-term proposal could be achieved within a decade, and at the same time provide the basis for realistic assessment of additional staffing needs.

We believe that at the present time the maintenance of the physical assets of the National Health Service are so underfunded that any injections of additional finance should be directed towards improving this situation rather than to any major expansion of the management structure to deal with a single aspect of maintenance.

4.1.1–4.1.12 The Institute concurs with the Committee's comment in this section of the report, and would emphasise some issues raised.

4.1.9 It is our opinion that the primary purpose and intent in the recommendations contained in HTM 12 were sound, except that in attempting to define responsibility and accountability for the management of maintenance it merely perpetuated conflict which already existed, and encouraged further division in the control of maintenance. Our inquiries indicate that a considerable amount of work has been done by group engineers towards implementing the requirements of HTM 13, but find that commissioning of schemes is dictated by lack of resources.

The majority of schemes which have been successfully launched are those which were originally specially financed by RHBs as pilot schemes.

4.1.10 In some regions of the country, experience at HMC level has been that revenue allocations for running costs of new capital development have been inadequate.

4.2.2 The report states that there has never been parity of qualifications between building supervisors and group engineers. We question the purpose of the statement, or that there is a need for parity.

The Committee's recommendations include revised qualification standards for building supervisors to HNC level. The Institute considers these do not compare with the academic standards of the National Certificates in the principal engineering disciplines. The comparison is even less valid when the endorsement subjects in engineering and administration required for group engineer appointments are also considered. We have already commented that the qualifications for group and hospital engineers are minimum qualification, and that, in fact, almost one-third of group engineers in post at the present time are chartered.

4.2.6 The report refers to the differences that exist in the association and liaison between the regional engineer and architect on the one hand, and the building supervisor and group engineer on the other. The Institute's membership includes engineers employed in all branches of the hospital service, and it is therefore aware of the common interest and liaison that exist between them. We consider that this liaison arises out of necessity, since the design engineer is concerned with the transmission and utilisation of energy in various forms in statisfying his design intent. The maintenance engineer has the expertise to operate, control and maintain the sources of energy and the machinery and apparatus motivated by them. In these circumstances the need for close liaison, feedback and feed-forward of information between the two branches of engineering is essential.

On the other hand the architect is concerned with the design of buildings which will satisfy a particular functional need, and at the same time provide an acceptable working environment for the activities within it. He must also consider the aesthetic influence of his work on others, and will design accordingly. The end product of his work will be a static structure.

The need for close co-operation and liaison between architect and design engineer is apparent. We consider that the reason that such a close liaison does not exist between the architect and those responsible for the maintenance of structures is not due to lack of interest by either party, but because the need is far less than with the two branches of engineering.

4.2.4 The report refers to the 'supervisory' role of the group engineer in the operation and maintenance of engineering services, and states that he is rarely qualified to carry out the full range of building-maintenance duties. The Institute considers the role of the group engineer to be one of organisation and management of the operational and maintenance services, not the direct supervision of them. The direct supervisory role is delegated to others. We do not consider it necessary or practicable for a chief officer responsible for the management of the total maintenance function in a group of hospitals to be academically qualified in all the disciplines within his span of control.

However, it is necessary for the chief officer to be academically qualified in the principal discipline concerned with operation and maintenance, and to have a good appreciation of other disciplines, together with the administrative ability to organise the various branches of his department to achieve common objectives. This is a common practice in industry, as was demonstrated by the oral evidence given by the Institute, in which it was said that, from a survey made, about 30 major industrial concerns organised engineering and building maintenance under an engineering manager.

5.1.3 The Institute is entirely in agreement with the Committee's comments on the effect of rapid technological advance in the operation and maintenance function. We agree that an element of improvement must accompany maintenance so as to develop knowledge of new techniques which are being applied in the engineering field at the present time. However, the Institute would go further, and suggest that research and development in the particular needs of hospital engineering shall be encouraged, and should take place at the centre of hospital activity, where the need first becomes apparent.

The hospital service has relied on industry for its technical development far too long, and has paid heavily for it.

5.1.4 We are entirely in agreement with the range of building maintenance work that the Committee suggests as applicable to the technical responsibility of a building supervisor.

5.1.6 The report suggests that it is generally accepted that building maintenance does not lend itself to a system of planned preventive maintenance. We agree that the frequency of regular inspection and maintenance can be much less for most aspects of building structures than for engineering, services and equipment, but we would dispute the general statement that p.p.m. cannot be effectively applied to building maintenance. We are aware of at least one large hospital group that is applying p.p.m. to both engineering and building maintenance with equal success. In fact, we consider that the application of the system to building maintenance would provide much of the information and data for permanent record that the Committee has so strongly advocated in relation to good estate management.

5.1.7 The report considers that there is no generally accepted standard for engineering maintenance in the hospital service. We consider that adequate standards have been recommended and developed by the Department, RHBs and HMCs over several years. The rate of progress and effectiveness has been slow and determined by the many factors to which the Committee refer in the report—not least the lack of adequate and consistent financial provision.

