# Hospital Engineering

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# Hospital Engineering

Vol. 24 February 1970

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The Journal of The Institute of Hospital Engineering

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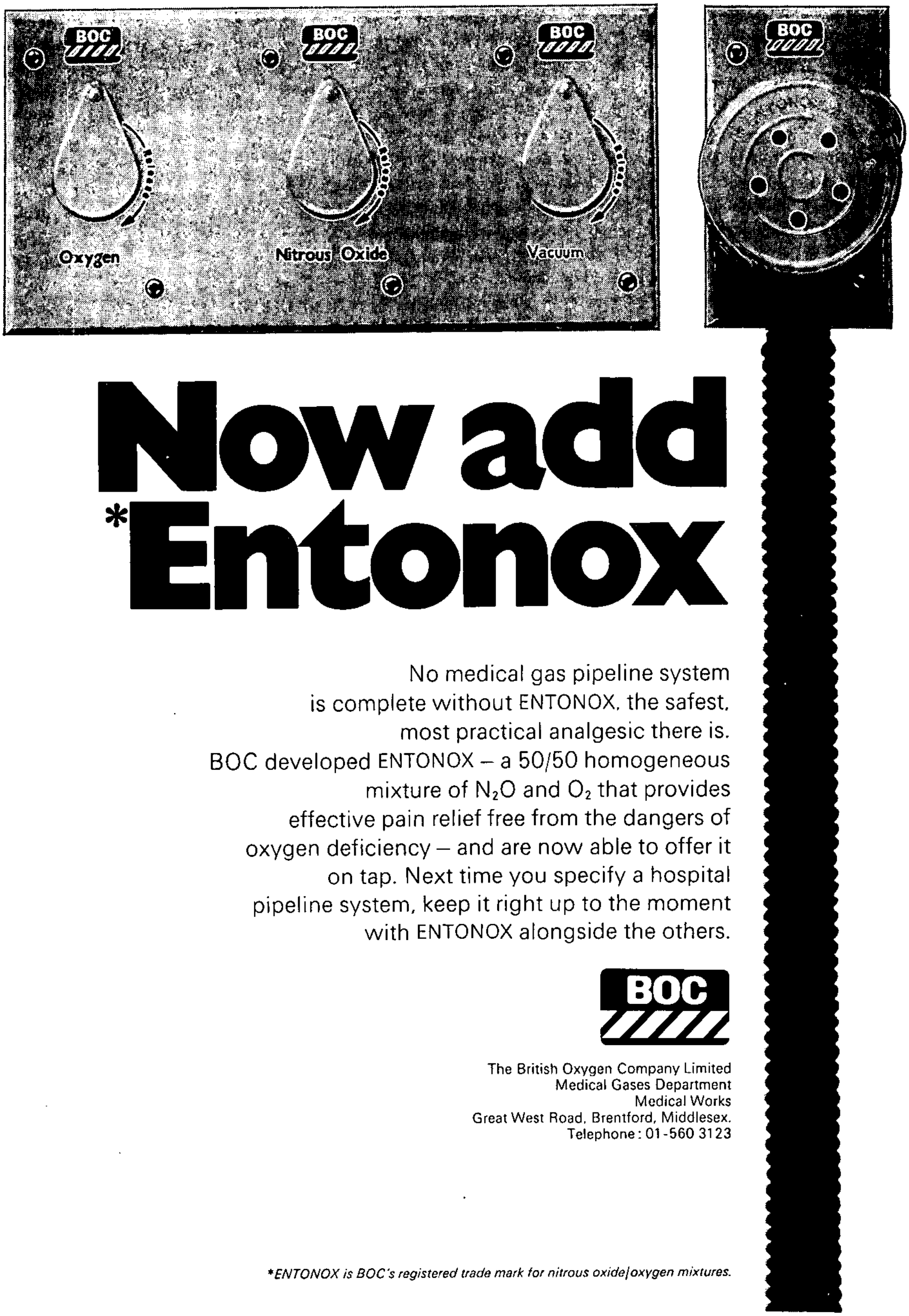


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## Reflections and forecasts

Some while ago I heard a long-service hospital engineer say, 'the Institute isn't what it used to be.' To be quite honest, I agree with him. But whereas his comment was a criticism, mine, with some reservations, was a compliment. There certainly have been changes since incorporation was granted and the Institute took on its new title in January 1967. I think that these changes are for the better.

We must not let ourselves forget the fine and devoted service given to both hospital engineers and hospital engineering by the founders and subsequent members of the Institution of Hospital Engineers. Their work, and their enthusiasm, made the foundation on which a wholly professional Institution could be built.

Since 1967 the Council and the branch committees have been getting themselves organised on constitutional lines, and setting out to perform the functions outlined in the Articles of Association. The new Institute has broadened its membership and outlook by recognising that the world of hospital engineering is not confined within hospital walls, but includes certain consulting engineers, and specialist contractors and manufacturers who develop and make the plant and equipment without which the hospital of today could not function.

This broader outlook has encouraged us to seek and produce speakers on subjects of wider appeal. For instance, the Midlands branch committee is always on the lookout for some new activity or topic that will be of interest to its members. Unfortunately, they have found that this inevitably involves them in a 'chicken or egg' problem. If they engage an eminent speaker they will be embarrassed should the number attending be low, whereas on the other hand there is the possibility that the presence of an eminent speaker will itself bring more members to a meeting. The numbers attending Midlands branch meetings are, on average, encouraging, but the visitor would not guess that the branch has a membership of around a hundred.

Hospital engineers have often bemoaned their status. They used to look to the old Institution to effect an improvement through its trade-union activities, yet a much higher status can be earned by the members themselves by raising the status of this Institute and the quality of its activities. This can only be achieved by supporting its publications, meetings, conferences and social functions, so that its voice becomes one that is heard in professional circles.

What of the future? Membership has grown steadily since January 1967, perhaps because engineers can see the advantages of joining the Institute while it is yet young. At present, the Institute of Hospital Engineering does not have its own examination, but uses as a yardstick the qualifications set by the Whitley Council for group and hospital engineers.

Clearly the time must soon come when the entry requirement will be more rigid, in line with the increasing needs of the hospital-engineering industry. It cannot be long now before all incorporated, but nonchartered, Institutions will link together under an umbrella similar to that of the Council of Engineering Institutions (CEI), and agree on common standards. When the CEI was formed, it raised the examination standards for the fourteen constituent Institutions, and permitted all existing members to become registered, and to use the letters 'C.Eng.' after their names. The day must surely be coming when all engineers wishing to practise in this country will be required to be registered, either as a chartered engineer, or under whatever title the link body decides to adopt, such as technician engineer. I am certain that this Institute will demonstrate that it is a learned body that cannot be left outside the umbrella, but this must be achieved through those who are fortunate enough to be members already becoming more active.

Two very good ways of helping in the near future are: write some good papers for the new Journal, and turn out in full force at the conference and dinner in Birmingham in May. Put it in your diary now, and don't forget to take your wife!

B.A.H.

*While the provision of standby generating plant is now far more standard practice than it was a few years ago - largely owing to the influence of the severe winter of 1962-63, the question of the choice of plant with the best balance of high reliability and coverage and low capital and running costs is inevitably a recurrent problem.*

# Electricity Supply for Hospitals

by Leonard H. Dale,

M.B.E., M.I.E.E.E., M.B.I.M., M.I.S.E.

*Managing director, Dale Electric of Great Britain Limited*

**Introduction**

I make no apology for quoting an extract of the opening paragraphs of an article on this subject, written by one of my colleagues in October 1963:

> It has been acknowledged that the present availability of electrical power is falling considerably behind the demands being imposed upon it, especially at peak periods, brought about by inclement weather and other critical conditions, such as were so forcibly demonstrated at the beginning of this year. Although increased capacity is being installed, there is nothing in the present rate of scheduled expansion to cause even the most sanguine to suppose that there will not be a short-fall in power supplies for many years to come—probably well into the 1970s. After the experiences of last winter, a number of manufacturers have attempted to interest hospital authorities in emergency plant, with, apparently, singularly little success. This is the more astonishing when it is known that at least one regional board considered it prudent to make emergency arrangements to obtain mobile plant at short notice from civilian and service sources, and that one manufacturer in another area was called upon to divert ten generating sets from export orders to as many hospitals in one week in February 1963.

It will be noticed that the author on that occasion forecast that power supplies would not reach the required degree of reliability until 1970. And we read early in December 1969 of the likelihood of short-fall because of difficulties with one or two large generators.

A continuous and reliable supply of electricity is a utility service that has come to be taken for granted today, and in hospitals it provides so many services that it is only when the supply is interrupted that we appreciate the part it plays, not only in our everyday life, but in the rhythm of the organisation of hospital management. With the arrival of the 'seventies' it would not be amiss, therefore, to review the position as it is today.

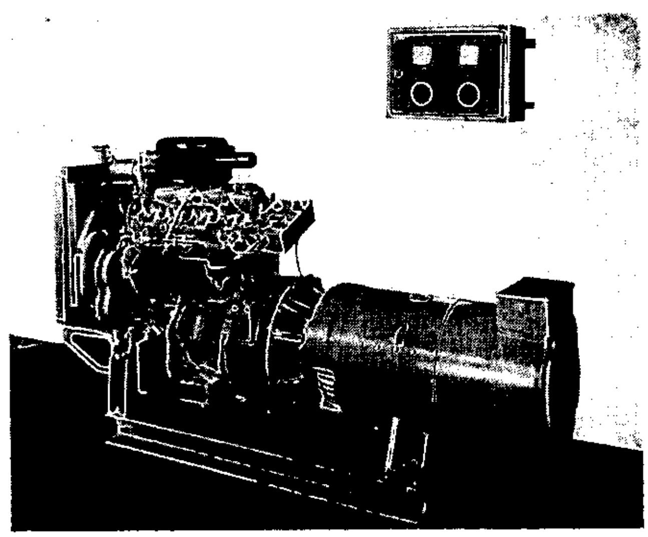
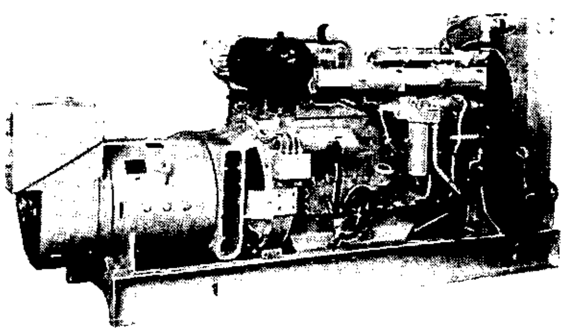


*Fig. 1 Manual-starting plant with simple wall-mounted control panel*

We are inclined to think that an electricity network designed on the ring principle, and, for that matter, a ring system in any essential building, as being the answer to our problems of supply.

In the last six or seven years, the CEGB and the area electricity boards have made enormous strides in providing a more reliable supply, and they are to be congratulated on the progress made, but we have still had experiences in recent years of ricocheted interruptions. For example, a few years ago we had areas of the South of England and parts of Greater London entirely without power. It is not so long ago that New York was without power, and only a month or two ago part of central London was in very serious trouble. If these things can happen in London, they are more likely to happen in a provincial city or town, which will probably be fed by the CEGB network of overhead lines. Last winter the town of Whitby, in Yorkshire, was entirely without



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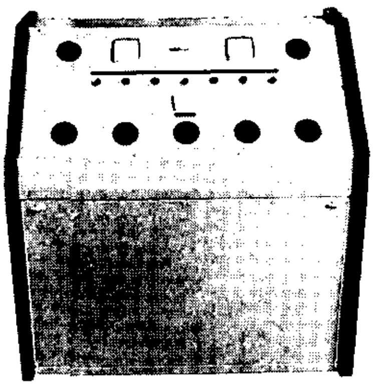


b

*Fig. 2 Fully automatic plant, output 154 kVA, as installed at Broadgreen Hospital, Liverpool*
*(a) Plant (b) Control panel*

electricity for a number of days, and the whole of the town was run by mobile generators.

The need for a standby power supply is fortunately all too obvious to those organisations and companies that must ensure a continuous supply of power to essential equipment; for example, in the fields of telecommunications, computing, data processing etc. The Post Office is heavily committed to installing completely automatic telephone exchanges all over the country to provide the s.t.d. service, and has thought it fit to install automatic standby power plant in every one of these exchanges. This is not a case of one national service hitting at another; it is brought about by wise planning, and facing up to the situation and facts as seen by the Post Office engineering department, to ensure a reliable communication service.

It is surely desirable that in a hospital, where danger to human life may occur if the electricity supply fails, an alternative supply must be made available at the earliest possible moment, depending upon the seriousness of the situation that could arise.

Certain overseas governments have recently passed a directive and recommendation that *all* hospitals, government buildings and public-authority establishments should install some form of electrical standby power with the least possible delay. That the problem is taken seriously all over the world is proved by the fact that the companies manufacturing standby equipment are busier than ever.

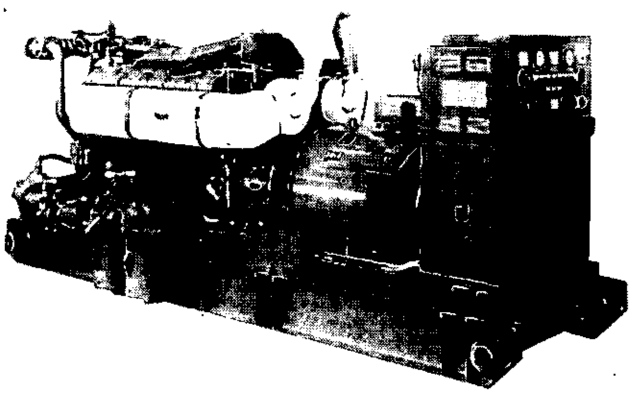


*Fig. 3 Automatic plant, with baseplate on the 'bed-within-a-bed' principle, enabling the plant to run without holding-down bolts if necessary. The integral control panel is on anti-vibration mountings and is within the overall dimensions of the plant. Thus this is a packaged unit, needing only connection to fuel and exhaust systems*

Therefore, I shall consider the various aspects of the installation of standby equipment in hospitals today. Many problems face the consulting engineer and hospital engineer alike, in deciding on the type of equipment best suited to the job.

### Decisions to be made

How much of the hospital services should be covered? The whole hospital, or operating suites and intensive-care units only? Or should the boilerhouse services controlling the air-conditioning, central-heating and catering facilities be brought into the scheme? They are of equal importance for the maintenance of the organisation's rhythm and of the wellbeing of all within the hospital. Future policies regarding the possible increased loading on the standby, and whether any expansion is anticipated in the hospital concerned, must also be considered.

### Choice of type

The established method of providing a standby supply is to install a self-contained alternator plant which is designed to suit the requirements of the essential load and is capable of starting within the time estimated as being the maximum that can be tolerated without extreme discomfort or danger. Diesel engines are ideal prime movers for emergency plants; the majority of plants in use incorporate diesel engines because they

- (i) are capable of rapid starting
- (ii) are available in a wide range of sizes
- (iii) are able to carry full load within seconds
- (iv) consume no fuel while stationary
- (v) have low running costs.

