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OCTOBER 1968

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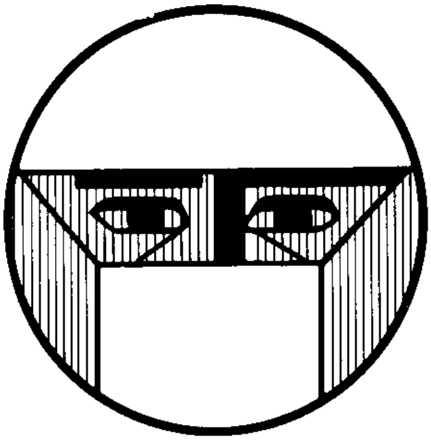
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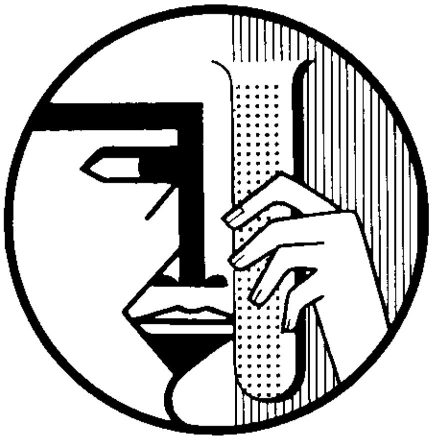
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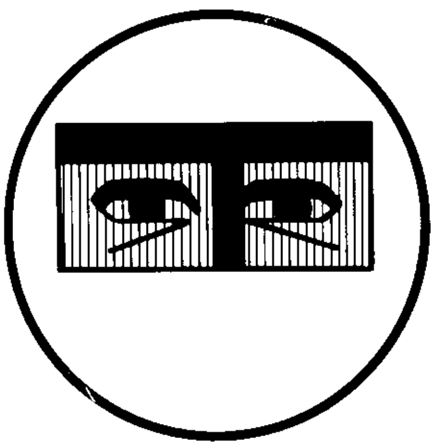
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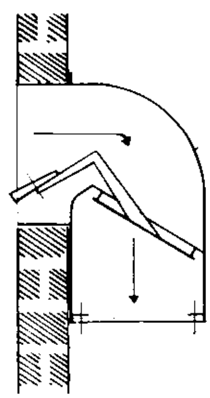

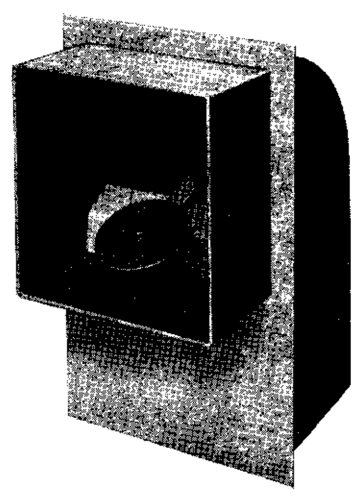

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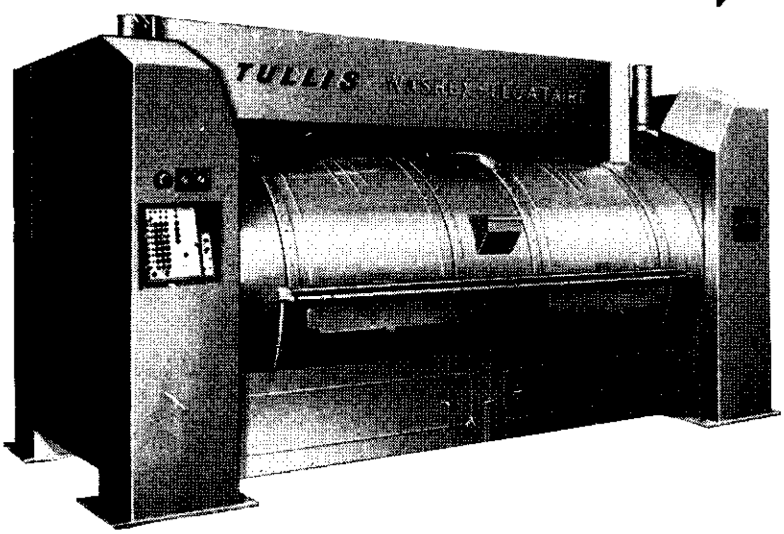

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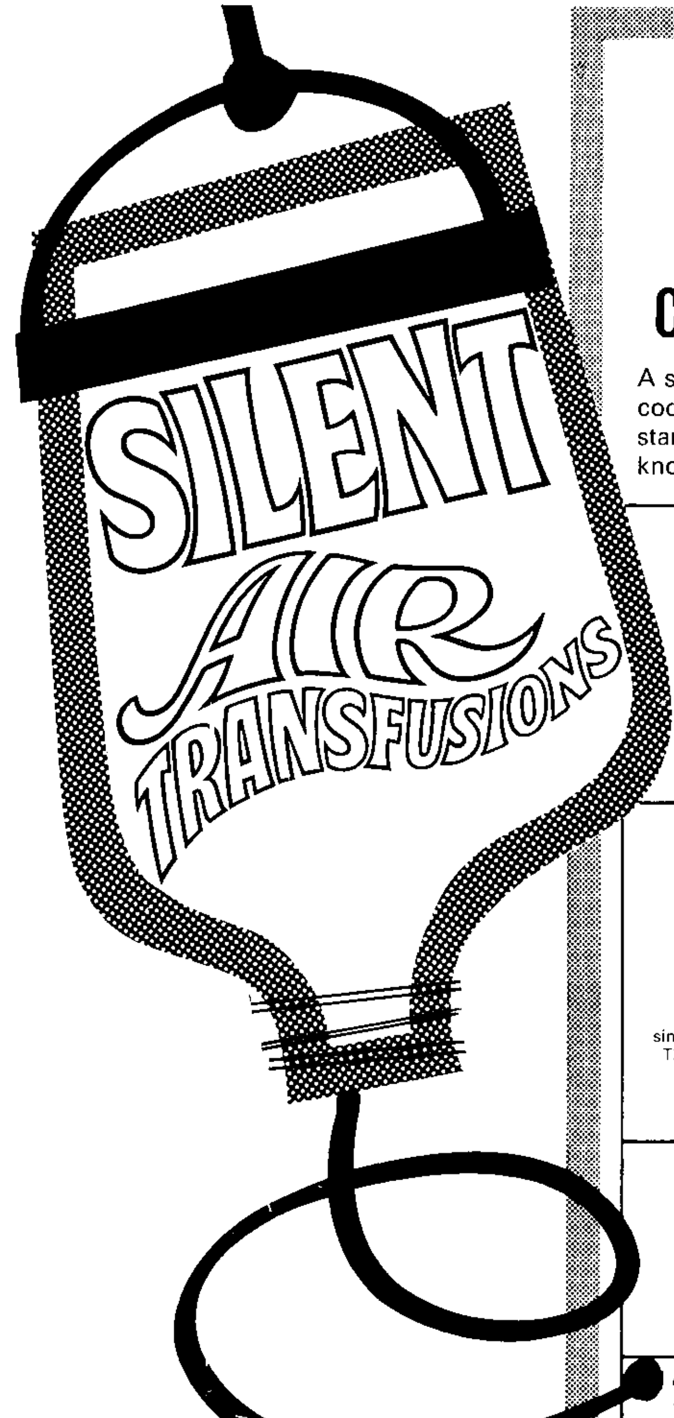

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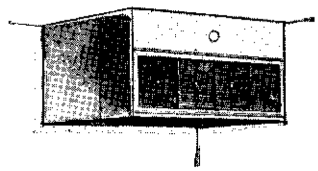

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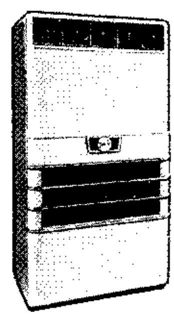

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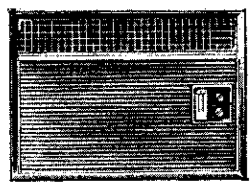

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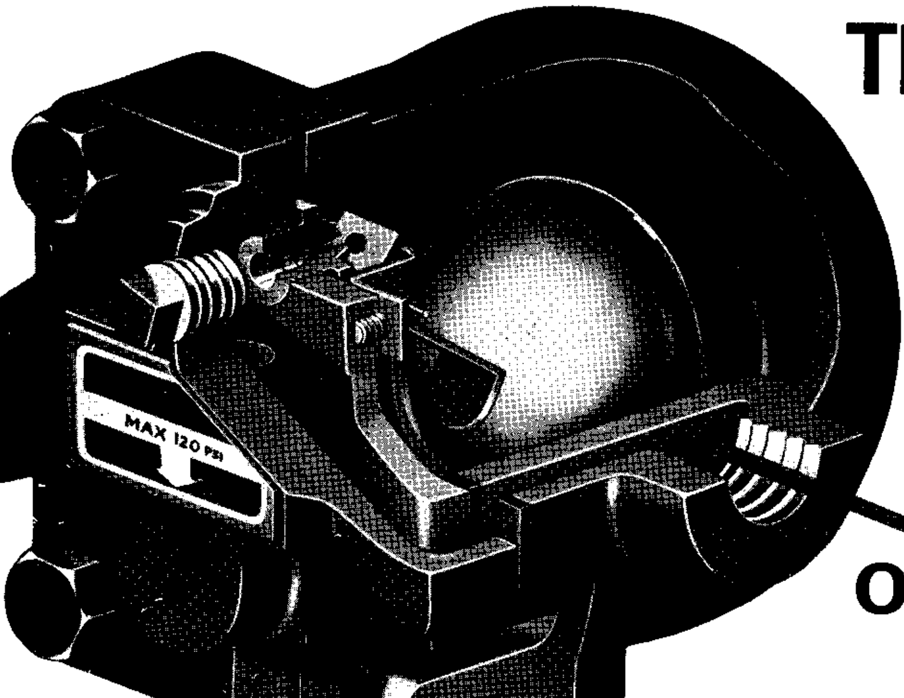

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The Design of Hospital Disposal Chutes

A SURVEY OF EXISTING INSTALLATIONS

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Building Services Research Unit, University of Glasgow

1. Introduction

IN October, 1966, the Planning Team for the rebuilding of the Royal Hospital for Sick Children of the Western Regional Hospital Board, Scotland, decided that disposal chutes should be installed in the new building. They further decided to sponsor a research project, to be carried out by the Building Services Research Unit, the purpose of which would be to investigate the design of these chutes.

The first report by the Research Unit* dealt with existing design practices and described the research work which had already been carried out in this field. That report also described the studies which it was proposed to carry out. Some of these proposals have been modified in the light of further experience and discussion; others have been carried out during 1967 and their results will be described in a series of reports.

2. Survey of Existing Chute Installations in Great Britain

The purpose of this survey was to find out which hospitals already had chute installations. A brief questionnaire was sent to all the Regional Hospital Boards in England, Wales and Scotland and to the English Teaching Hospital Groups (55 in all). Of these 42 (or 76 per cent) replied stating whether or not they used chutes, and if so, their size, height and any other relevant features.

It was found that there were just over 70 separate installations in the country. The general breakdown was as follows:

Regional Hospital Boards: 33 chute installations in 30 hospitals.

London Teaching Hospitals: 25 chute installations in 13 hospitals.

Provincial Teaching Hospitals: 14 chute installations in 10 hospitals.

Of these, 49 were used for linen only, 11 for refuse only and 6 for both linen and refuse—several others were used for plaster only or for soiled dressings, while some were disused. 37 of the chutes served wards, 20 served operating theatres and 6 of the installations served both these departments. Another 6 were located in nurses' homes.

The numbers of floors spanned by the chutes are given in table 1.

No. of Floors	1	2	3	4	5	6	7	8	9	10
No. of Chutes	21	13	12	6	5	3	1	0	2	0

Table 1. Breakdown of existing Chutes by number of Floors.

Most of the chutes served only 1, 2 or 3 floors. Of the two highest chutes, one was in a new hospital and served 6 ward floors; the other was a nurses' home refuse chute.

	Bagged	*Loose*	*Both Bagged and Loose*
Linen	33	11	6
Refuse	3	7	—
Linen and Refuse	6	—	—

Table 2. Bagging of material at existing chutes.

*"Disposal Chutes for Linen and Refuse in Hospitals." Building Services Research Unit, Report No. 70, February 1967.

Table 2 indicates the number of cases where bags were used or where linen and refuse were put down loose.

It can be seen that the tendency was to bag the linen, though in some cases this applied to foul linen only, the dirty linen being sent down loose. With refuse the position was the reverse, though there was only a small number of examples. In the six instances where the same chute was used for both linen and refuse, both these commodities were bagged.

So far as the bags were concerned, large linen ones were the most common for dirty linen, with nylon and terylene coming second. For refuse, plastic and paper bags were the most popular. All these bags come in a variety of shapes, sizes and colours.

It was also evident from this survey that the size and shape of the chute itself were by no means standardised over the country. They varied from 15 inches to 30 inches in diameter and from 18 inches square to 36 inches square and 36 inches by 15 inches rectangular. The most popular sizes were 24 inches (square or circular diameter) and 18 inches (in 23 and 15 cases respectively). In addition, a large variety of entry point designs were in use. These ranged from simple, side-hinged, non-locking doors to complex, electrically interlocked arrangements.

So far as ventilation of the chute was concerned, once again, there was no standard arrangement. In many cases, the chute was sealed off at the top, in some, the chute was continued up into the roof space, in others, a vent pipe was connected from the top of the chute to the outside air. In no case was a fan fitted.

The materials from which the chute was constructed were mainly galvanised sheet steel and mild steel. Aluminium alloys and glazed piping had been used in some cases and, exceptionally, stainless steel. In one instance, the chute was simply a plaster finished brick shaft, in another, "formica off-cuts" had been used to construct the chute.

The striking feature about this survey was the large variety of chute designs and disposal arrangements. Of those reported, no two were alike. Clearly, there is a strong case for some standardisation of many aspects of chute design. Equally clearly, there exists a fairly large pool of experience on chute usage in this country. It was therefore decided to tap this experience by visiting some of the existing installations, examining their features in detail, and eliciting comments on their use from the hospital staff, thus providing some much needed feed-back of information for designers of new installations.

The survey also brought to light the interest which several other Hospital Boards or Groups had in the project, and further enquiries have been received during the course of the study.

3. Chute Installations Visited

Twenty existing installations in eleven hospitals were visited during April, 1967. They were selected to give a wide variety of design and usage features.

During these visits, which generally lasted about two hours, not only were the design features noted, but the engineering and nursing staff were closely questioned concerning the practical performance of the chute. In general, there were very few complaints. No matter how rudimentary the installation, most members of staff preferred this method of disposal to the conventional portering arrangements.

The chutes which were examined ranged from those installed more than 15 years ago, to some which were only a few months old. Their heights varied from 1 to 9 storeys. Most were intended for the disposal of linen, though a few dealt with refuse and some were used for both. All of them handled materials from wards and/or operating theatres. Most were located in the London area, with a few others at Bristol, Cambridge, Glasgow and Edinburgh. One interesting Swedish installation was visited by a colleague who was in Sweden on other business, as well as the refuse disposal chutes in some local multi-storey blocks of flats.

4. Design Features of the Chutes Visited and Comments Thereon

4.1. *Construction*

The following materials and finishes had been used:

(*a*) Galvanised sheet steel.

(*b*) Galvanised sheet steel with internal coating of plastic paint.

(*c*) Mild steel sheet.

(*d*) Brick duct with plaster finish

(*e*) Glazed earthenware piping

(*f*) Aluminium sheet.

(*g*) "Formica" laminate.

All the metal chutes seemed hard-wearing and to have withstood the ravages of time. The internal coating of plastic paint appeared to be sound after about 5 years of use. A protective coating of bituminous paint had been applied to the outside of some of the galvanised external chutes, but others had withstood the weather for many years without any additional protection. The glazed earthenware pipe was also hard-wearing, but of course its weight was considerable, and its appearance rather massive in the 24 inch diameter size. This type of material was popular for multi-storey blocks of flats, but there, smaller sizes (12 to 15 inches diameter generally) were used. The plaster lined chute which had been in use for about seven years, was fairly smooth and crack-free.

So far as the best choice of material for the construction of a chute is concerned, the metal ones appeared to have the advantage, both from the point of view of manufacture and of hardwearing qualities. The best type of metal for any particular application can be reduced to a matter of cost. The correct choice of internal finish is rather more problematical, but will depend on the care taken during manufacture and erection of the chute, the method and frequency of cleaning and the desirability of a smooth impermeable surface.

4.2. *Size and Shape*

Of those visited, nine were circular (from 18 inches to 24 inches in diameter), ten were square (from 17 inches to 24 inches wide) and the remaining few rectangular. In no case was complaint made of jamming of material in the chutes.

Little comment can be made at this stage on the best size or shape for a chute since it will depend on several other factors in the design of the installation, in particular, the dimensions of the bags of material being deposited down it, and the avoidance of fittings likely to retain dirt.

4.3. *Location of Entry Opening*

These were situated in a wide variety of locations in the hospitals visited. The most popular place was of course the sluice room. However, entry points were also situated in corridors, on external balconies, in the wards themselves, and in small rooms kept exclusively for that purpose.

In most cases, the sluice rooms were naturally ventilated. Those on external balconies did not lack adequate ventilation, but using them could not be particularly pleasant in bad weather. The location of the entry point in the corridor had certain disadvantages also, not the least of which was the increased congestion. However, both these locations (balcony and corridor) were normally used where the chute had been added to an existing hospital and structural alterations had to be kept to a minimum.

Two of the chutes had their entry points located in small, unventilated, internal rooms—in one case, air flow could be detected flowing from the room into the ward via the door cracks, even when the chute door was shut.

There would seem to be little doubt that the best location for the chute entry point is in a sluice or dirty utility room. Adequate ventilation of the room is essential in any case, preferably by mechanical means, if some control of air movement to the rest of the ward is to be achieved.

4.4. *Design of the Chute Entry Opening*

In common with most of the other aspects of chute design, no two entry points were the same in the installations visited. In size, they ranged from 12 inches diameter to 36 by 19 inches rectangular; in material, from wood to various types of metal; some were located at floor level while others were three feet from floor level; some had complex interlocking arrangements while others were simply held shut by a ball-catch; some opened directly onto the chute, with others, the material had to travel anything up to six feet down a branch before entering the chute proper; and so on.