6.1.4 Reference is made to the Green Paper, and some of the proposals in the report are allied to a staffing structure which might only apply to the broad principles set out in the Green Paper. The Institute considers that building maintenance, or any revised staffing structure associated with it, cannot be considered in isolation. The maintenance and operational functions should be considered as an integrated service organisation with a management and supervisory structure designed accordingly. This we consider to be an immediate need, and not one that should be implemented piecemeal over a number of years.

6.1.7 Although we recognise the need for the introduction of a more senior grade to act as deputy to a building supervisor, we believe that the creation of a new and additional post of deputy building supervisor could develop into a purely 'staff' role as opposed to a line-management function. The Committee's proposal in this respect is also out of keeping with its long-term objective for a fully integrated maintenace organisation.

6.1.9 We are entirely in agreement with the Committee's recommendations that adequate general clerical assistance must be available to the managers of the maintenance and operation organisation. However, we strongly disagree with the suggestion that such assistance should be on a basis of secondment from the departments of group secretary/treasurer. Where the need is established, then such clerical and administrative staff as are necessary to the proper management of the maintenance organisation should be part of the normal staff establishment within that organisation.

6.1.39 We strongly disagree with the proposal that the group secretary should be recognised as the nontechnical co-ordinator of projects between the 'clients' and the maintenance organisation. We consider that, once policies, objectives and priorities have been translated into specific key tasks, then it is the responsibility of the maintenance organisation to implement any maintenance and development work arising from them, including the liaison with heads of departments, and co-ordination of activities necessary to bring to a satisfactory conclusion any project undertaken.

6.1.39, 6.1.40 We disagree with the proposal that 'co-ordination' of any project undertaken by a maintenance organisation should be carried out by a technical officer within whose province the major part of the project falls. We consider that this basis is too rigid, and the criteria on which it might be decided too nebulous, for the purposes of effective management. We believe that the need to lay down a rigid procedure in such situations only arises in HMCs where building maintenance is separated from all other aspects of maintenance and operation of services. In a fully integrated maintenance organisation, arrangements for co-ordination of any single project would be decided by the chief officer on the basis of capability and availability of staff related to the total work load. In such an organisation (many of which already exist in the hospital service), one could expect to find a building supervisor or assistant building supervisor co-ordinating a project in which the major content of work could be engineering. The same arrangement might also apply with engineering staff in the case of building works.

6.2.3–6.2.5 The report makes proposals for the introduction of a number of new grades of building maintenance staff and refers to the 'analogy' which exists between building and engineering maintenance staff gradings.

The report infers that there is a need to equate the proposed new building-maintenance staff grades with those of engineering grades, but without submitting any tangible evidence to support the necessity. The existing engineering staff structure in the maintenance and operational field has been developed in gradual stages over a period of more than 20 years. Each stage of the development and subsequent introduction of new grades of staff has been directly related to realistic need supported by ample evidence before gaining national recognition. We cannot see evidence in the report which substantiates the recommendation to equate a staff structure for the single discipline of building maintenance with the several disciplines involved in engineering maintenance. Although we entirely agree that engineering and building maintenance are integral parts of a common function, there are several aspects of engineering maintenance which require an entirely different staffing arrangement, particularly in the operational field and the increasing number of specialist technical fields.

The Regional Engineers Association

The Association supported the formation of the Committee of Inquiry on Hospital Building Maintenance, and generally welcomes the report. There are, however, reservations on a number of issues, and there is one major policy point which the Association finds unacceptable.

We note that the Committee extended their report far beyond their terms of reference. Although we appreciate that the Committee may have been in a situation of some difficulty, we regret that in substantially widening the basis of its deliberations it failed to realise the need for amended terms of reference, extended membership, and the necessity of calling for evidence pertinent to such extended terms of reference, in order to establish a sound basis for their subsequent recommendations.

It appears from the content and date of the report (February 1970) that the publication of the second Green Paper on the 11th February 1970 caused the Committee considerable difficulty. The comments of the Comptroller and Auditor General and staff pressure required early completion of the report, but uncertainty about the future structure of the Service indicated the need for caution, and for further consideration of basic organisational needs, if the recommendations were to be wholly relevant.

Maintenance is important, indeed vital, to the work of hospitals. It is not, and must never be considered as, a separate function. Although this view is almost unanimously accepted, it is less widely appreciated that the organisation and management of maintenance must therefore be carried out in parallel with the general organisation of the hospital service. In the absence of firm knowledge of the overall reorganisation proposed for the health services, the exercise of recommending a revised organisation for building maintenance is therefore seen to be interesting but unprofitable.

The roles of building and engineering have been established over the 22 years of the NHS. The fundamental need is for medical and nursing staff to be provided with buildings which are efficiently maintained. It is our view that this can best be provided by integrating this function within the larger responsibility for the continuous operation, maintenance and renewal of the vital engineering services on which all modern medicine depends. The desirability of the 'integrated works department' is accepted by the Committee, but only as part of their longer-term recommendations. This is despite the fact that the great majority of HMCs already operate such a system under the overall management of the group engineer. It is our considered view that the Committee has made a unilateral review of the system; that its report has been influenced more by its concern for the interests of the building trades than by the overriding needs of the Service. The proposal to create a further HMC chief-officer category is, in this case, totally against modern management principles. The separation of the building function with the expressed intention of its subsequent reintegration in the 'longer term' may suit building supervisors, but cannot be in the interests of the Service.

