THE HOSPITAL ENGINEER

THE JOURNAL OF
THE INSTITUTE OF
HOSPITAL
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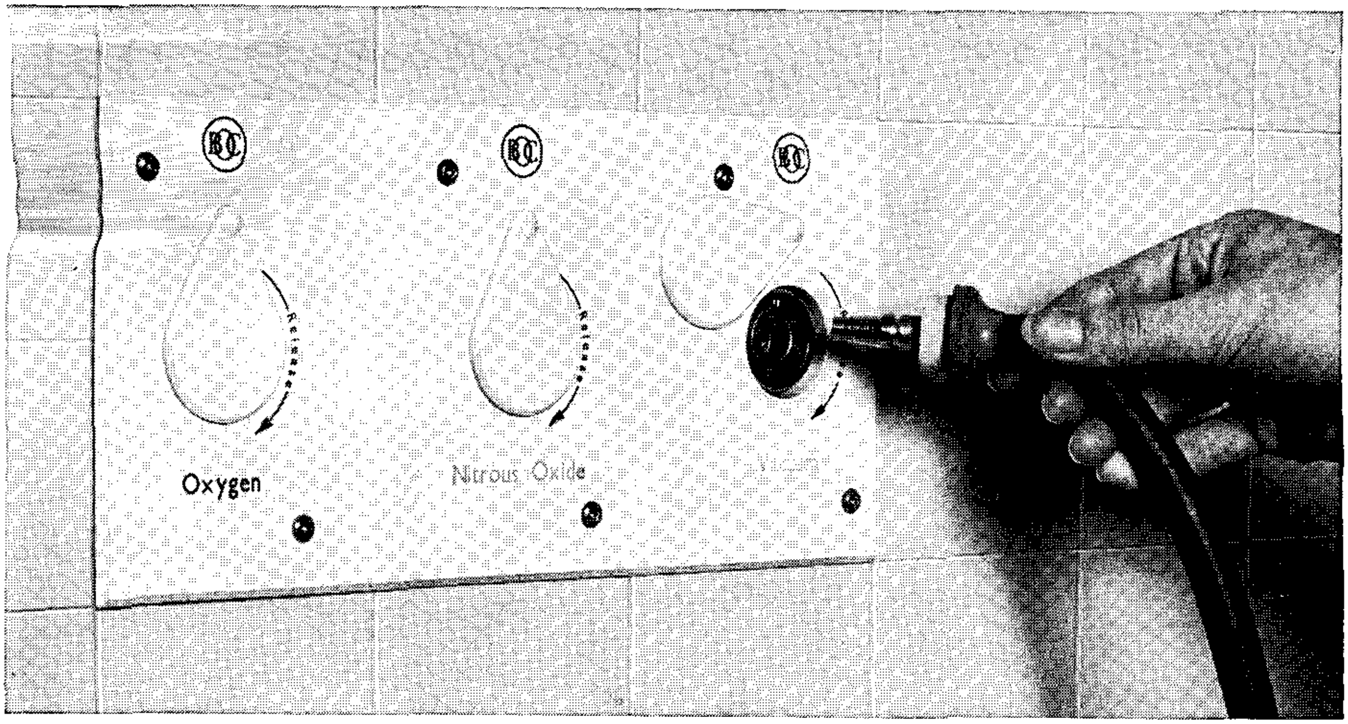
VOL XXIII No 6
JUNE 1969

FIVE SHILLINGS



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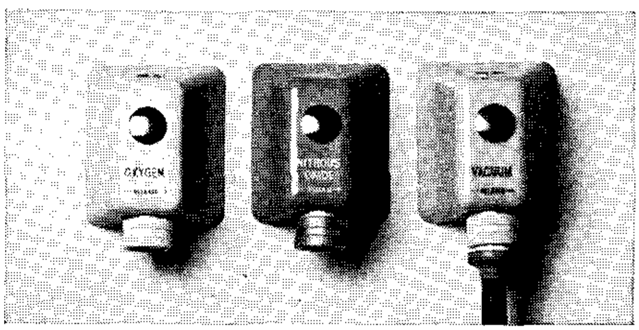

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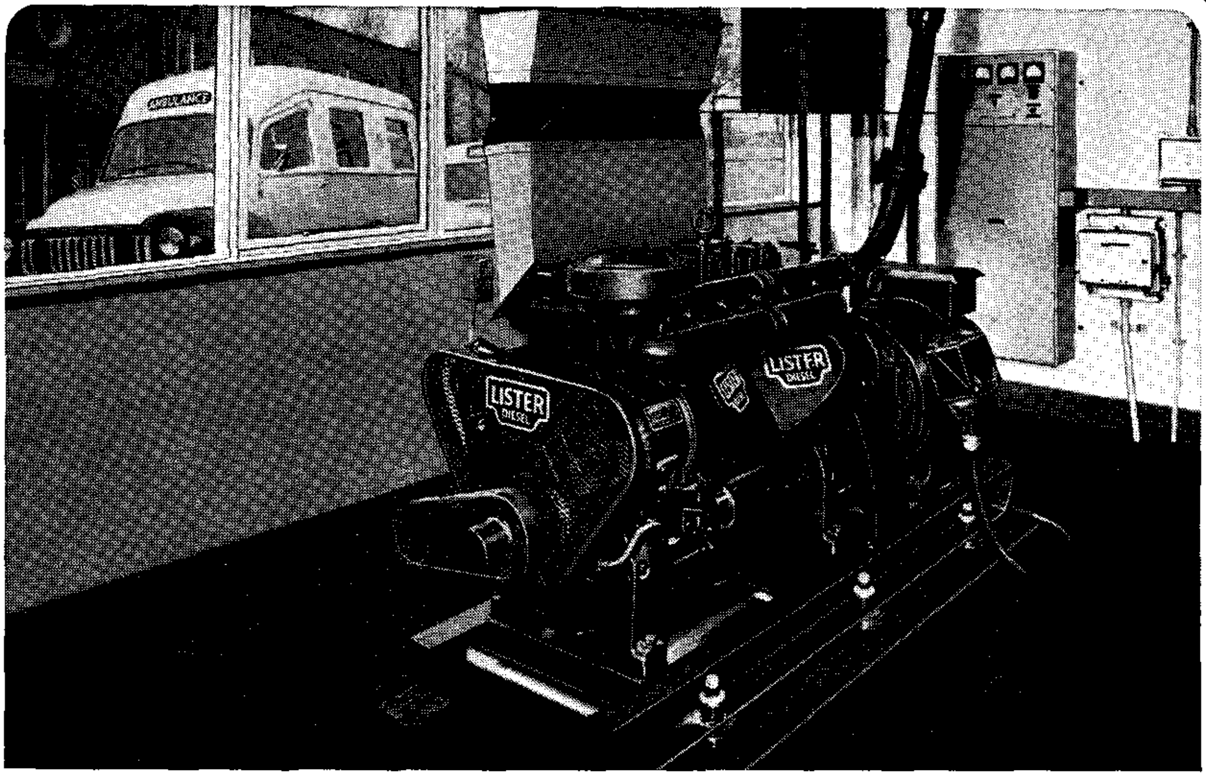

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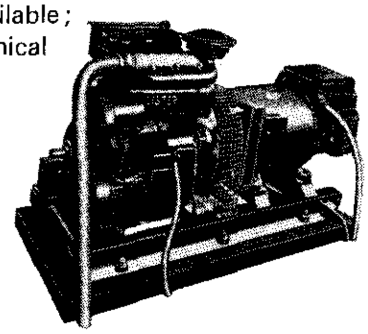

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Emergency Power Systems for Hospitals

By A. C. WATSON, B.Sc.
Dawson Keith Electric Ltd.

The Author's Company describe themselves as power systems engineers and not merely manufacturers of emergency generating plant. The reasons for this distinction are evident from the guiding notes which they provide for the assistance of engineers concerned with the design of electrical services and preparation of specifications for hospital standby power plant, and upon which this article is based.

IF the supply and installation of emergency generating plant in hospitals is looked at from the point of view of a complete power *system*, and not merely regarded as the provision of a standard piece of equipment, many problems can be avoided.

Since it is rare that two power installations are identical it may seem incongruous to refer to a "standard" type of mains failure set. Yet most power plant catalogues illustrate a range of such sets and they represent an attempt by manufacturers to establish some form of basic standard for design and production purposes even though it is usually necessary to modify the basic design to suit individual applications. The "standard" plant invariably embodies the mains sensing and changeover switchgear illustrated in Fig. 1. The controls and switchgear are housed in a set-mounted, wall-mounted or floor-standing cubicle depending on design and size of plant.

It should be observed when employing this type of plant that the standard switchgear arrangement is based on *identically* rated mains and alternator contactors. Such a plant can be used only where the emergency

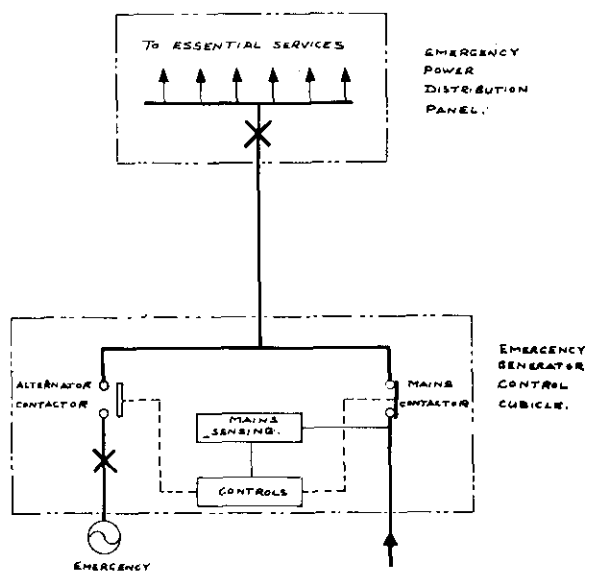

Fig. 1. Power System No. 1.

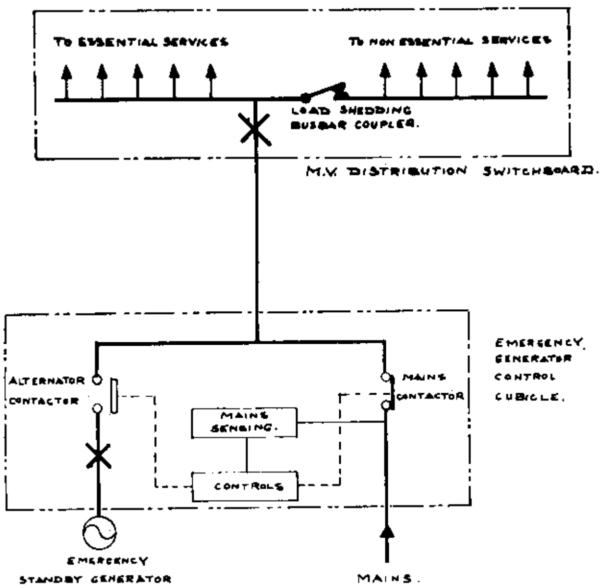

Fig. 2. Power System No. 2.

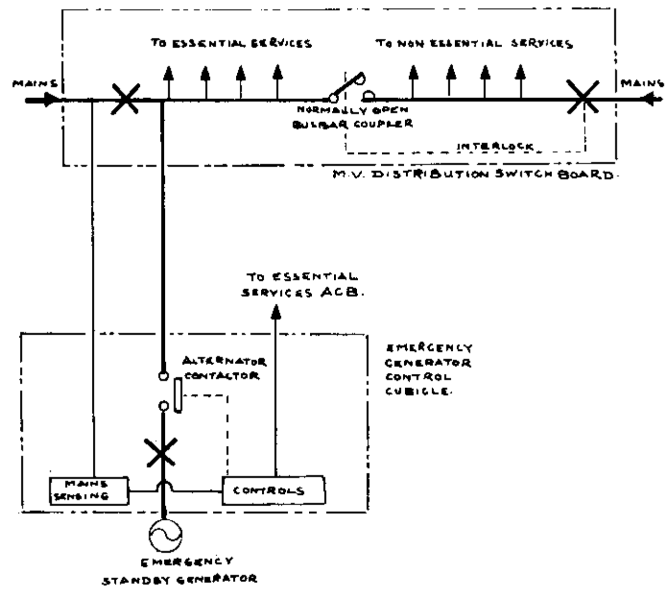

Fig. 3. Power System No. 3.

services have been segregated into a separate emergency services distribution panel and where it is convenient to bring the mains directly into the emergency generator control cubicle.

If the distribution system does not segregate the emergency services in this way and relies on dropping off the non-essential load following mains failure, as illustrated for example in Fig. 2, the "standard" generating set cannot be used. Modification is necessary as a mains contactor or circuit breaker of higher current rating must be substituted capable of carrying both the essential and non-essential load. The alternator contactor is not affected and remains rated only for the emergency power requirement.

It is necessary with this system that the non-essential load shedding contactor or circuit breaker be interlocked electrically with the alternator contactor via auxiliary contacts to avoid any possibility of the alternator contactor closing whilst the non-essential load is connected.

Frequently it is more convenient and economic to avoid bringing the mains into the emergency generator control cubicle and, instead, to connect direct to the main M.V. distribution switchgear. This means a further departure from the "standard" generating set design as no mains switchgear is now required in the emergency generator control cubicle. The alternator contactor or circuit breaker may remain in the generating set control cubicle.

Such a system is illustrated in Fig. 3 and lends itself to a split busbar system in the M.V. switchboard.

Normally, the essential services busbars will be decoupled from the non-essential busbars but if after mains failure it is found that the essential services are not at that time fully loading the emergency generator it is possible to select certain specified less essential services and supply emergency power to them by closing the busbar coupling switch. It is essential however that there be an interlock between the coupling switch and the non-essential services mains incoming circuit breaker to prevent accidental paralleling of the restored mains with the alternator. The alternator contactor or circuit breaker must be electrically interlocked via auxiliary contacts with the essential services mains incoming circuit breaker, the latter being solenoid operated and controlled from the generating set control cubicle.

