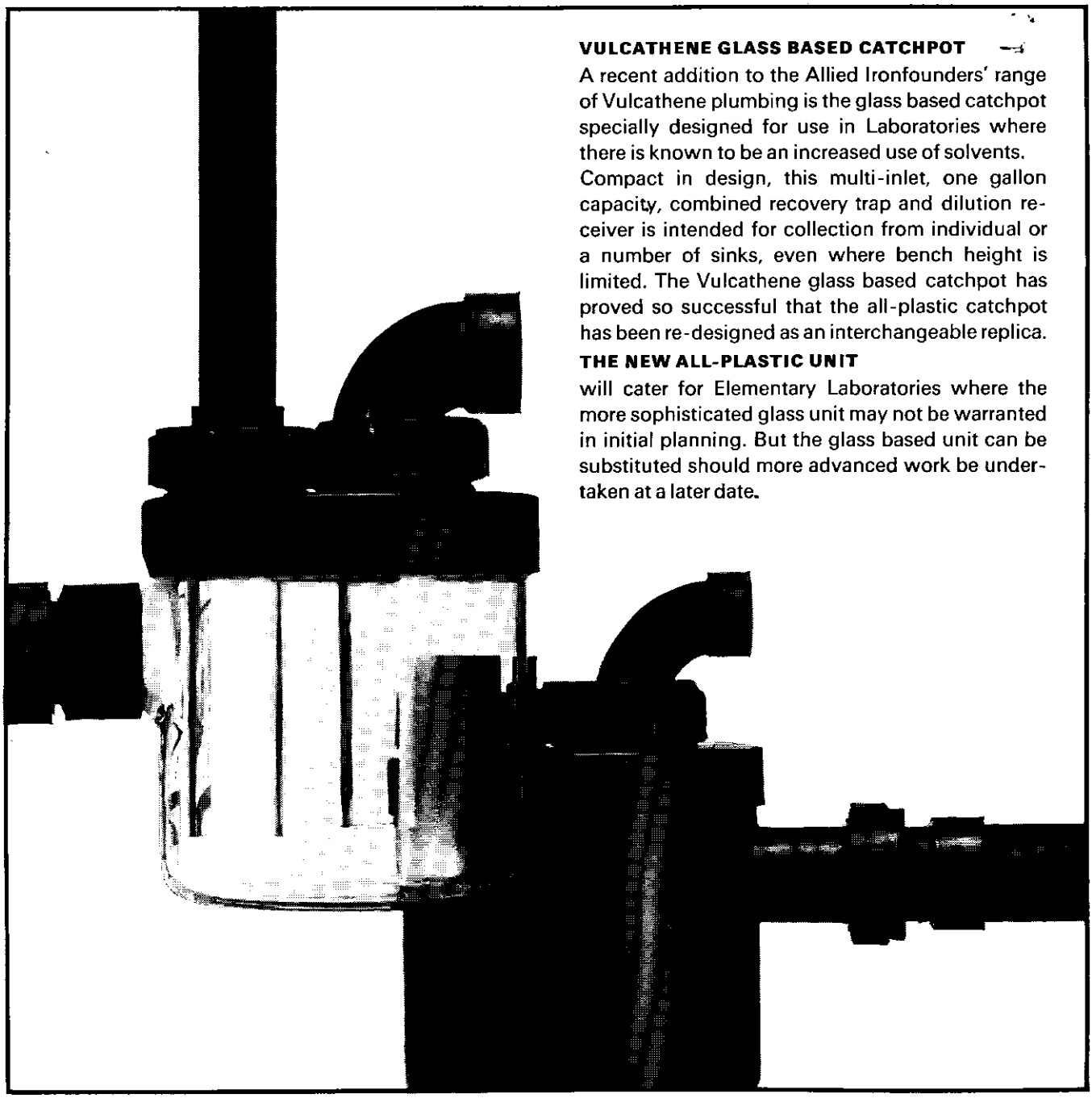
THE HOSPITAL ENGINEER

THE JOURNAL OF THE INSTITUTE OF HOSPITAL ENGINEERING

VOL XXII No 5
MAY 1968

FOUR SHILLINGS



VULCATHENE GLASS BASED CATCHPOT

A recent addition to the Allied Ironfounders' range of Vulcathene plumbing is the glass based catchpot specially designed for use in Laboratories where there is known to be an increased use of solvents. Compact in design, this multi-inlet, one gallon capacity, combined recovery trap and dilution receiver is intended for collection from individual or a number of sinks, even where bench height is limited. The Vulcathene glass based catchpot has proved so successful that the all-plastic catchpot has been re-designed as an interchangeable replica.

THE NEW ALL-PLASTIC UNIT

will cater for Elementary Laboratories where the more sophisticated glass unit may not be warranted in initial planning. But the glass based unit can be substituted should more advanced work be undertaken at a later date.

VULCATHENE CHEMICAL RESISTANT PLUMBING

Vulcathene is a *complete* system of plumbing equipment covering pipes, fittings, valves and vessels, especially for use with liquids of a corrosive nature. Vulcathene is tough yet light in weight, is non-toxic, cannot rust, corrode or support bacterial growth. And installation and jointing are cheaper than with any other conventional plumbing material. We can send you a booklet that gives details of the complete Vulcathene range.

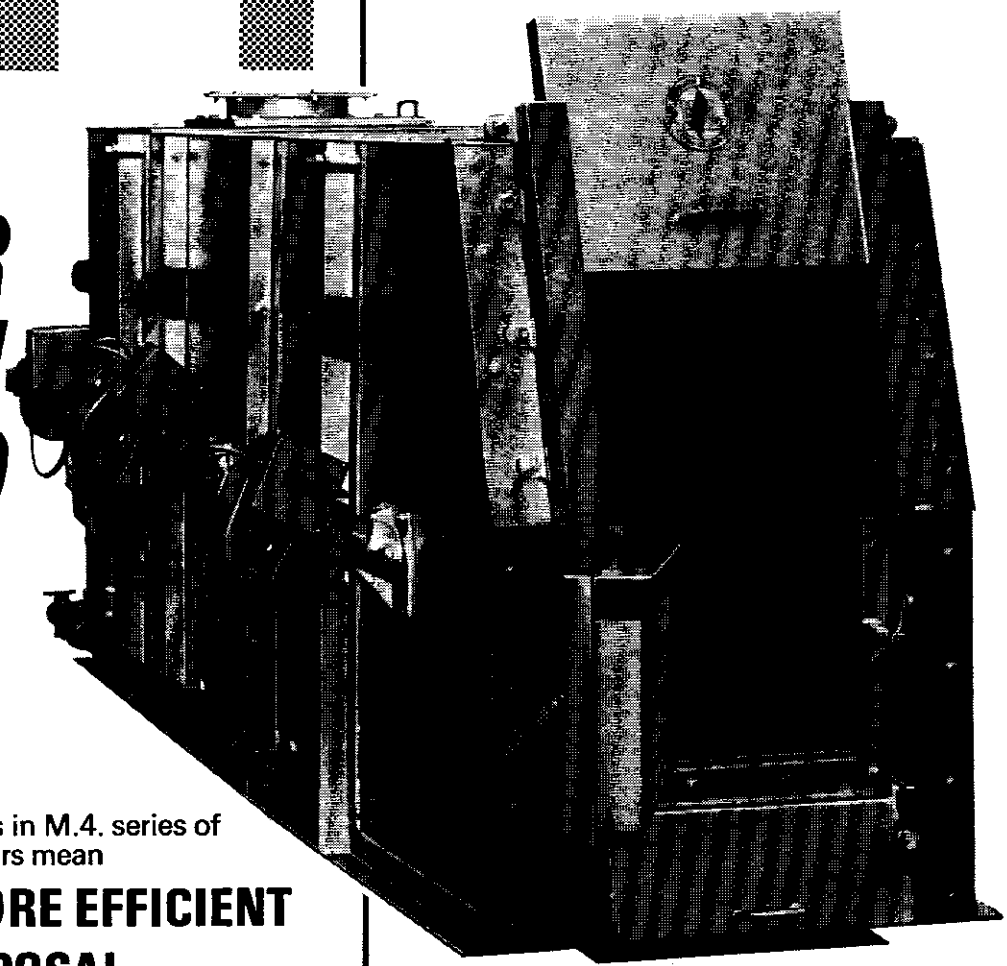
VULCATHENE CATCHPOTS AND PLUMBING FITTINGS ARE ESSENTIAL

FOR CORROSIVE CHEMICALS

Allied Ironfounders Limited, *Vulcathene Division, Vulcathene House, The Broadway, Mill Hill, London NW7 Telephone: 01-959 6961*

M4

FOR HIGH SPEED



New developments in M.4. series of Hospital Incinerators mean

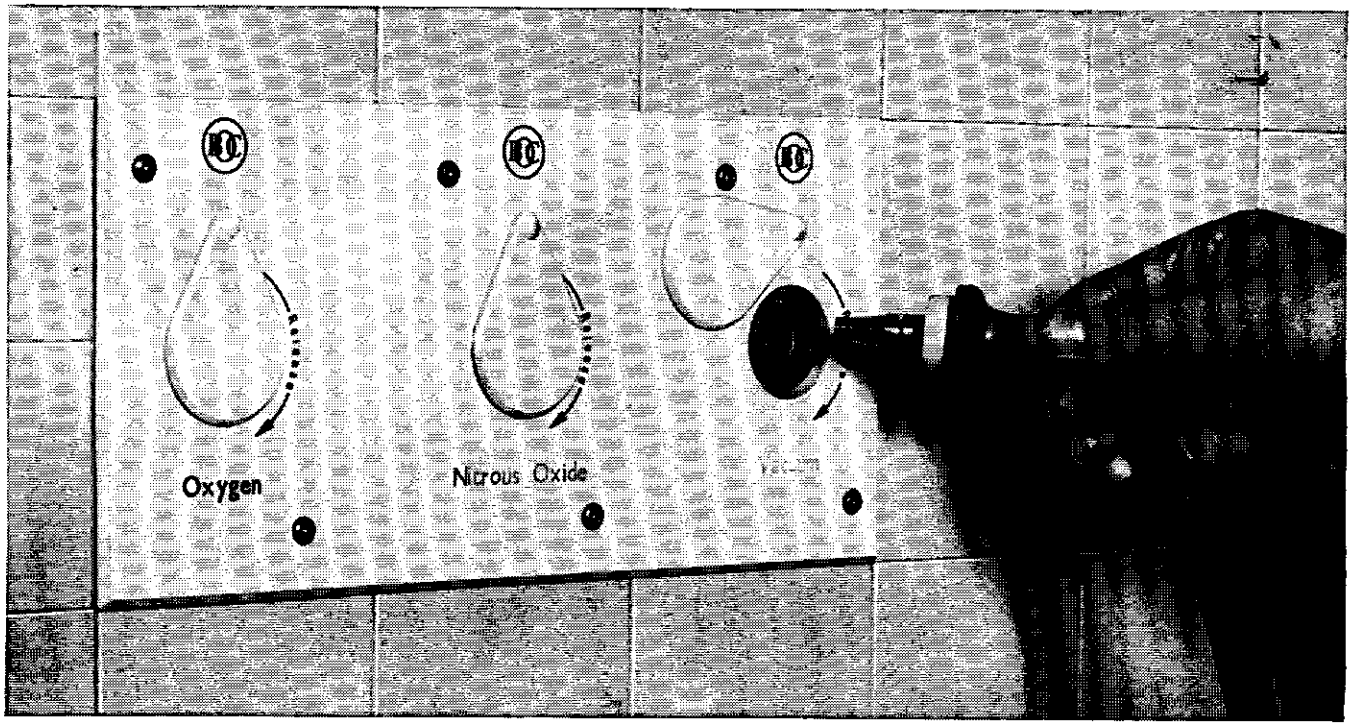
FASTER, MORE EFFICIENT WASTE DISPOSAL

Already the most advanced type of incinerator specially designed for hospitals, the gas or oil fired Scorer M.4. now has still more important advantages. New, improved arrangement of guillotine-type charging door and grate-cleaning door gives wider aperture, faster, easier disposal even of bulky objects. Incorporating separate troughed crematory hearth, packaged burners of nozzle-mixing pattern, flame failure control, electric ignition and timer controls, the M.4. sets new standards in the speedy, complete, hygienic disposal of infected and pathological waste without smoke, odours or combustible residue. Either town gas, bottled gas or oil can be used as auxiliary fuel. The M.4. is specially designed for the simplest, speediest, most inexpensive fitting of replacement parts when necessary.

Write today for full details or ask for a representative to call.