Standby plants are principally applied either as manually operated generator plant, or as an automatic mains-failure power unit.

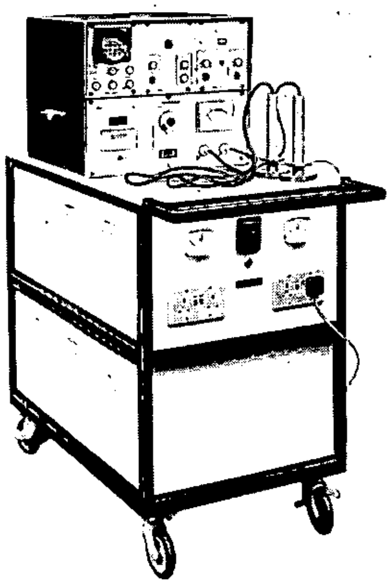


*Fig. 4 The Erskine bedside-power trolley*

### Electric starting sets

Manually operated generating sets are the most economical units, though they require manual supervision for starting, load selection and stopping, and are, of course, subject to human fallibility.

### Automatic mains-failure standby sets

Automatic mains-failure sets carry out all essential operations automatically, including monitoring the normal service, automatically starting when a failure occurs, selecting the load at the correct moment and isolating the normal service. The complete procedure can be carried out in a time in the range 6–15 s depending upon the characteristics of the unit and the requirements of the equipment to be protected. Stopping is effected automatically after the normal supply is restored and stable.

### Standard generator plants

A manually operated or fully automatic generator plant usually consists of the diesel engine directly coupled to a generator, together with a control cubicle arranged for electric starting or automatic operation as required. Certain auxiliary equipment is provided on the generator set of an automatic power plant. Fig. 1 shows a typical manually operated unit, and a fully automatic one is shown in Figs. 2 and 3. The engine is provided with all fuel, oil and cooling equipment, and starting facilities. If the plant is completely automatic, an integral electric starting and stopping system is incorporated, the stopping control consisting of a solenoid fitted to the fuel-pump stop lever. The start can be initiated by various events such as mains failure, or operation of a push button on the plant control panel or in any desired remote position.

The diesel engine is usually directly coupled to a generator which is selected for the particular requirements of the load; this is usually of the a.c. type supplied complete with automatic voltage-control equipment. The selection of alternator depends on the characteristics of the equipment being powered, which can vary from straightforward domestic loads comprising heating and lighting, to electronic equipment which may require stable voltage and frequency and sinusoidal waveforms with low harmonic contents. However, once the essential

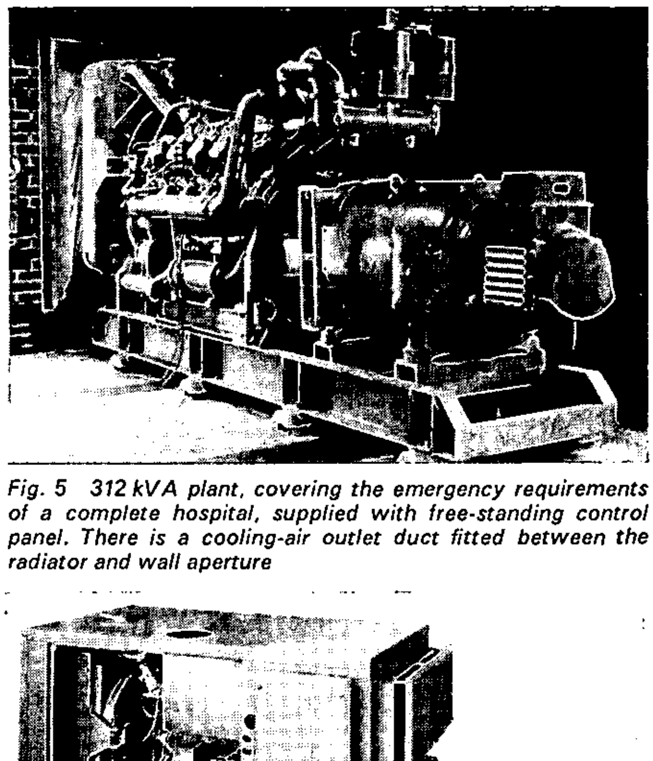


*Fig. 5 312 kVA plant, covering the emergency requirements of a complete hospital, supplied with free-standing control panel. There is a cooling-air outlet duct fitted between the radiator and wall aperture*

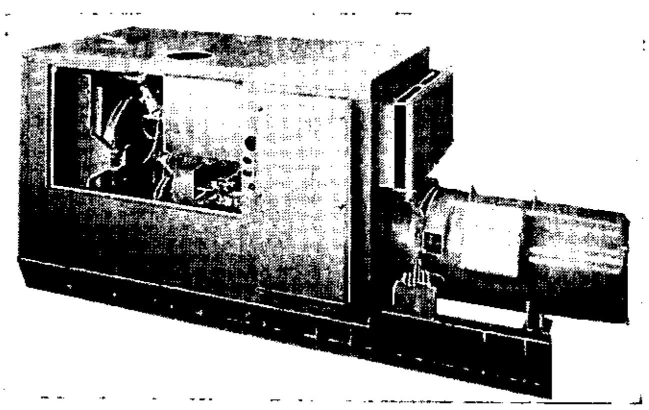


*Fig. 6 Plant at Ninewells Hospital, in the engineering block. It incorporates a special sound-proofing canopy*

characteristics of the load have been established, a suitable design can usually be incorporated with relatively little difficulty.

### No-break sets

No-break equipment is guaranteed to maintain an electrical supply at all times. It is more complex equipment, and can be offered either as a form of rotating or reciprocating equipment, or as static-invertor equipment backed up by a conventional mains-failure set.

This type of equipment has been used for a number of years in the telecommunications and radar fields and, owing to its cost, is only installed where failure of the electricity supply for a few seconds cannot be tolerated, for example, in an operating theatre effecting complex operations, where electronic patient-monitoring or similar equipment is used.

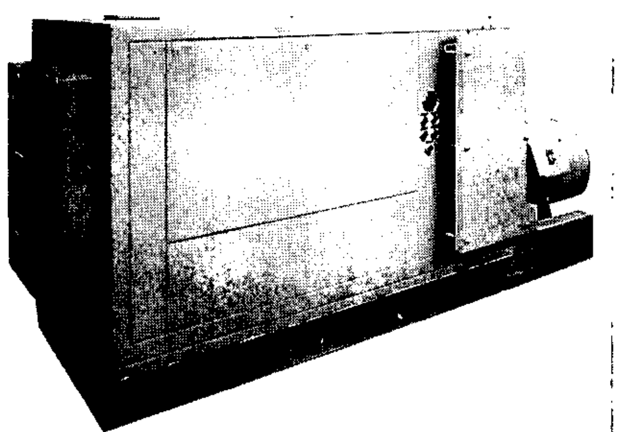


*Fig. 7 Plant shown in Fig. 6, with the sound-proofing canopy completely closed*

### Bedside standby power-supply trolley

Worthy of mention, in the field of standby power equipment, is a development which has been introduced recently for use in hospitals by Erskine Laboratories Limited, who, in response to requests from hospitals in Britain and Scandinavia, have developed a medical bedside power-supply trolley to ensure a continuous and instantaneous supply of power to essential equipment as used in i.t.u.s and coronary-care wards (see Fig. 4). While the majority of hospitals have their own generating equipment to guard against cuts, the changeover time on a standby set from the moment of interruption to standby power being available can be up to 6–15 s under the best circumstances. This delay can extend to as much as 30 min if, for example, it were necessary to switch off sufficient nonessential load to reduce the demand to within the capacity of the standby generating-set output.

Constantly linking items such as cardiac defibrillators, ventilators, electrocardiographs and other vital equipment to the mains, the Erskine trolley will, in the event of a mains failure, ensure a continuous supply of power without any apparent break in continuity for periods of one or two hours. On restoration of the mains, the trolley automatically reverts to recharge, and the power lost during standby action is restored in two or three times the period of the mains break.

The trolley, being mobile, is also able to cover journeys to and from the ward and operating theatre, when it might be necessary to accompany the patient with certain electrical equipment which must be in continuous use, or perhaps ready for immediate application. Eight models of the trolley are manufactured with a choice of outputs and capacities, rated at either 350 W or 500 W, suitable for sine- or square-wave generation, and with capacities of one or two hours.

### Installation characteristics

Before finalising the location of the installation of standby equipment, it is necessary to consider whether it would be advisable to have one large unit for the complete hospital, covering all the services deemed to be essential. For example, at the Royal Marsden Hospital, Sutton, a 312 kVA set was installed (Fig. 5) which was considered adequate to cover the essential services. Alternatively, it may be advantageous to have a number of sets covering different blocks of the hospital. This was decided upon at the Ninewells Hospital, Dundee, owing to the size of the new project, and to the fact that the various blocks were put into operation as soon as they were completed, before subsequently built blocks were operative.

At Ninewells, five sets were ordered, one each for the concourse, polyclinic, main-theatre, laboratory and engineering blocks. It is expected that the last set will not be installed and commissioned until approximately mid-1972, whereas the first set, in the engineering block, was delivered and commissioned in February 1967 (see Fig. 6).

### Location

Because of its heavy construction, the diesel engine, which is used on most standby power plants, is a little on the noisy side, and there are certain vibrations, both direct and indirect. It is therefore preferred, if possible, to mount the generating set in a building remote from the main hospital building, and feed the switchroom by means of cables, rather than put the generating set next to the mains intake, if this happens to be in the centre of the hospital. However, if it is necessary for the generator

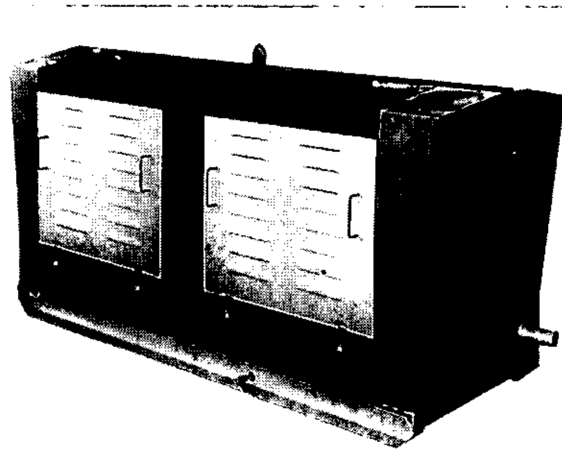


*Fig. 8 Typical completely packaged unit*

to be mounted within the main hospital block, it can be done. In fact a few of the specialist builders of power plants in the UK have facilities whereby the entire enginehouse, including sound proofing and vibration damping, can be offered (see Fig. 7).

### Complete packaged plants

In certain cases the standard installations cannot be installed owing to limited space or other reasons. The types of equipment discussed have therefore been designed as complete packaged plants where all services are built into one unit, and the power plants are totally enclosed in sheet-steel canopies. Thus they can be installed for the minimum cost, and, if necessary, operated in the open without the additional cost of engine rooms. Fig. 8 shows a typical example of this type of equipment, which can be supplied in a specially sound-proofed housing, so that it can be mounted anywhere, e.g. in a car park or yard adjacent to the boiler house.

The advantages of this system are attractive for smaller hospitals due for modernisation or extensions, in that the plant can be moved to another hospital at a later date. The construction of an engine house is, of course, eliminated.

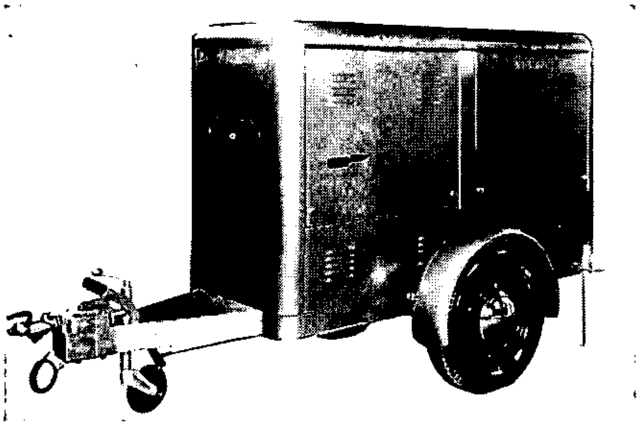


*Fig. 9 Trailer-mounted generator, suitable for outputs of up to about 65 kVA*

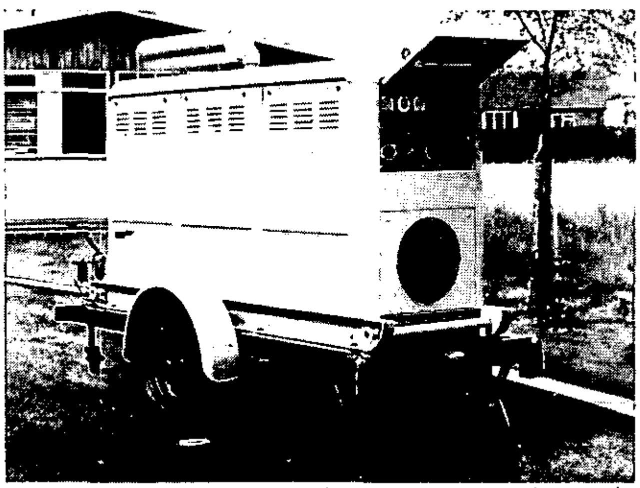


*Fig. 10 Setup whereby a trailer can carry one of a number of generators, depending on the expected requirements*

*Fig. 11 Trailer incorporating walk-round space for easy access to plant and control panel*

### Mobile plant

A further extension of this is a mobile power unit which can take care of a number of installations; this is essentially a fully self-contained mobile engine room (see Figs. 9–12). This equipment can be used to supplement existing mains-failure schemes during maintenance and service, or integrated into any system where a planned interruption is to be brought about.

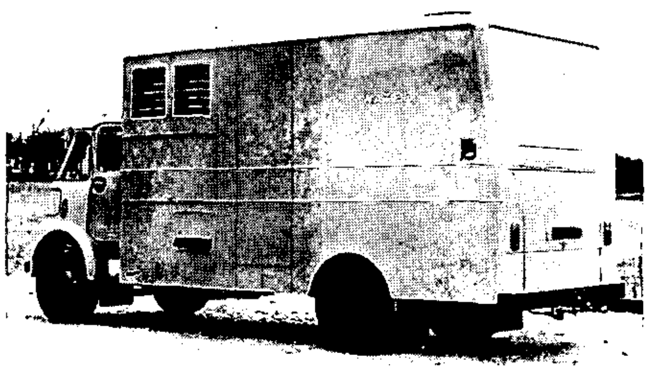


*Fig. 12 Completely self-contained mobile unit*

### General

The various schemes outlined above can be integrated one with another, so that an emergency system compatible with any particular application can be effectively designed according to the characteristics required and the economic limitations laid down.