By leaving the alternator contactor or circuit breaker in the generating set control cubicle it remains close to the low voltage d.c. control system upon which it must

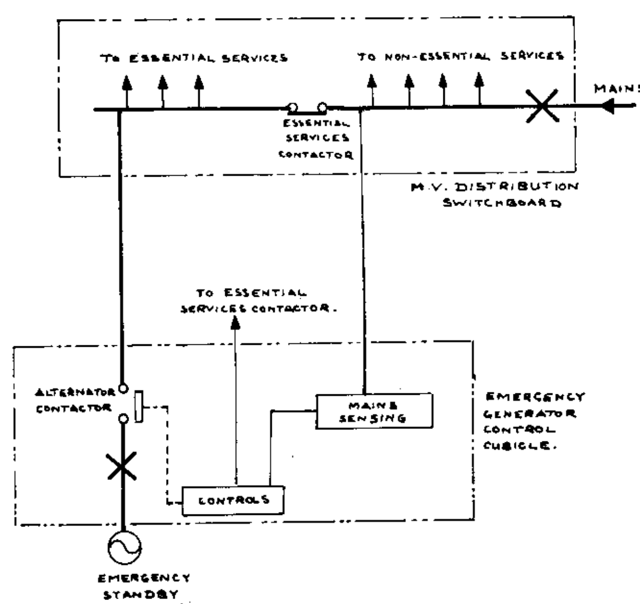

Fig. 4. Power System No. 11.

depend for operation, since closure should not occur until the generating set has started, run up to speed and is operating satisfactorily.

An alternative system is illustrated in Fig. 4.

As a means to reduce the cost of the standby generating set it is sometimes required that both the mains and the alternator contactors or circuit breakers be located remotely in the emergency power distribution section of the main M.V. switchboard, as shown in Fig. 5. In this case the juxtaposition of the changeover switchgear makes possible both mechanical and electrical interlocking, but control of the operating coils must still be vested in the monitoring, timing and control circuitry of the emergency generator cubicle.

With the mains sensing point and the switchgear remote, a multi-core control cable connection is necessary between the M.V. switchboard and the generating set controls. This has led in some cases to engineers insisting that the generating set controls also be housed within the M.V. switchboard. This solves no problems since multi-core control cabling back to the generating set will still be necessary to link up with the battery, the fuel control solenoid, oil pressure, water temperature and overspeed switches on the generating set—all carrying 12 or 24 volts d.c. As the entire control system will require for its operation 12 or 24 volts d.c. from the engine starter battery it is a bad principle to divorce the two.

A further complication arising from this practice is the highly controversial division of responsibility between the manufacturer of the M.V. switchboard and manufacturer of the generating set controls. Better that the entire generating set control cubicle, complete with mains sensing and changeover switchgear, be located remote from the generating set and close to the M.V. switchboard, thus reverting to the system illustrated in Fig. 1.

In both cases, however, the control system will be divorced from the engine starter battery and there will be no local controls or instrumentation close to the generating set—unless, at extra expense, these are duplicated to provide a local panel. If the switchgear must be divorced from the generating set, it is far better to adopt the system shown in Fig. 5 than either of the two alternatives mentioned above.

In a large hospital complex it may not be either economical or practicable to rely on a centralised distribution system for emergency power supplies. Instead, the hospital may be divided into a number of separate areas each served by its own essential services changeover and distribution panel. This arrangement may best suit the cabling requirements and at the same time, by monitoring the mains at the input to each local panel, each area can be protected not only against general mains failure but also against a local loss of mains power due to a cable fault within the hospital complex.

This system is illustrated in Fig. 6 which shows the mains sensing points and changeover contactors located in the remote panels.

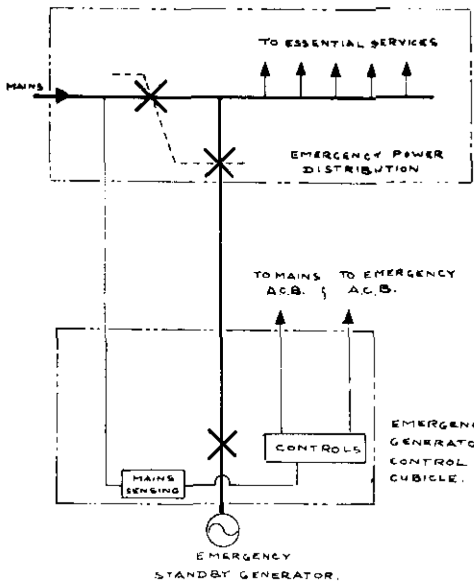

Fig. 5. Power System No. 4.

With this arrangement, the only switchgear needed in the emergency generator control panel is a circuit breaker for protection and isolation. The controls will include mains sensing relays and circuitry to control the operation of the remote changeover contactors. In addition to the main power cabling to each remote changeover panel, there will need to be control cable linkage from the emergency generator panel to each remote contactor coil and each remote mains monitoring point. The mains and alternator contactor in each remote panel will need to be electrically and mechanically interlocked. A variation of this system is shown in Fig. 7 where, instead of a pair of

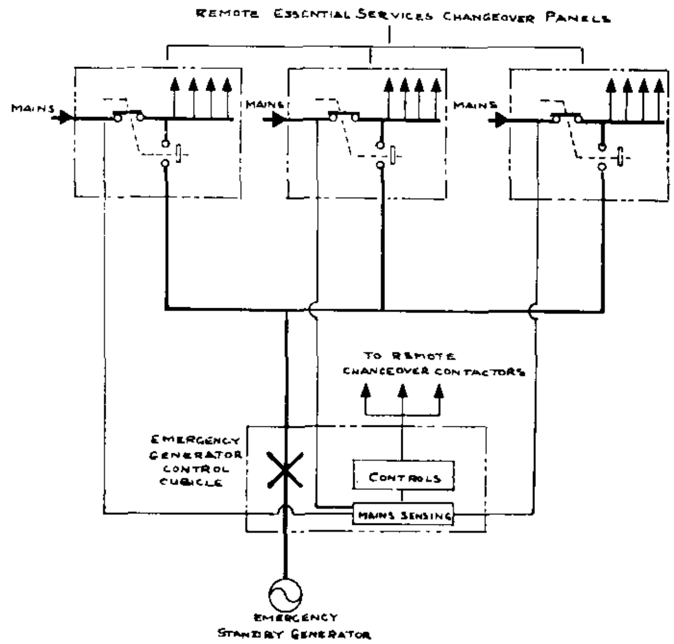

Fig. 6. Power System No. 5.

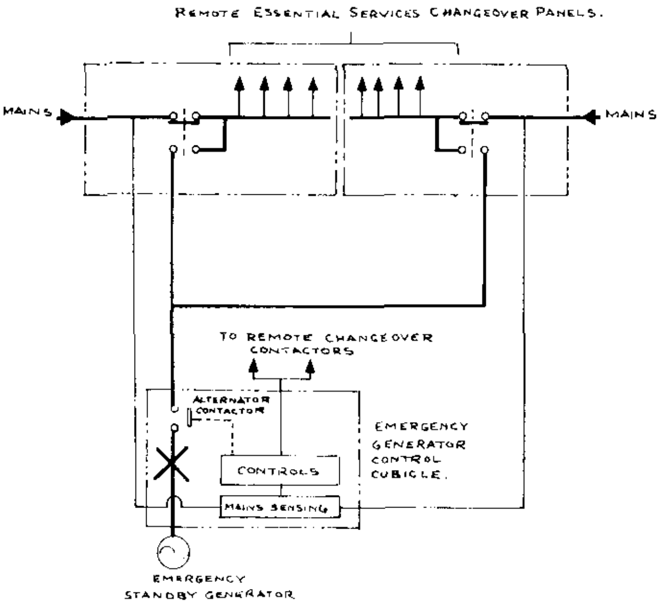

Fig. 7. Power System No. 6.

interlocked contactors, a single changeover contactor is employed in each remote panel. Such contactors are only available up to 100 amps which limits their use but, when this method is used, an alternator contactor or solenoid operated circuit breaker must be provided in the emergency generator control cubicle to prevent the alternator output being switched to load until the generating set has run up to speed and is ready to accept load. Modern brushless alternators employing fast response electronically controlled voltage regulation can suffer damage if switched to load at slow speed due to an excessive demand for field current in these circumstances. Control of alternator switchgear via output monitoring circuits is necessary to avoid such damage.

The system shown in Fig. 7 has the advantage of keeping the alternator switchgear close to the control system and simplifies the interconnecting control cabling to the local changeover contactor panels, but lacks the positive interlock and control of contactors shown in Fig. 6.

In all the systems described and illustrated above there has been observance of the Ministry of Health recommendation that mains sensing should always be connected as close as possible to the mains input to essential loads. This recommendation is commonly misinterpreted as meaning that, where the mains is not brought into the emergency generator control cubicle, mains sensing relays should be located in the M.V. distribution panels.

This practice deserves further consideration.

As already explained, control cable connections between the mains sensing relays and the emergency generator controls will carry only 12 or 24 volts d.c. As starting of the standby generator relies on the making of contacts and the establishment of a 12 or 24 volt d.c. signal, a fault in the control cable connections will prevent the standby set from starting when mains failure occurs. The system therefore fails to danger.

If, however, mains sensing is retained in the emergency generator controls and mains monitoring cables are brought back from the mains input of each distribution panel, two advantages are gained. The problem of long runs of control cable carrying low voltage d.c. is avoided and the system will fail safe because if a fault occurs in the mains monitoring cable connection this will be interpreted by the generator control system as a mains failure and the standby set will start, automatically transferring the essential services onto emergency power.

In addition to the seven commonly used systems described in the foregoing, many other systems are available, including systems based on the use of two or more standby generating sets with peak lopping and synchronising facilities, but space limitations prevent consideration in this particular article. Advice and information is always freely available, however, from Dawson Keith Electric Ltd., of Hillview Road, Sutton, Surrey, who may be contacted for assistance whenever needed.

WITHINGTON HOSPITAL RESIDENTIAL ACCOMMODATION

The Manchester Regional Hospital Board have placed a contract worth nearly £½ million with Tersons for the construction of Residential Accommodation at Withington Hospital, Manchester (Phase 1).

The contract involves the building of an eight-storey Hostel Block, eighteen three-storey dwellings in three blocks, six two-storey dwellings in one block and a single-storey Electricity Sub-Station. Completion is planned for mid-1971.

Architect: Scherrer & Hicks, in association with: H. McMaster, A.R.I.B.A., Manchester R.H.B.

Consulting Engineer: W. V. Zinn and Associates.

Mechanical and Electrical Engineering Services: Cramp and Frith, in association with: C. G. Daines, C.Eng., A.M.I.Mech.E., A.M.I.H.V.E., Manchester R.H.B.

POCLAIN L.C.80 FOR DEVON AND EXETER HOSPITAL CONTRACT

A Poclain L.C.80 hydraulic excavator is currently digging daily 1,500 cu. yds. of shale and shilett rock from the solid for its owners Henry & Co. (Ground Works) Ltd., of North London. The company has been awarded a sub-contract for bulk excavation, sewerage and drainage, and other general ground works by Higgs & Hill Building Ltd., main contractors for the new £4,500,000 Devon and Exeter Hospital at Exeter. This 424-bed hospital will replace the nearby Royal Devon and Exeter Hospital.

The Poclain L.C.80, which was purchased by Henry & Co. specifically for this contract—which is expected to last for about two years—is fitted with Monobloc boom, 8 ft. 6 in. dipper arm, and ⅞ cu. yd. back acter bucket. The bulk excavation involves digging down to 12 ft. and loading into a fleet of twenty lorries which dump the soil some three miles from the site.

The Works of Carl Zeiss

By P. C. VEDAST (Member)

The trip was arranged and conducted for the Zeiss distributors in Great Britain, Messrs. Degenhardt & Co. Ltd. of London.

A NUMBER of scientists and technical journalists were recently privileged to form a party to visit the works of Carl Zeiss and associated companies at Oberkochen, Wurttemberg, in West Germany.

Our objective was to see the various manufactures of this important company, particularly the wide range of instruments of special interest to hospitals.

In the event, the whole range of products, the factories, the staff, and the method of operation of the Carl Zeiss Foundation became an absorbing study, which successfully upset any plan to specialise in one restricted field.

The history of the beginning and growth of the Carl Zeiss and Schott Companies, and their eventual conversion in 1891 into the Foundation which still operates, is well known. Less well appreciated is the astonishing story of the Foundation's work over the past 24 years, following the occupation of East Germany after the second world war. Of the vast army of men employed before the expropriation, only 120 could be evacuated by the American armed forces into the allied Zone. They came without money, machinery, tools or other visible asset, and with no factory in working order.

Such was their enthusiasm and ability, and their attachment to the Foundation, that, under their guidance, in 24 years the working staff has grown again to 30,000 employed in the Company's many factories—6,500 of them at the Zeiss Works at Oberkochen.

New factories have been built and equipped with the best machinery, first class living accommodation provided for the staff and, in accordance with the principles of the

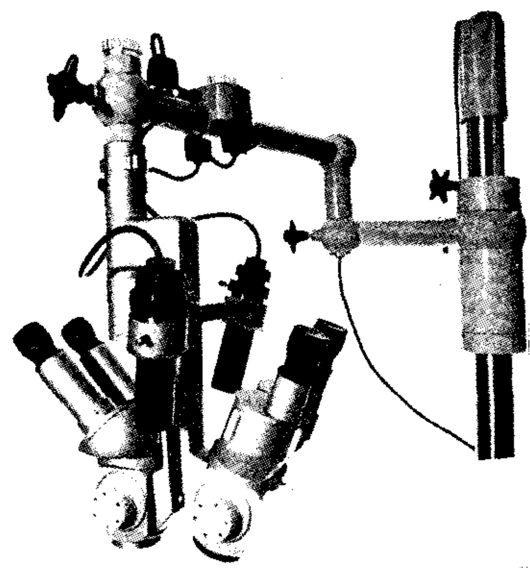

Fig. 2. (Above) Double Microscope after Harms. Two microscope bodies for simultaneous binocular observation of object area by surgeon and assistant.

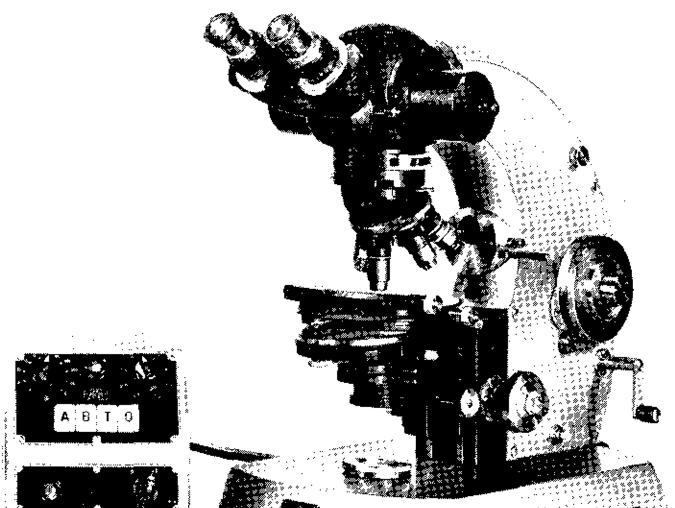

Fig. 1. (Left) Zeiss Photomicroscope with built-in fully automatic 35 mm camera. Equipment for transmitted light.