Only one of the door types seen could be said to be airtight when shut. The majority were fairly loose fitting due to either poor design, poor fitting or abuse. It was found that in practice the interlocking arrangements examined were prone to fairly frequent breakdown and in fact, the doors could be fairly easily opened even when nominally "interlocked". In one instance the button to release the electric lock was positioned too far away from the door handle to be operated by someone with a short reach. "In-use" warning lights were fitted on several installations, but were frequently out of action due either to faults in the electrical system or simply because a bulb had failed and had not been replaced.

In a few cases, a key operated lock was fitted to the door—this appeared to be a convenient method of controlling chute usage and preventing unauthorised use, but in practice the key was occasionally mislaid with a consequent build up of material waiting to be deposited, or was left hanging close to the door. In many cases, no locking arrangements of any kind were made. The door was simply opened as required, and there appeared to be no complaints about, or abuses of, this method.

In one instance a self-closing mechanism had been fitted to the door. However, this was out of adjustment and small "snibs" had been fitted to keep the door shut when not in use.

Much could be written about the various designs in use, but the general conclusions were as follows:

(*a*) Only one of the door designs was airtight when shut.

(*b*) The use of complex interlocking arrangements and/or warning lights either gave rise to maintenance problems or operational difficulties due to poor design and/or installation. Furthermore, the grounds for justification of their use have not been fully established. The point of having a key operated lock, whatever it might be, is lost, if the key is left hanging beside the door.

(*c*) With the size of bag in general use (holding up to 40 lbs. of linen) it would clearly be advantageous, if not essential, to have the entry opening at floor level. The use of smaller bags would of course make this less essential.

(*d*) The entry point should be as close as possible to the chute proper in order to simplify the layout and cleaning problems, consistent with user safety. A distance sufficient to allow a bag to be loaded, without fouling descending bags, appears to be sufficient, though it must be said that in many of the cases examined, the entry point was directly on the side of the chute.

(*e*) The entry itself should be as free as possible from projections and fittings likely to foul, or be fouled by, the loading of a bag of material. Its size will obviously depend on the size of bag used.

(*f*) Steps should be taken to ensure that builders' material does not enter the chute at the construction stage. One chute had hardened remains of concrete on its internal surface.

(*g*) The entry door should be clearly labelled regarding its purpose and method of use, and should not be situated close to other similar doors.

4.5. *Location of Exit Opening*

Only in a few cases was the chute exit opening located in a room adequate for that purpose. This was probably partly due to the fact that many installations had been added to the hospital long after it had been built and existing facilities had to be utilised as best as possible. In some cases, before a collection, the bags completely filled the volume of the room and sometimes accumulated in the chute itself. Most of these rooms had either no ventilation (internal rooms) or at best natural ventilation. However, in one case, an extract fan was fitted on the wall, and in another more recently built hospital, there was an extract point connected to the hospital's mechanical ventilation system. Other exit openings were located in the open air.

A few of the rooms were in rather poor condition, though some were brushed out periodically. Only one appeared to be cleaned and washed out daily with disinfectant.

It would, therefore, seem important that in any new installation:

(*a*) The chute exit opening should be located in a room specifically designed for that purpose, adequately sized to cope with the quantity of materials disposed of, bearing in mind the frequency of collection and the usage pattern. It should not be used for storing any equipment not related to the chute installation or for any engineering service installations such as pipes and cables.

(*b*) The room should be adequately ventilated and lit.

(*c*) The exit room should have easily cleanable surfaces and provision made for ease of cleaning (e.g., water outlets, electrical sockets, drainage points, etc., as required).

4.6. *Design of Chute Exit Opening*

At most of the hospitals visited, the chute was terminated at or slightly below ceiling level, the material dropping straight out onto the floor or into a container. However, at some installations, a 90° bend was fitted at the bottom of the chute which helped to slow down the descending material, though sometimes bags could be projected horizontally after dropping four or more floors. In one instance the chute had a long sloping section before the exit point, which did decelerate the bags, and in another, a 12 foot slide at 45° to the horizontal helped to slow down the bags.

The best arrangement seen was at a Swedish hospital where descending bags were turned progressively in the horizontal and vertical planes on a specially designed "deceleration track" which had a semi-circular cross-section. The bags dropped off the track, onto the floor, when they stopped sliding.

In some installations, a counterweighted door had been fitted at the bottom of the chute. This door was normally shut, but opened with the weight of a descending bag and presumably was intended to prevent updraught of air. In practice, these doors had either been discarded due to the noise caused by a bag hitting them or were not functioning correctly (remaining partly open) and sometimes causing bags to jam. Some of the chutes had doors at the bottom which were normally open—these were shut when required to allow cleaning of the chute. In other cases, counterweighted, normally-open doors were held open by a wire and fusible link—the purpose here was to close off the chute in case of fire in the exit room.

The main conclusion which may be made regarding this part of the survey is that, from the point of view of safety of personnel, and non-damage of bags of material, it would be desirable to terminate the chute with a "deceleration track" based on the design of the Swedish installation mentioned above.

4.7. *Ventilation and Air Movement*

As previously mentioned, none of the chutes in the survey were fitted with an extract fan. They were either vented at roof level (in one case apparently into the roof space) or closed off at the top.

An upward flow of air, into the chute, from the chute exit room was detected in every case. This flow increased when the door to the chute exit room was opened, and also, whenever a chute entry door was opened. The downflow due to a descending bag could be easily detected, but was extremely short-lived, the flow reverting to its natural regime almost immediately. Generally speaking, whenever a chute entry door was opened a strong airflow could be detected coming from the chute into the sluice room (or wherever the entry was located). Sometimes, mainly at the lower floors of an installation, the airflow was from room to chute. This is as one might expect from a knowledge of natural ventilation and stack effect.

With only one exception, air leaked into or out of the chute via the entry door cracks, even when the doors were shut.

Clearly, no real attempt had been made to tackle the problem of air movement control at any of the installations. This seems most surprising in view of the fact that the possibility of air-borne cross-infection is one of the main objections to this method of disposal: and particularly when the solution to the problem is simply to fit an extract fan to the chute. This would ensure not only that airflow is from sluice room to chute, but also adequate ventilation of the chute exit room. In conjunction with a reasonably leak-tight entry door and a mechanically ventilated sluice room, these air movement control arrangements should be adequate to combat this cross-infection route.

4.8. *Chute Cleaning*

Only a few installations had a regular cleaning programme. In one case this took the form of fumigation once a week. This process took virtually a full day, during which the chute was sealed off and out of operation. In another case fumigation was carried out occasionally. Two installations were fitted with water outlets at the top of the chutes and these were turned on at frequent intervals to wash down the internal surfaces. The remaining chutes were not subjected to any cleaning process.

Again, in view of the arguments most frequently put forward against the use of disposal chutes in hospitals, it is surprising that so little attention was paid to the cleaning of the surfaces of the chutes. On the basis of the present survey, it could perhaps be argued that cleaning is unnecessary.

4.9. *Bagging of Material*

As mentioned previously, where separate chutes were installed, the tendency was to bag the linen, but deposit refuse loose. Where a common chute was utilised, both commodities were bagged.

For linen, bags of various materials were used, the most popular being linen, terylene and nylon mixtures, and plastic. In some cases both foul and dirty linen shared the same bag (the foul linen sometimes being given a pre-rinse at ward level), in other cases, different coloured bags were used, one for foul linen, the other for dirty. When full, these bags could weigh up to 40 or 50 lbs., with a height and circumference of up to about $2\frac{1}{2}$ ft. and 6 ft. respectively. Where plastic bags were used, they tended to be smaller and lighter (about 30 lbs. weight).

Where rubbish was bagged, the sizes and weights were generally smaller than with linen, and paper and plastic bags were the most popular.

Little can be said by way of general conclusions at this stage regarding the bagging of materials. However it is apparent that the handling of a bag weighing 40 to 50 lbs. by ward staff is not a desirable practice. It may be acceptable while the bag is on a trolley, but unloading the bag and depositing it into the chute, particularly with an entry opening at high level, must be difficult. At an existing hospital it may be difficult to radically alter the system in operation, but for new projects, bagging arrangements should be designed with the above points in mind and in conjunction with ward and laundry requirements.

An additional point which should be borne in mind is that the bags should be designed such that they are easy to seal to prevent spillage of their contents.

4.10. *Sorting, Handling and Collection Arrangements*

So far as the provision of chutes was concerned, current practice varied from hospital to hospital. In most cases, the chutes were used exclusively for linen while porters collected the refuse. In others, a separate refuse chute was provided. However, in several instances, a single chute was used for both linen and refuse. Generally speaking the same chute was used for both dirty and foul linen, though in one case separate chutes were installed for these materials.

Sorting into the various categories (i.e., dirty or foul linen) was normally done at ward level. Whether or not the foul linen was pre-rinsed at this stage depended mainly on whether the hospital had its own laundry or let this out to contract. This pre-rinsing was done in the individual wards in some cases and in the chute exit room in others.

Where the linen was deposited loose, it was usually packed into bags at the chute exit room for dispatch to the laundry. In cases where the chute discharged directly into the laundry this step was not of course necessary. In one case the linen was emptied out of the plastic bags in which it had descended the chute, and put into large linen bags for transporting to the laundry—this was done in the chute exit room.

In most cases, the linen was collected from the chute exit room two or three times a day, either directly by a laundry van, or by porters with hand trolleys or motorised trucks. In many cases however the number of collections was reduced or even stopped at the weekends, causing large amounts of material to pile up in the exit room and sometimes in the chute itself.

Again, it is difficult to draw general conclusions since every hospital will have particular requirements. However, it would appear that provided efficient bagging of material is carried out, and steps are taken to ensure that the bags are subjected to the minimum amount of impact, a single chute will serve all the normal disposal requirements in the hospital. Sorting of material should be done at ward level (and of course this is normally the case, whether or not disposal chutes are used). The handling arrangements should not necessitate the transfer of material from one bag into another. Collection should continue over the weekend, or an appropriately larger capacity exit room provided, though even then, periodic inspection would be necessary.

5. General

In spite of the apparent shortcomings of some of the chute designs, the general impression obtained while visiting the various installations was one of satisfaction—indeed it was difficult to elicit even minor complaints. This was indeed surprising as there must be very few features in hospitals which escape the criticisms of the users. Of course, disposal chutes play only a minor role in the functioning of the hospital as a whole and may escape criticism due to this. Perhaps this is the best reason for ensuring that the design is right.

Acknowledgements

Thanks must be recorded to all the Regional and Group Engineers and others who were kind enough to reply to our initial questionnaire and in particular those who gave up their valuable time to show me round their installations. I would also like to thank all the members of staff at these hospitals who gave their valuable comments, and Mr. D. R. Wilson of this Unit who fitted in a visit to the Swedish installation during an already well-filled itinerary.

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Nevill Hall Hospital—
The Engineering Services

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Introduction

NEVILL HALL, once the home of the Marquis of Abergavenny, has been used for hospital purposes for a considerable time, but its present use dates from 1953.

The site, which affords some 22 acres, was chosen by the Welsh Hospital Board as a location for the new District General Hospital for the North Monmouthshire Area and, following the appointment of Sir Percy Thomas and Son as Architects for the project, planning commenced in 1961. The responsibility for designing the Mechanical and Electrical Engineering Services was undertaken by the Engineer to the Board, whose staff worked in close collaboration with the Nominated Consultants throughout the design stages.

The first stage of the development was to provide a total of 192 acute medical and surgical beds with supporting diagnostic, treatment and therapeutic facilities, together with residential accommodation.

The Nominated Architect produced a design consisting of a tower block containing three ward floors at 2nd, 3rd and 4th floor levels, each floor containing two 32 bed wards planned in an 'H' pattern, the wards being situated on the periphery of the building and the service rooms and lifts in the central core. The 32 bed ward unit being made up of six four bed wards and eight single bed wards.

The supporting departments are provided in mainly single storey buildings, contiguous with one another and with the tower block. A number of internal patios have been included within the single storey complex and the services of a landscape architect obtained to landscape the whole site.

The departments included in Phase I of the development are:-

(i) *Operating Theatre Suite* consisting of 2 Theatres with the necessary ancillary rooms, a Recovery Ward, Endoscopy Room, and Plaster Room.

(ii) *Outpatients Department* including an Accident and Emergency Department with Operating Theatre Suite.

(iii) *Diagnostic X-Ray Department* consisting of four Major X-Ray Rooms and a Mass Radiography Room, together with integral Dark Room facilities.

(iv) *Pharmacy Department* including an Aseptic Room and bulk manufacturing facilities.

(v) *Pathology Department* including the Mortuary and Post Mortem facilities.

(vi) *Central Sterilising Supply Department (C.S.S.D.)* capable of dealing with the needs of the Group.

(vii) *Physical Medicine Department* incorporating Hydrotherapy Pool and Gymnasium.

(viii) *Kitchen and Dining Room Complex*, the Kitchen having an ultimate capacity of 1,000 main meals.

(ix) *Residential Accommodation* comprising a Trained Nurses Home, an Untrained Nurses Home and four staff houses for senior staff.

(x) *Boiler House and Service Departments.*

(xi) *Visitors and Patients Concourses.*

Services—General

Distribution of services from the Boiler House Complex is by a system of subways which reach all parts of the hospital, and crawlway areas which extend beneath all departments. The crawlway is formed by the podium upon which the single storey complex is built and in no instance is it less than 3 ft. 6 ins. clear height and often is considerably more. The minimum subway height is 6ft, but in certain areas is nearly double this due to slope of the ground and the building construction. Numerous vertical ducts connect the crawlway areas to false ceiling spaces and roof plant rooms. Various plant rooms are located beneath ground floor level in the single storey areas and more detailed reference will be made to these later.

In general, services are conventional with certain exceptions, and I propose to deal in somewhat greater detail on these, the more interesting aspects of the design, than to dwell on the mundane and familiar features of hospital engineering services.

Boiler House Complex

An appropriate starting point is obviously the Boiler House Complex, and within that department, the boiler plant itself:—

The boiler plant comprises two treble-pass, dry back, economic steam boilers suppied by G. W. B. Boilers Ltd., of Dudley. Each boiler is capable of generating 14,500 lbs of steam per hour F & A 212°F., at a working pressure of 125 lbs per sq. in. Accommodation is available for the installation of a third boiler in a future phase of the development.

The boilers are fired automatically with Daw-Mill Singles, delivered pneumatically from a 77 ton storage hopper utilising a VEKOS patented coal feed device fitted to the crown of each boiler.

The fuel store, which is 15½ft. higher than the boiler floor, is a covered area divided into bays and able to store not less than three weeks supply of fuel.

Fuel is conveyed from the storage bays to the 77 ton storage hopper, located at one end of the fuel store, by a mechanical shovel which has a 17 cu. ft. scoop. The shovel is gas operated, thus obviating the risk of generating toxic exhaust fumes in a somewhat restricted area.

Ash is drawn from the boiler furnaces into receiving hoppers located in front of the boilers. Each hopper incorporates a motor driven crusher and is of sufficient capacity to contain all the ash and clinker removed during a normal de-ashing operation. Each ash hopper is connected via a manually operated discharge valve to a main delivery pipe which conveys the ash pneumatically to a cyclonic ash and dust separator and thence to the ash storage bunker which has a nominal capacity of 8 tons. An explosion door and access door is incorporated in the bunker, and the outlet, which incorporates a discharge valve with wetting device to prevent dust nuisance, discharges over a vehicle bay which accommodates local authority ash disposal lorries.

Boiler feed water is delivered to the boilers by duplicate steam operated 'Weir' feed pumps from two elevated hot wells of 2,240 gallons capacity each. A third electrically operated rotary pump is provided for initial starting and emergency use. Exhaust steam from the pumps is passed through heating coils in the 'hot well' before being discharged into the 'blowdown' pit. Automatic dosing of feed water treatment chemical is carried out by a Weir proportioning unit, fitted to the feed pump delivery line.

The usual boiler instrumentation is provided including:—Main Steam flow recorder, draught gauges, flue gas exit temperature indicators, CO_2 recorder, boiler feed water temperature indicator, hotwell contents gauge and smoke density indicators. Steam is generated at 125 lbs/sq. in., and enters an 8 in. dia. header at the rear of the boiler house, from which a 5 in. dia. tapping is taken for process work in the main kitchen, C.S.S.D., etc. Two 6-in. dia. mains are taken from the header to the adjacent engine room to feed two Bellis and Morcom two crank, compound vertical reciprocating 'V' type steam engines running at 428 r.p.m. Each engine drives a 3 phase, 415/240 volts, star connected brushless alternator with automatic voltage regulation and rated at 250 kVA at 0·8 power factor.

The alternators are capable of catering for about ⅓ of the maximum anticipated electrical load at the hospital and normally run in parallel with the S.W.E.B. supply. The exhaust steam pressure from the engines is at 5 lbs/sq. in., and is taken to non-storage and storage calorifiers in the Calorifier Room.

It is estimated that the total steam demand of the two engines when operating together at full load will be about 16,000 lbs/hour, and it is anticipated that this will be equal to the maximum steam demand for the L.P.H.W. heating and Hot Water Supply for the hospital. Should the steam demand exceed the capacity of the engines the deficit will be made up by steam from the boilers being passed through a Pressure Reducing Valve set direct to the calorifier plant.

The alternators will generally generate electricity in accordance with the demand for Low Pressure Steam by the calorifier plant, and the difference between the amount so generated and the electrical requirements of the hospital being taken from the Board's grid.

Should the S.W.E.B. supply fail for any reason, the bus coupler between the Essential and Non-Essential bus-bars will open, resulting in the Non-Essential bars going 'dead' and the Essential bars remaining 'alive' from the steam driven alternator supply. The opening of the bus coupler will operate an over-riding control in the back pressure control gear and allow sufficient steam to pass to the engines to enable the alternators to generate up to their maximum capacity, irrespective of the steam requirements of the calorifier plant. Surplus exhaust steam will be blown to atmosphere through low pressure relief valves. In this way the essential electrical requirements of the hospital will be safeguarded.