HODGKINSON BENNIS LIMITED

Little Hulton, Worsley, Manchester. Tel. Walkden 4411



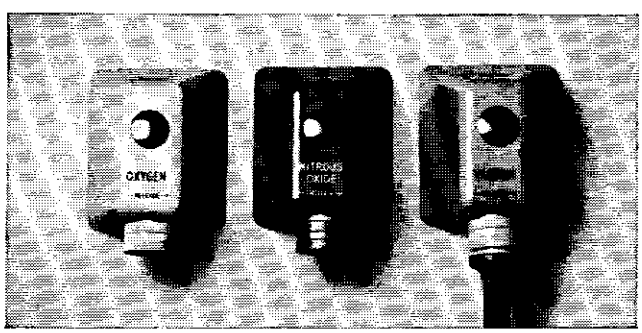
Nobody's taking any chances

When a BOC pipeline system is specified you are retaining a team which sees the job is done in all its stages—from drawing board, through installation, to testing, commissioning and maintenance. Always working to the highest professional standards, the BOC service carries with it the authority conferred by some thirty years' experience.

Here are some more facts. There are already over 50,000 BOC outlet points in some 550 UK hospitals (and more than 700 hospitals are similarly covered abroad). Outlet points can now be fitted flush to the wall but connectors for them will also fit box-type outlets where they exist. Equipment is easily transportable from ward to ward, or even to different hospitals without need for a change in connectors.

BOC service engineers are always available at short notice and gas supplies can be obtained from 20 depots throughout the country.

Get full details of these installations from your nearest BOC Medical Branch.



Connectors for flush outlets can be fitted into existing box-type outlets. The connector for each service is so designed that it is impossible to connect it into any service other than the correct one.

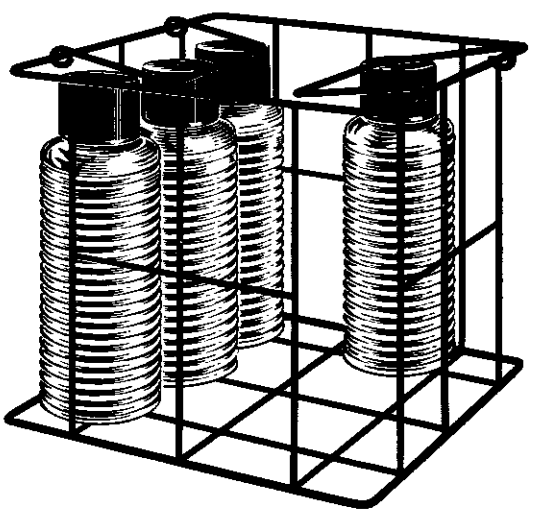
BOC

THE BRITISH OXYGEN COMPANY LIMITED,
Medical Department, Hammersmith House, London, W.6.
Tel : 01-748 2020

UNBREAKABLE STERILE WATER BOTTLE

sterilising time can be as short as five minutes!

Sierex aluminium water bottles provide non-injectable sterile water in five to fifteen minutes, using almost any type of steam steriliser. The bottles cannot burst (they are almost unbreakable), are quiet in use, easy to handle and water remains sterile until required. They are low in cost and there is *no further outlay for breakages*.

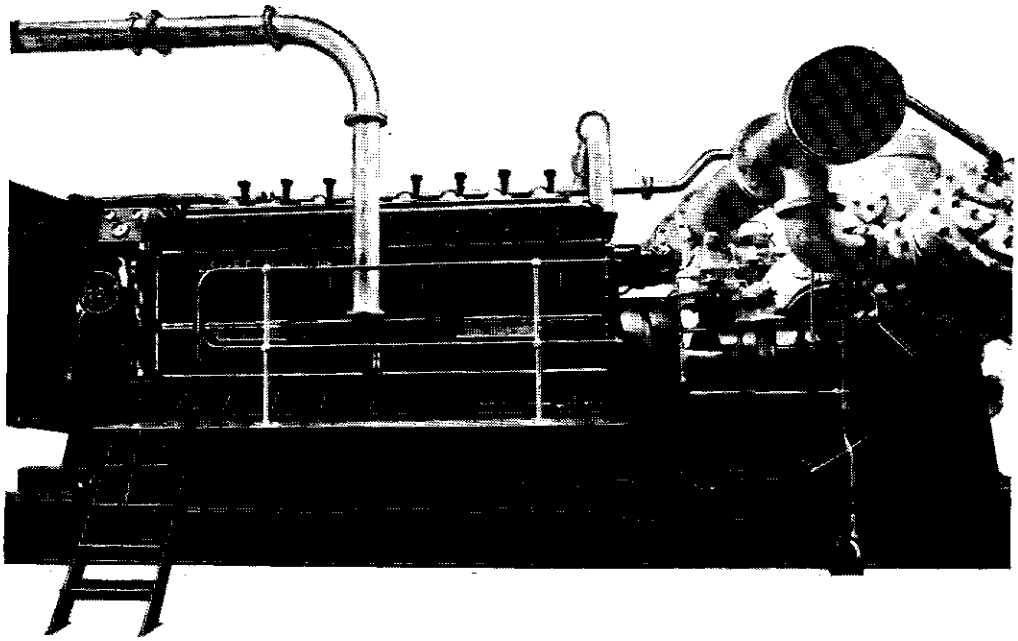


This nylon-covered steel basket can be placed in the steriliser and then used for carrying bottles after sterilisation.

Improve efficiency and cut costs. Write or phone for full details of the SIEREX SYSTEM FOR STERILE WATER

SIEREX

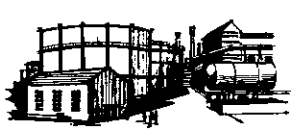
SIEREX LTD.,
15/18 Clipstone Street, London W.1. 01-580 2464
Branches in Birmingham, Bristol, Edinburgh, Glasgow, Leeds and Manchester.
Agents in Belfast, Dublin, Newcastle and Newport.



THIS IS YOUR BREAKFAST

(cooked by gas)

Stepping up gas production—through new developments such as the gas distribution grid and the tapping of the North Sea's natural gas fields—also steps up the demand for a reliable, robust power unit for both base load running and standby duty. Lister Blackstone do not simply supply diesel engines—they design them specifically to meet gas industry requirements. Power for boosters, compressors, pumps, generators—Lister Blackstone Diesel Engines can supply all the answers.



For more information write to Blackstone & Co. Ltd., Dursley, Gloucestershire.

LISTER BLACKSTONE

makes the power to keep things moving

A HAWKER SIDDELEY COMPANY

1967

Hawker Siddeley Group supplies mechanical, electrical and aerospace equipment with world-wide sales and serv.ce.

This pamphlet encourages you to lose all self control

It shows how you can let the outside weather control your steam or pressurized water supply to a non-storage space heating calorifier.
The outside thermostat partners an immersion one to make the valve do the necessary. And being Sarco, the whole thing works hydraulically, powerfully, reliably and accurately.
Which is only the beginning of a very good story. Read the rest for yourself in our free Pamphlet L2.

SPIRAX SARCO

HE 568

NAME

ADDRESS

Please post . . . copies of the Sarco Type 201 Control Pamphlet.

SPIRAX-SARCO LTD Charlton House, Cheltenham, Glos. Phone: 21361 Grams: Spirax Telex 43123 Cheltenham. London: 41 Curzon Street W1. Phone: 01-499 1671

THE JOURNAL OF THE INSTITUTE OF HOSPITAL ENGINEERING

Published monthly at
16, SPRING STREET,
LONDON, W.2.
Telephone: 01-262 7454
(For London 262-7454)

★ ★ ★ ★

★ ★ ★ ★

The Journal is available to non-members of the Institute at the following terms:

55s. per annum post free
(Overseas 58s. per annum post free)
Single copies 4s., or 4s. 9d. post free.
(Overseas 5s. post free)

★ ★ ★ ★

Circulating in:
AUSTRALIA
BELGIUM
CANADA
CHINA
CZECHOSLOVAKIA
EIRE
FINLAND
FRANCE
GHANA
GERMANY (Western)
GREAT BRITAIN
HOLLAND
HUNGARY
ISRAEL
ITALY
JAVA
MALTA
NEW ZEALAND
NIGERIA
NORWAY
PERSIAN GULF
RHODESIA
SOUTH AFRICA
SWEDEN
UGANDA
U.S.A.
WEST INDIES
YUGOSLAVIA

Member of the
International Hospital Federation

CONTENTS

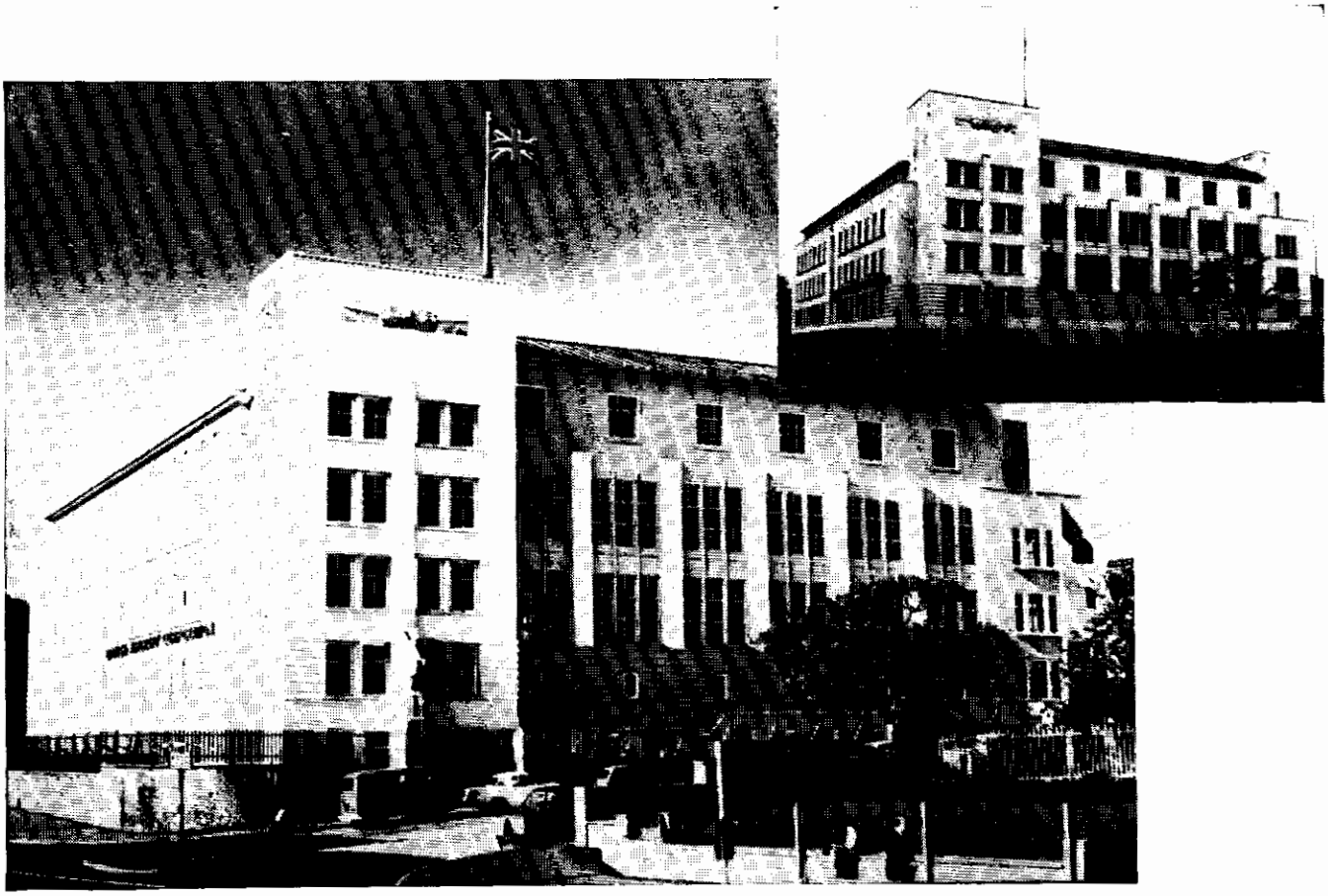
THE HOSPITAL ENGINEER

VOL XXII No 5
MAY 1968

MANDERS

STONAX

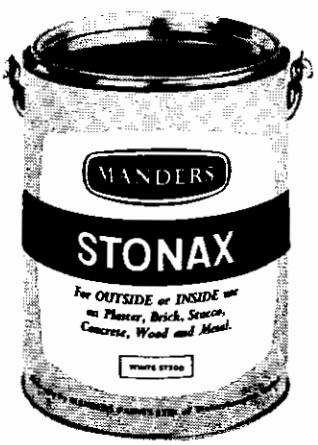
the low cost protective finish



Offices of The British Aircraft Corporation at Filton, Bristol.

