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The Journal of the Institute of Hospital Engineering

Vol. 24 March 1970

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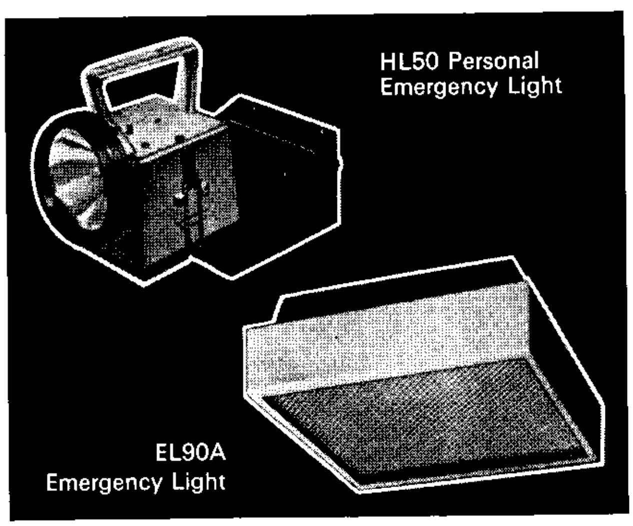

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Green Paper

One can well imagine that, for a long time to come, whenever engineers meet, the far-reaching recommendations embodied within the latest Green Paper, 'The future structure of the National Health Service', issued on the afternoon of the 11th February, will be the major talking point.

Reorganisation was, and is, expected. Indeed, in the minds of many people it is necessary if the service to the patient is to be improved, and 'unification', so often talked about, made a reality.

The main contention, that the three separate parts of the health service should be brought together, is not really in dispute. In addition, the accent on local participation will presumably be welcomed by many. Quoting from the Green Paper, where it refers to the principles of the new health service:

> These four aims—unification, co-ordination, local participation and effective central control—must be achieved if the weaknesses of the present service are to be countered. The reorganised National Health Service should also provide an administrative structure in which ill-health prevention, and health promotion, can be given a fresh and stronger emphasis.

Passing from the general to the particular, one can immediately sense the concern that will be in the minds of hospital engineers when they realise that their future is in doubt. (I should make it quite clear that engineers are far from alone in this respect.) The design of hospital services, the building of new premises, and the maintenance and operation of all existing and new premises, must, of course, go on, and presumably with the increasing need for hospitals the volume of work in this direction will increase.

The Green Paper, quite understandably, is not very explicit on how, for instance, services shall be maintained and operated, although mention is made of the necessity of engaging professional officers with specialist knowledge. However, the statement 'the weight of work on supplies, building and engineering functions would probably call for a separate department or departments for this purpose' (when discussing the organisation of Area Health Authorities' headquarters staff) seems strange. Can there be any doubt of the necessity for a department to deal with building and engineering functions?

It is suggested that the planning, progressing and execution of major building schemes should in future be performed by the Central Department, either directly, or through regional offices. The gathering together of this considerable workload into one monolithic organisation presumably takes its pattern from the present Ministry of Public Building & Works, so that there is indeed a vast storehouse of information and experience available to those who will ultimately advise the Secretary of State. However, there are differing opinions on whether this complete centralisation is the right approach, if the progressively increasing programme of hospital building is to be carried through successfully and efficiently. Within the technical departments of the Regional Hospital Boards there is considerable expertise. One would think that this would be available through, for example, staff transfers to the Central Department's regional offices, but the Green Paper does not make this absolutely clear. Certainly the collection, sorting, analysis and dissemination of information by a central authority is a very much needed function which is now met only partially.

While standardisation and rationalisation are so necessary to push forward the building programme, they must not be allowed to inhibit or restrict the designer, and so impede the development of planning and building techniques. This all too obvious problem, which is likely to occur within any large centrally controlled organisation, was to some extent overcome by the autonomy vested in hospital boards as planning and building authorities.

The health service is what its name suggests —an organisation to help people by providing all aspects of medical care. Therefore we, as engineers, providing a supporting service, must be careful not to allow our individual thoughts and anxieties to damage the overall concept. Nevertheless, we are well within our rights in asking the Secretary of State to take due account of the very important role of the engineer—a role which is increasing in its complexity as engineering techniques become used, not only to provide the right environment for the patients, but also to devise and manufacture the equipment used to treat them.

Continuing education

This month we begin a short practical 'course' in electrical-installation testing (see pp. 63-64). This is intended to be of particular use to those younger engineers whose training has largely been in the field of mechanical engineering, though it may prove a helpful 'refresher' for others. The course is written by A. Egley, C.Eng, M.I.E.E., M.I.PlantE., who is the assistant regional engineer at the Sheffield RHB, and it is reproduced with the permission of the Sheffield board.

The venture is in the nature of an experiment. Time only will tell whether it is really useful. As a start, we intend to give the course some semblance of permanence by printing it as a series of 2-page features, so arranged that they can be cut from *Hospital Engineering* if required and kept for future reference.

When the course comes to an end, the scheme may finish with it, but there are several others that could be presented. The decision as to whether to continue the idea, with courses on, for example, onsite generation or high-voltage supplies, must lie with the readers. There are around 24 text pages in the Journal, and the course will thus occupy about one twelfth of this. Perhaps it would then be reasonable to hope that courses such as the one beginning in this issue would be useful to at least one twelfth of the readership. In which case before the first course ends we hope to hear from at least 125 readers. If we do so, we shall continue. Drop the editor a postcard.

Instant home extensions for kidney-machine patients

Portakabin Limited, York, has developed a range of specially designed portable buildings to house kidney machines for patients who require extra accommodation for home treatment. These units, produced in conjunction with the medical authorities and County Architects, can be installed within a matter of hours of arriving on site, eliminating the delays encountered with modifications or extensions to existing houses.

The first of the new units was recently installed in Taunton, Somerset. Dropped by mobile crane into the back garden of the patient's council house, where there was little space available for conversion or extension, the unit removed the problem of the patient having to move from her existing house to a larger one.

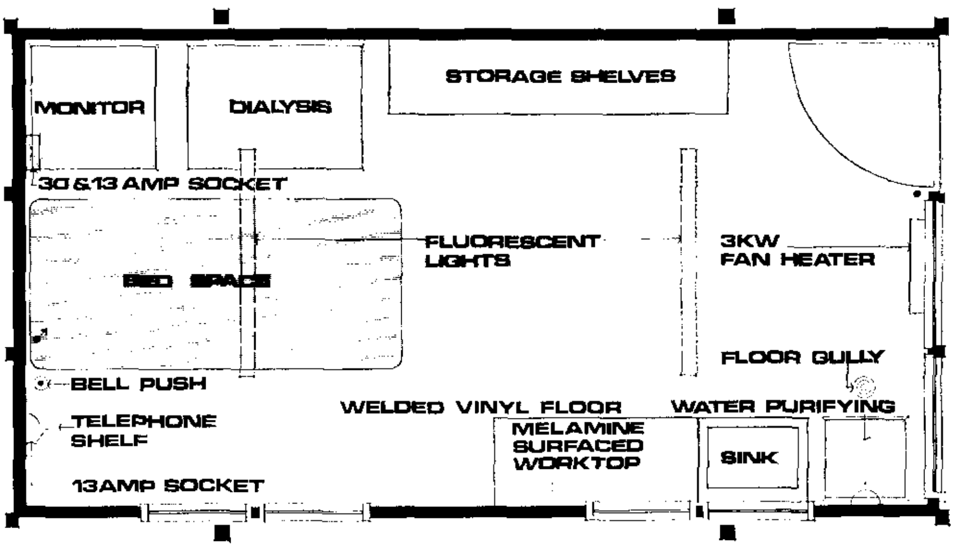


Fig. 1 Internal layout of the kidney-machine unit

The Portakabin building, a modified version of the standard PK16 model, measures 8 x 16 ft, and immediately it is positioned onsite it needs only to be connected up to water, drainage and electricity mains to be ready for use as soon as the kidney machine has been installed. With adjustable lodastrut legs there is a minimum of foundation work.

Special internal fittings include a 24 x 18 in sink with adjoining worktop, generous storage shelves for the chemicals needed to sterilise the equipment after use, and a battery-operated push bell in case of emergency. Electrical fittings include a thermostatically controlled fan heater, points for telephone, bedside lamp and cooker, two spare points and fluorescent strip lighting. Other medical equipment, such as water-purification unit, dialyser, monitor and bed, supplied by the NHS, will also be installed by Portakabin if required.

Structurally, the unit has a welded-vinyl floor with a drainage gulley, high-level windows, and an internal lining conforming to BS 476 Class 1 spread-of-flame rating.

The cost of the Portakabin unit- in the range £500 – £700—compares favourably with the cost of building extensions and modifications. However, the main advantages are to be seen in the speed of erection, delivery and convenience, which eliminate the lengthy planning, costing and construction work needed with traditional building. At the same time the unit can be transferred to another site with little difficulty should a patient ultimately move to another house. In the same way the unit can be delivered in advance, so that it can be used on hospital premises for training before the patient actually commences full-time home treatment. During this period, a patient will normally attend hospital two or three times a week, and afterwards will spend probably three nights a week at home actually using the kidney machine. By providing accommodation much more quickly, the patient is enabled to resume an active social life much earlier.

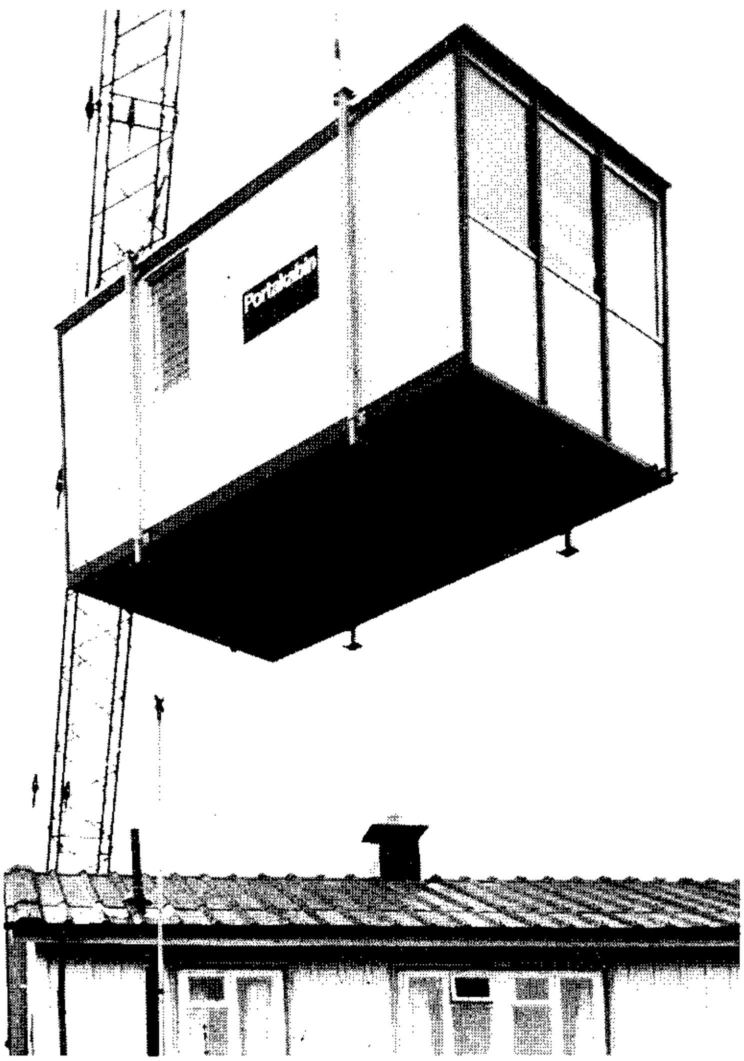


Fig. 2 First Portakabin kidney-machine unit being delivered. It was winched over the patient's home by crane and positioned in the back garden

A smaller version of the building, measuring 10 x 8 ft, has also been developed for use where space is at a premium. Both models are suitable for larger centralised layouts at hospitals or treatment centres where there is no available space in existing buildings to accommodate special dialysis units.

