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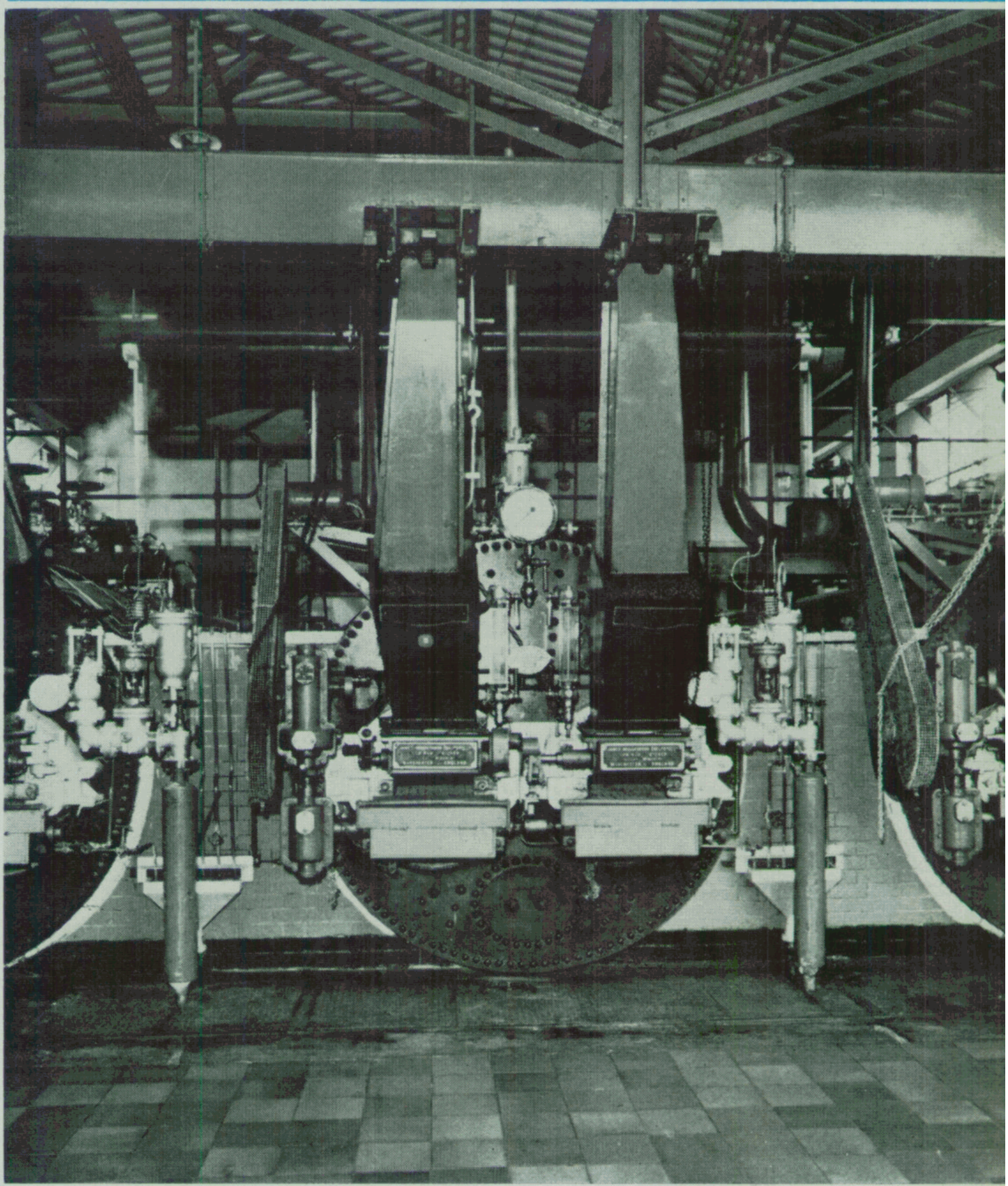
# Hospital Engineering

SEPTEMBER 1975

INTERNATIONAL FEDERATION ISSUE



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INTERNATIONAL FEDERATION ISSUE

No. 15

HE

# Hospital Engineering

Incorporating 'The Hospital Engineer'

**Vol. 29**
**September 1975**

The Journal of The Institute of Hospital Engineering

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*Front cover: Corbett Hospital, Stourbridge, England, has three coal-fired Lancashire boilers rated at 1783 kW. They burn about 2500 t of coal per annum (photo: National Coal Board)*

INTERNATIONAL FEDERATION ISSUE
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# Preventive maintenance in hospitals

by EDUARDO CAETANO
EL. Eng. (FEUP); Pres. A.P.E.H.;
Dir. S.I.E. (M.S.)

With a modern hospital representing huge sums of money, both in capital and running costs, the use of preventive maintenance can give considerable savings. More importantly, the prevention of equipment failure can help decisively to preserve patients' lives and to minimise suffering. The ideas expressed here are the results of the author's 25 years of experience in hospital engineering in Portugal, but the conclusions are equally applicable to other countries.

The old aphorism 'It is better to prevent than to cure' not only synthesises the vivid experience of people through the centuries, but also sounds rather logical.

It is also true when applied to hospitals since it has been noticed that, in some hospitals where there was not any preventive maintenance, the cost of 'curative' maintenance alone was higher than the total cost of both types of maintenance after the preventive type was introduced.

This article is based on a lecture by Mr. Caetano at the 3rd International Conference of Hospital Engineering

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Because a modern hospital represents huge sums of money, both in capital and running costs, using preventive maintenance will provide considerable savings. Therefore it may be said that preventive maintenance is a profitable investment.

Apart from the technical aspects (keeping buildings, engineering services and equipment in good running order) and the materialistic side (making a sizable profit) using preventive maintenance, there is the much more important human angle. Preventive maintenance, by avoiding most equipment failures, can help decisively to preserve patients' lives and minimise their suffering. Although some cynics will give a value to life, obviously, the truth is that life is priceless.

### Characteristics

The principal and basic characteristics of preventive maintenance are planning and time. Maintenance must be organised well in advance and performed according to a studied and approved plan taking the necessary and scheduled time to carry out each job.

To plan and to perform preventive maintenance adequately in a hospital, it is necessary to have:

- hospital projects, drawings, plans and schematic diagrams
- operating and maintenance instructions
- spare parts
- measuring and control apparatus and the appropriate tools
- a workshop
- qualified personnel.

In old hospitals it is quite common to be unable to find plans, projects or drawings of buildings and engineering services; sometimes, even the instruction manuals of the newest equipment disappear!

Good planning will make the best use of time, and will avoid 'deadtime'. All work is scheduled and must be performed regularly so as not to upset the planned rhythm. Good planning allows some spare time for unforeseen complications, so that everything will be on schedule.

Preventive maintenance applies to four main groups:

- buildings
- engineering services
- general equipment
- medical equipment.

Since the specific preventive-maintenance characteristics of each group are rather different, especially between those concerning medical equipment and the others, the solutions to the problem will vary accordingly. At present in Portugal, it is as follows:

- Preventive maintenance of buildings is performed usually by outside contractors under the supervision of the SIEH (Hospital Installations & Equipment Service) or the regional service; only small tasks are executed by the hospital through its own SIEH.
- Preventive maintenance of engineering services is carried out customarily by the hospital SIEH itself, with the exception of a few complicated items taken care of by regional or central services (Portuguese Ministry of Health).
- Preventive maintenance of general equipment is executed normally by the hospital SIEH (sometimes with the help of the regional service).
- Preventive maintenance of medical equipment depends on its complexity: that of simple medical apparatus is done by the hospital SIEH, but more complicated or sophisticated medical equipment is assisted by regional or central services and partially by suppliers (in large hospitals).

Other characteristics of preventive maintenance are perfection and control. If it is not performed perfectly, it will become more or less worthless; so that when checking vital points, certain parts or materials must often be replaced to avoid trouble later, even if they look normal.

Obviously it is necessary to control preventive maintenance both quantitatively and temporally.

## Preventive and curative maintenance

Curative maintenance is always urgent and must be performed immediately in certain cases, e.g. when a failure occurs in a ventilator to which a patient is connected.

Although some curative maintenance can be anticipated, e.g. in certain old equipment where repetitive failures occur, in general a deficiency shows up unexpectedly especially in new equipment or in engineering services of new hospitals.

Because preventive maintenance anticipates the occurrence of most failures, its work is smooth and it does not disturb hospital life as curative maintenance often does.

Consequently, preventive and curative maintenance are different but one may think of them as complementary.

They act as if they were inversely proportional to the maintenance of equipment and engineering services. Good and intensive maintenance of most equipment and engineering services decreases drastically their otherwise normal curative maintenance.

With the exception of buildings and eventually of parts of medical equipment, the same hospital maintenance personnel should perform both types of maintenance. When hospital personnel are performing preventive-maintenance work, they may be called at any time to do an urgent curative maintenance job. Therefore it may be said that hospital maintenance personnel must be on standby all the time as far as curative maintenance is concerned, even when their function is to perform preventive maintenence on a permanent basis.

## Normalisation on preventive maintenance

Normalisation means less time spent in maintenance work and therefore fewer personnel to achieve the same goal. Replacements of standardised elements or parts are easier and done more quickly than those not standardised. Normalisation also means less money invested in spare parts or materials not only because they are cheaper but also because the total quantity of the items is lower than the global sum of different types of items necessary to perform the same aim.

In a country like Portugal where hospital equipment from manufacturers all over the world is freely bought and sold, maintenance becomes more confused, difficult and costly. To make things easier, it would be advisable to select certain types of equipment (e.g. pulmonary ventilators, operating lights, cardiographs, etc.) from certain reliable manufacturers only and even accept the risk of being accused of bias towards them. Although this solution is unacceptable today, it is possible that it will become normal practice in the near future so that the many disadvantages of current practice can be avoided.

Probably, it would be rather difficult and practically impossible to standardise all medical equipment since there are many manufacturers in a number of countries unwilling to do so, mainly to protect themselves from foreign competition. However, manufacturers could use standardised components or parts as an effort towards a future, although yet somewhat platonic, hospital-equipment standardisation. The IFHE could be very usefully employed issuing technical recommendations.

Because everything concerning hospitals is very expensive and skilled manpower becomes more and more scarce, one may say, like W. Tatton-Brown, that 'rationalization, standardization and factorization' has to be the hospital policy in the future.

Although it is still relevant to ask whether strong standardisation would be helpful or harmful as far as technical research and progress are concerned, let us hope that normalisation will not be a mere word but a fact, in the times to come, for the benefit of patients.

## Preventive-maintenance personnel

Would it be advisable, in hospitals, to allocate certain personnel whose sole function is that of preventive maintenance? The answer is yes and no, depending on the hospital size and the nature of preventive maintenance to be practised. Yes, for building (partial) and some engineering services in a hospital group or in a single hospital big enough to be able to support personnel dedicated to preventive maintenance only. No is the answer for the average hospital or for preventive maintenance of specialised equipment. Today even large hospitals cannot afford to keep highly specialised technicians permanently on their staff. They would be underworked if they had to perform only the preventive maintenance of their specialties and this therefore is economically inadvisable.

At present, two or three electronics engineers plus one biomedical engineer on the staff would cover satisfactorily most of the specialised equipment in a hospital. It can be expected that in the future there will be hospital technicians devoted entirely to preventive maintenance of most engineering services and equipment. However, what seems more advisable today is to give both preventive and curative jobs to the same technicians, either electronics and electrical or mechanic. If, for example, a steam technician is performing preventive maintenance and a failure occurs in another part of the hospital, he must quit the work he is doing and repair (cure) the failure immediately. This example can be generalised, especially in the case of medical equipment.

Hospital-maintenance personnel are rather scarce, especially when it comes to hospital medical-equipment technicians. There are two principal reasons: the unattractive wages for public servants and a small market for private firms. As their sales are small, most private firms cannot afford to pay a highly specialised technician. Consequently, the solution to the shortage of hospital-maintenance personnel is to institute a training programme.

In Portugal it was decided to go ahead with the formation of a hospital-maintenance-personnel section. In 1975 an 18-month intensive course for general hospital technicians will commence and will be followed by another course for specialised technicians dealing with the maintenance of diagnostic and therapeutic medical equipment. The minimum qualification required for enrolment in the general course is the first diploma of technical schools or the Lyceum equivalent, and for the specialist course it will be the diploma of the general course, the technical school complementary course, or the Lyceum diplomas, in respective order of preference. Both courses will be more practical than theoretical, the relationship being approximately 4:1 h. The specialist course will be based on applied electronics.

Because the shortage of polytechnic engineers in hospitals is becoming more acute, there is an intention of starting a hospital-engineering services and equipment course for engineers of this level.

Training in hospital engineering is recognised all over the world as being valuable; in Portugal too it is practised, although on a small scale. Nevertheless, it has been quite rewarding.

Refresher courses have been promoted and are held regularly, most of them with the collaboration of British lecturers.

A policy envisaging the formation of hospital maintenance personnel or the improving of their technical knowledge is both desirable and deserving of priority.

## Role of private firms

To whom must responsibility for preventive maintenance be committed: to the hospital maintenance service itself (known in Portugal as the hospital SIEH) only; to official (Ministry of Health) Hospital Engineering Services, at (local) hospital level, hospital regional level and at national (central) level; to private firms, or to a combination of official services and private firms?

As a whole, hospitals prefer maintenance performed by official services for many reasons:

- The local stage is inside the hospital. Maintenance personnel belong to the hospital staff, and therefore, not only are they immediately and permanently available for curative maintenance, but also they carry out or can execute preventive maintenance.
- The local stage (hospital SIEH) will be complemented and assisted by the much more specialised regional and central stages, also official (or public) services, thus allowing the hospital to benefit from an almost complete coverage of preventive maintenance
- Official services try to save as much as possible, avoiding the purchase of costly parts and the repair of equipment that is otherwise unrecoverable. Public maintenance personnel try to work as well as possible since unreasonable failures after repair would mean a bad professional name for those who have to work in the same hospital or for the same Ministry.
- Both hospital SIEH and regional- and central-stage personnel can give advice to the hospital administration and doctors to avoid the installation of an excess of equipment (countering the usual activity of private firms, who always try to sell more equipment, some of which is unnecessary). They can also be a reliable source of technical information whenever the administration as well as doctors and nurses ask for it; and they can help users to get the best performance out of their equipment, either new or old, by co-operating with doctors, nurses and technicians.

On the other hand, the average hospital sees private firms as far as maintenance is concerned, as heavy burdens, especially because:

- private firms are profit motivated
- many firms take too long to repair failures in hospitals outside Lisbon and Oporto and often leave the equipment unsatisfactorily repaired. Costly parts or materials that could continue to be used are often replaced
- it is common to find private firms 'pushing' administrators and doctors to replace equipment that would work for several years longer.
- some administrations fear the appearance of eventual illicit connections, which would favour a particular firm.