Nonetheless, the Association supports the need, in the larger units of administration which are now developing, and which are likely to be perpetuated or increased under any reorganisation, for building skills at HNC level, and for these to be remunerated at salaries comparable with similar levels of responsibility outside the Service. The Association does not agree that such posts are required at the present smaller HMCs, and would limit recruitment of more highly qualified staff to raising the figure to the 'about 90' referred to by the Committee. It must be remembered that there were 240 building supervisors in post in England and Wales in March 1969, and that 63 of these held higher qualifications. It is therefore essential to make a manpower survey of existing staff against the firm knowledge of future organisational requirements before a recruiting policy is launched, to avoid the certainty of downgradings if the number of main units of administration is reduced.

Similarly, the Association strongly supports the necessity for good training facilities, although it feels that the role of the CITB has been overstated to the detriment of the special requirements arising within, and needing to be met from within, the Service.

The attempt has sometimes been made to estimate building responsibility relative to engineering by a comparison of maintenance expenditures. This has failed to take into account a number of major factors, and has totally excluded the costs of operating the engineering services. Building maintenance is relatively simple, involving a comparatively low level of technology; a very high proportion of its cost arises solely from repetitive painting and decorating. The effect of neglect of maintenance is a very slow deterioration of the asset, and loss of use does not arise. In comparison, engineering maintenance is a continuous process of high technological content, continuously required if the multiplicity of engineering services is to be available in support of the medical and nursing effort. Whereas building maintenance measured in cycles of may be a year, the comparable figure for engineering is in terms of weeks and, exceptionally, of days. Although it is not appropriate to develop a comparison fully in this document, it is worth noting that the relative responsibilities in hospitals are reflected by an expansion of most householders' own direct experience. The fabric of a house requires little building maintenance. Decoration forms the mjor part, and there is little that is beyond the capacity of the average occupier. This, however, is far from true of even the unsophisticated domestic engineering services of electric lighting, heating, hot water, television, refrigeration, household machinery etc. which it contains.

Although the conflict which will arise from the initiation of the comparison between building and engineering responsibilities by the Committee is to be regretted, it is necessary that the analogy it assumes should immediately be refuted. It is particularly unfortunate that the Committee has failed to comment on the submissions made to them giving information on the maintenance structures adopted outside the public services. It is highly significant that, in cases where the engineering services are of comparable importance, an integrated structure headed by an engineer has been adopted almost without exception. The hospital service should be prepared to take advantage of the wide range of operational and maintenance experience gained in industry and commerce.

There is a general indication running through the report of the existence of a crisis in the maintenance of hospital buildings. This is not true. Despite the very considerable and increasing pressures on revenue funds, standards of maintenance are higher than ten years ago, and show outstanding improvements on conditions just over 20 years ago when the buildings were taken over.

However, it is true that there has been a general failure to implement many of the general recommendations of HTM 12 on the administrative aspects of organising the maintenance of buildings. This failure arises principally from the lack of adequate resources at HMC level, where the conflict between direct clinical needs and supporting services is resolved. The Committee's report is inherently designed to meet not only the Comptroller and Auditor General's observations, but also the requirements of building maintenance under ideal conditions of unlimited finance. Transferring to a higher level of management any decision making on the priority of building maintenance relative to other and more direct hospital functions must be a matter of major policy. The major difficulty is, of course, reconciling central direction and accountability with decentralised management. It is, however, difficult to reconcile the greater expenditure on building maintenance inherent in the recommendations of the report with the decisions reached during the last 20 years at the practical level of hospital and HMC, and the constantly rising standards of building maintenance that have resulted.

Although individual officers have left the Service, the figures of recruitment and staff turnover do not support the allegation of general drift and declining morale. Some degree of change of staff with commerce, industry etc. is, in fact, welcomed as encouraging cross fertilisation of ideas and experience. The returns of building staff show a continuing increase in the number in post, and it is highly significant that the proportion of staff holding the HNC is rising sharply, although this is not a requirement. It is impossible to reconcile these facts with the allegation generally made throughout the report that the conditions, rates of pay etc. of building supervisors are inhibiting recruitment.

Nevertheless, the Association is sympathetic to the claims of building supervisors for better pay, conditions of service and training facilities, but cannot agree that this claim should be based or assessed on the unsupported assumption that their responsibilities are similar to those of engineers. The introduction of this comparison by the Committee is totally new to the Service, and is directly responsible for very considerably increasing the conflict of interest, the extent of which the Committee considered to be minimal. The principle of such a comparison has never been accepted within the Service, and it is extremely unfortunate that it is being raised. It was an issue very carefully avoided by the Tyler Committee when dealing with the engineering structure in 1962. Once raised, it necessarily leads to precisely that friction which must be avoided if the general interests of hospitals are to be best served. It is particularly unfortunate that a comparison should have been made of changes in the pay relationship of building supervisors and group engineers since 1951, because this is totally invalidated by the failure to assess subsequent changes in duties. It is broadly true that the building-maintenance commitment has hardly altered since that date, but engineering responsibilities have increased enormously. At that time, for example, typical ward services were limited to a row of central lights and a power socket near the door. Now the majority of beds require individual lighting, multichannel radio, and the clinical supporting services of medical gases, nurse-call systems and power supplies. In other hospital departments, e.g. X ray, pathology, theatres, laundries etc. the development has been even more pronounced, and has totally altered the earlier concepts of engineering responsibilities.