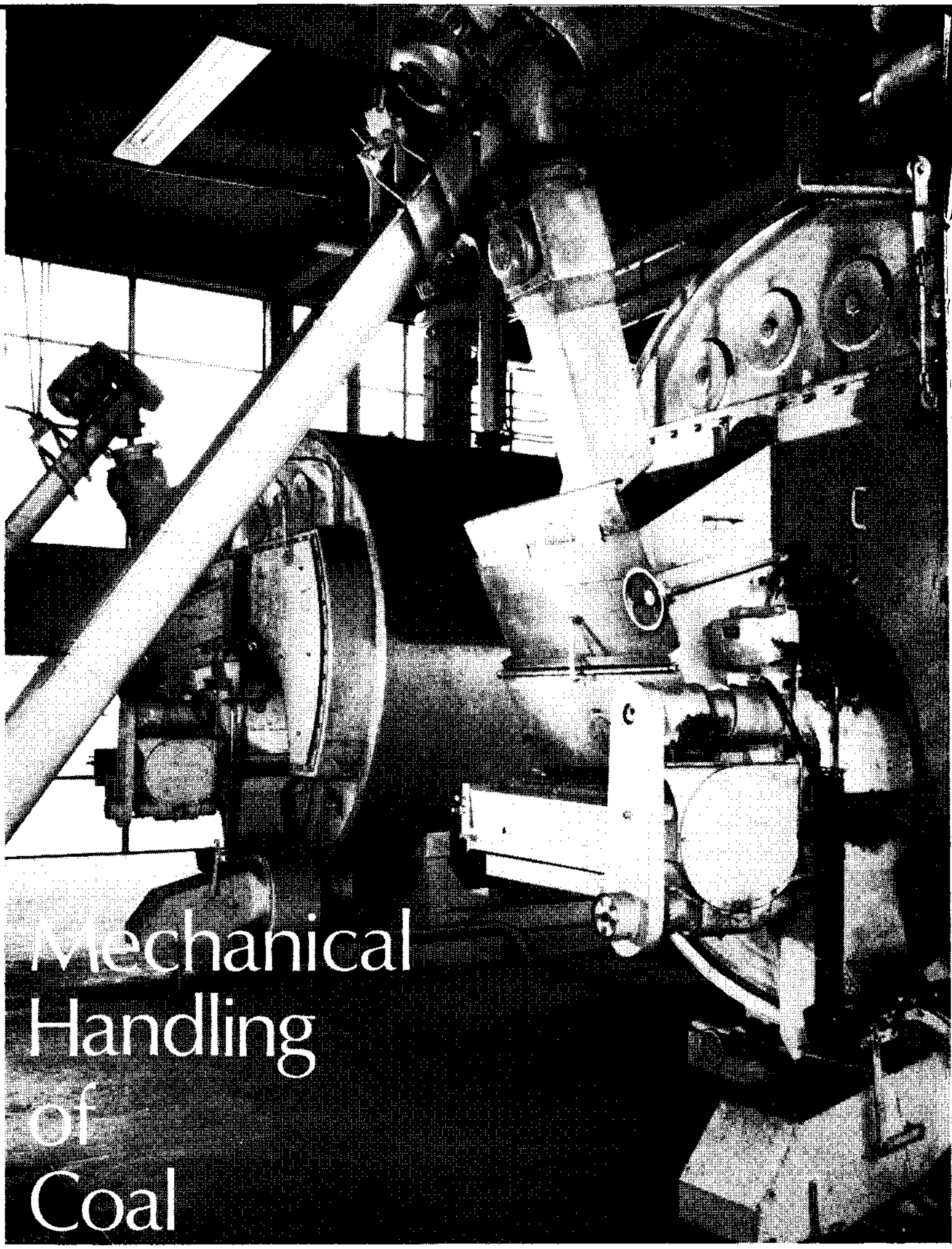


Fig. 1 Screw elevators feeding the low-pressure hot-water boilers in the fully automatic plant at Lynebank Hospital Dunfermline

Mechanical Handling of Coal

by Norman Glensy

1 Introduction

Although modern coal-fired plant is today synonymous with the concept of automation, and new boilers and their control equipment are greatly stressed, the mechanical handling of solid fuel tends to be less emphasised. The availability of present-day handling equipment has presented a situation where the need for manual labour—once thought to be part and parcel of coal firing—has all but vanished from present-day industrial coal-fired plant. Together with automatic coal-combustion control, providing smokeless, economic and efficient usage, mechanical fuel and ash handling produce a measure of automation comparable with any other primary fuel. This survey looks at some of the available mechanical coal-handling methods.

Although certain stokers convey coal directly from bunker to boiler, most are fed from an integral hopper, which has a limited storage capacity. The problem of keeping the hopper replenished is the primary problem in coal handling—with a boiler capacity of 20 MBtu/h a man would have to feed the hopper continuously, while a capacity of 15 MBtu/h would require the full time of an operator for feeding coal hoppers and removing ash.

Unlike the operation of hand-fired boilers, this does

Technical Press Officer, National Coal Board

not call for highly skilled workers, but the difficulty of finding staff and the cost of their wages mean that, in order to retain *all* the advantages of coal, it pays to adopt some mechanical means of filling the stoker hoppers. The principle has long been recognised for very large installations, but nowadays it is just as important for small and medium-sized ones. Present practice is therefore to convey coal from the storage bunker to the stoker hopper and boiler with no more human intervention than occasional examination and setting of controls, plus a periodic servicing of the installation. As a result, many appliances have been developed to carry out such work. Which of them is used depends largely on the particular installation, as all of them are capable of fully automatic control.

The ideal arrangement for the handling of both fuel and ash is obviously by gravity feed of the fuel from lorry to store and from store to boilers, and of ash from boiler to ash store, but this is seldom possible. A compromise then becomes necessary; this is effected by the adoption of mechanical handling. One of four main types of conveyor is most generally used, either singly or in combination, in small to medium plants. The four in question are screw conveyors, bucket elevators, drag-link conveyors and en-masse conveyors. While the screw is perhaps the cheapest, the en-masse conveyor is certainly the most versatile. Among the factors to be considered, when the choice of the conveyor or combination of conveyors best suited to the particular boiler plant is to be made, are the number of boilers to be served, the relative positions of the boilers and fuel store, the permanency of the installation, the grade of coal to be burned and the time to be spent on servicing. One must not, of course, rule out the application of one of the lesser-known forms of mechanical handling if its suitability is apparent; the skip hoist and the overhead monorail grab are just two examples.

2 Screw conveyors

Where coal has to be carried for only short distances, screw conveyors (Fig. 1) are popular because they are relatively inexpensive to install, require little maintenance, and will handle up to 10 ton/h of fuel. They cost between £160 and £190, and a hopper-switch control for a single unit costs an extra £50. They can lift fuel at almost any angle, though, in general, the steeper the angle the greater likelihood there is of excessive fuel degradation (unless special counter measures have been taken in their design).

Individual conveyors differ considerably. They range from light-weight portable models, to heavy-duty permanent installations giving continuous operation. The screw is normally driven at 400–700 rev/min, but some operate at speeds as low as 100 rev/min to minimise wear. For the portable versions a bunker is not strictly necessary as they will pick up fuel from a heap, and, although the heap generally needs hand trimming, this means that installation time is short and that the cost of civil-engineering work may in most cases be avoided. A permanent installation calls for a suitable bunker, and the manufacturers of the conveyor will advise on the best form of construction for it, or on the modification required to an existing one. Discharge can be arranged either for single or dual delivery. Head- and tail-end shafts are fitted with sealed bearings, and these assemblies are easily replaceable. Most manufacturers advocate the incorporation of a baffle board above the pickup to ensure that too great a weight of coal does not rest on the end of the screw creating the problem of fuel 'bridging' (also known as 'arching' or 'rat holing'), some incorporate in their bunker design other devices to make the screw easily accessible in the rare event of trouble. Screw elevators are particularly suited for use with existing plant, and may be used as a mobile unit.

Of course there are limitations, two of these being the size and moisture content of the fuel. 2–2½ in coal is probably the largest that can be conveyed, and bridging becomes a risk when smalls with a high moisture content are being burned. Certain manufacturers supply attachments to overcome these difficulties, either as standard or as an optional extra.

About 22 ft is generally considered to be the maximum length for a single inclined screw conveyor. Where the transfer distance is greater, or where a straight run from bunker to boiler is impossible, it is often possible either to link two screw conveyors or to combine one with another type of conveyor or feeder.

Screw conveyors are broadly divided into three groups:

(i) inclined
(ii) vertical and horizontal
(iii) open-screw feeders.

Simple inclined screw conveyors comprise the largest group, and, in fact, have the widest practical application.

The principle of this type of conveyor is that of the Archimedean screw operating in a tube, driven by a motor at the head. Capacity varies with the diameter of the tube and the rate of drive, and, to a certain extent, with the angle at which the conveyor is operating. On average, standard models are manufactured in the range of 0·5–10 ton/h capacity, but if greater delivery rates are required, special versions can be obtained. With screw conveyors, as with other coal-handling plant, operation is normally intermittent, and automatic controls can be provided to give the desired rates of feed within the capacity of the screw.

Next in versatility come the vertical and horizontal types. Vertical models are sophisticated variants of the conventional inclined version, but one manufacturer markets a model that can be adjusted to any angle from vertical to horizontal.

Open-screw feeders (Fig. 2) traverse heaped coal and transfer it to the feed inlet of a conveyor or of a bunker-to-boiler underfeed stoker. The combination of open-screw feeder and screw elevator can form one of the most economical store-to-hopper handling systems.

It should be noted that screw conveyors can also be used to replenish the magazines of gravity-feed boilers, or to fill elevated fuel bunkers.

3 Further handling systems

Although screw conveyors are a popular means of carrying coal from storage areas to the hoppers of boilers and stokers, there are many situations where their use is either impracticable or uneconomic. Typical of these situations would be one in which the store is so located, or space so restricted, that one of the following occurs:

(a) each boiler in a battery of boilers cannot be supplied by its own individual screw
(b) bends have to be negotiated
(c) coal must be elevated and then transferred horizontally
(d) the distance from store to boiler is greater than practicable for a screw conveyor.

These situations can be dealt with effectively by bucket

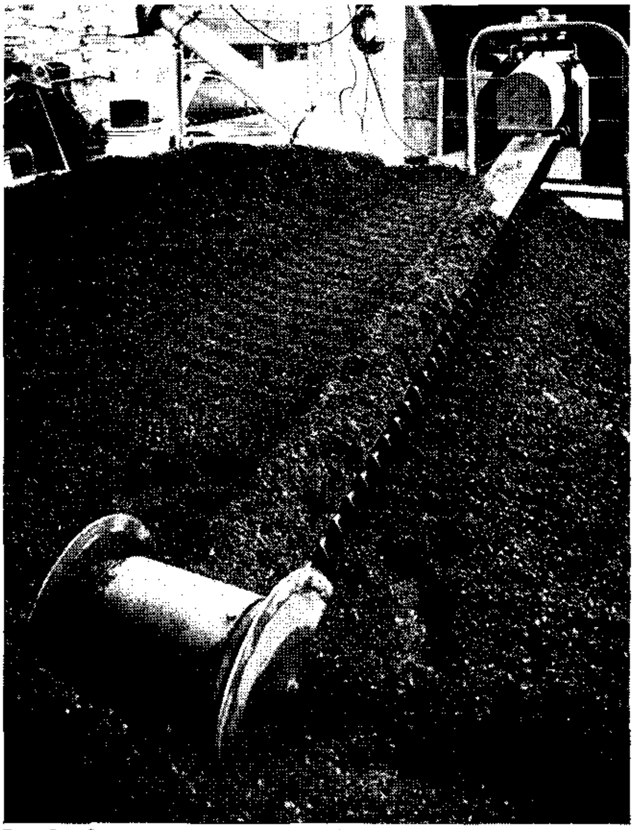


Fig. 2 Open-screw feeder capable of lifting coal up a slope of 10°–15°

elevators, drag-link or en-masse conveyors, or by one of several other less usual or well known methods that have proved extremely effective in certain circumstances.

3.1 Bucket elevators

The chain-and-bucket elevator (Fig. 3) is adaptable, can easily be fitted into a limited space, and is both simple and reliable, while in addition its initial cost is quite low. The totally enclosed case forms a clean unit, and its removable sections give easy access for any maintenance—which at the most is limited to the replacement of small and simple parts.

The five basic components that make up the standard bucket elevator are the feeding mechanism, the boot, the lower and mid-sections, and the head. The elevator may belong to either of two main types: chain and bucket or belt and bucket. When a vertical unit is installed, belt-and-bucket elevators can be used, but for an inclined installation these are not usually favoured because an allowance has to be made for the return belt to hang at a natural catenary, which would take up far more space than could be economically allocated. Hence, even though a belt-and-bucket elevator has the advantages of the belt being more resistant to abrasion and having fewer moving parts, and higher speeds being attainable at lower noise levels, in a situation where space is at a premium the chain-and-bucket type of elevator may ultimately be preferred. Both types are clean in operation as the casing can easily be made dust tight.

Bucket elevators, if handling singles or smalls containing only a small percentage of fines, run continuously without blockages and with very little maintenance. If, on the other hand, the coal contains a large proportion of fines and these are handled in a bucket elevator, some form of simple regular cleaning programme must be carried out. Reports of the time required for cleaning, however, tend to be exaggerated; half an hour every two or three days is usually enough to keep an elevator in good working condition, even during peak usage. Moreover, manufacturers have experimented with the shape of the bucket, and with the material of which it is made, to reduce clogging to a minimum. At least one manufacturer has introduced a simple but effective device which, it is claimed, eliminates manual cleaning. In choosing the means of carrying coal from bunker to boiler, it is therefore unwise to allow the problem of bucket cleaning to outweigh all the virtues of the bucket elevator. In addition to its cleanliness in operation and the ease with which worn parts can be replaced, it is

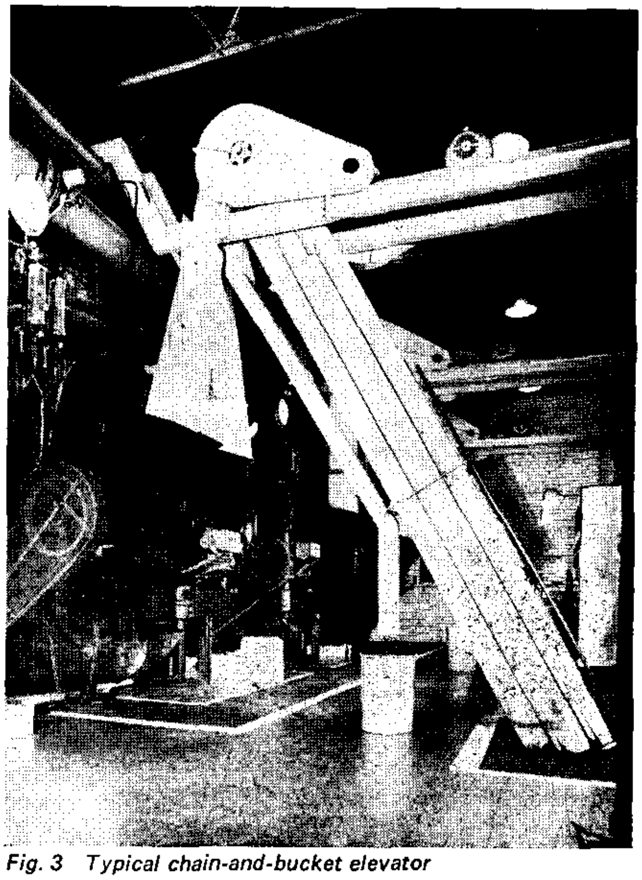


Fig. 3 Typical chain-and-bucket elevator

inexpensive to install, and can be arranged at any angle between 60 and 90°.