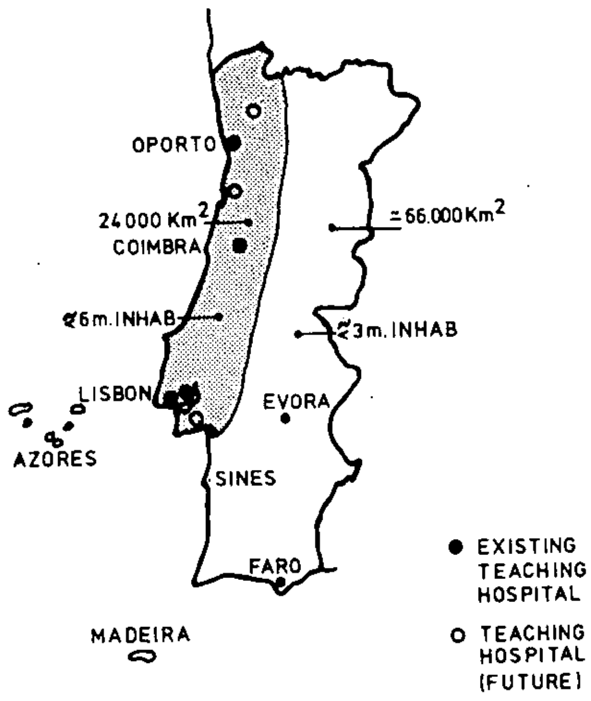
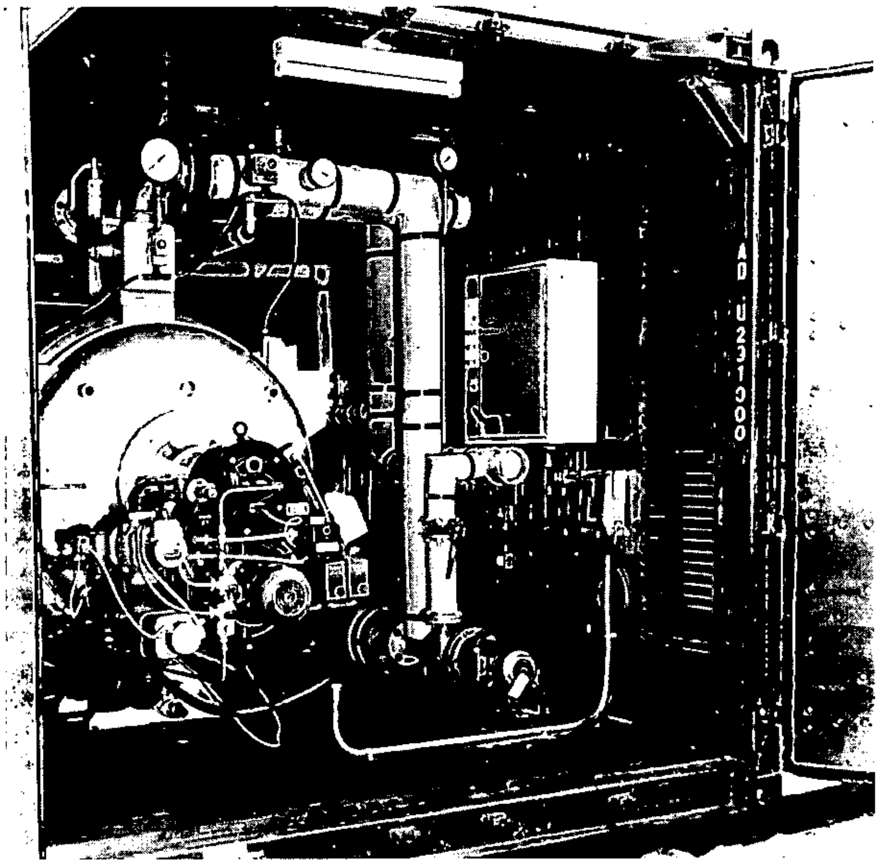



**Fig. 1 Asymmetry of development**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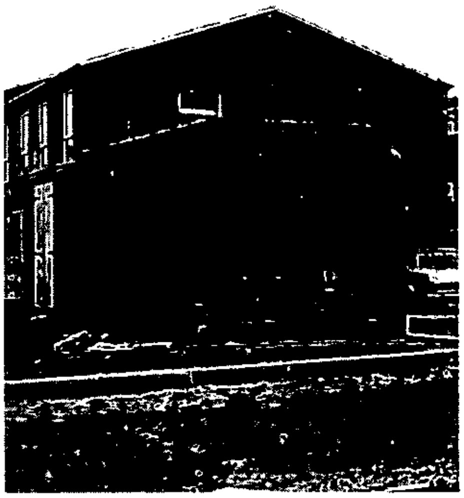


In Portugal most private firms cannot afford to hire or to maintain specialised technicians permanently because the market is small. Since Portugal is small and is not a rich country and equipment from all over the world is sold there, the portion of the market for each firm is rather small.

Nevertheless, those private firms maintaining highly specialised technicians are welcome, especially when new equipment is sold to hospitals in small numbers. In such cases, complementary work by private firms must be encouraged.

It is quite understandable that what happens in a small and semi-industrialised country is different from what goes on in a poor and developing country or in a rich and industrialised one.

It is possible that in some countries, where local manufacturers cover most medical equipment, or even the total range of this equipment, the solution might be different. However, it is well known that some manufacturers prefer to co-operate with public services because they will be free from a usually unprofitable and boring task, which sometimes adversely affects production.

Official services have a difficult task to obtain technical data from some firms that do not co-operate adequately. The principal reasons are:

- some firms fear that technical data might fall into competitors' hands
- others are afraid that their equipment will not be properly maintained, which causes bad performance and consequently gives a bad name
- other firms do not like to lose the amount of work involving their permanent technicians whom they ought to have available for the maintenance of equipment they have sold to private clients, although not in a large enough volume to justify highly specialised technicians for the private clients only.

Private firms must eliminate these fears, even if they are understandable, so that hospital maintenance can be improved.

### Preventive maintenance in Portugal

Portugal is a small country situated at the south-west extremity of Europe, with a population of approximately nine million inhabitants spread unevenly in 90 000 km² of mainland plus Madeira and the Azores.

Most of the population and activities (industry, commerce, schools, health etc.) are asymmetrically

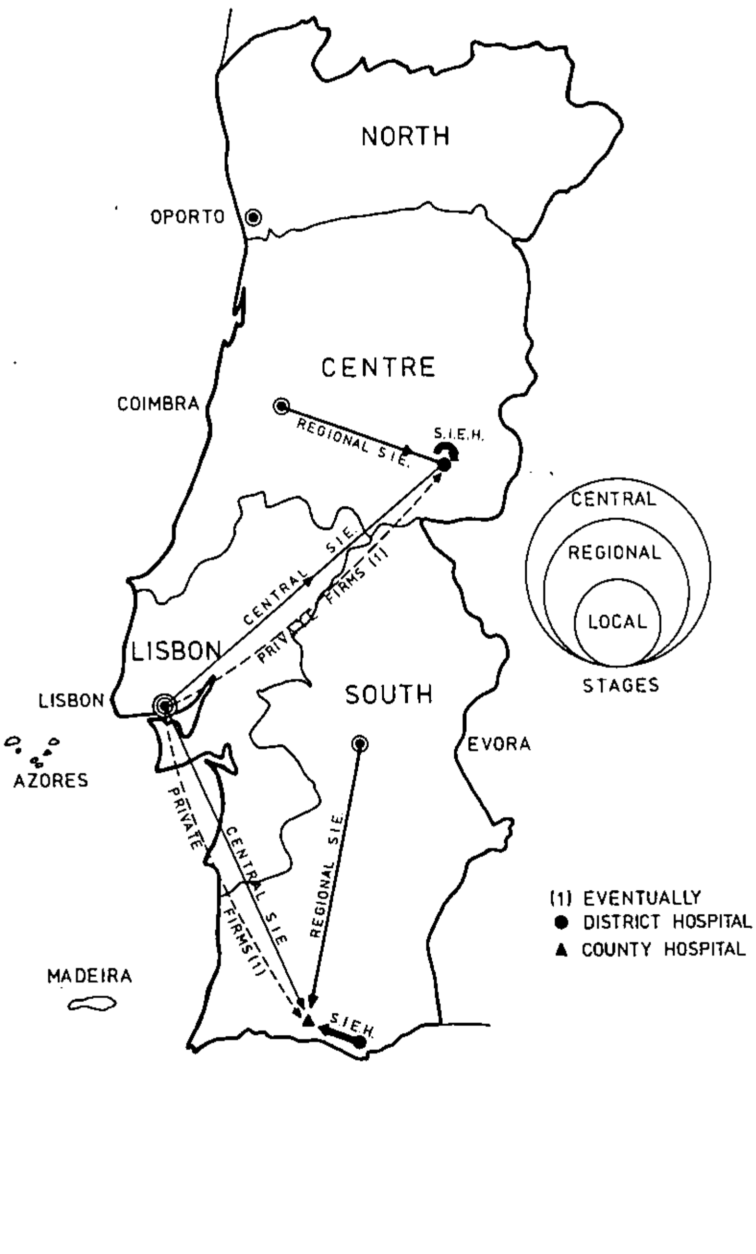



**Fig. 2 Improvement plan**

located in a narrow strip approximately 400 km long by 60 km wide by the sea, from the northern frontier to 50 km south of Lisbon. In less than one-third of the territory live a little over two-thirds of the population (Fig. 1).

The Universities of Lisbon, Oporto and Coimbra with their teaching hospitals are located there. New teaching hospitals at Braga, Aveiro and Almada will be installed there. With the exception of the new Funchal Hospital (at Madeira) that will move up eventually from district to central hospital status, all existing central hospitals are situated in that narrow strip.

At present, an interesting and sizable plan of new hospital building, remodelling and extension is being developed (Fig. 2). Also important is the plan of supplying new equipment (both general and medical) that started some years ago. In the near future, the country as a whole will be covered by modern new or remodelled hospitals supplied with good and modern equipment, although the strip asymmetry will continue to exist for many years.

The general policy towards regionalisation, also felt in the hospital field, calls for a decentralisation. However, if the existing conditions are taken into consideration, the advisable solution for the time being will be a 'centralised decentralisation'. The new organisation of hospital maintenance will be based on this principle.

In 1966 Portugal was divided into three hospital zones: North (based in Oporto), Centre (at Coimbra) and South (in Lisbon). Hospital-maintenance coverage was established accordingly and was based on three complementary stages: the local stage (or the hospital SIEH) inside the hospital, the regional stage based in the capital of each region and the central stage located in Lisbon (Fig. 3). The level of specialisation increases from local to regional to central stages.

At present the country is divided into Regions: North (based in Oporto), Centre (Coimbra), South (Evora), Lisbon (Lisbon), Madeira (Funchal) and the Azores (Ponta Delgada). Because the last two Regions-Plan are not relevant to hospitals, it was decided to consider four hospital regions only (the region of Lisbon taking care of Madeira and Azores), and maintain the three stages (local, regional and central)

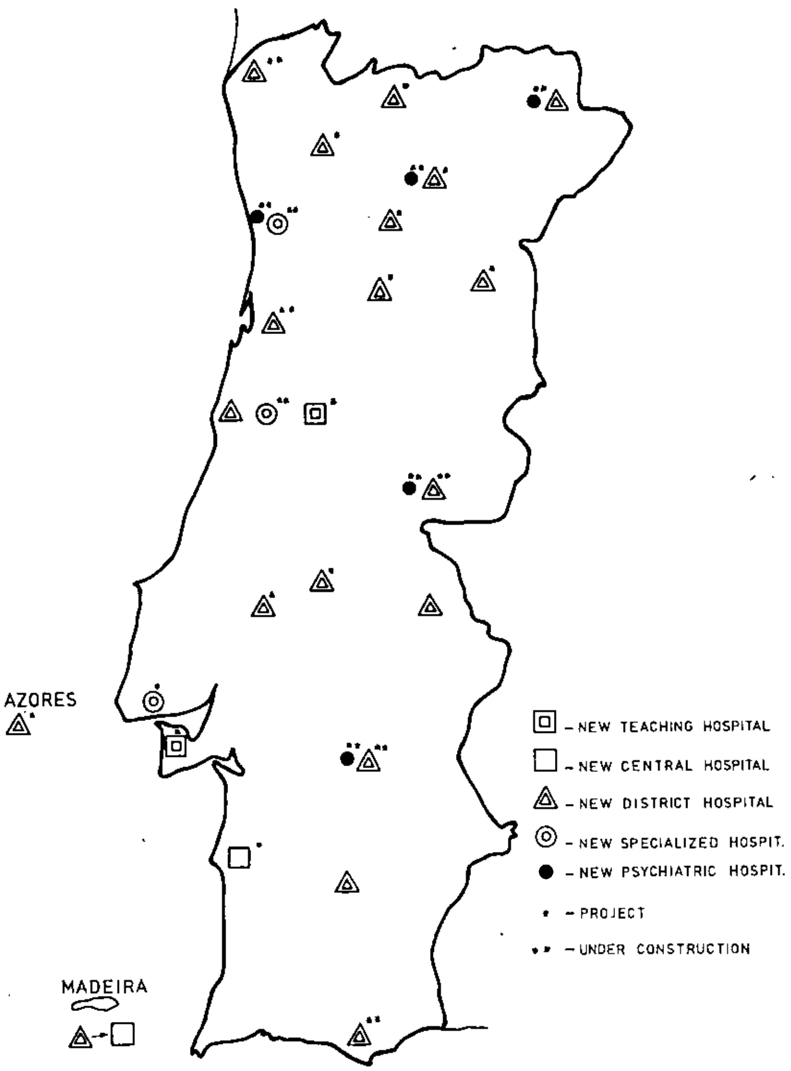



**Fig. 3 Maintenance coverage**

previously established for hospital-maintenance purposes.

From 1966–70 a reasonable preventive-maintenance plan of engineering services and equipment was carried out that covered twice a year all district, the more important county hospitals and (partially) teaching and central hospitals.

Since 1970, this preventive-maintenance work has been decreasing, and at the present time the amount of work done is much smaller than it should be for two principal reasons:

(*a*) lack of specialised personnel, who have been leaving the public service because of inadequate payment and who have been only partially replaced

(*b*) the personnel/equipment ratio has been decreasing owing to (*a*) and also because a good deal of new good and modern equipment has been supplied in recent years.

Some hospitals receive two preventive-maintenance visits per year, most hospitals get one visit only and others get none at all at present.

Each day the quantity and complexity of hospital equipment and engineering services increases (therefore increasing the need for more technicians who must be more specialised), so a new hospital maintenance organisation planning at least four preventive maintenance visits per hospital per year was proposed recently (Fig. 4). It is a public service within the Portuguese Ministry of Health because the amount of preventive maintenance done by private firms is not relevant, although it may be considered as a complementary specific work whenever very special equipment calls for it or a given hospital wants it for a special reason.