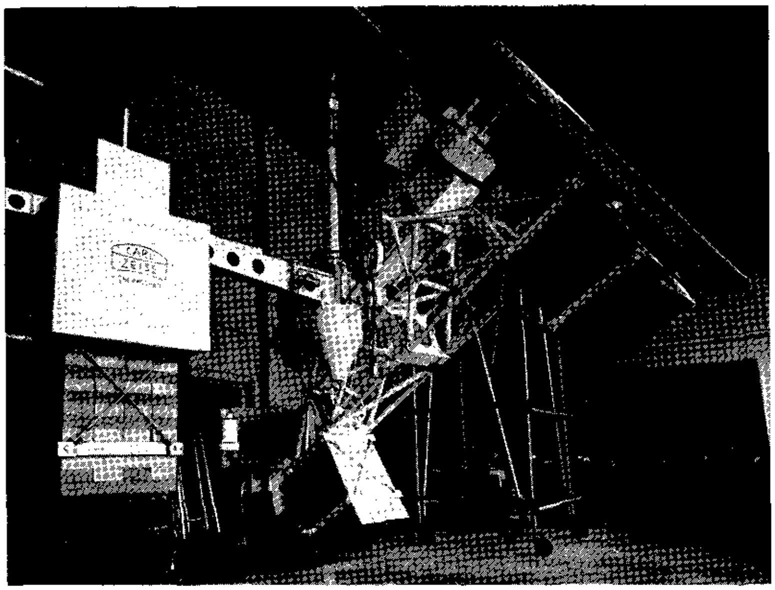

Fig. 3. Zeiss Balloon-borne Telescope. (Spectrostratoscope.)

Foundation, all the rights previously enjoyed—good wages, profit sharing, security in all emergencies such as illness, old age, etc. extending to relatives also, and perhaps most important of all, continuity of employment, a voice in the government of the Foundation and special rewards for work and efficiency beyond the normal contractual level.

We were most impressed by the atmosphere of equality and dedication in all departments, due in part, perhaps, to the fact that the bulk of the workmen are company apprentices who have spent their whole working lives together, and under the same management.

The attention to detail and hospitality provided by the company's representatives, willingly assisted by the inhabitants of the towns which we visited, were sure indications of the company's desire to make our visit worthwhile, and impressed us with the status which the company enjoys in the locality in which each factory is situated.

As hospital officers, we were most impressed with the wide range of equipment, either specially designed for, or capable of use in hospital departments. Amongst them, an impressive range of microscopes from the simplest bench unit through a bewildering variety to highly sophisticated electron beam units held our attention.

Microsurgical and ophthalmic instruments also covered a wide field. Operating equipment such as the double binocular operation microscope with fully automatic control, allowing two persons to work or view simultaneously, attracted much attention, as did measuring equipment for prescription and manufacturing processes.

Light coagulation units for treatment of retinal detachment and diabetic glaucoma were seen in course of construction.

Laboratory equipment for flame photometry, chromatography and other optical analytical procedures were demonstrated in the course of the tour.

On the general production side, many outstanding items in a wide field of application were seen; in particular, a planetarium in preparation for despatch to an Asian country, and a large balloon borne telescope to be floated over Texas to study weather conditions.

A whole range of photogrammetry equipment for aerial photography, interpretation, stereoscopic comparison, etc. impressed us with their size and complexity.

It was interesting to note that every piece of equipment from the humblest magnifying glass to utterly complicated items such as the planetarium or operating miscroscope were all designed around optical systems based on perhaps the greatest concentration of optical knowledge and lens design in the world, further amplified today by the use of computer design data.

Many industries are served by the extensive range of instruments made in the various works, the building and civil engineering sector having a wide choice of excellent surveying equipment, at once robust and simple to operate.

The spectacle industry also is supported by the world's largest production of prescription lenses which are exported to almost every country.

We were shown a large number of exceptional photographs taken from American Gemini space craft on production cameras bought from retail outlets, and these were sufficient evidence of the excellence of the products made by the many photographic equipment companies within the Zeiss organisation.

So much was presented to us in so short a time that difficulty arises in selecting what has to be a small number of outstanding items to include in this article.

The Diagnostic X-Ray Tube

Part 2

By W. TENNET, C.Eng., M.I.E.E.,
X-Ray Division, Mullard Ltd.

The Rotating Anode X-Ray Tube

The advantage of rotation

THE modern diagnostic tool is of course the rotating anode X-ray tube as depicted in Fig. 8, in which very high short time ratings are achieved in spite of the small size of the effective focus. In this type of tube, not only is the line-focus principle employed, but the actual target area bombarded is very greatly increased by rotating the target at high speed.

The cathode

The cathode, in principle identical with that of the stationary anode tube, is offset from the centre of the tube so that the focused electron beam falls near the edge of a solid tungsten disc. When this disc rotates the focus traces an annular path round the edge of the target. Fig. 9 outlines the principle and indicates the degree of thermal advantage obtained by this means.

The target

In modern rotating anode tubes the tungsten target is not backed with copper and is, therefore, cooled not by conduction but by the direct radiation of heat. The whole of the target disc can therefore be operated over the safe working temperature range applicable to *tungsten*, whereas in conduction-cooled stationary anode tubes the outer edges and under surface of the tungsten tablet are limited to the safe working temperature of *copper*. The surface of the target is processed to a dull finish to increase its surface area and thus enhance its heat radiation efficiency. Every

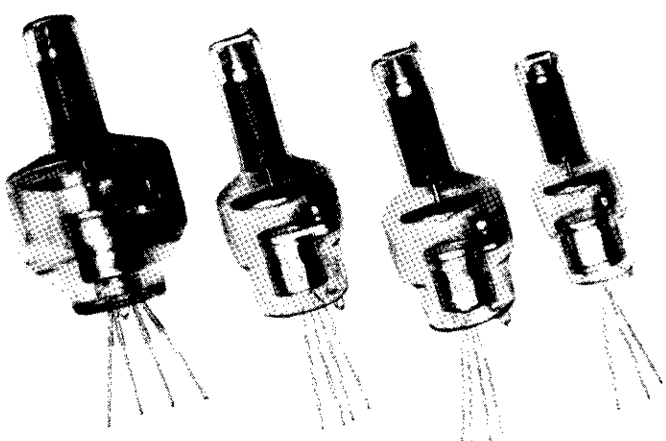

Fig. 8. A range of rotating anode X-ray tubes.

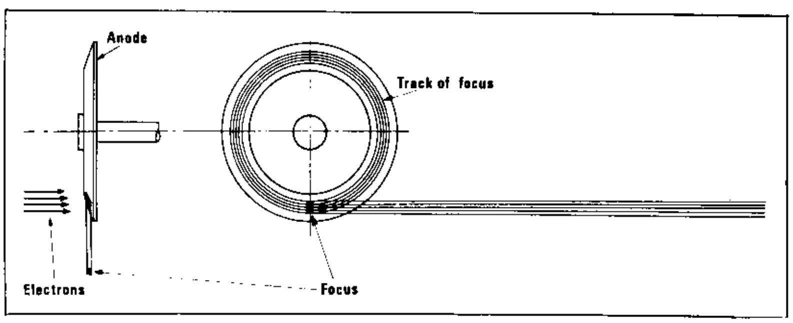

Fig. 9. The thermal advantage gained by anode rotation.

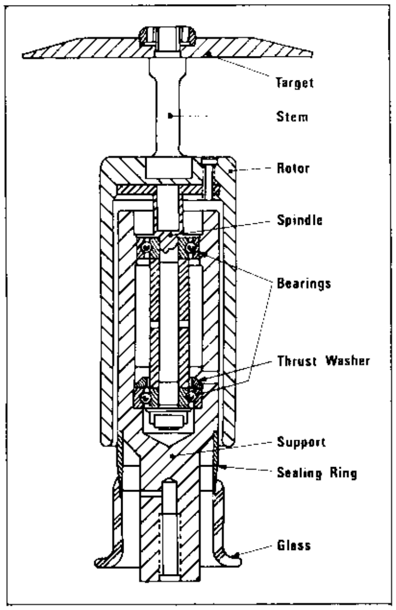

Fig. 10. Details of the rotating anode.

effort is made to prevent heat passing from the target by conduction to the rotor (see Fig. 10) in which the highly temperature-sensitive bearings are housed.

The relative thermal isolation of the target is achieved by making the connecting piece or stem between target and rotor as thin as possible consistent with mechanical rigidity. Moreover, this stem is made of molybdenum, a metal which has a low thermal conductivity and is a very good refractory, i.e. can stand being exercised through many temperature cycles without mechanical failure.

The rotor

The rotor, in the head of which the foot of the molybdenum stem is firmly embedded, is made of copper. It is in this copper that currents are produced by induction to bring about rotation of the anode. This will be explained more fully later.

The outer surface of the copper rotor is plated dull black and processed to increase its heat radiation properties, for in spite of our precautions some heat does pass down the stem, also some of the heat radiated from the back of the target falls on the head of the rotor. As much as possible of this heat must be radiated outwards from the rotor rather than be allowed to reach the bearings.

The bearing assembly

The bearing assembly consists of a precisely machined spindle, carrying two widely spaced ball bearings, fixed inside the copper shell of the rotor body, to which it is firmly and accurately secured. The final component of the anode assembly is the hollow, elongated-cup-shaped steel support. To this is soldered a sealing ring made from a metal, the thermal expansion coefficient of which is matched to that of the glass to which it is sealed. The anode assembly is fitted to the support and secured by screws engaging on the conical thrust washer, thus the outer races of the bearings, held in contact with the support, remain stationary, while the remainder of the assembly rotates.

The bearings are lubricated with a very thin film of soft metal, e.g. silver or lead, by an evaporation process performed in vacuum. Conventional lubricants, such as oils or greases, cannot be used because even with the most highly developed vacuum greases the vapour, whilst not being sufficient seriously to degrade the vacuum of the tube, causes the heated tungsten filament to distort in its slot, by contamination with carbon, thus distorting the focus.

The envelope

The bulb is of hard boro-silicate glass to resist thermal shock and electronic bombardment. Its shape and size are designed to occupy the minimum space consistent with satisfactory performance in the prevailing conditions of temperature and high voltage.

The Rotating Anode X-Ray Shield

Functional requirements

The functions of an X-ray shield are as follows:

(*a*) To surround the tube (or 'insert') with a complete conducting sheath which can be permanently and effectively connected to earth. This is obviously vital wherever voltages of lethal magnitude are involved.

(*b*) To surround the tube (except at the X-ray port or window) with a radiation barrier to ensure that, outside the useful beam, the intensity of X-rays emerging from the unit under the most adverse conditions is minimal—at least as low as specified in the International Recommendation on Radiological Protection.

(*c*) To provide highly insulating terminations through which the high voltage and tube filament supplies can be connected to the tube.

(*d*) To contain the insulating and cooling fluid and to provide for its thermal expansion and contraction.

(*e*) To provide a geometrically precise plane of reference on which beam-collimating devices can be mounted.

(*f*) To house a stator to drive the anode.

Consistent with the above requirements the shield must be as small as possible to allow maximum mobility in restricted spaces, e.g. under a tilting table, and as light as possible to minimize counter-balancing difficulties.

Fig. 11 shows in section a typical oil insulated diagnostic shield for use up to 135kVp.

General description

The shield shell (1) is machined from a thick-walled light alloy casting. It is lined, where necessary, with lead for X-ray protection purposes, the thickness of the lead at

INTERNATIONAL EXHIBITION GOES ON—REDUCED FROM SHOP-WINDOW TO SHOW-CASE

A hospital equipment exhibition will be taking place in June, despite the work-to-rule which caused the cancellation of the main exhibition. In announcing his plans, Mr. William Kern, Chairman of the Organisers, Contemporary Exhibitions, said: "We have had such enthusiastic support from the sponsors and exhibitors, as well as Government Departments, that we felt we had to try and present some form of exhibition for the hospital world, despite the formidable difficulties. Although much reduced in size – to an international show-case instead of the intended international shop-window – it will take place on the First Mezzanine Floor of EARLS COURT from June 2 to 6, 1969".

Covering an area of some 15,000 square feet, the "emergency" Hospital Equipment Presentation will occupy "table-space" in rooms normally used for meetings, conferences, lounges and refreshment purposes. Earls Court has been chosen as the venue because of the fact that, on the premises at the same time, many other conferences will take place. They include: the Institute of Hospital Administrators; the Hospital Caterers' Association; the National Association of Supplies Officers; the Institute of Hospital Engineering; the Institute of Hospital Building Supervisors; the Guild of Public Pharmacists; and the International College of Surgeons who will be meeting for their European Federation Congress – the first occasion in the United Kingdom.

The Conference of the Institute of Hospital Engineering will now be in the South Conference Hall, on dates and at times as published in "The Hospital Engineer" for January and May. Tickets issued for use at Olympia should facilitate entry into Earls Court (use Warwick Road entrance).

Classified Advertisements

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BRIDGEND GENERAL HOSPITAL, QUARELLA ROAD, BRIDGEND, GLAM.
HOSPITAL ENGINEER

Applications are invited for the above post. This appointment entails responsibility to the Group Engineer for the mechanical and electrical maintenance services at Bridgend General and other hospitals in the Bridgend and Maesteg areas. Applicants must have completed an indentured apprenticeship in electrical or mechanical engineering or have otherwise acquired a thorough practical background as distinct from a purely craft training. They should be familiar with planned maintenance procedures and have a sound knowledge of boiler plant, mechanical and electrical equipment and wide experience in their maintenance and should possess one of the following qualifications or an equivalent qualification approved by the Ministry of Health:—

(i) Higher National Certificate or Higher National Diploma in Mechanical Engineering with endorsements in Industrial Organisation and Management and Principles of Electricity or Electro Technology.

(ii) Higher National Certificate or Higher National Diploma in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S.III or O2 level) Applied Heat and Applied Mechanics provided they have suitable practical experience in Mechanical Engineering.

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

Experience in a large hospital or Group will be an advantage and consideration will also be given to applicants having a wide hospital experience but not possessing qualifications stipulated above.

Salary scale based on a pointage of 24½ or more points, i.e. £1,370 to £1,605 per annum plus £100 special responsibilities allowance. Married accommodation available at a reasonable rental.

Application forms obtainable from the Group Secretary, Garthmor, Old Road, Neath, Glam.