### Advisory services

Plant manufacturers are, in many cases, in a position to engineer complete schemes, as well as supplying standard generating plants and mains-failure units, and often have a free advisory service. It is often of considerable assistance if the emergency schemes are introduced at the initial stage, as this prevents the problems which occur when a standby service must be provided in an existing installation. As the foregoing examples have shown, there is wide diversity in both operating methods and complexity of installations. Maximum reliability and insurance can be guaranteed when the installation is designed to meet the requirements specified for each individual application, and British plant manufacturers are well able to advise on this matter.

A further two points which can be considered by the hospital engineer or the consulting engineer are natural-gas-powered equipment and total-energy projects. It is hoped that these subjects will be covered by a further article at a later date.


### Acknowledgments

The author wishes to acknowledge the assistance of Dale Electric of Great Britain Limited, Filey, Yorkshire, in supplying photographs and information.

*The need to be able to contact vital personnel has led to the development of personal-paging systems whereby people can be called through small pocket receivers. These systems are growing more and more involved — a fully automatic complex, in which any one of nearly a thousand people can contact any one of the others, is already a reality.*

# AUTOMATION IN ONSITE PAGING

by C. J. F. LIEBENROOD, B.Sc.(Eng.)

For some years, hospitals have used personal paging with individual selective pocket receivers for the rapid location of doctors and other key staff. Wherever a doctor may be within the hospital site, a selective call transmitted from a central point will cause his pocket receiver to emit a distinctive 'bleep' calling signal. The doctor may wander as he wishes, knowing that he can be found instantly if needed. No one else is disturbed—only one receiver responds to the call, and there are no loudspeaker announcements or flashing lights.

Industry and commerce are now joining the hospital in recognising the need to locate key personnel surely and rapidly. Special pocket receivers are available to meet the needs of industry; to withstand the environment and to emit a calling signal that can be heard in the noisiest factory. At the same time the base-station equipment has been developed to the point at which the operator can be eliminated, and where a wide range of additional facilities are available to aid location and communication.

In this article, we shall consider how automation has come to pocket paging, and describe the base-station equipment that has been designed for one fully automatic installation.

## Manual operation

The simplest pocket-paging systems are those operated by a receptionist or telephone operator. Using a desk unit, this operator can send a selective paging call to the person who is to be found. The pocket receiver carried by this person emits a distinctive 'bleep' calling signal, while all other receivers in the system remain silent. The called person may respond by going to the nearest telephone and speaking to the operator, to ascertain the reason for the call, or, alternatively, provision can be made for speech to be transmitted from the operator to the pocket receiver after the calling signal.

In this type of system, all the electronics required for generating the selective calling signal may be incorporated in the desk unit. This unit is called an encoder. The transmission equipment is mounted separately; it may be either a radio transmitter operating on v.h.f. or u.h.f., or an l.f. transmitter feeding a loop aerial around the premises.

A form of automatic operation is provided as a normal feature of these simple paging systems. When the desk unit is unattended (e.g. at night) a switch on it is thrown, and a preselected paging call may then be sent by closing a remote pair of contacts. This facility can be used to alert one person to a doorbell, a telephoned security alarm or an alarm from another source, when the paging equipment is not otherwise in use.

## Telephone-coupled paging

Many sites that have a pocket paging installation are also served by an automatic telephone system, either a GPO branch exchange (PABX) or a private automatic exchange (PAX), or one of the various multiextension intercom systems. In these cases, the pocket-paging installation can be linked to the telephone system, so that calls can be sent direct from any telephone without the intervention of an operator. In such a system a caller first dials a code number, which gives access to the paging equipment, and follows it with the paging number of the person to be called. On hearing the calling signal, the called person goes to the nearest telephone, dials a reply-code number, and is immediately connected with the waiting caller. It is usual in such systems to provide a desk unit at the manual telephone switchboard, so that the operator may page people for incoming telephone calls without having to dial through the system. In this case, two distinctive calling signals from the pocket receivers are provided, one for operator-orginated calls, and the other for calls direct from a telephone within the system.

*Project Leader, Research & Development Division, Multitone Electric Co. Ltd.

Depending on which signal is received, the called person will either dial the reply-code number or contact the operator.

There is another method of dealing with telephone-originated calls which saves the called person from having to find a telephone. The origination of the call is as described above, but after the transmission of the selective calling signal a speech circuit is extended from the originating telephone to the transmission equipment, and from there to the pocket receiver. The caller is then able to speak directly to the called person.

A telephone-coupled system of the first type described above can only handle one paging call at a time, because of the need to ensure that the called person is connected to the correct caller. If, say, three callers dialled in rapid succession, then the three called persons might answer in any order. Some difficulty then arises in correctly associating the calling with the called. This can be overcome by providing a system in which the called person dials his own paging number after the reply code, his reply then being automatically routed to the correct caller. When this is done, there is no need to limit the number of callers that may use the system at any one time, and systems with paging equipment carrying up to ten speech channels are currently being used. In large installations, where a single speech channel would be completely overloaded, such techniques are essential for efficient operation.

### Fully automatic paging

One such fully automatic paging system has recently been designed for the Mayo Clinic, at Rochester, Minnesota, USA. The Mayo Clinic is a large diagnostic unit with a very large number of doctors in daily attendance. To enable these doctors to consult each other readily, the clinic requires a fully automatic doctor-to-doctor communication system. This is based on a comprehensive telephone system, using 'Touch-Tone' telephones supplied by the Bell Telephone Company, which is coupled to a pocket-paging installation. The overall operation of this system is as follows.

When A wishes to call B, he goes to a telephone and keys B's personal number. B is paged by a selective call to his pocket receiver, and responds by keying his own number on the nearest telephone, which is then immediately connected to that at which A is waiting. In the event of B not answering within 40 s, the call is automatically transferred to B's secretary, who can take a message. The doctor may still answer and take over the call as long as A remains on the line.

The majority of the necessary routing and timing is done within the special telephone exchange associated with the system, which also routes the call demands to the pocket-paging encoder. This encoder is required to generate selective call signals for up to 870 individual pocket receivers. A maximum call rate of 35 calls per minute is expected, and as the instantaneous rate may well exceed that figure, the encoder provides storage and queueing facilities to ensure that no calls are lost owing to overload.

### Encoder for Mayo clinic

The encoder is capable of generating selective calling signals for up to 870 individual pocket receivers, although it will initially only be equipped for 720 receivers. Demands for paging calls come solely from the special telephone exchange, and are stored in input registers. The encoder continuously scans the registers for waiting calls, which it transmits at a rate of 35 per minute. When the encoder is lightly loaded, incoming calls are transmitted immediately, but if demand is heavy a queue builds up, and there is some delay.

Extensive use has been made of digital integrated circuits for call storage, for storage scanning to locate waiting calls and for transmission timing. Incoming calls are stored in flip-flops comprising two crosscoupled NAND gates. One such storage element is provided for each receiver; 870 in all. Scanning of these is performed by an address counter, which consists of three binary-coded decimal counters cascaded to give a total counter of 1000. The output of this drives decoders, which in turn feed coincidence-logic circuits. Discrete circuit-buffer amplifiers are used at points in the decoding circuits where loads of 90 logic inputs have to be driven.

The address counter has a frequency of about 10 kHz, so that all input registers are scanned in about 100 ms. When a stored call is detected, the counter is stopped, and its decoded output then determines the call that is to be transmitted. Once the required call has been transmitted, a reset pulse is applied to the appropriate flip-flop; this erases the stored call. The address counter clock is then switched on again, thus restarting the scanning process. The timing of this operation is such that the time required to find one stored call is within the duration of the preceding call, so that the rate is not impaired.

Selective calling is by two-tone sequential audio signals. An electronically switched oscillator is used to produce 30 separate audio frequencies. Frequency selection is performed by control signals derived from the address counter, under the control of a gate-pulse generator determining the timing and duration of the call. Switched LC circuits perform the frequency selection.

### Other automatic-paging facilities

The encoder described above is an extreme example of automation, where there is no provision for direct manual operation. At present, most large systems demand one or more direct manual-access points, frequently with telephone coupling in addition. Automatic operation of the form mentioned in connection with simple manually operated systems can also be provided, albeit in a more elaborate form. A number of input channels are provided in which the closure of a pair of contacts results in a preset paging call being sent, a different call for each channel. Such channels may be used for many purposes; simple nurse call, process-control-system alarms directed to the plant operator or maintenance man concerned, simple doorbell or telephone alert and so on. With sophisticated large-system encoders, this type of input is not restricted to periods when the encoder is not otherwise in use, but operates in parallel with the direct manual and telephone-coupled inputs.

These encoders, designed to accept mixed manual and automatic inputs, are constructed in modular form, and the combination of facilities required for any particular installation may be quickly assembled from the basic modules.

# Television doctor

A new medical use for closed-circuit television has been pioneered by the Department of Surgical Neurology of Edinburgh University and the emergency department of the Edinburgh Royal Infirmary. A television link enables new patients at the Infirmary to be examined by a specialist three miles away. If necessary, the specialist can direct the surgical staff to prepare the patient for an operation ready for his arrival. In this way, rapidly deteriorating conditions can be detected and treatment started with the maximum speed.

The new system was developed by Prof. John Gillingham, neurosurgeon at Edinburgh Western General Hospital, together with the South-Eastern RHB, Scotland, and it was engineered and installed by the Marconi Electro-Optical Systems Division, Basildon. The Marconi V322A vidicon television camera in the Royal Infirmary accident unit is carried on a movable boom above the patient trolley and is fully controllable for panning, tilting and zooming. It can view the whole patient, or zoom in enough to inspect just one eye, depending on the specialist's directions.

The television signal is carried the three miles from the Royal Infirmary to the Western General Hospital by a GPO link, and there is a permanent telephone link between the Infirmary and Prof. Gillingham's office on which he can be told of a new admission. He may then give instructions directing the camera movements, and, if necessary, order an operation to be prepared.

Prof. Gillingham said about the installation:

This new system has proved that closed-circuit t.v. can reduce delays in both diagnosis and treatment; it enables the doctor to make a full interpretation of the patient's clinical signs, and is the only adequate way of conveying X ray, encephalographic and microscopic

information without delay. I foresee that it will have considerable value in making specialist skill immediately available to general practice anywhere, including remote areas. Video recording is used in the new system, allowing a slide-by-slide inspection of the stages in a patient's progress.

## * Postbox *

**Dear Sir,**

I should like to comment on several points arising from Part 2 of Mr. S. B. Tyrer's article 'Evolution of the boiler and good boiler-house design' (*The Hospital Engineer*, Dec. 1969, pp. 269–277).

In the third paragraph of the section 'Boiler feedwater and feed-water treatment', hydrochloric acid is mentioned as a gaseous impurity in feed water. This, in fact, would be most unusual, and it seems likely that Mr. Tyrer is referring to the formation of hydrochloric acid by the hydrolysis of magnesium chloride, which latter is a frequent constituent of water hardness. This hydrolysis can occur at boiler temperatures, but is rarely met nowadays, because boiler waters are kept alkaline—as Mr. Tyrer later indicates.

A solution of slaked lime can be added to a feed tank as described by the authority Mr. Tyrer quotes, but few water-treatment specialists would advise this process nowadays. One reason for this is that the precipitation of carbonates in the feed tank, pump and feed lines is undesirable, and may eventually prevent water from reaching the boiler. Additionally, if part or all of the lime addition reaches the boiler, then the amount of sludge and suspended matter there is proportionately increased. This is particularly disadvantageous in the modern packaged boiler with its more limited water capacity.

The dispersion of suspended matter in the boiler described by Mr. Tyrer under 'Colloidal treatment' occurs with organic materials other than starch; e.g. lignin sulphonates, tannins etc., and with the newer synthetic organic additives introduced during the past few years.

Yours truly,

*C. O. Smith*

*Nalfloc Limited*
*PO Box 11*
*Northwich, Cheshire*

**Late edition**

We apologise for the delay which occured in the mailing of some copies of the January 1970 issue of 'Hospital Engineering'. This was due to technical difficulties at the printers.

# Internal transport in hospitals by 'Cyberail'

by G. J. Belt

Material-handling-systems engineer, Drayton Castle Limited

The problem of materials handling in hospitals is so large and so complex that any system involved enough to provide a total internal-transportation service must be designed into the structure of the hospital building itself, and the cost, inevitably, is high. However, the expense may prove to be justified, on the grounds either of costs saved over a period, or of convenience. In fact, systems such as 'Cyberail' are already in existence in the US and Europe; the question seems to be 'How far behind is the UK going to be?'

A very great deal of progress has been made in the field of internal hospital transport in recent times, but this subject is possibly the largest single problem that still remains to be analysed and solved. Various factors have contributed to this, but the single fact that it is such a complex problem, spanning the whole spectrum of finance, management study, hospital design, departmental and medical requirements etc. has possibly been the major reason for more work not being done previously.

The situation is now changing fast, and pressures are building up to force methods of transportation into the foreground. These pressures are coming from many different directions:

(*a*) The hospital service, absorbing some 3·5% of our working population, is bound to suffer seriously in the increasing competition for labour. This is related to relative rates of pay and conditions of work.

(*b*) The educational system is producing more specialists, and fewer people likely to be interested in simple repetitive tasks. This trend is of particular importance, as so much transportation falls into this category.

(*c*) The steady move towards intensive medical care is creating an even greater need for nurses to nurse, with all the skill that their profession has given them. Incidental duties which at present still fall to the nurses will have to be more correctly allocated. This trend can easily call for more staff, in direct conflict with the previous factors.

(*d*) There is a growing appreciation that the capital cost of a hospital is insignificant when the revenue charges incurred over the life of a hospital are taken into account. This is encouraging more research into 'best-buy' proposals, and lines of financial thought more akin to normal industrial procedures.

(*e*) Internal transportation has up to now had to rely on adaptations of standard industrial equipment. This has been useful in some instances, such as with records, and in kitchens, laundries and some c.s.s.d. installations. The problem of *total* transportation could not be solved until a completely different system had been developed to meet the very special needs of a hospital—a system quite unlike anything previously available. This allows the problem to be analysed with a possible solution in mind—a far more profitable activity than proceeding without any known means of meeting the requirement.