Owing to reasons previously referred to, preventive maintenance will be the principal maintenance work in the near future, and therefore this principle was taken into consideration in the new organisation of hospital maintenance where the three stages will function in a complementary way as follows:

*Local stage*

- The hospital maintenance service goes into action immediately whenever a failure occurs, although its

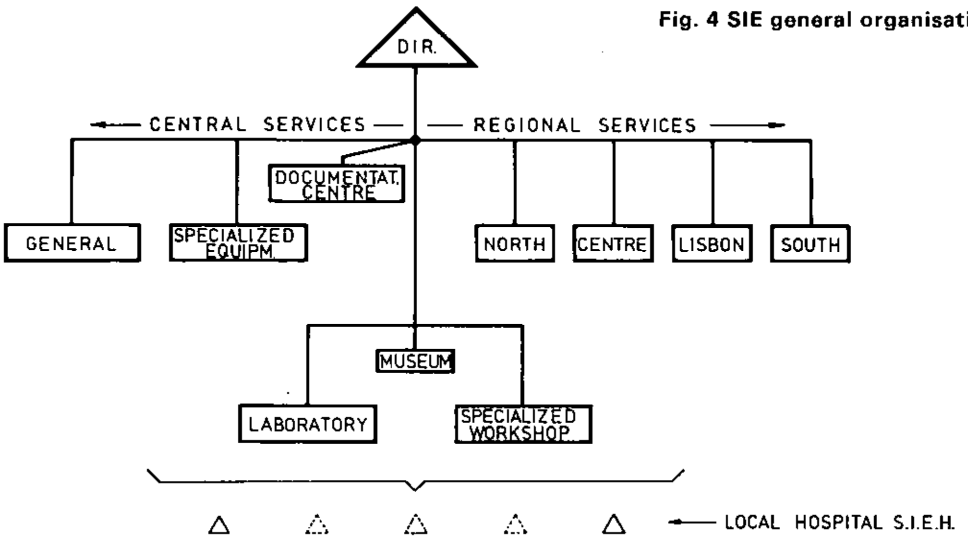
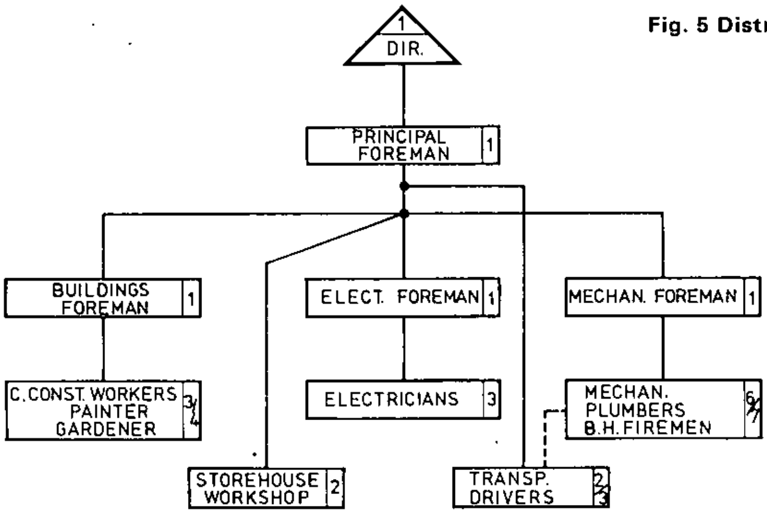



**Fig. 4 SIE general organisation**




| PERSONNEL | |
|---|---|
| QUALIFIC. | NO. OF PERSONS |
| POLYTECHN. | 1 |
| TECH. SCHOOL | 4 |
| PROFESS.(SYND.) | 15 TO 17 |
| NO PROF. QUAL. | x |

**Fig. 5 District-hospital organisation**

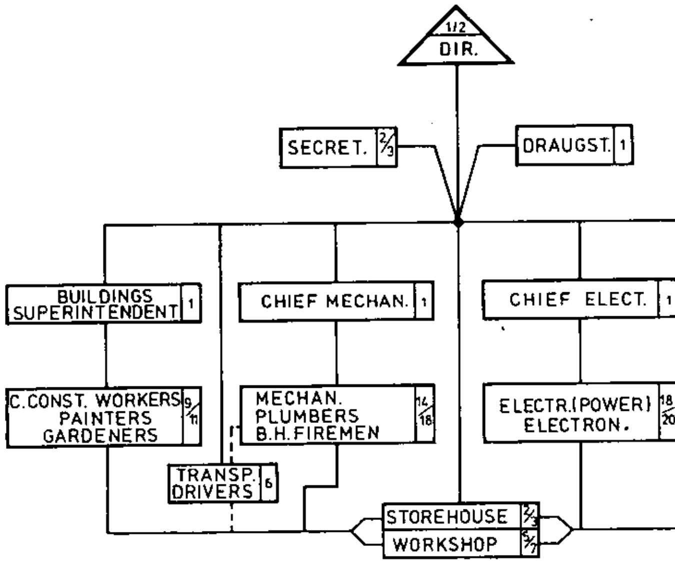



**Fig. 6 Central-hospital organisation**

| PERSONNEL | |
|---|---|
| QUALIFIC. | NO. OF PERSONS |
| UNIVERS. | 1 or 2 |
| POLYTECHN. | 4 |
| TECH. SCHOOL | 16 TO 18 |
| PROFESS.(SYND) | 40 TO 48 |
| NO PROF QUAL | X* |

* FEW

work will be of the first-aid type for specialised equipment, in which case it would call up the regional service, or even the central service, for further technical assistance.

- The hospital maintenance service generally supervises maintenance of buildings and usually maintains most engineering services and nonspecialised equipment.
- It collaborates with the administration and doctors in purchasing equipment and some consumer goods.
- It helps doctors, nurses and technicians to obtain better efficiency from equipment.
- It repairs general equipment and simple medical apparatus in its own workshop.

Fig. 5 shows the organisation of the SIEH for an average (300–400 bed) district hospital. Fig. 6 shows the maintenance personnel necessary to take good care of a large (1000–1200 bed) central hospital. Fig. 7 indicates the minimum personnel to maintain adequately a 1200-1500 bed teaching hospital.

*Regional stage*

- The staff assist technically all hospitals of the region

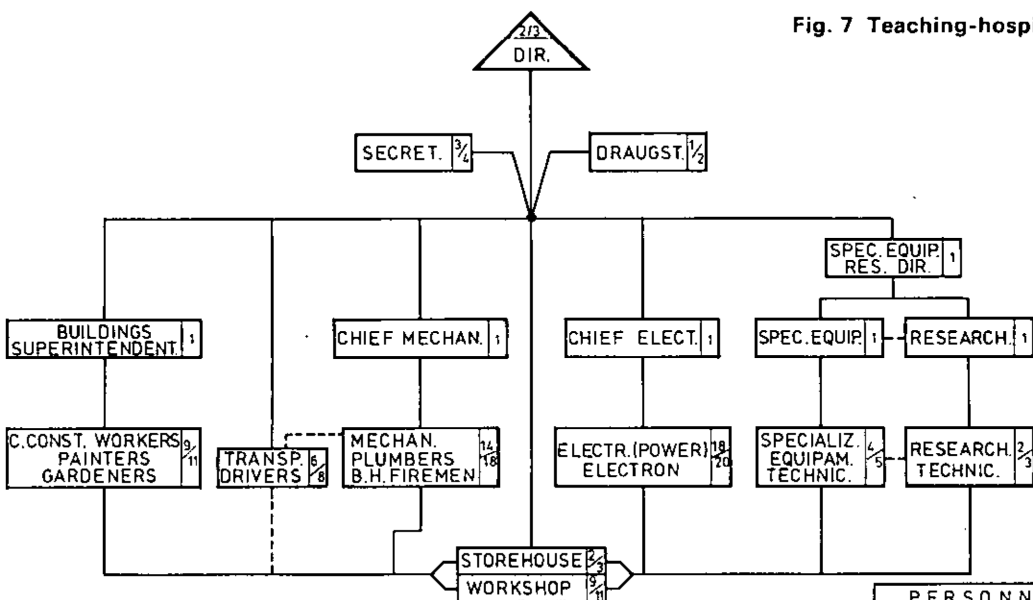


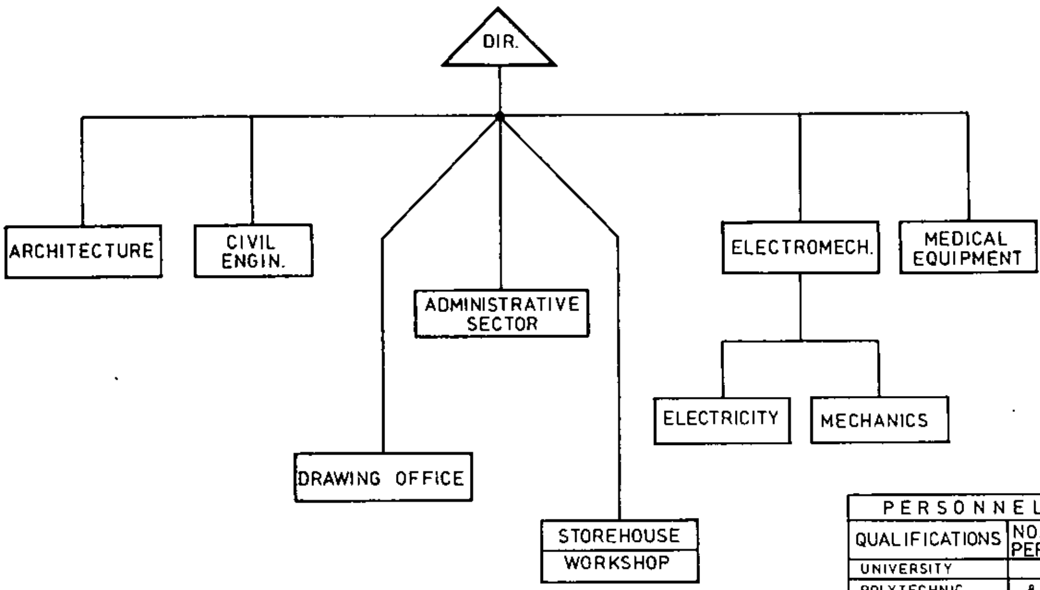

**Fig. 7 Teaching-hospital organisation**

| PERSONNEL | |
|---|---|
| QUALIFICATIONS | NO. OF PERSONS |
| UNIVERSITY | 3 or 4 |
| POLYTECHNIC | 5 |
| TECH. SCHOOL | 22 TO 26 |
| PROFESS.(SYND) | 42 TO 53 |
| NO PROF. QUAL. | X* |

* FEW

REGIONAL SERVICES

**Fig. 8 Regional SIE**




| PERSONNEL | |
|---|---|
| QUALIFICATIONS | NO. OF PERSONS |
| UNIVERSITY | 5 |
| POLYTECHNIC | 8 TO 10 |
| TECH. SCHOOL | 32 TO 40 |
| PROFESS. (SYND) | 20 |
| NO PROF. QUAL. | X • |

• FEW

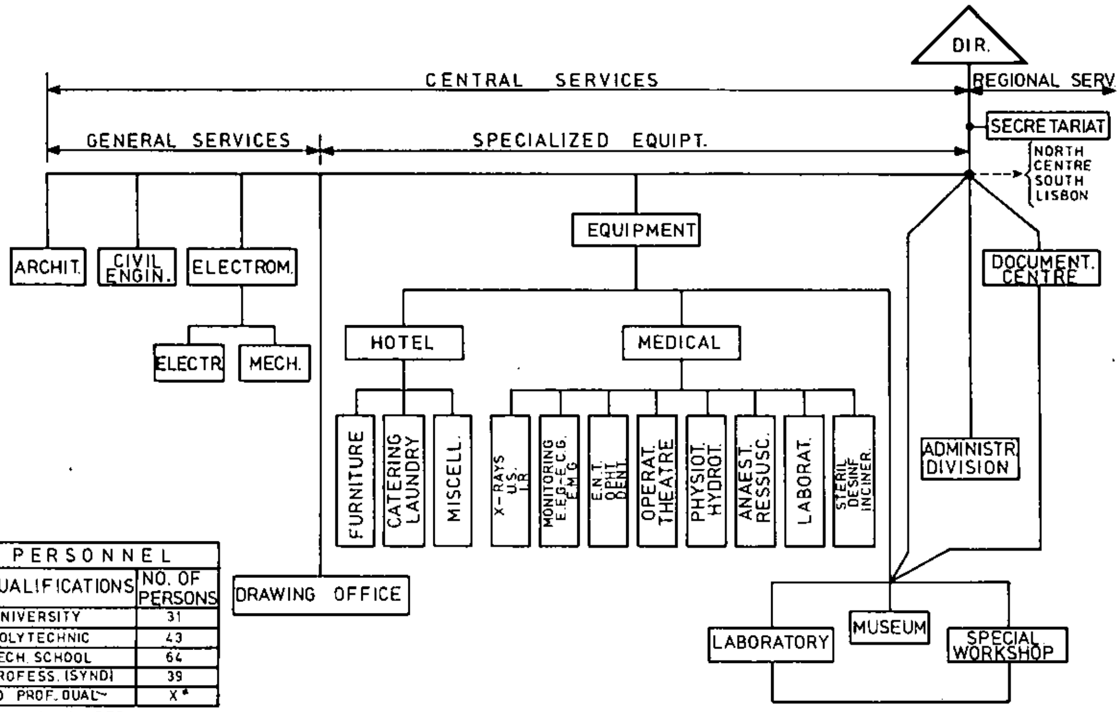
although it may work in hospitals of other regions if necessary, either in an emergency or for preventive maintenance.

- They take care of most specialised equipment directly.
- They perform general preventive maintenance in small hospitals without any SIEH.
- They collaborate with hospital administrations giving technical advice in special studies, hospital remodelling and extensions or about any advanced technological engineering problem.
- They advise on purchases and tests of specialised equipment.
- They repair most specialised equipment in its own sizable workshop.

Fig. 8 shows the basic organisation necessary to supply technical assistance and perform maintenance in a hospital region.

**Fig. 9 Central SIE**

CENTRAL SERVICES




| PERSONNEL | |
|---|---|
| QUALIFICATIONS | NO. OF PERSONS |
| UNIVERSITY | 31 |
| POLYTECHNIC | 43 |
| TECH. SCHOOL | 64 |
| PROFESS. (SYND) | 39 |
| NO PROF. QUAL. | X • |

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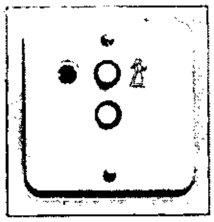
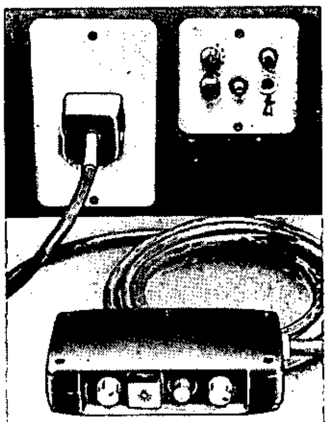


Bedhead Combination Unit



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*Central stage*

- This will cover, supplementarily, everything that the regional stages will not be able to do, namely curative and preventive maintenance of very specialised equipment as well as a few highly specialised engineering services.
- Staff collaborate with regional stages and hospitals in the study of: hospital-engineering policies; remodelling, extensions and new buildings; specifications for purchasing and tests of highly specialised equipment.
- Regional and hospital SIE personnel are trained here.
- Staff repair highly specialised equipment in a large workshop.

The Research & Normalisation Laboratory, to be built in the near future, will perform special tests of medical equipment, will assist in establishing and issuing technical standards for hospital materials and equipment, and will enhance the value of maintenance personnel.

Fig. 9 shows the organisation of the central services, Lisbon.

According to the nature of the work, preventive maintenance will be (although some hospitals do it already) performed as follows:

*Building and exterior work*

| | |
|---|---|
| local stage | yes; some work done directly but mainly supervision of contractors |
| regional stage | no; occasionally supervision of some work |
| central stage | no; supervision rarely |
| private firms | yes; most work |

*Engineering services*

| | |
|---|---|
| local stage | yes; most work |
| regional stage | yes; complementing local stage |
| central stage | yes; just a few highly specialised jobs |
| private firms | no |

*General equipment*

| | |
|---|---|
| local stage | yes; a great deal of work (in teaching, and large central hospitals, practically all work) |
| regional stage | yes; complementing local stage |
| central stage | no |
| private firms | no |

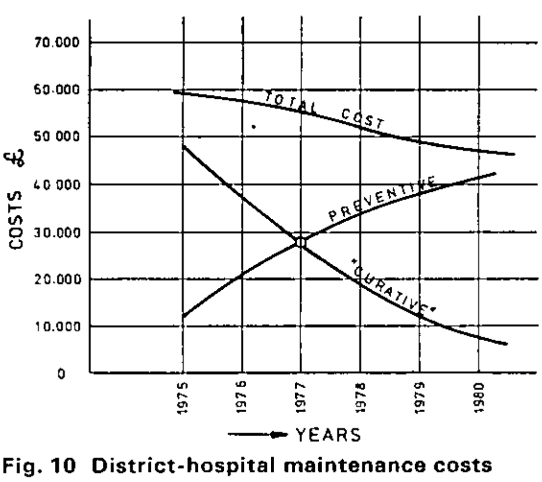


**Fig. 10 District-hospital maintenance costs**

*Specialised equipment (mainly medical)*

| | |
|---|---|
| local stage | no (yes for teaching and large central hospitals) |
| regional stage | yes; most work |
| central stage | yes; some highly specialised work |
| private firms | yes, little highly specialised work (eventually) |

It is expected that each region will be capable of handling all work (not performed by the local stage) in the future. When reaching this point, the central stage will devote its activity mainly to research, specialised studies, standardisation and the training of hospital-engineering personnel at different technical levels.