SEVEN YEARS after receiving one coat of sealer and one coat of Manders STONAX, the exterior of The British Aircraft Corporation Offices at Filton, Bristol was repainted last year by Messrs. Alfred Bagnall & Sons Ltd. Where necessary, the brickwork was touched in with Manders Sealers followed by two coats of Manders STONAX. The colour scheme was prepared by Manders Architectural Service Department and the illustrations show this contract before and after the work was completed.

Further information and the STONAX Colour Range will be sent on request to Department H.E.5.



Manders Paints Ltd · Wolverhampton · England

Telephone: Wolverhampton 20601 (8 lines)

and at over 50 Service Centres throughout Britain

Makers of Fine Paints & Varnishes Since 1773

Refer to Barbour Index

R.113

THE
HOSPITAL
ENGINEER

THE JOURNAL OF
THE INSTITUTE OF
HOSPITAL
ENGINEERING

VOL XXII | No 5
MAY | 1968

The Protection of Domestic and Industrial Electrical Installations

By J. A. ROBBINS, B.Sc.(Eng.), C.Eng., F.I.Mech.E., F.I.E.E.
J. A. Crabtree & Co., Ltd.

SOME NOTES ON THE PROBLEMS OF EARTH LEAKAGE PROTECTION — PART I

What is implied by Full Protection

TO appreciate the high degree of protection which may be afforded to domestic, commercial and industrial installations by earth-leakage circuit breakers, it is first necessary to realise the part normally played by fuses or miniature circuit breakers in circuit and sub-circuit protection. For such applications, these devices are intended to protect both the installation and the user against the occurrence of fault conditions which may give rise to risk of electric shock or risk of fire.

Shock risk arises when an earth fault makes accessible metalwork "live." Fire risk may be due to (*a*) leakage currents to earth; (*b*) sustained overloading of the wiring or appliances to be protected or (*c*) short-circuit faults on the installation or appliance. Undoubtedly, however, a major proportion of fires attributed to electrical causes are associated with earth-leakage conditions.

Reliable protection is therefore required against the possibilities of electric shock, earth-leakage fire risk, overloading and, finally, short-circuits—either between conductors or between conductors and earthed metalwork.

An ideal protective device should be capable of detecting all these various fault conditions and of isolating the faulty part of the circuit before any real danger can arise. It must also be safe and convenient in operation; should be suitable for use by unskilled operators; and should be effectively tamperproof. A final requirement is that, whilst the protective device must be sensitive enough to detect any dangerous conditions, it must not operate when no real danger exists; nor should it be subject to age deterioration.

Ideal Shock-risk Protection. There are a number of solutions to the problem of giving complete protection to installation metalwork against shock risk. The first possibility is to use low voltages, thus ensuring that the potential difference between accessible metalwork and earth—in fault conditions— cannot exceed about 40 volts, which is generally accepted in this country as being a safe limit. (On the Continent 65 volts is regarded as a safe working limit.) Unfortunately, this method cannot be accepted as a general solution, due to the size of the cables and conductors which would be involved, although it often can be used as a means of ensuring safety for portable electric tools.

A second possible method is to attempt to restrict the maximum sustained earth-leakage current to a non-lethal limit. This may be achieved by the use of sensitive protective devices. The threshold of danger is possibly at about 10 mA. This effectively is the "let-go" current limit: it tends to become impossible to release live conductors or live metalwork if the leakage current through the human body exceeds this threshold limit. The danger increases with increasing values of current, and

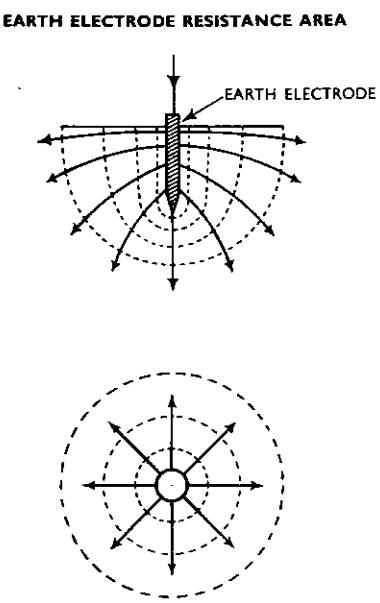


Fig. 1.

sustained currents in excess of about 50 mA can be directly lethal.

Bearing in mind these two limiting parameters, a sensitivity of about 25 mA may be considered a reasonably acceptable compromise. A sensitivity of this order, however, may not necessarily be suitable for adoption as a general solution as, amongst other considerations, it may well lead to trouble from nuisance tripping—particularly from transient switch-on leakage currents such as those often associated with cooker hot-plates and similar equipment.

The third method (commonly adopted in the United Kingdom) is to attempt, by means of protective devices, to restrict the duration of any possible shock. The ideal to be achieved in this respect is of immediate circuit isolation when voltages in excess of about 40 volts to earth appear on installation metalwork. For complete protection against the risk of direct permanent ill effects —particularly when using portable tools—circuit isolation should take place in less than about five cycles ($^1/_{10}$ second). Preferably it should take place in less than two cycles ($^1/_{25}$ second) if full mains voltage is involved.

The Problem of Fire-risk Protection. In order to ensure an adequate degree of protection against earth-leakage fire risks, there must be some method of limiting the maximum undetected earth-fault current which can flow. To provide complete protection to normal installations, this maximum level would need to be set at quite a low value: it would certainly involve reliable detection of earth-leakage currents of the order of a fraction of an ampere.

A device capable of detecting about 1 amp. earth-leakage current should, however, provide an *extremely acceptable level of fire-risk protection* to a 60 amp. circuit. This should be compared with conditions on the same circuit if it were protected by a conventional over-current device such as a fuse. With 60 amp. fuses, an earth-leakage current of 100 amp. may flow undetected for at least a minute. This could constitute a very serious fire hazard, *particularly on ageing installations*, as the heating effect is proportional to the square of the current.

Why are earth-leakage circuit breakers necessary?

The answer to this question is given by a study of what happens on a normal installation in earth fault conditions. To begin with, every earth electrode has a definite electrical resistance to "true" earth— that is, the general mass of the Earth. As shown at Fig. 1, current flowing from the electrode to the general mass of earth has to traverse the concentric layers of soil immediately surrounding the electrode. Soil is a relatively poor conductor of electricity and, as the cross-sectional areas of the layers of soil nearest to the electrode are rather small, the net effect will be that of a graded resistance, concentrated mainly in the first few feet of soil immediately surrounding the electrode.

The actual resistance of an earth electrode depends on its size, its shape, and the nature and resistivity of the soil. In general, it is found that earth rods form the most efficient electrodes: a 4-ft. long, $\frac{1}{2}$-in. diameter rod will probably have an earth-electrode resistance of between 10 and 200 ohms. Even in bad earthing conditions, the resistance of a 6-ft. long, $\frac{1}{2}$-in. diameter rod electrode would not normally exceed—in the United Kingdom—a maximum of 500 ohms, apart from a few exceptionally bad areas, such as some of the rocky, mountainous areas in North Wales.

The value of the earth-electrode resistance can be measured directly in ohms. (For method of measurement, see Appendix "A".) From Ohm's Law, if a 5 ohm earth electrode is carrying an earth-leakage current of 10 amp., the actual electrode itself must rise to a potential of 50 volts to true earth. Moreover, the surface of the soil near the electrode will also become "live," and Fig. 2 shows a typical surface voltage distribution near a rod electrode. From this it will be seen that an animal standing on the ground near this "live" electrode may have a considerable voltage applied between its fore and hind feet, resulting in a dangerous and possibly lethal shock. This is not just theory: it is a practical condition which has resulted, on numerous occasions, in fatalities to livestock. For this reason it is advisable to bury electrodes beneath the surface of the ground, thereby reducing the surface voltage-gradients.

The earth-loop path

There are a number of factors which determine whether a protective fuse will blow when an earth fault occurs. As can be seen from Fig. 3, the fault current flows from line and load via the earth continuity conductor and the consumer's earth electrode to earth. It

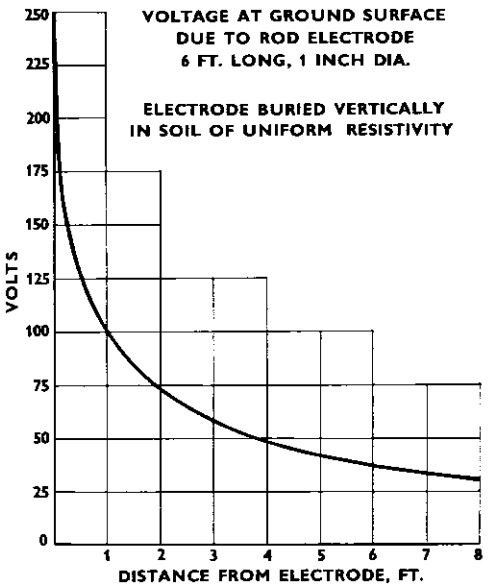


Fig. 2.

then flows back from earth to the neutral star point of the transformer by way of the supply transformer's neutral earth electrode. The earth fault current must therefore be limited by the total impedance of this earth-loop path, together with the impedance of the fault itself. This may not be a direct earth fault, but may occur part of the way down the winding of a faulty appliance.

If the total impedance of the earth-loop path on a 240 volt installation is of the order of 20 ohms, the maximum possible leakage current, even assuming a direct earth fault, would only be 12 amp. This current would, of course, be carried indefinitely by a 15 amp. sub-circuit fuse. As a result, any metalwork bonded to the installation earth terminal would now be permanently connected to the live circuit: it could therefore be live at anything up to full mains voltage.

In such circumstances fuses can offer no protection against earth fault conditions. Some alternative form of protection, such as an earth-leakage circuit breaker, must be adopted.

At this point it is perhaps of interest to note that not only is a 15 amp. sub-circuit fuse incapable of differentiating between a 12 amp. leakage current and a normal healthy load, but that the supply authority's meter is also incapable of drawing any such fine distinction. Consequently, any uncleared earth-leakage current, in addition to constituting both a shock and a fire hazard, also increases the running power charges for the installation—a not unimportant consideration from the user's point of view.

A final important consideration—also not widely appreciated—is that even a small leakage current can, within an hour or so, render what was a reasonably good earth connection completely useless. This is due to the fact that the earth-leakage current can dry out the soil surrounding the electrode. Until the soil has again become saturated with water, the electrode is useless with any protective device other than an earth-leakage circuit breaker.

The practical aspects of earthing

What, then, in practice is the likelihood of fuses and direct earthing offering adequate protection?

A very practical basis for deciding whether correct operation in earth-fault conditions can be achieved is set out in some detail in the 14th Edition of the I.E.E. Wiring Regulations. The relevant clause, D.22, is therefore reproduced in its entirety as follows:

"D.22. Earth-leakage protection may be afforded by means of fuses or excess-current circuit breakers provided that the earth fault current available to operate the protective device and so make the faulty circuit dead, exceeds—

(i) 3 times the current rating of any semi-enclosed fuse, or any cartridge fuse having a fusing factor exceeding 1.5, used to protect the circuit (see Table D.1.), or

(ii) 2·4 times the rating of any cartridge fuse having a fusing factor not exceeding 1·5, used to protect the circuit, or

(iii) 1·5 times the tripping current of any excess-current circuit breaker used to protect the circuit.

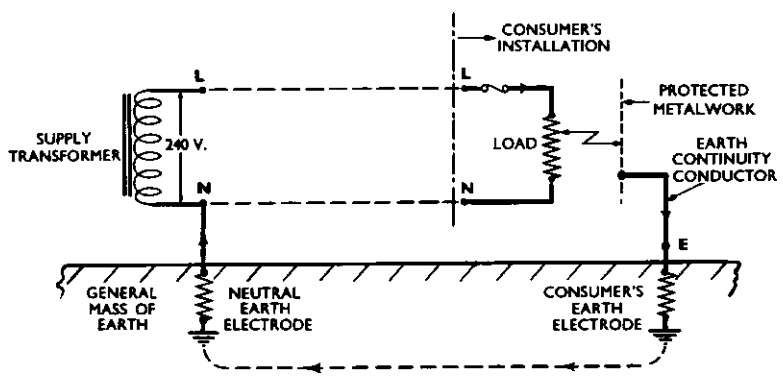


Fig. 3.

TABLE D.I

Maximum earth-loop impedances for earth-leakage protection by semi-enclosed fuses, or cartridge fuses having a fusing factor exceeding 1·5.

(Systems operating at 230-250 volts to earth*)

Current rating of fuse	Impedance
Amperes	Ohms
5	16
10	8
15	5·3
20	4
30	2·7
45	1·8
60	1·35
100	0·8

*For systems of any other voltage E_0 to earth the impedance values tabulated are to be multiplied by $E_0/240$.