The health service is the sixth largest industry in Britain, and its function is twofold. On the one hand there are the critical medical services, and on the other, giving an equally important service, are what may be called the 'hotel services'. Although a hospital is generally thought of as being a medical centre, in fact about

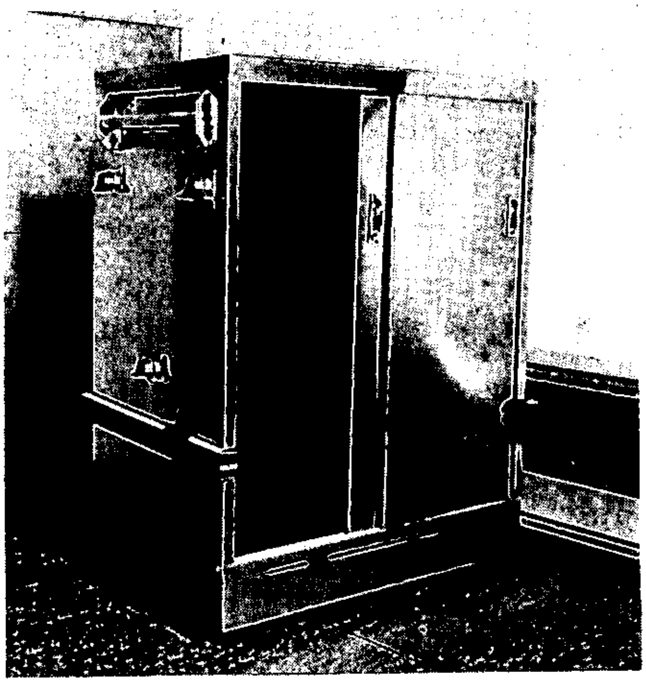
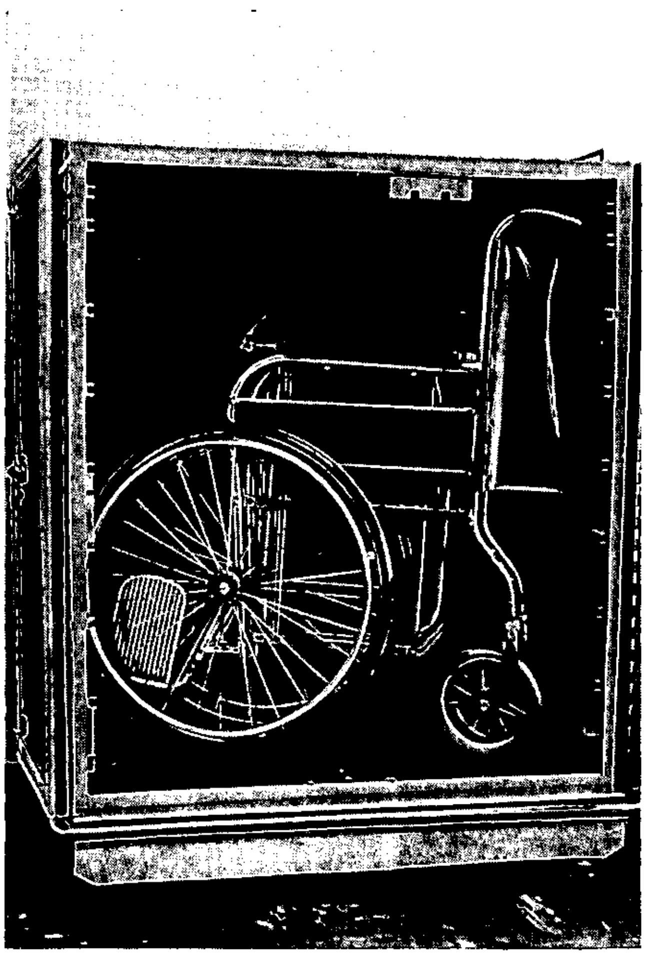


*Fig. 1 The Cyberail container is made of stainless steel and weighs 190 lb. It has a capacity of about 16ft$^3$ and a maximum load of 220 lb. It can be washed or sterilised if required, and is fitted with four large conductive castors. The interior can be equipped in many ways, illustrated are forms suitable for bulk carrying, e.g. wheelchairs and meal distribution*



half of the total patient-care cost is allocated to the hotel services.

For example, more patients and staff sleep in hospitals than in all of our hotels put together, and the hospitals' meal-service output comes near to the total number of meals produced by the hotel and industrial installations over the whole country. The engineers, anyway, recognise the size of the operation, as they, assisted by some 30 000 maintenance staff, manage to keep this vast organisation in running order.

Putting money figures into the UK operation, it appears that we are spending some 30% of our total annual costs on *staff* for the hospitals' hotel services.

This should be compared with the 37% of the total cost applying to supplies, maintenance and services, 17% of expenditure on nursing staff, 9% on capital expenditure, and the remaining 7% for professional fees.

Around 30% of the total cost is £335m every year, and clearly represents a worthwhile area for investigating the holding or even reduction of costs, especially as an annual increase of 5% would very nearly be equivalent to the total annual capital budget for hospital buildings (excluding equipment).

The hospital service is a large industry, but unfortunately the 203000 manual workers employed are dispersed throughout the country on hundreds of installations, varying from quite small to very large, and having from relatively simple to extremely complex internal-transport requirements. Over this wide range of application we may assume that the larger and more complex installations are the ones most certain to give the quickest return on the costs of an automated system, as well as offering the maximum advantage to the management side.

*Fig. 2 Containers in a horizontal shaft. The shaft width for two tracks is 120 in and the height is 84 in except where the switch points are installed, where an extra 6 in is required*

Experience on overseas projects has shown that the basic layout of a hospital is very largely related to the traffic-flow pattern; the hospital streets or corridors form the skeleton around which the building is planned. In analysis it has been found that creating an entirely new *alternative* traffic-flow pattern in an existing complex only produces a sort of halfway stage; for example, the relocation of supply points to meet the ideal of goods being delivered to the exact point of requirement is not, in general, possible.

In practice, a total internal-transport system is so much a part of the overall design that it may be assumed that design should only be considered at the draft planning stage—otherwise there is no prospect of using the equipment to the full advantage of all departments. The complete co-operation of administration, medical, architectural, work-study and engineering branches are required before even a draft proposal can be annalysed and costed. However, the result can be expected to show savings and organisational advantages that are at present hard to imagine.

### Origin of Cyberail

Messrs. Eisen and Stahlwarenfabrik, of Switzerland, manufacture special conveyor systems for moving, for example, large plate glass from production line to stores, baggage at airports, documents in various Post-Office installations, and laundry in the Basle central laundry.

A horizontal monorail with route selection was fully developed, and limited vertical travel was added by using modified lifts to give fully automatic handling. Most of this work was with industrial systems using single-direction flow patterns that had been fully scheduled by the production engineers. The loads and times are regular and repetitive on this type of work. This gave the Swiss company a reputation for relatively complex and highly reliable special conveyor systems.

About five years ago, work started on the design of equipment for St. Joannes Hospital, Haarlem, Holland, and despite the fact that this was a very big technical development, involving new mechanisms, electrical systems and logic, this installation is now working perfectly, particularly in regard to the use of a single monorail for movements in both horizontal and vertical directions. On completion, it became widely publicised, and it became apparent that the equipment was years ahead of other developments. In the US there was a clear realisation that the field was ready for major development, but, as in other countries, the progress was slowed by attempts to adapt existing industrial systems to meet the very special requirements.

About three years ago a vast amount of development resource was applied towards completing the work, both in Switzerland and in the USA. Unfortunately no European company in the hospital field had the necessary financial resources, and, possibly just as important, the realisation of the urgent need.

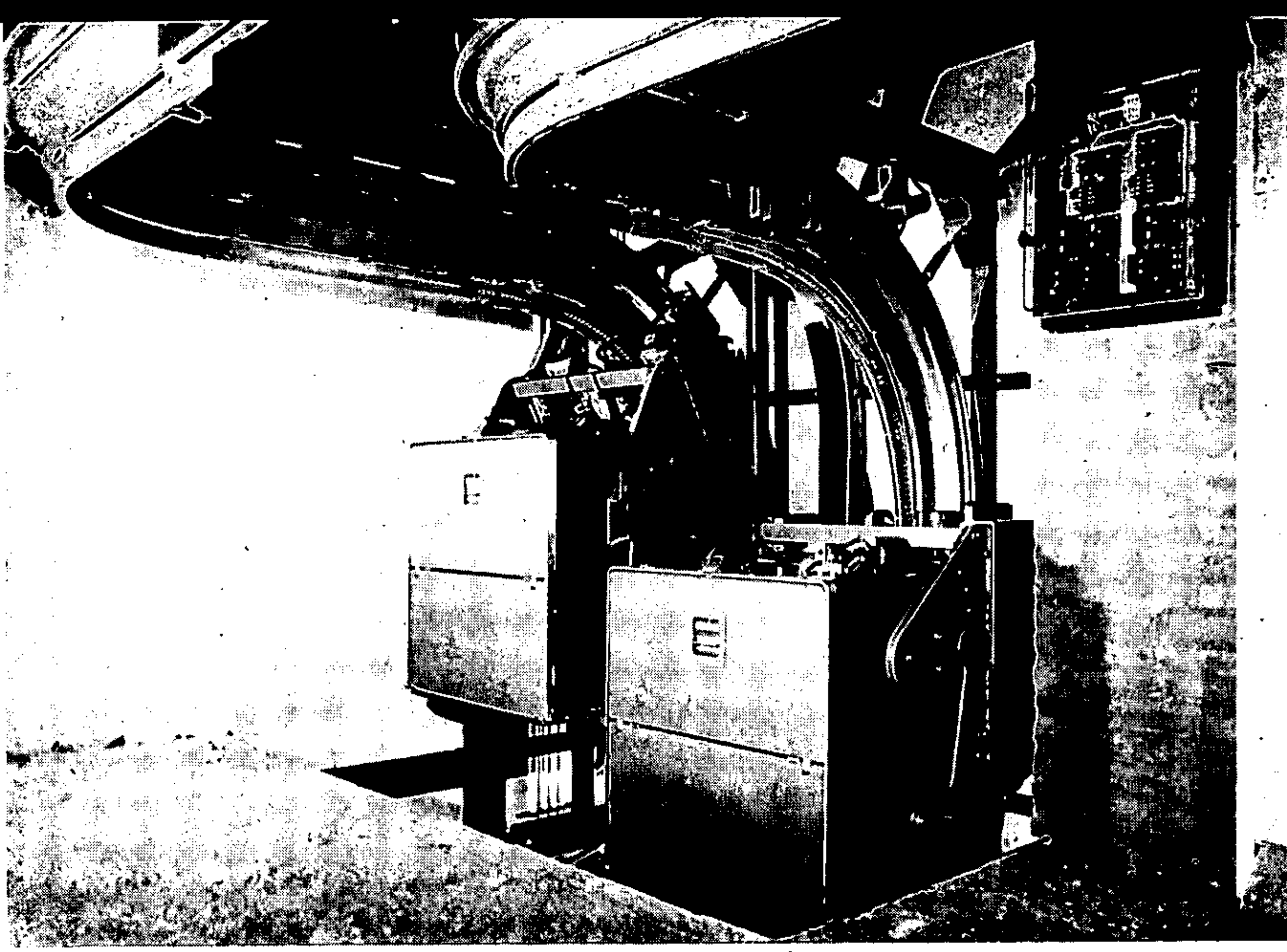


*Fig. 3 Radii of curvature of the tracks are for horizontal turns 24 in, and for vertical turns 30 in*

However, the fact that so many of these major installations are going ahead only just about two years after final development gives great credit to the Swiss conception and to the detailed engineering that has followed.

The requirements for a hospital system are fairly easy to list.

(i) The system must not, of itself, lead to any possibility of crossinfection.

(ii) The security must be such as to ensure that the goods are only available at supervised areas which are scheduled to receive the shipment.

(iii) There must be no danger to personnel, either public or staff.

(iv) Exceptional quietness in operation is required.

(v) The system must allow transit of all scheduled goods.

(vi) The goods handled should, ideally, cover the total requirement; for example, mail, drugs, refuse and anaesthetic machines, as well as the more obvious groups such as linen, food and sterile supplies, must be considered.

(vii) Total reliability must be built in.

(viii) The system life should be equal to the hospital life, assuming planned maintenance of the equipment.

Knowledge of present equipment such as flat-bed conveyors, dumb waiters, chutes and pneumatic tubes will confirm that this type of equipment cannot possibly cover the total requirement without very considerable manual assistance.

One area still open for further investigation is the question of message transmission. The telephone will always play a major part, but in fact one Dutch hospital is installing 'Script-writing' equipment for the transmission of written messages and indents. This covers the requirement for both records and authorisation—a serious deficiency of the telephone system—and indicates one line of thought.

It has been calculated that the cost of the power used to move a Cyberail container over 900 ft is approximately 0·1p. If this is compared with a pneumatic tube, which uses very nearly continuous current regardless of the number of transits, it will be realised that even a large container can be moved at a comparable cost, since current is only used during transit. This allows records and small-item shipments to be included in the system.

### The Cyberail system

Cyberail is a fast, automatic, materials-distribution, point-of-use storage and collection system, which makes available the means of increasing operating efficiency while reducing costs. It is best described by reference to the Figures.

The system employs push-button-controlled, monorail supported, self-propelled transporters, capable of travelling at 200 ft/min horizontally and 100 ft/min vertically. Containers (Fig. 1), loaded with up to 220 lb of goods, are automatically attached to or detached from the transporter at stations strategically located throughout the hospital. They are sealed and travel in a level position with a steady motion (Fig. 2), even on more complicated routes (Fig. 3), allowing fragile or fluid loads to be handled satisfactorily.

Container destinations are programmed in on dispatch (Fig. 4), the electrical 'block system' prevents collision, and inbuilt logic ensures that a sending station (Fig. 5) can only dispatch to an approved receiving station; this can arrange that a dirty station can only send to another dirty station or to the container-washing plant. Automatic accumulation of loads to be dispatched, or of loads being received, allows operation without manual assistance at the station.

The system is highly flexible as regards initial design, and can be extended as the hospital complex expands or changes its function.

The advantages of an automated system can be very briefly summarised in the statement that the hospital streets become pedestrian ways; the need to carry some 30–50 tons of materials daily is obviated.

The sending departments are directly connected to all user points throughout the 24 h period, and, even without elaborate works study, the departments will move towards a regular pattern of operation.

With sealed containers such items as returned dirty linen can be held, and dispatched by wards during the night—morning issues of clean linen would then complete the ward requirements. This also indicates that ward stores become less important, even undesirable, when a total transport system is available.

As each activity has to be analysed before design of the system can be initiated, the major works study of the hospital operation is automatically covered as the hospital is being planned. This is distinctly different from adding the requirements of each department, as separate and independent items, each out of context with the other. One of the greatest advantages comes from this programmed pattern of the total activity; particular goods are planned to be at particular points at particular times. This must be rigid enough to assist work organisation in all the departments concerned, but not put the operation into a straight jacket.

Random time is allowed on all cyberail programs; this covers the unexpected event that is bound to arise. The rest of the program must always be to the benefit of the department, not to suit the peculiarities of the transport system.

For the first time ever the planners can consider that the kitchen, which normally issues the highest density over short periods, need not be placed relative to a street system, but may be located in relation to the incoming supplies only. Similarly, the ward landing or corridor is no longer a critical point, and clean supplies can enter direct to the ward station at the obviously correct supply point; dirty returns may exit from the other end of the ward, or from any other more desirable point.

Taking the system a little further, it is possible to operate a complex on a sloping site and with remote buildings—a concept that no architect could consider previously. This great freedom may well, in due course, produce layouts quite different from those we currently consider to be good practice; in particular, the problem of building in stages becomes much easier since the supply lines can almost be treated as plug-in connections to the new blocks.