## Preventive-maintenance costs

The total preventive-maintenance cost can be obtained by integrating job costs and using one of three different methods:

*According to the nature of the work performed*

- civil construction work
- engineering services
- general equipment
- medical equipment.

*According to the nature of the jobs*

- labour
- materials or parts
- other charges.

*According to the agent*

- the SIEH itself
- regional and central public services
- private contractors (usually civil construction work)
- private firms (usually medical equipment).

It is possible to predetermine preventive-maintenance costs with a certain degree af accuracy, which decreases from civil construction work to engineering services to general equipment, and also to medical equipment when performed by local, regional and central services. Obviously costs will be accurate when preventive maintenance of general and medical equipment, for example, is made by private firms under contracts where previously agreed prices must be accepted.

Preventive-maintenance cost is a function of several variables, e.g. the age and quality of buildings, engineering services and equipment as well as the nature of previous maintenance work. In fact civil construction costs, for example, will be irrelevant for a brand new hospital but will be quite important for a very old hospital without previous adequate preventive-maintenance care.

Fig. 10 shows the theoretical costs expected for preventive and curative maintenance in a new district hospital with an average capacity of 300–400 beds. It is expected that the total maintenance cost in 1980 will be approximately 20% lower than the cost in 1975 (at current prices).

As far as medical equipment is concerned the following example will show how profitable preventive maintenance is. It is assumed rather optimistically that the average life expectancy for medical equipment is 10 years. If adequate preventive maintenance prolongs this average life 2 years more, the gross saving would be

16·6% over the average replacement cost ($C_2$). However taking into consideration that:

(*a*) the initial price ($C_1$) increases continuously (about 5% p.a.)

(*b*) preventive maintenance costs 1·5% p.a.

(*c*) better reliability (equipment working properly and permanently) is translated into a monetary value (10%)

the net profit will be:

- the initial price, $C_1$
- 'replacement' cost: $C_2 \simeq 1{\cdot}32C_1$ (average half life is 6 years)
- value of +2 years: $C_3 \simeq 0{\cdot}22C_1$
- preventive maintenance cost: $C_4 = \frac{1{\cdot}5}{100} \times 12 \times 1{\cdot}32$ $C_1 \simeq 0{\cdot}2376\, C_1$
- reliability: $C_5 = 0{\cdot}1 \times 1{\cdot}32\ C_5 = 0{\cdot}132\ C_1$
- net profit: $p = C_3 + C_5 - C_4 = 0{\cdot}22\ C_1 + 0{\cdot}132\ C_1 - 0{\cdot}2376\ C_1 \simeq 0{\cdot}115\ C_1$

Even with disadvantageous parameters, the net profit would be about 11·5% over the initial price just in materialistic terms and not taking into account (because it is unaccountable) the human benefit of having medical equipment working properly and continuously. If better reliability is valued at 20%, the net profit would be about 24·6%

## Technical co-operation between countries

It is accepted by all that intensive hospital technical co-operation between countries is both desirable and necessary. The IFHE is too young and therefore has not yet the strength and means to implement an intensive programme of technical co-operation although it would wish to do so.

Every year the French National Association of Hospital Engineers organises study journeys (lasting for 3 days) during which some quite interesting hospital technical problems are warmly and brilliantly discussed. The United Kingdom organises several courses for hospital engineering technicians each year.

The Portuguese Association of Hospital Engineering (APEA) organises every month either working journeys or discussions where technical subjects concerning hospital-engineering are freely discussed and debated; some seminars, e.g. that dedicated to sterilisation, have gained with the participation of experts from different countries.

Portuguese hospital-engineering technicians have been obtaining fruitful results from a technical agreement between the United Kingdom and Portugal arranged in 1969; once a year, two British lecturers come to Lisbon to talk and debate on hospital-engineering matters for a week; also some Portuguese engineers have received training in the United Kingdom.

In one way or another, as the above examples illustrate, each country works almost individually to improve its own hospital-engineering technology. However, it should be an IFHE job to act as a catalysing agent of international co-operation, sponsoring or holding once a year, in the near future, concise and intensive refresher courses, discussions, seminars or even simple study journeys or study tours for hospital technicians from different countries.

The IFHE could have a decisive role in the training of junior engineers from different countries by organising hospital-engineering courses which would last 6 months to 1 year.

Another important IFHE task could be the organisation of periodic 4–6 week intensive hospital-engineering courses for senior 'cadres', using a relatively small 'numerus clausus' and lecturers from different countries.

Friendship born in the courses would be a strong agent of future international co-operation between countries.

### Entretien préventif dans les hôpitaux

Dans un hôpital moderne où sont investies de vastes sommes d'argent, en capitaux et frais d'exploitation, des mesures d'entretien préventives peuvent engendrer des économies considérables. Plus importantes encore, des précautions contre le mauvais fonctionnement de l'équipement peuvent aider d'une façon décisive à préserver la vie des malades et à minimiser leurs souffrances. Les idées exposées ici sont le résultat de l'expérience acquise par l'auteur durant 25 ans comme ingénieur des hôpitaux au Portugal, mais ses conclusions s'appliquent également à d'autres pays.

### Vorbeugende Wartung in Krankenhäusern

Da ein modernes Krankenhaus zur Deckung der Anlage- und auch der Betriebskosten ungeheure Geldmengen verschluckt, können durch vorbeugende Wartungsmaßnahmen erhebliche Einsparungen erzielt werden. Noch wichtiger ist jedoch die Tatsache, daß die Verhinderung eines Ausrüstungsversagens einen entscheidenden Beitrag zur Lebensrettung und zur Leidenserleichterung leisten kann. Die hier zum Ausdruck gebrachten Gedanken sind das Resultat der 25-jährigen Erfahrungen, die sich der Verfasser in der Krankenhaustechnik in Portugal angeeignet hat. Sie lassen sich aber genauso gut auch auf andere Länder anwenden.

### Manutenzione preventiva in ospedali

Il costo capitale e le spese di gestione di un ospedale moderno sono entrambi notevoli e l'esecuzione della manutenzione preventiva può comportare risparmi considerevoli. Più importante, la prevenzione di guasti della apparecchiatura può rappresentare un decisivo aiuto nella preservazione della salute del paziente e nella minimizzazione di sofferenze. Le idee espresse qui sono il risultato di 25 anni di esperienza dell'autore nella tecnica ospedaliera in Portogallo, ma i risultati sono ugualmente applicabili ad altri paesi.

# Improving your interviewing

**by ALAN JONES**

Recent Keele courses have contained in their programmes some work on the interviewing process devised to improve a manager's social skill in the vast area known as human relations. Interview situations created thus far on both intermediate and advanced courses have ranged from the selection-type interview to interviews concerning day-to-day work situations.

Interviews, for one strange reason after another, seem to settle into eyeball-to-eyeball encounters between a manager and an individual employee or, in the case of selection interviews, between several managers (generally far too many) sitting on a panel facing a solitary candidate. The manager is then at a considerable advantage over the unfortunate interviewee; the manager knows what he wants from an interview and the interviewee is usually completely in the dark.

The very word 'interview' is of course an unfortunate one, since the situation should become a discussion between two people on common points of interest. Unless it develops into a discussion it will degenerate into no more than an eyeball-to-eyeball encounter with precious little finalised and problems remaining unsolved.

There are many kinds of interview but the principles for all remain constant whether they be for selection, appraisal, counselling, fact-finding, corrective, ticking-off or farewells. All merit the same degree of concern for the individual and all require careful thought in their preparation and execution.

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This article is based on a Keele course lecture.

### Analysis of the interview

The interview analysed reveals that five phases need to be borne in mind in arranging an interview of any kind: preparation, setting the scene, reception of the interviewee, conduct of the interview, follow-up activity.

*Preparation*

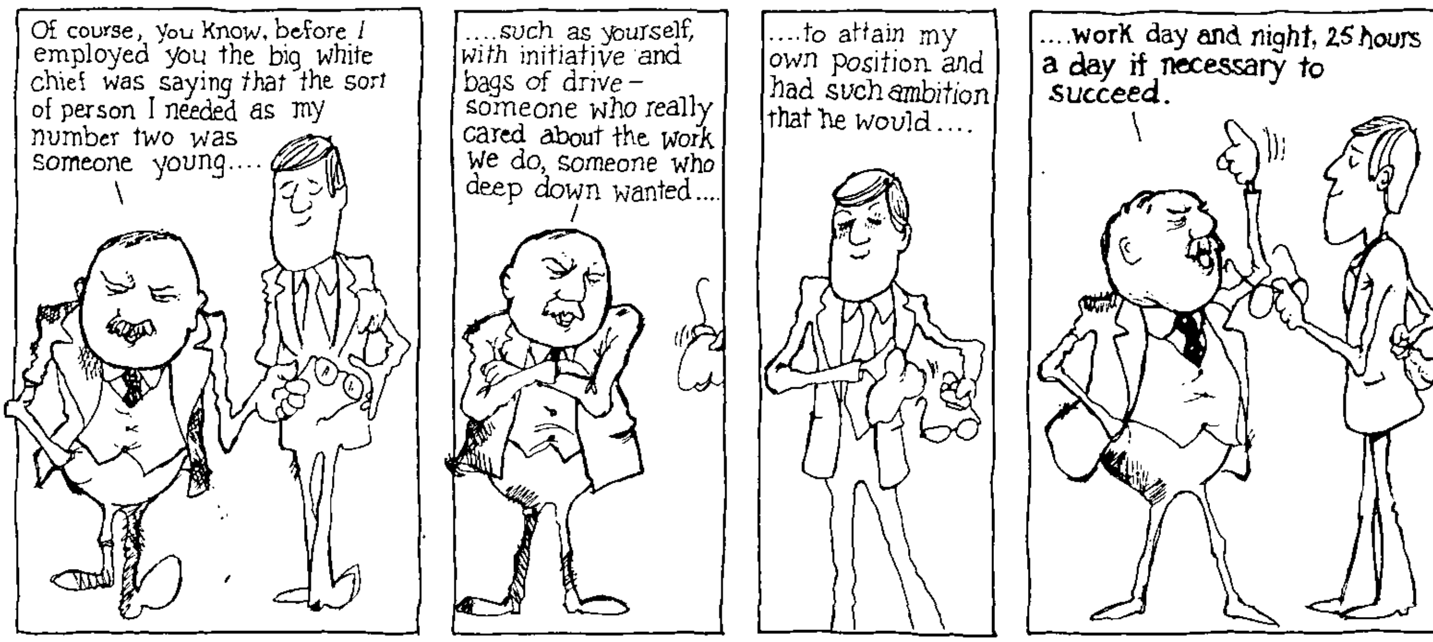
An interview stands little chance of success if the interviewer has not fully prepared himself beforehand. He must know its purpose, what he expects to achieve from it, the up-to-the-minute detail and anticipated results with follow-up action clearly understood as a commitment arising from the interview.

*Setting the scene*

This is crucial to the conduct of the interview, since the initiative rests firmly with the interviewer, who should see to it that the scene is set in such a way as to provide a climate conducive to a good discussion.

It is imperative that the interview arrangements are given meticulous attention. Nothing is more important in working life than the discussion that is to take place between two people (usually the manager and a member of his staff) about their work, their relationships, the need for improved performance, and so on. It should be an agreeable business and not one in which a high measure of apprehension is inherent in either or both parties while the interview progresses.

The situation can be eased quite considerably if the scene is set beforehand and if some well-established methods of conducting an interview are given a rigorous shake-up. An attempt should clearly be made to determine how communication barriers can be eliminated from the proceedings. One of the main barriers to free communication is the manager's desk. If the interview is to be conducted across the desk then immediately the interviewee is placed at considerable disadvantage since he will instantly regard it as the typical 'them-and-us' situation. Can the interview be conducted elsewhere? Can the desk be eliminated



completely? An interview conducted around a small occasional table stands a much better chance of progress than one conducted in the usual way whereby the boss makes no effort to get away from his safety net. If it is not possible either to arrange the interview elsewhere or to find room for an occasional table in one's office, then cannot the interview be conducted across one corner of the desk rather than across the whole desk.

*Reception*

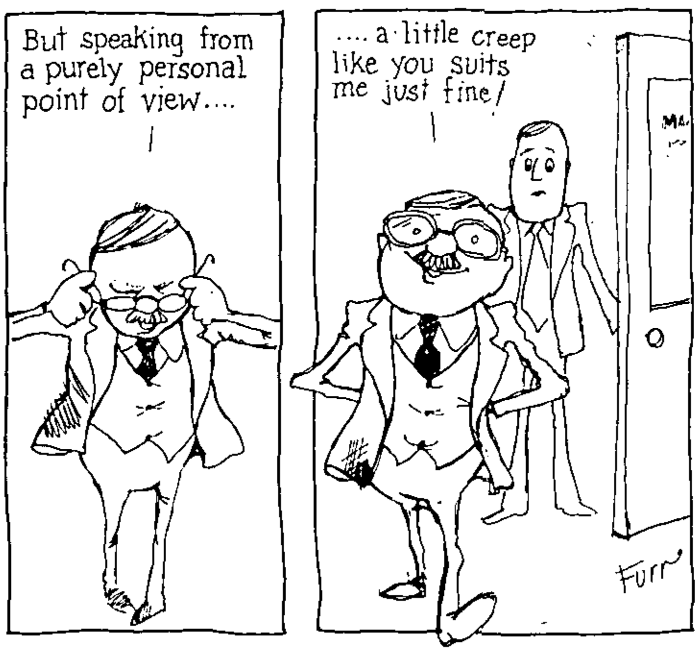
Reception of the interviewee merits a degree of positive attention. The interview must at all costs be conducted in complete privacy. There should be no interruptions of any kind. A notice on the door to deter all callers and the cancellation of all telephone calls are matters to be attended to in advance of the interview.

The interviewer has a responsibility towards the interviewee for the proper procedures concerning attendance at interview. It is pertinent to arrange a suitable date and time convenient for both parties. Once the appointment has been made it must be adhered to since this is a contributory factor towards creating the right atmosphere. There really is no excuse for keeping people waiting once a time has been fixed. The onus for reception is quite definitely in the hands of the interviewer so that the minute the interviewee arrives the interviewer should be ready to accept him with due courtesy.

*Conduct*

Conduct of the interview reveals that every interviewer has his own style and, short of receiving intensive training in interviewing techniques, he will be unlikely to amend his style through written advice. Some pointers towards technique are given below but the improvement of technique is a matter for the individual. Having fully prepared himself for the interview the other major factors requiring attention are:

- Open the interview in a way that puts the interviewee at ease. Make him feel wanted.
- Preserve an atmosphere of timeless calm. No interview should be hurried.




- Listen to what the interviewee has to say. Help him to say things if he has difficulty in saying them.
- Do not interrupt but listen intently.
- Look for underlying feelings. A summarising remark can sometimes help an interviewee to realise he is understood and to see his problems more clearly.
- Develop the interview so that it becomes an amicable discussion.
- Accept bonuses offered you by the interviewee. Additional information might well be given you, so pick it up as a point for continuing discussion.
- Avoid the use of leading questions or the type of question that can produce no more than a 'Yes' or 'No' answer. The intelligent use of questions can help considerably in developing discussion. Time your questions. Use them to follow up leads. Save difficult questions until rapport and confidence have been firmly established with the interviewee.
- Control is firmly in the hands of the interviewer.
- Note taking is permissible in interviews but it should be seen to be done openly.
- Terminate the interview in a courteous manner.
- Recollect in tranquility to finalise your report.
- Finally if anything has been overlooked ask to see the interviewee again, or better still proceed to his place of work to clarify the points at issue.

*Following up the interview*

Follow-up activity is precipitated from the interview. You will fail miserably if you do not do something about the things to which you committed yourself during the interview. You now have a considerable responsibility to initiate action otherwise your honesty of intent and your integrity generally will suffer a severe jolt. Nor is it sufficient to initiate action. Such action needs in itself to be followed up to ensure that it is the correct remedial activity for the shortcomings revealed in the interview.