Following restoration of the S.W.E.B. supply, the 'Non-Essential' supply will be restored, and automatic synchronisation of the alternators with the S.W.E.B. supply will take place together with the closing of the bus coupler between the Essential and Non-Essential bus-bars.

The electricity supply to the hospital is taken from the Electricity Board's 11 kV 3-phase main via H.T. switchgear and necessary protection gear to two 500 kVA., 11 kV/415V, transformers.

The calorifier plant installed under the first stage of the development consists of four cast iron, non-storage, L.P.H.W. heating calorifiers, each having a nominal rating of 3,320,000 B.T.U.'s per hour, with provision for an additional unit of similar capacity, at a later stage, and two copper Hot Water Supply storage calorifiers of 1,000 galls. capacity each.

All these califiers and associated control equipment, ancillary plant etc., are housed in the Main Calorifier Room adjacent to the Boiler Room. Separate calorifier rooms are provided for the Trained and Untrained Nurses Homes and a separate single calorifier is provided to heat the Hydrotherapy Pool in the Physical Medicine Department.

Apart from the areas already mentioned, the Boiler House Complex contains a Low Tension Switchgear Room, well equipped workshops, staff rooms and Incinerator House. The Incinerator is a Riley Gaserator capable of disposing of 600 lbs of dry rubbish per hour and incorporates additional gas burners to enable it to deal with pathological additional gas burners to enable it to deal with pathological waste and to ensure smokeless combustion. A separate flue is taken from the incinerator to the new multi-flue chimney.

The chimney is 134 ft. high and contains three separate flues, one for winter use, one for summer use, and the incinerator flue. The external diameter of the chimney is 10 ft. 6 ins. and internal ladder access is provided for the full height.

Leaving the Boiler House, I should like to refer to some of the more unusual aspects of the engineering services being installed at the hospital and, in particular, to ventilation and air treatment.

Dual Duct H.V. Air Conditioning

The single storey complex containing all the supporting departments and entrance concourses results in the creation of a large number of internal rooms. To ventilate these rooms by natural means would have meant a multitude of openable roof lights, which, besides being costly to instal and to maintain, were architecturally undesirable and would be a considerable disadvantage when one considers the problems of artificially lighting these rooms. It was, therefore, decided that conditioned air would be supplied to all internal areas via ceiling diffusers. Because of the distances involved in distributing conditioned air, the need to provide for a variation in conditions between zones, and above all the limited space in the crawlways, and particularly the ceiling voids where the terminal runs of air ducting would occur, it was decided that a dual duct, high velocity system of air conditioning would have to be installed. Such a system would meet all the requirements of control and overcome the difficulties of space limitations. At the same time it was realised that the high level of illumination, which would necessarily have to be provided the whole time the rooms were in use, would create considerable heat gain problems.

This particular heat gain would occur in the ceiling spaces where the bulk of the module type fluorescent lighting fittings would be located. At first it was thought that adequate ventilation of the ceiling voids would satisfactorily dissipate the unwanted heat—unfortunately, the Fire Officer required the ceiling voids to be compartmented to prevent the spread of fire and smoke. Whilst the heat gain would be somewhat of an advantage during the winter months, in the summer the heat loss from the roof would frequently be nil, due to the high ambient temperature, and occasionally, on sunny days, there would be a source of additional gain due to solar radiation. The only alternative, therefore, was to incorporate a refrigerated cooling system into the central plants.

The resulting installation comprises four separate plants: A, B, C, and D, and the final design and installation was entrusted to Heat and Air Systems Ltd., of London.

Plant 'A' serves the Pathology, Pharmacy and Central Sterile Supply Departments and is located in Plant Room No. 1, beneath the Main Kitchen and Dining Room areas, delivering 22,300 cu. ft. of treated air per minute.

Plant 'B' serves the Accident and Emergency Departments, delivering 7,360 cu. ft. of air per minute.

Plant 'C' serves the X-ray Department, delivering 7,800 cu. ft. of air per minute.

Plant 'D' serves the Physical Medicine, Out-Patients, Admin., and Records Departments, delivering 20,600 cu. ft. of air per minute.

Plants 'B', 'C', and 'D', are all located in Plant Room No. 2, which is situated beneath the Out-Patients Department.

All four Plants are basically the same and are Ozonair/Kennard-Nelson High Pressure Dual Duct Units comprising:—

(i) Fresh Air Inlet with air ducted from the roof of Tower Block No. 2, in the case of plants B, C, and D, only. Air for Plant 'A' in Plant Room No. 1, is taken from the external face of the Plant Room.

(ii) Anti Frost Coil by Matthews and Yates (nominal duty to raise temperature of air from 30°F to 40°F.)

(iii) A pre-filter section using Ozotex dry-throwaway type filters. The filters will retain all particles down to 5 micron size.

(iv) Pre-heater section—nominal duty to raise air temperature from 40°F to 71°F, with L.P.H.W., at 170°F mean as a heating medium.

(v) Spinning disc humidifier section by Copperad Ltd.

(vi) Fan Section using a centrifugal, multi-vane fan with backward curved blades and 'V' belt drive. Fan motors are 12·5 h.p. each for the two smaller units and 40 h.p. each for the two larger units. Air outlet velocities vary between 2,100 to 2,400 ft. per min.

(vii) Reheater section and Cooling section in a double decked arrangement. The heating section having a nominal duty to raise the air temperature from 50°F to 100°F with L.P.H.W., at 170°F mean as a heating medium.

The cooling sections having a nominal duty to lower the air temperature from 77°F D.B./64°F W.B., to 53°F D.B./52·5°F W.B., when using chilled water in the cooling coils at 41°F flow and 49°F return.

From the plants, insulated circular ducts carry the conditioned hot and cold air to mixing boxes located in the ceiling voids. The ducts are spirally wound, lock seamed, galvanised sheet steel, and are insulated with glass silk mattresses faced with aluminium foil. The system has been sized so that the hot ducts will handle approximately 70% of the cold duct capacity. The mixing boxes are by Barber Coleman and a total of 42 are installed. Each box serves a 'zone' of from 1 to 12 rooms or conditioned spaces and all rooms in the particular zone are maintained at the same environmental condition.

Each zone has a 'control' room which contains a thermostat and this governs the conditions for the remainder of the rooms in the zone. The 'control' room is, of course, chosen as being the most critical in the group from an 'environmental' point of view. Zones have been arranged to contain not more than one critical area and, in many cases, no one room has a particularly critical environmental requirement. In such cases, the choice of a control room can be quite arbitrary.

The mixing boxes incorporate a constant volume damper and a thermostatically controlled, pneumatically operated, air mixing device, which regulates the mixture of hot and cold air to give the correct outlet temperature at the ceiling diffusers in the conditioned spaces.

The boxes also include an acoustical chamber which causes the air velocity and hence the air noise to reduce to an acceptable level before the mixed air is distributed through normal low velocity rectangular ducts to the diffusers. Each diffuser incorporates a volume control damper and is adjustable for throw.

Ventilation rates of air changes are, in all cases, dependent on the air quantity required to offset the sensible and latent heat gains in the various conditioned spaces. However, in every case, the air change rate is equivalent to, or more than, that recommended in the appropriate Building Note or section of the I.H.V.E. guide.

Chilled water for the cooling coils is provided by two "Lightfoot" packaged water chillers located in Plant Rooms 1 and 2, and which use Refrigerant 22. The chilled water is stored in each of the two plant rooms in insulated 1,000 gallon storage tanks which act as reservoirs and avoid overfrequent stopping and starting of the compressor motors.

The condensers are water cooled and the cooling water is circulated through twin cooling towers located on the roof of the Ward Block, one tower serving each plant room. Air is provided for the towers by two centrifugal fans sited alongside the towers; one fan is 38 ins. dia., and $7\frac{1}{2}$ h.p., and the other 43 in. dia., and 10 h.p.

Thermostatic Controls for the Dual Duct systems are by Honeywell and consist of:—

(i) Room thermostats for controlling mixing boxes, as previously mentioned.

(ii) Temperature and humidity controls on the air handling plants.

These controls are basically:—

(*a*) Winter dew point thermostat operating 3-way mixing valve on L.P.H.W. to pre-heater.

(*b*) Hot duct thermostat operating 3-way valve on L.P.H.W., to re-heater which is linked to a re-setting fresh air thermostat, which also operates the anti frost heater on a drop to minimum temperature.

(*c*) Cold duct fixed temperature thermostat operating a 3-way valve on chilled water to cooling coil.

(*d*) Humidistat fitted in extract duct system from treated area (these systems will be referred to later), which on drop in average space humidity switches on the spinning disc, or on rise in humidity sets up the re-heater duct 'stat' setting.

(*e*) Controls to maintain a fixed chilled water temperature, operating the refrigerator-compressor capacity stages.

In all cases, the H.V. air conditioning systems provide heat to meet the total heat loss requirements of the conditioned spaces.

Low Velocity Air Conditioning

Conventional low velocity air conditioning installations are provided for the twin Operating Theatres, Recovery Room, Endoscopy Room, Plaster Room, and other ancillary rooms in the Theatre Suite. Two plants provide conditioned air for these areas and are located in Plant Room No.1, previously mentioned, and located beneath the Kitchen and Dining Room area. One of these plants serves the two Theatres, Anaesthetic Rooms, Sterilising Rooms, etc., and incorporates a chilled water coil.

The Theatres are supplied with conditioned air in accordance with the need to offset heat gains, but not less than 20 air changes per hour, and a positive pressure cross ventilation system is employed. Conditioned air enters the Theatres through polished aluminium ceiling grilles, $\frac{1}{3}$ of the input mechanically extracted at low level on the opposite side of the Theatres. Trimmer heaters are installed in individual ducts to conditioned spaces enabling independent temperature control of each Operating Theatre with in the range 65°F to 75°F. The relative humidity is maintained between 50% and 60%.

The second of the two plants serves the Recovery Room, Plaster Room and other ancillary rooms. Cooling is also included in the plant and trimmer heaters give individual control to certain areas as described for the first plant.

A low velocity plant supplies filtered heated and humidified air to internal rooms, including Treatment Rooms, in the central core of the Tower Block. This plant is located in a Plant Room situated on the roof of the Tower Block, and delivers treated air to two zones via trimmer heaters giving individual temperature control to the northern and southern end of the block.

A further similar plant which is located in Plant Room No. 1, beneath the Kitchen, supplies conditioned air to certain internal rooms within the Kitchen and Dining Room areas, including Dining Room, Coffee Lounge, Sandwich Room and Servery.

All the Low Velocity Air Conditioning Plants are basically the same and include: throwaway type filters, L.P.H.W., pre-heater, spinning disc humidifier, chilled water coils (Operating Theatre Suite only), centrifugal fans, and re-heaters.

Controls for all Low Velocity Plants are by Messrs. Honeywell Controls and are of the pneumatically operated type.

The relative outputs of the various plants are:—

(1) Operating Theatre Plant	4,330 c.f.m. at 5 h.p.
(2) Recovery Room, Plaster Room, etc.	3,600 c.f.m. at 3 h.p.
(3) Ward Block Plants	3,089 c.f.m. at 4 h.p.
(4) Kitchen Plant	7,000 c.f.m. at 3 h.p.

The cooling water for the condensers is provided from one of the cooling towers previously described for the High Velocity Systems and more than 200 tons of refrigeration is required to meet the total needs of all the air conditioning systems installed. None of the Air Conditioning Plants and Air Treatment Plants described incorporates any recirculation of air from treated spaces.

Mechanical Extract Systems

Mechanical extract ventilation is, of course, provided. A total number of 48 individual fans are installed, some being of the concealed wall type, some window mounted and others in roof extract units. These fans are located all over the hospital and in the Nurses Homes.

In addition, there are a total number of five extract ventilation systems, comprising slow running centrifugal or axial flow aerofoil fans with interconnecting ductwork and extract grilles. The extract fans for these systems are situated in two plant rooms located in the crawlway areas beneath the single storey complex, and the type of extract provided falls into three categories:—

(i) High level extract from internal W.C.'s with duplicate axial flow fans—one fan for standby.

(ii) Low Level Extract from rooms in Operating Theatre Suite.

(iii) High Level Extract from rooms such as Ward Pantries, Kitchens, Sluice Rooms, Test Rooms, internal Changing Rooms, Cloaks, Utility Rooms, etc.

Three further separate extract systems are provided in the Ward Block and the fans are located in the Plant Rooms on the roof of the Block previously mentioned in connection with the Air Treatment Plants.

All vitiated air is taken through ducting to discharge above Ward Block roof level.

A special mechanical extract system is provided in the Post Mortem Room and consists of extract through a slot which is located in the perimeter of the Post Mortem table. Air velocity at the slab is sufficient to effectively prevent any unpleasant odours from travelling beyond the immediate vicinity of the Post Mortem table. Similar extract is provided above the working surface of the dissecting table. Pioneering work on this method of improving conditions in Post Mortem Rooms was carried out at the Dorset County Hospital, Dorchester, and a visit to this hospital was made by members of the design team and the Group Pathologist, during the design stage of this project.

The Main Kitchen is naturally ventilated, using 12 Colt ventilators installed in the sides of the raised section of the roof.

Centralised Tray System of Food Distribution

Modern techniques of plating up meals and delivering them in perfect condition to each patient are employed at the hospital. Each patient, with the exception of those on special diets, will be given a choice of meal from a comprehensive menu, the choice being recorded, together with special requirements such as large or small portions.

Cards, indicating the patients' name, ward, and choice of menu, are taken to the Kitchen prior to the meal being served and placed in holders, which in turn, are clipped to individual trays. The trays are laid with cutlery, plates, etc., and placed on a conveyor belt which carries them past servers stationed each side of the conveyor belt.

The plates for hot meals are placed in metal containers which have in their base a special metal alloy pellet, about the size and shape of a pineapple ring, which is at a temperature of about 450°F. These pellets are heated in electric ovens and mechanically dispensed into the containers. As the trays reach the servers, they place the required helping of the chosen food on the plate, according to the coding which is shown on the patient's menu card clipped to the tray. When the tray reaches the end of the belt it is checked by a supervisor for correctness, and lids and covers are placed on the various dishes, as necessary. Warm air movement is promoted within the container and cover of the hot food by the heated pellet and this ensures that the patient receives the meal as hot and appetising as when it was plated up in the kitchen, even though it has taken 20-30 minutes to reach the patient.

Soups and sweets are maintained at their correct temperature by being served in special insulated bowls with covers.

With staggered starts for ward meals, 600 patients can be served from one belt which can handle 8-10 trays per minute. An optimum number would be about 400. Trays are taken to Wards on purpose made trolleys which are used to take the dirty crockery, cutlery, trays, etc., to the Central Dishwashing Department, adjacent to the Main Kitchen.

The system is known as 'Ganeymede' and is supplied and erected by Messrs. Allied Ironfounders Ltd.

Centralised Dishwashing

The central dishwashing department, which handles all crockery and cutlery from Wards and Staff Dining Room, contains a Dawson 'Flight' Type Dishwashing Machine, Model C.T.1.D. This machine incorporates five separate processes:—

Pre wash at 90°F.

Detergent wash at 145°F.

Hot water wash at 160°F.

Final scalding rinse at 190°F.

Steam heated battery for hot air drying.

Crockery is conveyed through the machine on P.V.C. coated carriers on conveyor chains, but cutlery, of course, is first placed in baskets. About 6,300 pieces of crockery per hour can be handled and only two operators are required, one to place 'dirties' on the conveyor at one end of the machine, and one to off-load and stack at the other. The advantages of the 'Ganeymede' form of serving and centralised dishwashing are numerous and I think self evident. Apart from providing the patient with a better and more personal service, more economical use is made of available labour and food wastage is reduced.

Staff Dining Facilities

The Staff Dining Room has a servery which provides a full Cafeteria service and a wide choice of menu to all staff. A separate Coffee Lounge is located at one end of the Dining Room and a Sandwich Room is also provided.

Main Kitchen

The Main Kitchen will ultimately cater for 1,000 main meals but, in the first stage of development, only sufficient cooking equipment has been installed to meet Phase I needs.

Over 1,000 cu. ft. of refrigerated storage space is being installed in the initial phase and this will be sufficient for the whole hospital requirements, it not being economical or practical to instal cold rooms in two or more phases.

Pneumatic Tube Installation

Documents such as patients records, X-ray films, Pathological specimens, Prescriptions, Menus, and numerous other items are transported between departments by a Lamson 4-in. Station Operated Ring Air Tube System.

A total of 17 stations are provided throughout the hospital with provision for an additional ten stations in a future stage of development. The carriers used in this system have internal dimensions of $2\frac{3}{4}$ in. dia., and $14\frac{1}{2}$ in. in length. The central plant consists of two turbine blower units with silencers and $7\frac{1}{2}$ h.p. motors. Each station has a despatch and receiving point and a control dial, together with indicating lights. When sending a carrier, the destination station is selected on the control dial and the carrier inserted in the despatch tube.

As soon as the system is clear and ready to take the carrier, it is automatically despatched and indicator lights appear at both sending and receiving stations. As soon as the carrier reaches its destination, a "carrier arrived" signal is given by an indicator light at the sending station.

The air tube circuits used to convey the carriers are located in the crawlways below the single storey complex, except of course, the tube serving the Tower Block stations, which is run in vertical service ducts.

The cost of such an installation averages out at about £1,000 per station, so it is of course important that the fullest use be made of the service the installation has to offer. There is every reason to expect that in this hospital it will prove successful, as there will be no long established messenger systems to be overcome, and staff will become familiar with the pneumatic tube system along with many other new things—not the least, the hospital itself.

Permanent Supplementary Artificial Daylight (P.S.A.D.)

As stated previously, there are a large number of internal rooms in the Nevill Hall Hospital, and nearly all these areas have no natural lighting. A considerable amount of artificial lighting has therefore been installed, contributing substantially to the heat gains referred to earlier. It will be appreciated that during daylight hours, patients and staff will be passing frequently from a naturally lit area to one having only artificial illumination and, of course, from artificial lighting to daylight. Normal levels of artificial lighting would be noticeably unsatisfactory under such circumstances and permanent supplementary artificial daylighting has been provided in accordance with the Hospital Building Note recommendations for internal rooms.