Added to these financial, labour and technical aspects, we can briefly consider the possible benefits to patients and staff. The main requirement will remain the maximum care under the most favourable conditions to allow patient recovery. This care is not entirely medical; an automated transport system assists very greatly by reduc-

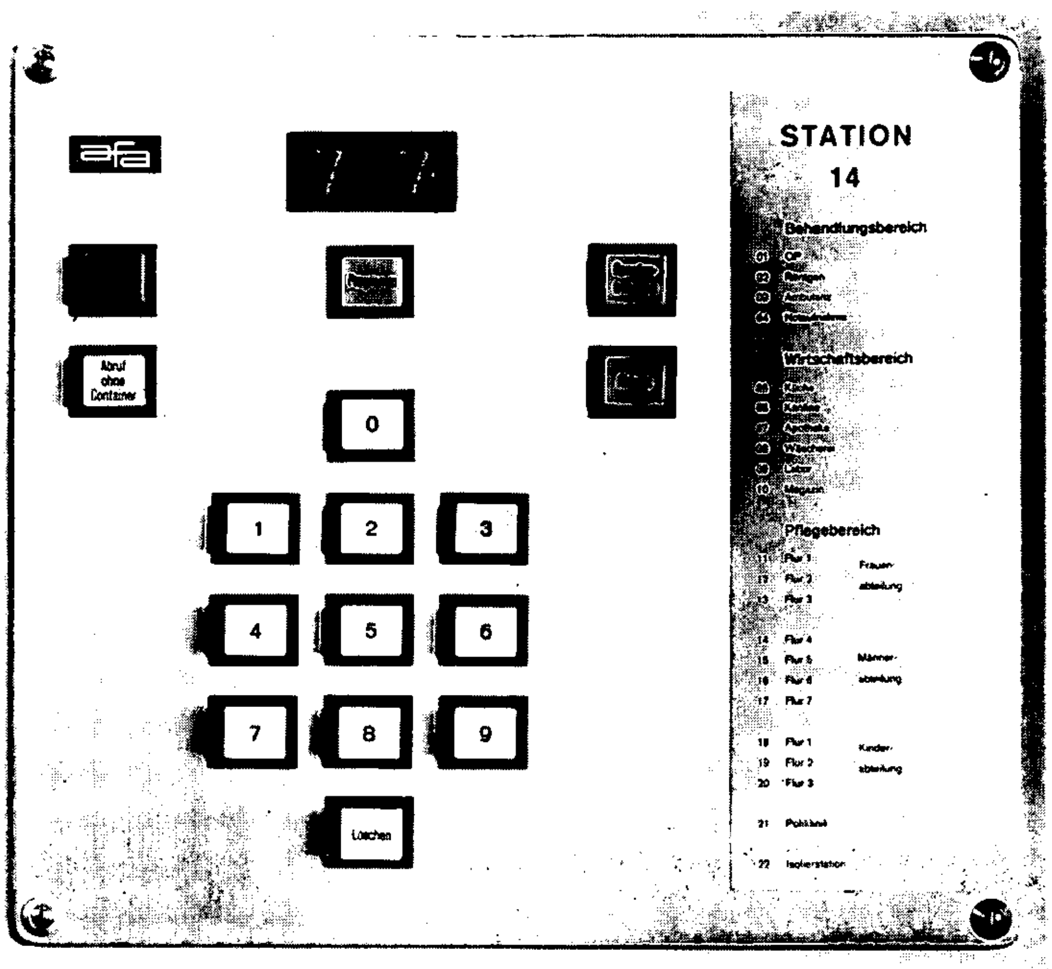



*Fig. 4 Sending-station control panel, incorporating a list of destination codes, push-button destination programming and a 'call-container' button*

ing the general noise and clutter, but, more important, the nursing staff have much more time to spend with patients. The psychological benefits this contact brings may be as important as medical care at quite an early stage of recovery.

In addition, the movement of materials within the hospital, which may be the biggest single source of cross-infection, has been eliminated, so that there is every possibility that the patients' medical condition will improve more rapidly. There is a growing indication that a noticeable shortening of the average patient stay will

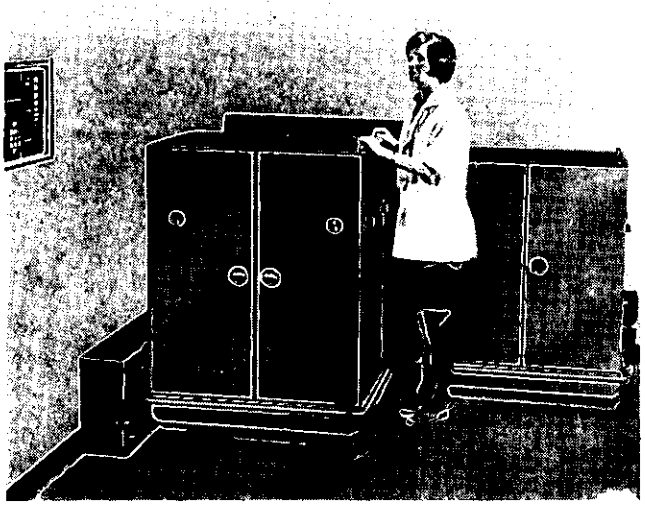


*Fig. 5 Vertical station, receive and dispatch. The station door is rated as a class B constructed fire door. When the station is in use a support platform forms an extension of the floor into the shaft. When not in use the platform is stored vertically behind the station door, so that access to the shaft cannot be gained even by forcing open the station door. No open shaftways are presented at any time*

result from these improved conditions, and this reflects back on the building, labour, finance etc., as a 1000-bed hospital will then be able to do the work equivalent to a 1100–1200-bed unit.

Cyberail is now developed for hospital use; great interest has been shown overseas, and about 25 hospital authorities have already completed detailed initial studies. Installation work is now proceeding, and before too long there will be a selection of installations available for inspection. For example, the Haarlem Hospital is operational, and is to be followed by Meppel, Holland, in 1970–71 and Copenhagen in 1973. The American installations at Rochester, Cleveland and Connecticut are also under way, and new projects are expected to follow in a number of overseas countries.

Systems design work is already starting on projects for completion in the 1980s, and in this respect we are a little behind our overseas colleagues. This is a disappointing situation, as the UK health service has all the experience required to undertake the investigation of this problem, and overall, we must stand to benefit enormously if our experience can be applied on a national basis.

### Costs

Obviously the capital cost is high, but one can be assured that this aspect has been very carefully analysed by all the financial authorities involved in studies of the application of automated systems.

The UK position appears to be that, with costs amortised over 20 years, the accumulated savings give a break-even point at about the tenth year. This is deduced from the American picture giving 6–7 years, and European studies, showing about 7–8 years to reach the break-even point. The simple assumption is that our costs will be about the same, but our lower labour rates take us to about 10 years before we break even. This period is related to the shortage of labour, and its effects on labour rates in hospitals. The fact that a labour shortage is the initiating factor indicates that redeployment of labour is what is actually going on; it is certainly not true that the spread of automation is creating any continuous unemployment—in fact better employment is continuously being generated.

The capital expenditure is justified by the annual savings, which, over 20 years, are more than equal to the capital used. These savings could be used to re-equip the whole system after 10 years without any overall loss, or alternatively, replace it after 20 years and install an additional system.

If we proceed to 60 years (taking this as the life of a new hospital, and of the Cyberail equipment), we have the prospect of one initial Cyberail system generating enough savings to equip a total of 63 major hospitals without the need for any further true capital investment. In one way this sounds rather frightening, but it also indicates that the financial involvement is perhaps not the main area for thought. It is the policy that needs resolving, the rest can be substantiated quite easily.

It should be remembered that our *national* health service allows us to apply these savings to the full. The overseas installations will look forward to a saving in operating costs, but very few can apply this saving to an additional installation, as usually only one local hospital is involved in each city.

Unfortunately, one cannot sit back and wait for the overseas installations to give all the answers. Our hospitals are different, our costs and charges are different, and our organisation is different. This makes it extremely urgent for a start to be made now on some initial studies of internal-transport requirements, and of systems to meet these requirements, on the evaluation of true costs, and on the very serious consideration of just what labour is likely to be available to run our hospitals in 20 years' time.

All the signs are that we cannot leave this problem any longer. It represents not only a short-term means of holding our rising costs, but also a long-term means of meeting the basic problem of manpower shortage. Hospitals being designed today are expected to give service through the next 60 years at least. Looking back over the last 60 years, it is obvious that a great deal of progress has been made, except in the field of transport inside the hospital, where the trucks and trolleys have only become more numerous.

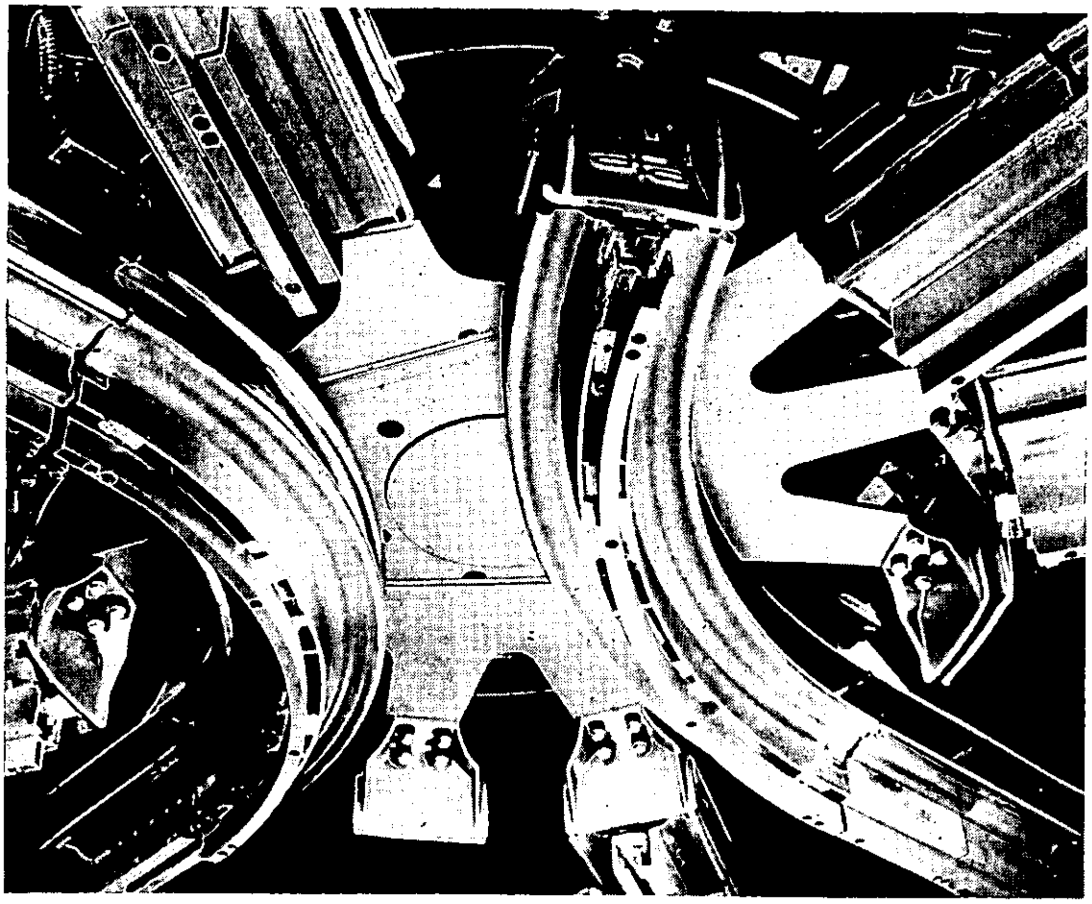


*Fig. 6 A switch will automatically direct containers by the shortest route. Each switch has four entrances and four exits; unused paths, if any, are available for future expansion. Should more than one container approach a switch simultaneously, they will be held and sequenced through at a rate of ten per minute*

*Fig. 7 The transporter is the primary moving device and is driven by two 2 hp motors. Magnetic clutches provide positive fail-safe braking*

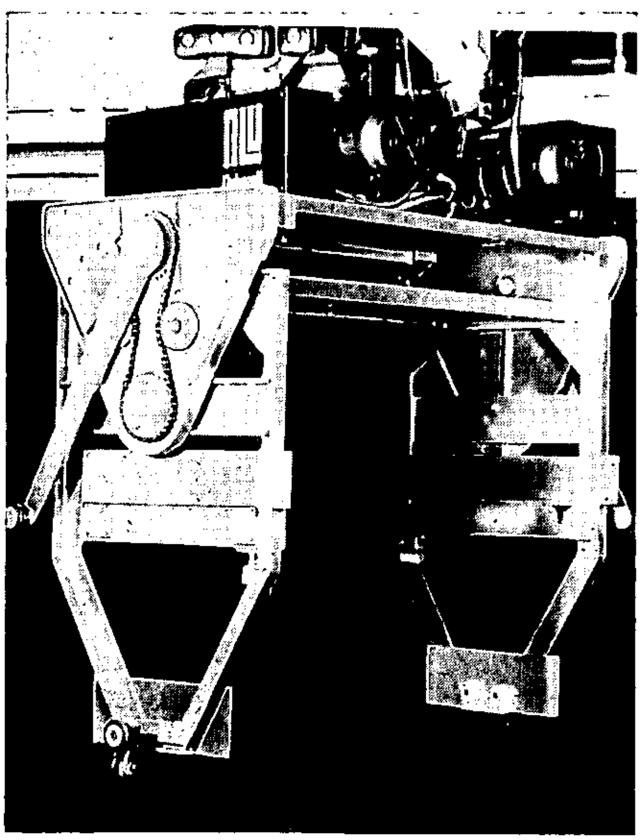


*Fig. 8 Container fitted with general-purpose modular fittings*

# * Market News *

*For further details, simply encircle the relevant number on the reply-paid postcard*

## Roof extract units

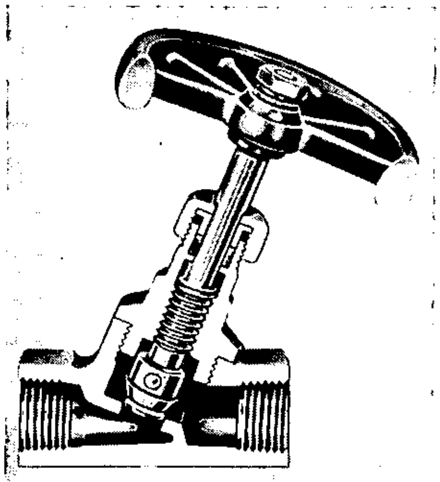
A new range of belt-driven roof units has been announced by Brooks Ventilation Units. This is an extension of the mixed-flow Extra-Lo-Liner range, the belt-driven units are only fractionally higher than their well established direct-drive counterparts. They are designed for kitchen ventilation etc., where grease-laden air must be discharged vertically from the building at high velocity, but with low sound levels. Onsite speed and volume adjustments can be made by simple pulley and belt changes. A built-in on/off safety isolating switch fixed inside the motor compartment is now a standard item provided at no extra cost.

*Brooks Ventilation Limited, Trafalgar House, Bedford Park, Croydon, Surrey* **HE 94**

## Stop valves

Mil Limited has improved its range of steam stop valves, which covers 0·5, 0·75 and 1·0 in sizes.