## Improving your skills

The skills of interviewing can be improved through a self-learning process. You may tape record your interviews so that you can play them back to establish how your technique is developing. You may invite a third person into your interview room so that he may give you a critique of your performance. Completion of an analysis sheet (see below) by a third person could

**Interview analysis sheet**
(to a 5 point scale with 5 the highest rating)

| | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| Opening | | | | | |
| Rapport | | | | | |
| Coverage | | | | | |
| Detail | | | | | |
| Attitudes | | | | | |
| Flow | | | | | |
| Manner | | | | | |
| Question technique | | | | | |
| Control | | | | | |
| Close | | | | | |
| Commitment | | | | | |
| Duration | | | | | |

*Indicative factors relating to analysis sheet*

| | |
|---|---|
| *Opening* | How well done? |
| *Rapport* | How soon and how well established? |
| *Coverage* | Have all points established in preparation been covered? |
| *Detail* | Adequate or skimped? Too hurried? |
| *Attitudes* | Did a good atmosphere prevail? |
| *Flow* | Did the interview proceed in a logical manner? |
| *Manner* | How well were relationships established? |
| *Question technique* | How well handled? |
| *Control* | Did the interviewer maintain control was it too rigid? |
| *Close* | How well did it come to an end? |
| *Commitment* | What occurred from the interview? |
| *Duration* | Too long? Too short? About right? |

be of considerable assistance. A word of warning, however. Should you decide to use the self-learning methods of using a tape-recorder or invoking the use of a third person, the interviewee should be informed of your intentions and of their express purpose. He should be given the clear option of acceding to your request or refusing to co-operate with you. Any tape-recorded interview should be subsequently destroyed in the presence of the interviewee. This is essential if confidence is to be preserved between you and your interviewee.

Alternatively, if the above techniques are unacceptable to you, it should be possible to arrange a get-together of managers for a teach-in session, when role-playing can be used to good effect and where the use of the analysis sheet (below) can play a useful purpose in assessing one's continued performance.

It will be seen that the interview properly prepared, conducted and controlled is an intricate affair. There is so much benefit to be derived from a well conducted interview that it should no longer be regarded as a time-consuming business. Seeking to come to terms with a person's strengths and needs for his future development for the benefit of the organisation is as important a feature of a manager's role as anything else he does in his day-to-day management function.

# 10th Scottish Conference

As intimated in the July issue of *Hospital Engineering* the Conference this year will be held in Glasgow and accommodation is being made available at the Walton Conference Suite in the grounds of the Southern General Hospital.

Simpson Stevenson, Chairman of the Greater Glasgow Health Board, will open the Conference and the Institute President, F. Hugh Howorth, will introduce the first session. It is hoped that the conference will receive full support from members.

All sessions will be open at no charge to visitors who may attend independently or as guests of members. No special ticket will be required.

Morning coffee and afternoon tea will be provided each day of the conference and lunch will be available in the dining hall.

A list of accommodation and plans of the City of Glasgow will be forwarded to those who register.

It is intended that a social evening be arranged for members and their friends on the 23rd October. Details of this are included in the registration form.

Further information and forms of registration may be obtained from: T. M. Sinclair, Hon. Branch Secretary, West of Scotland Branch, 3 Morven Way, Kirkintilloch, Glasgow G66 3QL, Scotland.

## Programme

*Thursday 23rd October* Assemble and coffee 9.30 a.m.

The official Opening and welcome by Simpson Stevenson, Chairman of the Greater Glasgow Health Board 10.00 a.m. Reply by F. H. Howorth, F.R.S.A., F.Inst. P.I., F.I.I.C., F.I.Hosp.E., President, Institute of Hospital Engineering.

*Session 1* Chairman: F. H. Howorth, F.R.S.A., F.Inst.P.I., F.I.I.C., F.I.Hosp.E. President, Institute of Hospital Engineering 10.15 a.m. 'Air technology in medicine' by Mr. L. Hornby, M.I.H.V.E., Technical Director, Howarth Air Conditioning Limited.

*Session 2* Chairman: T. D. W. Astorga, D.A., Dip.T.P., F.R.I.B.A., F.R.I.A.S., Director, Scottish Health Service Common Services Agency, Building Division 2.00 p.m. 'Energy conservation in hospital ventilation systems' by A. Rae, B.Sc., R. Robertson, B.Sc., and R. M. Smith, B.Sc. Members of the Building Services Research Unit, University of Glasgow.

*Friday 24th October* Assemble and coffee 9.30 a.m.

*Session 3* Chairman: J. Bolton, LL.B.(Lond.), C.Eng., F.I.C.E., F.I.Mech.E., F.Inst.F., Hon. M.I.Hosp.E., F.R.S.H., F.I.Arb., Chief Engineer, DHSS 10.00 a.m. 'Research into sterilisation with steam at sub-atmospheric pressure' by Cameron Weymes, T.D., M.D., M.Sc., F.R.C.P.(G), F.F.C.M., D.P.H., Medical Director, Greater Glasgow Health Board, Sterile Supply Service.

*Session 4* Chairman: A. Wotherspoon, C.Eng., M.I.C.E., M.I.Mech.E., M.I.E.E., Assistant Chief Engineer, Scottish Development Department 2.00 p.m. 'The quantitive approach to maintenance' by Dr. A. H. Christer, B.Sc., M.Sc., Ph.D., A.F.I.M.A., Senior Lecturer in Operational Research, University of Strathclyde

*Saturday 24th October* Assemble and coffee 9.30 a.m.

*Session 5* Chairman: K. W. Wilson, C.Eng., F.I.Mech.E., F.I.H.V.E., F.I.Hosp.E., M.B.I.M., Assistant Director, Maintenance, Scottish Health Service Common Services Agency, Building Division, 10.00 a.m. 'Some implications of the Health & Safety at work Act 1974' by L. Munro, Dip. Pol.Econ., HM District Inspector of Factories, (Glasgow South District), Appointed as an Inspector for Health & Safety under Section 19 of the Health & Safety at Work Act 1974

# Single-point emergency light fittings

by E. C. BOYLAND,
M.I.HospE., C.Eng., M.I.E.E.

When the UK Fire Precautions Act (1971) is applied to hospitals by means of a designating order, it will be necessary to provide hospitals, large and small, with a system of emergency lighting that will need to comply with the particular requirements of the Act. The requirements for hotels and boarding houses have already been defined, and it is expected that the hospital requirements will be similar to these in many respects.

Some extracts from the *Guide to the Fire Precautions Act, 1971*, referring to the provision of emergency lighting in hotels and boarding houses are as follows:

### 1.5 Emergency lighting

1·5·1 Some form of emergency lighting should be provided in all premises and whatever is provided for this purpose must be capable of illuminating all stairways, routes of exit, exit and directional signs, sufficiently to enable persons to make their way out of the premises.

1·5·3 In small buildings, i.e. not having more than one floor above ground floor and not more than ten bedrooms, electric handlamps may be accepted.

Electric handlamps should preferably be of a type which is connected and secured to an electrical circuit and which is released and illuminated automatically on the power to the circuit failing. Where in small premises escape routes are uncomplicated and relatively easy to traverse and there is normally indirect lighting from outside the premises, then ordinary electric handlamps may be used. Where electric handlamps are accepted there should be a requirement that one such lamp should be issued to each member of the resident staff in addition to any provided for the use of guests.

1·5·4 In premises other than small premises the system should be a permanent installation supplied with electricity from a source independent of the main supply and arranged either:

(*a*) to come into operation automatically on the failure of the main supply; or

(*b*) to be maintained operating at all times when natural light is insufficient for escape purposes.

Such systems should be capable of maintaining the necessary level of illumination for a period of 3 h from the time of failure or disconnection of the normal supply. However, a system which is capable of maintaining the required level of illumination for 2 h may be accepted provided that the fire authority is satisfied that the system will be kept in that condition.

1·5·5 Either self contained battery powered lighting units incorporating their own charger, or lighting powered from a central source within the premises, will afford an acceptable system of emergency lighting.

1·5·7 The power supply equipment for an emergency lighting system shall not be used to supply any other equipment.

The above extracts give some indication of the standards that could be applied to hospitals, and the question that will need to be answered by hospital engineers and designers is quite simply: what system shall I use?

The purpose of this article is to highlight some features regarding one form of emergency lighting: single-point units.

Before doing so, however, it must be pointed out that the DHSS has not given general approval for their use and prospective users should refer to the guidance given in the relevant HSE notes and 'Dear Engineer' letters. Until the specific requirements for emergency lighting in hospitals are made known it is suggested that designers should tread warily when considering single-point units. Some fire brigades are insisting on such units as the only form of emergency lighting, but this appears to conflict with the views held by the DHSS, particularly where hospitals are already supplied with emergency generating plant. A common policy acceptable to both parties is needed. A compromise solution could be the provision of non-maintained units above fire exits only.

### Nonsustained category

Single-point units fall within the nonsustained or nonmaintained category, and come into operation when the main supply fails.

There are basically two types of light sources employed: filament bulb and low-wattage fluorescent tubes. Each unit contains a battery, a charging circuit, a relay or switching circuit, and, for the fluorescent type, an invertor circuit to produce an alternating waveform. The introduction of sealed nickel–cadmium batteries has enabled more compact and lighter units to be produced, and has obviated the need for topping up as is necessary with conventional electrolyte types.

### Positioning

The question of whether to employ single-point units or a centralised system (i.e. a system with a single battery source feeding a number of fittings) depends on a number of factors, such as the degree of lighting required, the size and structural features of the building, cost etc. In general, centralised systems are more suited to new buildings where the cabling can be easily installed during construction, and single-points units are more appropriate in smaller or special situa-

Mr. Boyland is district engineer for the Portsmouth & South East Hants. Health District.

tions and older-type buildings where the installation of long cable runs could be difficult.

In common with other systems of emergency lighting where the public is at risk, one should not attempt to use the fittings as a substitute for the normal lighting of the area under consideration, unless there is a positive need for a higher level of illumination in a particular area. In hospitals this would normally only apply to intensive-care units, operating theatres and possibly casualty centres.

The fundamental rule for the positioning of emergency fittings, particularly in the hospital situation, is to illuminate stairways and escape routes. They should not be fitted in the centre of a room or adjacent to windows and fanlights where natural light may assist in illuminating the surrounding area.

Most hospitals should by now be provided with generating plant, and, whether this is connected on an automatic or manual basis, it should be arranged to supply some degree of lighting throughout the hospital should the main supply fail. This arrangement suffers the same disadvantages as centralised systems, in that fire damage may prevent power being available in the very area that it is needed. From the point of fire safety therefore single point units have considerable merit as they are totally independent of any external wiring during supply failures.

## Standards

The *Guide to the Fire Precautions Act, 1971* (*Hotels and Boarding Houses*) stipulates in essence that emergency-lighting fittings must be of the 3 h duration type unless the fire authority is able to permit a 2 h type to be used. This point has some significance, as the difference in cost in providing a 2 h type as opposed to a 3 h type for a large number of hospitals could be considerable.

One should not lose sight of the primary function of emergency lighting, i.e. to provide instantaneous lighting to allow safe exit in emergencies when the normal supply has failed. If one accepts the fact that most hospitals can now restore the most essential supplies within a matter of minutes, then the duration of battery emergency systems is less significant taken in the context of fire precautions. BEAMA recommend that an emergency-lighting system shall be suitable provided that it is capable of operating automatically within one second. A further recommendation is that, if a standby generator set requiring a run-up period is used, then an additional battery system of 1 h duration shall be provided.

It would appear therefore that, where single-point units are used in hospitals with standby generators, the 2 h duration type will be acceptable to the local fire authorities.

There are currently on the market a large number of single-point units of various designs, and, while cost is an obvious factor to bear in mind, there are a number of other features to be taken into consideration if one is contemplating the use of the units. These considerations really embrace the standards that the fittings should attain.

Unfortunately the standards for this type of fitting have not yet been published, and the prospective user has to shop around in order to obtain one which he considers will suit his particular requirements. His task would be made easier if certain safety and operational features were mandatory.

It may seem an obvious requirement but all single-point fittings should be made with noncombustible materials. The possibility of a fitting catching fire is remote, but, where a number of electrical components, some of which are inherently heat producing, are totally enclosed in a small space then the device must be considered a potential fire risk. Lighting fittings in an emergency system should therefore be flame retardant, as recommended in BS 4533, Section 1·13.

When considering the single-point fittings as an electrical device which requires protection, one would also have to consider the implications of a fault developing within the unit, and how this would affect the circuit to which it is connected. The protection requirement, as in other electrical devices, would depend on the current normally taken by the device, and the current produced within the device under fault conditions. From this point of view the single-point fitting may be regarded basically as a transformer-operated device with a 240 V input producing approximately 6 V for charging purposes: a ratio of 40 : 1. With this ratio therefore, and neglecting losses, a current of 1 A flowing on the low-voltage side of the unit would produce only 25 mA on the mains input side of the transformer. This serves to illustrate that a large and unacceptable current could flow on the low voltage side (in the d.c. wiring) under fault conditions, which would need to be cleared before any heat buildup presented a fire risk. The obvious solution would be to ensure that the mains input side of the unit is fitted with a fuse of sufficiently low value to permit the unit to function satisfactorily under all conditions of charging, and prevent excessive currents flowing when the unit is faulty. A typical value for the fuse, depending on the type of unit, would be 50–100 mA. Some manufacturers have recognised that single-point units should be fused, but there are a number of units currently being marketed that unfortunately do not contain this feature.

## Maintenance

There is a widely held belief that single-point units can be fitted and forgotten. Unhappily this is not the case. All units should be fitted with a low-powered lamp to indicate that the bulb is healthy and that direct current is available, but even with this facility provided there is no guarantee that the unit will perform satisfactorily when needed. The only positive way to establish if the unit is ready for service is to simulate a mains failure. The fuse provided on the mains input side should therefore be easily removable which will allow all checks and maintenance to be carried out on a local basis without involving any associated wiring. BEAMA recommends that units should be checked for operation monthly and tested for the stipulated duration annually.

## Installation

It is perhaps not clear how single-points units should be connected to existing wiring. A number of codes recommend that emergency systems should be wired in either mineral-insulated copper-covered wire or conduit, and it is suggested that this policy should be followed for the installation of single-point units. Fused units only should be used, and these should be wired direct to the nearest lighting circuit, ensuring that they are independent of local switching.

## Conclusion

Summarising the above it is the opinion of the author that single-points units should be:

(*a*) fitted with a readily accessible fuse of low rating on the a.c. side
(*b*) ventilated
(*c*) made from noncombustible materials
(*d*) at least 2 h maintained
(*e*) fitted with a clearly visible operational lamp
(*f*) designed so that components are easily accessible
(*g*) fitted with batteries with a life expectancy of at least 5 years.
(*h*) positioned on fire-escapes routes, taking into consideration wall projections etc.
(*i*) wired to the nearest lighting circuit (not connected to fused spurs or other power circuits).

## References

1 *Guides to The Fire Precautions Act, 1971*
2 *Recommendations for the provision of emergency lighting in premises* (BEAMA)

### Eclairage de secours à point unique

Lorsque le Décret Britannique sur les mesures de précaution contre l'incendie (1971) sera mis en vigueur dans les hôpitaux en vertu d'un règlement, tous les hôpitaux, grands et petits, devront être munis d'un système d'éclairage de secours conforme aux exigences spéciales du Décret. Les exigences relatives aux hôtels et pensions ont déjà été définies et il est prévu que les exigences relatives aux hôpitaux seront du même ordre que les précédentes sous vien des aspects.