ASSISTANT ENGINEER required within the Chelsea and Kensington Hospital Group at St. Mary Abbots Hospital, Marloes Road, Kensington, W.8. Must have served an engineering apprenticeship and hold a recognised qualification (Ordinary National or equivalent). Building knowledge an advantage. Salary scale £975 to £1,270 plus £90 London Weighting. Apply naming two referees to Secretary, 5, Collingham Gardens, London, S.W.5.

BRO MORGANNWG HOSPITAL MANAGEMENT COMMITTEE
PARC HOSPITAL, BRIDGEND (1,132 BEDS)
HOSPITAL ENGINEER

Applications are invited for the above post. This appointment entails responsibility to the Group Engineer for the mechanical and electrical maintenance services at this large psychiatric hospital. Applicants must have completed an indentured apprenticeship in electrical or mechanical engineering or have otherwise acquired a thorough practical background as distinct from a purely craft training. They should be familiar with planned maintenance procedures and have a sound knowledge of boiler plant, mechanical and electrical equipment and wide experience in their maintenance and should possess one of the following qualifications or an equivalent qualification approved by the Ministry of Health:—

(i) Higher National Certificate or Higher National Diploma in Mechanical Engineering with endorsements in Industrial Organisation and Management and Principles of Electricity or Electro Technology.

(ii) Higher National Certificate or Higher National Diploma in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S.III or O2 level) Applied Heat and Applied Mechanics provided they have suitable experience in Mechanical Engineering.

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

Experience in a large hospital or Group will be an advantage and consideration will also be given to applicants having a wide hospital experience but not possessing qualifications stipulated above.

Salary scale based on a pointage of 24½ or more points, i.e. £1,370 to £1,605 per annum plus £75 special responsibilities allowance. Married accommodation available at a reasonable rental.

Application forms obtainable from the Group Secretary, Garthmor, Old Road, Neath. Glam.

DEPUTY GROUP ENGINEER

Doncaster Hospital Management Committee invite applications from men able to act for the Group Engineer over the whole range of his duties.

Applicants for this progressive post should have wide experience in the management of mechanical and electrical plant and must hold HNC or HND in Electrical Engineering with endorsements in Industrial Organisation and Management and including (at S.III or O2 level, or with endorsement in) Applied Heat and Applied Mechanics.

Salary on a scale up to £1,605 plus £100 special responsibility allowance. Temporary rented accommodation is available.

Full particulars will be sent to applicants. Please write, giving details of age, qualifications and experience, and the names and addresses of two (one technical) referees to: The Group Secretary, Doncaster Royal Infirmary, Doncaster.

BRIGHTON AND LEWES HOSPITAL MANAGEMENT COMMITTEE

HOSPITAL ENGINEER required for the Royal Sussex County, Sussex Eye and Sussex Throat & Ear Hospitals.

The Royal Sussex County Hospital is in the process of development as a District General Hospital and the 1st Phase of the building (Emergency and Accident Department) is due to open shortly.

Salary scale is £1,370 to £1,605 plus responsibility allowance of £75 per annum.

Applicants must hold one of the following qualifications or equivalent 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 Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course; or

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

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

Further particulars, job description and application form obtainable from the Group Engineer, 'B' Block, Brighton General Hospital, Elm Grove, Brighton, BN2 3EW.

PORTSMOUTH GROUP HOSPITAL MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER

Applications are invited for the post of Deputy Group Engineer who will be required to deputise for the Group Engineer over the whole range of his duties. This includes responsibility for the efficient operation, maintenance and co-ordination of all engineering services and engineering activities in the Group, including design and estimating for minor work. Responsibility for specific areas of work may also be delegated to the Deputy.

Applicants must have completed an apprenticeship in mechanical or electrical engineering and hold one of the following or equivalent qualifications:—

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

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

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

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

The Group contains seventeen hospitals with a total of 2,331 beds. Extensive development is taking place in the two District General Hospitals.

The Salary scale is £1,370 to £1,605 over five increments plus a special responsibility allowance of £200 per annum.

Whitley Council conditions of service and National Health Service Superannuation apply.

Apply giving full details including age, qualifications, experience and naming three referees to the Group Secretary, Saint Mary's General Hospital, Milton Road, Portsmouth, by the 20th June, 1969.

Further information may be obtained from the Group Engineer, Saint Mary's General Hospital, Milton Road, Portsmouth.

SENIOR SUPERINTENDENT (ELECTRICAL)

required by the GOVERNMENT OF KENYA, Ministry of Works, on contract for one tour of 24 months in first instance. Salary according to experience in scale: Kenya shgs. 29,880 to 33,420 (approximately £1,743 to 1,949 STG) plus an Inducement Allowance of £926 to 956 STG a year, paid direct to the officer's bank in the U.K. Gratuity: 25 per cent of total salary drawn inclusive of generous leave or 45 per cent without leave. Free passages. Education Allowances. Quarters provided at reasonable rental. Contributory pension scheme available in certain circumstances.

Candidates, under 50 years of age, must possess City and Guilds Full Technological Certificate or equivalent, and have at least 12 years experience (including a comprehensive engineering apprenticeship followed by at least seven years in a supervisory position). They must also have specialist experience in Teaching Hospitals, and officers will be required to liaise with the Ministry of Health in the design, specification, construction and maintenance routine for all hospitals' electrical installation and equipment. Duties include the installation, inspection and testing of hospital electrical equipment.

A professionally qualified electrical engineer with hospital experience would be acceptable for appointment in an appropriate salary scale.

Apply to CROWN AGENTS, M. Dept., 4, Millbank, London, S.W.1, for application form and further particulars, stating name, age, brief details of qualifications and experience and quoting reference M2T/681110/HR.

LEICESTER No. 4 HOSPITAL MANAGEMENT COMMITTEE

CARLTON HAYES HOSPITAL, NARBOROUGH, LEICESTER, LE9 5ES

HOSPITAL ENGINEER

required to be directly responsible to the Group Engineer for the maintenance of the engineering and electrical services at this Psychiatric Hospital of approximately 800 beds.

Applicants must have had a thorough practical training appropriate to the post and should hold one of the following qualifications or an approved equivalent. Consideration may be given to applicants not in possession of these approved qualifications at an abated salary.

(i) City and Guilds Mechanical Engineering Technicians Certificate (Part II) which must include Plant Maintenance and Works Service; or

(ii) City and Guilds Certificate in Plant Engineering; or

(iii) Ministry of Transport First Class Certificate of Competence which includes an Ordinary National Diploma or Ordinary National Certificate.

Salary scale £1,270 to £1,500 per annum, plus special responsibility allowance of £25.

House available at moderate rental. Assistance with removal expenses may be granted to a successful applicant from within the Health Service.

Applications, stating age, training, qualifications and experience with name and address of three referees to Group Secretary, Carlton Hayes Hospital, Narborough, Leicester, LE9 5ES, not later than 11th June, 1969.

YORK 'A' HOSPITAL MANAGEMENT COMMITTEE

Appointment of Hospital Engineer

Applications invited for the above appointment for duties at City, St. Mary's and associated hospitals in York. Applicants must have completed an apprenticeship in mechanical engineering, have a sound knowledge of steam boiler plants (oil-fired at the City Hospital) with a wide experience in the management of mechanical and electrical engineering plant similar to that of modern hospitals. Candidates must hold City and Guilds Mechanical Engineering Technicians Certificate (Part II) which must include Plant Maintenance and Works Service, or City and Guilds Certificate in Plant Engineering or Ministry of Transport First Class Certificate of Competency which includes an O.N.D. or O.N.C. Applications will, however, be considered from candidates without the stipulated qualifications, the salary scale being suitably abated.

Salary £1,270 p.a. rising to £1,500 p.a. plus £50 p.a. special responsibilities allowance.

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

UNITED BRISTOL HOSPITALS
BRISTOL ROYAL INFIRMARY

Hospital Engineer required at this Hospital which is at present being extended by a major development. The post would give excellent experience to an enthusiastic engineer.

The engineer appointed will be responsible to the Group Engineer for the operation and maintenance of engineering services and should have wide experience with mechanical and electrical plant and services.

Qualifications required are:—

(a) H.N.C. in Mechanical Engineering with endorsements in Electro-Technology at S.III or O.2 level; or

(b) H.N.C. in Electrical Engineering with endorsements in Applied Heat and Applied Mechanics at S.III or O.2 level.

Salary scale £1,470 to £1,705 per annum, by five annual increments, includes special responsibility payment of £100.

Applications stating age, qualifications, experience and the names of two referees, to Secretary to the Board, Bristol Royal Infirmary, Bristol BS2 8HW.

HOSPITAL ENGINEER

HIGHCROFT HOSPITAL, ERDINGTON, BIRMINGHAM, 23

1,175 PSYCHIATRIC BEDS

Applications are invited for the above post. Salary scale £1,370 rising to £1,605 per annum plus special responsibility allowance of £50. Extra duty allowance payable. First class opportunity for man with go-ahead ideas. Complete Works Department with all trades represented and adequate supervisory assistance. Applicants should have a wide experience in the maintenance of engineering and building services, and the control of men and materials. The successful applicant will be directly responsible to the Group Engineer.

Qualifications: H.N.D. or H.N.C. Electrical or Mechanical Engineering with endorsements in Organisation and Management and either Electro-Technology or Applied Heat and Mechanics; or equivalent qualifications approved by the Department of Health.

A rented house is available if required.

Applications within seven days, with names of two referees to: Group Secretary, North Birmingham & District Hospital Management Committee, Good Hope General Hospital, Sutton Coldfield, Warwickshire.

MISCELLANEOUS

CIRCULATING PUMPS and Steam Turbines, Complete units, electric and steam, spares and service. TURNEY TURBINES Ltd., 67, Station Road, Harrow. Tel: 01-427 1355 and 01-427 3449.

Stethoscopes, Eartips, Headphones and Pillowphones—Supplies and Service. Workshops for the Disabled, Northern Road, Cosham, Portsmouth. Tel: Cosham 76533.

any given point being determined by the intensity of radiation emerging in that direction. Little in the way of lead lining is necessary at the anode end of the shield because this region lies behind the main source of X-rays and is shielded by the target, the rotor and other massive components.

The bellows and thermal limit switch

At the other (cathode) end of the shield, closure is effected by means of a flexible diaphragm or 'bellows' (9) of large capacity. Its function is to accommodate the change in oil volume that takes place due to thermal expansion and contraction over the whole rated temperature range of the shield, i.e. between the sub-zero conditions that can occur during transport and the maximum operating temperature which may be as high as 80°C. As the shield heats up and the oil expands the bellows moves slowly outwards. This process can continue without any significant rise in pressure inside the shield until further bellows movement is prevented by the bellows stop plate (10). The diaphragm at the anode end of the shield, being small in effective area, has not yet moved. However, if heating is continued past this point, pressure begins to build up. The small diaphragm, being the only yielding surface remaining in the vessel, moves outwards and operates the micro-switch (8). The switch is normally connected to the apparatus in such a way that when it operates, as described above, further radiography or screening is prevented and a warning lamp is switched on. It is most important to remember that this device is *slow* in operation and, therefore, only protects against the excessive *average* heat input which can occur if a session of radiography and/or screening represents an average power higher than the continuous rating of the shield. The target of the tube could be totally destroyed by radiographic overload before the average oil temperature had even started to rise.

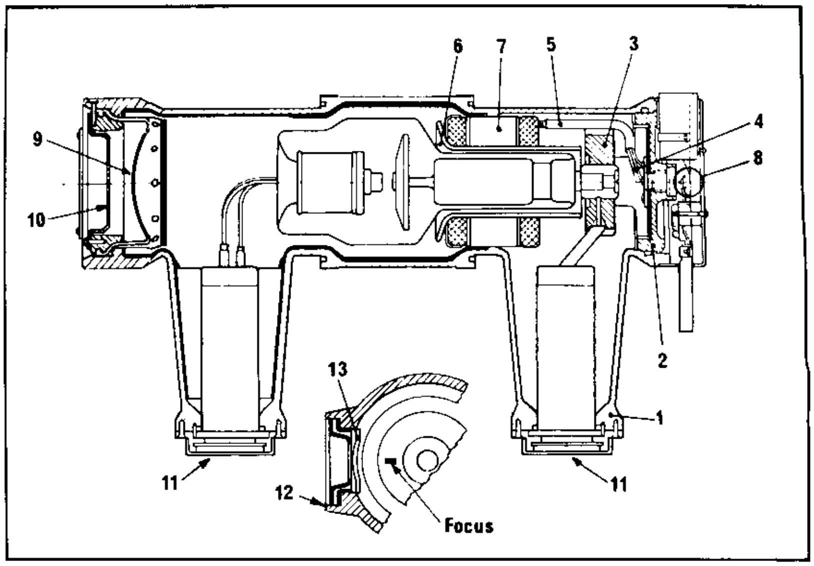

Fig. 11. A typical rotating anode X-ray shield.

In this particular design the end-casting (2) as well as serving to close the anode end of the shield, also supports the tube mounting insulator (3) to which the tube anode is rigidly secured. The tube is, of course, co-axial with the main cylinder of the shield, the focus lying precisely on the axis of the shield window. The accuracy of the alignment of the focus with the window axis is checked by a pinhole camera mounted on the shield window plate. Three insulating terminals, through which the low voltage supply to the stator is connected, pass via oil-tight glands through the shield end casting. They are connected to the stator by the three leads (4) passing through a rigid conduit (5). The purpose of this conduit is two-fold, namely to improve the electrical stresses between the leads and the tube anode connection and to ensure that the leads follow a fixed, pre-determined course inside the shield.

A lead glass flange (6) is fitted between the neck of the tube and the (earthed) stator (7). This also serves two purposes, namely to reinforce the insulation in this highly stressed region of the shield and, in conjunction with the lead lining at the end casting, to provide shielding against extra-focal radiation and scatter.

The central hole in the shield end-casting is closed by a small, flexible diaphragm which, via a plunger, operates a micro-switch (8). The purpose and operation of this device is explained later. The space between the shield end-casting and the end cap also contains the plug and socket by which connections to stator and micro-switch are led to the shield.

The high voltage connections—cables

To simplify the insulation problem in the shield and generator and to enable thinner, and therefore more flexible, high voltage cables to be used, diagnostic tubes are energised symmetrically about earth. This means that instead of earthing one electrode and applying for example 125kVp to the other, the cathode operates at 62·5kV negative with respect to earth and the anode 62·5kV positive with respect to earth. Since the shield shell is at earth potential, such an arrangement requires two highly insulated sockets (11) into which the anode and cathode high voltage cables can be plugged.