A simple bucket elevator and drag-link conveyor system, including builders' work, for two or three boilers each of about 10 MBtu/h, would cost up to £3000. Such an installation could reduce the labour required by one man per shift. With one shift working this would show a saving of up to £750 per annum, and the capital cost would be recovered in four years. With a 2-shift operation the outlay would be recovered in two years, and with three shifts it would only take sixteen months. In installations of four or more boilers, a very good case can be made for complete coal and ash-handling plant.

conveyor of 6 in internal width has shown that it can handle up to one ton per minute.

The technique of fixing the flights to the V belt by extended attachments or tongues permits a light conveying medium, and while chain conveyors of similar capacity have chains weighing up to several pounds per foot, the flighted V-belt may weigh well under one pound per foot. Thus a greater payload can be carried via a lighter conveying medium, resulting in a far lower power requirement. At the same time, the advantages of the totally enclosed ductless conveyor are maintained. The gentle movement with which the fuel is pushed along, in one solid mass without any dragging or scraping, means

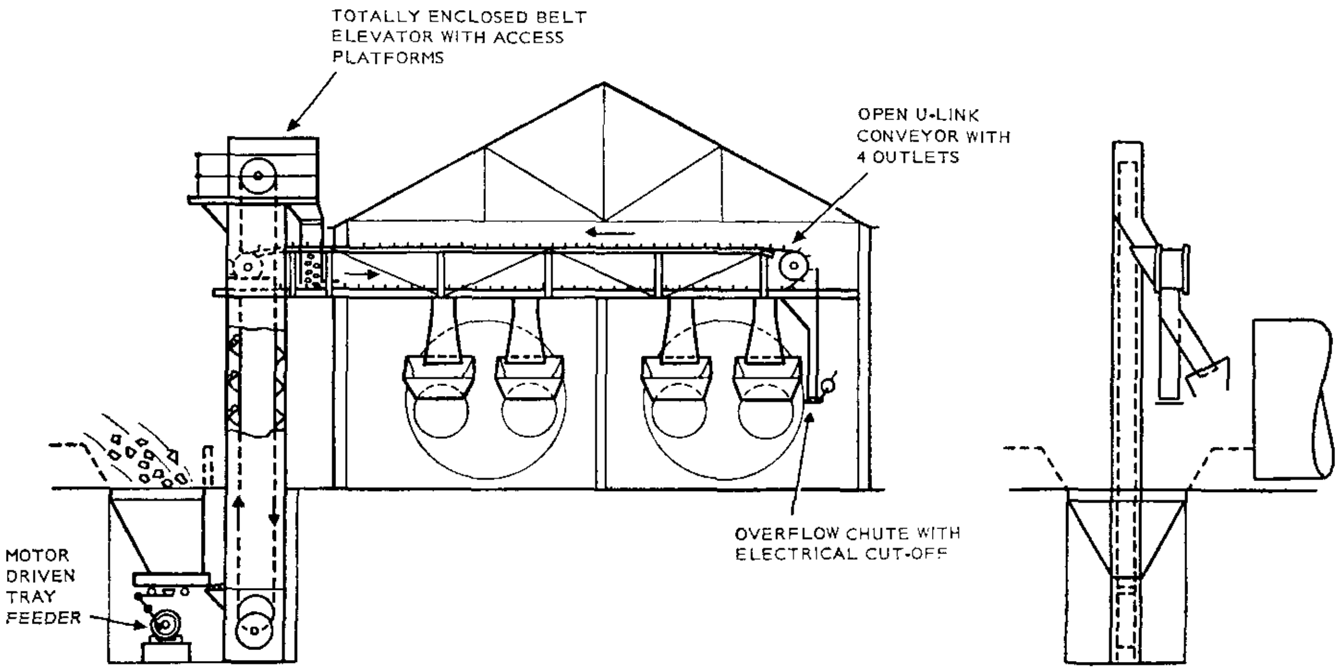


Fig. 4 Layout for a scheme incorporating belt elevator and U-link conveyor

3.2 Drag-link and en-masse conveyors

A U-link or drag-link conveyor, either alone or combined with an elevator (Fig. 4), is one of the cheapest methods of mechanically moving coal from a single point above the stokers to the hoppers. These conveyors consist basically of a trough through which a chain with regularly spaced flights is drawn. The shape of the flight varies, each manufacturer having his own preferred pattern. The drag-link conveyor is very cheap to install, being simple in design—a mild-steel flat is formed into the 'U' shape, thus combining the drag bar with the tension members, and the connection of each link by pins or rivets gives flexibility for running and driving. The carrying side runs in a mild-steel trough which has openings, at intervals, for discharge. Control at these points is exercised by draw-plate valves, which may be operated by hand or remotely by chain and wheel.

More sophisticated, and consequently more expensive, the en-masse conveyor has a number of advantages which could make it preferable in many installations. To cite the constructional details of one particular system, the conveying medium is a segmented or solid V belt operating through V-groove pulleys. In practice a small

that there is virtually no degradation, and again a single conveyor can carry in a horizontal, vertical or inclined plane, and can pass round corners without difficulty.

3.3 Conveyor belts

The conveyor belt is probably the most important form of handling for larger plants (those using over 100 ton/day). Being simple and robust in construction, with a totally enclosed driving mechanism of the ball- or roller-bearing type, it will readily achieve a high efficiency with very low maintenance costs.

For the smaller installation an additional alternative elevator is usually required. The reason for this is that belts cannot elevate coal at an angle of more than 30°, so that, where a steeper angle is called for, it is necessary to have a number of separate stages. On the other hand conveyor belts are relatively inexpensive. Widths of various belts are from 10 in upwards, and even the longest conveyors are carried on a single belt, without intermediate drives or breaks in the conveyor itself. This means that fuel, once placed on the belt, remains undisturbed for the whole length of the conveyor, so that the likelihood of degradation is minimal. One manufacturer incorporates special features to guide the belts, ensuring that they remain straight on their idlers under all conditions. The driving pulleys are designed to eliminate any spread on the shaft, their edges being supported by a web both to prevent breakage and to increase the power and efficiency of the drive.

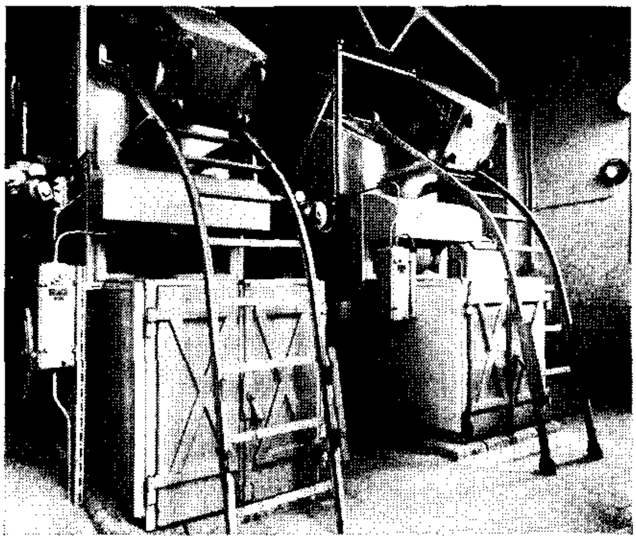


Fig. 5 Skip hoists supplying solid fuel to gravity-feed boilers

One form of conveyor belt on the market can, in fact, elevate the fuel at a steep angle, and gives a performance comparable to that of bucket elevators. The belt is made of rubber and fabric, and comprises three elements: a flat conveyor belt, fluted-skirt or corrugated sideplate elements, and flanges. Although the belt runs on straight rollers, its normal carrying capacity is claimed to be about 50% greater than that of a troughed belt of equal total width. This belt is obtainable in a number of different widths in the range 9–36 in, and the fluted skirt may be either 2 in or 3 in high. Cross flights may be incorporated, but if they are not used, the gradient at which this conveyor may be run will be over 10% more than that of a troughed belt. If the flights are used an additional 20% is achieved. This increased angle is due mainly to the fluted skirts, which act as if fully loaded, in much the same way as the flights of the en-masse conveyor. Operating speeds are high, usually exceeding those of bucket elevators.

4 Additional coal-handling methods

Although compact and reliable in operation, the skip hoist (Fig. 5) has the disadvantage of not being capable of very fine control. In large plants where this is not particularly important—magazine boilers are one instance—the use of skip hoists may well be appropriate. One manufacturer of such equipment makes both semi- and fully automatic models. In complete automatic operation, the skip ascends to the overhead bunker, tips and discharges, descends and opens the feed chute and reloads. This sequence is then repeated until stopped by the operator. For semiautomatic working the next cycle has to be reset by the operator when the hoist has descended to the feed point.

However, in smaller plants, especially where a boiler load is subject to wide and sudden fluctuations, more easily adjustable rates of feed are usually required. On the other hand, while it has some limitations where the fuelling of boilers is concerned, the skip hoist has proven very valuable in ash-extracting systems.

As an alternative to the above system, versatile handling has been achieved recently by running an electric hoist and grab on an overhead monorail (Fig. 6). This can be used to reclaim fuel from stock, to convey it to the boiler house, and then to discharge it into stoker hoppers or bunkers. This system can be automatically controlled so that all hoppers are charged automatically according to a predetermined programme. In an installation where a number of tracks are needed to cover a bunker adequately, points can be included to switch the carriage from one track to another. Should these points

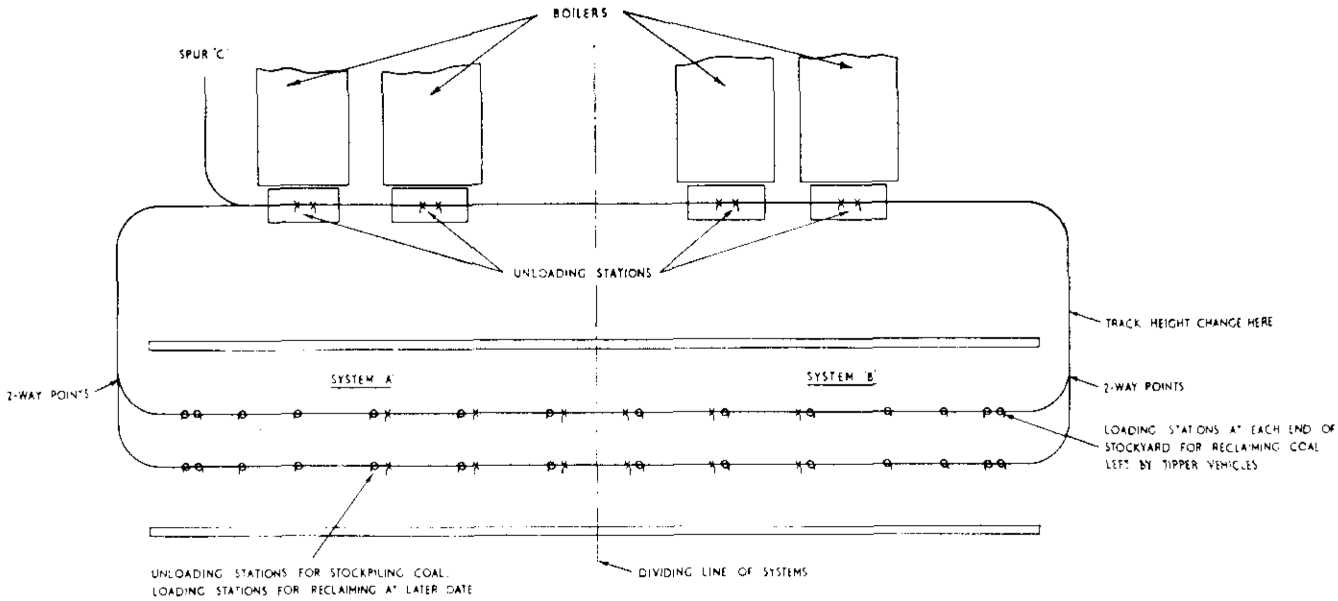


Fig. 6 Typical layout for 'Electro-Rail' coal-handling system

not be fully engaged a safety device will block the track. In the fully automatic installation, the points can also be operated from the control panel.