Note 1—It is desirable that the impedance of the earth loop at any socket-outlet of rating 15 amperes or less which is so protected, should not exceed 4 ohms.

Note 2—Earth-loop impedance tests to indicate whether a fuse or excess-current circuit breaker will afford adequate earth-leakage protection are required by Regulation E.4. The total earth-loop impedance will be influenced by the requirements for earth-continuity conductors, earthing leads, and methods of earthing, which are severally dealt with in Regulations D.27-34."

From these requirements in the I.E.E. Wiring Regulations, it is clear that the normal 60 amp. supply to a domestic consumer necessitates an earth-loop path of 1·35 ohms or less, if semi-enclosed fuses are to be used for earth-leakage protection. A value as low as this may often be very difficult to achieve.

Whilst in urban areas it was at one time often possible to obtain a low-impedance earth-loop path by bonding to the supply authority's cable sheath or to a water main system, the increasing use of non-metallic water pipes and water mains has caused difficulties even in these areas: in areas served by overhead distribution it is usually very difficult to get a good low-impedance earth path.

In any event, I.E.E. Wiring Regulations no longer permit the use of water or gas services, either independently or jointly, as the primary means of affording earth-leakage protection to an installation. The metalwork of both the water and gas services must be bonded to the consumer's earthing terminal, but this must not be done until the earthing terminal itself has already been connected to "an effective means of earthing. . . ."

Less Onerous Requirements. There are certain ways in which the earth-loop requirements can be rendered less onerous, without in any way impairing the degree of protection afforded to the installation. Miniature or moulded-case circuit breakers to BS.3871, for example, could be used instead of semi-enclosed fuses. As British magnetic-hydraulic type miniature circuit breakers will

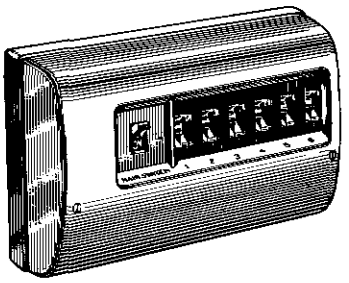


Fig. 4. An all-insulated circuit-breaker consumer's unit with a 100 amp. isolating switch.

trip on a sustained 35 per cent overcurrent, the value of earth fault current to meet the requirements of D.22 (iii) reduces to approximately twice the circuit breaker current rating (1·5 × 1.35 approximately equals 2). On this basis, a loop impedance of 2 ohms would be acceptable for a circuit protected by a magnetic-hydraulic type 60 amp. circuit breaker.

A further easement of the earth-loop impedance requirements may be achieved by using an all-insulated consumer's unit, such as the circuit breaker consumer's unit illustrated at Fig. 4. In this way, the incoming supply on a normal domestic consumer's installation can be treated as an all-insulated supply, up to the point where it is sub-divided into sub-circuits inside the all-insulated consumer's unit. The earth-loop impedance requirements are then only related to the maximum current rating of the final sub-circuits—usually 30 amp. for either a ring final sub-circuit or for a cooker—rather than to the 60 amp. or even 100 amp. rating of the in-coming service. With a 30 amp. circuit breaker (Fig. 5) in the consumer's unit illustrated at Fig. 4, an earth-loop impedance of up to 4 ohms would be deemed acceptable.

This compares very favourably with the limiting values which would otherwise be required of 1·35 ohms for a 60 amp. incoming service, or 0·8 ohm for a 100 amp. service feed.

Earth electrode impedance

In practice most of the loop impedance is located at the two earth electrodes, although—on older installations in particular—the impedance of the installation earth-continuity conductors may well be of the order of 10 ohms or more. This is due to corrosion effects at conduit joints, etc., and hence the earth continuity conductor

Fig. 5. A magnetic-hydraulic type single-pole miniature circuit breaker.

cannot always be ignored as a contributory factor to high loop impedance.

Transformer Neutral Earth Electrode. There must always be an economic limit to the amount the supply authorities can spend in endeavouring to obtain a low resistance earth at the neutral earth electrode. As a result, values of the order of 30 ohms are not uncommon, and a figure of 12·9 ohms has been quoted as the average value for the earth-electrode resistance at 25 rural sub-stations in an area where earthing conditions were considered to be comparatively favourable.

Consumer's Earth Electrode. In view of the foregoing conditions at the main transformer earth electrode, it is a reasonable assumption that the resistance of the consumer's earth-electrode will normally be at least of the order of 10-100 ohms, unless some special conditions exist on the installation. As mentioned previously, however, the resistance of a 6-ft. long $\frac{1}{2}$-in. diameter rod electrode would not normally exceed 500 ohms, except where soil resistivity exceeds about 100,000 ohm-cm.[3], i.e., in exceptionally bad earthing conditions.

Probable Loop Impedance. Bearing in mind these three major factors of earth-continuity conductor, transformer neutral earth electrode and consumer's earth-electrode impedance, it is clear that in all except the very worst conditions an earth-loop impedance of less than 500 ohms should readily be obtainable—but it is often an economic impossibility to achieve the 60 amp. fuse or 100 amp. fuse values of 1·35 ohms and 0·8 ohm respectively. Whilst on domestic installations, the acceptable value of loop-impedance may be increased to about 4 ohms by using all-insulated consumer's units and 30 amp. miniature circuit breakers, as explained in page 100, even this value may be somewhat difficult to achieve.

I.E.E. earthing requirements

The 14th Edition of the I.E.E. Wiring Regulations contains a number of important requirements regarding earthing arrangements at consumer's premises. To comply with these Regulations, a consumer's earthing terminal shall be provided adjacent to the consumer's incoming supply terminals.

If earth-leakage protection by fuses or excess-current circuit breakers is to be used, this earth terminal must be earthed by one of the following methods:

(a) by connection to an earthing point provided by the Supply Authority—this earthing point in turn being connected by a metallic return path to the neutral earth point, e.g. by means of an underground cable sheath or an overhead earth wire.

(b) by connection to a suitable earth electrode or electrodes. It is important to note that neither gas nor water pipes, either separately or jointly, may be used as the sole earth electrode of an installation.

(c) by connection to a means of earthing provided by the Supply Authority, utilising Protective Multiple Earthing (P.M.E.) for this purpose.

After making these connections, the suitability of the earthing arrangements for protection by means of fuses or excess-current circuit breakers has to be proved by a test of the earth-loop impedance. (See Appendix "B".)

If earth-leakage circuit breakers are to be used, suitable earth electrodes again have to be provided, and again neither gas pipes nor water pipes are to be used, either separately or jointly, as the sole earth electrode of an installation.

Although neither gas nor water pipes are to be used as the sole earth electrode, the I.E.E. Regulations require the consumer's earth terminal to be bonded to the metalwork of any gas and water service on the premises. This bonding must be done after the earth terminal has been connected to a suitable means of earthing, as described above—the bonding connections being made as near as practicable to the point of entry of the gas and water services into the premises.

Measurement of Earth-Loop Impedances—See Appendix "B".

Portable appliances are a special hazard

Even when earthing conditions are such that I.E.E. Regulations permit reliance on direct earthing, allied to fuse or miniature circuit-breaker protection, *the installation is still not completely protected against shock risks.* This is particularly important where portable appliances are concerned, as if an earth fault occurs whilst the appliance is being handled, neither fuse nor circuit breaker may operate quickly enough to protect the user. If the actual fault current is only approximately three times the fuse rating, i.e., the I.E.E. limit, the fuse can easily take a matter of ten seconds or so to blow—a time delay which could have fatal consequences.

For such applications, the instantaneous protection against dangerous voltage conditions afforded by the two types of earth-leakage circuit breaker has outstanding advantages.

The use of earth-leakage circuit breakers

Where earthing conditions are such that the requirements of the I.E.E. Wiring Regulations for earth-leakage protection by means of fuses or excess-current circuit breakers cannot be satisfied, i.e., if the earth-loop impedance is too high, earth-leakage circuit-breakers must be used. Furthermore, they may also be used for applications where a far better degree of protection against earth-leakage fire or shock risk is required than can be obtained by conventional excess-current protection—even though the value of the earth-loop impedance may be low enough to satisfy the requirements of the I.E.E. Regulations.

There are two basic types in use in the United

Kingdom: the "voltage-operated" type, built in accordance with B.S. 842; and the "current-operated" or "current-balance" type.

Voltage-operated units are designed to be directly responsive to fault voltages appearing on protected metalwork. Their primary function is to give protection against earth-leakage shock risk. At the same time, their sensitivity is such that—under normal operating conditions—they will give a high degree of protection against earth-leakage fire risks. If the only connection to earth is through the earth-leakage circuit breaker, leakage currents of about 50 mA will produce immediate circuit isolation. Should other parallel connections exist between the protected metalwork and earth, the overall degree of current sensitivity is reduced: but unless the resistance of this parallel earth path is exceptionally low, earth-leakage currents of a few amp., will still be readily and instantaneously detected. The resistance of the parallel earth path has to be exceptionally low before the sub-circuit fuse or circuit breaker will operate before the earth-leakage circuit breaker.

Correctly installed, voltage-operated earth-leakage circuit breakers will aways give full shock risk protection to the installation. Furthermore, in no circumstance is the degree of fire risk protection less than that of fuses: in the majority of installations the degree of protection provided by voltage-operated earth-leakage circuit breakers is much better.

The current-operated or current-balance type of earth-leakage circuit breaker relies on detecting out-of-balance currents. As these units are thus directly responsive to earth-fault currents they limit the maximum earth-leakage fire risk. Where earthing conditions are reasonably good, they may also provide very good shock risk protection. The normal sensitivity for such units ranges from detecting about 500 mA ($\frac{1}{2}$ amp.) out-of-balance, for a 30 amp. unit, to about 1 amp. out-of-balance for a 60 amp. unit.

It is important to note that both types of unit have two major operational advantages, as compared with protection by means of direct earthing and fuses. The first important point is that both types of unit have the inherent circuit-breaker advantage of being virtually tamperproof. Thus the excellent degree of fire and shock risk protection provided cannot be upset by arbitrary uprating of circuit fuses.

A second advantage, and an extremely important one, is that both types of unit will continue to provide adequate protection, even if earthing conditions deteriorate to a major extent. This is in marked contrast to direct earthing, where an increase of only an ohm or two in the earth-loop impedance may be sufficient to prevent the protective fuse ever blowing.

(Note: For a detailed comparison of the degree of fire and shock risk protection afforded by direct earthing and by each of the two types of earth-leakage circuit breaker, as applied to a 30 amp. cooker circuit, see the tables in Appendix "C." These tables also show very clearly the comparative effect of deterioration of the earth path on the efficiency of the various methods of protection.)

Current-operated earth-leakage circuit breakers

The basic principle of operation of this type of earth-leakage circuit breaker is illustrated at Fig. 6. From this it will be seen that the load current of the appliance

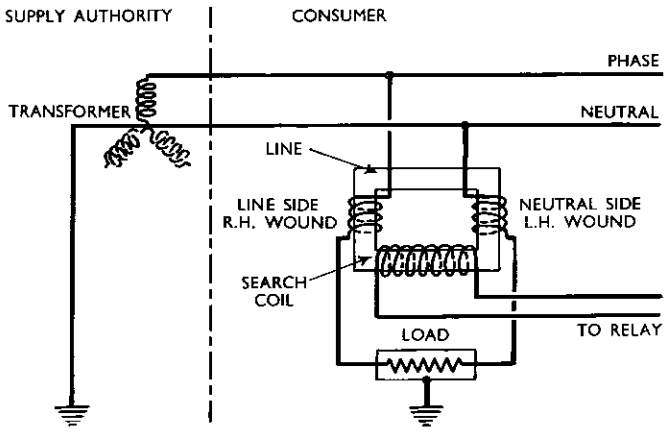


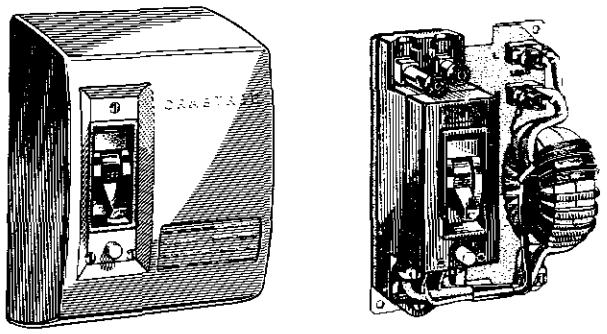
Fig. 6.

is fed through two equal and opposing coils, wound on a common transformer core. When the line and neutral currents are balanced, as they should be on a healthy circuit, they produce equal and opposing fluxes in the transformer core. Hence there is no resultant voltage generated in the search coil. If, however, more current flows in the line side than in the neutral side, an out-of-balance flux will be produced which will be detected by the search coil. This search coil can then be arranged to trip a protective circuit breaker.