The amount such supplementary lighting is in excess of normal levels, varies between locations, and has been adjusted in the design to avoid sudden changes in lighting levels. An example of such conditions is the change one would experience when passing from a room wholly lit by natural means, through a corridor which would have a certain amount of 'borrowed' daylight plus some artificial lighting, into an internal room wholly artificially lit. The percentage of supplementary lighting therefore varies between 50% and 80% depending on circumstances.

Lighting of internal rooms is provided by flush type module fittings, and each fitting contains four fluorescent tubes, all of which are on during the hours of daylight to produce the required level of illumination. During normal artificial lighting hours only two tubes are on and, to avoid a disconcerting sudden drop in lighting intensity, this reduction is achieved in two stages by automatically switching off one tube at a time, there being an interval of about 30 minutes between the two switching off operations. The advice for timing the change from P.S.A.D. to normal artificial lighting, and of course back again, is a single solar time clock which controls all P.S.A.D. fittings throughout the hospital.

One of the two tubes used during the hours of normal artificial lighting is connected to the "essential" supply for the hospital and, where this particular tube occurs in corridor fittings, it is also controlled by a key operated secret switch. This provides the facility of ensuring that corridor lighting remains on for the benefit of patrolling night staff and can only be switched off by them as required.

Lifts

Lift provision consists of an eight passenger lift in the Nurses Home serving five floors, being fully automatic with up and down collective control and power operated sliding panel doors. Also, a bank of three lifts is located in the centre of the 'H' in the Tower Block. The lift bank in the Tower Block justifies a more detailed description as it contains some unusual features.

Two of the lifts are double ended Bed/Passenger, and the third is a single ended Passenger Only lift. The lift halls served by three lifts are on what is known as the 'service' side and the halls served by the two Bed/Passenger lifts are on the 'clean' side.

All three lifts are provided with up and down collective control, and operate on a Duplex system on the 'clean' side and on a Triplex system on the 'service' side. The single ended passenger lift is provided with a Fireman's Control which, when operated, immediately calls the lift to the ground floor, irrespective of its current activity, and also cuts out all landing call elements leaving the lift under the sole control of the fireman in the car, including all door operations.

Lifts can be used by personnel from 'clean' and 'service' sides at the same time, the service side calls having a choice of three lifts and the clean side calls a choice of two lifts.

The lift control system is biased in favour of 'service' side calls so that when the lift car contains two categories of occupant, i.e. personnel from 'clean' and 'service' sides, the 'service' side doors will always open first, giving the staff member the opportunity of ensuring that the 'clean' side doors are not used by unauthorised persons.

'Up' and 'Down' buttons are provided on all floors and when pressed will cause the nearest lift travelling in the required direction to stop at the appropriate floor. Calls are registered in the lift's memory in the control room and are dealt with in an order which results in the shortest service to the various calls. Doors open on the 'call' side only, obviating the risk of visitors disembarking on the 'clean' side.

In the event of a lift being required by the Medical or Nursing Staff during visiting hours due to an emergency, and possibly entailing the movement of a patient, a staff member will call a lift from the 'clean' side lift hall. When the lift arrives, the doors on the 'clean' side will open and if, as is likely, the lift were to contain a number of visitors, the staff member who had called the lift will enter the car, switch the lift to 'independent control', operate the service side doors and, having briefly explained the circumstances to the occupants, usher them out of the lift and into the service hall. The lift will then be free and entirely available to deal with the emergency. Solid state switching devices have been incorporated in the lift control systems in the interest of dependability, and provision has been made for the lifts to run at half speed off the "essential" power supply in the event of mains failure.

Communications

A Nurse/Patient Call System has been installed, comprising a call push at each patient bed, bathrooms, W.C's, etc., with reassurance lights and reset provision for each ward, together with indicating lights in corridors and on indicator boards in the Nurses Stations and Duty Rooms.

A Call System is installed in the Operating Theatre Suite to operate from individual beds in the Recovery Room and which will indicate in all areas likely to be used by Doctors and Specialists in the Suite, that a patient in 'Recovery' requires attention.

G.P.O. telephones are installed throughout the hospital and a 'Centrum' system provided instead of the normal internal telephone system. The 'Centrum' system consists of a number of individual instruments which provide a unique voice operated intercommunication system throughout the hospital. The system allows hands to be free during a conversation and permits movement within the vicinity of the instrument. Special facilities are included, e.g. conference facilities, for a number of selected personnel to conduct a private discussion without interruption, also earpiece or handset attachments where the loudspeaker is not required. This particular installation incorporates a staff location system which enables a 'bleep' call to be initiated from any instrument to a chosen pocket receiver which is carried in the usual way.

Locker Units

After full discussion with all 'project team' members, including representatives of the H.M.C., a standard locker unit has been produced and over 200 of these have been handed to the Management Committee for fixing to the bedside lockers. Each unit comprises: switch for bedhead light, Patient/Nurse Call toggle switch, Radio programme selector, volume control, socket for stethoscope type headphones, and facility for extending the Nurse Call to pear push operation. Maximum voltage on the locker unit is 24 volts.

General

There are many other features of the engineering services which could be mentioned, but as I said at the beginning of this paper, I do not propose to describe services and installations which will be familiar to you, and which would be less interesting than those which I have attempted to describe.

I should like to conclude by saying that, as designers, it is our intent to produce the best hospital engineering services installations for the money available. Every effort is made during the various design stages to keep the installations abreast of modern engineering practice and thought, and to use reliable equipment and materials.

We are all very conscious of the fact that you are the people who have to 'eat the pudding' so to speak. What may seem a first class idea to the designer, and in fact look just as good on paper, may in practice prove to be of very limited value and perhaps become the source of endless trouble to the maintenance staff. Such unhappy occurrences may be attributed to any one of a number of causes, but one which does not, in my opinion, receive sufficient attention is that of acquainting the hospital engineer with the intent of the designer. It seems to me that there is a case for the man who designs the services to spend some time with the man who uses and maintains them; the purpose of such a 'get together' to be for the designer to explain what he intended in respect of certain installations and which may not be self evident from an examination of the drawing or the technical specification.

Finally, may I just add one or two facts about the Nevill Hall Engineering Services Installation:—

Cost of Mechanical Services £450,500 including £86,000 for the Dual Duct Air Conditioning Installation.

Cost of Electrical Engineering Services £203,000.

Contract commenced June, 1965.

Anticipated Completion—September, 1968.

It is hoped that site work on Stage II will commence in the 1970/71 financial year.

Electrical Services in Hospitals

PART 2

By J. H. LEVERTON, B.Sc.(Eng), C.Eng., F.I.E.E.,
Assistant Regional Engineer, N.E. Metropolitan R.H.B.

Lighting

This is probably one of the most controversial subjects that the Engineer encounters in the field of electrical installation, as it involves so many factors to which precise measurement cannot be allocated. Levels of illumination can be calculated with some degree of accuracy and can certainly be measured in the final event, but the assessment of the levels required for various tasks is another matter which, ultimately, depends to some extent on the age and opinions of the individual operator.

The recent edition of the I.E.S. code has now defined glare factor and has made a serious attempt to solve the question of the avoidance of glare which, of course, assumes greater importance with the increased levels of illumination now being provided.

I do not propose to discuss the methods of calculating these factors as they are adequately covered by literature such as the I.E.S. Code and various trade and other publications which have followed rapidly from the production of the Code. Levels of illumination required are also set out in various publications and reference should always be made to the appropriate Hospital Building

CORRECTIONS

We regret that two errors occurred in Part 1 of this article (September issue) and the following corrections should be noted:

p.195, para 8, line 2—'and no other services'.

p.196, para 10, line 1—'less than 18 inches below'.

Note, but, as the tendency is continually to increase levels, the final design should be such as to allow for upgrading in the future without major alterations.

The basic requirements for lighting in hospitals do not differ in principle from the requirements of other situations. The main function of an installation is to provide adequate illumination for the task in hand with the maximum comfort for the occupants and at the most economical cost. The main specialty about hospital installations is the wide range of tasks which are carried out and the physical conditions of the occupants.

There are obviously certain circumstances where lighting is provided rather for decorative purposes than for utility. Installations of this type will be needed in public rooms, such as waiting spaces, assembly halls, recreation halls, etc., and care must be exercised to ensure that considerations of decorative appearance do not detract unduly from the illumination levels attained.

The design of special fittings, when only few are required, is not to be recommended as the cost will be high and difficulty may be experienced in the future with spares in the event of damage or extension.

The siting of fittings with reference to ease of lamp replacement and cleaning must always be considered. It is quite unjustifiable to instal fittings in such a position that the only means of replacing a lamp is by the erection of scaffolding. This can easily occur in stair wells and similar situations. Preference should be given to fittings which house tungsten lamps mounted cap up or cap down, as the life of tungsten lamps is considerably shortened by sideways burning.

The decision as to the use of fluorescent or tungsten sources is in many instances quite clear cut, but there are always borderline cases. Fluorescent sources must be used in the following situations:—

(*a*) Where artificial lighting is in use for many hours per day.

(*b*) Where high levels of illumination are required in other than very localised fields.

(*c*) In situations devoid of natural lighting and ventilation, where it is necessary to reduce the heat output of fittings to a minimum, in order to reduce the load on the ventilation plant.

(*d*) Situations where shadowless lighting is essential.

The choice of tube colour should be made at an early stage in the design, as the difference in efficiency of the various colours is sufficient to effect the number and disposition of the fittings required. The larger the tube, the higher the efficiency and, therefore, the largest acceptable tube should be used. The use of 8 ft. tubes is somewhat limited, as they are considered to be mainly for industrial and commercial use and the range of fittings with which they can be used is limited. Tungsten lighting is still the most suitable for local lighting and situations where the use is intermittent, such as toilets, bathrooms, small store rooms, etc. It is also preferable where low levels of illumination are required, since at levels below about 15 Ls/sq. ft. fluorescent lighting gives a very gloomy appearance, the warmer tungsten effect being much more acceptable.

In all clinical areas where colour recognition is necessary, double coated tubes must be used and it must be remembered that the output of these tubes is only about ½ that of the warm white tubes. Care must be taken to ensure that correct replacements are available and used.

The so called "racetrack" plan comprises a central core housing utilities and service rooms surrounded by a corridor on the outside of which are situated the wards which are open to daylight. The interior rooms will require a higher level of illumination during daylight than is normally supplied for the tasks carried out therein. Levels of at least 50 lumens per sq. ft. will be required and a transition zone should be provided in the corridor, so that the change from daylight levels to the interior are gradual. Means must also be provided to reduce the interior level to normal when artificial light is in use in the exterior rooms.

As stated previously, the use of fluorescent sources is essential in these circumstances. Areas which need special treatment include the following:—

Operating Theatres

The lighting of theatres will comprise general lighting combined with special lighting for surgeons. Levels of general lighting need to be of the order of 30 lumens/sq. ft. and should be provided from recessed fittings in order to reduce dust collection and cleaning. With the ceiling heights employed, minimum 10 ft., the number of fittings required will be considerable and it may be necessary in some instances to combine the lighting fittings with the ventilation diffusers in the ceiling. Auxiliary lighting may be required for such items as instrument cupboards and possibly for needle threading. The centre shadowless lamp may be either of the scialytic type employing one central lamp with a specially designed lens system, or of the multilamp type. In the former, separate peripheral lamps are provided for emergency purposes, whilst in the latter type the same lamps are used for both purposes. The multilamp unit should be fed from two circuits at least, so that failure of one circuit will leave at least half the lamps unaffected. Both types of lamp should be supplied at low voltage fed from a transformer, since it is possible to obtain a higher efficiency. The low voltage A.C. will be the same as that of the battery emergency equipment for multilamp units.

Each theatre will be provided with a control panel and it is convenient to control all lighting from this point. In order to provide sufficient light for entry into an unoccupied theatre a switch should be provided near the door, which will control a shielded light in the panel, which can also be used to illuminate the controls when the theatre is blacked out for certain operations.

Fluorescent sources may be used for operating table lights when the work is confined to skin grafting and similar work where large areas are to be illuminated, but for normal operating it is quite unsuitable as a narrow beam is required to penetrate cavities and give easy perception of depth without giving too high an intensity to the areas surrounding the cavity.

(*a*) Ward Centre Lighting

Indirect lighting by means of cornice units, has been rejected on account of economic considerations, dust collection and flat, lifeless effect. In view of the necessity to provide illumination of the ceiling and to limit the glare factor neither recessed nor semi-recessed fittings are acceptable and suspended fittings are essential. Designs are available for both fluorescent and tungsten. Those for fluorescent can be made much slimmer in appearance and the light spread is more uniform. Tungsten fittings having the desired characteristics of cut-off, tend to be somewhat bulky. Fluorescent is recommended, but illumination levels should be kept somewhat higher than the recommended values to avoid a dull and lifeless effect. A ceiling mounted fluorescent fitting is now being produced which gives adequate ceiling lighting with prismatic control.

(*b*) Bed Head Lighting

Both fluorescent and tungsten fittings are available for this purpose. At first sight the longer light source of the fluorescent fitting would appear to make it most suitable but it is subject to the following objections:—

(*i*) The maximum length of tube is limited to 2 ft. from space consideration and the output of this tube is not satisfactory to provide the recommended illumination level on a patient's book, etc.

(*ii*) No light falls upon the front of a semi-recumbent or sitting patient.

A tungsten fitting is recommended therefore, and this should take the form of a bracket, having a horizontally swivelling arm. Such a bracket is less susceptible to damage from bed fittings, since the arm can be swivelled to one side and if hit will move sideways without damage.

The lamp unit should also have a limited movement on the arm in order to project the light back to the patient when the arm is swivelled over to one side to avoid an obstruction, but so limited as to avoid glare to adjacent patients. It is not recommended that this bracket be attached to the locker.

This fitting is not intended to be used for inspection purposes. It is recognised that for detailed examinations or treatments which must be carried out in bed, an inspection lamp will be used. This should be a casual requirement and not necessary for every visit to the patient.

Attempts have been made to produce dual purpose fittings which can be detached from wall brackets and used as portable units, but I have not yet seen an acceptable pattern. It is necessary either to use an all insulated pattern, which severely limits the possibilities of design as a bracket, or else to rely on a flexible earth connection which must be the subject of regular testing, no mean task in a hospital of 900 or more beds.

Patients are now encouraged to become ambulant at a very early stage and night lighting should be provided which will enable them to find slippers and walk to the door without encountering obstructions. Louvred lights at low level will provide this illumination and, if mounted under a bed, will be subject to minimum obstruction and the bed will act as additional obscuration to prevent annoyance to patients. Night lighting of corridors can be provided by low intensity central lighting, but if partitions to wards are glazed then low level louvred lights should be employed.

Watch lighting is required for certain patients and also for minor attentions required at night. It should be individually controlled for each patient and, if fluorescent fittings are used for bed-head units, a coloured lamp of small wattage mounted above the tube and close to it will prove very effective.

Nurses' Homes should be treated as domestic premises and every endeavour must be made to provide a homely atmosphere. Minimum requirements for a bedroom should be:—

(*a*) General light.

(*b*) Local light for writing desk.

(*c*) Either a fixed wall light for the bed or a bedside lamp for which a suitable socket is required.

All points should be separately switched at convenient situations.

Common Rooms where television is to be used should be provided with local lights, such as floor standards, to enable occupants to read if they wish without disturbance to viewers.

External lighting and road lighting require careful design and all main thoroughfares of traffic, particularly those which have to be used by nurses at night, must be adequately lit. All such lighting should be controlled by a central time switch, which should be capable of being overridden by a manual switch. This circuit should also control all external direction sign illumination, which should be discussed and settled at an early stage. Too many illuminated signs have the appearance of having been added at the last minute, as indeed they often are.

Some economy in consumption can be attained by zoning exterior lighting as, although some is required during all the hours of darkness, other areas, such as visitors' car park, require lighting only during certain well defined and comparatively short periods. Lighting for the main access road should be designed to render an abrupt change in level from that of the adjacent public road to be avoided and any lighting immediately adjacent to railway lines is subject to approval by British Railways, to avoid confusion with railway signal lights.

The wiring of fittings, especially tungsten, using the bulbs with smaller envelopes, requires special attention in order to avoid the effects of overheating. Fixed terminal blocks should be provided in conduit boxes adjacent to fittings to enable the change from hard wiring to heat resisting to be made. Where a number of fittings are close together it is more convenient to use heat resisting cable throughout. Wiring should not pass through bulkhead fittings, which should be connected to a conduit run by means of a "T" box.

Adequate earthing provision must be made for all fittings and Regulations C19 which calls for the screening of terminals which may be live when the switch is off (i.e. 3 plate roses), C21 which calls for an earth terminal in all ceiling roses and D6 which calls for an earth terminal at every lighting point.

Socket Outlets

The 13 A socket outlet should be used as standard in all new constructions, but for the sake of interchangeability with existing sockets it may be necessary to continue to use 2, 5 and 15 A sockets in extensions to existing buildings. Sockets should be provided as set out in the Building Notes and, in general, the ring main system should be used to reduce wiring and size of distribution boards. A realistic assessment should be made of the diversity factor on each situation. For instance, the sockets in a Ward will be provided one per bed with additional ones for cleaning, etc., but the amount of equipment used in a Ward at one time will be very limited. On the other hand, a Path Lab. provided with sockets at close intervals on the benches, will have a large number of pieces of equipment which may be in use at one time.

Switch sockets should be used throughout and where they are to be used with equipment which does not emit light when it is alive they should be fitted with pilot lights. Mounting heights should be determined in relation to equipment liable to be used in each situation. Sockets for cleaning equipment may be at low level, but high enough to avoid damage. In many other situations switch height is more convenient.

To avoid clusters of units, opportunity should be taken to combine sockets with other units, e.g., in the bedhead unit which will contain all the services required at that position.

Non-standard sockets should only be used for differentiation of different supplies, i.e. low voltage hand lamps etc., and a scheme should be prepared at the outset of the job which will be carried on throughout and, of course, continued in any future extensions. The facility for using any piece of equipment in any part of the hospital is most important. Standard switch sockets are shuttered but not interlocked and in cases where explosive anaesthetics are used, interlocking is essential to avoid sparking on withdrawal of the plug.