Another recent addition to the coal-handling scene is the pneumatic conveying system (Fig. 7). This is used to convey washed coal, ranging in size from 1–1/16 in, into overhead bunkers which feed the boiler's mechanical stokers. The coal, normally delivered to the plant in 12 ton loads, is tipped into a concrete bunker situated over the blower unit. As delivered, the coal has a moisture content of approximately 20%. Whenever coal is required in one of the bunkers the boiler operator sets a single control, which is placed in a convenient position close to the coal-preparation house. This governs the length of time the blower will operate before switching itself off, and so determines the amount of coal which

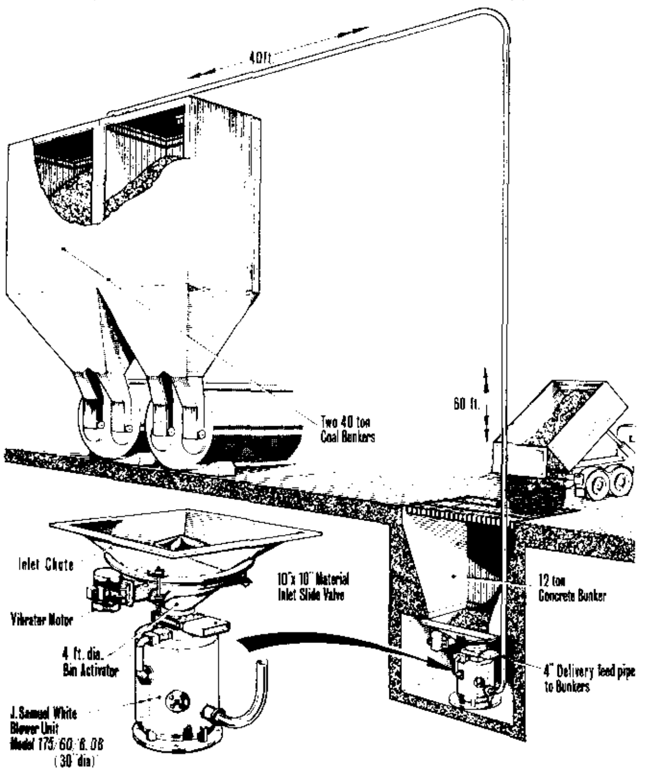


Fig. 7 Pneumatic conveying system

will be fed into the bunker through the pipeline, which has a total length of approximately 90 ft.

The operator has only to move a switch to set the blower in action. To enable the moist coal to flow into the material chamber it is agitated above the blower unit by a bin activator. The material-inlet valve on the blower unit opens, and closes after 10 s, during which time approximately 158 lb of coal flows into the material chamber. The blower unit is charged with air, and the coal is then blown to the overhead bunker. This cycle is repeated by a sequence timer, until a preset timer returns to zero, when the system stops. Air is fed to the blower unit from an air line at 100 lbf/in², and is reduced to 25 lbf/in². The system operates at one blow discharge per minute, thus enabling the blower to feed approximately 12 tons of washed coal into the bunkers in $3\frac{1}{4}$ h.

5 Automatic controls

The simplest form of control for the conventional screw conveyor is a push button for starting and stopping. Where more than one motor is involved, further starters can be fitted, and the plant attendant starts and stops the equipment. Overload trips are usually incorporated in the starters.

A common form of automatic control comprises a number of starters with adjustable thermal overloads, a timer, a relay and a level control. Level controls suitable for use in conjunction with conveyors are of two main types: diaphragm switches and probes.

5.1 Diaphragm switches

The diaphragm switch is a very simple piece of mechanism requiring little maintenance—all that is generally necessary to keep it in good working order is a periodic inspection of the diaphragm, which must be replaced as soon as it loses its flexibility. Probes require a little more attention; they have to be wiped clean regularly to ensure satisfactory working.

A typical unit consists of a housing, of which a rubber diaphragm forms one side, this being connected to a single-pole microswitch so that pressure on the diaphragm actuates the switch. The switch incorporates three contacts, two fixed and one movable. The fixed ones are contacted alternately, pressure on the diaphragm opening the closed circuit and closing the open one. Release of the diaphragm pressure permits the switch to return automatically to its original position.

The unit is bolted to the chute connecting the conveyor and the stoker hopper, or is fitted high up in conveyor-filled overhead-storage hoppers. The units can also be used low down to give a visual or audible warning that the handling machinery needs restarting or even, in certain favourable circumstances, may be used to start the equipment automatically.

5.2 Probes

These consist of a control box (which takes the place of the conventional contactor starter) and a combined microswitch and probe. This is clamped to the overflow chute of the elevator or conveyor.

At required intervals a test is made to determine whether the main chute is full or not. The test consists of starting the elevator motor by means of a process timer. If no coal has been used since the previous test, surplus fuel flows down the overflow chute and trips the hinged probe connected to the microswitch. If the stoker requires coal, the conveyor continues to run until the main delivery chute is fully charged, when overflow will again strike the probe. When the conveyor is stopped, the process timer is reset automatically and again measures the interval to the next test. The delay between each cycle can be hand set by turning a knob; this delay can vary from 2 min to 40 min, the setting being visible on a dial inside the panel.

For hand control, a switch can be thrown, whereupon the coal-handling plant will start and stop in the normal way. The plant can be started manually and left to stop automatically, irrespective of the setting of the timer, by pressing the hand switch and then returning it to the 'automatic' position.

* Browsing Around *

EVALUATING NEW HOSPITAL BUILDINGS

K. Baines, B. Langslow and C. C. Wade

King Edwards Hospital Fund for London, £1 3s. 6d.

Although an immense amount of time and money is expended in the planning, design and building of new hospitals, comparatively little effort has been made to evaluate the success or failure of the hospitals in practical use. This situation is now changing. Managements are becoming increasingly aware that bad design in buildings and equipment is costly, and at the same time designers are realising that there is a shortage of information based on practical experience rather than on theoretical calculation. This report highlights these facts, and gives recommendations for a future programme of studies related to the growing complexity of hospital planning and design problems.

In introducing their argument for the systematic evaluation of new hospital buildings, the authors make this comment:

> There is no doubt that all over the country mistakes in hospital design are being perpetuated. For example, nearly all the evaluation studies described reveal the great difficulty of maintaining the desired temperature in modern buildings. Many were too hot, some to the degree where working conditions became almost intolerable. At night, the buildings were often noisy and the lighting too bright or too dark. Time and again the reports show the misuse of carefully designed facilities; sometimes their underuse; sometimes their complete nonuse. In only one case was the building and equipment being used in exactly the way predicted by the skilled team which planned and designed it.

Against this background, the book sets out to describe the principles and methods that could improve the situation by making it possible for studies conducted in the conditions of day-to-day use to be an accepted and important part of the hospital planning process. The insistence is that normal management techniques can be adapted to the purpose, and that the work should be undertaken by those engaged at regional level in other planning and management activities.

The book represents an up-to-date analysis of the success or failure of recent studies, and is a practical handbook, combining the best approaches to the task of assessment. On one hand, it is an evaluation of evaluations: on the other, it is a valuable contribution to the methodology of its subject.

SAFETY CODE FOR ELECTROMEDICAL APPARATUS (Revised)

Hospital Technical Memorandum

Department of Health & Social Security, pp. 25, 5s.

The aim of this memorandum is to establish adequate standards in the design and construction of electromedical apparatus so as to ensure a high standard of safety from electric shock and from the dangers associated with overheating. It is also intended to ensure that controls are adequate and clearly marked, and that apparatus is conveniently accessible for servicing.

Clippings

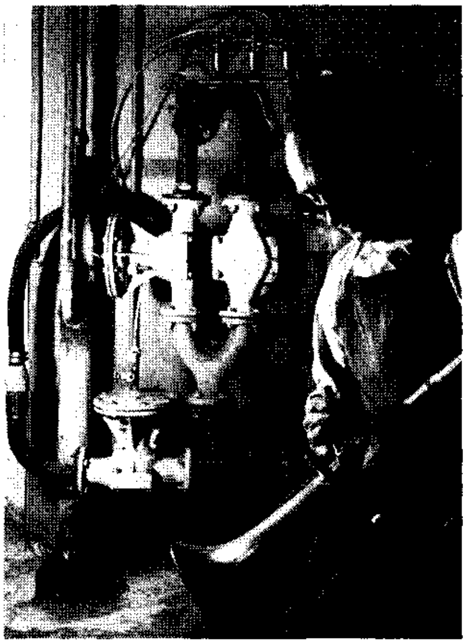
Patients of the Risca Health Centre (Mons) will soon have the benefit of a speedy and efficient minibus service to transport them to and from their doctors, since the bus is soon to be equipped with a radiotelephone system, which will enable the transport to keep in constant contact with the health centre.

The centre's five doctors serve over 14 000 patients and the radiotelephone will enable transport to be made readily available in the event of an emergency, no matter where it is at the time. In addition, expert advice will be given direct to the bus crew, if there is an emergency, as to how the patient should be treated.

The equipment will be supplied by Pye Telecommunications Ltd.

A new British-built computer in the Dutch Medical Registration Centre in Utrecht is the centre of a project in medical-data processing unique in Europe. The computer, a Honeywell model 125 built in Scotland, operates as a central statistical data base for a group of 110 hospitals.

The hospitals each send to the centre a complete case abstract of all patients as they are discharged, and these—personal details, diagnosis, treatment and results—are held in the computer. Full documentation and special statistical data are prepared by the centre, enabling hospital specialists and hospital administrators to receive a detailed hospital-activity anlysis, and to compare results in methods of treating diseases, with those obtained by colleagues elsewhere. Reports are sent out from the centre each month, but in view of the nature of the work, plans are in hand to expand the computer system to go online to the hospitals.



Putting the finishing touches to the first of the piped-music generators to be donated by the Inter-Group Wagnerian Ensemble. A spokesman said, 'We are convinced that the eventual installation of this equipment in every hospital in the country will radically benefit patients, and ensure their rapid return home'.

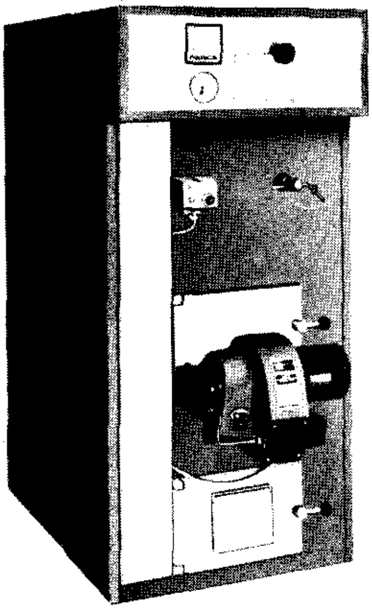
⁎ Market News ⁎

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

Combination boiler range

The Parca 300, 500 and 700, new combination central-heating/hot-water boilers, are designed basically for oil or gas firing, and have ratings of 140 000–480 000 Btu/h. Capacities in the upper range are achieved by the fitting of simple turbulators.

Types 300 and 500 are available with alternative integral water

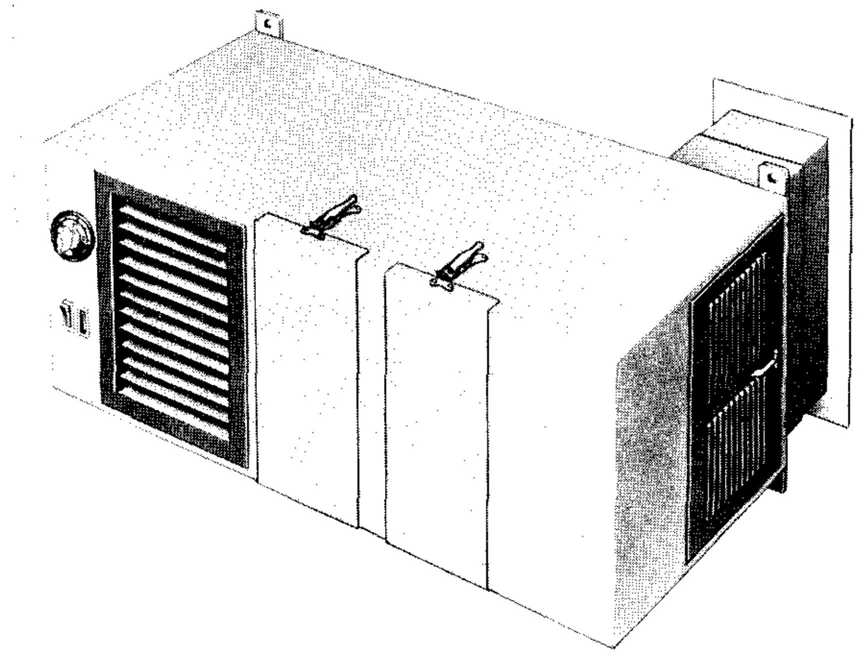


heaters; either with an instantaneous hot-water battery, or with a built-in copper hot-water storage cylinder. The Parca 700 is offered with battery water heater only, although, like the other two models, it can also be supplied as a heating-only boiler.
Parca Heating Products, 90 Staines Road, Hounslow, Middx. **HE60**

Foot switch

The extra-heavy-duty foot switch manufactured by Herga Electric is now available with a safety guard which shrouds and protects all moving parts and removes the possibility of inadvertent operation. It can only operate when approached from one direction, and its low profile makes it almost impossible to knock over. The switch is dust- and water-tight, and is available with optional extras such as a hold-on latch or double-action switching.
Herga Electric Limited, Northern Way, Bury St. Edmunds, Suffolk **HE61**

Packaged clean-air ventilation



The 'Vequip' range of fine-filter ventilation units has recently been extended, and standard models are now available to handle from 200 to 4000 ft³/min. In the smaller models switches and controls are built in with component parts easily accessible from the front. Filtration efficiencies can be varied to suit requirements from 95% to 99·98%, embracing particle sizes in the range 5–0·5 μm.

The activated-carbon filter element, when fitted, operates in the sub-micron range, and removes trace elements of fume and odour molecules. Double deflecting grilles are a standard feature enabling the clean air to diffuse without draft.