The specially designed disc has a plug end which fits closely into the seat, preventing a rapid flow of steam until the disc and seat faces are well separated. This reduces to a



minimum the destructive action of wire drawing. The valves now incorporate p.t.f.e. packing, giving a permanent self-lubricating seal under any conditions; the valves will never require repacking.

The operating range is $-50°C$ to $265°C$, with pressures of up to 250 lbf/in$^2$.

*Mil Limited, Heath Town Works, Wolverhampton, Staffs.* **HE 95**

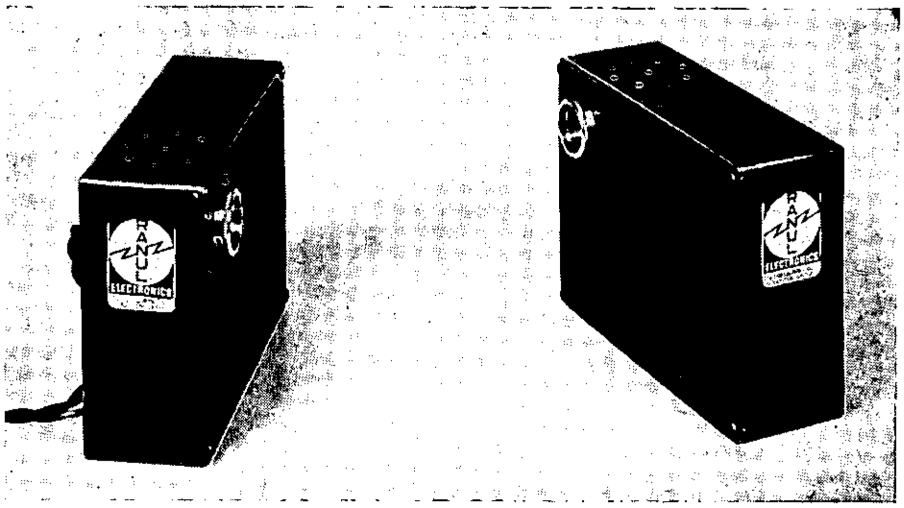
## Burglar alarm

A new intruder/fire-alarm system, that cuts the cost of crime prevention and fire protection, is called the 'Vigilante'. It comprises two compact electronic units, transmitter and receiver, and costs £18 18s. including batteries.

The alarm is activated by an electronic 'eye', which has a range of up to 40 ft, either in a straight line or 'bounced'. The transmitter and receiver are simply plugged into standard 3-pin electricity points, and, when the detector beam is interrupted, a piercing klaxon sounds until switched off by an authorised person. If the mains supply has been cut, the built-in batteries take over automatically, and, if activated, will sound the klaxon for over half an hour. The Vigilante is controlled by a patented switch, which, if interfered with in any way, activates the alarm. The klaxon also sounds if the flex leading to the switch is cut.

*Ranul Electronics Limited, 18 Temple End, High Wycombe, Bucks.*

**HE 96**



## Mains-failure generating plant

Designed to meet customer demand for a reliable emergency system without unnecessary frills but retaining all the essential control components, the new range of Petbow generating sets for 12·5–75kVA embody the most advanced circuitry with plug-in control assemblies, and provide compact standby units at reduced costs.

Fully or semiautomatic control can be supplied. With fully automatic control, the set starts automatically on full or partial failure of the mains, and automatically shuts itself down and reconnects to the mains when power is restored. Semiautomatic sets start in the same way, but require manual switch-over back to the mains.

Sets are powered by Ford, Perkins or GM engines driving statically excited alternators. Brushless machines are available. Supplied with all normal equipment including built-in resilient mountings, the double-frame construction provides overall vibration protection.

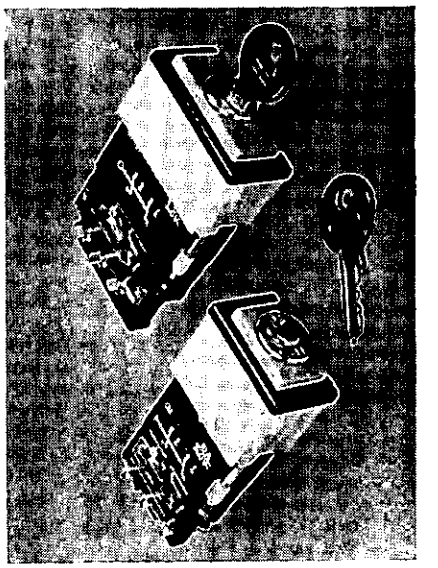
A limited range of optional extras including 4-pole contactors, bypass switches and residential silencers can be supplied. **HE 97**

*Petbow Ltd., Sandwich, Kent*

## Locking switches

Highland Electronics Limited has introduced a new range of push-button switches, fitted with a cylinder lock and key.

The standard switch may be locked



in the 'on' or 'off' position, with the key remaining in the lock or withdrawn. Other nonstandard arrangements are available to special order.

The switches have 2-pole change-over contacts, and each pole will switch up to 10 A, 415 V, on an alternating resistive load. A simple panel mounting provides anti-vibration fixing. **HE 98**
*Highland Electronics Limited, 33 Dallington Street, London EC1*

## High-output dimmer

A new high-output thyristor dimmer for fluorescent lighting from Industrolite Limited, is rated at 5000 VA on single-phase supplies. The dimmer is suitable for use on major lighting installations, as it will handle up to sixty 30 W lamps. A special high-speed fuse protects the thyristors from normal fault conditions, and a harmonic choke and filter ensure freedom from audio and radio-frequency interference. **HE 99**
*Industrolite Limited, Radiant Works, Pegasus Way, Croydon, Surrey*

# * Members Diary *

### KEELE UNIVERSITY NATIONAL POSTGRADUATE COURSES: 1970

Members are advised that the Department of Health & Social Security has given approval for the Institute to stage two further courses during 1970, and the Scottish Home & Health Department has indicated their support.

Members are asked to note that, contrary to previous practice, the course for assistant engineers will be held on 19th-24th July and that for group and hospital engineers on 20th-25th September.

While every year's programmes are planned on a progressive basis, the programme for the 1970 course for group and hospital engineers will show an appreciable departure from the pattern of previous courses, and it is hoped, therefore, that many of those who have attended earlier courses will take the opportunity to attend again. The programme of the course for assistant engineers will include visits to hospitals to inspect the engineering plant and equipment, and the management systems employed.

Details of these courses have been distributed to RHBs and all employing authorities, and it is hoped that most nominations will be received by the end of May and July, respectively.

### NEW FACES

J. A. Hill, M.I.Hosp.E., formerly Group Engineer, Dorset (Herrison, Dorchester) HMC, has been appointed Assistant Regional Engineer, Sheffield RHB.

P. F. Pike, M.I.T.E., M.I.Hosp.E., is now an Associate of Chas. Beal Paterson and Partners, Consulting Engineers. He continues to be in charge of electrical services at their Leeds office.

R. A. Richards, graduate member, has taken up the appointment of Hospital Engineer at St. Mary's Hospital, Eastbourne, Sussex.

A. J. Whittle, graduate member, has taken up the post of Hospital Engineer at Highcroft Hospital, Highcroft Road, Erdington, Birmingham.

D. J. Wicks, M.I.Hosp.E., who was the Hospital Engineer at Southampton General Hospital, has been appointed Deputy Group Engineer, Southampton Group HMC.

# * Among the Branches *

### SOUTHERN BRANCH

Meeting at Queen Alexandra Hospital, Cosham, Portsmouth, on the 15th November 1969, the Southern branch heard a talk by Mr. R. G. Smith, Group Engineer, Birmingham (Dudley Road) HMC, on the report 'Management in hospitals'. This report was produced by a working party set up by the Midlands branch when proposals from the secretariat of the Birmingham group concerning the reorganisation of the management structure proved to be unacceptable. Although it was conceded that no two groups were alike, the report was likely to prove universally helpful, and had, in fact, been referred to the King's Fund College of Hospital Management, Engineering Panel.

### SOUTH-WESTERN BRANCH

Mr. Mosley and Mr. Stockwell, of the British Engine Insurance Co., Ltd., visited the South-Western branch meeting at the BRI School of Nursing on the 26th November 1969, and gave a very interesting talk entitled 'Boiler plants and heating vessels'. With the aid of slides they covered the various types of damage that can occur, including the devastation of major explosions, and described the various ways in which damaged plant can be rendered fit for service.

### WELSH BRANCH

On the 1st November 1969 the Regional Radiation Officer, Mr. R. G. Wood, talked to the branch about radiation sources and machines. He described the engineering aspects of the three types of machine used at Verlindre Hospital, namely the conventional X ray machine, the Cobalt-60 isotope unit and the linear accelerator.

### LANCASHIRE BRANCH

The Branch held a meeting at the Christie Hospital and Holt Radium Institute in Manchester on the 29th November 1969, when a talk on medical electronics and its applications was given by Dr. D. Green of the research and development department of the Christie Hospital.

Members toured the various treatment units, and Dr. Green explained and demonstrated the use of the equipment, and showed how, by the use of transistors, integrated-circuit amplifiers, solid-state switches etc., equipment is now much smaller and more reliable.

The meeting was well attended, and the members enjoyed a most interesting and instructive discussion on the techniques of cancer treatment. It is hoped that an article giving more detail will be available for the Journal in due course.

# Clippings

The Institution of Heating and Ventilating Engineers has received a donation from Carter Thermal Engineering Limited to set up an annual award to be known as the 'John Carter Prize'. The prize, of £15-£20, will be awarded to the candidate obtaining distinction in group C or D of Section 2 of the Associate examination of the Institution. These groups cover air conditioning and refrigeration and refrigeration in industry, respectively. The donation is made in memory of John Carter, the founder of the Carter Thermal Industries Group, who was a pioneer in the introduction of sophisticated air-conditioning techniques in Britain after the last war.

If you fancy a free play with a high-powered computer, to work out your tax return or do the pools for you, try entering the *New Scientist* 'Dial-a-Computer' competition. 'Dial-a-Computer' is the registered business name of G.E.I.S. Ltd., who are co-operating with *New Scientist* in the running of the competition. Each of the six winners will have a computer terminal, connected by an ordinary s.t.d. line to one of the G.E.I.S. central time-sharing computers, installed in their home or office, and £1000 worth of computer and telephone time will be provided free.

Entries must comprise a description of a problem that could usefully be solved on the equipment, with some explanation of the benefits resulting from using the computer. The rules stress that the judges will pay special attention to the originality to the suggestions, which should separate the acumen from the playboys.

Britain's largest firm of chimney builders and steeplejacks, P. C. Richardson & Co. Ltd., who number the hospital boards among their largest clients, have been widening their experience with a spell of maintenance work on the radomes at the UK Ministry of Defence Fylingdales early-warning station. Said a company spokesman, 'It was like working on giant-sized golf balls'. It must have been a wonder the job was ever completed, with the locals shouting 'Tee up, then' the moment the workmen began putting up the ladders.

Parliament has been debating the Gas Bill. So have I—the difference being that if I reject mine the gas gets cut off.

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**OFFICIAL APPOINTMENTS**
**SITUATIONS VACANT**
**MISCELLANEOUS**

## APPOINTMENTS AND SITUATIONS VACANT

**BROMSGROVE GENERAL HOSPITAL**
**BROMSGROVE**
**HOSPITAL ENGINEER**

Applications are invited for the above post. Salary scale £1403–£1658.

Practical experience is essential, and preference will be given to applicants who possess one of the following:

(*a*) City & Guilds Mechanical Certificate (Part I) which must include plant maintenance and works service
(*b*) City & Guilds Certificate in plant engineering
(*c*) MOT First-Class Certificate of Competency which includes an Ordinary National Diploma or Certificate

or equivalent qualifications approved by the Department of Health.

Applications, together with the names of two referees, to be returned by the 27th February 1970, to the Group Secretary, Mid-Worcestershire Hospital Management Committee, 165a Birmingham Road, Bromsgrove, Worcs.

---

**SOUTH-WEST LONDON HOSPITAL GROUP**
**DEPUTY GROUP ENGINEER**

required for this new post in a busy acute group of seven hospitals. Salary scale £1754–£2014 per annum inclusive of responsibility allowance and London weighting.

Applicants should hold a Higher National Certificate or Diploma in electrical engineering, including applied heat and applied mechanics, or an approved equivalent qualification (i.e. HNC mechanical).

Application forms and job description from Group Secretary, South-West London Hospital Group, St. James' Hospital, 72 St. James's Drive, London SW17, to be returned by the 28th February 1970

---

**GROVE PARK HOSPITAL**
Marvels Lane
London SE12

ASSISTANT ENGINEER required. Ordinary National Certificate or equivalent qualification required. (Unqualified candidates may be considered, but will be subject to an abated salary scale.)

Application forms available from the hospital secretary.

---

**MID-STAFFORDSHIRE HMC**
**HOSPITAL ENGINEERS required for**

(i) Staffordshire General Infirmary, Stafford, and four other hospitals in area: to be directly responsible to the group engineer for engineering and building maintenance.
Applicants must have approved practical training and experience, and qualifications recognised by the Department of Health.
Salary: £1403–£1658, plus £75 per annum special-responsibilities allowance.
(ii) New post at Groundslow Hospital, Tittensor, near Stoke-on-Trent, and three other hospitals in area: to be directly responsible to the group engineer for engineering and building maintenance. Duties will include introduction of planned maintenance.
Applicants must have approved practical training and experience, and qualifications recognised by the Department of Health.
Salary: £1403–£1658, plus £50 per annum special-responsibilities allowance. A semidetached house is available for rental.
Applications for posts, with full details and names and addresses of two referees, to the Group Secretary, Mid-Staffordshire HMC, Foregate Street, Stafford, within 14 days.

---

Lewisham Group Hospital Management Committee

# GROUP ENGINEER

This post, in a busy acute hospital group, becomes vacant from the 1st July owing to retirement of present holder. Applicants must be qualified in accordance with PTB 191 (or equivalent, approved by Department of Health). Salary scale £2134–£2499 (including London weighting) and special-responsibility allowance of £150 (currently under review).

Application form (returnable by the 25th February), and further details, from Group Secretary, Lewisham Hospital, London SE13 (Telephone: 01-690 4311).

---

**KING'S COLLEGE HOSPITAL**
**DENMARK HILL, LONDON, SE5**

# Hospital Engineer

Exciting and exhausting position for ambitious engineer. Every possible engineering problem to be tackled in a modern teaching-hospital complex containing 581 beds, vast laboratories, specialist departments and a medical and dental school. Ideal post for man wanting responsibility and experience. Job description, salary details and application form available from the Hospital Secretary, King's College Hospital, Denmark Hill, London SE5. Reference P75. Applications to be returned by the 23rd February 1970

---

**MAPPERLEY HOSPITAL**
**NOTTINGHAM**
**ASSISTANT ENGINEER**

required for the above psychiatric hospital. Applicants must have completed an apprenticeship in mechanical or electrical engineering and hold an Ordinary National Certificate in engineering, or an approved qualification. The successful candidate will have the opportunity to gain experience over a wide range of hospital engineering, and will be encouraged to study for further qualifications.
Salary Scale £1077–£1403
House available
Applications to the Group Engineer.