Ample sockets should be provided in all situations to avoid long trailing leads which may be subject to damage and are liable to be tripped over. In Operating Theatres sockets may be provided on the control panel or may be spread on the walls at the nearest points to the table. An alternative arrangement is to provide a pedestal at the foot of the table to house all supplies. This is not always considered as acceptable, since it may prove an obstruction and may have to be fitted with a small red light to locate it under black-out conditions. Wiring access is not easy and a plastic cover is necessary to prevent damage by water during washing down.

The problem of providing the correct rating of fuse in plugs is not peculiar to hospitals, but this will be simplified by including a clause in the Contract calling on the Contractor to fit plugs to all portable equipment, whether supplied by him or not and to fit the appropriate fuse in each case.

In areas where inflammable concentrations of anaesthetic gas may occur, sparkless sockets must be installed. Analysis of explosions which have occurred indicate that the danger areas are much more limited than previously envisaged. The Ministry is proposing to issue recommendations that the use of sparkless sockets may be confined to areas within 4 ft. of the anaesthetic apparatus, even if they are mounted below a level of 4 ft. 6 in. as previously allowed. This will allow standard sockets to be used where wall mounted in Theatres.

If sockets using plugs with mutilated (e.g. slotted) earth pins are used for interlocking it is necessary to ensure that the plug tops can be used in any make of standard 13 A socket without jamming.

Sockets provided for the use of power tools in confined spaces where special shock risks are present should be fed from 1/1 isolating transformers having the centre point of the secondary earthed through a suitable resistance to limit earth fault currents to about 15 mA. The circuit should then be protected through a balanced current type earth leakage breaker having a sensitivity of not less than 10 mA and incorporating overload protection.

Such breakers are at present obtainable at 30 A rating and in view of the diversity which can be anticipated in such situations one breaker and a ring circuit will be suitable for most Boiler Houses and plant rooms.

Low Voltage Sockets

These are required for use with low voltage hand lamps. The sockets should be of a different gauge from the main sockets and fed from a transformer having the centre point of the secondary winding earthed. An earthed shield should be provided between primary and secondary windings. Where a number of sockets are provided in close proximity, a fixed transformer should be installed but for isolated points consideration may be given to a portable unit operated from 13 A mains sockets.

Screened Rooms

In all rooms which are screened to prevent interference (i.e. E.G.G., E.M.G., and E.C.G. rooms) it is essential that the earth pins of all sockets should be earthed by means of a separate cable run back to a major earthing point and not rely on the continuity of the conduit system which could be considered adequate for normal situations, and that all other service pipes should be earthed at the point of entry and exit.

Sockets for X-Ray Equipment

"Portable" X-ray units are small units of very low output which can be dismantled and carried in suitcases. These units will work satisfactorily from normal 13 A sockets but in view of the low output obtainable are very rarely found in a modern hospital.

"Mobile" units have outputs approaching that of major units and are mounted on a wheeled chassis which may be motor driven from a pair of 12 volt lead acid batteries. One or more of these units will be found in every hospital.

These units may take up to 100 A on a 240 V circuit but these peaks are of very short duration and do not exceed 0·1-0·15 seconds. The heating effect of these currents may be ignored but, in order to obtain the maximum rated output, voltage drop is of major importance. On a 240 V supply the resistance at the socket must not exceed 0·34 ohms overall including mains transformer etc. No advantage is to be gained from obtaining a figure below this value.

30 A sockets are adequate for this duty but they must be protected by fuses having 60 A rating. With this high fuse rating they must not be used for any other purpose.

The Ministry is suggesting that 13 A sockets may be used subject to the following conditions:—

(*a*) All sockets must be in a ring circuit, no spurs may be used.

(*b*) As far as is known only one make of 30 A H.R.C. fuse will withstand the overload duty.

If consideration is being given to the use of 13 A sockets the following points should be borne in mind:—

(*a*) It is relatively easy to design a new system with all sockets on a ring but it is more than likely that subsequent additions will be in the form of spurs and will be unsuitable for the purpose.

(*b*) The 30 A fuses will not be satisfactory if they are preloaded and it is therefore essential to ensure that no other loads are connected to the ring when it is to be used for mobile X-rays.

(*c*) The special plug required to accommodate the flexible cable is very heavy and difficulties may be experienced in preventing damage to standard sockets and also in retaining the plugs fully home due to the weight of the plug and flex.

In view of these limitations and remembering that a number 30 A socket may be connected to one circuit, it may be considered that the small additional cost is warranted when set against the cost of subsequent maintenance costs.

Normally, the maximum length of cable used with the units is 30 ft. and account of this must be taken when siting sockets.

In view of the cost of provision of these sockets, advice should be taken from Medical Staff as to the minimum number of beds which will need mobile X-ray coverage. Sparkless sockets are available for use in Operating Theatres.

Outlets should be provided in all X-ray rooms so that a mobile unit can be used in the event of a breakdown of the major unit. A socket will also be required at the storage point for battery driven models to operate the built in charger during idle periods.

Sockets may be looped or wired on ring circuits as convenient since there will only be one unit available in a department at any one time.

Maximum run of spur cables or total length of ring cables for various sizes of cable on 240 V supplies are as follows:—

Resistance at bus-bars	*Type of Wiring*	*Cable length (yds)*			
		7/·036	7/·044	7/·052	7/·064
Less than 0·05 ohms	Spur	40	60	84	125
	Ring	160	240	335	500
Between 0·05 and 0·1	Spur	33	49	69	105
	Ring	130	195	275	415

Occasionally it may be desirable to use an extension lead of a further 30 ft. of flexible cable on the unit, in which case the above figures must be reduced by approx. 20%.

The above figures are supplied by A. E. Dean and Co., but are applicable to other makes of unit.

(To be continued)

CHANGE OF ADDRESS

The Vauxhall Boiler Company Ltd. announce that, in order to rationalise the manufacture of the Company's products within the Babcock & Wilcox Group, of which it is a member, the Company's Offices and Works transferred as from 1st June, 1968, to the premises of Penman & Company Ltd., 64, Strathclyde Street, Glasgow, S.E. (Telephone: 041-554 2011).

£140,000 HOSPITAL BEAM AND COLUMN ORDER

Anglian Building Products Ltd., of Lenwade, Norfolk have won an order for approximately £140,000 worth of concrete beams and columns for a new general hospital at Crewe.

The beams and columns are similar to £150,000 worth being supplied by Anglian Building Products for a hospital in Yorkshire.

Small gas turbines have expanding use

By GRAHAM LOVE

THE last few years have seen a steady increase in the use of gas turbines of less than 500 h.p., particularly in oil producing countries. Turbines in this range are now undertaking many of the duties previously served by diesel engines, and are used in many instances as auxiliary units to much larger turbine installations.

The versatility of sets using turbines in this range has been fully appreciated by Auto Diesels Ltd., of Uxbridge, which has produced a range of generating and pumping sets, mobile and skid mounted, using the Austin 250 gas turbine. This size of unit has become extremely popular in industry generally.

Uses natural gas

The natural gas running capability is, of course, of great importance in these fields. Similarly, the small size and low weight of the set enables it to be easily transported and installed in difficult terrain.

Small power stations can be established quickly, at low cost, and without the need for special buildings to house the sets. Arrangements can also be made for the units to be converted quickly from natural gas running to liquid fuel and vice versa, and two such sets constitute an ideal, and extremely small, duty and stand-by arrangement.

Easy maintenance

Maintenance between overhaul periods is of an extremely elementary nature and requires no special tools or training. In fact, in most instances, after the initial installation a company's own fitter takes over this responsibility with no difficulty.

Particular problems such as dusty and sandy conditions can be overcome with special air filters, but it has been found that in most cases the standard simple air filters are sufficient so long as they are regularly removed for cleaning.

Mobile applications

The small industrial turbine is also proving extremely popular for mobile applications. The truck size required is about 5 tons, and in the case of liquid fuelled turbines, a 200 gallon fuel tank is usually fitted at the rear end.

Applications which were previously monopolised by diesel engines are now considered to be ideal material for the small turbines, e.g., for water pumping, crude oil pumping, stand-by electricity sets, compressor sets, and boost pump units to assist the suction for large pumping installations.

In the case of electricity generation, a unit can now be provided with a single 320 kilowatt alternator driven from both ends by a 250 h.p. turbine, one contra rotating to the other. This arrangement can be used with one of the turbines providing 160 kilowatts while the other is on stand-by. A recent addition to this range has been the type 300 engine producing an additional 50 h.p. for the same overall size as the 250 h.p.

Started with jets

Auto Diesels' interest in the turbine field began some years ago with the introduction of their own Stad turbine for jet air starting and this particular turbine has been developed to meet all the starting requirements of the most modern jets today.

The unit can be used to supply 2·1 lb. of air per second at 40 p.s.i.g., and, although normally mounted on a very small trailer, can even be installed on a simple two-wheel trolley capable of being moved by one man.

A conventional diesel-driven compressor set of this output requires a sizeable truck to carry the complete installation.

Whereas the above size of set is generally considered as small turbine application, the third turbine in the Auto Diesel range can only be described as minute. This is the Saurer G.T.15 turbine coupled to a special alternator of Auto Diesel design producing up to 12 kVA, and a complete set of this nature including a fuel tank weighs less than 120 lb.

Valuable by-product—heat

Exhaust heat from turbines is, of course, an extremely valuable by-product. In this connection a package deal can be provided consisting of turbine generator set delivering 160 kilowatts, exhaust heat boiler for domestic and heating water, and refrigerator pack driven from the alternator. Again, and when required, some of the exhaust heat may be used in conjunction with Auto Diesels' evaporators to provide fresh drinking water from brackish or salt water. This type of package unit is ideal for use in remote establishments, villages or well heads.

Overall, the continually reducing capital cost of small turbines allied to the recent discoveries of natural gas in the Northern hemisphere will do much to emphasise the attractions of the small industrial gas turbine for many duties.

Naturally, Auto Diesels is very sensitive of the contribution small turbines may make in a variety of fields. Consequently, a comprehensive service has been established to cover every aspect, ranging from the provision of technical advice to the production of units manufactured to meet specific end purposes.

Published by courtesy Braby of Britain Group.

APPOINTMENT

One of Britain's leading authorities on the principles of blood-flow metering, Mr. G. D. Cutler, has been appointed product manager of S.E. Medic, the medical electronics division of S.E. Laboratories (Engineering) Ltd., of Feltham, Middlesex.

YORK WATER CHILLING SETS FOR NEW BRISTOL HOSPITAL

An order has been received by York Division of Borg-Warner Ltd., North Circular Road, London, N.W.2, to supply two packaged water chilling sets for air conditioning at the new Outpatients Department of the Bristol Royal Infirmary.

The two sets will operate with the evaporators in series and the condensers in parallel to provide chilled water to air cooler batteries operating in dual duct systems and operating-theatre air conditioning systems.

Consulting Engineers for the project are Hoare, Lea & Partners, Bristol.

Abstract of Reports

MID GLAMORGAN H.M.C.

The nineteenth Annual Report of the Mid Glamorgan Hospital Management Committee deals mainly with work carried out during the year 1967.

The total number of patients awaiting in-patient treatment at 31st December, 1967 was 2,000 compared with 1,771 in December, 1966. The waiting list for General Surgery has increased from 418 in the previous year to 526.

In previous years attention has been drawn to the fact that the waiting list consists entirely of the surgical type of case and this is due to shortage of surgical beds and to insufficient theatre accommodation at the two main hospitals, namely, Neath and Bridgend General Hospitals.

This amount of theatre accommodation falls far short of that required and it is difficult to envisage more work being done without increasing the accommodation. It must also be stressed that the admission of patients to Neath General Hospital Annexe is limited to the number of beds available at the main hospital and the shortage of female surgical beds has been and still is very acute. These facts have been stressed time after time and the position will not improve until additional female surgical beds and theatres are provided.

It was not possible to commence work to provide additional accommodation in the X-ray Department at the Bridgend General Hospital during 1967, but this will certainly commence early in 1968.

An additional locum tenens Consultant Pathologist was allocated to the Group in September and this has helped to cope with the heavy demands made on the service.

The appointement of various additional Consultants within the Group in different specialties has added to the work of the X-ray and Pathology Departments and the proposed increase in their medical staffing is welcomed.

The demands in the specialties other than those already mentioned has continued to be met on the whole except that there is some pressure on certain types of bed during certain periods of the year and this applies especially to the medical wards during the winter months.

The Physiotherapy Staff at the Neath General Hospital continue to provide physiotherapy treatment at the hospital and a total of 31 patient treatments were afforded to five patients.

The small Geriatric Day Unit which came into use in June, 1965, is still proving very satisfactory and during the year 12 new patients attended with a total of 1,918 attendances.

The Committee's proposal that the 14-bedded Infectious Diseases ward at the Cefn Hirgoed Hospital should be used for post-operative gynaecological patients transferred from the Bridgend General Hospital was accepted and came into effect on 1st July, 1967.

A Day Hospital undoubtedly adds considerably to the already heavy demands on the Ambulance Service and the Committee have always appreciated the excellent service afforded by the Glamorgan County Council to the Group in general and to Maesgwyn in particular.

The Maesteg General Hospital is the only complete General Practitioner Unit within the Group. The bed complement is 69 and this shows an increase of two beds over the previous year.

The success of this hospital as a General Practitioner Unit is due to the fact that the doctors in the area have always agreed to attend to each other's patients in an emergency and no difficulty has been experienced in this respect at any time during the day or night.

Criticism of out-patient and casualty facilities has always been far greater than of any other section of the Hospital Service. With the vast increases in attendances, especially over the last twenty years, without a corresponding increase in accommodation, it would not have been surprising if the number of complaints had been much greater. There are management problems in these departments which do not exist in any other section of the hospital and this justifies the need for a constant review and appropriate action where necessary.

The deficiences of the Out-patient Department at the Neath General Hospital have been commented upon in many previous Reports. It is not possible to centralise out-patient work as the main Department is far too small and this has meant that accommodation has had to be provided in various parts of the hospital for this purpose.

Capital and Maintenance Work

During the last few years the comment has been made that the number of minor capital works in this Group have been very few but during the current year a number have been carried out and others are in varying stages of completion.

Unfortunately, no material progress can be reported with regard to the development of the two main hospitals as District Base Hospitals.

The following are particulars of some of the schemes dealt with during the year:—

1. Capital Works

The difficulty in accommodating medical staff, both married and single, has been commented upon for many years. It has now been agreed to build additional medical staff quarters on the garden ground adjoining the Manor House and the building was expected to be available by the end of April, 1968. It consists of eight bedrooms, with bathing and toilet facilities, and a "quiet" sitting room.

At the Bridgend General Hospital the provision is somewhat better than it was at Neath. The three new houses which were purchased in 1966 have been fully used by married medical staff during the past year.

Neath General Hospital

The extension to the Pathological Laboratory was contemplated as part of the main Maternity Department scheme but has been brought forward and is now approaching completion. It will consist of a total area of 1,500 square feet and will provide much needed additional accommodation for the Laboratory, which is grossly overcrowded.

The reorganisation of the Central Kitchen: This scheme was also included as part of the main Maternity Department scheme but was brought forward and the work carried out by the hospital maintenance staff. The layout of the kitchen was completely altered and new equipment installed.

The fairly major scheme for the provision of additional sanitary annexes including toilets, bathrooms and sluicerooms for seven Wards was commenced in September, 1967, and was due to be completed in July, 1968.

Bridgend General Hospital

Nurse Training Unit, Postgraduate Accommodation, etc.

The General Nursing Council had condemned the Nurse Training accommodation at the Bridgend General Hospital and had refused to consider the proposals for the introduction of the 1962 Syllabus of Training until new accommodation had been provided. The Hospital Board agreed that a building similar in every respect to the Nurse Training Unit, Postgraduate Accommodation and Hospital Staff Reference Library which had already been provided at Neath General Hospital should be adequate at Bridgend. Work commenced on this building in January, 1968, to be completed by the middle of August and available for the new intake of Student Nurses commencing on 1st September.

The only heating provided in the Nurses' Home was on the ground floor and no heating of any kind was available in any of the bedrooms or corridors on the first and second floors. Work has now commenced on the installation of a new central heating boiler and the provision of radiators throughout the whole building.

Urgent Future Developments

Although very little progress has been made regarding the hospital development as envisaged in the Ten-Year Plan, a considerable amount of preparatory work is still going on.

The work at Neath General Hospital continues to increase and as previously stated, is outgrowing the resources of several important departments.

It is unlikely that the proposed new Maternity Department will be completed in less than three years and it would appear that the present state of affairs will have to continue in all these other Departments until that time. There seems little or no prospect of increasing theatre space until further development of the hospital is undertaken as it is doubtful whether additional theatres can be provided in any other way.

At the Bridgend General Hospital the scarcity of theatres and the limitations of the X-ray and Pathology Departments have been commented upon for some years. Fortunately, work has already commenced to provide additional temporary accommodation for the X-ray and Pathology Departments and this provision is a "must" to meet current demands.

At Bridgend, as at Neath, it is difficult to envisage how additional theatre accommodation can be provided without embarking on a major scheme of rebuilding.

B.S.I. News

Abstracts of information supplied by the British Standards Institution

NEW BRITISH STANDARDS

B.S. 787 : Mining type flameproof gate-end boxes.

787 : Part 2: 1968 Gate-end boxes with air-break circuit-breakers (for use on 3-phase a.c. circuits up to 650 V) 10s.

Boxes in which the essential apparatus is an air-break circuit-breaker. Service conditions; ratings, design and construction, including means of protection; test requirements. (SBN: 580 00277 2).

B.S. 2690 : Methods of testing water used in industry.

2690 : Part 7: 1968 Nitrite, nitrate and ammonia (free, saline and albuminoid) 7s.

Gives 1 method each for nitrite and nitrate and 3 methods of increasing sensitivity for ammonia. Includes details of distillation procedure for ammonia determination. These methods are intended to supersede those given in the 1956 edition. (SBN: 580 00280 2).

B.S 2854 : 1968: Soiled linen trolleys 6s.

Specifies materials, thickness, testing and marking requirements for synthetic resin-bonded cork sheet jointing material from which gaskets can be cut or stamped. (SBN: 580 00264 0).

REVISED BRITISH STANDARDS

B.S. 2858 : 1968: Soiled linen trolleys 6s.