We do not agree that planned maintenance is more applicable to mechanical and electrical engineering than to building maintenance. The development and application of this technique is a difficult and time-consuming management task, and so there has been considerable reluctance to apply this engineering technique to those sections of the building maintenance for which it is appropriate.

Paragraph 6.1.10 is presumably a drafting error, as it implies that the building supervisor should operate engineering.

The method adopted by the Committee for determining a suitable staffing structure is by analogy with the existing engineering organisation. This is illogical since the duties are dissimilar; building includes no element comparable with the responsibility of keeping operational the working engineering services of a hospital.

The proposal to establish the grade of 'Hospital Building Officer' indicates particularly strongly the illogicality which results from the adoption of a parallel organisation when the needs are different. The post of hospital engineer arises from the inherent needs for a senior engineer to supervise on site the day-to-day operation, rather than maintenance, of the engineering services. In the absence of such an operational task, and with the greatly reduced maintenance load for the building elements, the location of a senior building officer at hospital level is totally uneconomic, and cannot be justified. All experience to date indicates that, where building staff are directly employed, they can only achieve an economic level if they are centralised as a group service, and indeed this point is recognised by the Committee. The local siting of building staff is therefore impossible to justify on the basis of the needs of the service.

A further new post which has only been justified on the basis of analogy with engineering is that of Deputy Building Supervisor. Although the Committee records that their recommendation for this post 'assumes that this does not run counter to current organisation theory', there has been no attempt to analyse the work load and to develop a logical structure. It is highly probable that such an investigation would indicate that the creation of this post, in the absence of the 24-hour operational needs of engineering, would inhibit the development of an economic and functional organisation.

It is disappointing that the review of directly employed labour (d.e.l.) against contract work has not led to clearer advice. We consider that the use of d.e.l. should be strongly discouraged for all work other than that of an emergency nature.

In view of the considerable investigations by the DHSS, and the extremely detailed published recommendations on engineering maintenance, it is very surprising that the Committee can comment that it is 'forced to record that there is no commonly accepted standard of . . . engineering maintenance'.

It is inevitable that our criticisms should occupy more space than our comments supporting the report. Such a volumetric assessment of our views would be wrong, for the majority of the report represents balanced assessments founded on careful investigation. Nevertheless, it must be in the ultimate interests of both building maintenance and building supervisors that the few areas of error should be delineated as early as possible.

---

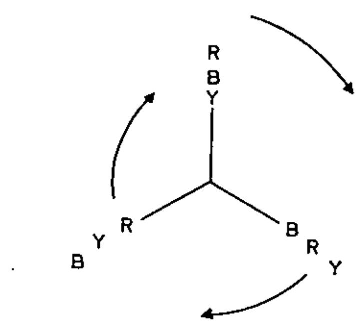
* Postbox *

Dear Sir,

With reference to Mr. Egley's articles on electrical-installation testing, although the author does not claim that his articles are a complete treatise on the subject, I feel that the subject of phase testing has not been dealt with sufficiently. As it seems unlikely that it will be referred to again, I would like to make some remarks on this particular aspect of the subject.

One has to take the word of the supply company as regards the correct marking of the phases of the main incoming cable. But at all internal distribution and switchboard sections, 3-phase outlets and 3-phase motors, *identification* as well as phase-sequence tests should be carried out. A sentence in Paragraph 2.3.3 reads: 'During the tests observe that cable ends are correctly marked'. This cannot be done unless you know the incoming phases—regardless of their colour marking. This must be done by testing.

The phase-sequence test described does not *identify* the phases. Any one of the three colour combinations shown below will indicate the same rotation.



Yours faithfully,

B. G. Palmer (Retired)

STRUCTURAL FIRE PROTECTION

by C. S. SHAW

Structural fire protection in modern hospitals is generally of a very high standard, but the same cannot always be said of some of the older buildings. This article is intended to explain the principles used in modern construction, which should be aimed at wherever possible in older hospitals.

In spite of precautions, a fire may break out. It may get out of control, in spite of efforts by the staff. And it may start to spread. If this happens, the structure of the building could be the last line of defence.

Fire can be an unpleasant enough experience for healthy people, but for hospital patients it could be a severe strain on their mental and physical resources. They must be guarded from this; ideally, they should not be aware that anything is amiss at all. If patients need to be moved, this should not mean anything more than transferring them from one area to another *on the same level.* If structural fire protection is adequate, complete evacuation, involving vertical movement, should only rarely be necessary.