The units are designed particularly for situations where clean positively pressurised air is required at a controlled temperature.
Ventilation Equipment and Conditioning Limited, 320 Latimer Road, London W10 **HE62**

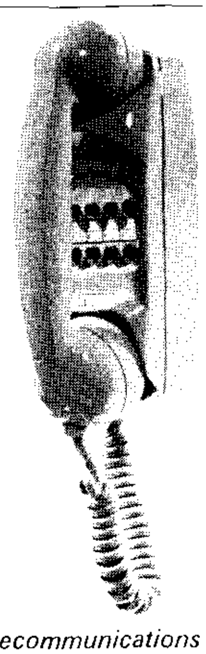
Intercom system

Small intercom systems are becoming popular and practical in factories, offices, shops, surgeries, schools and hotels, in fact wherever quick communication increases efficiency.

A. B. Telecommunications has introduced a range of small intercom systems which can be purchased rather than rented.

The range maintains excellent speech clarity and can be obtained as a two-instrument single-line system, with 5 buttons for 6-way intercommunication, or with 10 buttons for 11-way intercommunication. An 11-way executive master station is shortly to be introduced to complete the range.

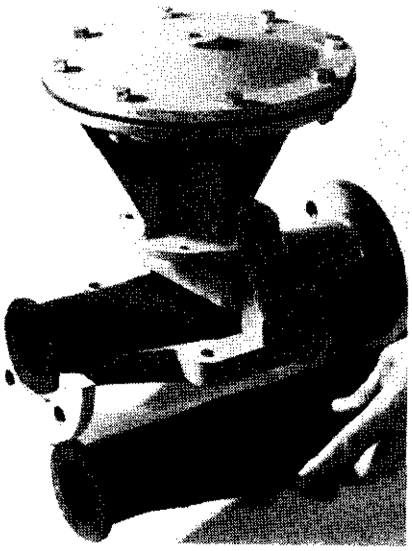
Battery or mains operated, the instruments are supplied with point-wiring diagrams, cables and clips, and are fully guaranteed for 12 months.



A. B. Telecommunications Limited, Block 9, Wolverhampton Airport, Pendleford, Staffs. **HE63**

Diaphragm valve

A Guernsey firm claim two design improvements over traditional diaphragm valves: the closing method has been completely reversed to eliminate flow-through obstruction and the associated stress problem, and replaceable liners have been introduced, superseding the normal



interior-bonded anticorrosion protection.

Prototypes of the 'ITS area rule valve' have been on test over the past twelve months on working locations, and three preproduction valves have had over 2000 h of satisfactory operation.

Channel Concessionaires Limited, 17 High Street, Henely in Arden, Warks. **HE64**

Automatic voltage stabiliser

Zenith Electric, makers of the Variac, have announced the introduction of their range of Powerstay automatic voltage stabilisers, which covers 2·4 kVA to 95 kVA single- and three-phase models. These protect and maintain the performance of all voltage-sensitive equipment by smoothing out fluctuations caused by seasonal supply variations or intermittent loading of local distribution systems.

The standard range includes many important features; in particular high-speed response and high accuracy, unaffected by normal environmental changes. There is no introduced distortion, and true r.m.s. sensing with a transistorised control amplifier.

Zenith Electric Company Limited, Cranfield Road, Wavendon, Bletchley, Bucks. **HE65**

Loop recorder

A new endless-loop recording instrument carrying vital information on a patient's immediate condition can assist doctors when they are called to a bedside at a moment of crisis.

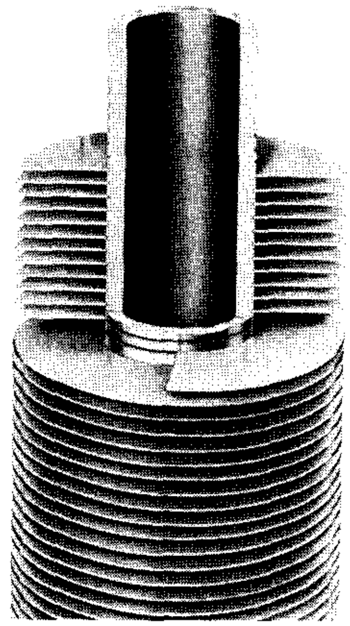
Named Pamela (Patient Automatic Monitoring Endless Loop Attachment), the instrument constantly records a patient's e.c.g. on magnetic tape over a 20 min cycle, wiping itself automatically. Should the patient's condition suddenly deteriorate, thereby actuating the monitoring system's alarm, the recording will continue for a preset time, say 5 min, and then stop. Thus the doctor, when he arrives, has a record of the e.c.g. immediately before, during and after the moment of crisis.

The taped signals may be fed into a pen recorder or an oscilloscope for further study if required.

S. E. Laboratories (Engineering) Limited, Feltham, Middx. **HE66**

Finned tube

An improved method of construction for grooved and peened finned tube has been developed by Hunt Heat Exchangers. Known as Keyfin, the new finned tube is produced by a process resulting in a positive, uninterrupted bond between fin and tube to ensure maximum thermal contact. Hence, a more constant heat-transfer

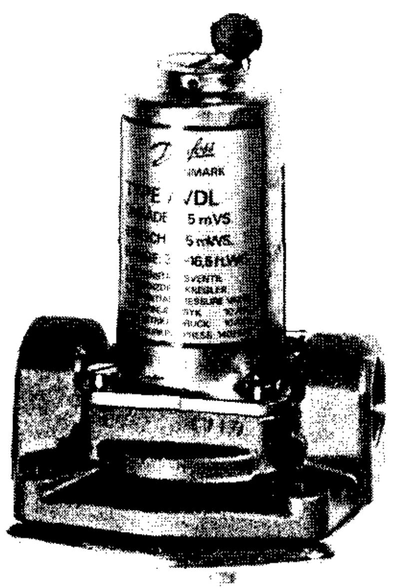


efficiency than previously obtained can be achieved, and the tube may be used for temperatures of up to 750°F (398°C).

Hunt Heat Exchangers Limited, Middleton, Manchester **HE67**

Pressure regulator

A new unit, type AVDL, from Danfoss, is a self-contained and proportionally acting water-pressure regulator. In large-scale heating projects, variations in load can cause pressure changes which affect the regulating capacity of the system's individual thermostatic valves. By using the AVDL these pressure changes can be avoided, and the differential pressure can be reduced to a level acceptable to the thermostatic regulating valves.



Available for three capacities, 0·6, 1·0 and 1·6 gal/min, the AVDL may be fitted in any position in the flow or return line. The maximum operating pressure is 142 lbf/in², the maximum differential pressure 65lbf/in², and the maximum water temperature 110°C. **HE68**

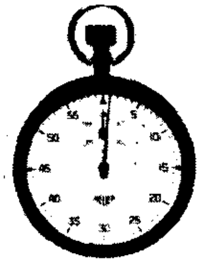
Danfoss (London) Limited, 6 Wadsworth Road, Greenford, Middx.

Trolley bumper

Primarily intended to take patients to and from the operating theatre, a trolley which is often used to do duty as a temporary bed in the recovery room, is also equipped for use as an emergency operating table, should circumstances demand it.

Designed and manufactured by S. Barford & Son Ltd., one of its particular features is the bumper rail, enclosing all the fitments, which has a capping of vinyl to prevent damage to walls. Called 'Marleyrail', it is smooth and as strong and corrosion-resistant as typical p.v.c. **HE69**

Marley Limited, Sevenoaks, Kent.



Work Study

Its Effect on the Design and Planning of Laundries

by L. A. Edwards

Hospital service departments need to be as productive as their counterparts in commercial establishments, and methods evolved in industry for increasing efficiency are being more and more widely introduced. The laundry is perhaps the prime example of a department in which work-study techniques can prove highly effective, but the lessons to be learnt will no doubt have application elsewhere.

Introduction

It is probably quite safe to assume that everyone has at some time been associated with, or at least has heard of, work study. Nevertheless, since its application has been mainly carried out by specialists in the field of management or industrial engineering, it must also be assumed that few will have used the special techniques associated with it.

I must start by explaining that work study, in its simplest form, is not a mysterious subject, only capable of being applied by highly trained personnel. It is within the capabilities of all—in fact another name for it could well be 'applied common sense'. However, having said that, I must qualify it by stressing that work study can become very involved, and demands patience, understanding, technical capability and tact, and something which in the final analysis is probably the most important of all, time.

The application of common sense is necessary at whatever level you work, but as you reach higher levels technique and craftsmanship become necessary; this is where the trained work-study engineer comes in.

Scope of work study

Work study is a method used to reduce or prevent waste of time in labour and plant, of motion in labour and plant, and of materials. These are the main considerations, but in seeking to achieve them, a considerable amount of measurement and study takes place, which, if carried out methodically, and with a systematic analysis of each stage of the work, gives rise to several important byproducts. In many cases these assume an importance equal to that of the main objective.

L. A. Edwards and Partners, Laundry Design Consultants

For example, it can show where increased output can be obtained through improved efficiency of existing methods and plant. It enables estimates to be prepared on the increased efficiency to be expected from proposed new methods, it can assist in the establishment of a production basis for processes, and it will reveal the causes of excess costs, and can be the basis of a closely knit control system. It is probably the only completely equitable basis for any system of payment by results, and the accumulated basic data can provide an accurate means of allocating plant loading.

For all this, work study is only a tool of management; it should never become the master.

In describing the introduction of the system, it would be best if I went through the subject as if actually carrying out a work-study investigation in a laundry.

Preliminaries

The first thing to do is to establish mutual trust between everybody concerned, the people with whom I am going to work for the next few weeks or months. This can be done while collecting useful information on the people, the plant and the products handled. So I start by collecting a reference-period file.

This will include a detailed count of every article produced in a representative period—two weeks is usually sufficient—as it is necessary to know exactly what is being handled in the plant. While this is being done, and it should be supervised closely, the plant can be examined in detail, and a preliminary assessment of its output capabilities can be made. This work entails mixing with the personnel, and provides the chance of getting to know them, and of establishing their confidence in your ability to do the job. It is also a chance to help them realise that what is being done is not a solo effort, but a team job, which concerns them as members of the team.

It is during this period that you try to get them all thinking about the job they are doing, and endeavour to sort out all the snags and problems that beset them. Many of the ideas for reduced waste will come from talking to the operators; their keen participation in the exercise will make the work much more pleasant, and the results will be better for it. At the start it is often a good idea to have a meeting of all staff, at which an outline of what is going to be done can be explained. It is particularly helpful if a few illustrations of the sort of thing you are looking for can be shown to them.

It is of vital importance that your initial sorties be successful. It increases the chances if you start where you are sure that you can get fairly quick results; so it is very important that your initial efforts are made with the operators who you know will co-operate to the full. You will have noted these during the reference period.

The chosen operators have their particular jobs to do. Select the job which occupies most of their time, and begin your work study.

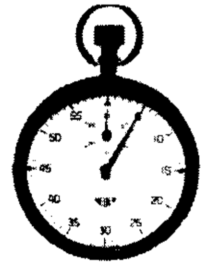
Technique

For recording the study details, a small piece of plywood with a pad of study sheets clipped to it is required. Explain to the operator that you are now going to carry out a work study on the particular operation he is carrying out. Make a note of everything that will be relevant at the top of the first sheet of paper; for example, operator name, the date, machine, steam pressure, machine speed, moisture content etc. Then take up your stand, preferably where the operator can see you—not too close, not too far away. Adopt a business-like attitude to discourage conversation during study, and make arrangements with the supervisor that you will not be interrupted.

Observe the cycle of operation until you are sure that you have seen the entire process. Then begin to break the operation down into the shortest possible elements, preferably about 5–10 s in duration. In this connection an element is a complete movement or series of movements; preferably a series of movements with a clear-cut starting and finishing point. Write a full description of each element down on the study sheet, and make any marginal notes that you think appropriate.

Each element of the work study may be given a symbol to denote the degree to which the element contributes to actually performing the task to be done.

Watch the operator closely, study his hand and foot movements, until you are sure that you have really covered the operation. Draw a simple sketch on the study



sheet showing distances—measure them if necessary. It is in this close elemental analysis of work that wastage is revealed. If a long element were taken, it might include some work and some waste, but since the whole was grouped together, the waste part cannot be isolated in subsequent examinations.

Let us assume, for example, that we are studying the pressing of a white coat. We may find on analysis that the operator has too many coats on the press at one time, and, as a result, she picks up and puts down the same coat several times. By careful work study this can be revealed and eliminated, but were the pressing operation taken as one long element, the frequent pick up and put down of a coat would not be recorded, and might well escape attention.

As a further example, the question of plant layout would not be examined, if the distances were not measured. Assume that there were four pressers all collecting work out of a common work container. We should find an element, perhaps occupying several seconds, describing the operators walking four paces to pick up the next coat and returning four paces to press it. Our examination of the work study would lead us to question the need for this, and as a result we would provide a work container for each operator so that these eight paces were eliminated.

In the overall assessment, then, we would endeavour to reduce the distance between operations by finding out how serious a loss of time was involved in the movement of work. Starting at the receiving department, we would try to enable the van driver to put the work in the closest position to the girl who is going to sort it, to save her time fetching and carrying. If it were not possible to bring the work straight from the van to the sorter, we would find out why, and if possible move the sorter's workplace closer to the receiving point, or see if there were any way by which the receiving point could be brought closer to the sorter.

Our studies would reveal the amount of time it took to get the bundles of work into the position from which the operator could most efficiently, and with the least fatigue, sort them. We would devise better ways for this to be done; by the time our studies were complete we might have revised the layout of the receiving and sorting rooms.