Specifies materials, dimensions, construction and general requirements for single and twin trolleys for carrying soiled linen in hospitals. Details of suitable bags are given. (SBN: 580 00265 9).

AMENDMENT SLIPS

Please order Amendment Slips by quoting the reference number (AMD . . . . or PD . . . as appropriate) and not the B.S. number.

B.S. 889 : 1965 Flameproof electric lighting fittings. Amendment Slip No. 2	AMD 36
B.S. 1187 : 1959 Wood blocks for floors. Amendment Slip No. 1	AMD 21
B.S. 1297 : 1961 Grading and sizing of softwood flooring. Amendment Slip No. 2	AMD 35
B.S. 3456 : The testing and approval of domestic electrical appliances Part A. Heating and cooking appliances. 3456 : Section A12: 1962 Electric cookers and boiling plates. Amendment Slip No. 3	AMD 26
B.S. 3456 : The testing and approval of domestic electrical appliances Part A. Heating and cooking appliances. 3456: Section A2: 1962 Electric room heaters 3s. Amendment Slip No. 4	AMD 51
B.S. 3955 : Electrical controls for domestic appliances Part 2. Specific requirements 3955: Part 2F: 1967 Room thermostats Amendment Slip No. 1	AMD 18

On the Market

A review of new equipment and materials and their development

NEW RANGE OF INSTRUMENT AIR DRYERS

Dryvent Ltd., Hollygrove House, Staines Road, Hounslow, Middlesex, makers of air and gas drying plants, announce the introduction of a new range of instrument air dryers, specifically designed for use on pneumatic systems with working pressures between 40 and 100 lb/in²g.

Known as the HCD Mk IV range, the new dryers are produced in five standard sizes with output capacities of 1 (HCD.010), 3 (HCD.030), 6 (HCD.060) 10 (HCD.100) and 15 (HCD.150) ft.³ of free air per minute at an operating pressure of 80 lb/in². They are fully automatic in operation and require little maintenance.

Each unit incorporates two adsorber cylinders filled with pelleted desiccant arranged so that whilst drying takes place in one adsorber, reactivation of the desiccant is carried out in the other. The changeover from one adsorber cylinder to the other is controlled automatically by an electric synchronous timer motor. At changeover, the pressure in the adsorber to be reactivated falls to atmospheric pressure and a reverse flow of dry, expanded, compressed air, bled from the dry air outlet, is passed through the desiccant to remove the moisture released by the desiccant to atmosphere. Towards the end of the reactivation cycle, the adsorber gradually builds up again to line pressure so that there is no pressure drop or interruption of the air supply at changeover—a feature of particular importance on instrument air lines.

For use in hazardous atmospheres or with portable compressor sets, models are available fitted with pneumatically controlled timer units requiring no electricity supply for operation. All units can be supplied suitable for wall mounting.

As with all Dryvent units, the new HCD Mk IV range is backed by a country-wide after-sales service. Delivery is within two weeks.

Further details, including prices, can be obtained on request to the manufacturers only.

COMPLETELY NEW VINYL FLOORING

A new, quality vinyl sheet flooring has been introduced by **The Marley Tile Co.** of Sevenoaks, Kent. It is considered to be of exceptional commercial value both in technical suitability and price.

The flooring is "Vinyl 80", a fully homogeneous material 80/1,000 in. thick in 4-ft. wide rolls and twelve very attractive architectural colours.

Vinyl 80 can be applied to all the customary types of sub-floor finish using the recommended Marley adhesive. All sheet joins are seam welded with vinyl strip to provide a sealed jointless finish.

Installation will be on a supply-and-fix basis, either by Marley or their approved flooring contractors. Samples and literature may be obtained from any of Marley's branches or depots.

ELECTROMAGNETIC FLOWMETER FOR WIDE RANGE OF FLUIDS

A perfectly smooth bore and the absence of any moving parts are the key features of the new electromagnetic flowmeter designed by **Meterflow Ltd.** of Royston Road, Baldock, Herts., for measuring a wide variety of fluids. Having an accuracy of $\pm 1\%$ of full scale at velocities of 3-30 feet, the Magflow model can measure fluids bearing solids in fine or coarse distribution, sludge, paste or abrasive slurries, as well as corrosive liquids and high viscosity media.

The operating principle is purely electrical and the reading, which is independent of variations in temperature or pressure, is automatically averaged for pulsating flows. The flow may be bi-directional without loss of accuracy.

Simplicity of installation is another feature, and it may be fitted at any attitude in the pipeline. Remote indication may be provided at a distant station if required.

Converter unit

A fully transistorised magnetic flow-to-current converter unit is also being marketed for use with magnetic flowmeters. Designated the M.20, the unit is designed for wall-mounting in a dust- and splash-proof case with a transparent front cover plate.

Features include: Solid-state circuitry; exceptional linearity, repeatability and accuracy; and bi-directional output.

THE NEW AEI EM8 SERIES ELECTRON MICROSCOPES

GEC-AEI (Electronics) Ltd. are introducing a whole new range of electron microscopes. In 1964, AEI pioneered the concept of high performance specialised instruments with exceptional ease of use. Since that time the scientific requirements have changed somewhat and the three instruments which form the new EM8 series, will meet these needs.

The EM801 provides a unique set of specimen facilities for the biologist to take advantage of new specimen preparation techniques. Notable amongst these is the ability to examine a whole series of serial thin sections without any loss of area. This stage was specially designed for Professor Sjostrand in Los Angeles, California, who can now cut up to 100 serial sections.

FURSE PACKAGED LIFT RANGE FOR GREATER VERSATILITY

The range of packaged lifts produced by **W. J. Furse Ltd.** now includes goods/passenger units, service lifts and goods lifts in a variety of capacities. Designed on a modular basis, lifts in the range can be installed with a minimum of builders work in spaces where it would be impossible to fit a conventional lift of the same capacity. The modular construction of the main frame and lift components allows for rapid alterations of re-positioning whenever a change of layout becomes necessary. Standardised jig-made modular components are used for the entrances, sides, back and motor compartment sections. These are built up from rectangular hollow steel fitted with spigots so that one panel fits exactly to another.

The number of car entrances in an installation can be changed, for example, from one to two or even three, by removing the existing panel and substituting a standard frame and gate. The lift can be arranged to serve more or less floors with equal ease.

The replacement period of lift ropes has been reduced to a minimum by the use of special elevator ropes which are used by Furse on 95% of all goods lifts and elevators produced. Many of the lifts in the Furse range are now fitted with a completely new type of Shaw Rope, especially designed for elevator work. The rope is constructed with 6 strands of 26 individual wires, giving a longer working life due to improved fatigue resistance.

Further information from **John Shaw Ltd.**, Sandy Lane, Worksop, Notts.

PLASTIC CASES FOR PRESSURE GAUGES

Plastic casing for pressure gauges, to provide more resistance to corrosion and to reduce the price of the instrument, has been introduced by the **British Rototherm Co. Ltd.**, Merton Abbey, London, S.W.19. The standard colour is black, but a chrome plated finish is available for the 4 in. dial size.

The pressure gauge is manufactured in 3 in., 4 in. and 6 in. dial sizes; mounting is either direct or by means of a back flange. The 3 in. dial size is only available with a brass bezel; the 4 in. and 6 in. sizes can have brass or plastic bezels.

The Bourdon tube is a phosphor bronze for measurement of pressure up to 2,000 p.s.i. and of steel for higher pressures up to 25,000 p.s.i.

Prices for this range of gauge are from 29s., a reduction of approximately 20 per cent from the prices of British Rototherm's brass gauges.

NEW ATTACHMENT CONVERTS STANDARD MICROSCOPES FOR PROJECTION

A projection attachment for use on their whole range of Standard Microscopes has been developed by **Carl Zeiss** of West Germany. An additional base plate houses the illuminator which is reflected into the light path to boost the light level. The normal eyepiece is replaced by a monocular tube and a projective. Four projectives are available, choice depending on the screening size required and the projection distance.

For normal use a CS1 250W metal-halide lamp gives very accurate colour rendering with a colour temperature of 3400° Kelvin. Alternatively, an HBO 200W high pressure mercury lamp is available with over twice the power (33,000 stilbs). Because of its richness in ultra violet and blue light, some colour distortion is discernible in projecting stained specimens.

As a compromise between projecting for an audience in a darkened room and individual observation through an eyepiece, is a ground glass viewing screen attachment. An evenly illuminated image 15 cm. across can be examined without the room having to be darkened. A version is available with a capping shutter and an insert to take 9×12 cm. or 5 in. × 4 in. plate film (including Polaroid), making a simple conversion of the Standard Microscope to a photomicroscope. For further details contact Anthony W. Armitage, EDC Public Relations Ltd., 10 Wardour Street, London, W.1.

BUBBLE-TIGHT VALVE FOR GAS MAINS CONVERSION

A new valve has been developed by **Elliott & Garrood Ltd.** for gas mains conversion. Known as the E.L.G.A. Converter Valve, it is designed for natural gas conversion but is suitable for other applications.

It has a Grade 17 cast iron body with seals of high nitrile rubber, an aluminium plate passing between the seals for valve closure. In operation, the bore is fully opened by pulling out the plate and, as there are no working parts, the valve is claimed as one of the most economical gas conversion valves on the market.

The specially developed seal renders the valve bubble tight for working pressures of up to 10 p.s.i. when the valve is shut and is self-sealing when the plate is withdrawn. A cast iron bonnet covers the plate aperture acting as a secondary safeguard against leakage and to prevent access of foreign bodies to the seal. This design allows the top to be easily removed for re-insertion of the plate if isolation is again required.

These E.L.G.A. Converter Valves are currently available in 2, 3, 4, 6 and 8-inch bore sizes from the manufacturers at Gosford Road, Beccles, Suffolk.

NEW PREMIER COOLING TOWER WITH DUFAYLITE HONEYCOMB FILL

A range of small packaged cooling towers—named the Premcool series—is being marketed by **Premier Cooler Ltd.**, Shalford, Guildford, Surrey. The packing is Dufaylite impregnated honeycomb, giving a large heat transfer surface within a small space.

The Premcool series is suitable for air conditioning and refrigeration installations, compressors and internal combustion engines. There are 13 sizes ranging from model PC—04, 2 ft. wide by 2 ft. long, to PC—64, which is 8 ft. square. All models are 9 ft. high.

The coolers are delivered to the site already assembled, needing only pipe and electrical connections to be made before commissioning.

The Premcool coolers are operated by induced draught. An axial flow fan and motor unit is mounted at the top of the tower and within the casing, ensuring a low noise level and mainaining a streamlined appearance. The motor is protected for operation on the saturated outlet vapour stream and the unit is complete with fan guard. The motor requires no maintenance.

Ease of maintenance is an important point in the design and the tank is simple to clean. A 3 kW immersion heater and thermostat are available for the cold water tank.

CYCLOPAC PACKAGED AIR CONDITIONING UNITS

Matthews & Yates Ltd., incorporating Turner & Brown Ltd., announce the introduction of their latest "Cyclopac" CPN Packaged Air Conditioning Unit.

"Cyclopac" air conditioning units are available in a range of eight standard sizes, giving volumes from 800 c.f.m. to 21,000 c.f.m., and generally operating within static pressures up to 8 inches w.g. Modular in-line construction enables completely self-contained sections to be coupled together in any combination.

All "Cyclopac" section casings are fabricated in hot dipped galvanised sheet steel, suitably reinforced, internal surfaces are coated where necessary with an Epoxy based paint, giving maximum corrosion resistance, effective insulation at least $\frac{1}{2}$ in. thick in all modules ensures minimum heat losses.

Basically, each "Cyclopac" packaged air conditioning unit comprises a sound proofed fan section utilising centrifugal fans from the proven "Cyclopac" range, which is used in conjunction with other sections for dampering, mixing, filtering, heating, cooling and humidifying.

Alternative types of humidification are available including steam, spinning disc or spray type, and for the Filter Section there is a variety of filtering media including Automatic Roll type.

Optional additional equipment includes silencers which are provided on the fan section discharge. Maintenance and inspection is simplified by side access to the filter, heater, cooler, humidifying and fan section.

Prices and further information may be obtained from Department P.D., Matthews & Yates Ltd., Turbro-Cyclone Works, Gibraltar Street, Bolton.

MINI AND MINOR POWER UNITS

Newly introduced by **Adan Hydraulics Ltd.,** are the Mini and Minor standard ranges of hydraulic power unit. These enable a complete hydraulic system to be presented at an economical price whilst maintaining a high performance and pleasing appearance.

A compact self-contained construction ensures an efficient quiet-running hydraulic power source which may be used equally well as a free-standing unit or for incorporation as an integral part of a machine.

Standard units comprise a style cast tank, the top plate of which carries a vertically mounted motor/submerged pump assembly, relief valve built into the porting manifold, pressure gauge, oil level gauge, breather, suction strainer, and a micronic return line filter incorporating a visual contamination indicator in the filler.

The Mini unit is of 5 gallon capacity and fitted with electric motors up to 3 h.p., the Minor unit is of 10 gallon capacity and carries motors up to 10 h.p.

Maximum flexibility in circuit design can be achieved by the use of additional manifold blocks designed to mount onto the standard units and to accept J.I.C. valve mountings of the sub-plate type.

Literature is available from Adan Hydraulics Ltd., Hanworth Road, Hounslow, Middlesex.

NEW CLOSE DIFFERENTIAL PRESSURE SWITCHES

Ward Brooke & Co. Ltd., members of the Norcros Group, Loudwater, Nr. High Wycombe, Bucks, announce a new range of pressure switches especially suitable for applications where very low switch differentials are required.

Available in two basic types—metallic bellows or Bourdon tube—the switches cover pressure ranges as low as 0-10 lb/in.^{2} (in the case of the bellows models) or 0-100 lb/in.^{2} for those incorporating Bourdon tubes. At the upper end of the range the bellows series extends to 0-100 lb/in.^{2} while for the Bourdon units the top range is 0-6,000 lb/in.^{2} All units can be fitted with two 10A switches suitable for connection to 125, 250 or 480 V a.c. supply, or two 5A-125A d.c. switches.

The set point is fully adjustable over the entire operating range and is indicated on a setting scale located inside the case. Setting scales can be calibrated for switch operation on either a rising or falling pressure.

Should any of the switches in the range be used for controlling steam pressure, a syphon must be included in the connecting tubing in order to isolate the pressure element from the live steam. Similarly if a unit is used with a hydraulic system the pressure element must be protected from surge pressure by a restrictor.

Any special customer requirement such as special purpose micro-switches can be provided. All switches can be supplied with surface mounting or flush panel mounting cases. Where necessary, twin Bourdon tubes are used to ensure that the mechanism has adequate operating power to give reliable and consistent switch operation.

MARINE TYPE DOUBLE SPRING HIGH LIFT SAFETY VALVE

Samuel Birkett Ltd., Queen Street Works, Heckmondwike, Yorkshire, have now designed a Marine Type Double Spring High Lift Safety Valve.

With cast steel as body material, the Marine Valve will withstand temperatures up to 450°F, and steam pressures up to 350 p.s.i. Steam discharge rates up to 91,000 lbs. per hour can be accommodated through one valve.

The Birkett Marine Safety Valve achieves a high rate of discharge and stability of operation. Pressure tightness is maintained under all conditions, and there is freedom from distortion due to rapid changes in temperature.

The Marine Type Valve is available in sizes $1\frac{1}{2}$ in., 2 in., 3 in. and 4 in.

The new design incorporates the following features: Clear bore due to top guiding. The use of two ball pivot points so that the valve disc can accurately align itself with the seat, irrespective of the temperature distortion of the surrounding components. Protection of the spring from main flow of steam when discharging: this ensures it is not affected by the steam temperature.

An adjustable blow-down ring is fitted to provide consistently good re-setting performance.

The manual easing gear is arranged so that both valves are lifted together. The extension rod from the easing gear can be lengthened to a convenient position to facilitate easing.

Notes for Members

WELSH BRANCH

The Welsh Branch met on 4th May at Nevill Hall Hospital, Abergavenny.

Mr. V. Riley reported upon the first A.G.M. of the Institute in its new guise and this proved to be a short meeting as there had been no controversial matters to discuss. He added that members were now entitled to obtain 100% relief of Income Tax on Membership Subscriptions.

After a short discussion it was unanimously agreed to support the Midlands Branch views upon the publication "The Shape of Hospital Management in 1980." The Branch deplored the fact that there was no engineer on the Working Party responsible for issuing the Report and believed that the Institute could not agree with the recommendations which it made.

The meeting then received a Paper from R. T. Leech on "The Engineering Services at Nevill Hall Hospital," and this is published elsewhere in this issue. Mr. Leech is Assistant Regional Engineer to the Welsh Hospital Board.

SOUTHERN BRANCH

The Southern Branch held its 129th meeting at Park Prewett Hospital, Basingstoke on 20th July.

Members listened to a lecture by A. K. Dobbie, B.Sc., C.Eng., A.M.I.E.E., Electrical Safety Officer to the Ministry of Health.

Mr. Dobbie talked on the dangers of explosion and fire in operating theatres due to the possible concentration of inflammable gases, and the dangers of electrostatic sparking. In conjunction with the latter, anti-static flooring, the various types, its suitability and usefulness, were also covered.

The safety factor of equipment and electrical accessories, the use of portable X-ray apparatus and the size of outlets necessary were discussed.

The lecture proved a most instructive event and led to much lively discussion.

A number of members subsequently had an opportunity of visiting the new Boiler House and Maternity Department which are in course of construction.

MIDLANDS BRANCH

About 20 members of the Midlands Branch visited the sewage purification works of the Upper Tame Main Drainage Authority, Minworth, on Saturday, 6th July, 1968, with the kind permission of M. R. Vincent Davis, O.B.E., B.Sc., M.I.C.E., P.P.Inst.W.P.C.

The members saw the methods of treating sewage and dealing with storm water, and the method of taking analytical tests was explained.

The Upper Tame Main Drainage Authority operates 57 sewage works receiving sewage from a total population of 2,100,000 within a drainage area of 340 square miles. The works range in size from the Main Tame Valley works which treats sewage from a population of 1,002,500, to Barston Eastcote Works which treats sewage from a population of 16. Minwortth is part of the Main Tame Valley Works.