The intention of structural fire protection is to confine any outbreak to as small an area as possible, to buy time for unhurried evacuation of affected areas, and to enable the fire brigade to fight the fire on its own terms. This is achieved by compartmentation—dividing the building into a number of firetight compartments which will withstand a complete burnout of their contents.

The Ministry of Health feels that compartments should be no greater than one storey in height and 20 000 ft^2 in area; in Scotland the corresponding figure is 15 000 ft^2. This is the absolute maximum, and it suggests that such compartments should be divided into smaller fire-resisting subcompartments within the main ones.

Mr. Shaw is the Press Officer of the UK Fire Protection Association

Structural elements—load-bearing walls, floors and structural frames of the building and of main and subcompartments—should be able to contain a fire, without collapse or penetration, for at least 1 h for buildings up to 90 ft high, and for $1\frac{1}{2}$ h for higher buildings. In below-ground areas, the figures are $1\frac{1}{2}$ and 2 h. Such figures are by no means difficult to achieve. For example, an ordinary load-bearing brick wall, 8·5 in thick, can resist fire for at least 6 h, and, at the other end of the scale, 3 in load-bearing reinforced-concrete wall will resist fire for 1 h.

Structural steelwork is prone to early failure in a fire, and needs to be protected. A $\frac{5}{16}$ in layer of sprayed ' limpet ' asbestos will protect a steel column for an hour, and, by correct choice of the thickness and materials used, steelwork can be given a fire resistance of 6 h or more.

The doors in any compartment or subcompartment wall should generally have a fire resistance equal to that of the wall in which they are fitted, if the principle of compartmentation is not to be prejudiced.

High-fire-risk areas such as stores, laboratories and boiler rooms should be separate compartments, preferably separate buildings. Storage compartments or subcompartments should be limited to a volume of 50 000 ft^3, or 20 000 ft^3 if in a basement. Good ventilation is important. Flammable-liquids stores should be non-combustible, and should have a doorway sill which will contain all the contents with a 10% safety margin.

The main areas of high life risk are, of course, the wards themselves, which should be in compartments separate from all other parts of the building, including corridors and staircases. As already stated, they should be so constructed that, in the event of fire, patients can be moved horizontally from one compartment or subcompartment to another.

The Ministry of Health recommends that no point in any compartment should be more than 100 ft from another compartment, subcompartment or staircase. If alternative escape routes cover common ground for part of the way, this common ground should not be more than 50 ft long. Subcompartments greater than 2000 ft^2 in area should have at least two exits.

Every floor should be served by at least two staircases, except where the top floor is less than 20 ft above the ground *and* is less than 2000 ft^2 in area, where one staircase may be acceptable. No such concession is given in Scotland, where there must be two staircases in all circumstances.

Staircases, lift shafts, ducting and roof voids also need protecting on the compartmentation principle, since they can spread flame and smoke extremely rapidly, hampering escape, causing panic and perhaps endangering life. The fire resistance of staircase compartments or lobbies should be equal to that of adjoining compartments, though their doors need only have a fire resistance of at least half that of the walls, or half an hour, whichever is the greater.

Basements require special precautions, because basement fires can be especially troublesome. Poor ventilation, coupled with the likelihood of delayed discovery, means more heat and smoke and greater difficulty with fire fighting. These factors make it vital that any fire which does break out is prevented from spreading upwards.

If the building has only one staircase, it should not lead directly to the basement; access should be by a separate staircase, leading directly to the open air. However, if there are two or more staircases, one may lead direct to the basement, provided that it is fully enclosed and protected by lobbies at ground and basement levels.

Should the worst happen, and a staircase becomes smoke-filled, the smoke may spread into corridors and compartments if it cannot rise further. Besides endangering patients and staff, this will also hamper fire fighting, and it must be removed. Windows and vents will help to achieve this, but in buildings with floors higher than 60 ft additional means should be provided.

Lobbies for staircases should be provided on every level in buildings more than 60 ft high. At ground level, staircases should have access to the open air, either directly, or by a protected corridor. The aim all the time is to minimise the chances of smoke or flame spreading from one floor to the others.

Lifts should *not* be regarded as part of an escape route, as they may become affected by fire. They must nevertheless be considered, because they can affect the fire spread within the building in the same way as a staircase. Any lift system involving a vertical shaft communicating with all floors is a potential ' chimney ' which, unless properly protected, could prove extremely dangerous within minutes of an outbreak starting.

The worst type of lift shaft is little more than a series of holes on each floor, surrounded by a ' birdcage ', This offers no resistance whatever to the spread of fire or smoke, and the enclosed shaft with trellis gates on each landing is little better.

A lift shaft must be a compartment in its own right if it is not to prove a dangerous liability. The shaft or lift area should be surrounded by an enclosure with a fire resistance of $1-1\frac{1}{2}$ h, depending on its height, and the doors on each landing should have a rating of at least 30 min. Again, there is a risk of smoke-logging, and there should be 1 ft^2 of vent area at the top of each lift shaft. The shaft itself could be the starting point for a fire if the lift motor room is wrongly sited or inadequately protected. Ideally, it should either be at the top of the shaft or should form a compartment separate from the shaft, with small openings for ropes and cables. In either case, there should be ventilation to the open air.