---

**COVENTRY HOSPITAL MANAGEMENT COMMITTEE**
**GEORGE ELIOT HOSPITAL**
**NUNEATON**

HOSPITAL ENGINEER required, responsible to group engineer for the maintenance of all engineering services in three hospitals.

Applicants must have a sound knowledge of boiler plant, mechanical and electrical equipment, wide experience in maintenance, and hold one of:

(i) City & Guilds Mechanical Engineering Technician's Certificate (part II), to include plant maintenance and works services
(ii) City & Guilds Certificate in plant engineering
(iii) MoT First-Class Certificate, including OND or ONC.

Salary scale £1478–£1733 per annum (including special-responsibility allowance of £75 per annum).

Applications, with details of training, qualifications and experience and three referees, to the group secretary
Coventry Hospital Management Committee,
The Birches,
Tamworth Road
Keresley,
COVENTRY CV7 8NN
by Monday 26th February 1970

---

**ASSISTANT ENGINEER**

required to assist Hospital Engineer in the operation and maintenance of all engineering services in ST. STEPHEN'S HOSPITAL, SW10 (acute general). Appointment offers experience towards promotion. Day release for higher qualification considered. Practical experience and approved qualifications necessary. Salary £1167–£1493. Applications to the Secretary, Chelsea and Kensington H.M.C., 5 Collingham Gardens, London, SW5

---

SENIOR TECHNICIAN in HOSPITAL PHYSICS DEPARTMENT WORKSHOP with experience in steam, fitting and maintenance, to analyse faults in and maintain all types of autoclaves, together with investigations into the efficiency of various types of sterilising procedures and equipment used within the hospital. Salary in the range of £837–£1455 per annum inclusive (increase pending). Applications, with the names of two referees, should be sent to the Clerk to the Governors, St. Bartholomew's Hospital, London, EC1, quoting ASC/2258.

---

HOSPITAL ENGINEER required for St. Mary Abbots Hospital, W8 (acute; 399 beds). Recognised qualifications (or Department of Health service requirements) necessary. Consideration given to the appointment, on an abated salary scale, of applicants without qualifications but with considerable practical experience of the management of hospital plant. Building knowledge an advantage. Successful candidate needs to reside within easy reach of the hospital. Salary £1493–£1748 per annum (plus £50 special-responsibility allowance). Applications to: The Secretary, Chelsea and Kensington Hospital Management Committee, 5 Collingham Gardens, London SW5

THE MIDDLESEX HOSPITAL TEACHING GROUP
POST 1 ASSISTANT ENGINEER
POST 2 ASSISTANT ENGINEER

Applications are invited for the above posts at this large London hospital teaching group.

Post 1: applicants should have served an apprenticeship in electrical engineering and possess ONC in engineering

Post 2: applicants should have served an apprenticeship in mechanical engineering and possess ONC in engineering

The posts offer young engineers an excellent opportunity for advancement in engineering.

Single accommodation can be made available.

Salary in the range £1167-£1493. Suitable applicants may be eligible for entry to the scale £1245 including London weighting.

Applications stating age, qualifications and experience, together with the names and addresses of two referees, should be submitted to the Chief Engineer, The Middlesex Hospital, Mortimer Street, London W1 not later than the 5th March

**GROUP ENGINEER**

**£2555 - £2975**

for NORTH LONDON GROUP OF HOSPITALS. HNC qualification, or equivalent, and experience in planned maintenance of mechanical and electrical plant, management of staff and preparation of estimates and reports essential.

**Further details and application form from Group Secretary, Royal Northern Hospital, Holloway Road, London N7 (Telephone 01-272 7777), to be returned by the 23rd February 1970.**

WHITTINGHAM HOSPITAL MANAGEMENT COMMITTEE
Whittingham Hospital
(2231 beds; PSYCHIATRIC)

HOSPITAL ENGINEER

required at the above hospital, responsible to the group engineer for the mechanical and electrical maintenance services. Applicants should have completed an apprenticeship in mechanical or electrical engineering and possess HNC or HND in either electrical or mechanical engineering with appropriate mechanical or electrical endorsements.

Consideration will be given to the appointment of a suitable applicant without the requisite qualifications but with an abatement of £200 per annum on the salary scale.

Salary at present over 24½ points is £1514-£1774 per annum, plus £75 responsibility allowance.

Single accommodation available, married accommodation may be made available if required.

Further details, including full details of qualifications required, and application forms available from the Group Secretary, Whittingham Hospital, nr. Preston, Lancashire, to be returned not later than February 23rd, 1970

Classified advertisements for the next issue of HOSPITAL ENGINEERING published 12th March, should be received not later than Thurday 26th February.

ASSISTANT HOSPITAL ENGINEER

Ideal experience and training for young engineer seeking advancement. ONC (02) engineering desirable, and good practical training in the maintenance of mechanical and electrical services. Salary £1077, rising to £1403, plus London Weighting. Consideration will be given to the appointment on an abated scale, of persons without these qualifications.

Job descriptions are available from the Hospital Secretary. Applications, giving full details of training, qualifications and experience, naming two referees and quoting reference P77 should be sent to the Hospital Secretary, Kings College Hospital, Denmark Hill, London SE5 by the 26th February 1970

YORK 'A' HOSPITAL MANAGEMENT COMMITTEE
Assistant Engineer

Required for duties at Naburn, Fulford and maternity hospitals in York. Applicants must have completed an apprenticeship in mechanical engineering, have a sound knowledge of steam-boiler plants, with a wide experience in the management of mechanical and electrical-engineering plant similar to that of modern hospitals, and must hold an Ordinary National Certificate in mechanical or electrical engineering. Applications will, however, be considered from candidates without the stipulated qualifications, the salary being suitably abated.

Salary commences at £1077 per annum, and rises to a maximum of £1403 per annum.

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

BOARD OF MANAGEMENT FOR GLASGOW SOUTH-WESTERN HOSPITALS
DEPUTY GROUP ENGINEER

Applications are invited for the above new post. The successful candidate will be required to deputise for the Group Engineer for the operation and maintenance of all engineering services in this group of four hospitals of approximately 1500 beds. Experience in hospital or allied service engineering is desirable. Applicants must have completed an apprenticeship in mechanical or electrical engineering and must hold one of the following qualifications or an approved equivalent:

(*a*) HNC or HND in (i) mechanical engineering with endorsements in industrial organisation and management and principles of electricity or electrotechnology, or (ii) in electrical engineering with endorsements in industrial organisation and management, and including (at SIII or 02 level) endorsements in applied heat and applied mechanics, or

(*b*) City & Guilds Mechanical Engineering Technician's full Technological Certificate (Pt. III) which must include plant maintenance and works service.

Salary Scale £1514-£1774 per annum, plus £75 special responsibility allowance. Applications, stating age, qualifications and experience, with names and addresses of two referees, should be sent to the Secretary, Board of Management for Glasgow South-Western Hospitals, 1345 Govan Road, Glasgow SW1, not later than the 28th February 1970

**ST. CRISPIN HOSPITAL MANAGEMENT COMMITTEE**

# HOSPITAL ENGINEER

required for the new PRINCESS MARINA HOSPITAL—550 beds for the mentally subnormal. Phase I, consisting of the first 270 beds, is being commissioned, and the building of Phase II has already commenced.

Applicants must have a sound knowledge of mechanical and electrical equipment and wide experience in its maintenance, and should possess one of the following qualifications, or an equivalent qualification approved by the Minister of Health:

(*a*) Higher National Certificate or Higher National Diploma in mechanical engineering with endorsements in industrial organisation and management and principles of electricity or electrotechnology, if this was not taken as a subject of the course

(*b*) Higher National Certificate or Higher National Diploma in electrical engineering with endorsements in industrial organisation and management and including (at S.III or 02 level, or with endorsement in) applied heat and applied mechanics, provided he has suitable practical experience in mechanical engineering

(*c*) City & Guilds mechanical engineering technicians full technological certificate (Part 3), which must include plant maintenance and works service.

Salary scale £1403-£1658, plus special-responsibility allowance of £25.

The person appointed will be responsible to the group engineer for the operation and co-ordination of all maintenance work in the hospital.

Consideration will also be given to the appointment, on an abated scale, of applicants without the stipulated qualifications.

Accommodation will be provided.

Applications, giving details of training, qualifications etc., and names and addresses of two referees, should be forwarded to the Group Secretary, St. Crispin Hospital Duston, Northampton, not later than the 23rd February 1970

HOSPITAL ENGINEER required, to be responsible to the Group Engineer for St. Mary's Hospital, and other small hospitals in the group. The successful candidate will be based at St. Mary's Hospital, Luton, and have control of the works staff for each hospital.

The salary scale is £1403-£1658 plus a responsibility allowance of £25 per annum. Candidates should possess HNC in mechanical or electrical engineering, or an equivalent qualification approved by the department.

Further details of the post are available from the Group Secretary, St. Mary's Hospital, Luton, to whom applications, including the names and addresses of two referees, should be sent by the 25th February 1970

## MISCELLANEOUS

# Index to Advertisers



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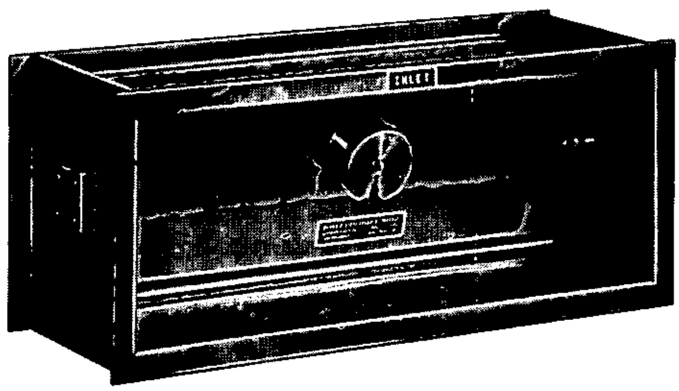
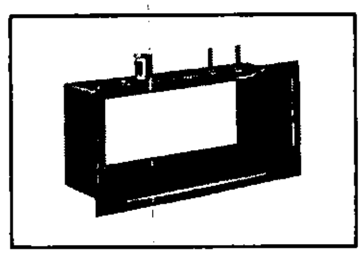
# THIS IS THE NEW EVACUATION VALVE BY POWER UTILITIES LTD*

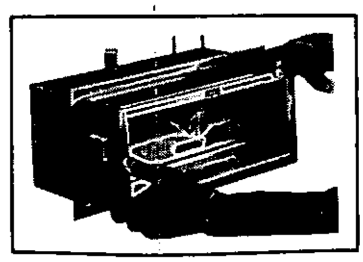


This type W Valve has been specially designed to:-



1 Control the air pressure in clean air areas, such as operating theatres, served by plenum systems.

2 Give extreme accuracy of pressure control down to 1/200th inch W.G.



3 Enable each valve to be easily adjusted on site to meet the requirements of cascade air spillage systems.

Easily cleaned. All parts in contact with the air flow are manufactured in stainless steel.

* Manufacturers of the well known range of Type M, S and X Aercon Evacuation Valves.

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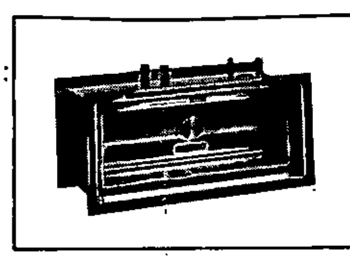

**POWER UTILITIES**

Power Utilities Ltd., Lombard House, Great Charles Street. Birmingham, 3. Tel: 021-236-3446.7-8-9.

If you are interested in any of the products advertised or mentioned in this issue, please make use of our information service.

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# Hospital Engineering

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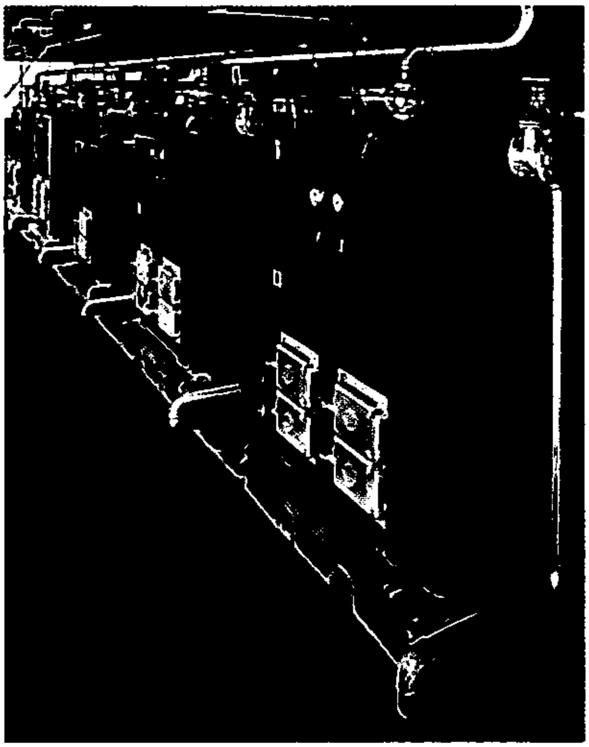
# From mammoth smelters to market gardens, coal saves money for go-ahead British Firms.



*Five Centrax boilers are accommodated in one compact boilerhouse as a result of their unique shape and design.*

**Centrax boilers – a happy marriage between Swedish design and British engineering.**

Some years ago, A. B. Gustavsbergs Fabriker of Stockholm developed a boiler design offering substantially greater thermal efficiency and fuel economy than the conventional boilers then being produced. The Gustavsberg principle depends upon high fan pressures and large pressure drops in the gas passages, which make possible unusually high flue gas velocities and, therefore, greater heat transfer rates. This, in turn, produces an unusually compact and efficient boiler of a convenient rectangular shape.

There are substantial differences between the original Gustavsberg boiler and the Centrax design, this latter taking into account the stringent requirements of British insurance companies, and conforming to the appropriate British Standards. But the essential principles are maintained, and the resulting operating efficiency of 80% over the full range of output.

Underfeed stokers can conveniently be installed to feed from front, back, or sides of the boiler, and ash can be removed manually or mechanically. Alternatively, chain-grate or coking stokers can be as easily installed. High-speed gas flow minimises soot deposits, and cleaning and maintenance become easy and, therefore, economical.

When the doctor is seen taking his own medicine, you know it must work. The National Coal Board has installed Centrax solid-fuel boilers in several of its premises.