Normally the only reason for more current flowing in the line than in the neutral winding is that some line current has returned to the neutral star point through an earth fault. Hence this method may be regarded as a means of directly detecting earth-fault currents.

Can Three-Phase Feeders be Protected? As with voltage-operated earth-leakage circuit breaker protection, this method may be applied to T.P. or T.P. & N. feeders. The transformer used to protect a T.P. & N. feed has four main windings—one for each of the three phases, and one for the neutral—in addition to the search coil. In this way, the residual current in the neutral will automatically compensate for any lack of balance in the loading on the individual phases.

This does not in any way affect the ability of the transformer to detect any current, such as an earth fault current, which flows in one phase coil, but does not return by way of one of the other phase coils, or by way of netural. Any out-of-balance due to earth fault currents will be readily and instantaneously detected.



Complete unit. Cover removed.

Fig. 7. A single phase 60 amp. current-operated earth-leakage circuit breaker.

On a three-phase feed, where the vector sum of the currents in the three phase lines automatically should be zero, the problem of unbalanced phase loading does not arise, and the neutral coil is no longer required.

Limits of Sensitivity. There is, at present, no British Standard* laying down standards of performance for this type of unit, which is known variously as a "current-operated," "current-balance," "core-balance" or "differential-current" earth-leakage circuit breaker (see Fig. 7).

The 14th Edition of I.E.E. Wiring Regulations, however (in a footnote to Regulation D.24), indicates that the operating current, i.e., the rated earth-leakage tripping current, should not exceed 2 per cent of the rated current of the circuit. This would correspond to a sensitivity limit of 1·2 amp. for a 60 amp. unit, and 0·6 amp. for a 30 amp. unit. The values normally adopted, in practice, for the rated tripping current—which is the out-of-balance current at which the circuit breaker will trip in less than 0·1 second—is 1 amp. for a 60 amp. unit and 500 mA for a 30 amp. unit. According to the I.E.E. Regulations, operating currents of less than 500 mA are not normally necessary.

With this order of sensitivity, the degree of direct protection against earth-leakage fire risks, as illustrated in some detail in the tables in Appendix "C," is infinitely superior to that given by conventional overcurrent protection. A 30 amp. fuse, for example, protecting a 30 amp. ring circuit, would carry an earth-fault current of about 60 amp. for some considerable time before it would blow. In direct comparison, a 30 amp. current operated earth-leakage circuit breaker, protecting a similar circuit, should trip instantaneously on an earth-fault current of only 500 mA.

Is Shock Risk Protection Ensured? Voltage-operated earth-leakage circuit breakers are designed to ensure complete shock risk protection for accessible installation metalwork, even though the earth-loop impedance is as high as 50 ohms. Current-operated earth-leakage circuit breakers can also ensure complete shock risk protection for such metalwork, but at somewhat lower values of earth-loop impedance.

By applying the same safety factors as are applicable to voltage-operated protection, i.e., not more than 40 volts on exposed metalwork, earth-continuity conductors, etc., the earth-loop impedance values which may safely be associated with current-operated earth-leakage circuit breakers are as follows:

30 amp. units — 80 ohms loop-impedance.

60 amp. units — 40 ohms loop-impedance.

This is the approach adopted in the 14th Edition of the I.E.E. Wiring Regulations—the relevant requirement being that the product of the earth-leakage circuit breaker operating current, in amperes, and the earth-loop impedance, in ohms, shall not exceed 40. Thus a rated tripping current of 1 amp. would correspond to a maximum earth-loop impedance of 40 ohms. Above this value, voltage-operated earth-leakage circuit breakers should be used.

Livestock are a Special Hazard. In some instances, however, such as on farm installations, where danger to livestock is a major consideration, it may be necessary to limit the maximum sustained voltage, on exposed metalwork, to a value corresponding to the 24 volt, 200 ohms limit of voltage-operated units. On such installations, the maximum loop-impedance associated with a 60 amp. unit, tripping at 1 amp. out-of-balance, preferably should not exceed about 24 ohms.

With such considerations in mind, 20 ohms has been suggested as a rule-of-thumb value of loop-impedance, below which current-operated protection would normally be considered more suitable than voltage-operated protection for a 60 amp. feeder on a farm installation.

Is Selectivity a Problem? An important point of comparison between voltage- and current-operated protection is that current-operated units are inherently selective: the earth-leakage circuit breaker only trips out when a fault occurs on the feeder it is protecting. With voltage-operated protection, however, it is necessary to isolate the various sections of installation metalwork in order to get selective operation, as a voltage-operated earth-leakage circuit breaker is only concerned with the presence of dangerous voltages on installation metalwork, not in the source of the dangerous voltages.

As a result, whilst there is considerable scope for voltage-operated units in industry so far as the protection of portable and semi-portable equipment is concerned, the current-operated unit is far more suitable for general application to industrial and commercial installations. Similar factors also apply when considering the question of earth-leakage protection for blocks of flats or for large blocks of offices, as selective operation need no longer be a problem—particularly as the value of the earth-loop impedance is usually relatively low on installations of this nature.

Using the Test Switch. Current-operated earth-leakage circuit breakers normally incorporate a test switch. This

*Since the above statement was written, B.S. 4293: 1968 has been introduced. This defines the required standard of performance.
—*Editor.*

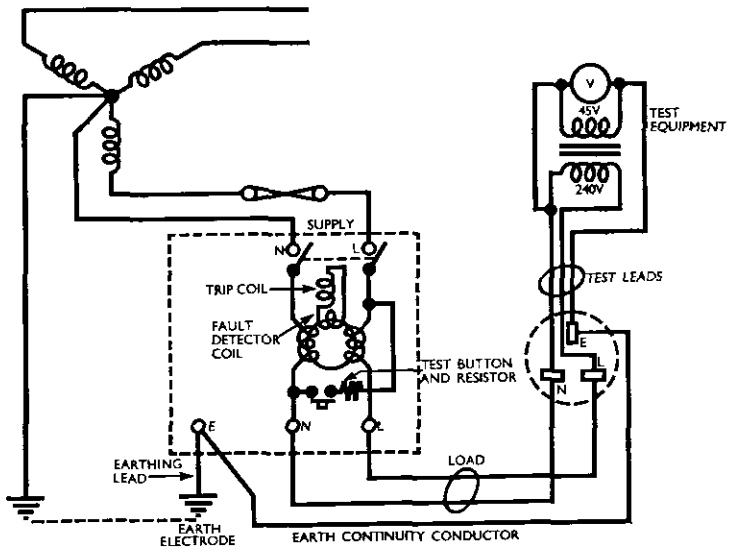


Fig. 8. Method of test for compliance with I.E.E. Regulation E.5, for a typical current-operated earth-leakage circuit breaker.

switch is arranged to create a simulated condition of out-of-balance, by injecting a test current which by-passes one of the primary windings. The magnitude of the test current is limited by the test resistor, so that the test switch may be used to check both that the transformer and circuit breaker are correctly connected, and also that they are operating at the correct order of sensitivity.

It is important to note that the test switch does not check the earth-continuity conductor: nor does it check the condition of the earth electrode. It simply checks that the earth-leakage circuit breaker is functioning correctly. This is in contrast to the test switch on a voltage-operated unit, which checks that the circuit breaker is functioning correctly, checks the continuity of the insulated lead to the reference earth-electrode, and also checks that the resistance of this earth-electrode is not too high.

Testing the installation

The primary function of an earth-leakage circuit breaker is to prevent a dangerous voltage, i.e., a voltage in excess of 40 volts, from persisting on installation metalwork. The preferred method of testing the effectiveness of a current-operated earth-leakage circuit breaker installation is therefore to use a step-down transformer to inject a potential difference of about 40 volts between installation metalwork and neutral. The 14th Edition of I.E.E. Wiring Regulations recommends the use of a 45 volt transformer having a short-time rating of not less than 750 VA for this purpose, the test circuit connections being as shown at Fig. 8.

Relative Costs. When installation conditions are such that either voltage-operated or current-operated earth-leakage circuit breaker protection would be suitable, the question of relative cost of the two methods may arise. Whilst the cost of a current-operated type unit may be two or three times that of a comparable voltage-operated unit, there may be very little to choose between the *installed* cost of the two units.

This is because the installed cost of a voltage-operated unit also has to include the material and labour costs involved in running the insulated lead to the separate earth-electrode, and in providing and correctly siting this electrode outside the effective resistance area of other earthed metalwork. On the other hand, if extra expenditure would be involved in reducing the resistance of the main earth-electrode to a value low enough to permit the use of current-operated protection, this also will affect the comparative installed costs of the two types of unit.

Other Advantages. When considering the use of current-operated earth-leakage circuit breakers, it must not be forgotten that—in common with voltage-operated units—they have certain major operational advantages, as compared with direct earthing and fuses.

Firstly, they are inherently tamperproof in operation: the degree of fire and shock risk protection provided cannot be vitiated by arbitrary up-rating of circuit fuses. Next, both types of unit will continue to provide a reasonably acceptable degree of protection, even if earthing conditions on the installation deteriorate quite badly. Finally, both units incorporate a test switch, which enables the user to check the effectiveness of the protective device.

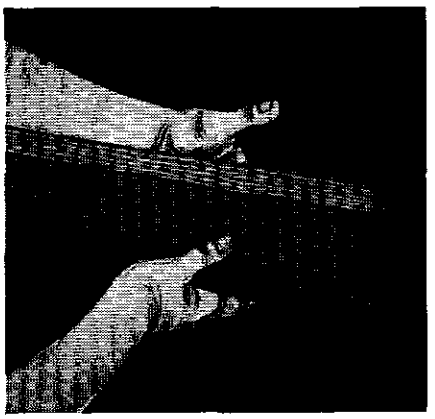
Parts 2, 3 and 4 will be published in consecutive issues. Part 4 will contain the Appendices.

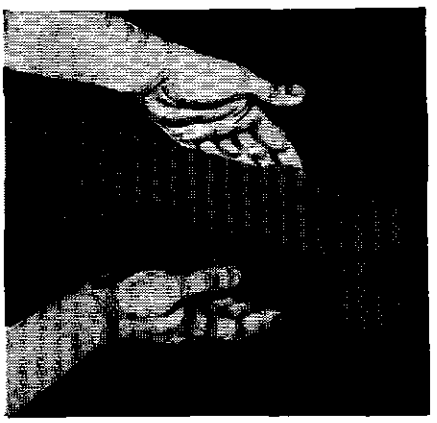
DISTRIBUTORS OF EXTROL IN BRITISH ISLES

Granville Controls Ltd., 120, Wilton Road, London, S.W.1, have been appointed the sole distributors U.K. and Ireland of *Extrol Diaphragm Expansion Tanks* and complete associated equipment for Closed Heating Systems.

A Closed Systems catalogue is available detailing the range of products and interesting technical information, application examples, "easy to read" selection charts and duty graphs.

just say 'Newalls Super Glass Fibre Rigid Pipe Insulation' and it's on!

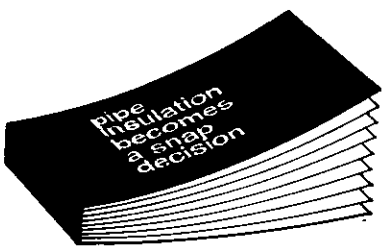




It's as simple as that. The one piece rigid sections simply slip over the pipe and snap tightly closed, providing the quickest, the simplest, the most efficient and reliable method of pipe insulation in use today.

The 3 feet sections are available in a variety of sizes and insulation thicknesses and can be supplied plain or in a range of factory applied finishes in canvas, aluminium foil and easy-seal black and white PVC.

Save time and trouble – quick application reduces insulation costs. Newalls Super Glass Fibre Rigid Pipe Insulation is waterproof, vapourproof, fireproof, verminproof and rotproof.