There are other, perhaps unexpected, ways in which fire can spread—through service ducts and roof voids, for example. A fire in, say, the boiler or transformer room could spread into wards or other parts of the building through air-conditioning trunking or wiring ducts if they bypass the compartmentation system. The answer to this, of course, is that they must not. They should be compartments in their own right, with a fire resistance equal to that of the compartments they pierce. Where ductwork passes through compartment walls or floors, automatic steel shutters will lessen the chance of flame or smoke spreading between compartments.

Roof voids can be almost as dangerous a feature as unprotected staircases or lift shafts, but here, of course, the danger is of horizontal spread over several compartments. If the topmost ceiling has an inadequate fire resistance, the remedy is to continue the compartment walls up through the ceiling as far as the roof itself. Naturally, any openings in the roof-void compartments must be protected by doors of a similar fire resistance to those below.

Suspended ceilings are another consideration. Their use is often entirely aesthetic, being one of the most common ways of ' modernising ' an old building at comparatively little cost. Unfortunately, they can create a fire hazard; the similarity with a roof void can readily be seen. For the purposes of fire protection, there are only two types of suspended ceiling: those which are intended to contribute to the fire resistance of the floor above, and those which are not. In the former case, the design and construction must be such that the ceiling does not collapse or joints fail if the supports become affected by heat. Again, compartment walls should be carried through the ceiling to the underside of the floor above. Because the ceiling void will be carrying services which may in themselves constitute a source of ignition, it may be advisable to have additional fire stopping.

Suspended ceilings which are not part of the fire protection of the building must certainly not contribute to the fire hazard. Early collapse of the ceiling must be avoided, and materials should be noncombustible, or have a very low surface spread-of-flame characteristic. Similarly, combustibility of the contents of the ceiling void should be as low as possible. Good fire-stopping of this type of ceiling is especially important.

Finally, there are the internal linings and finishes, which should wherever possible be noncombustible, and should not involve the creation of hidden voids. This could happen in an old building, where the panelling could be boarded over for the sake of easier cleaning and a more modern appearance. Only noncombustible materials are acceptable as linings to staircases, corridors and passages which form part of an escape route, although linings with a low surface spread-of-flame characteristic may be used in wards.

This article has covered very briefly the aspects discussed in a very useful publication, ' Hospital design note 2: *Protection against fire* '. Those who wish to know more about fire protection in hospitals may obtain this and other Department of Health publications from Her Majesty's Stationery Office.

change is evident for several days with a particular solution. When the water then reaches a concentration or temperature at which scaling would normally take place, precipitation, in the form of a flocculent loose sludge occurs instead. This sludge is easily removed by strainers, or, in the case of a boiler, by a simple blowdown technique, as would be used if conventional chemical treatment were employed.

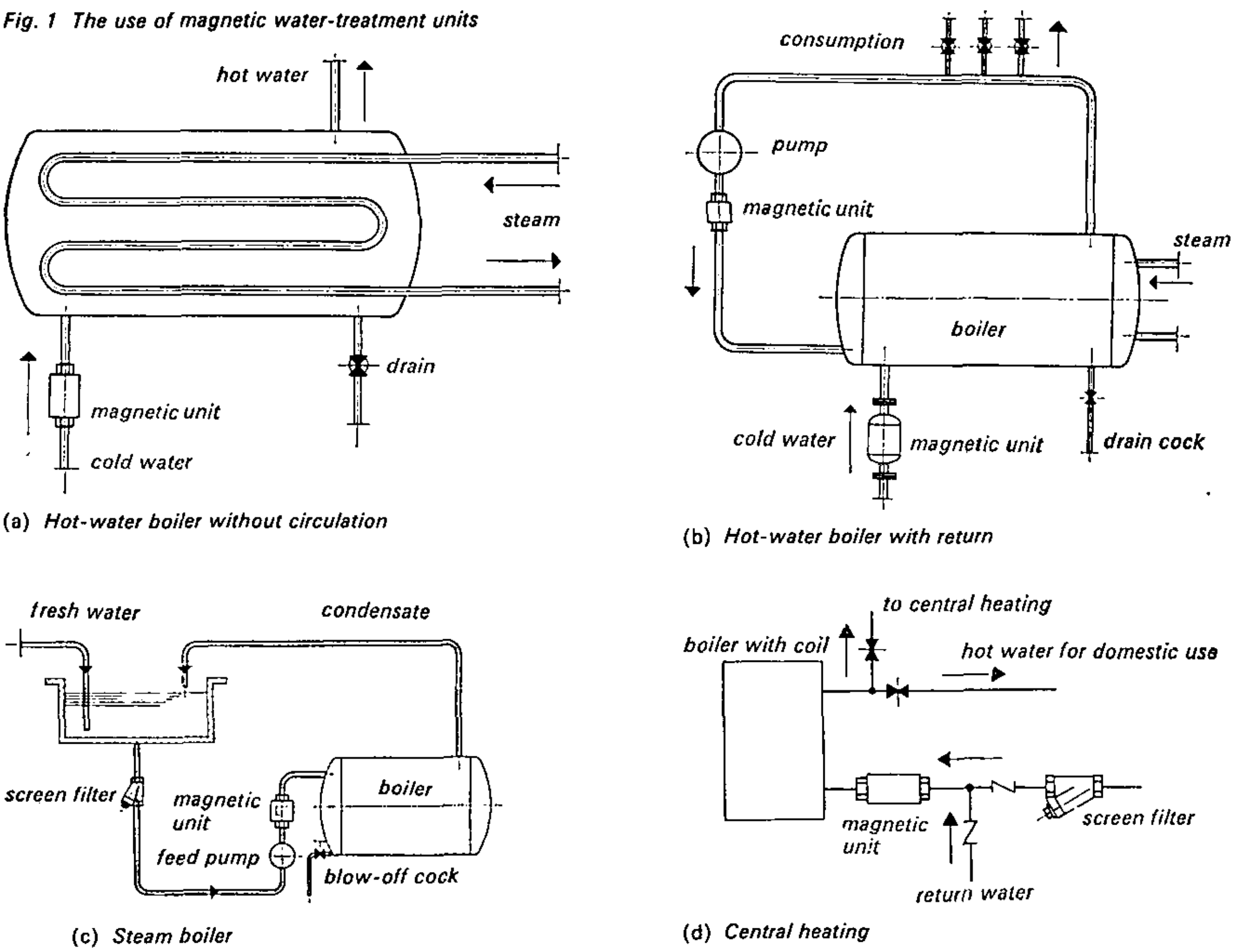
The advantages over conventional treatment are that no chemicals are needed and no analysis of the water is required. The permanent magnets in the unit never age and have a virtually unlimited life. The only regular attention needed is the periodic cleaning of the various filters and strainers, and of the magnet gap itself. The labour requirement of this is very small compared with the constant attention required by conventional dosing and ion-exchange plants.