The cable itself comprises a central core of three separate conductors surrounded by a thick layer of insulation. Outside the rubber is a sheath of woven copper wire which is, in turn, covered by a protective layer of cotton braiding or plastic. The cable is terminated by a plug of insulating material designed to fit the socket of the shield, the three central conductors being led right through the length of the plug to three contact pins in its extreme end. The outer copper sheath of the cable is stopped short at the root of the plug and is connected to a metal flange. When the cable is fitted into the shield socket the three contact pins engage in matching recesses in the socket and the flange is secured firmly to the shield shell. This means that, in addition to any special earthing wires which may be used, the shield shell is connected directly to the earthed frame of the high voltage generator via the outer sheath of each cable.

The X-ray tube fitted in this shield is a double focus type, i.e. it has two filaments, giving the user a choice of effective focus size. In such a tube three leads emerge from the cathode end. The first is connected to the cathode block of the tube (to which the 'common' ends of both filaments are internally connected). The second and third are connected to the 'live' ends of the large and small focus filaments respectively. These three leads are plugged into the head of the cathode cable socket of the shield and are thus connected to the three central conductors of the cathode cable. At the generator end, these conductors pick up the negative terminal of the high voltage supply (connected to 'common') and a heating supply for each filament.

The anode cable is identical but here the three central conductors are connected together by a shorting link in the head of the anode cable socket of the shield, from which a spring connector runs through the tube mounting insulator to make contact with the anode boss. At the generator end the cable picks up the positive terminal of the high voltage supply.

The window—inherent filtration

X-rays emerge from the focus in all directions, the useful beam being simply that cone or pyramid of radiation which is allowed to escape through the shield window. The window then is basically an area of low attenuation in the form of a plastic cup (13) sealed to the shield. The window is cup shaped to reduce the thickness of the layer of oil over the surface of the tube in this region. The main beam passes through three stages of attenuation before emerging from the shield, namely the glass of the tube bulb, the oil layer and the plastic cup. These elements constitute the 'inherent filtration' of the unit and, therefore, establish the lowest half-value layer of the beam at any kV.

The inherent filtration is usually kept low, the addition of filtration to meet specific requirements being thus left to the user.

In the shield we are using as an example provision is made for an additional, beam-width-restricting lead diaphragm to be fitted in the window cavity. Such a diaphragm, placed reasonably close to the focus, has the effect of reducing the amount of extra-focal radiation falling on the image field. Radiation other than that from the focus can, of course, only detract from the diagnostic quality of the image and uselessly increase the dose to the patient.

The window faceplate (12) provides an accurate datum plane on which to mount beam-control devices, e.g. applicators and leaf diaphragms.

The stator

The stator is the device which produces the rotating magnetic field required to accelerate the tube anode to operational speed in readiness for each radiographic exposure. It depends for its operation on the fact that every electric current produces a magnetic field. It consists essentially of two coils of copper wire disposed in slots in a cylindrical soft iron core such that the axes of the coils are at right angles to each other. The purpose of the iron core is, by virtue of its good magnetic properties, to increase the strength of the magnetic field produced by the coils and to concentrate it in the rotor of the tube. The core is built up of thin laminations to reduce electromagnetic losses in the iron. A schematic circuit diagram of the stator is shown in Fig. 12.

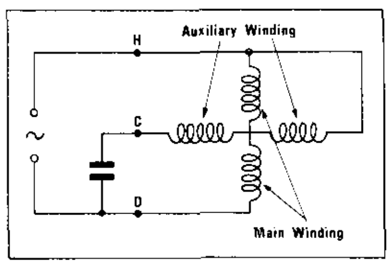

Fig. 12. Schematic diagram of the stator circuit.

When an alternating current supply is switched to the stator, current flows through the main winding (via points H & O) and sets up an alternating magnetic field or 'flux' in the vertical direction. Similarly, current flowing through the auxiliary winding (via points H & C) sets up an alternating flux in the horizontal direction. Now, if these two currents were 'in phase', the effect would simply be to produce a resultant alternating magnetic flux in a direction of approximately 45° to the coil axes. However, due to the condenser connected in series with the auxiliary

(Continued on page 145)

Automatic Boiler Control as applied to Industrial Boiler Plant

By R. HUSSEY, M.I.H.V.E., M.Inst.F., M.I.Plant.E.
Elliott Process Automation Ltd.

MODERN steam raising and hot water boiler plant is designed to give optimum conditions to the plant load to be served. Therefore in order to justify its cost, not only from the capital point of view but also with respect to the subsequent running and maintenance costs incurred, it is of paramount importance for the user to obtain the desired efficiency, otherwise the overall cost will be unnecessarily increased.

For many years now it has become increasingly obvious that it is physically impossible for human operators to manually control the many variables associated with boiler plant and still retain a consistent degree of control related to load variations. Given correctly designed and applied automatic control, the task of the boiler operator is simplified, thereby enabling him to incorporate within his duties such essentials as routine maintenance, efficiency checks, etc.

Generally speaking, it is believed that *"simplicity, whilst at the same time meeting the plant characteristics"* is the yardstick by which any automatic control should be judged. If this is put into effect, and combining to get the best out of it not least of all the boiler operator, who, whether or not he appreciates it fully at the early stages, ultimately realises that it will relieve him of some of the more tiresome jobs such as getting the water back into the gauge glass or having to modify the draught and fuel quantities every time there is a plant load change.

Automatic controls must not be looked upon as a means whereby any undesirable operational fault associated with the previously manually operated boiler plant can be immediately overcome. It should be borne in mind that, by introducing automatic control to a particular boiler plant, the controls themselves, having been set up correctly, can only reproduce the highest possible plant performance obtainable under manual control.

Where the real benefit lies in introducing automatic control is in the *maintenance* of the highest plant performance and the fact that when a plant load change occurs, necessitating a modification to the firing rate etc., the boiler auxiliaries are being reset as the load change occurs rather than sometime after the load change has been witnessed by the plant operator having reference to the instrumentation he has available.

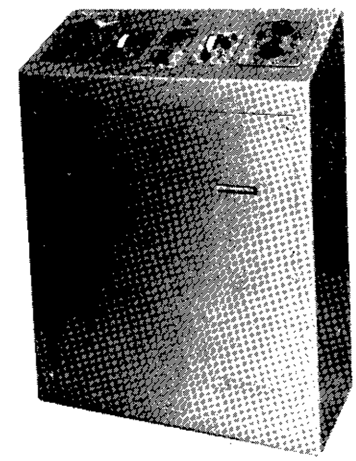

Fig. 1. Typical control console for twin-furnace chain-grate stoker-fired Shell Boiler.

The "benefits" as outlined collectively contribute toward appreciable saving in the fuel consumption by making more efficient use of the available heat in the fuel. This is brought about by the fact that the fuel fired is the minimum compatible with satisfying the plant load demand, and the air input for the combustion process is that required to extract the greatest heat from the fuel.

A further, and possibly the greater benefit of all, is that the heat losses carried away in the flue gases are appreciably reduced, once the controls, regulating the rate at which the combustion gases are removed from the furnace, have been commissioned.

Modern industrial boiler plant covers a wide range of boilers, both in type and capacity, something in the order of, say, 2,000 lbs/hr. to 100,000 lbs/hr. There are, of course, boilers with larger evaporation rates in current use but the majority of these are concerned with Central Electricity Generating Board activities or similar power production plant and, as far as automatic boiler controls are concerned, require something of a specialised nature which is usually foreign to most industrial boiler plant applications. These controls involve a far greater capital expenditure and sophistication, but when you consider

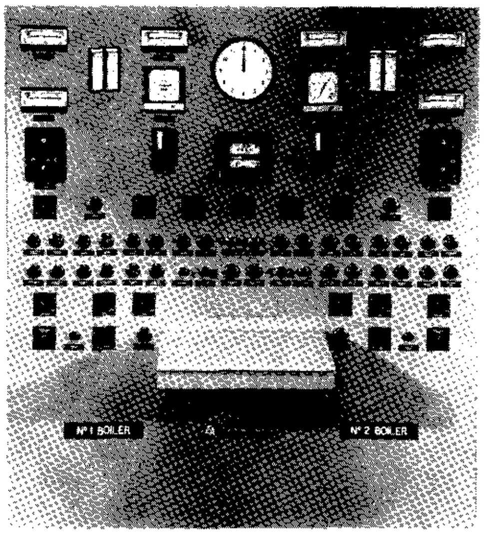

Fig. 2. Main instrument and control panel for four single-furnace stoker-fired Shell Boilers (Eastern General Hospital, Edinburgh).

that a $\frac{1}{4}\%$ improvement in thermal efficiency will, by virtue of the quantity of fuel consumed over the course of the year, bring about a saving in fuel costs amounting to something in the order of several hundred thousand pounds, the additional capital expenditure is justifiable.

This now brings me to the point which is to my mind one of the most important in any discussion relating to automatic boiler control. This concerns the "value" of any automatic boiler control scheme; by value meaning the capital cost, and just how effective or efficient the scheme will be, once installed (i.e. cost in use). From experience I would state quite definitely that far too little attention is paid to the suitability of a control scheme for a given application and too much to the initial capital cost of the project. It is no use having automatic boiler control installed on a boiler plant unless detailed discussion has taken place on, and not necessarily in order of priority, the following:—

(1) The type and range of plant load envisaged.

(2) The magnitude of plant load swings and the time cycle.

(3) The anticipated boiler turndown required, which will of course be related to the type and range of plant load.

(4) The availability and quality of power supplies, i.e. electrical/pneumatic.

(5) If an existing boiler plant, how much modification, if any, is necessary to modify the boiler auxiliaries, i.e. dampers, speed control devices etc., to accommodate automatic controls.

(6) What instrumentation is available to set up the automatic controls and prove the performance of the controls in operation and subsequent service.

(7) Is the ability of the boiler house operators such that they could understand the operation of the automatic controls being considered or does this mean employing more highly skilled plant operators.

(8) Is the existing maintenance facility capable of maintaining the automatic control equipment once it has been installed. If not, then this provision must be catered for in the overall exercise.

(9) Do the suppliers of the automatic controls have facilities for periodic service checks to ensure that the full benefits of the automatic controls are consistently materialised.

(10) The two greatest savings available once automatic controls have been fitted to a boiler plant are:—

(i) A reduction in fuel costs, and

(ii) A reduction in the number of plant operators required to man the boiler house.

Therefore, how soon will it be before the capital invested in purchasing the automatic controls can be recovered.

If this question was understood and looked into in more detail, I am sure there would be more existing boiler plants fitted with automatic controls today.

(11) If, by spending a little more initially on an automatic control scheme tailor made for the plant application, will it result in obtaining a higher thermal efficiency, thereby justifying the additional capital expenditure?

(12) Could the boiler plant be left unattended for periodic intervals permitting the boiler house attendant to fulfil additional duties or, alternatively, limit the number of attendants required? If so, then, in order to satisfy insurance requirements, certain additional monitoring equipment will be required to satisfy the A.O.T.C. (Associated Offices Technical Committee) requirements.

Normally, most insurance companies adopt the recommendations and requirements of the A.O.T.C. in any dealings with boiler plant insurance and the current requirements of 1963 (4th Edition) clearly illustrate what these are.

Having so far discussed the variations which should be taken into account prior to the installation of automatic boiler control and also the approximate range of boilers currently associated with Industrial Plant, it will be appreciated that the size of the boilers and, consequently, the quantity of fuel consumed, play an important part in determining the automatic control employed, particularly so in a case of combustion and feed water level control.

With reference to the actual controls that are normally fitted to the present day boiler, it will be appreciated that, in view of the wide range of boilers in respect to type and rating, a complete coverage is impossible.

therefore reference is made to a number of typical control schemes.

Generally speaking, an Industrial Boiler fitted with Automatic Controls, and employed for steam or hot water raising purposes, will be provided with pneumatically or electrically operated equipment effecting control of some or all of the following:—

1. The combustion firing rate.
2. The quality of combustion, i.e. air/fuel ratio.
3. Feed water level.
4. Furnace pressure.
5. Steam temperature

or 6. Water Temperature.

It would be fair to say that for most Shell boiler plants the automatic controls would be electrically operated primarily because of the economic consideration, i.e. the simple proportional acting electrical control is cheaper than the more costly, but more flexible, pneumatic equivalent. The cost basis, assuming a suitable air supply is already available, would be, for pneumatic control, 20% higher than the electrical equivalent.

Most oil or gas fired Shell boilers are provided with a packaged burner plant of varying manufactures supplied complete with electrically operated combustion controls.

The combustion controls would normally form a control loop providing proportional corrective action and would consist of a pressure transmitter incorporating a slide wire potentiometer, a motorised drive housing a shaft feed back potentiometer and an interstage balancing relay which would combine to form an electrical "bridge circuit". The motorised drive would be mechanically connected to both the combustion air fan damper and also a mechanically operated oil control valve, the former via an adjustable cam arrangement which would enable the desired fuel/air ratio to be set at the commissioning stage.

The "bridge circuit" control loop would control the firing rate relative to plant load requirements such that the pressure transmitter, suitably connected to the boiler steam header, detects any plant load change by virtue of a variation in steam pressure. The movement of the slide wire potentiometer creates an electrical "out of balance" in the bridge circuit with the result that the motorised drive will modify the fuel and combustion air quantities until such time as the current flow in both sides of the bridge circuit is the same, thereby restoring electrical equilibrium and, by virtue of this condition, a return to the desired set point steam pressure.

Furnace pressure controls are not normally required for the present day "packaged" type oil or gas fired boilers which operate under "pressurised furnace" conditions. The possible exception to this is where the fuel firing equipment has been introduced to an existing plant previously coal fired. In such instances, the fuel firing equipment more often than not operates under balanced draught conditions which means that regulation of the induced draught must be effected to maintain the desired balanced draught condition in the furnace. This is usually carried out by use of an electrically operated "floating" control loop comprising a diaphragm operated draught controller and motorised drive which would be mechanically connected to the boiler outlet damper or, alternatively, I.D. Fan Damper.

Whilst the aforementioned controls represent the standard basic requirements for this type of boiler, it is becoming increasingly more attractive to the plant user to incorporate the additional interlock equipment which satisfied A.O.T.C. requirements in order that the boiler plant can be attended by a reduced number of plant operators and periodically unmanned whilst in operation.

The additional controls normally fitted enable the boiler to be started up and shut down automatically, with the burner control programme incorporating interlocks which are arranged to monitor continuously such variables as flame condition, fuel pressure, fuel temperature, combustion air pressure, excess steam pressure, feed water level etc. and, on the occasion of one of these variables veering from the design setting, the boiler would be shut down and audible warning of the "fault" condition initiated.