Members of the Midlands Branch attended a meeting at Powick Hospital, Malvern, Worcestershire, on Saturday, 7th September.

The programme began with a film entitled "Inserting a Damp Proof Course." The main paper "Reducing and Pressure Relief Valves" was presented by B. Thornton, Technical Manager, Samuel Birkett Ltd. Mr. Thornton demonstrated in simple terms, with the aid of charts and valve sections, the characteristics of different types of valve.

The programme continued after tea with a further film entitled "Services for Shell."

Future Events

The next meeting will be at Lea Hospital, Bromsgrove, on Saturday, 2nd November, at 2.15 p.m. The programme is:—

Paper—Director Contract or Labour by E. Bampton, F.I.O.B., F.I.A.S. Mr. Bampton is the Superintendent of Buildings, and Chief Engineer at the University of Birmingham.

The paper will be followed by a film which shows the building of Coventry Cathedral.

EAST MIDLANDS BRANCH

The Branch advise us that their Annual Dinner and Briggs Award function will be held at the Doncaster Royal Infirmary on Friday, 29th November next.

Further details may be obtained from the Branch Hon. Secretary—R. R. Blagborough, 70, Malton Road, North Hykeham, Lincoln.

KING'S FUND ESSAY COMPETITION

1st Prize—100 guineas, 2nd Prize—50 guineas, 3rd Prize—25 guineas. There will be nine consolation prizes of 5 guineas.

King Edward's Hospital Fund will award the above prizes to the authors of the best essays entitled Staffing the Hospitals—Problems and Solutions. Competitors should consider, in their essays, one or several of the following aspects of hospital staffing.

Determination of staffing levels
Recruitment techniques
In-service training
Productivity
Morale
Career structure.

Competitors may relate their entries to a particular group of staff, for example, nursing or laboratory staff, or to hospital staff in general. They should be as pragmatic in their approach as possible. Questions of remuneration should be excluded except in relation to increasing productivity.

Essays will be judged by a panel of independent judges invited by the Fund to serve in this capacity. The judges will look for logical argument, constructive suggestions, clear presentation and good literary style. If this panel should consider that the essays do not attain a satisfactory standard, the Fund reserves the right not to award all the prizes.

The King's Fund also reserves the right to arrange for publication of the winning essays and to make use of material contained in any of them in the courses which are held at its College of Hospital Management.

It is hoped to announce the names of prizewinners during May 1969.

Conditions of entry

1. The competition is open to anyone working in the hospital service in Great Britain. If any question arises in reference to the eligibility of a candidate or the admissibility of his or her essay, the decision of the Essay Committee will be final.
2. Essays must not be less than 2,000 or more than 4,000 words in length. Each competitor is asked to state the total number of words on the entry form.
3. Essays must be typewritten in double spacing and on one side of the paper only. Pages must be clearly numbered and securely fastened together.
4. Each entry must bear a pseudonym and have no other visible mark of the author's identity. The entry must be accompanied by a sealed envelope bearing only the pseudonym and containing an official entry form duly completed. (Because of the need for maintaining anonymity, the receipt of essays will not be acknowledged.)
5. The last date for the receipt of entries is 31st December, 1968.
6. Any entry which fails to comply with the rules of the competition will be automatically disqualified.

Entry forms for the competition can be obtained from Miss M. D. Hinks, King's Fund Hospital Centre, 24, Nutford Place, London, W.1.

FIREPROOF PHOENIX

The Phoenix Timber Treatment Service of Frog Island, Rainham, Essex, now has flameproofing facilities for timber, using 'Celcure' 'F' fire retardant wood preservative.

The copper/chrome/ammonium salts with which the wood is impregnated also give protection against insect and fungal attack.

FUSE-LINK STOCKISTS

Harmsworth, Townley and Co., Wellington Road, Todmorden, Lancs., have been appointed official stockists for English Electric H.R.C. Fuse-links, types GS and GSG—which are for the protection of semi-conductor rectifiers and thyristor circuits. These components are available for immediate delivery and a 24-hour service is in operation.

HOPE'S HEATING AND SUPERJET

Crittall-Hope Ltd. announce that as from 30th August, 1968, the Oil and Gas Burner Division of Hope's Heating and Engineering Ltd. and Superjet Ltd. have formed into a new Company: Hope Superjet Ltd.

Hope Superjet Ltd. will continue to trade from Halford Works, Halford Lane, Smethwick, Warley, Worcs.

AUTOMATED HOSPITAL FOR SAUDI ARABIA

AGREEMENT has been reached for an automated hospital to be designed, built, staffed and managed for King Faisal of Saudi Arabia by the Medical Group of Vickers.

Architects working in association with the Medical Group of Vickers for the project are J. G. L. Poulson.

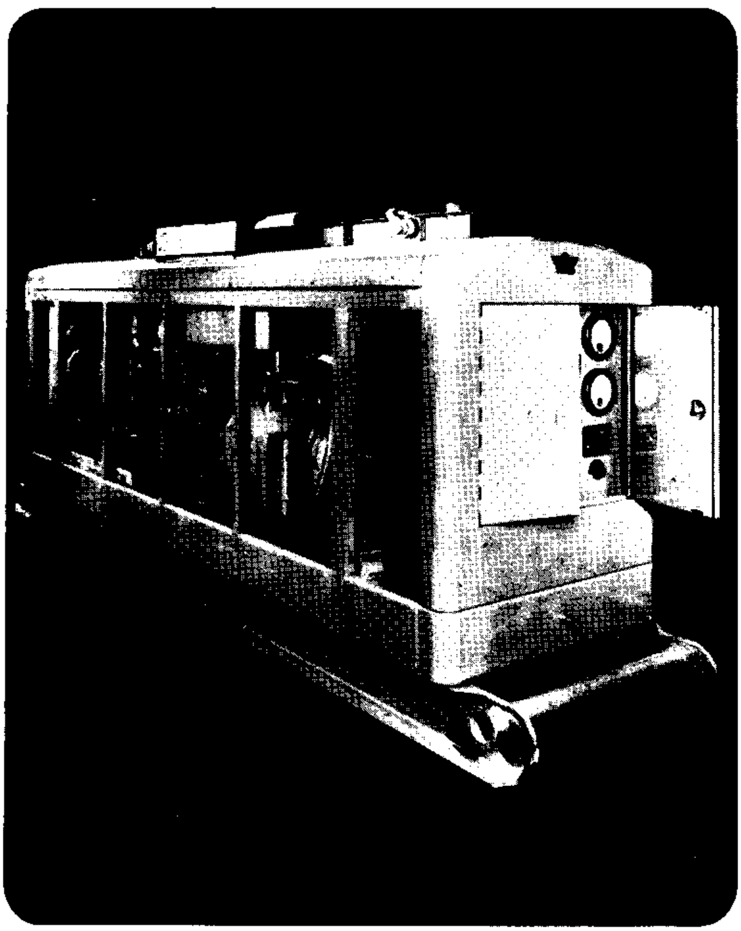
The hospital will be built at Riyadh, the Saudi Arabian capital, and is expected to be commissioned in 1971. Total value of the project, including all services and staff accommodation and training, will be about £5½m.

The requirements of the 216-bed hospital, which is designed for extension to 400 beds later, have been worked out against the background of the existing resources and future requirements of the Saudi Arabian health programme.

The design provides for computer-controlled automated handling of supplies, and data processing systems. Systems engineers at Vickers Barrow Works are undertaking some of the development work. The hospital will incorporate the most advanced medical technology such as the Multichannel '300' automated biochemical analyser and the hyperbaric oxygen therapy equipment developed through Vickers Medical Group's research programme.

Automation will reduce the need for supporting staff and enable the most efficient use to be made of medical and nursing specialists by relieving them of routine work.

Index to Advertisers



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Classified Advertisements

SITUATIONS VACANT

OXFORD REGIONAL HOSPITAL BOARD

MAINTENANCE AND FUEL ENGINEER

required for a new and interesting position calling for enthusiasm and ability to work harmoniously with other staff. Duties will be wholly concerned with the implementation of a Planned Preventive Maintenance Scheme for new and existing engineering installations at hospitals within the Oxford Region embracing several Counties.

Wide experience of mechanical and electrical services and plant installed in buildings, coupled with detailed knowledge of maintenance work and planned preventive maintenance procedures, is essential. Training will be given in the more specialised hospital equipment but a knowledge of installations for hospitals is desirable.

The Engineer must be capable of carrying out efficiency surveys and making reports and recommendations on the optimum use of fuel, heat and power for engineering services installations.

Minimum technical qualification required is H.N.C. (Mechanical or Electrical) but consideration will be given to applicants not so qualified having particularly appropriate experience.

Salary scale £1,520—£1,870 p.a. but for a Chartered Engineer a higher scale would be agreed.

Write in the first instance to the Secretary to the Board, Old Road, Headington, Oxford for application form and further particulars. (Quote V72/68B). Form to be returned by 31st October, 1968.

BRENTWOOD GROUP HOSPITAL MANAGEMENT COMMITTEE

ASSISTANT ENGINEER

Appications are invited for the above appointment, at Harold Wood Hospital, from suitably experienced and qualified persons, who will be required to assist the Hospital Engineer in the supervision of the mechanical and electrical sevices.

The post will provide good experience for a young engineer seeking to enter the hospital service, and day release facilities for study may be given.

Salary scale £975-£1,270 p.a. for qualified engineers, plus London Weighting £90 p.a. Consideration may be given to appointment of engineers, without full qualifications, with an abatement of £100 p.a. on the above scale.

Please apply giving full details to the Group Secretary, High Wood Hospital, Brentwood, Essex, by 26th October, and from whom further details can be obtained.

ELECTRICAL ENGINEER

(£1,825 per annum)

and Deputy Chief Engineer for large Teaching Hospital. Corporate Member of the Institute of Electrical Engineers preferred.

The details of the successful candidate's responsibilities can be worked out to suit his particular background, but ideally we would want him to assume overall responsibility for the electrical engineering aspects of the work with particular responsibility for the electrical requirements for new installations. As he will depatise for the Chief Engineer in a broad capacity, evidence of management experience would be a distinct advantage.

The range of plant and equipment is becoming increasingly wide and an interesting and varied career in hospital engineering can be assured.

Write to the House Governor, The London Hospital, E.1.

WEST HERTS GROUP HOSPITAL MANAGEMENT COMMITTEE

HOSPITAL ENGINEER

Applications are invited for this post at Shrodells Wing of Watford General Hospital which will become vacant on the retirement of the present Engineer on 1st February, 1969. Shrodells Wing is undergoing major redevelopment and will ultimately have a total of 800 beds. Salary range £1,270-£1,500 with a special responsibility allowance of £50 p.a.

Qualification required is Higher National Certificate in Mechanical, or Electrical, Engineering. Applications stating full particulars and naming two referees should be addressed to the Group Secretary, 9 Rickmansworth Road, Watford.

NORTH LANCASHIRE AND SOUTH WESTMORLAND HOSPITAL MANAGEMENT COMMITTEE GROUP ENGINEERING DEPARTMENT

HOSPITAL ENGINEER

LANCASTER MOOR HOSPITAL

He will be directly responsible to the Group Engineer for the satisfactory maintenance and co-ordination of all engineering services at Lancaster Moor Hospital.

Candidates should have a sound knowledge of the principles and practice involved in the operation of a steam boiler plant and engineering/electrical services generally. They must also have completed an apprenticeship in mechanical or electrical engineering and must hold an H.N.C. or H.N.D. in mechanical or electrical engineering with endorsements in the principles of electricity or applied heat and applied mechanics or hold an equivalent approved qualification.

Salary scale £1,370 rising to £1,605 per annum plus a special responsibility allowance of £100 per annum. Whitley Council Conditions of Service will apply. Married accommodation not available. Form of application from the undersigned, to be returned not later than 31st October, 1968.

H. Carr, Group Secretary.

Lancaster Moor Hospital, Lancaster.

SHEFFIELD NO. 2 GROUP HOSPITAL MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER

This is a new post in a Group of nine hospitals with expanding activity in the upgrading of buildings and plant and with the impending development of a new 600 bed hospital.

The successful applicant will be required to deputise for the Group Engineer over the whole range of his duties and be specifically involved in organising the introduction of planned preventive maintenance.

Applicants must hold one of the following qualifications or an equivalent approved by the Ministry of Health:

1. H.N.C. or H.N.D. in (a) Mechanical Engineering with endorsements in Industrial Organisation and Management and Principles of Electricity or Electro-Technology, or (b) in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S.III or O2 level) or with endorsement in Applied Heat and Applied Mechanics, or
2. City and Guilds Mechanical Engineering Technicians full Technological Certificate (Part III) which must include Plant Maintenance and Works Service.

Salary scale £1,370 x 5 to £1,605 per annum plus £75 per annum special allowance. Three bedroomed centrally heated bungalow available at moderate rent if required in the hospital grounds which is convenient for both the City Centre and the Peak District National Park.

Job description and application forms are available on request from:

The Group Secretary, Middlewood Hospital, SHEFFIELD, S6 1TP

and must be returned by the 31st October, 1968.

PETERBOROUGH AND STAMFORD HOSPITAL MANAGEMENT COMMITTEE

Stamford and Rutland Hospital

HOSPITAL ENGINEER required, to be directly responsible to the Group Engineer for the maintenance of all engineering services at the following:—

Stamford and Rutland Hospital, Stamford

St. George's Hospital, Stamford

Group Central Laundry, Stamford

Bourne Chest Hospital, Bourne

Bourne Butterfield Hospital, Bourne

Applicants must have acquired a thorough practical training appropriate to the responsibilities and duties of the post and must hold one of the following qualifications, or an approved equivalent:—

(1) Higher National Certificate or Higher National Diploma with endorsement in Industrrial Organisation and Management and Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course.

(2) Higher National Certificate or Higher National Diploma in Electrical Engineering, with endorsements in Industrial Organisation and Management and including (at S.III or O.2 level, or with endorsement in) Applied Heat and Applied Mechanics, provided he has suitable experience in Mechanical Engineering.

(3) City and Guilds Mechanical Engineering Technicians Full Technological Certificate (Part III) which must include Plant Maintenance and Works Service.

National Health Service Whitley Council Conditions of Service; salary scale £1,270-£1,500 per annum. Special responsibility allowance will be paid.

Applications stating age, qualifications and experience, together with the names of three referees, to be sent to the Group Secretary, Peterborough and Stamford Hospital Management Committee, Memorial Hospital, Peterborough.

HULL (B) GROUP HOSPITAL MANAGEMENT COMMITTEE

Deputy Group Engineer required for Group which comprises five hospitals, and post carries responsibility for deputising for Group Engineer over whole range of his duties, which include responsibility for the satisfactory operation, maintenance, and co-ordination of all engineering services and activities therein.

Commencing salary £1,370-£1,605 plus £125 special responsibility allowance. Whitley Council Conditions of Service; superannuable post. Candidate must have served an apprenticeship in mechanical or electrical engineering and should possess:—

(i) Higher National Certificate or Higher National Diploma in Mechanical Engineering with endorsements in Industrial Organisation and Management and Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course; or

(ii) Higher National Certificate or Higher National Diploma in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S.III or O2 level, or with endorsement in) Applied Heat and Applied Mechanics, provided he has suitable practical experience in mechanical engineering; or

(iii) City and Guilds Mechanical Engineering Technicians Full Technological Certificate (Part III) which must include Plant Maintenance and Works Service.

This appointment provides excellent experience for a qualified engineer seeking advancement, and it is a new post which will give scope to a man of initiative and with a special interest in planned maintenance.

Application forms obtainable from Group Secretary, De la Pole Hospital, Willerby, Hull, to be returned by 6th November.

HOSPITAL MANAGEMENT COMMITTEE No. 9
WAKEFIELD 'A' GROUP

ASSISTANT ENGINEER required to assist the Group Engineer in the operation and maintenance of the engineering services of hospitals and ancillary premises in the Group. Knowledge of principles and practice of steam and oil-fired boiler plant operations an advantage. Applicants must have completed an apprenticeship in mechanical or electrical engineering and must hold an Ordinary National Certificate in Engineering or an equivalent qualification approved by the Ministry of Health.

Salary scale £975 to £1,270. New entrants normally start at minimum of scale but up to two increments (£1,045 per annum) may be given for relevant experience.

Application form from Group Secretary, 113 Northgate, Wakefield.

QUEEN VICTORIA HOSPITAL, EAST GRINSTEAD

HOSPITAL ENGINEER (up to 24 points) required at this hospital for post which offers wide experience in hospital engineering. Hospital plant includes oil-fired boilers and a fully air-conditioned plastic surgery unit. The following qualifications are desirable:—

C. & G. Mechanical Engineering Technician's Certificate (Part II), which must include Plant Maintenance and Works Service; or

C. & G. Certificate in Plant Engineering; or

Ministry of Transport First Class Certificate of Competency which includes an O.N.D or O.N.C.

Consideration will be given to the appointment on an abated salary scale of applicants without the stipulated qualifications. Salary scale £1,270 to £1,500 p.a., plus £75 allowance for special responsibilities. No accommodation available.