The installation of the plant is a specialist job, and the maker's advice must be followed to obtain maximum efficiency of operation. If, however, such a plant is installed and operated correctly, it will work remarkably well with even very highly polluted waters. It is by far the cheapest of all water-treatment methods from the point of view of running costs, and a unit capable of treating 5500 gal/h (25 m^3/h) costs only about £250 initial outlay.

Possible uses in hospitals include the following:

Water treatment of the main boiler feed-water supply
Even extremely impure grades of water can be used, as there is no tendency towards scaling after the water has passed through the magnetic field. The sludge can be removed from the boiler by a standard blowdown technique.

Fig. 1 The use of magnetic water-treatment units



Hot-water supply to wards, theatres etc.
Scaling in supply lines, tanks etc. is avoided absolutely. The sludge precipatates formed are easily filtered off.

Treatment of condenser water to air-conditioning systems
Magnetic treatment is particularly suitable, as the quantities of water tackled are usually large, and the water employed usually has a high concentration of hardness salts.

Acknowledgment

The author acknowledges his indebtedness to CEPI Ltd. of 46 St. James Place, London SW1, for help in the preparation of this paper, and for supplying the illustrations.

Classified Advertisements

For full information, please write or telephone:
Classified Advertisement Department, *HOSPITAL ENGINEERING*
Peter Peregrinus Ltd.,
PO Box 8, Southgate House,
Stevenage, Herts, England.
Telephone Stevenage (s.t.d. 0438) 3311, ext. 27

OFFICIAL APPOINTMENTS
SITUATIONS VACANT
MISCELLANEOUS

APPOINTMENTS AND SITUATIONS VACANT

Department of Health and Social Security

ENGINEERS

(ARTIFICIAL LIMBS AND APPLIANCES) UP TO £3176

Two posts, demanding initiative and adaptability, in the Department's Scientific and Technical Services Branch. The posts are based in Roehampton, London but will involve some travelling.

The work is concerned with surgical appliances and other aids, including artificial limbs and body supports, and also items of hospital equipment such as patient-lifting devices and beds.

The successful candidates will liaise with centres conducting research and evaluation, act as project officers for sponsored work, and generally contribute towards the achievement of satisfactory design and construction for production purposes.

Candidates must be either corporate members of the I.Mech.E., I.Prod.E. or I.E.E. or holders of engineering degrees with appropriate experience. They should have experience of design and/or production control and a sympathetic approach to the disabled.

Starting salary will be within the scale £2434–£3176 according to qualifications and experience. Noncontributory pension.

For full details and an application form (to be returned by the 27th October 1970), write to Civil Service Commission, Alencon Link, Basingstoke, Hants., quoting reference **S/7542/70**

BOARD OF MANAGEMENT FOR GLASGOW MATERNITY AND WOMEN'S HOSPITALS

APPOINTMENT OF GROUP ENGINEER

Applications are invited for the post of GROUP ENGINEER to be responsible for all the engineering services in the Royal Maternity Hospital, Rottenrow, Glasgow C4 (188 beds), the Royal Samaritan Hospital for Women, Coplaw St., Glasgow S2 (184 beds) and Redlands Hospital for Women, Lancaster Crescent, Glasgow W2 (101 beds), and premises associated therewith. The salary scale is £1977 × 63(2) × 66(1) × 63(2) to £2295 p.a. (12½–24 points range), plus a responsibilities allowance at present assessed at £108 p.a. Candidates should hold one of the undernoted qualifications, but an equivalent qualification may be approved. Engineers already in the hospital service, who have less than the stipulated qualifications, may also apply, but such a candidate, if appointed, will require to be employed at an abated salary.