The automatic controls fitted to plant comprising oil or gas fired hot water boilers would be essentially the same as those outlined previously for steam boilers, with the exception, of course, that the aforementioned steam pressure transmitter would be replaced by a

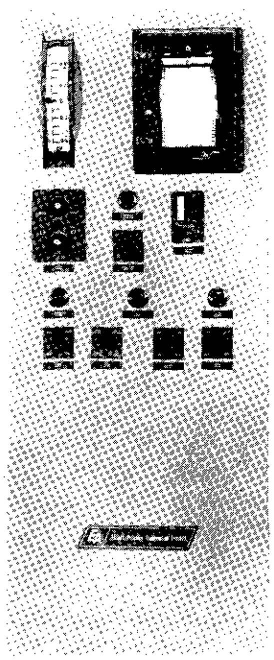

Fig. 3. Instrument and control cubicle for one single-flue Boiler (Ideal-Standard Boilers, Hull).

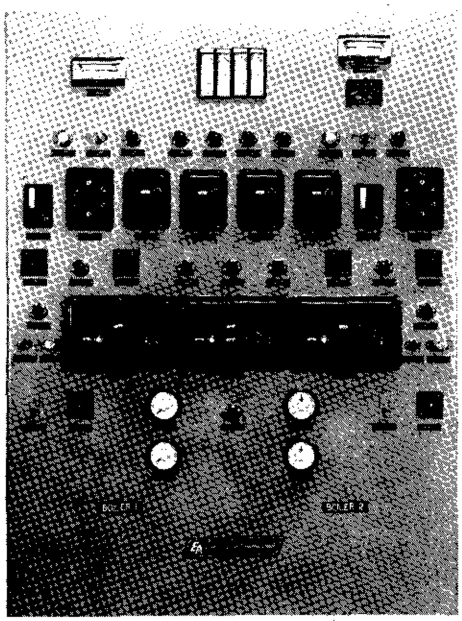

Fig. 4. Main instrument and control panel for four single-furnace stoker-fired Economic Boilers (Liberton Hospital, Edinburgh).

temperature transmitter, normally of the capillary or electrical resistance type.

For the chain grate coal fired equivalent type of boiler, automatic control would be electrically operated requiring a standard single phase lighting supply.

The range of automatic controls in question can be supplied with or without low fire kindling control and can, if required, incorporate in addition full A.O.T.C. interlocks.

With reference to the water tube type of boiler, there are very few such boilers fitted with automatic control which do not employ the pneumatically operated type of equipment. This is due to the fact that with the more versatile pneumatic control equipment, the higher working forces, pressures and temperatures can be taken care of and most important of all with purely proportional acting control and the inherent offset from the desired set point, the permissible tolerance applicable to the Shell boilers does not apply when water tube boilers are involved. This is particularly so in applications where a turbine plant is being supplied with steam from the boilers.

In a multi-boiler plant, the steam pressure measurement would be taken at a point in the common header directly downstream of where the last boiler joins the header, thus avoiding any inter-action amongst the boilers due to dissimilar instrument characteristics and actual measured steam pressures which would be apparent if each boiler was fitted with its own pressure controller. This is, of course, one of the limitations of the current trend of oil and gas fired packaged type Shell boilers which are fitted with electrically operated boiler controls on a per boiler basis, with the boilers operating control wise independently of each other.

For applications involving water tube boilers which have to contend with large process plant load swings, a more elaborate fully metering control scheme would be most beneficial in order to obtain the efficient control of fuel and air quantity.

Naturally, this alternative type of scheme would cost some 25% more than a simple positioning scheme, but this would, on a large boiler plant, soon be recovered for the reasons previously mentioned.

It is common practice for burner manufacturers to incorporate in their overall burner control programme, the various interlocks catering for flame failure, combustion air fan failure etc. and these are bound to be included in applications involving this type of boiler plant.

With regard to coal fired water tube boilers, the combustion control scheme would be similar to those previously mentioned with the fuel control valve being replaced by a stoker speed regulator and the air-fuel ratio relay would be incorporated in the fuel control loop, for the reason that in the oil or gas fired boiler the fuel is faster in response than the combustion air, whilst in the case of the coal fired boiler the reverse is the situation.

In applications where this type of boiler is required to operate under balanced draught conditions, a furnace pressure control similar to that illustrated in Fig. 5 would be applicable on a per boiler basis with the relevant regulator being mechanically connected to the boiler outlet damper or alternatively I.D. Fan Inlet Damper.

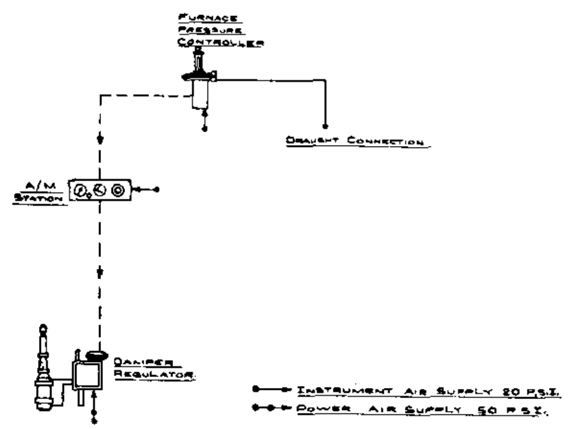

Fig. 5. Proposed Furnace Pressure Control.

In many water tube boiler plant applications, where the boilers supply superheated steam to processes of varying kinds, close control of the steam temperature is necessary.

Such control maintains the temperature of the steam passing from the superheater outlet to the process within narrow limits, by regulation of the gas bypass damper alternatively in some applications by regulation of steam flowing through or bypassing a non-contact type attemporator or, alternatively, by regulation of de-superheating water via a spray nozzle in the contact type attemporating systems.

With reference to control of the feed water level in the boiler, in the case of Shell boilers and in the steam drum in the case of water tube boilers, the ideal as far as feed water is concerned is to feed into the boiler sufficient feed water to match the weight of steam that leaves the boiler, plus that feed water which is lost through blowdown etc. and at any given time.

It is most undesirable to feed large quantities of comparatively cold water into the boiler, for, in addition to setting up thermal stressing within the boiler shell or drum, a large change in the water level will also affect the combustion controls and act upon them in the same way as a sudden plant load change, with the result that to overcome one error condition, i.e. low water level, it is overcome by creating another, i.e. low steam pressure.

With present day packaged type Shell boilers, the quantity of water above the top row of tubes is quite small compared with that previously considered desirable, with the result that control of the feed water level now becomes more critical. Similar comments would apply in the case of the water tube type of boiler in so far that, in the manufacturer's endeavour to improve the output/weight ratio, this type of boiler is frequently "packaged" and the steam drum not least of all is one of the items that is being reduced in size and, consequently, capacity.

A two element pneumatically operated control would be suitable for all Shell and most packaged water tube boiler plant applications. In addition to the actual measured water level in the boiler or drum, a measurement of steam flow introduces an anticipatory effect into the overall control and eliminates to a large extent, wide changes in water level when sudden plant load swings are apparent.

For refined control of the water level for larger water tube boilers subject to wide or sudden process plant load swings, it is desirable to use a three element control scheme which incorporates a measurement of the feed water passing to the boiler, in addition to the steam flow and drum level measurements. In effect, the control is basically, feed water flow=steam flow$\pm$drum level.

Where Shell boiler plants are involved, particularly those below, say, 20,000 lbs/hr. evaporation, it is more usual to find the single element direct steam operated feed water control system similar to the "Mobrey" or "Thermofeed" type. These are more than adequate for such boilers as long as plant load swings are comparatively small.

Particular attention should be paid to the A.O.T.C. requirements and recommendations as far as feed water level controls are concerned if it is intended to operate the boiler plant unattended for any periods.

Whilst it is extremely difficult to cover all aspects of automatic control relating to Industrial Boiler Plant, it is hoped that some of the points covered will be of interest.

This Paper was read before the Welsh Branch of the Institute.

Photographs by courtesy of South-Eastern R.H.B.

ELECTRONIC EQUIPMENT FOR THE MEDICAL PROFESSION

A NEW COMPANY known as GEC-Elliott Medical Equipment Ltd., has been formed as part of GEC-Elliott Automation Ltd., to manage the GEC and Elliott-Automation activities in this field. It will be mainly concerned with diagnostic X-Ray equipment and in the major growth areas of computer based systems for patient monitoring and other medical applications.

GEC-Elliott Medical Equipment is the largest company of its kind in Britain and is wholly devoted to the design, development and production of equipment for the medical profession. The strength of the new group will enable maximum support to be given to expansion of the company's already substantial export business.

The company's X-ray capability is based on the ranges of equipment manufactured by Watson & Sons (Electro-Medical) Ltd., and A. E. Dean & Company (X-Ray Apparatus) Ltd., with the X-ray tubes and associated valves made by Machlett X-Ray Tubes (Great Britain) Ltd.

The new company is also responsible for the design, manufacture and marketing of equipment produced by Elliott Medical Automation and its subsidiary, Godart CPI Ltd. Elliott Medical Automation is primarily concerned with computer based systems for patient monitoring and laboratory use, including the automated biochemical laboratory systems recently ordered by the Department of Health and Social Security.

Godart CPI provides bedside equipment for comprehensive patient monitoring systems and supplies a range of haemodialysis (artificial kidney) apparatus.

DOCUMENT CONVEYOR SYSTEM FOR ST. BARTHOLOMEW'S

Lamson Engineering Co. Ltd., have received an order from St. Bartholomew's Hospital, West Smithfield, London, E.C.1, for a Selective Document Conveyor System to be used for conveying patients' documents and X-ray records from the Records Office in the basement to any one of six floors. To provide this service Lamson will be installing two (one long and one short) separate towers with intercommunication between them at the ground floor ceiling level.

The first (short) tower will service between the ground floor and the basement (with a station serving from the tower to each floor) while the second (long) tower will serve the remaining four floors by means of two 90° double turn-tables and a two lane conveyor. Both tower systems will enable records and X-ray plates to be conveyed continuously at speeds of up to 100 ft. per min.

CLUES ARE STILL SPARSE ON HOW THE BRAIN WORKS

How do we think? What inside the brain enables us to remember? What causes us to forget? What phenomena in the brain make us recognise a familiar face, or landscape, or printed page?

In this third quarter of the twentieth century when men can set out in rockets to travel to the moon, clues remain sparse about what actually happens in the "inner space" that occupies the upper part of the human head.

The brain has been slow to give up the mystery of its workings. Techniques remain severely limited for discovering the physiological aspects of mental activities.

Scientists assume that every thought and even every dream, and every subconscious or unconscious mental process, must somehow be manifested in some physical way—some chemical or electrical action or reaction. But what these actions and reactions might be and, especially, how they may relate to any specific thought or stimulus has been little known.

Gradually, however, scientists are moving in on the brain. Little by little, they are deciphering its "code". Though this research is still in its infancy, its beginning has been spectacular.

While the research takes many directions, a fairly typical example of science's forays into the human brain is the experimentation at the Visual Sciences Laboratory of the J. Hillis Miller Health Centre at the University of Florida in Gainesville, Florida.

It has long been known that certain regions of the brain control particular functions. As a result it has been possible through brain surgery to alter small portions of the brain to obtain relief from disease symptoms—such as in Parkinson's disease.

The Visual Sciences Laboratory is concerned with the area at the "inion", the bulging part of the rear of the head in what is called the "occipital" region of the skull. It is in that region where brain activity resulting from visual stimuli can be most readily monitored.

In their experiments, the Florida researchers use computers to help them analyse "brain waves"—the miniscule electrical currents generated by the brain and recorded by an electro-encephalograph (EEG) on a continuing strip of paper in the form of zigzagging or wavy lines.

From brain waves, analysts can easily determine whether the subject being monitored is awake or asleep, or whether he may be suffering from certain disease conditions such as epilepsy.

Evoked responses

University students who volunteer for these experiments wear headsets which look similar to those worn by some telephone operators. But instead of ear pieces, these headsets contain tiny electrodes which press slightly against the inion.

The volunteers are in a dark, sound-proof room so as to keep exterior stimuli to a minimum. Then a light is flashed on. What happens to the brain waves?

Human analysts can detect no change in the wave patterns. But when examined by "averaging computers", a large sample of EEG patterns shows very definite alterations as the result of light stimuli. The computers can pinpoint for the scientists the exact location in the brain wave patterns where the "evoked responses" occurred.

Carrying the experiments a step further, lights of different colours have been used and the computers have shown that the evoked response is "colour-specific", meaning each different colour evokes a slightly different pattern of brain waves.

The experimenters believe that after another two or three years of work they will be able to tell directly from the brain waves whether a subject is colour blind, and to what extent.

This would, indeed, be a research breakthrough. Colour blindness can easily be determined from visual charts, but this requires the subject's co-operation. If colour blindness can be diagnosed directly from brain waves, even subjects unable or unwilling to communicate can be tested.

The experimenters have also found that specific wave patterns result from the projection of meaningful patterns such as numerals or letters or pictures. These patterns change as the image is deliberately shifted out of focus, and reappear as the image is refocused.

No scientist is willing to predict that it may become possible to read a person's thoughts directly from brain waves. But the experiments point toward very valuable uses for the knowledge that is being obtained.

Already, the experimenters are able to detect and locate tumours in the brain's visual pathways. Though there are other ways of locating brain tumours, this additional technique can add precision to the diagnosis.

Paralleling these visual experiments are auditory experiments—sound is projected, and the brain waves are computer-analysed for an evoked response. The experience gained may soon permit scientists to test for hearing loss and degrees of deafness with a precision not previously possible, especially when the subject is unable or unwilling to co-operate.

One of the main problems remains the relative weakness of the evoked response in comparison to the "background noise" that originates continuously from the brain.

Though no one knows the source of this background noise—it is not really "noise", but electrical current, and some researchers say the brain is surrounded by a continuous "polyneural roar"—the general belief is that it is generated by routine brain functions such as continuous guidance by the brain of body temperature, blood pressure, breathing, digestion and numerous other activities of the living body which end only with death.

Limited value

For years, researchers have probed into the brain of animals to learn about the brain's workings. This has led to the beginnings of some understanding of the chemical as well as electrical brain activity. But it has also shown that animal experiments have only limited value in learning about the human brain.

(Continued on page 148)

Abstract of Reports

DERBY No. 1 H.M.C.

THE FOURTEENTH Report which covers the period from 1st April, 1965 to 31st March, 1968.

The whole of the three-year period reviewed in the Report has been one of increased activity in the various hospitals in the Group, and in particular, during the last twelve months, considerable changes have taken place in the Group structure and responsibilities of the Hospital Management Committee and its officers.

On the 1st April, 1966, following the disbandment of the Derby No. 2 H.M.C. by the Minister of Health, seven hospitals, formerly administered by that Committee, were transferred to the Derby No. 1 H.M.C.