At the next stage—from sorting to wash house—we may find operators tossing work into piles on the floor on the opposite side of the sorting room to the wash house. The wash-house man will then have to push a barrow all the way from the washing machine, past the sorters, to the pile of work, where he will pick up armfuls to fill his barrow, and then return to the wash house.

Work study will describe this, and thought during the analysis will show that

(*a*) walking distance can be reduced

(*b*) by getting the sorter to throw the work straight into a barrow, the wash-house man will be saved the extra job of filling his barrow.

Ideally the sorter should throw the work into a trolley beside the washing machine. A study of the layout will show how far this is possible; there is always scope for improvement.

Time factor

I have deliberately refrained from mentioning the time factor hitherto, but we can no longer proceed without considering it. Obviously, the only way to prove that one way is quicker than another is to know how long each method takes.

It is evident that to time an operator without any other consideration would not be very accurate, because people work at varying speeds. Some people work quickly, some slowly, at certain times a fast operator may work slowly, and on occasion even the slowest operator will work briskly. Whatever the cause, it must be taken into account before any measurement of time can be made. In other words we have got to be able to time a fast or slow operator, and have some means of normalising the resultant elapsed time.

At the same time it is possible that the operator being studied will have a natural aptitude for the job which other people cannot emulate. For example there is the press operator who appears to simply flick a white coat onto the press buck, and it sticks there just as she wants it. She does not seem to be working fast, she makes the job look easy. On the other hand, there is the operator who lays a coat on the press buck and pulls it this way and that, and fusses over it until it lays as she wants it. She seems to be working very hard, but is actually wasting effort.

Both operators are doing the same job, but have vastly different time factors. Allowances have to be made for these variations, and it is therefore insufficient to know how long a certain operator takes to do a certain job. We have to know the effectiveness with which she does it.

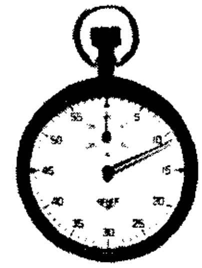
This brings us to one of the fundamental aspects of work study—the assessment of this effectiveness, which is called *effort rating*.

Effort rating

The question of effort rating is probably the most difficult aspect of work study, depending, as it does, upon judgement coupled with keenness of observation.

The set standard for effort rating is 60. There is no significance in the figure, except perhaps that it fits in with our time system of 60 minutes to the hour and 60 seconds to the minute.

A rating of 60 symbolises a normal operator working at a normal rate. Not fast—not slow. The universal yardstick is that of a person walking at 3 mile/h, which is normal. An effort rating of 40 indicates an operator working at two-thirds of normal, whereas an effort of 80 indicates an operator working one-third faster than normal. Following the yardstick 3 mile/h, 2 mile/h gives a 40 rating, 4 mile/h gives an 80 rating.



In order to bring the time taken to normal, we have to increase or decrease the time taken, according to the rating. The time taken must be multiplied by the effort rating and divided by 60. Thus if the time taken was 10 s at 80 rating, the normal time would be

$$10 \times \frac{80}{60} = 13{\cdot}3 \text{ s}$$

This then is the process by which we bring everybody's effort and speed to normality. It is a universal yardstick which is completely flexible, and applicable to any function except thinking. Note that special care must be taken in applying a rating when any deep thinking is involved.

Timing an operation

With the effort rating in mind we can return to the point where we had studied an operation, broken it down to its elements and prepared a study sheet. We now endeavour to place a rated time against each of the elements.

We need a clock to check the passage of time, and for the short periods which will elapse, a specially constructed clock must be used. This is, in fact, a stopwatch. I explain it this way because tact must be exercised when introducing a stopwatch in any workshop, as people are inclined to associate stopwatches with greyhounds or racehorses, and may resent the implication that you expect them to work excessively fast. Until they are used to seeing you with a stopwatch it is wise to propagate the idea that times will be measured on a clock. In due course this will be accepted.

A stopwatch with a snap-back action is the best tool to use, but takes a little practice. The idea is to let the watch run on while the operation proceeds, and then as the particular element ends, a quick but careful glance at the watch will tell the elapsed time, a snap of the finger returns the hand to zero and immediately starts recording the time of the next element. The noted time can then be written against the appropriate element. Do not confuse the snap-back stopwatch with those which stop at the first press, reset at the second and restart at the third. These can be used, but are not nearly as suitable as the snap-back variety.

It will be found that even for identical elements the time taken will vary, and for this reason several readings must be obtained. In fact readings must be taken until you are satisfied that you can make a fair selection.

It would appear that at this stage the work study is completed. In fact, it has only just begun and apart from any other consideration, it is imperative that you check to ensure that everything has been included. Your studies should link together like a chain, taking the article right through its process. If part of the operation is to pull forward a barrow full of work, obviously at some stage somebody has to push away an empty barrow. If an operator is wrapping up parcels, then obviously at some stage she has to get the wrapping materials. It may be that she can get a whole day's supply in one trip so that you do not see her make this trip. It is the responsibility of the work-study engineer to realise this, and, if necessary, in order to see what is involved, the operator's bench should be cleared, and she should then be asked to prepare her work bench again. Of course, it may be that a labourer is employed to keep her work bench stocked, in which case a note to this effect should be made.

Methodical examination

At last the preliminary study has been completed, and it now has to be really closely examined.

The object now is to think about all you have seen, and rearrange the sequence of movements to achieve a better product, in less time, with reduced operator fatigue. It will not always be possible to make startling improvements in all three directions, but it is usual to find that some improvement can be made in at least one direction.

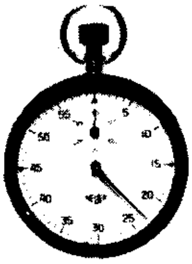
In order that every possibility should be explored, each stage of the operation should be subjected to severe examination. To simplify the process, ask

why?
how?
who?
when?
where?

Firstly, why should it be done? The answer is sometimes that it does not have to be done, and the operation can be eliminated completely. I found an example once of an operator folding shirts who took the pin with which she would secure the sleeves and passed it through her hair. She insisted that it made the pin slide through the material easier. The work-study chart revealed that to slide the pin through her hair took two seconds, and did not reduce the pinning time at all.

Secondly, how shall it be done? By handiron, calender or press. This way round? That way round? Folded double?

Thirdly, who shall do it? Never take it for granted that somebody automatically does a given job. It may be far better done by somebody else, and the work flow may be balanced better because of the change. Why, for example, should a special person be engaged to prepare tea towels? Would it not be far quicker for the girl who feeds it into the calender to prepare it as she feeds it? It may reduce the calender output, but it will reduce the labour cost. All you have to watch is that you still get the final output. It may be that it will be better for the press hands to fold their own work, or it may be better for a separate folder to be engaged.



Fourthly, when shall it be done? Should the sleeves of a white coat be pressed first, or should the yoke? Is it better to sort the various classes of small work in the sorting room or on the calender?

Finally, where shall it be done? There is plenty to say on the subject of work flow, and you will realise that this is a particularly important question (see under 'Planning').

Training

Having decided upon the changes it is wise to check thoroughly to make sure that there are no hidden reasons for not making the change. Then, when you are sure you are right, arrange with the supervisor to have the new method tried out.

Teach the operator carefully, make quite sure that she understands what you want, and see that she does it. When you feel that she can do the job satisfactorily, leave her for a while to work on her own. Make a visit regularly to ensure that she still does the job to your satisfaction. Finally, when the operator has a thorough grasp of the new method, check with the supervisor that the product is of the quality required. Everything being in order, you may leave the operator to obtain the maximum dexterity on the new method for so long as you think necessary

The final job is to go through the whole work-study process on the revised method. The procedure is exactly the same and in due course you have a new study, complete with a series of rated times. This should be converted into a full dual instrument of control, which may well be effective and useful for years to come.

Units of work

The first instrument of control to be derived from a satisfactory work study (or series of work studies) is a standard time or work value, expressed in standard minutes.

The unit of measurement is expressed as a fraction of a minute of work, plus a fraction of a minute of rest, adding to unity. The relative proportions of work and rest will vary from operation to operation, according to the nature of the strain imposed. The fraction of rest allowed is referred to as the *coefficient of relaxation*, usually abbreviated to c.r. An easier term would be 'rest allowance'.

Coefficient of relaxation

In order to present the results of a work study as a standard time for the job, it is necessary to normalise the selected time readings for each element, and to add to this the appropriate c.r.

The c.r. for each case must be taken on its merits. It must include time for personal needs, in many cases it includes an allowance for tea breaks, and in all cases it takes account of periods of rest.

We may find, therefore, that the c.r. comprises three parts as follows:

personal needs	7·5%
tea breaks (say two periods of 10 min in a 9 h day = 20 min in 540 min	3·7%
rest periods (on a heavy physical job for example)	10·0%
	21·2% (say 21%)

Therefore, if your normalised time is 12 s, adding 21½% to it gives 14·6 standard seconds, or ·244 standard minutes (units of work).

Standard time as a unit of measurement

This standard time should not be referred to as a period of time, but as a quantity of work. For example, an operator may produce 80 units of work in an hour, in which case she would be working at an 80 rating (sometimes called an 80 performance) assuming that she had used her c.r. during the hour. The operator should not get the idea that a job that is valued at 20 s.m. must take 20 min; she should aim to produce more standard minutes in a period of time than elapses on the clock, when she will be beating the norm. In places where an incentive bonus is paid, her bonus will be measured by the number of standard minutes produced in excess of clock minutes.

The use of standard minutes is not confined to bonus payments, by any means, as it provides an accurate method of calculating how long given quantities of work will take to do. For a better explanation of this a simple working example is given below.

A load of mixed press work has to be pressed, and the length of time it will take is to be assessed. Each group of articles must be multiplied by the time allowance, as follows:

150 white coats @ 240 s.m. per 100	=	360
35 pillow cases @ 80 s.m. per 100	=	28
72 pyjama trousers @ 100 s.m. per 100	=	72
140 nightgowns @ 185 s.m. per 100	=	259
total time allowed		719 s.m.

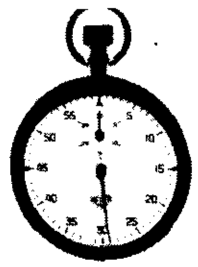
If the operator is capable of working at 80 performance, then this would take

$$\frac{60}{80} \times 719 = 540 \text{ min}$$

If on the other hand, the operator normally works at a 65 rating, then it will take

$$\frac{60}{65} \times 719 = 664 \text{ min}$$

It will readily be seen from this illustration that the uses of the work value are fundamental, not least the



advantages to be derived when planning new extensions.

Suppose, for example, that a hospital laundry was handling 40 000 pieces, and an additional hospital wing was built to yield a further 10 000 pieces. It would be a relatively simple matter to analyse the various articles to be handled by each department, and extend this by the work values to enable the exact amount of additional plant and labour required to be calculated.

Work specification

I have mentioned two instruments of control, and so far I have only described one of them. The second is the work specification, which is derived from the work study.

Having established the best method of doing a job, and trained the operator to use this method, it is important that some means be employed to see that these conditions prevail. The work-study engineer may go to Australia, the operator may get married, the various supervisors may retire or get different jobs. In no time at all the carefully worked-out methods, and the production schedule, will go completely awry, as the carefully devised methods will be forgotten.

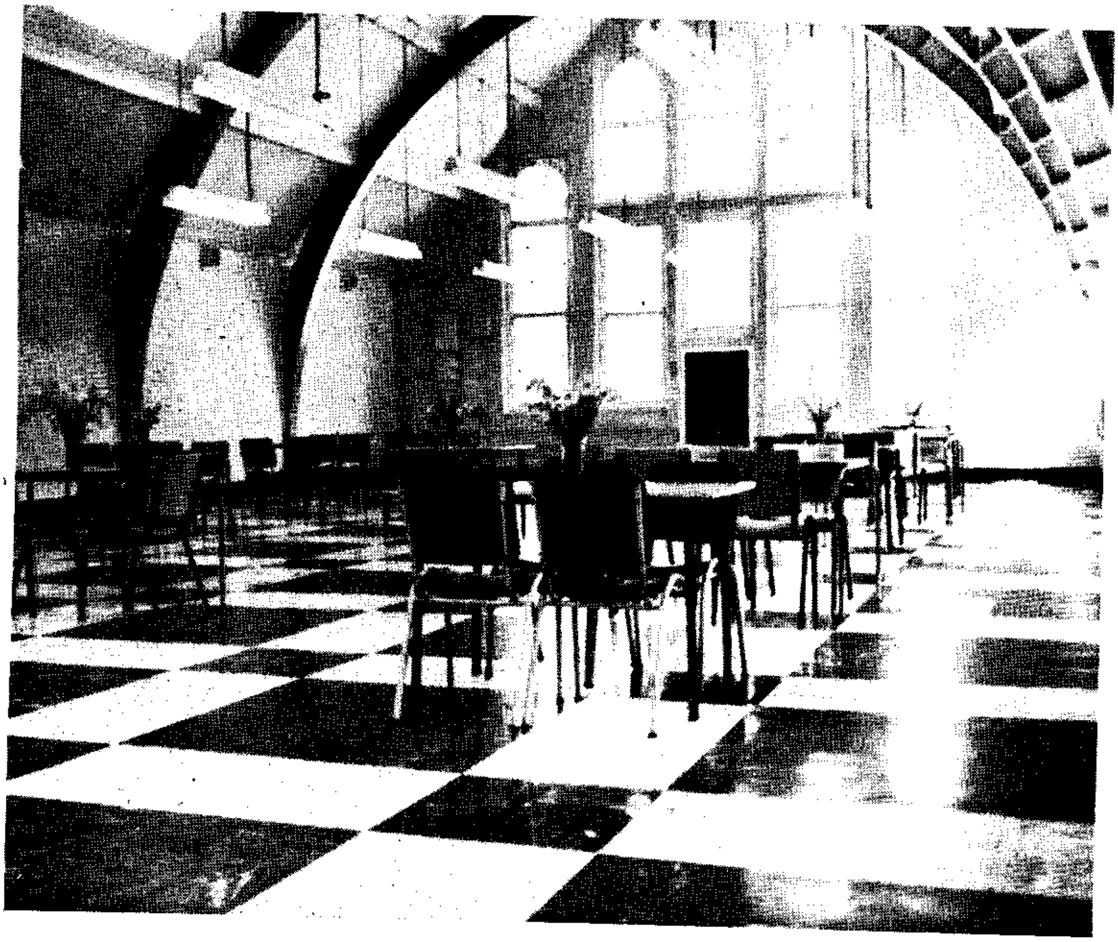
To prevent this, a work-specification sheet must be prepared from the work study. It is frequently used to summarise the work-study data. The work-specification sheet should contain all information as regards machine speed, steam pressure, air pressure etc. A small sketch showing the immediate layout is advisable. There should then be a concise, but very clear, word picture of the various elements comprising the operation, and the sequence of movements. An entirely different set of people should be able to take the specification, and from it establish exactly the same methods. New operators should be trained from a work specification; it is common for it to be copied and fixed to a piece of plywood so that the floor supervisor can use it in the works.