### Einpunkt-Notbeleuchtung

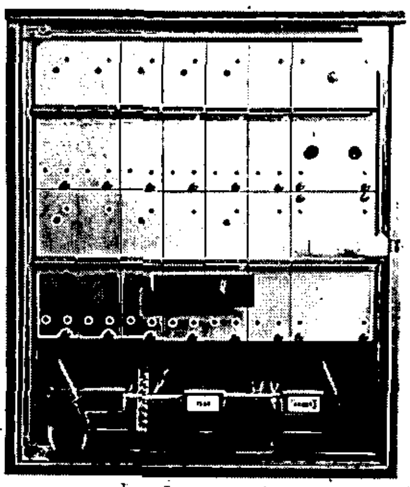
Wenn das Feuerschutzgesetz (1971) in Großbritannien auf Grund einer Anwendungsverordnung auch für Krankenhäuser gilt, müssen alle Krankenhäuser ohne Rücksicht auf ihre Größe mit einem Notbeleuchtungssystem ausgerüstet werden, das die speziellen Vorschriften dieses Gesetzes erfüllt. Die Vorschriften für Hotels und Pensionen wurden bereits definiert, und man rechnet damit, daß die Krankenhausvorschriften in vielerlei Hinsicht ähnlich sein werden.

### Accessori luce di emergenza a punto unico

Quando la Legge Britannica Antincendio (1971) entra in vigore per ospedali per ordine di designazione, ospedali, sia grandi che piccoli, dovranno venir provvisti di un sistema di luce di emergenza conforme alle disposizioni della legge. Le norme per alberghi e pensioni sono già state definite, e si prevede che le norme per ospedali saranno simili a quest' ultimi in molti aspetti.

## No alarm with Alarmline

Monogram Electric Ltd. has announced plans to produce a fire detection system for use in tunnels or ducting where risk of overheating in cables or other apparatus is present, but where normal access or surveillance is restricted.



Known as Monogram Alarmline, the system is a method of continuous line detection and uses an integrating solid-state detector cable developed from a type already well established in the company's heating systems. The cable is of dual concentric construction, and contains a dielectric material that is an efficient insulant at normal temperatures but becomes a conductor when exposed to heat. A notable characteristic is its high degree of sensitivity at low temperature levels.

In addition to the cable, the Alarmline system consists of a zone control unit, which will accommodate up to ten detector cables each of 100 m in length. Overheat or fire is sensed in a detector cable and the signal is received by the appropriate detector module mounted within the zone control unit. A signal from any of the 10 detector modules is, in turn, fed into a common logic circuit and translated into the alarm or other antifire action systems. The system has a uniform sensitivity to heat through each 100 m cable.

# Technical news

## Additive to fuel fire

Combustion Chemicals Ltd. has released details of an additive for oil-fired boiler plant that it has been developing since 1973. The additive, designated MM (manganese/magnesium) is a solution of manganese, magnesium and alumina compounds.

The specially activated manganese in MM acts as a combustion catalyst and promotes a more complete fuel combustion, so that less excess air is required for the combustion process. This limits the conversion of $SO_2$ and permits lower back-end temperatures, and increased combustion efficiency without increase in smoke number and with consequent fuel saving. As a

*continued on p. 23*

# Cape

# Every picture tells a story

The picture shows an inflexible storage facility which wastes valuable space and is not readily adaptable to meet changing procedures or allow rapid expansion of facilities. Equipment which appears attractive at the purchase stage often becomes an uneconomic proposition in the long term.

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**Cape**

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*continued from p. 21*

result, soot and smoke formation is reduced to a minimum, and stack emission is controlled.

The magnesium compounds raise the ash fusion temperature of the fuel oil, thus preventing vanadium slagging in the high-temperature zone and plate out on the heating surfaces of the boiler and as retarding or preventing the catalytic conversion of $SO_2$ to $SO_3$. They also neutralise sulphuric acid which, with the reduction of unburnt carbon, effectively controls acidic smut emission.

The solvents in which the principal chemicals are dissolved, condition the fuel and ensure control over sludge formation with consequent fuel saving, and control over burner coking.

## New hospital to be built

The Trent Regional Authority is to provide a comprehensive 1062–bed hospital on the 33 ha Plover Hill Farm site at Calow, Chesterfield. The hospital will serve north Derbyshire and Chesterfield, which has a population of about 350 000, but it will continue to rely on other hospitals for certain specialities.

The first phase of the new hospital will provide an accident and emergency department, outpatient department, department of physical medicine, eight operating theatres, X ray department, intensive-therapy and coronary-care units together with 408 acute medical and surgical beds, 40 children's beds and other supporting services. A second phase of development will be required to complete the hospital.

## £100 000 switchboard contract awarded

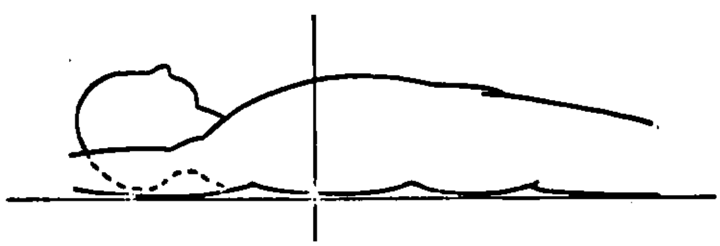
A contract for more than £100,000 to supply a PABX switchboard to Sunderland General Hospital has been awarded to Telephone Rentals Ltd. This installation will link the hospital with the majority of other hospitals in the Sunderland area, giving network operation, and will provide for emergency calls such as fire, cardiac arrest and staff location.

## Courses for boiler operators

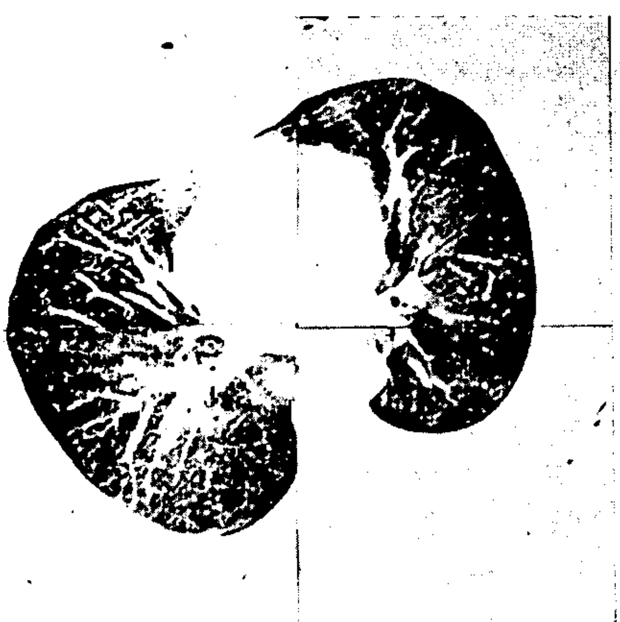
A series of 3-day residential courses for boiler operators, to be held in Birmingham between September 1975 and June 1976. The course is aimed at achieving safe and economic operation of boiler plant, and sessions are to be of limited numbers to provide maximum personal attention.

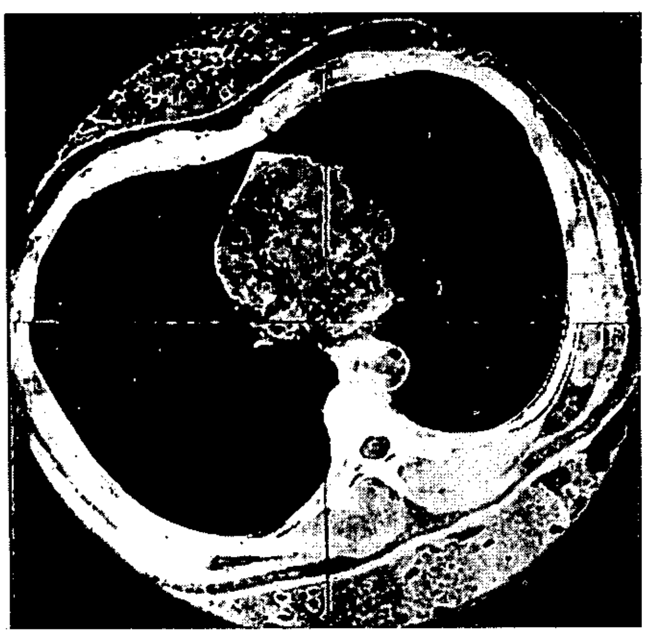
The syllabus includes fuels, combustion, practical fuel economy, steam generation and properties, feed-water treatment, firing methods and equipment, types of boiler, safety, instrument and control, and log records. Reservations can be made by contacting the National Industrial Fuel Efficiency Service, 26 Calthorpe Road, Edgbaston, Birmingham B15 1RP, England.

# Whole-body scanner



**These two pictures demonstrate the versatility of EMI's medical diagnosis system which uses a new X ray technique to produce detailed internal sections of a patient. Both pictures, cross-sections through the chest, were produced from the data recorder during a single scan. Lung tissue (left) and muscle, bone and fat tissue (right) are shown, viewed from the feet to head**

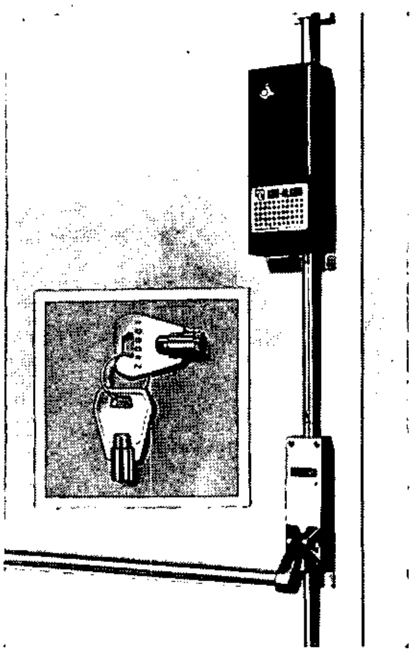




# Product news

### Alarm unit

The Brition ADD-ALARM is a self-contained battery-operated local alarm unit, giving an audible alarm of alternating frequency up to 85 dB (A) at 1 m. Although originally designed for use with Briton panic bolts, the ADD-ALARM is adaptable for use with similar products of other manufacture. The alarm is initiated automatically and immediately the panic bolt push bar is depressed, and also if there is an



attempt to remove the alarm unit cover. The alarm is fitted with a radial pin tumbler lock cylinder with 10 000 key combinations. Once the alarm has been initiated, only the official key holder can switch it off. An override with automatic reset is included in the keying arrangement. A long-life alkaline, Duracell high-power 9 V battery is used, and provision for testing is included in the circuit.

*Newman–Tonks Ltd., Hospital Street, Birmingham B19 2YG, England*

### High-pressure washing guns

Kina hot- and cold-water high-pressure washing guns are designed for use with medium- and high-pressure washing and jetting machines of all types, and will operate at water pressures of up to 175 kgf/cm² and handle flow rates from under 1 l/min to 50 l/min. A cleaning lance of 610 mm is standard but shorter or longer lengths are available. Various high-pressure spray patterns are obtainable depending upon the end jet fitted and the guns can be fitted for wet abrasive blasting operations. Both guns can handle cold or hot water up to 80°C but the hot-water model is insulated for operator protection. The on/off trigger control is fitted with an automatic fast safety shut-off valve and a safety locking device is fitted to prevent accidental operation by children or interested on-lookers.

*Kina Engineering Ltd., Industrial Estate, Hadleigh, Suff., England*

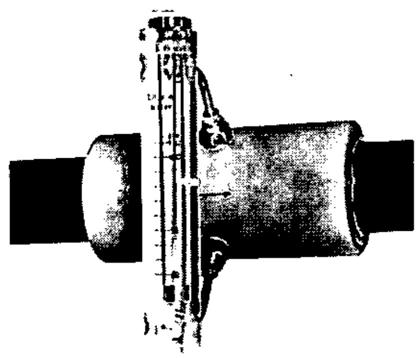
### Sound-level meter

The type 1419E portable battery-operated sound-level meter with built-in octave-band filters is designed to give accurate measurements of sound level and spectrum analysis over the audio frequency range. The instrument consists of a ceramic microphone, an impedance-matching circuit, a high-gain amplifier, weighting networks, octave-band filters and an indicating meter. When required, the microphone can be mounted separately from the measuring instrument by means of the 6 m lead supplied with each meter. In addition to the standard weighting curves A, B and C, a linear frequency response is provided. The meter exceeds BS3489: 1963 and IEC 123 for industrial-grade sound-level meters. An alternative version calibrated to ANSI S.I.4–1971 is available. The instrument measures sound levels over the range 26 dB to 140 dB.

*Dawe Instruments Ltd., Concord Road, Western Avenue, London W3 0SD, England*

### Flowmeter

This flowmeter is designed to measure flows in pipes of between 25 and 300 mm diameter and is primarily for use with clean, cold fluids, but it can also be used to register the flow of most common gases and diluted acids and alkalis. Working on a 'bypass' principle, it operates by forcing a small proportion of the main flow through bypass tubing, to be measured by a small, rotameter-type flowmeter. The meter is machined from a solid block of Perspex and can be used under



rigorous conditions without being damaged. An orifice pipe unit, for pipe sizes up to 50mm inside diameter, or an orifice carrier, for fitting between pipe flanges of 50mm inside diameter and above, provide the main orifice unit. They are available in u.p.v.c., polypropylene or mild steel, cadmium-plated.

*Paul Poddy Ltd., 16 Minerva Road, London, NW10 6HJ, England*

### Indirect post-top lantern

The HA 6760 and the HA 6762 post-top lanterns have a new patented optical system which, by using twin reflectors made from pure aluminium, enables the lamp to be concealed from direct view. Standard HA 6760 lanterns are for use with 125 W mercury fluorescent lamps. The 250 W sodium lamp can be incorporated to order in the HA 6762. The bowl is moulded from clear impact-resistant polycarbonate and, by varying the profile of the top reflectors, the light output can be altered to give circular, square or asymmetrical distribution. The top cover into which the top reflector fits is made from pressed aluminium sheet and the spigot cap/gear housing which also incorporates the lamp and lamp reflector is made from extruded aluminium. The lantern is mounted onto a hot-dipped galvanised vertical steel pole which is supplied with a separate base plate, access to cut-out connector and a cable to the lantern head. A wall-bracket version is also available.

*Hume Atkins (Lighting) Ltd., Carolyn House, Dingwall Road, Croydon CR0 2NA, Surrey England*

### Vibration-monitor system

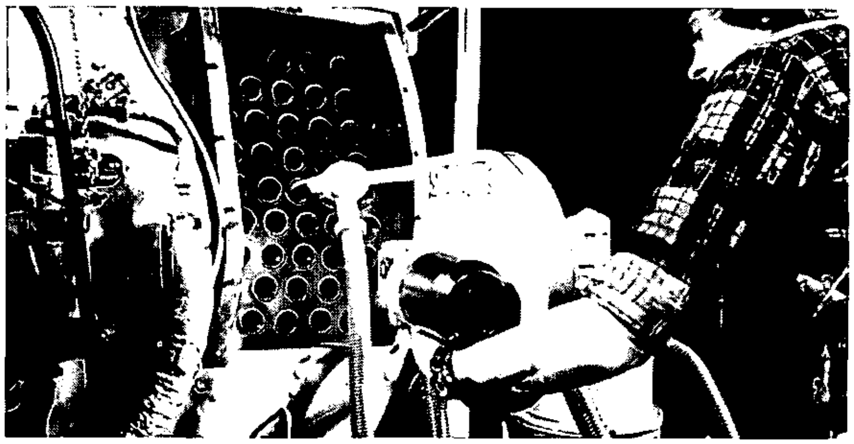
The 1440–10B voltage amplifier is an addition to the 1440 vibration-monitor system, which is designed to protect plant from excessive vibration. The type 1440–10B, incorporates two alarm circuits which can be set to provide high–high, high–low or low–low vibration limits. With the high–high setting, the first high trip may be set to give a warning that the vibration level is higher than normal while the second high trip may be set to shut down the plant being monitored automatically before a dangerous vibration level is reached. Each alarm is provided with adjustable delay time.