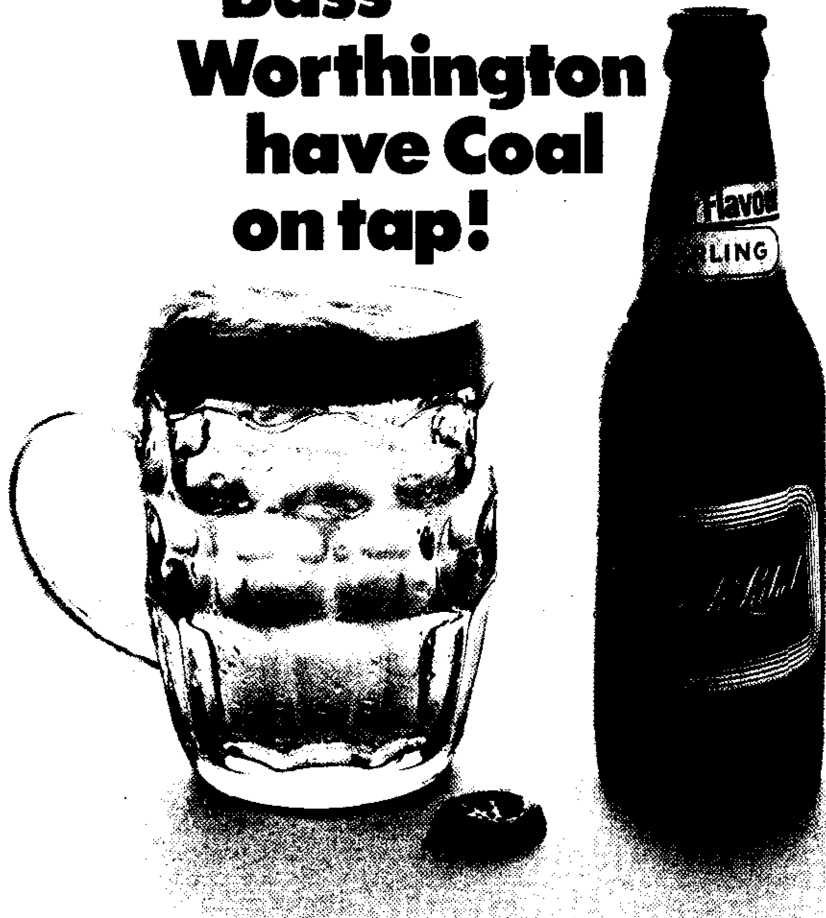
Applications, stating age, qualifications and previous experience, together with names of two referees, to Group Secretary, Tunbridge Wells Group Hospital Management Committee, Sherwood Park, Pembury Road, Tunbridge Wells.

MISCELLANEOUS

Tank up for the 70's

-(with help from coal).

Bass Worthington have Coal on tap!



There's something 'just right' in the way Bass Worthington brew that satisfying glass of beer, they achieve this by using the most modern equipment. Their boiler plant is no exception. They rely on coal at their main brewery at Burton-on-Trent where Worthington Green Shield, Bass Blue Triangle, Worthington 'E' and Bass are produced—also at their Hope and Anchor Brewery in Sheffield, which produces Carling Black Label Lager and Jubilee Stout.

For example, at Burton-on-Trent they were faced with the problem of simplifying their heating plant. Mr. C. G. Pegg, the chief engineer of Bass, approached NCB technical services, and with their help, made a thorough investigation of costs.

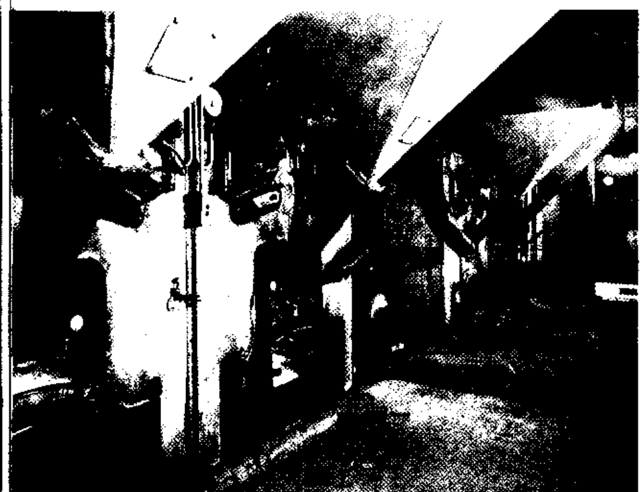
As a result the management of Bass Worthington decided to install a solid fuel plant, operating costs for which were calculated at £8,000 a year less than those for competitive fuel.

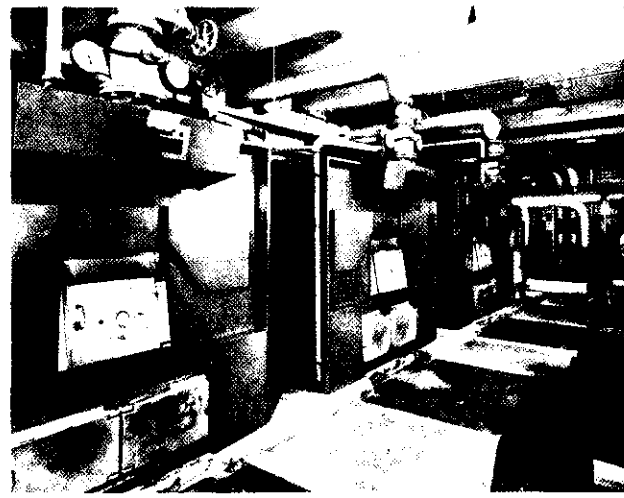
The plan?—a two stage extension of their boiler plant. The first stage now commissioned consists of five 21,000 lbs/hr boilers working at 200 lbs/sq.in. These are John Thompson three pass economic boilers fitted with automatic chain grate stokers.

The coal is delivered by road vehicle, tipped into a receiving bunker, and lifted by bucket elevator onto a shuttle belt conveyor. It is then distributed into the five overhead bunkers. These are each of 90 tons capacity—and glass lined to ensure that the coal flows freely and that maintenance is reduced to a minimum. Ash removal is also completely mechanised, being fed pneumatically to a 60 tons disposal hopper.

These photographs were taken in the main brewery at Burton-on-Trent.

A long-term investment in power.





The Earleymil System of Combustion — Automated, Efficient, and Highly Versatile.

Earleymil is essentially a fuel and labour saving system for the production of heat, versatile enough for use with domestic and industrial sectional boilers, and also in the horticultural and malting industries. Its low installation and running costs have been proved in many installations.

The basic conception is very simple.

A hopper above the boiler holds enough fuel for 8-24 hours' combustion – or more, according to heat demanded of the boiler. From the hopper, fuel is automatically fed through to the fire box, where an ingenious and foolproof system ensures that absolute combustion takes place leaving only a small quantity of clinker for removal. This and the re-filling of the hopper take only a few minutes a day.

For boiler-houses with three or more boilers, Earleymil have developed an automatic system for delivering fuel to the hopper and this provides a further valuable saving in labour costs.

'Ideal Standard' No. 7 series 'Vanguard' boilers

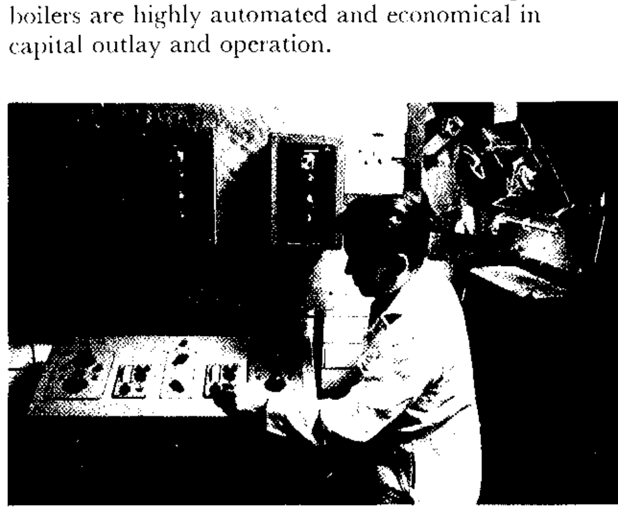
As buildings grow taller, methods of heating them become a problem. This is because the higher pressures involved limit the choice of boilers and the metal from which they are made. 'Ideal Standard' have a new solution to this problem which apart from withstanding these pressures, offers improvements in total installation costs and resistance to corrosion. This new metal is Spheroidal Graphite cast-iron.

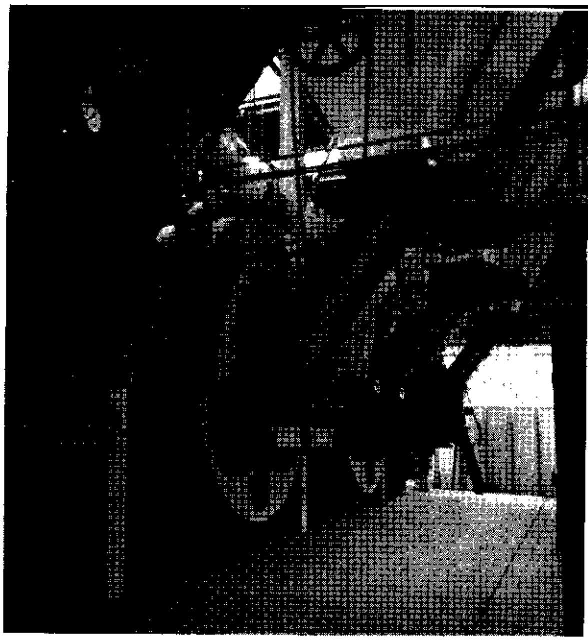
Using new high efficiency sections, 'Vanguard' boilers are easy to install, especially where access to the boiler house is restricted. The boilers are made in sizes ranging from 2,480,000 to 3,894,000 Btu/h, and a mechanical stoker of the underfeed type is recommended.

'Ideal Standard' also produce a 'Vanguard' range in grey cast-iron suitable for buildings of average height. Like all modern coal-fired installations, 'Vanguard' boilers are highly automated and economical in capital outlay and operation.

The 'Series 75' is made by Elliot Process Automation Limited. This is a fully automated packaged control system for boilers and furnaces using chain-grate stokers. With the 'Series 75', running costs are much lower because manual boilerhouse attention is reduced to a minimum and automatic control gives a more efficient fuel combustion and results in less wear and tear on the boiler. The capital cost of a 'Series 75', including installation and commissioning charges, is less than other comparable automatic control systems.

Automatic controls also ensure maximum efficiency under all conditions, so that steady pressure and temperatures are maintained continuously.





CASE HISTORY No. 9

AT CAMBRIDGE: coal keeps down hospitals' fuel costs.

Post-war expansion and improvement of patient, laundry and engineering services at the Fulbourn Hospital, Cambridge - coupled with the erection of the new Ida Darwin psychiatric hospital on an adjacent site - resulted in the opening, in September 1966, of a completely rebuilt and re-equipped, coal-fired boilerhouse. This replaced the earlier, decentralised coal-and-oil-fired boilers which had become inadequate.

At the same time, a new central calorifier chamber - to service the improved space heating and hot water systems - an 80 ft. high cold water storage tower, a centralised range of engineers' workshops, stores and offices, a new incinerator and bin cleansing building, have all been provided.

The four new, coal-fired boilers are of three-pass, wet-back, Economic type - manufactured by John Thompson (Wolverhampton) Ltd., and each rated at 13,000 lb h. Mechanical firing is by low-ram coking stokers and each boiler is fitted with induced draught fans, grit arrestors, and complete instrumentation.

The coal is transferred mechanically by elevator and conveyor from ground-level storage to overhead bunkers, from which it is fed, under automatic controls geared to the required steam output, to each boiler firing mechanism. Ash removal has also been automated, the ash being moved from boilers to an outside silo by submerged conveyor and automatically-operated hoist.

Fulbourn's up-to-date coal-firing equipment permits the burning of a cheap grade of fuel, while plant attention is minimised by the installation of modern coal and ash handling methods, and fully automatic controls.

CASE HISTORY No. 45

AT BOURNE: Coal the best treatment for hospital heating.

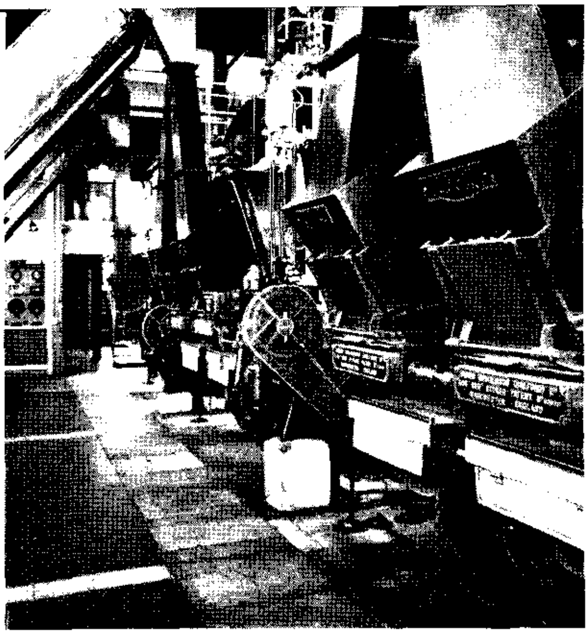
A new boiler was installed and commissioned by the Sheffield Regional Hospital Board at St. Peters Hospital, Bourne, Lincs. in 1965 following consultations with the N.C.B. technical services branch. This replaced an existing steam installation, for having closed the hospital laundry, steam was no longer required.

Three new low-pressure hot water boilers were installed, two Potterton MEG cast iron sectional boilers type MU7-KR7 each rated at 1,240,000 Btu/h and one Potterton MEG type MU5-KR4 rated at 720,000 Btu/h.

These boilers, under normal conditions, are capable of operating efficiency at excess of 75% - giving great economy in fuel consumption. All three units are fired by a Riley 'Direkto' bunker type underfeed mechanical stoker, and the coal (washed singles) is delivered pnuematically into the fifty-ton bunker, cutting labour costs considerably.

For economy and efficiency, the Sheffield Regional Hospital Board have discovered that they were right to choose coal for St. Peters, where - as with many consumers large and small - it will continue to be used for years to come.

See back page for latest developments in automated coal-burning equipment.



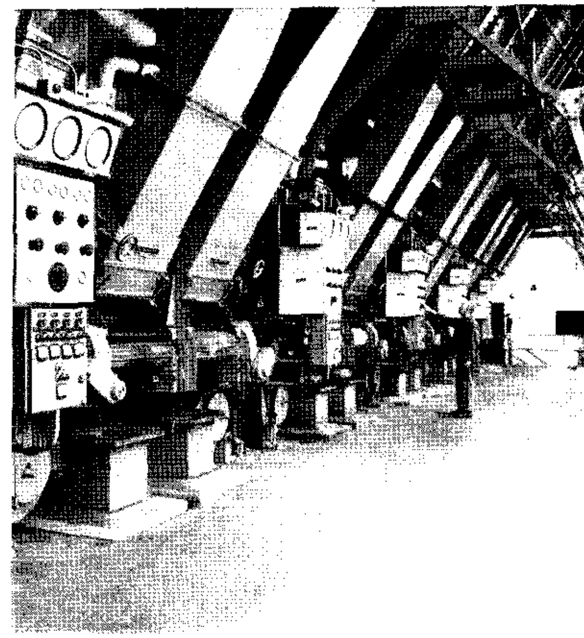
CASE HISTORY No. 150

AT HOLMES CHAPEL: hospital chooses coal for cleanliness.

Cranage Hall Mental Hospital has grown steadily in recent years. A new villa, laundry, kitchens, an audiology unit and a children's autistic unit, have brought the number of beds to a total of 574. Plans are already in hand for a further expansion costing £1,250,000.

To meet the increasing demand on hot water, steam and space heating, a new boilerhouse was built and equipped with the latest automatic solid-fuel plant. With its own eating quarters, washrooms, showers and toilets, it is an outstanding example of the cleanliness that can be achieved with modern coal-fired equipment.

The steam-raising plant centres around three Ruston & Hornsby horizontal Thermax boilers, two rated at 10,000 lb/h and one at 5,000 lb/h, operating at a pressure of 100 lb/in^2. Firing is by Hodgkinson low-ram coking stokers, and fuel is mechanically elevated from the 27-ton bunker to the stokers. A compact instrument room gives the one attendant per shift a quick visual picture, and complete control of steam-raising consumption and demand throughout the entire hospital. Cranage Hall is a clear demonstration of the cleanliness, economy and efficiency with which modern solid fuel equipment can serve a hospital.



CASE HISTORY No. 20

AT CARDIFF: Coal included in plans for new hospital.

The University Hospital of Wales (the largest hospital development in the country) now being built at Cardiff, is expected to be completed by January, 1971. The project includes Medical, Dental and ancillary training schools. There will be some 800 beds and accommodation for 800 resident staff and students.

The boiler plant is already completed and consists of six 16,000 lb/hr Ruston & Hornsby Wet Back Economic Boilers working at 140 p.s.i., fired by local Washed Smalls on John Thompson chain grate stokers. The coal is mechanically handled, after being tipped by lorry into the boot of the inclined belt conveyor, and distributed by conveyor belt to the storage bunkers. Ashes are disposed of by means of a submerged conveyor belt to a bunker and from there they are removed by contract.

The boiler plant will serve the whole project – economically, cleanly and efficiently.

The 1970s start here: in these pages you will read how people responsible for heat and power are basing their long-term plans on coal.

Coal is the one fuel that can offer you a guaranteed supply coupled with stable prices – prices as low as Britain's most dynamic industry can hold them.

We know you have individual heat and power problems – and we shall be glad to help you solve these. But, in broad terms, it always comes down to this: you can go confidently into the 1970's with coal from a modern, automated pit, used with modern, automated coal-burning equipment.

Let's talk it over. As you can see from the case-histories here, there are three basic problems which can be solved by modern automated coal-burning equipment. How to spend less on fuel. And how to cut down on both labour and maintenance costs.

You are probably looking for the answer to at least one of these problems. Coal-firing can provide it – but exactly how depends very much on your special requirements. This is why we should be glad to arrange for an NCB representative to visit you and discuss your problems.

This service is entirely free. For details and for any other information on modern coal-burning techniques please write or 'phone your nearest NCB Regional Sales Office.

Scotland R. J. Griffiths, 80 Lauriston Place, Edinburgh 3. Fountainbridge 2515
Northern J. P. S. Kean, Team Valley Trading Estate, Gateshead 11. Low Fell 878822
Yorkshire L. A. Willsmere, Ranmoor Hall, Belgrave Road, Sheffield 10. Sheffield 32921
North Western K. Yates, Anderton House, Lowton, Warrington, Lancs. Leigh 72404
Midlands K. Taylor, Mansfield-Woodhouse, Notts. Mansfield 22500
London & Southern L. C. Bowler, Coal House, Lyon Road, Harrow-on-the-Hill, Middlesex. 01-427 4333
South Wales & West of England C. H. Gwynn, Coal House, Ty Glas Avenue, Llanishen, Cardiff, CF4 5YS. Cardiff 753232
Bristol Branch B. G. Wonfor, Eagle House, St. Stephens Street, Bristol 1. Bristol 26541
Northern Ireland R. D. F. Cameron, 87 Eglantine Avenue, Belfast BT9 6EW, Belfast 667921