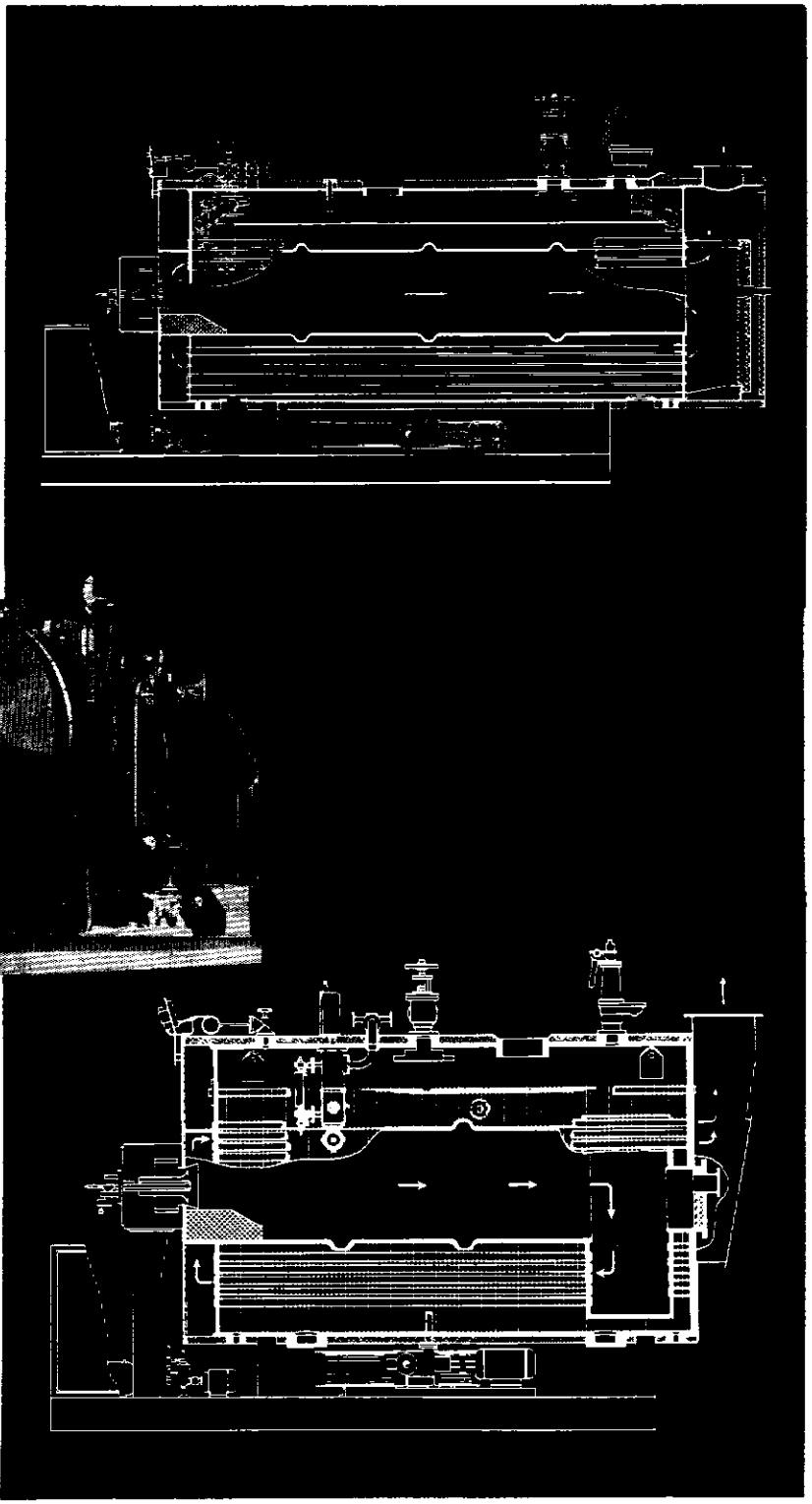
* *To illustrate the speed of application we have produced a flip book. This will be sent to you on request together with full technical literature. Just write to:*

NEWALLS
Insulation & Chemical Co. Ltd.
A TURNER & NEWALL COMPANY

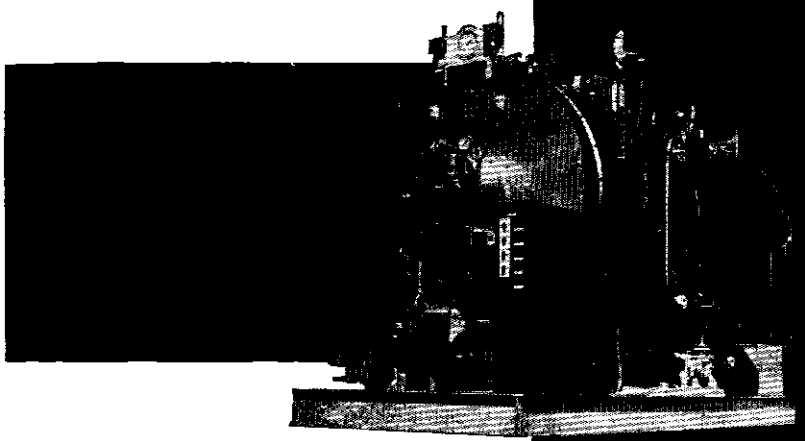
NEWALLS INSULATION & CHEMICAL CO. LTD. Head Office: WASHINGTON, CO. DURHAM. Tel: WASHINGTON 3333
Telegrams: NEWCHEM Washington. Telex: 53413 NEWCHEM WSHNGTN. Offices and Depots at BIRMINGHAM, CARDIFF, GLASGOW, LONDON, MANCHESTER and NEWCASTLE UPON TYNE. Agents and Vendors in most markets abroad.

choose Steambloc....
DRY-BACK OR WET-BACK PACKAGED BOILERS

Whichever you prefer in packaged boiler design Babcock can supply your every need — the Steambloc is now available as a *dry-back* or a *wet-back* boiler. The choice is yours.



The dry-back, 'DB' series, is constructed in a wide range of sizes up to 50,000 lb. steam/hour; their well-proven design of gas transfer chamber is ideally suited to incorporate superheaters for temperatures up to 700°F. More than 6,000 dry-back units are in operation throughout the world.



The wet-back, 'WB' series, is now available in twelve sizes from 5,000 to 35,000 lb. steam/hour. This increasingly popular design permits a very compact arrangement especially valuable for installation in restricted spaces.

Standard working pressures of 145 and 245 p.s.i.g. are available for both series. Please consult us should you wish to operate at higher pressures.

BABCOCK & WILCOX (PACKAGED BOILERS) LTD

A Member of the Babcock & Wilcox Group **Head Office & Works: Renfrew · Scotland · Tel: 041-REN 4141**
London Office: 165 Great Dover Street · S.E.1 · Tel: 01-407 5500

Blood Testing by Automation

Revolutionary new machinery for blood testing by automation is to be manufactured by the Medical Group of Vickers. The Multichannel "300" machines—the first of their kind in the world—are capable of the biochemical analysis of 300 samples of blood or other body fluid per hour.

How the Multichannel "300" was born

THE Multichannel "300" is the result of close teamwork between the health services, the National Research Development Corporation, and the Medical Group of Vickers.

The thinking started this way: The work load on the biochemical and laboratory staffs of Britain's hospitals was doubling every four or five years.

Operational research indicated that a delay of several days could occur between the admission of a patient to hospital and initial diagnostic check-up.

Various laboratory instruments and automatic methods were already being established in clinical laboratories, but the long term view emerged that these would not be sufficient to satisfy future requirements.

The solution was seen to lie in more automation—and in processing samples at a much higher rate than existing laboratory machines or aids could do, with increased accuracy. The aim was to replace many of the processes previously performed by hand.

Biochemists began to work out new methods, and Vickers Medical Group, headed by Dr. Kenneth Williams, approached the National Research Development Corporation, who decided to support the project towards the end of 1966.

In the 1966/7 report of NRDC, it was stated:

"The Corporation is sharing the cost of developing a batch type analyser for body fluids working at high speed and measuring up to twelve variables selected from a wide range of tests.

"The emphasis will be on modular construction and reliability. The equipment has an important potential in preventive medicine. In particular, it is suitable for mass screening."

Arrangements for the construction of experimental prototypes began. These brought in Medelec Ltd of Woking for electronic development work; the Vickers South Marston Engineering Works for overall mechanical design; Southern Instruments Ltd. of Camberley for flame photometry; and Vickers Instruments of York for certain optical components.

Assisting in the work on chemical methods and prototype development were Professor John Butterfield at Guy's Hospital Medical School Department of Medicine, who has been studying problems of mass population screening; Dr. John Buckle of Guy's; and Dr. Clifford Riley, Consultant Pathologist at Royal Sussex Hospital, Brighton, who is also now engaged on evaluation studies.

A full-scale experimental prototype is now at a special laboratory at St. Olave's Hospital, Bermondsey, an offshoot of Guy's, for further development work.

Final aspects of the design are being worked out in close co-operation with Ministry of Health officials and advisory staff.

Prices are expected to range between £15,000 and £30,000 depending on the number of channels and the constituents to be measured.

How the Multichannel "300" works

The Multichannel "300" is a self-contained machine designed primarily for the rapid analysis of the biochemical constituents of blood samples, where large through-puts are involved or where analyses need to be made on small batches in a short period of time.

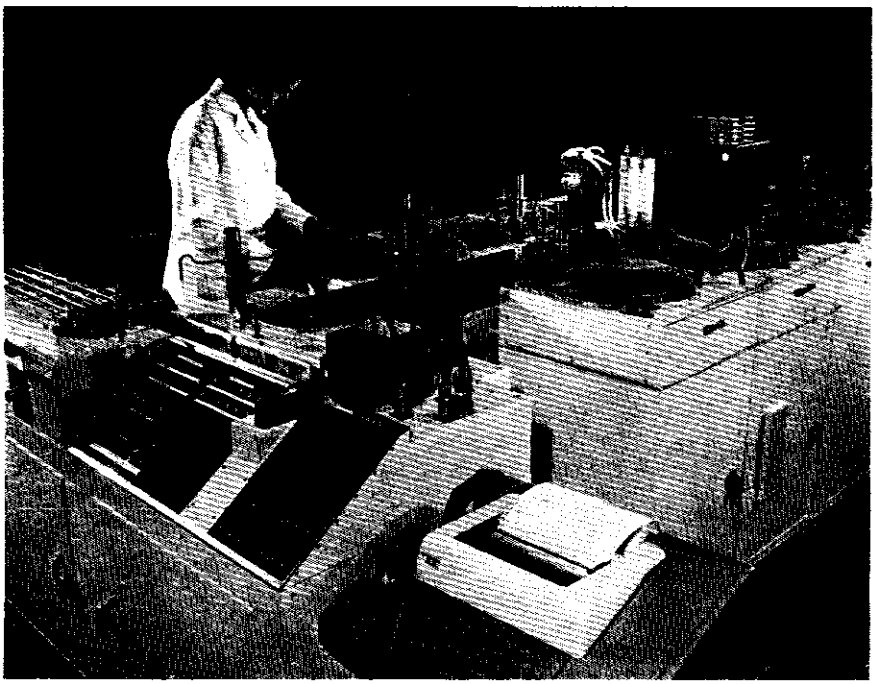
Alternatively, it can be adapted to analyse other fluids such as urine.

The high rate of sampling is made possible by the use of discrete reaction cavities. Since the machine performs mechanically the sort of manual procedures used in bench methods—for example pipetting and constant temperature incubation in a test-tube—it can be used for any colorimetric, fluorimetric or flame photometric method for which there may be a future demand.

Because of the modular nature of the equipment, new analyses may be introduced and other changes made without interfering with the operation of the remaining channels.

After collection, the vials are centrifuged and loaded into magazines. Complete automation is applied to all further handling of the samples and the presentation of results.

The analysis begins with a quality control check at which haemolysed and lipaemic samples are rejected. A quantity is then taken from each satisfactory sample



Multichannel "300" experimental prototype in a special laboratory at St. Olave's Hospital, Bermondsey, undergoing development and evaluation.

and a primary dilution is made. A diluted sample is presented in turn to a series of analytical units.

At each point, a separate quantity is withdrawn, diluted further and transferred to an individual cavity in a thermostatically-controlled reaction rotor.

The reagents are added at pre-set times. Measurements are made by colorimeters and flame photometer.

The data handling system converts the colorimetric and flame photometric readings directly into printed results.

This typed record gives the identity and origin of the samples followed by a numerical list of the analytical data. For reference purposes, a punched tape output is provided. The output is in a form which can be used for on-line computation.

Individual Components and Sub-systems

Sample Vial

Standard specimen vials are unsuitable for a machine of this type for two reasons. Firstly, it is difficult to attach a label capable of being read by machine which will stand up to the handling and centrifuging processes to which the container is subjected. Secondly, the usual cylindrical vial would pose problems at the quantity and quality detection stages. Such objections are taken into account in the design of the sample container for this machine.

The vial, which takes 5 ml samples, consists of a flat, rectangular, transparent container moulded in polystyrene. The inside is treated with an anticoagulant. Two sides of the container are covered with a numbered label. Closure of the vial is achieved by removal of a peel-off strip, which protects an extension of the adhesive label, and pressing the adhesive flap in firm contact with the rim of the container.