*Dawe Instruments Ltd., Concord Road, Western Avenue, London W3 0SD, England*

### Boiler-tube cleaner

The Sootvac boiler-tube-cleaning unit consists of a helical wire brush attached to a high-tensile steel tape fed into the boiler tube by a reversible motor, all housed in what is termed the pistol. The pistol has various nozzles and brushes to accommodate various sizes of boiler tubes, and is connected to a cyclone so that all residue and soot dislodged by the brush is sucked into a collecting bag. Once the nozzle of the pistol is inserted into the boiler tube the unit is self-supporting. The brush traverses the length of the boiler tube and back, the length of travel being indicated on the pistol housing. The top of the cyclone can be removed, carried by shoulder straps and used as a portable vacuum cleaner.

*Sootvac Ltd., Eldon Way, Hockley, Essex, England*



## Formation of Indian Institute

On the 22nd June, after five or six years of discussion, the Institute of Hospital Engineering, India was formed. The 2 hour inaugural meeting was attended by about 100 delegates, including engineers, architects, town planners, doctors and hospital administrators.

In addressing the delegates, J. C. Mehta, the convenor of the meeting, said that he saw the new Institute as having the following prime objectives:

- the initiation of inservice training courses on hospital technology for technicians and engineers
- the commencement of postgraduate and postdiploma courses in hospital engineering as a specialist branch of environmental engineering
- the holding of a forum with industry to collect, monitor and disseminate knowledge on hospital engineering

Mr. Mehta added that there are efforts being made to open documentation centres and international testing laboratories for hospital equipment. He felt that India ought to follow this trend so that it could export equipment developed in India.

The new Institute is planning to apply for membership of the International Federation of Hospital Engineering.

## Institute news

### MID-SCOTLAND BRANCH

A party of 13 visited the Seafield Colliery on the 29th May and were given the full treatment, from being equipped with helmet and breathing apparatus to being searched on entry to the cage. The party was then lowered 300 m down the shaft and then by train to a point 5 km below the River Forth where members transferred to a bogie which lowered the party down to the entrance to the face at an incline of 1:2. On arrival at the workings the party was taken down the 1:1·2 face through the mass of hydraulic jacks, where they witnessed the vertical cutter in action.

### Theses and papers

Council's Publications Committee endeavours constantly to widen the interest and range of material and subjects published in the journal.

Many members may write a thesis in connection with their studies, in connection with a diploma in management studies, for instance or a technical paper relative to some other course or activity.

Publications Committee would always be pleased to consider such material for possible inclusion in the journal. Theses or papers should be sent to the Institute Secretary, 20 Landport Terrace, Southsea, Hants. PO1 2RG.

### SOUTHERN BRANCH

The branch has the following activities planned for the next six months:

**1975**

| | |
|---|---|
| 13th September | Works/establishment visit Portsmouth |
| 8th November | 'Health & Safety Act' Basingstoke |

**1976**

| | |
|---|---|
| 10th January | 'Recent advances in sterilisation procedures' by S. Drewitt Portsmouth |
| 13th March | 'The new health service' Southampton |

Further information can be obtained from the Honorary Secretary, D. R. Wilson, 5 Orchard Gardens, Fordingbridge, Hants.

# Cooling-water treatment plant for the Cantonal Hospital, Basle

by J. TYLMANN

A plant treating water from the Rhine has been engineered for supplying cooling water to various facilities in the Cantonal Hospital at Basle. Owing to the restricted space at the site, by the Johanniterbrücke, problems arose, particularly with the accommodation of all plant components for the complex treatment process.

### Basis of project

The purpose of the plant is to supply cooling water of suitable purity for the requirements of refrigerating machinery, emergency diesel generating sets and heat exchangers of the air-conditioning installations, with a flow rate varying steplessly between 50 and 1100 $m^3$/h On the strength of exhaustive tests extending over many years with water from the Rhine in the Basle area, the treatment adopted was a coarse settling stage followed by flocculation filtration through multilayer filters. To accommodate the variation in the cooling-water demands of the hospital, control of the discharge rate of the pumps installed emerged as the best solution.

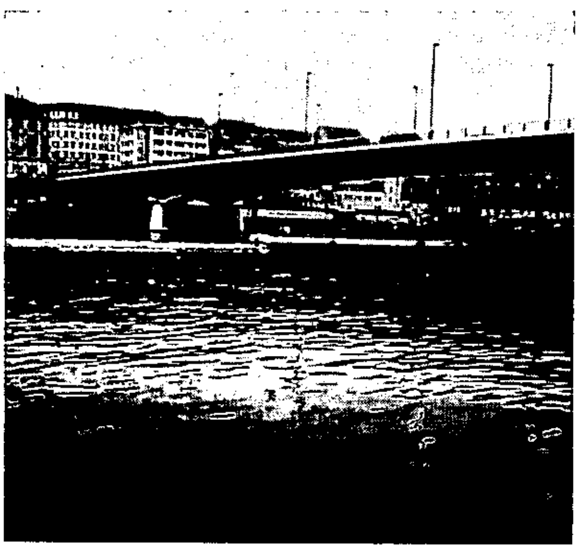


**Fig. 1 The Johanniterbrücke in Basle The plant is built into one of its abutments**

Mr. Tylmann is with the Water & Waste Water Engineering Department, Sulzer Brothers Ltd., CH-8401 Winterhur, Switzerland.
This article was first published in the *Sulzer Technical Review*

**Fig. 2 Eight raw-water pumps laid out in a row between the filters**

### Rhine-water intake

The river-water intake is divided into two concreted chambers accommodated in the wall of the embankment. Though both intake chambers are operated in parallel normally, each one is dimensioned for the full flow rate of 1100 $m^3$/h, allowing one chamber to be cleaned or overhauled without interrupting plant operation. Because the authorities would not allow rack cleaning equipment to be erected on the embankment, the screens with bars spaced at 25 mm arranged before the chambers have to be freed manually of the trash arrested by them. Owing to the flow conditions at the intake site, considerable amounts of smaller-sized foreign matter were able to get through the screens. Consequently, raisable perforated plates with smaller passage cross-sections had to be installed afterwards.

Behind the screens are the actual intake chambers, which can be closed with stop logs. Leading out from them are the trumpet inlets of the raw-water pipes. Each of the two intake lines can be shut off with valves, whose drive shafts are led up to the level of the embankment. After the inlet chambers the two inlets are united, and the river water runs under gravity into the two settling basins. This pipe is of steel; besides the necessary protective coating it is also provided with cathodic protection.

### Coarse pollutant separation

The river water is distributed between two longitudinal basins, whence, after removal of the precipitates, it passes into the suction chamber of the raw-water pumps arranged between the basins. The incoming river-water pipe leads first through a control shaft, in which a butterfly valve regulates the inflow of water according to the level in the pump sump. An emergency valve is provided downstream to prevent flooding in the event of inadmissibly large inflow of water due to failure of the butterfly. The pipes to the two settling basins also branch off from the control shaft. Each of them can be closed with manually operated valves, enabling one basin to

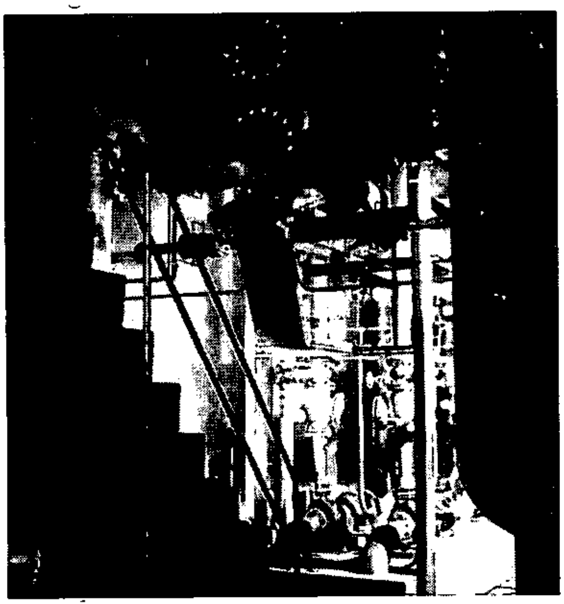


**Fig. 3 Layout of treatment plant**

be isolated for cleaning or overhaul and the treatment plant operated at half its capacity. The inflowing water is distributed over the full width of the basin in the usual way, i.e. by means of an inflow slit covered with a baffle plate. There are times when the Rhine carries a great deal of pollution. Hence settling is essential to remove the coarse dispersed phase to ensure an economic filter operating cycle. The sedimented sludge is conveyed by a sludge scraper into pits, from which it is delivered by submerged pumps into the drainage.

Overflow channels, which lead the clear water to the pump sump, complete the equipment of the settling basins.

## Raw-water pumping station

The pumping capacity of the plant is provided by eight identical units, which draw the raw water from the sump and pump it through the filtration plant straight into the consumer network. After the first pump has been started all further pumps are switched in to match the flow rate. A Woltmann water meter is used to control the discharge rate automatically.

The raw-water pumps (Fig. 2) are standard low-lift types driven by squirrel-cage motors.

## Filtration plant

Eight standard Sulzer filters are installed. They have three layers, making them suitable for flocculation filtration, which is indispensable for the treatment of the water, which has been freed only of the coarse impurities.

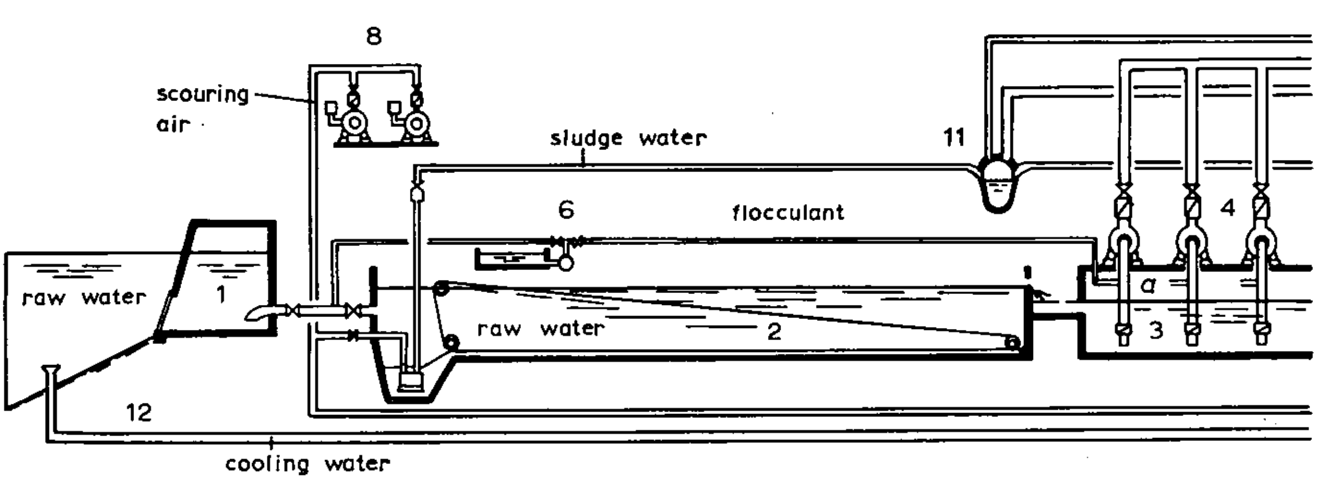
All filters are operated in parallel at all times, regardless of the throughput rate. Diaphragm valves assure tight closure even with polluted water. They are controlled hydraulically by an automatic system for filtration and flushing.

Fig. 3 shows the arrangements of the filters in two rows, with the raw-water pumps installed between them and all collecting tanks above the pumps.

## Flocculation

Colloidally dispersed matter accounts for a large part of the pollution in the raw water, and flocculants must be employed at times in order to enable it to be filtered. Iron chloride is used as flocculant. The dosing equipment is put into operation automatically according to the level of pollution, by means of a turbidimeter. The dosage is governed by the flowrate, a metering pump being provided for each raw-water pump. To ensure good mixing with the raw water the flocculant is added immediately upon entering the raw water pumps. The pipework and overdamming volumes above the filter beds are dimensioned so that the contact time suffices only for the formation of microflocs. This allows the two upper filter media to perform their intended functions as volumetric filters in full. Only the bottom layer acts as a surface

**Fig. 4 Hydraulic layout of plant**



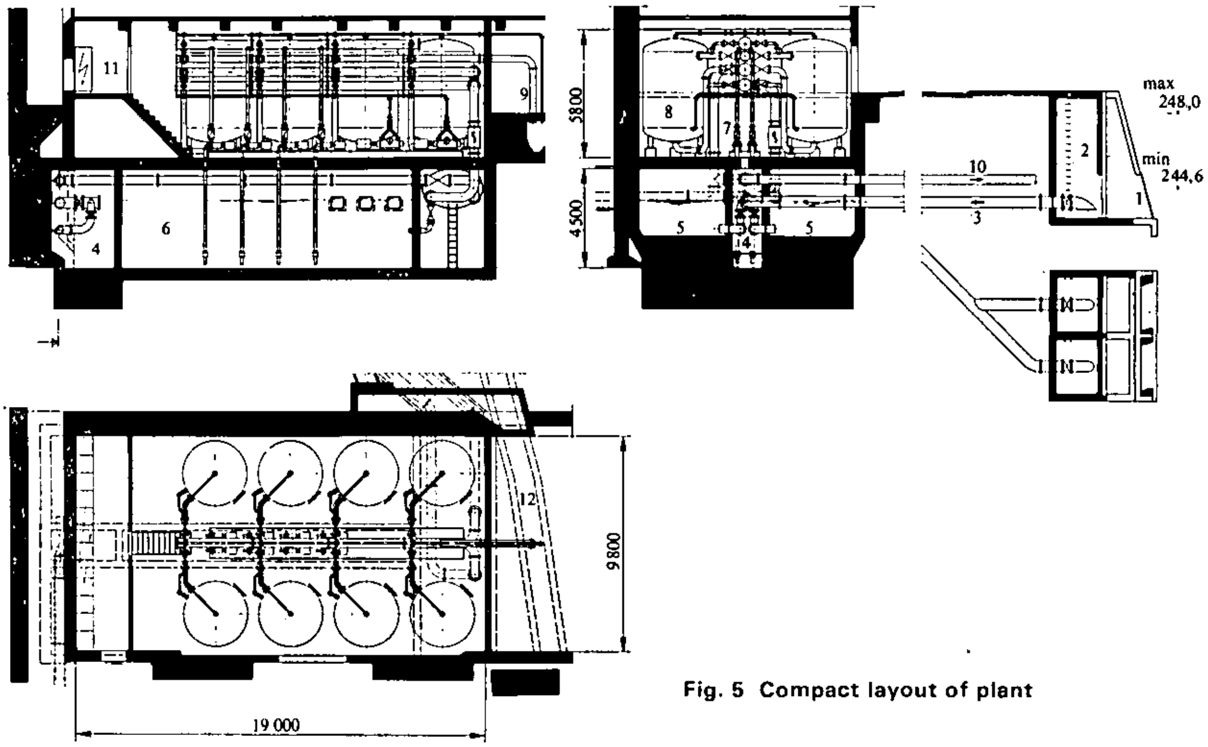


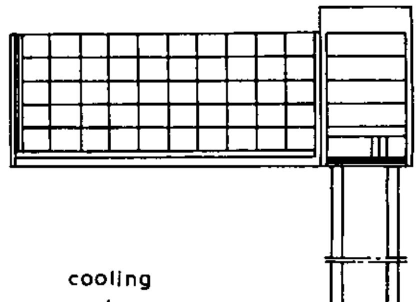

Fig. 5 Compact layout of plant

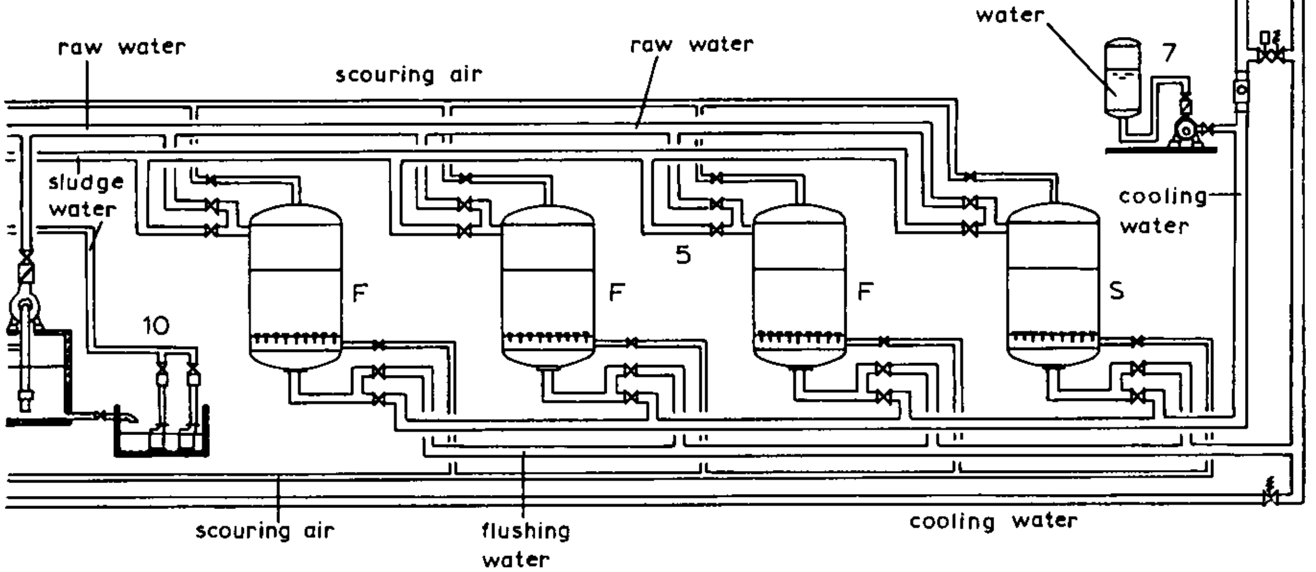
filter for retention of the finer particles of dirt. By combining the filter media employed in the form of a 3-layer filter with microflocculation, the required degree of purity is assured as well as an adequate operating cycle between filter flushings.