The other four hospitals administered by Derby No. 2 H.M.C. were transferred to the Chesterfield H.M.C.

Developments

During the period under review, a number of important additions and improvements to the Hospital Service in the area have been completed.

Progress has been continued in respect of the planning of the major developments envisaged for the Derby City Hospital and Derbyshire Royal Infirmary.

At the Derby City Hospital, a new Pharmacy and new Pathological Laboratory have been provided in the form of large pre-fabricated structures, pending the permanent Developments which will come at a later date as part of the new District General Hospital proposed on the Derby City Hospital site. These additions in working space are, however, even though of a temporary nature, greatly welcomed as they have replaced older and quite inadequate accommodation and are now making it possible to provide a better service for patients at the Derby City Hospital, and also at the adjacent Manor Hospital.

The Committee has been informed that the first phase of the major development at the Derby City Hospital is to be postponed, owing to the over-commitment of the Regional Board's Capital Programme, until 1973. This first phase will include a 150-bedded Maternity Unit and Midwives Training School, a new larger boilerhouse, and an area laundry.

Consideration has been given during the period of this Report to the inadequacy of the existing single main Operating Theatre at the Derby City Hospital, and approval in principle has been given by the Regional Board to a scheme to erect a new Twin Operating Theatre Suite and associated Theatre Sterile Supply Unit, on the area of land adjacent to the new Pathological Laboratory. It is expected that the commencement of this development, costing £200,000, will be in the spring of 1970.

The other major development entails the rebuilding on a phased basis of the Derbyshire Royal Infirmary to form a District General Hospital. The detailed planning of the first phase of this scheme has now been virtually completed, but the date for commencement of the actual building has been postponed by the Regional Hospital Board from 1966 to 1968, and more recently until the autumn of 1970. It is hoped, however, that certain of the preliminary works involving the erection of a number of temporary buildings to house existing departments whose present accommodation will need to be demolished to clear the site for new buildings, would commence in the autumn of 1968.

The first phase of the development proposed at the Derbyshire Royal Infirmary comprises a new Accident Unit and Administration Departments, together with additional beds for orthopaedic and other specialties. This will be situated on the portion of the hospital which is at present occupied by the main entrance buildings facing London Road, and which includes the existing inadequate Casualty Department, Administrative Offices, the Chapel and the old Twin Operating Theatre Suite.

The new building will include, on the ground floor, adequate reception and treatment facilities for accident and emergency admissions, including children, three minor Operating Theatres, Recovery and Day Beds for Outpatients, four X-ray Viewing Rooms and a new Orthopaedic Out-Patient Consultative Department.

On the first floor will be situated the main offices accommodating the Group Secretary's, Treasurer's, Supplies' Departments, the Matron and her staff, Medical and Patients' Library, Medical Staff Common Rooms, the Postgraduate Medical Centre, the School of Radiography and the Board and Committee Rooms.

The second floor will be entirely devoted to specialised In-patient care. The accommodation will include four major operating theatres, two primarily for neurosurgery, two Intensive Care Nursing Units of nine beds each, a special unit of nine beds for the treatment of burns cases and four additional X-ray Viewing Rooms and associated accommodation.

The third and fourth floors will provide two wards of thirty beds on each floor making a total of 120 extra beds, and this extra accommodation will give the hospital a much needed addition to the facilities for accident and emergency patients, including children.

Also included in Phase I of the development is a fourteen-storey residential building mainly for student nurses, a large three-storey building for senior nursing staff, individual houses for the Matron and for married medical officers, and a new School of Nursing to accommodate the Combined Nurse Training School at present situated in 'Wilderslowe'.

Laundry Services

An average of 79,640 articles per week are washed at this laundry which still only caters for the hospitals comprising the Derby No. 1 Hospital Management Committee prior to 31st March, 1966. The laundry from the seven hospitals transferred from Derby No. 2 Hospital Management Committee is still being undertaken at the Pastures Hospital Laundry.

Since the modernisation of the Group Laundry in 1957, further up-to-date machinery has been installed in an endeavour to cope with the ever-increasing work load. Accommodation problems continue to be acute and it is hoped that the proposed new laundry based on the City Hospital site will not be too long delayed. Representations are being made to the Regional Hospital Board accordingly.

In December, 1965, a 'Swiftlay' coat cabinet unit began production. This machine was the first to be installed in a hospital laundry in the British Isles; it has since proved its worth by enabling two operators to finish between seventy-five and ninety coats per hour, nearly twice the previous production.

In September, 1966 the first washer hydro-extractor was installed to cope with the increasing amount of cotton cellular blankets and extra requirements at the Manor and St. Oswald's Hospitals; this machine washes and extracts water from 400 lbs. of linen every seventy-five minutes; this again saves labour.

In October, 1966, an 'Easi-prep' machine was installed; this spreads sheets and counterpanes for the ironing machine; it saves hand spreading and enables between 600 and 700 sheets per hour to be continually processed.

In spite of the additional equipment provided in this laundry, the facilities at the Manor and Pastures Hospitals are still inadequate and upon the completion of Phase I of the Development Scheme of the Derbyshire Royal Infirmary, a proportion of the laundry will undoubtedly have to be undertaken by a commercial firm unless approval is given to the development of the Group Laundry Service.

Babington Hospital, Belper

The activity at this hospital has been maintained at a high level throughout the year. The programme of upgrading continues.

In view of the flooding of the hospital grounds in December, 1965, the rear boundary wall has been strengthened and water-proofed. The electric power and lighting circuits have been re-organised and an emergency electricity generator installed.

Many lesser schemes of improvement and renovations have been carried out, including floor and lighting modernisation, replacement of equipment, etc.

Very extensive improvements to the kitchens (also a minor capital scheme) are almost completed. This included purchase and installation of new cooking equipment, re-arrangement generally and the provision of mechanical ventilation.

Derby City Hospital

During the last three years a considerable number of improvements have been carried out and extensions in the form of new departments provided.

The whole of the hospital benefits from the use of pre-sterilised packs of dressings and instruments which are prepared at the Group Central Sterile Supply Department at the Derbyshire Royal Infirmary.

The manufacture of intravenous fluids has commenced in the Pharmacy Department.

The capital scheme for the building of new Pathology and Pharmacy Departments was completed in the summer of 1966 and the new facilities are providing extended services to the hospital patients.

Derwent Hospital, Derby

The transformation of this hospital to become a third general hospital for acutely ill medical and surgical patients in the area has continued. An extensive programme of up-grading is being undertaken.

Major alterations including day-rooms have been carried out to Ward I at an overall cost of £5,500.

'D' ward was up-graded at a cost of £10,000. This ward consisted of four separate wings radiating from a central service area. The corridors to the four wings were open corridors and the central area was not used to the best advantage. The four corridors have been enclosed, heated, and extensions built to provide new day-rooms. The central area has been converted into ancillary rooms. New heating and flooring was provided in all the extended areas.

The Derbyshire Royal Infirmary

It was possible to release part of the central area of Ward 6 for conversion into an Intensive Care Unit. As Ward 6 is situated on the first floor of Gee Block and contains a major operating theatre as well as medical and E.N.T. wards, the Intensive Care Unit is ideally positioned. This is a major development in the medical services and provides highly specialised staff and equipment concentrated in one part for the treatment of dangerously ill patients.

The Intensive Care Unit has four beds generously spaced and is provided with all appropriate special apparatus and services such as piped oxygen, suction, monitoring equipment, recording temperature, pulse, respiration, blood pressure, and E.C.G. readings and equipment for hypo- and hyperthermia. A very high standard of electrical installation and finishes generally were incorporated and there is an adjoining store and utility room.

Adjoining the Intensive Care Unit, is a single bed ward specially adapted for haemodialysis. Peritoneal dialysis is also carried out in the Unit.

Another main development was the construction of the Grace Burton Memorial Fund Extension for the Radiotherapy and Isotope Department at a cost of £3,300. This is a single storey extension constructed at the south end of Gee Block adjoining the former Isotope Department and provides a large 'scanning room', consulting room, and a considerable extension to the Isotope Laboratory. A special electronic scanning machine was purchased at a cost of £4,600 and this is used for investigating and diagnosing abnormalities of the brain, thyroid, liver, spleen and other sites. A renogram is also located in the new accommodation for testing the function of the kidney with isotopes.

A second hyperbaric oxygen chamber for the hospital has been provided in the Radiotherapy Department, its main use being to treat certain conditions which were very difficult to treat by radiotherapy in ordinary atmospheric conditions.

A new liquid oxygen installation has been provided by the British Oxygen Company Limited to serve the hospitals as this allows the purchase of oxygen at a lower unit charge than applied with gas and obviates the need to carry heavy oxygen cylinders round the hospital. This was initially connected to the piped systems serving the operating theatres and intensive care unit. Subsequently the Regional Board financed a scheme at a cost of £12,000 for installing piped gas and suction services to most of the wards in the hospital. The wards which were not included in this contract will be dealt with in the near future by means of a separate contract.

On the Market

A review of new equipment and materials and their development

NEW ROTOTHERM CONTROLLER

The new mercury-in-steel, indicating temperature controller—Model 1056A—manufactured by the **British Rototherm Co. Ltd.,** Merton Abbey, London, S.W.19, is designed as a low-cost instrument for industry generally. It has a single mercury switch and is intended for installations which need less elaborate control than is provided by the company's multi-switch units.

The dry electrode 5 amp 250 AC or DC mercury switch (10 amp also available) can be set to make or break over the complete range. With this current rating, there is no relay and arc-ing is avoided.

Any temperature range between minus 30°C. and plus 650°C. (or equivalent Fahrenheit), with a minimum coverage of 30°C. is possible.

The dial is 6 in. in diameter and the case is an aluminium alloy weatherproof casting; standard finish is black. Wall, panel, front flange or direct mounting models are available.

Standard capillary length is 10 ft., copper sheathed with 6 in. stainless steel armouring at case and bulb. Standard bulb is ½ in. diameter, mild steel.

Adjustment of the switch is by a spring-loaded knob in the centre, and this knob can also be used for manually checking the switch operation.

NEW LIGHTWEIGHT ARC WELDERS

To meet the demand for handy lightweight welding equipment which is easy to carry and can be used from ordinary household sockets **Direct Welding Supplies** of Ladies Lane, Northampton, have recently introduced the Eagle range.

The Eagle 80 weighs 40-lbs. and operates from a 13 amp single phase supply. It handles 14, 12 and 10 swg electrodes with four current settings giving 50-100 amps output on 240 volt supply. Price complete £40, delivered.

The Eagle 140 weighs 64-lbs. and requires a 30-amp single phase supply to give full output. Electrodes from 16-18 swg. may be used with nine current settings 35-150 amps on 240-volt supply. Price £57 10s. 0d. complete, delivered.

Both machines are built to the highest Swedish electrical standards and incorporate a thermal switch disconnects and allows the welder to cool down in the event of accidental overloading. Both models are supplied with a full kit of accessories comprising 8-ft. supply, welding and return leads, fully insulated electrode holder, earth clamp, hand shield, wire brush, chipping hammer and sample electrodes.

GREASE ELIMINATORS IN STAINLESS STEEL

A redesigned range of grease eliminator panels for use in the kitchens has been introduced by the Air Filter Division of **Vokes Ltd.,** Henley Park, Guildford.

Principal change in design of the new panel is the use of a stainless steel construction instead of galvanised steel.

Two basic types of grease eliminator are available; a single unit for wall mounting and a double sided 'V' unit for hood mounting. Any number of these units can be bolted together to form multiples. The normal layout arrangement is to use one, two or three panels for wall mounting and two, four or six panels for 'V' mounting.

The redesigned Vokes range of panels are available in sizes from 20 in. x 10 in. to 20 in. x 20 in. for both single units and double sided units.

Single sided units have air flow capacities from 600 cubic feet per minute using one panel to 3,600 c.f.m. using a three panel arrangement. With double sided 'V' mounted units, flow capacity is from 1,200 c.f.m. with two panels to 7,200 c.f.m. with six panels.

FLY-SCREENED VENTILATORS

New from Evered & Co. (Hardware) Ltd., of Surrey Works, Smethwick, Warley, Worcs., are two Hit and Miss Ventilators Nos. 3047 and 3048. Both incorporate a fly-screen. Injection-moulded in white high impact polystyrene, each has been designed to fit an air-brick of the appropriate size, but can be used to cover any similar size aperture.

At each corner, there are two break-out holes—the inner for box-fixing and the outer for wall-fixing.

No. 3047 fits an airbrick of 9 in. by 3 in. and No. 3048 9 in. by 6 in. Prices, respectively, are 4s. 3d. and 6s. 6d.

EXTENDED RANGE OF CONDENSATE RETURN UNITS

The range of packaged condensate return units, recently introduced by **Megator Pumps and Compressors Ltd.,** 151 Gower Street, London, W.1, has now been extended to handle higher condensate temperatures.

To handle condensate temperatures above 195°F. and up to a maximum of 205°F. (96°C.), additional units have now been added to the Megator range. In the new units the tank is mounted above the pumps to provide the positive suction head required at the higher temperatures. The arrangement is neat and compact compared with conventional layouts and, as with the original range, the new units occupy a minimum of floor space.

All Megator condensate return units are available with single pumps, or with duplicate pumps for main and standby duties. Standard units will handle up to 10,000 lb/hr (4,500 kg/hr) of condensate with total heads up to 75 ft. (22·5 m.).

Units are supplied with pumps, valves and floatswitch assembled with the tank as a complete unit. Wall-mounted starters, protected sight glass and changeover switch are available as optional extras.

For capacities, heads and temperatures in excess of those covered by the standard range of units, special units are built to customers' requirements.

ADJUSTABLE LIGHTING IN HOSPITALS

To meet the complex and diversified problems of hospital lighting **Thousand and One Lamps Ltd.,** of 108 Bromley Road, London, S.E.6, make a range of specialised lights and fittings.

The shade of the bedhead unit LH340 has been specially designed to eliminate glare and there are provisions to prevent the lamp from striking the wall. The adjustable arms, which have a total reach of 45 inches, are so constructed that the patients are unable to use them as a support. Screws and knobs are tamper proof and telescopic plastic covers conceal the springs. Two types of wall fixings are available with the lamp. One is a simple bracket, the other incorporates a dimming unit which provides an ordinary light and a night light from a single bulb.

Where wall fixing is unsuitable in some departments and in such instances, the ceiling mounted model L8 is the answer. This model has a ceiling plate and a tube with a 2ft. drop, as standard, from which one, up to as many as four, adjustable lamps can be fixed. Each adjustable lamp has a total extension of 54 inches. For a small additional charge a shorter or longer drop (maximum 4ft.) can be supplied.