Use of work study in design

I have not mentioned the effect of work study on design. Many articles and machines have, in the past, been designed without any consideration for the person who is going to handle or process them, and you will have seen improvements in machines and articles in the course of your work which make life easier. You may be familiar with the old side-load tumbler, for example, and you will have noticed with relief the introduction of the simple end loader with its vastly improved handling technique.

Work study is not a new technique, and this example of rationalisation is taken from 1955. It occurred at the then Rubery Hill and Holymoor Hospitals.

The 'before and after' illustrations show: (top) wash house and hydroextractor room, and its conversion to the complete laundry (bottom) drying and calendering room, and its conversion to a completely new occupational-therapy department



If every industrial engineer were to work hand-in-hand with the work-study engineer, as some of them do, then we should see a rapid improvement in our equipment and plant.

In our particular trade, work study can tell the precise effect of a badly designed nurse's apron, or of a goffered nurse's cap. Critical analysis of a batch of sheets being calendered will reveal the loss of production due to the differing shapes, sizes and thicknesses which can accumulate after years of different suppliers or local manufacturers.

It is possible to recognise these things without the aid of work study—after all, we are at the level where work study equals common sense—but to reveal these things adequately one must settle down to the methodical collection of data and the analysis of it by work-study techniques. Then one can present an irrefutable case to the person who must take the necessary action to put things right. That is where work study goes beyond the realm of common sense, and demands a large degree of training.

Planning

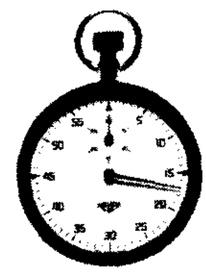
Finally, I want to mention the effect that work study has on planning and production control, which is the direction in which I am finding most use for it at present.

There is a condition of mind that develops with the continued use of work study. One gets to resent wastage in any form, and the most expensive wastage today is that of people's time. It is logical, therefore, that in setting out to design a laundry, or redesign one, the route along which work flows is given a lot of thought. If an existing building is to be used, the overall picture must be borne in mind. Where is it best to start? Where is it best to finish? What is the best path in between?

I find it very helpful to imagine that I am doing the work. I go over the operations and moves in my mind, thinking all the time of every detail involved, and seeing if any part of it can be done a better way. It is very difficult to explain the mental processes necessary to carry out planning based on work study; every situation may be different, so that the more thinking and the less taking for granted that goes on, the better will be the final result.

I suggest that one thing to do is to endeavour to make the next stage of progress follow on immediately, both in time and distance, from the previous one. Reduce storage time to the absolute minimum, and reduce the distance through which the work has to pass from stage to stage. Obviously a lot of work must be moved from start to finish, and one cheap way to do this is to use the machine as part of the movement. A calender is an excellent example of this. A 20 ft calender carries our flat work towards the packing room, and irons it at the same time. Add to this an automatic folder, and we get 30 ft of progress while our flat work is ironed and folded. This may seem obvious to you, but I have seen calenders that take the work away from the packing room. Another cheap way to move work is by gravity chutes, and roller conveyors can be used with no running costs if the layout is suitable.

A failing which really shrieks at me is the tendency



of people to accumulate work. Work tables, work barrows, shelves, ledges, under tables. Everywhere that things can be put, they are put, and the resulting appalling clutter is allowed to destroy the work flow and production balance in many laundries.

Laundry work should never be allowed to come to rest until it is in the packing room. I remember being told by a brilliant engineer, 'Don't let it touch the floor'. You may say that this is all very well, but laundry work is bulky, and cannot be handled like a box of nuts and bolts. Clearly, though, it is for this very reason that it must never be allowed to choke up the gangways. The use of work studies will show where unnecessary storage is being allowed.

In this connection, one must recognise where the driving force, the key position around which all other departments revolve, should be. And invariably, this is in the packing room.

In my opinion there is only one criterion, assuming that you have a balanced plant, and that is the speed with which the work can be pulled out of the production departments. It is absolutely useless for any department to produce work faster than the next. There is a constant feed in of work, a constant feed out of work, and which must be recognised, because it is the reason for our existence—constant use of linen to keep the supply going.

This paper has so far dealt with the practical aspect of work study, insofar as it is applied on the floor of the works. However, there are far wider applications in the machinery it provides for higher management—up to board-room level—in the field of planning and cost control.

Very briefly (because this aspect really justifies a full treatment on its own), with every productive element measured, it follows that if operators are to be paid by results, all of their lost time (i.e. time lost through no fault of their own), must be recorded and paid for as an excess cost. Such losses as machine breakdown, time off for first aid due to an accident, waiting for material, electricity failure, and any other source of lost time that occurs, should be recorded on each operator's work sheet.

It is by the methodical analysis of these work sheets that a works summary can be prepared, giving a complete analysis of any day's or week's or month's operation, for any individual, department or complete unit. These analyses, when read intelligently, will highlight all the good and bad points in a plant, and will provide data for future policy decisions and planning arrangements.

Part I

Electrical-installation testing

by A. Egley

1 INTRODUCTION

1.1 Scope of course

Electrical-installation testing tends to be treated as a necessary evil rather than as an important part of a good installation, which is unfortunate when we consider the risk to life and property which can result from a dangerous installation. The apathy with which this subject is treated stems from a lack of understanding of the meaning and importance of the tests.

This course explains the reasons for the tests and some of the basic theory. It is not a full technical treatise on testing—such an undertaking would take thousands of pages. It does set down the principal tests which may be carried out on a hospital electrical installation. (It may not be necessary to carry out every test on every installation.) It lists the tests and the types of instrument that should be used, and describes recommended procedures. It introduces the basic theory, the reasons for the tests, and the detailed methods which should be adopted. The Figures illustrate the main points of the tests.

It contains a summary of test results obtained in average conditions. These will comply with the current edition of the Regulations for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers, wherever appropriate. Some parts will comply with the Factories Acts and the Electricity Supply Regulations, both of which are published by HM Stationery Office.

It briefly describes the instruments which form the basis of the test equipment, and gives details of other electrical instruments which are in use for tests other than the principal tests listed.

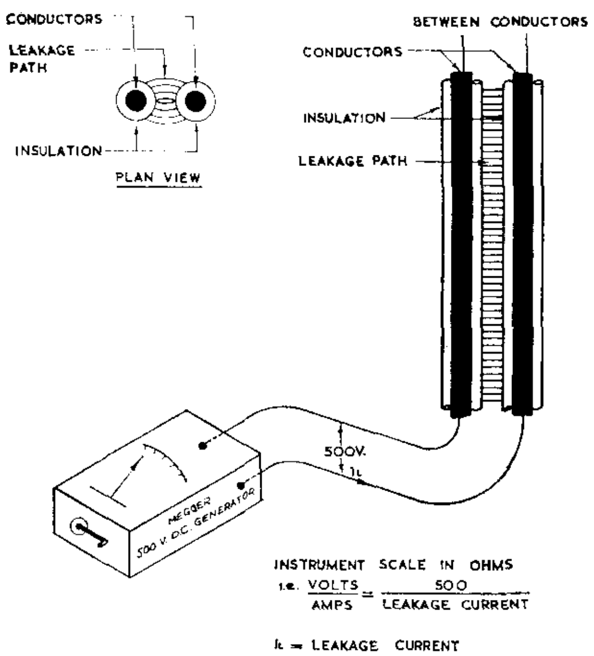


Fig. 1 Testing between conductors

1.2 Summary of tests

The following shows the tests to be described:

	Tests	*Instrument*
1	insulation-resistance test	Megger tester
	(*a*) between conductors	Megger tester
	(*b*) between conductor and earth	Megger tester
2	earth-continuity test	ohmeter
3	polarity test	test lamp or voltmeter
4	phase-sequence test	phase-sequence meter
5	earth-loop impedance test	
	(*a*) line earth	eli tester
	(*b*) neutral earth	
6	earth-resistance test	
	(*a*) resistivity	earth tester or
	(*b*) electrode	null-balance tester
7	antistatic-floor testing	
	(*a*) floor-to-floor dry	Megger tester
	(*b*) floor-to-earth wet	Megger tester

1.3 Test procedure

Tests 1 and 2 are conducted as the job proceeds, with the supply disconnected. They are repeated at the end of the job in the presence of the commissioning engineer, site engineer and/or board engineer responsible for the contract. Only when the tests have been carried out to the satisfaction of the responsible engineer, can the supply be connected to that part of the installation.

Tests 3, 4 and 5 are then carried out on part of or the whole installation as required. The supply must NOT be left connected if either tests 3 and 4 are not satisfactory.

Test 6(*a*) will have been carried out before the substation is installed, but it should be repeated on completion of the whole installation. Test 6(*b*) should be made at six-monthly intervals thereafter, once during the summer and once during the winter, and records kept. The tests should be carried out by Electricity Board engineers, or by other suitable qualified staff.

Test 7 is special and applies only to floors in theatres etc. It is not part of general installation testing.

2 THEORY AND PRACTICE OF ELECTRICAL TESTING

2.1 Insulation-resistance tests

2.1.1 Object

To measure the resistance between conductors in an installation, and the resistance between conductors and earth (conduit, armouring or sheathing). The tests are carried out before the supply is connected.

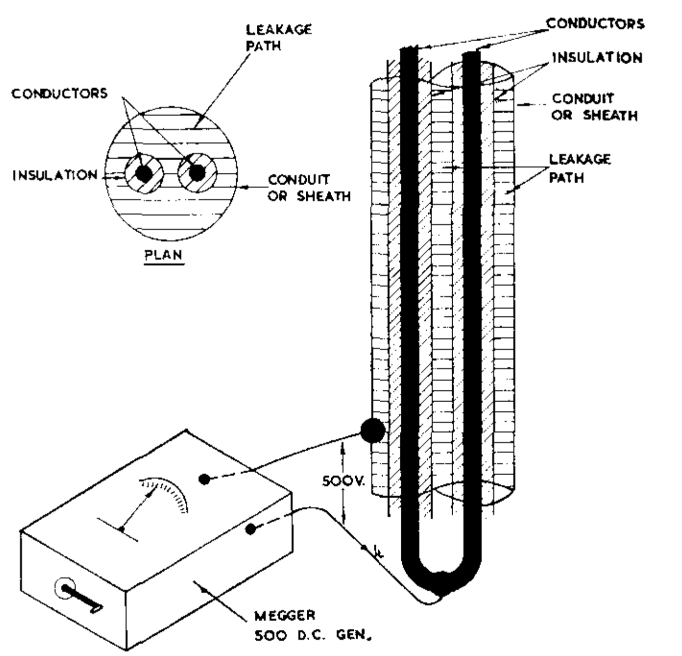


Fig. 2 Testing between conductors and earth

2.1.2 Instruments

A Megger tester, or equal-test set is a hand-driven direct-current generator with an output of 500 or 1000 V, depending on its type. Two flexible leads with crocodile or other terminal clips are provided to connect the set to the installation.

2.1.3 Method

(*a*) *Between conductors* (*see Fig. 1*)

Take as an example a single-phase circuit. Ideally, all lighting fittings should be disconnected, and the switches in the 'on' position. Sockets should be connected, but all apparatus disconnected. On power (motor) circuits, the motor only should be disconnected.

Connect the two test leads, one to each conductor. Turn the generator handle at the recommended speed and take the reading on the instrument scale, which is in megohms (MΩ).

(Remember: $1\,M\Omega = 10^6\,\Omega = 1\,000\,000\,\Omega$)

(*b*) *Between conductors and earth* (*see Fig. 2*)

Bunch all conductors together, and connect one lead to the junction. Connect the other lead to the conduit, armour, sheathing or earth wire, and repeat test. If a low reading is obtained, separate the conductors and test each one individually to earth to find the faulty conductor.

2.1.4 Theory

No material is a perfect insulator. The best ones are porcelain, mica and glass, but these are not suitable for cables. Cable insulation is usually rubber, p.v.c., waxed paper or magnesia.

Where two or more conductors at different voltages run close to each other, some leakage current flows through the insulation between them, and some flows from each conductor to earth. In high-quality insulation this leakage is small, and with low-quality insulation it is higher.