- (i) Higher National Certificate or Higher National Diploma in mechanical engineering with endorsements in industrial organisation and management and principles of electricity or electrotechnology, if this was not taken as a subject of the course: or
- (ii) Higher National Certificate or Higher National Diploma in electrical engineering with endorsements in industrial organisation and management and including (at SIII or O2 level, or with endorsement in) applied heat and applied mechanics, provided he has suitable practical experience in mechanical engineering: or
- (iii) City & Guilds mechanical engineering technicians full technological certificate (Part III) which must include plant maintenance and works service.

Applications giving full details of training and experience, stating age, and naming two referees must reach the secretary of the Board at 64 West Regent Street, Glasgow C2 not later than 10 a.m. on Monday, 19th October 1970

ASSISTANT ENGINEER

Applications invited for above post for duties at Naburn, Fulford and Maternity Hospitals (all on one site) in York. Previous applicants for this post are being considered and new candidates should have completed an apprenticeship in mechanical engineering, have a sound knowledge of steam boiler plants with a wide experience in the management of mechanical and electrical engineering plant similar to that in modern hospitals. Applicants must hold an ONC in mechanical or electrical engineering.

Salary: £1251 per annum rising to £1650 per annum.

Apply giving full details of age, education, qualifications and experience together with the names of two referees to the Group Engineer, Bootham Park, York

NORTH-WEST METROPOLITAN REGIONAL HOSPITAL BOARD

Technical Assistants (mechanical, electrical or heating and ventilating) required to carry out the design of engineering installations.

Applicants for Technical Assistant I and II must have HNC or ONC or equivalent qualification, plus relevant experience of 10 years and seven years, respectively.

Applicants for Technical Assistant III must have ONC plus four years experience. Exceptionally, applicants with three years relevant experience can be considered for entry to this grade.

Salary scales (including £90 London weighting):

Technical Assistant Grade I
£1871–£2280 Ref. 235

Technical Assistant Grade II
£1566–£1811 Ref. 236

Technical Assistant Grade III
£ 922–£1542 Ref. 237

Application form from the Secretary, North-West Metropolitan Regional Hospital Board, 40 Eastbourne Terrace, London, W2, quoting appropriate reference number, returnable by the 26th October

GREENWICH & DEPTFORD HOSPITAL MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER

Engineer with experience of labour supervision and plant and environmental-engineering services required, to act as deputy to present Group Engineer, with base at the new GREENWICH DISTRICT HOSPITAL, Vanbrugh Hill, London SE10. Applicants should be qualified, and full details, together with job description are obtainable from Group Secretary at hospital (telephone: 01-858 8141, ext. 683). Engineers of mature age without required qualifications, but with experience with either consulting engineers, a large contracting organisation, military-service engineering or, alternatively, a large hospital or factory with a complex of modern environmental-engineering plant and services, would be considered. Salary £1932 rising to £2235 p.a. FURNISHED FLAT AVAILABLE AT REASONABLE RENT IN NEW HOSPITAL TOWER BLOCK. Applications, giving details of qualifications, experience and naming two referees, to Group Secretary by the 23rd October 1970

CRAY VALLEY & SEVENOAKS HOSPITAL MANAGEMENT COMMITTEE

HOSPITAL ENGINEER

required for duties in the Sidcup subgroup of hospitals involving three hospitals and group laundry, based on Queen Mary's Hospital, Sidcup (365 beds). Post vacant owing to promotion of present holder. A new maternity department and residential accommodation are already in use and the remainder of the building of a new 500-bed District General Hospital has now commenced. The post will offer valuable experience to a person who wishes to further his career and attain higher posts in the Hospital Service.

Candidates should hold the following qualifications:

- **City & Guilds Mechanical Engineering Technician's Certificate, part 2, which must include plant maintenance and works service,**

or

- **City & Guilds Certificate in Plant Engineering or Ministry of Transport 1st-class Certificate of Competency if it includes an Ordinary National Diploma or Ordinary National Certificate.**

Salary scale £1800–£2091 per annum, inclusive of responsibility allowance and London weighting. An unfurnished 3-bedroom detached house is available for the successful applicant. Applications, with full details of age, experience, qualifications and the name of two referees, to: Group Engineer, Orpington Hospital, Orpington, Kent BR6 9JU. Closing date: 16th October 1970

APPOINTMENTS AND SITUATIONS VACANT

MISCELLANEOUS

Printed in England by C. F. Hodgson & Son Limited, 23 Pakenham Street, London WC1

Index to Advertisers

Please mention 'Hospital Engineering' when replying directly to advertisers

Reader Information Service

If you are interested in any of the products mentioned or advertised in this issue, please make use of our information service. Simply encircle the relevant numbers on the prepaid card which appears in this issue, fill in your name and address, and post the card to us. You will quickly receive full details, without obligation.