Other adjustable lamps of interest are the 1001 examination lamps on movable floor stands.

NEW RANGE OF SPLIT AIR CONDITIONING UNITS

Stewart King Industries Ltd., of Industrial Estate, Waterlooville, Hants., are marketing a new range of split system packaged air conditioning units which comprise an air handling console and a separate air cooled condensing unit which can be situated up to 40ft. apart, with refrigerant and electrical connections between the two units. The first of the range, manufactured in non-corrodible materials throughout, is a 10,000 Btu/per hour model called the 'Castor', available with 3 kW of heating.

A feature of the internal air handling console is a thyristor infinitely variable fan speed control.

During the next two months, two larger models of 12,000 and 15,000 Btu/per hour capacity will be introduced.

The inside unit has a depth of only 9″ x 27$\frac{3}{8}$″ wide x 28$\frac{1}{2}$″ long, and the exterior condensing unit only 12.11/16″ deep x 25$\frac{1}{4}$″ wide x 16$\frac{1}{2}$″ long.

All units are supplied with 3kW heaters with automatic thermostat control of heating and cooling. The air handling unit is fitted with twin centrifugal fans, which with the compressor installed in the condensing unit outside the conditioned area, ensures virtually noiseless operation. Air flow is regulated by a variable speed control.

SIMPLE, STURDY GARMENT RAILS

Of simple design and construction, the garment rails now being offered by **Fabrique du Metal Organisation,** Steimar Works, Everett Road, N.W.10, have several specialised features. Made of 16-gauge tube, the rails have great strength and the base and legs are in one piece.

Easy movement is facilitated by four 3 in. rubber castors, fitted with oil-impregnated fibre washers for adequate lubrication. Price is approximately 68s. 6d.

PRECISION RUBBER SEALS FOR STERILISERS

Special inflatable rubber seals are produced by **Dunlop's Precision Rubber Division** at Bagworth, Leicester, for Manlove Alliott hospital sterilisers which incorporate a unique door sealing method. Instead of using mechanical or electrical link devices attached to the door to form the seal, these sterilisers rely solely on the inflatable rubber components to provide a hermetically secure closure.

The precision rubber seal simplifies the door mechanism and permits the use of 'guillotine type' sliding doors. A considerable saving of space is thus effected by eliminating the necessity for outward opening doors.

The seals must withstand pressures of up to 32·5 p.s.i. and temperatures of 134°C. (+4° −0°). The chamber is evacuated down to a pressure of approximately 15/20 mm. of mercury. The seal must also withstand the considerable stresses imposed by continuous inflation/deflation cycles.

Manlove Alliott sterilisers are exported to a number of countries including the U.S.A., Canada and South Africa where one incorporating Dunlop seals has been used by Dr. Christian Barnard's heart transplant teams.

A NEW CONCEPT IN PERSONAL EMERGENCY LIGHTING

Alkaline Batteries, of Redditch, Worcestershire, have introduced a new personal emergency light, the Bardic HL50, which is a small hand-held lamp for use in emergencies only. A bracket to hold the lamp is fixed to the wall and wired into the mains supply. At all times that the current is flowing, the lamp is held firmly in place by a patented solenoid lock which stops unauthorised people from removing it.

Upon failure of the mains supply, the Bardic HL50 is automatically lit and the solenoid lock released. This enables any person to remove the lamp and use it in an emergency. Upon replacement on the bracket the Alcad nickel-cadmium alkaline battery is recharged.

This emergency light is particularly useful for such situations as fuse board inspection, in boiler rooms or at other critical points in old people's homes, nursing homes, and other institutions.

DAVIDSON'S INTRODUCE METRIC FAN RANGE

A new range of low-cost axial fans—known as Sirocco MA—has been designed to metric dimensions by **Davidson & Co. Ltd.,** Sirocco Engineering Works, Belfast. The fans are available in eight standard arrangements.

The MA range caters for direct-coupled and belt-driven types in various configurations, and includes units for higher temperature work in which the motor is protected by a hood plate forming an integral part of the fan. In addition, each of the eight arrangements is manufactured in ten sizes—ranging from 400 mm. (1 ft. 3$\frac{3}{4}$ in.) dia. to 1,000 mm. (3 ft. 3$\frac{3}{8}$ in.) dia—and each size is available with either three or six blades, which can be obtained in any one of six standard angular settings.

The fans are designed to give outputs of up to 70,000 m³/h (40,000 c.f.m.) and pressures of up to 70 mm. (2·75 in.) w.g. They will be followed shortly by centrifugal and high pressure ranges.

Notes for Members

FIVE BRANCH MEETING

About 50 Members of the Midlands, London, Southern and East Anglia Branches spent an enjoyable day together at the Radcliffe Infirmary, Oxford, on 3rd May, where the programme began with an amusing film entitled "A Home of your Own" in which many of the funny situations appeared somewhat true to life to the experienced engineers in the audience.

The afternoon's programme began with a talk given by J. Lancaster, M.A., A.R.I.C.E., A.M.T.P.I., the Chief Surveyor for Oxford University, who was supported by the staff responsible for the design of the new lecture theatre in which the meeting was held. Mr. Lancaster described some of the difficulties that they had to overcome and explained many of the facilities available to the lecturers and the medical students.

An interesting talk was given by C. S. Whitby, Chief Heating Engineer of Electrolux Ltd., on "The Anatomy of Storage Heater Design." Mr. Whitby outlined the history of the development of storage heaters and, by the use of graphs, showed how input and output can vary according to dimensions and the nature of the thermal storage materials. Mr. Whitby terminated his talk with a film showing the laying of soil heating cables at Murreyfield.

Mr. Donald A. Goldfinch completed the programme with a talk on the Shree Sayaji General Hospital in Baroda. His talk was supported with a large number of colour slides through which he was able to indicate many of the difficulties with which he has been faced in trying to re-develop an existing hospital where a large number of the present buildings have to be integrated into the final development. He drew attention to some of the difficulties in maintenance and the members were amused to note that monkeys are in the habit of clambering over the roof of the hospital, removing the tiles to throw at the inhabitants beneath!

The meeting concluded, with tea, at approximately 6 p.m.

EAST MIDLANDS BRANCH

A meeting of the East Midlands Branch was held at Scartho Road Hospital, Grimsby on 15th March, 1969.

The meeting was addressed by Mr. B. Starling, an ex-Director of Blackburn and Starling Ltd., on the subject of "Lighting Protection".

It is hoped to publish a Paper on the subject in a future issue of the Journal.

SOUTHERN BRANCH

A meeting of the Southern Branch was held at St. Mary's Hospital, Portsmouth on 22nd March, 1969.

The Chairman opened the meeting by introducing S. E. Drewett, F.I.M.L.T., Chief Technician, Bacteriological Research Dept. of the Portsmouth Group H.M.C.

Mr. Drewett talked on "Modern techniques in the Sterilization of Instruments and Dressings by High Vacuum and Sub-Atmospheric Equipment," and commenced by saying that sterilization in a primitive form had been carried out in the time of Moses and also by Homer. There was then a gap of approximately 2,000 years and little seems to have been attempted until the first microscope was invented and this then made possible the study of bacteria by microscopic examination.

The first known autoclave was made in 1887 by a Frenchman and was the forerunner of many similar types still in use. In 1958, Professor Knox was the instigator in the method of using 'Pre-Vac' and since then there have been various modifications of this theme. The respective merits of Hot Air Sterilization and Steam Sterilization was covered, and Mr. Drewett completed his talk by discussing the various types of modern autoclaves that are available and can be used for the complicated procedures carried out in the modern hospital for the total destruction of all spores.

Venues of Branch Meetings for the ensuing year. Subject to confirmation, the following were agreed:—

17th May, 1969	Coldeast
19th July, 1969	Weymouth (Dorset)
20th September, 1969	Knowle or Winchester
15th November, 1969	Queen Alexandra (Cosham)
17th January, 1970	Royal South Hants. (Southampton)
21st March, 1970	St. Mary's (Portsmouth)

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The Diagnostic X-Ray Tube

coil-winding, the current in this coil leads that in the main winding and there is, consequently, a time interval or 'phase difference' between the fluxes produced by these two coils. The net effect of this is to cause the flux inside the stator to rotate, completing one revolution in the time occupied by each cycle of the applied alternating current, i.e. at 50 cycles per second the field would rotate 50 times per second, or 3,000 times per minute. The effect of this rotating field on the anode of the tube is to induce currents in the copper rotor. These currents, in turn, set up their own magnetic fields and the rotor behaves as a magnet. A magnet in a rotating field will, if free to do so, rotate.

The stator is connected to the apparatus in such a way that when the exposure switch is thrown to the 'prepare' position, the stator is energised (at, for example, 110 volts).

The rotor reaches operational speed (slightly less than 3,000 rpm) within 1 second so that when the exposure takes place the tube is ready to withstand its full rated energy. Incidentally, the preparation stage also boosts the tube filament temperature to its full pre-set radiographic value. At the termination of the exposure both stator and tube filament return to their standby state, for neither is rated for long or continuous operation at these high levels of power.

CORRESPONDENCE

THE EDITOR,

5th May, 1969.

Dear Sir,

Terminology

I read with interest the article entitled "Problems of Planned Maintenance" which was presented in the April edition of THE HOSPITAL ENGINEER.

I did, however, gain the impression that the author was "playing safe" in respect of the title that should convey to the reader the type of maintenance referred to; Planned Maintenance or Planned Preventive Maintenance?

The author of the supporting article entitled "Planned Maintenance—Does it Work?" seemed convinced that the scheme, as detailed in Hospital Technical Memorandum No. 13, is in fact Planned Maintenance.

Let us be precise in our terminology. Planned Maintenance and Preventive Maintenance are two different schemes, but they can be integrated to effect a scheme for Planned Preventive Maintenance as described in H.T.M. 13.

The term Planned Maintenance is used far too loosely and, as in the two articles referred to, is used when one really means Planned Preventive Maintenance. It is rather like a Company advertising for a Plant Manager when they really want a Head Gardener. Such titles, and especially those terms used for some pipe fittings (the likes of which would make any lady storekeeper blush) are descriptive, and unless the extreme occurs as in the analogy, no confusion can arise as to what is really meant.

Consider, though, the titles given to various types of maintenance, Planned Maintenance, Preventive Maintenance, Planned Preventive Maintenance, Scheduled Maintenance and Breakdown Maintenance (which isn't really maintenance but repair). One is presented with a choice of titles and, therefore, it is important that the correct title for the respective type of maintenance is used so as to avoid confusion and effect efficient and correct liaison and communication.

In the lack of any official standardisation to terminology, I purport the following definitions:

Scheduled Maintenance

This is the scheduling of works to be carried out at certain dates, e.g. painting, wall washing, lubrication, rose tree pruning, etc. In this case, no explicit method or time allocation is detailed and the object is not necessarily to prevent any failures or breakdowns.

Planned Maintenance

As the title should imply, the particular maintenance function to be carried out is planned. This involves the determination of a method of doing the job and allocating a time in which the function is expected to be performed. Planned Maintenance can be employed on Breakdown Maintenance (repair) where it is necessary to fix a time in cases where incentive bonus schemes are in operation. On scheduled maintenance, too, it may be employed where pre-planning is necessary, as in the case of ward closures scheduled for painting, for example.

Preventive Maintenance

This is maintenance which is performed before failure is anticipated, e.g. examining drive belts for wear and replacing as necessary, or, in more mundane terms, ordering fuel before existing resources are exhausted.

Preventive maintenance proper also involves the scheduling of plant etc., to denote frequencies and dates of inspections, i.e. employing the techniques of Scheduled Maintenance.

Planned Preventive Maintenance

In this method, Scheduled and Planned Maintenance are integrated with the techniques of Preventive Maintenance and I suspect that here lies the key to the loose terminology.

A Planned Preventive Maintenance System sets out to eliminate failure by anticipating the same (Preventive Maintenance). To avoid any 'hit or miss' techniques, it is necessary to keep a proper record of plant and how often and when inspection should be carried out (Scheduled Maintenance). This, then, requires refining even more to ensure that all inspections are systematic so that tradesmen know what method of approach to employ and what parts in particular they should check. To cater for this, then, each inspection

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and task is planned (Planned Maintenance) and the method is handed to the tradesman, e.g., Maintenance Manuals. In most cases a time is allocated for the task, arrived at either by actual work study or analytically. This can be used to provide the financial incentives referred to in the article and/or assist the management i ndetermining labour utilisation and staffing.

Here, then, all three techniques are integrated to effect not a Planned Maintenance system but a Planned Preventive Maintenance system as described in H.T.M. 13.

"Beware anyone who is considering setting himself up as a Consultant on Planned Maintenance when he really intends Planned Preventive Maintenance—remember the Trade Descriptions Act!"

A. MILLINGTON (Member)

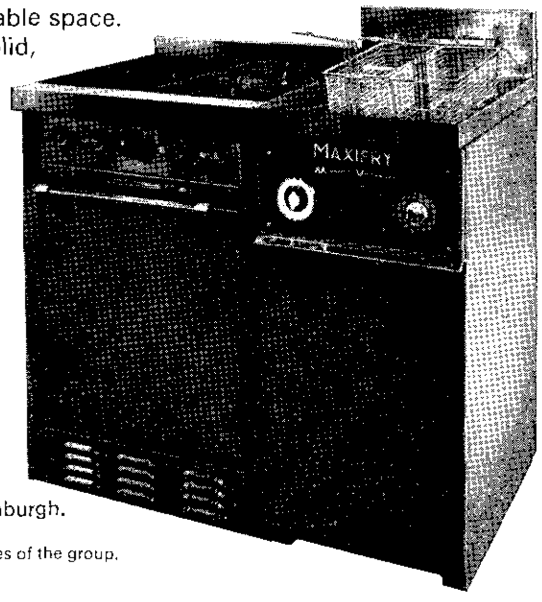
34 Harbourne Avenue,
Worsley, Manchester.

(*Continued from page 140*)

Many animals have no colour vision or binocular vision as humans do, and extrapolation of animal findings to human vision has been found to be difficult and even hazardous. The vision of cats, for example, is very different from that of humans.

At present much of the research is still concentrated on merely determining what is "normal"—to construct a "normal template." This in turn will permit detection of abnormal or unusual patterns and, thereby, perhaps permit scientists to predict the onset of and diagnose certain diseases and to detect visual defects.

The day could conceivably come when it will no longer be necessary for subjects to read progressively smaller lettering on an eye chart—one would simply slip on a headset and allow the brain waves to tell the examiner about one's visual acuity plus, perhaps, a few bits of gratuitous information observable over the brain's normal "roar."



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