Where cables are enclosed in sheathing or conduit, the paths taken by the leakage currents are similar to those which heat would take when it flowed from a hot pipe to a cold pipe adjacent to it (ignoring losses to the atmosphere). When earthed sheathing is present, currents also flow to the sheathing.

If the leakage current is excessive, the insulation heats up owing to dielectric loss, and may break down or even ignite.

This current flow is occurring along the whole length of the circuit. Therefore the leakage current is proportional to the length of the cable. This is why, for a given type of cable, the insulation resistance drops as the length increases.

In practice this leakage through insulation is too small to worry us. Our test is for faulty insulation, and we use twice the normal circuit voltage.

There is also leakage at *all* outlets, junction boxes, switches etc., and the test tells us the insulation resistance of the whole installation. The IEE Regulations provide considerable guidance on what should be expected of an installation. It is sufficient to say that:

(i) if an installation is large enough, it is not possible to obtain a reading of 1 MΩ for the whole of the installation. Hence, the installation is tested in sections (wards, blocks and departments), each section containing at least 50 outlets.

(ii) On new sites, considerable dampness will be present. It may then be necessary, provided that no subcircuit is less than 1 MΩ, to switch the supply on and test some time later. If the heating system has been connected some weeks before the second fixing of electrical services, i.e. light fittings, switches, sockets etc., the insulation-resistance test should be good first time.

(iii) If the insulation is connected to the supply with lower readings than normal to allow a 'drying-out' period, this should be endorsed on the 'completion and inspection' certificates. Takeover certificates should not be issued for such a section until a proper reading has been obtained.

(iv) *All* m.i.c.c. cables, except those terminated with glass–resin seals, should read INFINITY when tested. If they do not, trouble is in store. DO NOT accept them.

∗ Members Diary ∗

FIRE TRAINING

In 1970 the Fire Protection Association is running three one-week residential courses at Elvethan Hall, Hartley Wintney, Hants. They are intended for managers, supervisors and works fire and safety officers, and provide two levels of instruction:

(i) *Regular* (two courses, 8–13th March and 2–7th August) A sound basic understanding of the nature and control of fire is the aim of this course; aspects include: fire hazards, controlling spread and planning fire protection.

(ii) *Advanced* (one course, 6–11th September) Intended for those with some experience of fire protection, this course continues where the 'regular' ends. Examples of subjects are combustion behaviour of industrial materials, and problems of handling, storing and processing.

Both courses make use of the syndicate system, in which students discuss set problems and experienced assessors comment on their reports.

For further details write to the Fire Protection Association, Aldermary House, Queen Street, London EC4.

NEW FACES

C. H. Blackburn & Co. Ltd., Affiliate Members, have closed their London administrative offices and moved to their works at Calne, Wilts. All communications should now be addressed to Stellex Works, Calne. Tel. Calne 3294.

∗ Among the Branches ∗

EAST ANGLIAN BRANCH

The technical director of Engineering Appliances Limited, Mr. V. Westerman B.Sc., visited the branch at their meeting on the 10th January 1970 at St. Mary's Hospital, Bury St. Edmunds. He chose as his topic 'Bellows expansion joints', and supplemented his talk with a number of slides showing particular applications.

MIDLANDS BRANCH

Many Institute supporters were hit by the flu virus and were unable to attend the talk 'Some aspects of district heating design' at the Queen Elizabeth Hospital on the 3rd January. The speaker was Mr. J. Knight, of G. N. Haden & Co. Ltd., and the meeting proved most informative to those members who were able to be present.

It became clear that new district general hospitals and hospital centres would be ideal candidates for this form of heating, since the centralised boiler plant is able to use the heat from refuse incineration to generate electricity, thus economising considerably on the cost of fuel.

LANCASHIRE BRANCH

The branch was invited to visit Parkside colliery at Newton-le-Willows, Lancs., on the 31st January 1970. The party was met by Mr. H. Corfield, Deputy Colliery General Manager, who gave a talk on the mining of coal at Parkside, and of the very stringent conditions that had to be complied with when the colliery was being planned and developed.

Then members proceeded to the pit shaft, 2657 ft deep. The area covered by the mine workings is approximately four square miles; the furthest coal face is 2700 yd from the shaft, of which half can be travelled by railway—the rest, one has to walk. A belt conveyer system carries the coal, and coal-cutting machinery is transported on a monorail system. Both of these are suspended from the tunnel roof because of the ever-changing levels of the tunnels due to movements in the ground.

The 1970 Annual General Meeting of the Lancashire branch will be held at Prestwich Hospital at 3 p.m. on the 21st March.

YORKSHIRE BRANCH

On the 10th January 1970 the branch met at Chapel Allerton Hospital, Leeds, to hear a paper entitled 'Types and uses of pumps' given by Mr. C. F. White, B.Sc., F.Inst.Ex.E., M.I.Hosp.E. Mr. White is now retired, but he was the Group Engineer, Dewsbury and Batley HMC, and had, over the last 21 years, given a number of papers before branch meetings.

Members heard that there were about 32 types of pump available, though there was only time for a detailed description of seven of these. It was surprising to learn that there were still over 700 wind-driven pumps in existence in Lincolnshire alone. The main point of Mr. White's talk was that with the extreme variety of pumps available, it was essential to consult manufacturers carefully before ordering, so as to ensure that the most suitable equipment was obtained.

∗ Postbox ∗

Dear Sir,

I was delighted to read in the December issue of the Journal the article, by J. Cushnaghen, about New Mulago Hospital. I hope that many more of the Institute's overseas members will give us the benefit of their experiences through the medium of *Hospital Engineering*.

Yours faithfully,

B. A. Hermon

Oxford Regional Hospital Board,
Old Road,
Headington, Oxford

Classified Advertisements

For full information, please write or telephone:
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OFFICIAL APPOINTMENTS
SITUATIONS VACANT
MISCELLANEOUS

APPOINTMENTS AND SITUATIONS VACANT

Assistant Engineer

required at

ST. STEPHEN'S HOSPITAL
CHELSEA, LONDON SW10

Post offers valuable experience in the operation and maintenance of all engineering services in an expanding acute hospital. Practical experience and approved qualification required. Day release for higher qualification considered. Salary £1167–£1493 per annum.

Applications to the Secretary, Chelsea and Kensington HMC, 5 Collingham Gardens, London SW5

KING'S COLLEGE HOSPITAL
LONDON SE5
ASSISTANT GROUP ENGINEER

Applications are invited for this post which offers excellent experience and career prospects in a large hospital-engineering department.

Candidates must have completed a thorough training in mechanical engineering, and hold either the higher national certificate or diploma in mechanical engineering with endorsements in electrical engineering.

A sound knowledge of steam boiler plants, control equipment and the installation and maintenance of all engineering services will be required.

Salary range: £1514–£1774+ £200 special-responsibilities allowance £90 London weighting.

Job description and application forms, returnable by 2nd April 1970, available from Assistant House Governor, King's College Hospital, Denmark Hill, London SE5

SOUTH WARWICKSHIRE HOSPITAL GROUP MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER

required. Mixed group of ten hospitals. Salary scale £1514–£1774 per annum, with special-responsibility allowance at present £175 per annum. Job description of post available on request.

Applicants:

(1) must have completed an apprenticeship in mechanical or electrical engineering, or acquired a thorough practical training appropriate to the duties and responsibilities of the post, and have had wide experience in the management of mechanical and electrical engineering plant, the control of staff, the preparation of maintenance estimates and reports and the carrying out of engineering renewal or constructional works

(2) **Must hold:**

(i) HNC or HND in mechanical engineering with endorsements in industrial organisation and management and principles of electricity or electro-technology, if this was not taken as a subject of the course

or

(ii) HNC or HND in electrical engineering with endorsements in industrial organisation and management and including (at SIII or O2 level, or with endorsement in) applied heat and applied mechanics, provided that he has suitable practical experience in mechanical engineering

or

(iii) City & Guilds mechanical engineering technicians Full Technological Certificate (Part III) which must include plant maintenance and works service.

(3) Have adequate experience of building-maintenance work.

Applications, giving age, experience, qualifications, and naming three referees, to the Group Secretary, 50 Holly Walk, Leamington Spa, by Wednesday 1st April 1970.

Papworth-Huntingdon Hospital
Management Committee

HOSPITAL ENGINEER

required to be responsible to the group engineer for the maintenance of all engineering services at the following hospitals:

Papworth Hospital
Huntingdon County Hospital
Primrose Lane Hospital
Petersfield Hospital
Royston Hospital

candidates must have completed an apprenticeship in mechanical or electrical engineering, or otherwise acquired a thorough practical training appropriate to the responsibilities of the post. They must have had sound experience in the maintenance and operation of boiler plant, electrical distribution and equipment, hot-water supplies, etc.

Higher National Certificate in mechanical or electrical engineering, or other suitably recognised qualification, is necessary.

Salary scale £1403, by £50 (3) by £49 (1) by £56 (1) to a maximum of £1658 per annum, plus a special responsibility allowance of £50 per annum.

Consideration will be given to the appointment of an applicant without the requisite qualifications, but with an abatement of £150 per annum on the salary scale.

Details of age, qualifications, training and experience, and names and addresses of three referees, to the Group Secretary, Papworth Hospital, Papworth Everard, Cambridge

WESTMINSTER HOSPITAL

ASSISTANT ENGINEER

The person appointed will be required to assist the hospital engineer in all aspects of electrical and mechanical maintenance.

Candidates must have served an appropriate apprenticeship and should have some appreciation of principles of organisation and modern management techniques.

Technical qualification to ONC or equivalent is necessary.

Present salary range £1077–£1403 × £90 London weighting.

The post is attractive to young engineers intent on a hospital-engineering career and provides exceptional opportunity for varied experience.

Short-listed applicants will be invited to the hospital.

Two references will be required at final interviews.

Apply with personal and career details to

The Group Engineer,
Westminster Hospital,
Dean Ryle Street,
Horseferry Road,
London SW1

Closing date: 14 days after publication of this advertisement

NORTH WIRRAL
HOSPITAL MANAGEMENT
COMMITTEE

HOSPITAL ENGINEER required to be directly responsible to the group engineer for the engineering services of certain hospitals within the group.

Salary scale £1370–£1605 per annum, plus responsibility allowance of £100 per annum.

In addition to having served an engineering apprenticeship applicants must have a sound knowledge of mechanical and electrical equipment, and wide experience of its maintenance, and should possess one of the following qualifications or an equivalent qualification approved by the Secretary of State for Social Services:

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

(ii) Higher National Certificate or Higher National Diploma in electrical engineering with endorsements in industrial organisation and management and including (at S111 or 02 level, or with endorsement in) applied heat and applied mechanics, provided he has suitable practical experience in mechanical engineering

(iii) City & Guilds Mechanical-Engineering Technician's Full Technological Certificate (Part III) which must include plant maintenance and works services.

Engineers who are not qualified academically may apply for the post but it will be subject to an abated salary scale.

Previous applicants need not re-apply as their applications will be reconsidered.

Applications, giving details of training, qualifications etc., together with names and addresses of two referees, to the Group Secretary, Group Headquarters, Mill Lane, Wallasey, Cheshire, 144 5U-F, by Tuesday 31st March 1970

CENTRAL MIDDLESEX
HOSPITAL
Acton Lane, London NW10

HOSPITAL ENGINEER required for the above hospital (737 beds), responsible to the group engineer for the efficient running of coal-fired boiler plant and mechanical maintenance services throughout the hospital. Applicants should have completed an apprenticeship, and must possess an HNC or equivalent qualification.

Commencing salary (at present under review), plus allowances, is £1704 rising to £1964, and in addition a long-hours' gratuity will be paid. Accommodation may be available.

Application forms obtainable from the Group Personnel Officer, Central Middlesex Hospital, Acton Lane, Park Royal, London NW10

CLASSIFIED ADVERTISEMENTS *continued from previous page*

APPOINTMENTS and SITUATIONS VACANT

BURY AND ROSSENDALE HOSPITAL MANAGEMENT COMMITTEE

HOSPITAL ENGINEER

Applications are invited for the post of hospital engineer at Bury General Hospital, with responsibility for four smaller units within the group.

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

(*a*) City & Guilds mechanical engineering Technicians 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.

Salary will be on the scale—up to 24 points—£1403–£1658 per annum plus a special-responsibility allowance of £75 per annum. Conditions of service will be in accordance with the Whitley Council recommendations.

Consideration will be given to applicants not possessing the above qualifications, such persons being appointed on an abated scale.

Applications, together with the names of two referees, should be made to the Group Secretary, Bury General Hospital, Walmersley Road, Bury BL9 6PG, as soon as possible.

ROMFORD GROUP HOSPITAL MANAGEMENT COMMITTEE

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One of the following qualifications or an equivalent is required:

(i) HNC or HND in mechanical engineering with endorsements in industrial organisation and management and principles of electricity or electro-technology, if this was not taken as a subject of the course

(ii) HNC or HND in electrical engineering with endorsements in industrial organisation and management, and including at SIII or 02 level or with endorsements in applied heat and applied mechanics provided he has suitable practical experience in mechanical engineering

(iii) City & Guilds mechanical engineering technicians Full Technological Certificate (Part III), which must include maintenance and works service.

Preference will be given to those candidates with an electrical main qualification.

The group contains four main hospitals and has a bed complement of 1643.

Further particulars, including job description and application forms, obtainable from the Group Secretary, Romford Group HMC, Oldchurch Hospital, Romford, Essex, RM7 0BE. Closing date: 23rd March. Quote Reference 28/52

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