The vial is wide enough at the top to accept the nozzle of a syringe from which the needle has been removed. In use, having injected the sample into the vial and sealed the end, the vial is identified by marking the labelled faces with a numerical code. Twelve digits are available for this purpose, in groups of six on each of the two faces. One group can be used to identify the patient and the other the particular hospital or department. This is done by pressing marked digits, which appear in twelve columns, against indentations corresponding to each column. This procedure guarantees that the sample will be positively identified at the time of machine analysis and provides the means whereby the results of analysis are tabulated against the reference numbers without any clerical procedures being necessary.

On arrival at the laboratory, the vials are centrifuged before loading them into the machine. A centrifuged bucket holds the vials in batches. The bucket will fit the standard large capacity heads on most centrifuges in common use. The vials are then loaded into magazines for measurement.

Magazine Feed System

The mechanism will hold several magazines loaded with specimen vials. Empty magazines can be removed and full ones added during use.

The vials when loaded into a magazine are held against a gate at one end by a constant tension spring. In use, vials are delivered from the magazine at regular intervals by a system of pawls which release a gate in the delivery block and so allows a vial to be pushed out of the magazine under the action of the

spring. When a magazine is empty the next indexes across into position automatically.

Serum Check Position

After release from its magazine, the vial is first checked to ensure that it is correctly filled and that the serum and blood cells have been separated satisfactorily. An insufficient quantity of serum would lead to incorrect dilution and a haemolysed or lipaemic specimen would give a false reading on analysis due to turbidity or improper colour development. Samples of this kind are, therefore, rejected.

The serum check uses an optical method. The device only allows a vial to move into the main part of the machine if the level and quality are satisfactory. An incident beam of light passes through a sample which is satisfactory and excites a photodetector placed to allow for the refraction that occurs as the light beam passes through the serum. A vial which is inadequately filled produces an incorrect light path. A haemolysed or lipaemic sample causes too weak a signal to reach the detector.

Specimens which are unsatisfactory are moved into a separate vial holder which will take up to twenty rejected vials. An over-ride button on the control panel of the machine allows rejected samples to be passed through to the next stage without further rejection if it is decided that a given sample, though unsatisfactory, may be acceptable for limited analysis.

Primary Transfer Diluter

On leaving the serum check position, the tops of vials containing satisfactory samples are pierced automatically. A quantity of serum is taken from each vial by the primary transfer diluter and dispensed with diluent into an open container on a distributor system for transfer to the individual reaction rotor consoles.

The transfer diluter head, which is raised and lowered by the action of a cam, consists of two parts in the form of a rotary valve. The upper part has two capillary probes set on opposite sides and it is rotated through half turns. The lower part, which is stationary, is connected to the diluent supply. One probe descends into a vial to withdraw a sample of serum, while the opposite probe is delivering serum taken from the previous vial, followed by diluent, into one of the containers on the distributor.

Distributor Assembly

The distributor assembly acts as a spine to the machine. The reaction consoles are equally spaced along each side of it.

A sample, after dilution, moves to the first reaction console and an empty container moves under the primary transfer diluter. As empty containers are presented to the primary transfer diluter, those containing diluted sample move in turn to each reaction console where an aliquot is taken. Each sampling container is inverted and washed out at a laundry position before passing under the primary transfer diluter for its next sample.

Reaction Consoles

Each reaction console is set to perform a specific analytical function according to the needs of the laboratory. The sequence of mechanical operations in each case is, however, basically similar. An aliquot taken from the primary diluted serum is dispensed into a cavity in a reaction rotor with further diluent. Reagents are added at appropriate intervals and the sample incubated for a given period of time at a temperature set by that of the reaction rotor block. The sample is then withdrawn from its cavity and passed to a colorimeter or flame photometer.

The detailed working of a reaction console is as follows:

(1) *Secondary Transfer Diluter*

This is of smaller capacity than the primary transfer diluter. The quantity of serum and diluent which is dispensed is adjustable and will be determined by the particular analysis being carried out.

(2) *Reaction Rotor*

The top of the reaction console has a rotor containing sixty reaction cavities in the case of a standard rotor, or one hundred and twenty cavities in a rotor which allows blank determinations to be made. The cavities are lined to provide a chemically inert and non-wettable inner surface. The temperature can be maintained at pre-set values. At a sample rate of three hundred per hour, the rotor moves through an angle equivalent to the spacing between neighbouring reaction cavities every twelve seconds, giving a total time for complete rotation of twelve minutes.

(3) *Reagent Dispensers*

Reagent dispensers are set around the periphery of the rotor so that additional diluent and reagents can be added to the reaction cavities. The position of these dispensers will depend on the particular reactions and the time required for incubation.

(4) *Sample Measurement*

A suction probe is placed at the final sample position and enters the cavity automatically. The sample is then transferred to the cuvette of a colorimeter (or to the atomiser of a flame photometer).

The time of withdrawal of a sample for measurement is adjusted, by positioning the suction probe around the rotor, so that aliquots of the same initial specimen are measured in each analytical channel at the same time.

(5) *Tube Laundry*

After withdrawing a sample for measurement, the residue is washed out, and the cavity is

cleansed and dried at subsequent positions to prepare it for the next cycle.

Colorimeter

A double-beam densitometer has been designed for use with the machine. It can be used for simultaneous blank determination when required. Inaccuracies due to variation in colour temperature of the light source are avoided by using a beam splitting prism and a dual parallel light system. The photodetectors are mounted in a common heat sink to minimise difference due to temperature differentials. Known non-linearities in the relationship between the optical density of the solution and its chemical composition may be corrected by fitting a special scanning aperture.

The lamp, in a housing with means of centering the filament, illuminates a single slit. The beam is split into parallel beams each of which pass through an aperture adjacent to cuvettes into which the sample and blank are drawn.

Flow of the sample through the cuvettes is unidirectional. The capacity of each cuvette is small and a major portion of each sample is used to wash out the previous one.

Flame Photometer

In this case, the diluted sample is mixed with a fixed volume of a solution of a strontium salt which acts as an internal standard (lithium may also be used). At reading, the sample is injected into an air/acetylene flame which is viewed simultaneously by four different photocells, sensitive to the appropriate wavelengths for the internal standard, calcium, potassium and sodium.

Data Handling and Vial Reader

During the time which elapses between the vial top being pierced and the primary transfer and dilution made, and the simultaneous measurement of the different aliquots of this sample at the various reaction consoles, the vial moves stepwise towards an address reading head. It reaches this position the instant the different measurements are being made. The reading head detects the digits which have been depressed on the vial label. A teletype machine automatically produces a typed record of the results of the multiple analysis against the vial code. A punched paper-tape is simultaneously produced both for record purposes and for further data handling and computer procedures. Alternatively, the digital output may be fed directly into an on-line computer.

The vial is then moved to a storage position, and should no further analysis of the sample be needed it is allowed to fall into a waste container for disposal.

The main controls of the machine and electrical indicator and warning lights are situated on a panel of the control console. An adjacent panel contains the operating buttons for the data handling units.

Analytical Methods

Biochemical measurements of the kind considered here have traditionally been carried out manually by simple bench techniques. The demand for an ever increasing number of such measurements to be made within the hospital service has led to the introduction of instruments into the chemical pathology laboratory to assist in those measurements. The first stages in the provision of mechanical assistance have been in common use in laboratories for a number of years now. The use of these devices has involved the development of special chemical techniques.

The future demand on the chemical pathology laboratory presents further problems, which can only be satisfied by adopting a different approach again. To this end, the Multichannel "300" is a significant step towards full automation in the analytical laboratory. Furthermore, by using discrete reaction cavities, it is now possible to return in modern form to the principles used in bench methods, but with the various stages in the analytical process being carried out without manual intervention.

Principles of Operation

The machine will reproduce mechanically, and at a high sample rate, the various standard processes normally carried out manually in analytical determinations of the chemical constituents of blood.

To use the full capabilities of the machine, analytical methods should satisfy the following criteria:

(1) Coloured reaction products should obey Beer's law.

(2) The number of reagents used should be limited in number to avoid unnecessary complexity and expense.

(3) For convenience, the reagents chosen should be sufficiently stable at room temperature for the method to give reproducible results over at least one hour.

(4) For operation at the full rate of three hundred samples per hour, reactions should be not less than sixty per cent complete within a period of ten minutes from starting the reaction.

Analytical Determinations

The following list of determinations is an indication of the wide range of analytical methods which are within the capabilities of the equipment:

Urea, Sodium, Potassium, Chloride, Total protein, Albumen, Glucose, Bilirubin, Alkaline phosphatase, Thymol turbidity, Zinc sulphate turbidity, Aspartate transferase (S.G.O.T.), Lactic dehydrogenase, Calcium, Uric acid, Serum cholesterol, Bicarbonate, Inorganic phosphate, and Serum iron.

The determination of other constituents should also eventually be possible. In fact, the overall concept of the machine is such that an increasing range of possibilities and alternatives for use of the system can be expected. Additional analytical methods can be developed in the light of experience and clinical need.

Moorfields Install six Modular Theatres

MODERN, factory-built operating theatres, incorporating the most up to date operational and teaching facilities for ophthalmic surgery—including closed circuit TV—have been completed at Moorfields Eye Hospital. Four of the theatres, designed, constructed and installed by Honeywell, are at the Moorfields City Road branch and a further two at the hospital's Holborn premises. The new facilities were officially opened on 28th March by H.M. the Queen Mother.

The ground floor of the suite at City Road comprises four Honeywell Modular Operating Theatres, each with its own scrub-up, anaesthetic and preparation room. Also included is a six-bedded recovery room, a TSUU and changing/domestic facilities. At the upper level are panels for overhead viewing of all four theatres and a closed circuit television centre—giving Moorfields the most advanced teaching facilities in Britain for ophthalmic surgery.

Surgeons will be assisted by the high degree of built-in instrumentation of the theatres, the positive pressure air conditioning which ensures germ-free atmosphere, and the planned segregation of "clean" and "dirty" area and staff movement, in the layout.

A feature of each theatre is the ceiling-mounted TV boom which allows the camera to be positioned over the patient, while the technician operating it stands at the foot of the operating table. The TV control centre at viewing level enables the operator to select transmissions from any, or all, of the theatres and to feed these to screens in the viewing gallery and to lecture rooms situated in the main hospital block. The television system was designed and installed under the supervision of the Institute of Ophthalmology.

The two-storey building housing the theatres at City Road has been constructed above the eye clinic completed in 1960 and is designed to allow for further vertical extension. A dry construction technique was used to minimise disruption to existing hospital facilities. Main contractors were Sir Robert MacAlpine & Sons; structural engineers were E. J. Cook & Co. (Engineers) Ltd. The whole project was designed and supervised by K. Graham Smith, A.R.I.B.A., on behalf of the Board of Governors of Moorfields Eye Hospital. Mechanical and electrical services were designed and installed by Ashwell & Nesbitt Ltd. and Troughton & Young Ltd., respectively.

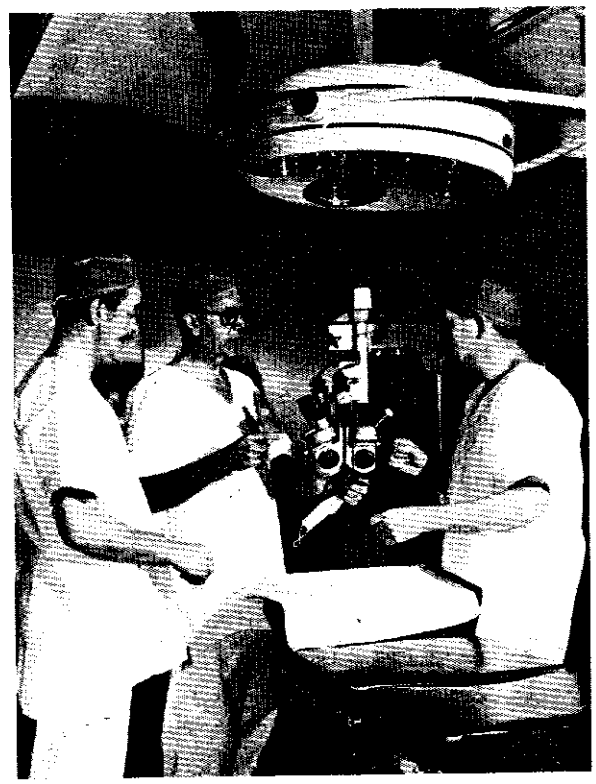
Scientific Movements for Theatre Staff, Patients & Supplies

Designed to promote efficient and labour-saving working, the layout of the Honeywell Theatres permits scientific movement patterns for theatre staff, patients and supplies.

Theatre Staff

Surgeons and nurses enter the suite via a link corridor, 'A', and proceed to their respective changing rooms and, having changed, come out into the "clean" corridor.