## Flushing

In this plant the filters are backwashed using the spent cooling water, which is collected after the coolers. Instead of being discharged into the Rhine again it is first made to flow backwards through the filters.

Fig. 4 shows the hydraulic layout of the plant; only one half is represented. It can be seen how the backflowing water is branched off for flushing. Before the outflow into the Rhine is a pressurising valve, which maintains the pressure needed for flushing. If the consumers are using less water than is needed





for flushing, the automatic flushing control system switches on the requisite pumps and the necessary flow of water is taken from the supply pipe through a bypass into the backwashing pipe. In the bypass tree is also a pressurising valve, which ensures the necessary supply pressure for the coolers at all times.

The filters are flushed automatically. Primarily the flushing operation is initiated by a time switch, which is programmed for the periods of lowest coolant demand. If premature flushing becomes necessary owing to particularly severe pollution, the backwashing operation is triggered by a differential pressure switch.

The filters are flushed in the conventional manner, i.e. with air and water. Two scouring air blowers and a pressure-boosting unit for the control water complete the mechanical equipment of the treatment plant.

This installation, which has been in service for more than a year now, is notable for its compact layout (Fig. 5). Not only the configuration of the mechanical equipment had to satisfy exacting requirements, however, the process itself had to be engineered with the utmost precision in order to accommodate the high plant capacity in the available space of about 2200 $m^3$.

**Installation de refroidissement de l'eau pour l'Hôpital Cantonal**

Une installation pour le traitement des eaux du Rhin a été construite pour alimenter en eau refroidie différents aménagements de l'Hôpital Cantonal de Bâle en Suisse. L'espace restreint du site, près du Johanniterbrücke, a créé plusieurs difficultés, en particulier pour l'installation de tous les appareils nécessaires à ce traitement compliqué.

**Kühlwasser-Aufbereitungsanlage für Kantonalkrankenhaus**

Zur Vosorgung verschiedener Einrichtungen im Kantonalkrankenhaus von Basel wurde eine Anlage konstruiert, die Rheinwasser aufbereitet. Die beschränkten Platzverhältnisse am Aufstellungsort bei der Johanniterbrücke brachten verschiedene Probleme mit sich, besonders was die Unterbringung aller Anlagenteile für dieses komplexe Aufbereitungsverfahren betraf.

**Impianto di trattamento acqua di raffreddamento per l'Ospedale Cantonale**

Un impianto per il trattamento dell'acqua del Reno è stato progettato allo scopo di fornire acqua di raffreddamento alle varie utenze dell'Ospedale Cantonale di Basilea, Svizzera. A causa dello spazio limitato de luogo, presso il Johanniterbrücke, problemi si sono verificati soprattutto in relazione alla sistemazione di tutti i componenti dell'impianto peril complesso processo di trattamento.

## X ray film in trough

An automatic conveying system for handling X ray film cassettes has been installed at the New York District Hospital by Lamson Engineering Co.

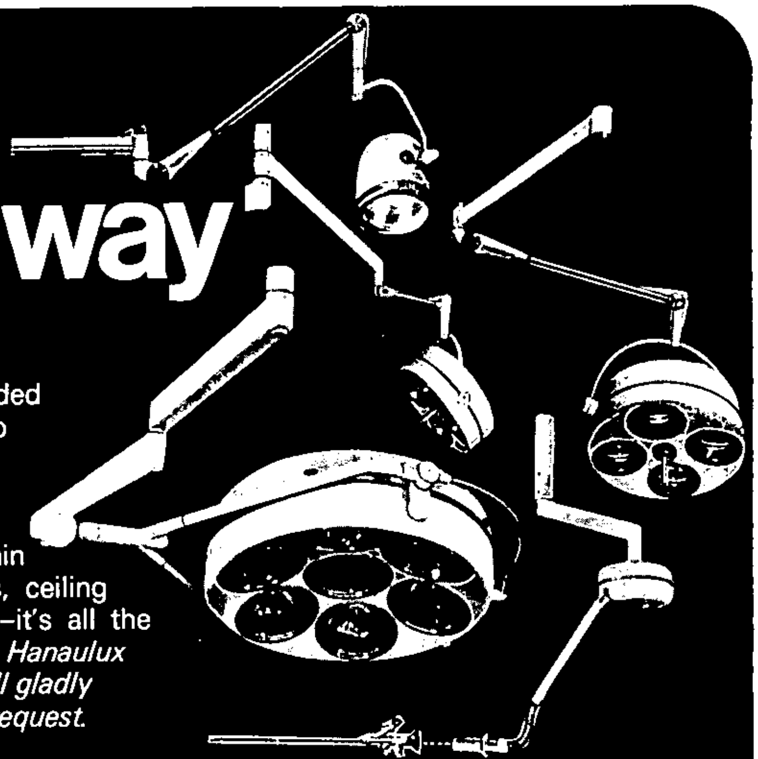
The Lamson conveying system uses a 'V' trough conveyor and each diagnostic room has a separate conveying lane through which it can despatch cassettes to the processing room and receive recharged cassettes. By using this design, the cassettes can be carried on edge in an extremely confined space with the minimum of friction. Each room has access only to its own lane, so that interference with passing through traffic is impossible.

The exposed cassettes are dropped into a local charging slot and conveyed to the processsing room at about 18 m/min via wall-mounted, cladded conveyors. The cladding is important to prevent any scatter radiation from fogging an already exposed plate. Cassette handling by 'V' trough conveyor requires a linear layout of X ray rooms and dark room.

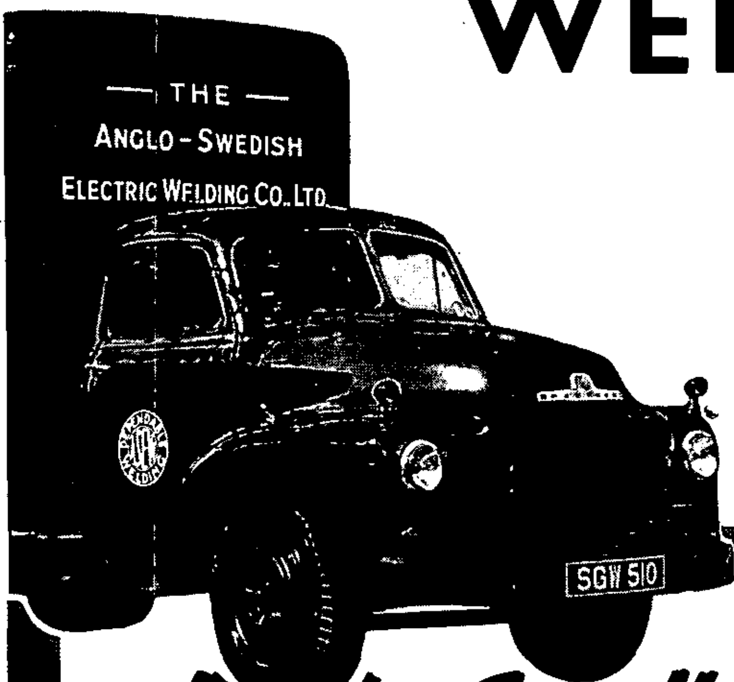
## On the move

John B. Packer, F.I.H.V.E., F.I.Hosp.E., C.Eng., F.I.Mech.E. has joined the practice of W. F. Johnson & Partners, architects, engineers and quantity surveyors, as a partner responsible for

engineering services. Mr. Packer was Deputy Regional Engineer, East Anglian Regional Hospital Board, from 1960 to 1968. Following this appointment he was an Associate with Oscar Faber & Partners and was responsible for engineering services associated with major hospital developments including the new Royal Free Hospital, Hampstead.



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It is anticipated that the successful applicant will hold HNC in Mechanical or Electrical Engineering or an equivalent qualification and on top of his annual salary a special responsibility allowance is paid.

South Birmingham as a place to live and work has much to offer with all the advantages of a major town plus being at the hub of Britain's motorway complex can offer easy access to all parts of the Country.

Please apply for application forms and further information to Mike Clitheroe, District Personnel Officer, South Birmingham Health District, Oak Tree Lane, Birmingham B29 6JF. Persons interested in viewing the site are welcome to contact the Administrator, Selly Oak Hospital. Telephone 472 5313.

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MANCHESTER AREA HEALTH AUTHORITY (TEACHING)
SOUTH DISTRICT
WITHINGTON HOSPITAL,
MANCHESTER M20 8LR

Vacancies exist for three Assistant Engineers for the following posts:

1. District Electrical Design
2. District Auditing Mechanical/Electrical
3. Hospital Mechanical Maintenance

Applications are invited from Engineers who have preferably served an Engineering Apprenticeship and obtained an O.N.C. in the respective Engineering disciplines.

Salary is payable on the scale of £3063–£3507 and new entrants normally start on the minimum of the scale.

Application forms and Job Descriptions can be obtained from the District Engineer at the above address. Application forms to be returned within three weeks of the date of the advertisement.

# Technical Assistants

## Electrical & Mechanical

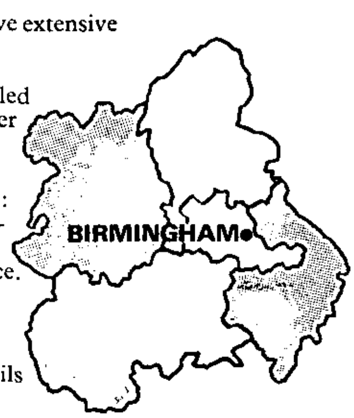
## (£2,352-£4,692 p.a.)

## Birmingham & West Midlands

The West Midlands Regional Health Authority, Britain's biggest with more than 1,000 establishments for a population of five million, has opportunities for young technician engineers looking for career development and job variety. As well as working on a number of differing projects, you will find opportunities and active support for further education.

The successful candidates, who must have extensive practical experience of designing and installing mechanical and/or electrical services, will be responsible for the detailed preparation of engineering schemes under the direction and supervision of a more senior engineer.

There are three grades and salary ranges: £2,352-£3,384; £3,447-£3,903; £3,906-£4,692; *and candidates will be graded* according to qualifications and experience. Qualifications required include City & Guilds, ONC Mech. and Eng, HNC.




For an application form and further details please write to or 'phone:
**Tony Johnson, Personnel Officer,**
**West Midlands Regional Health Authority,**
**Arthur Thomson House, 146, Hagley Road,**
**Birmingham B16 9PA. Tel: 021-454 4828**
*Initially, preference will be given to transferred officers in the NHS.*

West Midlands
Regional Health Authority

**CLASSIFIED ADVERTISEMENTS** *continued from previous page*

## APPOINTMENTS AND SITUATIONS VACANT

### EALING HAMMERSMITH & HOUNSLOW A.H.A. (T)

SOUTH HAMMERSMITH DISTRICT

# Charing Cross Hospital

## Hospital Engineer
**£4164-£4689**

A qualified engineer preferably with H.N.C. in Mechanical or Electrical Engineering, or a recognised equivalent, is required to manage the day to day operation of the 900 bed Teaching Hospital. The complex comprises Medical School, School of Nursing, residential accommodation and hospital premises.

The engineering services represent an investment of several million pounds and the Hospital Engineer would be expected to provide supervision of contractors, ensure that safety regulations are being observed and liaise closely with the Planned Preventative Engineer. Family accommodation may be available to the successful applicant.

## Planned Preventative Maintenance Engineer
**£4164-£4689**

This appointment would suit a qualified engineer with a broad practical background in plant engineering. He will be closely involved with the Hospital Engineer in extending and maintaining the present Preventative Maintenance system. He will be a member of the District Works Officer's Team.

Preference will be given to applicants with H.N.C. in Mechanical or Electrical Engineering or full Technicological Certificate in Plant Engineering.

Staff facilities include Social Club and heated swimming pool, there is also excellent Public Transport.

For application form and job description please write or telephone Miss H. Dann, District Personnel Department, Charing Cross Hospital, Fulham Palace Road, Hammersmith, London, W.6. Tel.: 01–748 2050 Ext. 2997

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SULTANATE OF OMAN

*Ministry of Health*

# HOSPITAL ENGINEER

Applications are invited for the post of Hospital Engineer in the Ministry of Health, Sultanate of Oman, Arabian Gulf. Applicants must be experienced maintenance engineers with a thorough practical knowledge of Central Air Conditioning Plant, H.V. Autoclaves, Steam Boiler Plant, Laundry Plant and all associated hospital equipment. They must also be experienced in the control of Maintenance Staff and Maintenance Programming. Applicants must hold a higher National Certificate in Electrical or Mechanical Engineering (or equivalent) and preferably be Members of the Institute of Hospital Engineers. Appointment is for two years in the first instance. Salary Rials Omani 5400 per annum (approximately £6750). There is no income tax at present in Oman. Other benefits include free accommodation, free medical treatment and generous leave.

Applications giving details of educational qualifications and experience together with photo-copies of certificates and testimonials should be sent to:

DIRECTOR OF PERSONNEL
MINISTRY OF HEALTH
POST BOX 393, MUSCAT
SULTANATE OF OMAN

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### HOSPITAL ENGINEER EPSOM

Salary scale: £3615–£4140 per annum, plus £183 p.a. Special Responsibility Allowance, and £312 London Weighting Allowance.

Primarily responsible to the District Engineer for the operation and maintenance of all engineering and electrical services at Epsom District (General) Hospital, Dorking Road, Epsom, Surrey.

Applicants must be in possession of a Higher National Certificate in Mechanical or Electrical Engineering; an equivalent City & Guilds Certificate or other qualifications acceptable to the Secretary of State as an alternative.

Further details and application form are available from:

Personnel Officer,
Epsom District Hospital,
Dorking Road,
Epsom, Surrey.
Tel.: Epsom 26100 Ext. 327.

Mid Surrey Health District

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## APPOINTMENTS AND SITUATIONS VACANT



## MISCELLANEOUS



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