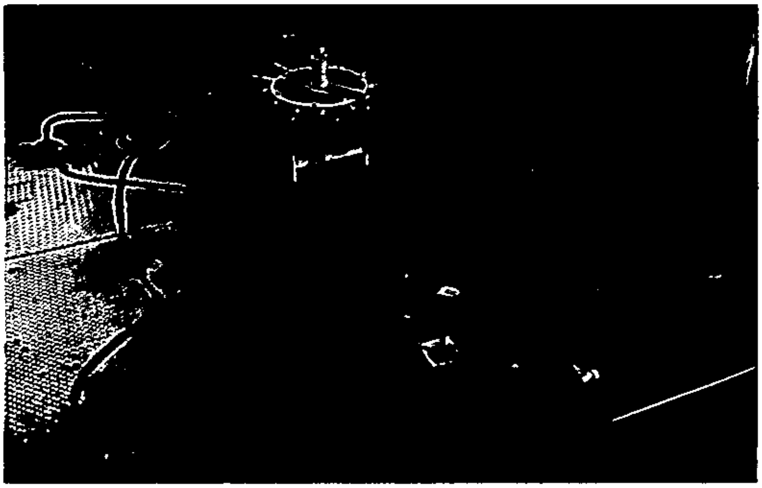
---

**'Octopus' offers a new upswing in profitability to the brick industry.**

Here's another breakthrough in solid-fuel utilisation – a dramatic improvement in kiln-firing techniques that has already proved itself in Britain's leading brickworks. Each of the tentacles of the 'Octopus' is a distributor-pipe which blows an air/coal mixture into the kiln. The coal burns in suspension inside the kiln, so that combustion is uniquely complete and uniform. The even distribution of heat makes control of temperature more exact, which is especially important where the firing cycle is fully automatic. Thermocouples inside the kiln can be linked to the feeders and control the temperature to within 10° at 1000°C.

In practice, it is found that the 'Octopus' gives better quality bricks, lowers wastage, minimises fuel costs – with *no* off-setting disadvantages. One brickworks, for example, hopes to double its annual output from 6,500,000 to 13,000,000 bricks with the installation of a new kiln and an 'Octopus' firing system. Another raised its output of first-quality bricks from 80% to 95%, with 4% of seconds and only 1% waste.

Another advantage is that production can be speeded when the 'Octopus' is installed. In one 16-chamber continuous kiln, it has proved possible to fire one more chamber a week, on average. Conversion is easy, too. 'Octopus' can be installed without interrupting production. This is only one example of the way in which solid-fuel technology is keeping pace with the needs of the 70s.



*The 'Octopus' in action at the Throckley Brick Factory of the Northern Brick Company, in Northumberland.*

H

# Advisory Services.

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0742 306533

**North Western** K. Yates, Anderton House, Lowton, Warrington, Lancs.
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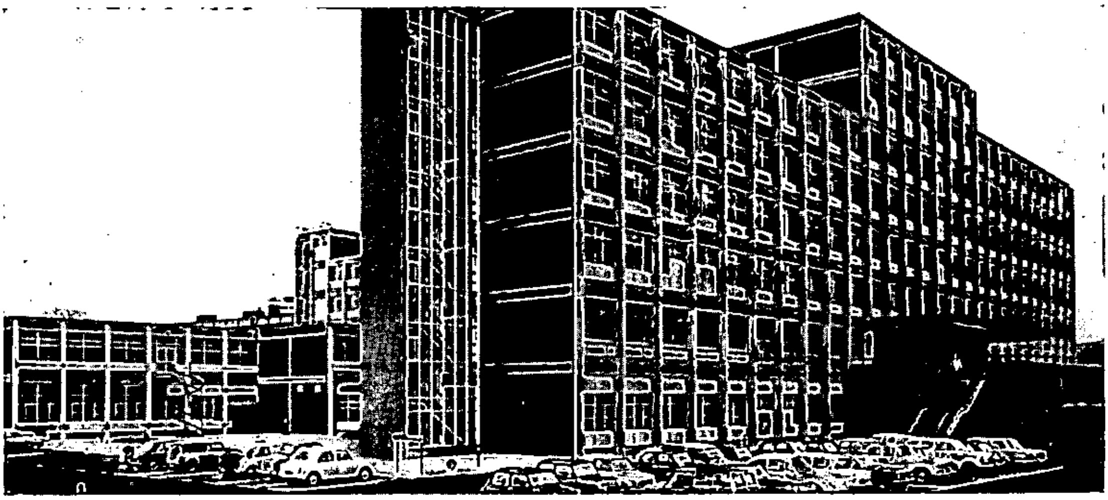
# You can make it with Coal.

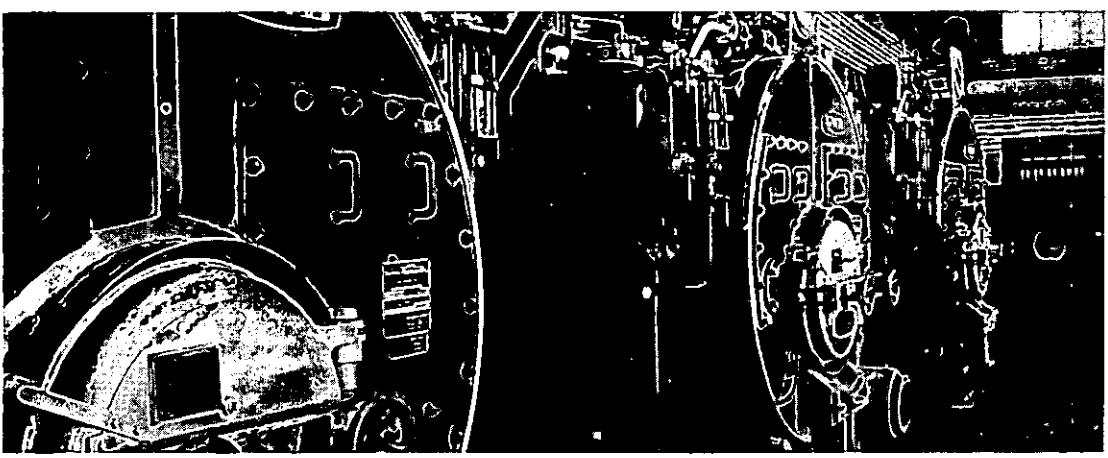
# Rowntree Mackintosh

# ney for Britain's Hospitals.



## AT BIRMINGHAM: coal saves National Health Service money

It is difficult to put an exact monetary figure on the economies produced by the new coal-fired boiler plant at Birmingham's Queen Elizabeth Medical Centre; it has been operating too short a time for accurate estimates to be made. But there is no doubt that the capital expenditure on this vast installation is producing large, continuous, and increasing economies in labour costs and the 'lb of steam per lb of coal' ratio.
The plant, consisting of 6 John Thompson wet back Economic boilers (each rated at 20,000 lb/hr) with John Thompson Triumph chain-grate stokers, serves the Queen Elizabeth Hospital, Maternity School, School of Nursing, School of Physiotherapy, the Medical School of the University of Birmingham and Birmingham Regional Hospital Board's Blood Transfusion Laboratories.
There is full Smith-Kelvin instrumentation, with an elaborate system of automated fuel feeding. John Thompson extractors feed the ash into a vacuum system by BVC Ltd., which delivers it into a storage bunker for periodic collection. This enables the labour force in the boilerhouse (6 men in all) to remain at the same level as that which operated the old plant, which was $\frac{1}{3}$ the size of the new plant.
The continuing development of the Queen Elizabeth Medical Centre will necessitate extending the boilerhouse, and this is already allowed for. The present consumption of 18,000 tons a year of Snibston Washed Singles will eventually be increased to 30,000 tons.
It is pleasant to think that every ton is offering greater efficiency to the hospital services at a lower cost to the taxpayer.



# These facts prove it, Coal saves mo

## AT DUNFERMLINE: up-to-date hospital instals up-to-date heating

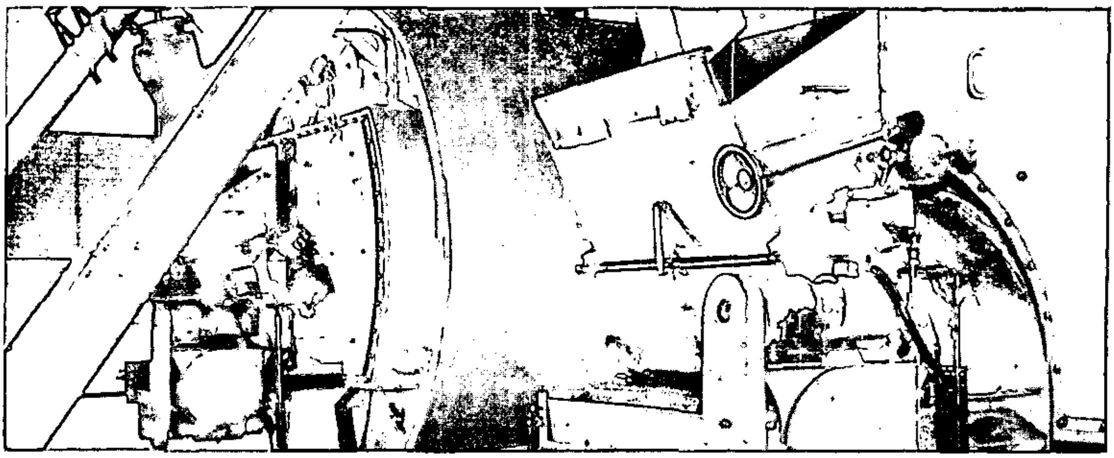
The Lynebank Hospital, Halbeath Road, Dunfermline is the first totally new, purpose-built mental hospital to be built in the United Kingdom for a full thirty years. As might be expected, it is up-to-date in its whole concept of treatment of mental disorders and up-to-date in the facilities it offers. It is a whole world in miniature, with its own school for the children, its sports, its film and drama shows, its church services, its workshop block.

Such a building must be equally up-to-date in its mechanical equipment – as, for example, the fully automatic coal-fired boiler plant which supplies all hot water and heating services. There is a mixed heating system (comprising warm-air units, radiant panels, underfloor heating, together with domestic hot water from a number of calorifiers), and the boiler plant itself consists of three John Marshall low-pressure hot-water boilers, each rated at 10,000,000 BThU/hr, and fired by Hodgkinson Bennis chain-grate stokers.

Coal is delivered into three low-level glass-lined bunkers by a tipper. From here, it is transmitted into the stoker hoppers by Hodgkinson Bennis 6-in. screw elevators, fitted with Redler 'Tidal' level controls. Ash is automatically discharged by a Riley 'Convator', the multi-directional conveyor-elevator system. This discharges the ash into a 7½-ton overhead hopper for collection by lorry.

Each boiler is fitted with 'Unitherm' automatic combustion control equipment, and the whole plant is fully instrumented by Cambridge Instrument Company indicators and control panels. Lea coal meters and recorders are fitted to each boiler.

Lynebank Hospital provides an excellent example of combining low-cost fuel with the advantages of sophisticated control equipment.



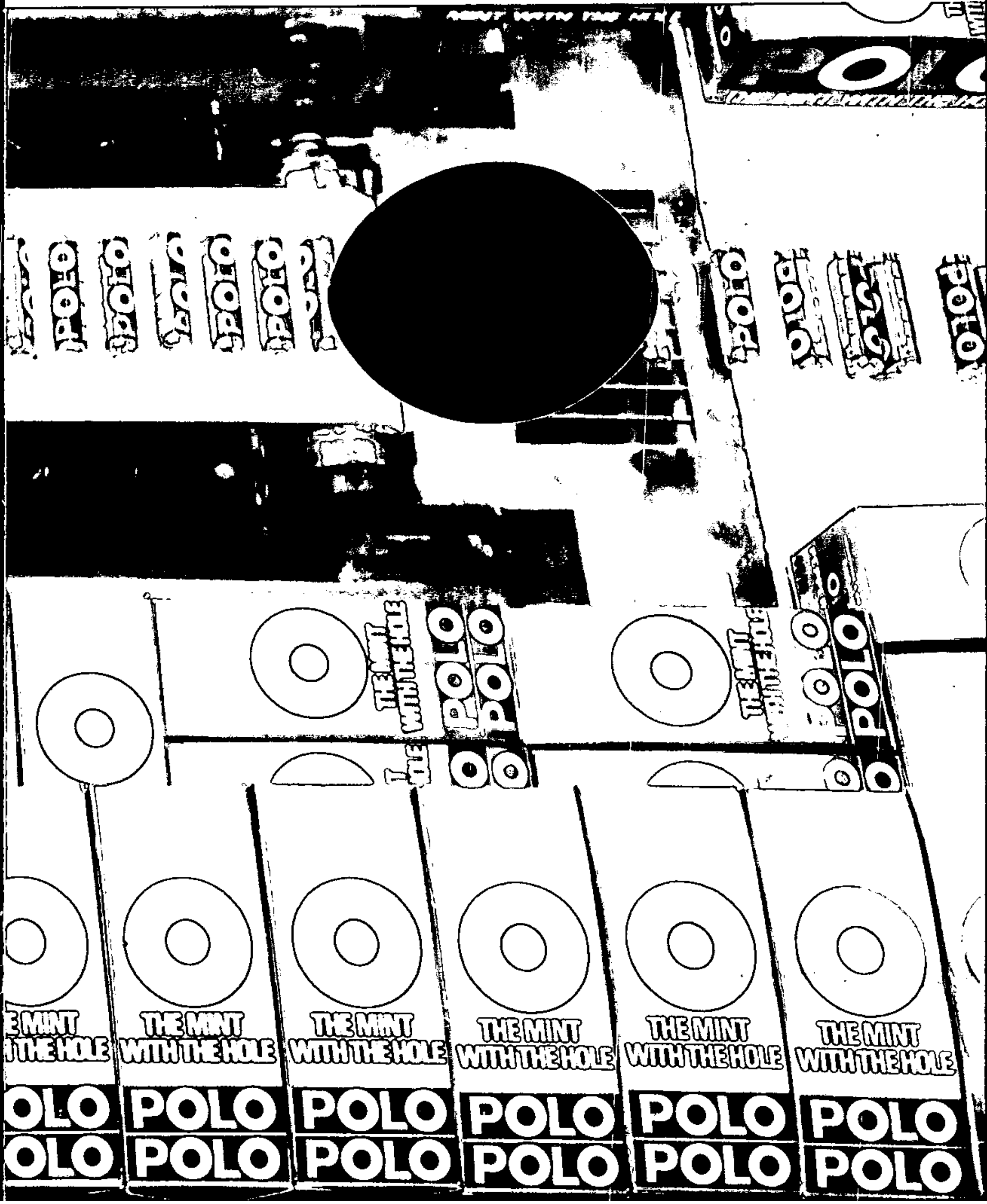
## AT GRIMSBY: another hospital relies exclusively on coal

When a heating plant reaches the end of its useful life, the vital consideration is the fuel that will be used in the modern replacement.

Most Boards (whether industrial or in the public service) will want to give detailed consideration to more than one fuel. So it proved in the case of Springfield Hospital, Grimsby. And – as so often happens – the decision was for solid fuel.

The obsolete plant was replaced by three GWB Model 100 Vekos Powermaster boilers, each rated as 3,450 lb/hr, pneumatically fed after screw extraction from storage bunkers. The total annual tonnage of fuel is about 1,300 of Washed Singles. The labour costs could theoretically be lower than they actually are, because Hospital Board rules call for 24-hour manning with one man per shift. Even so, costs are substantially lower than they were with the old plant – as it is a fairly recent installation, exact figures are not yet available.

# Rowntree Mackintosh are making it with Coal



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