The surgical teams enter the theatre through the respective scrub-up room where they scrub, glove and gown. It should be noted that the nurse handling sterile supplies in the theatre preparation room should only enter this room via the theatre, having scrubbed. The domestic and other staff requiring access to the "dirty" corridor area of the suite enter via the TSSU.



Inside one of the four new modular operating theatres at Moorfields Eye Hospital (City Road) Dr. Littmann, scientist responsible for overall development of Zeiss medical instruments, discusses one of his instruments with Professor Barrie R. Jones. The Zeiss Double Microscope after Harms is the only one in the world which permits two ophthalmic surgeons to view the eye simultaneously with individual binocular observation. On the left is Mr. Gerald Powell, sales director of the UK Zeiss agency.

Patients

Patients enter via the link corridor, 'A', and pass into the airlock. Here the theatre sister is able to control the movement of patients within the suite and direct them to the appropriate anaesthetic room. On the completion of the operation, the patients exit from the theatres into the "clean" corridor and remain in the recovery room, or return directly to the wards via the air lock.

Supplies

The cycle for sterile supplies is as follows:

(a) on completion of operations, all dirty instruments, linens etc., are placed in the double-door transfer hatch in the theatre.

(b) the hatch is emptied on the "dirty" side and the material sorted. Linens are collected for dispatch to the laundry; disposables are placed in the appropriate containers, which, together with the linens, are eventually removed from the suite.

(c) instruments and other re-usable equipment are passed to the receiving/cleaning area, where they are washed and inspected.

(d) the instruments are then packed and sterilized, using ethylene-oxide, dry heat ovens, or steam as the sterilizing method, according to the classification of the instrument, e.g. special "sharps" use the ethylene-oxide agent.

(e) all sterile supplies for use in the theatre are passed, via the "clean" corridor, through the double-door sterile supply hatch serving each pair of preparation rooms.

(f) the lotions are pre-sterilized outside the suite and a solution warming cabinet is supplied for each pair of preparation rooms for maintaining them at a set temperature.

Services and Equipment

The services for the suite include a full air conditioning system for the four theatres and their ancillary rooms, recovery room and the "clean" corridor, with pressures at their greatest in the theatres and sterile areas. The air filtration system includes a coarse pre-filter, followed by electrostatic precipitators with microbiological terminal filters at all points of discharge. Standby fans ensure that ventilation is maintained at night and under power failure conditions. The remainder of the suite is heated by a tempered air system.

A Honeywell Pneumatic Senior System provides complete automatic control of cooling, heating and humidity within the suite. Centrally supplied piped gases are provided in each theatre, anaesthetic room and the recovery rooms. and include oxygen, nitrous-oxide, vacuum and compressed air.

Each theatre has wall-mounted equipment so arranged as to be accessible for maintenance by the hospital engineering staff from the "dirty" area. This equipment includes a panel on which the controls are situated for the variable intensity, general lighting system; the temperature within the theatre; the switching for the surgical operating lamps and the theatre "status" signs. Fine adjustment controls for the TV monitor are also positioned on this panel and above is a glazed panel behind which a television monitor is placed for viewing in the theatre.

Other equipment includes X-ray viewing screens, surgical suction units and two booms—one for medical gases and the other for electrical supplies for equipment such as diathermy, operating microscopes, etc. Theatres number two and three each have a wall-mounted double-glazed window with internal blind to enable physiological monitoring equipment to be used outside the theatre.

NEW LITERATURE FROM ROBERTS

Limpet pvc rainwater goods, now produced in grey and white, are described in a new eight page A4 size leaflet available from the manufacturers J. W. Roberts Ltd., Horwich, Bolton.

The Limpet system is made from an unplasticised pvc compound specially selected for good weather resistance, high impact strength and colour-fastness. The system comprises a complete range of gutter, downpipe and fittings in an aesthetically pleasing rectilinear design.

COPPERAD SILL-LINE CHOSEN FOR £1½ m. MANCHESTER DEVELOPMENT

Gateway House, Piccadilly for Manchester Regional Hospital Board

Over 7,000 feet of Copperad Sill-Line continuous-run convection heating has been installed in the £1½ m. Gateway House development, Station Approach, Piccadilly, Manchester, one of the most important new building developments in the Midlands area. The entire building has been taken over by the Manchester Regional Hospital Board, who will be taking possession in March.

Copperad Sill-Line has been installed in a continuous run, its telescopic overlapping of panels enabling it to follow accurately the unusual "S" shape curvature of the perimeter walls. Offices can be erected at any point along the run without affecting the overall performance, individual heat control being achieved by means of separate dampers on each panel section.

Hot water is provided by three cast iron sectional boilers, oil fired, using 200 secs. viscosity oil. There are two separate zones each complete with their own pumps and automatic controls.

The heating installation was carried out by Norris Warming Co. Ltd. of Manchester. In addition, they supplied hot water, cold water, fire mains and all plumbing and sanitary services.

Architects were R. Seifert & Partners of Manchester and the main contractors, Richard Costain Ltd.

FROST PROTECTION AT HAMPSTEAD HOSPITAL

New Product Aids Building Programme

At the Royal Free Hospital, Hampstead, where a new staff accommodation and medical block is being erected, John Laing Construction Ltd. have maintained their building programme despite adverse weather conditions by protecting floor constructions with an efficient frost protection blanket.

Each floor of this £400,000 13-storey block is constructed of 7½ inch thick reinforced concrete. In order to keep to schedule, the concrete must be cured to reach a minimum strength of 1,500 lb. per square inch in two days so that work can begin on the next storey. Curing at this rate can only be done by maintaining for at least 15 hours the mean hydration temperature of 50°C. In summer conditions this presents no real problem, but in winter the position is vastly different. An efficient insulant, itself adequately protected from damp, is required.

On the new building, blankets manufactured and supplied by B. R. Ainsworth Ltd. of Lorne Road, Forest Gate, London, are being used. These consist of three 3 ft. square of 1 in. thick 5 lb. per cubic foot density Stillite Mineral Wool mat encased in 500 gauge polythene. The total length of the blanket is 10 ft. 6 in.

Work proceeding on the 4th storey showed that when the concrete was first laid hydration temperature climbed to about 60°C. The following morning, approximately 12 hours later, the frost protection blankets had maintained the temperature in the region of an acceptable 50°C. Manufacturers of the insulation material are Stillite Products Ltd. of Station Road, South Bank, Middlesbrough, a Turner and Newall Company.

A PIPEWORK TERMINATION FOR THE STANDARDISATION OF MEDICAL GAS OUTLETS

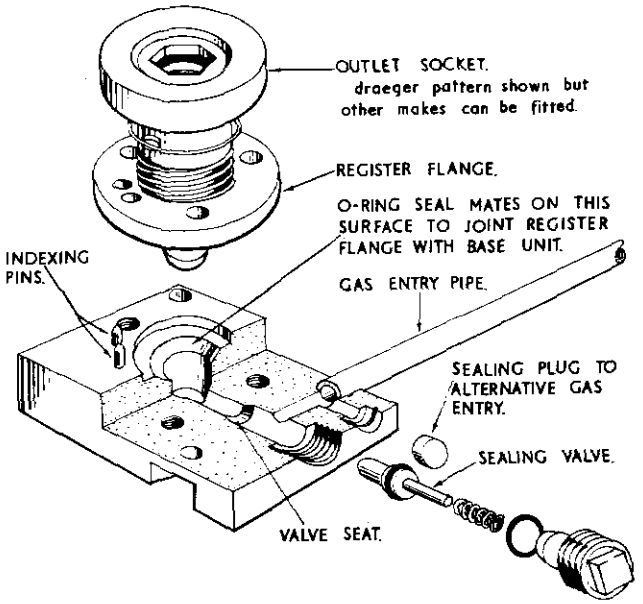
IN RECENT years the increased demand for piped Medical Gases and Vacuum in Hospitals has brought to light a need for standardisation of outlets to avoid adaptation of equipment and to attain a higher degree of safety by the non-interchangeability of fittings. In the past the majority of outlets have been to the design of one firm but recently others have achieved an increasing proportion of the installation contracts, and design variations have been introduced.

The use of the various gases and the possibility of gas mixtures in a hospital demands close attention to deail in order to prevent the wrong selection of gas by the user. It is important to make provision to enable a patient to be transferred from theatre to recovery room and to acute ward without adaptation or alteration to any connected apparatus, and the adoption of a standard outlet unit is a very important development.

The Ministry of Health, through its Engineering Study Groups, have developed a standard terminal unit. This terminal is metrically sized and will incorporate a standard pin index system, similar to that laid down in B.S.1319, to identify the outlet with a particular gas and prevent the connection of the outlet to a wrong supply.

Another feature of the outlet base is the provision of a shut-off valve which operates when the outlet valve is removed for maintenance. The index pins prevent incorrect assembly and will be an aid to maintenance. The B.S.I. are at present considering the standardisation of outlet valves for the different medical gases and for medical vacuum, all of which it is proposed will be used in conjunction with the outlet base.

The illustration shows the details of the terminal unit and the way in which the outlet valves will be assembled.



Medical Gas Terminal Unit. Insertion of the Register Flange in the Base Unit pushes the Sealing Valve Open.

The design development has as one of its aims the incorporation of the outlet in 4" (100mm.) Industrialised Hospital Building partitions, and the development of a back to back arrangement in which the overall depth of the complete outlet unit will be 50mm. This will facilitate the standardisation of bedhead services and will be an important contribution to the Hospital Building programme.

JARVIS AWARDED LANCS HOSPITAL CONTRACT

J. JARVIS & SONS Ltd. have been awarded a major contract valued at £117,470 for alterations to a ward block of the Winwick Hospital, near Warrington, Lancashire.

Part of a building and renovation programme by the Liverpool Regional Hospital Board, the alterations are confined to a 40 ft. high "U"-shaped block built in 1900. The renovation work is mainly concerned with modernising their second and third floor ward layout and ground floor dayroom and dining area facilities. Work to be carried out in the building will also include new anti-slip floor covering, and improved sanitary, heating and ventilating services.

An important feature of the modernisation will be the construction of a lift shaft onto the side of the existing building. The shaft will be the full 40 ft. height of the building and its construction entails the removal of part of the existing fabric.

The architect is David G. MacConville, A.R.I.B.A., in collaboration with T. Noel Mitchell, B.Arch., F.R.I.B.A., Liverpool R.H.B. The consulting engineers are R. W. Gregory and Partners.

SAUDI ARABIAN CONTRACT FOR AMALGAMATED DEVELOPERS

AMALGAMATED DEVELOPERS announce that the first four shipments of British equipment destined for four new Saudi Arabian hospitals have left this country. The hospitals are the new National Independent Hospital in Ryadh and three Ministry of Health Hospitals—the Maternity Hospital in Ryadh, the new Jezzan Hospital and the new El Rass Hospital.

The total of these contracts is £160,000 and it is believed that this is the first time that British manufacturers have been asked to equip completely Saudi Arabian hospitals. Previously, fulfilments were provided from America or Germany on a Continental Consortium. Amalgamated Developers got the contract because they offer the first complete mix "across the board" of kitchen equipment, gowns and linen, furniture, bedsteads, surgical instruments, X-ray equipment, etc.

Amalgamated Developers, of 17 Bedford Row, London, W.C.1, is a consortium of 70 British companies specialising in the design, construction and equipping of large buildings and industrial projects, with wide experience in supplying such units as complete hospitals on a "package-deal" basis.

LEEDS (GROUP B) H.M.C.

The 19th Annual Report of Leeds (Group B) refers to the period ending March, 1967.

Mental Sub-normality

Following regional consideration of the disposition of mentally sub-normal beds, the Management Committee was asked to make arrangements to receive at Meanwood Park Hospital, unstable and delinquent female patients. A similar unit for male patients was established elsewhere in the region. The main problem involved in this arrangement is one of staffing, as more supervision and more nursing care is obviously involved. It was also decided that in future, the care and follow up of mentally sub-normal patients suffering from tuberculosis should be undertaken within mentally sub-normal hospitals under the care of the appropriate psychiatrist backed by a consultant chest physician.

The policy of trying to make the hospital a more integrated part of the community by a better understanding on the part of people generally was pursued.

Cardio Thoracic Services

The work of expansion in the surgical department at Killingbeck Hospital continued and the building of the second main theatre, complete with ancillary suites, was well advanced by the end of the year. This has been a particularly difficult building operation owing to the proximity of the new building to the existing operating theatres and the need to link them together. A partial closure of theatres had to be effected in February and March to enable inter-connecting doorways to be inserted and towards the end of the scheme a complete shutdown of all theatre work will have to take place.

At the same time, the planning of a new Intensive Care Unit was undertaken and a start on building operations for this project will follow on almost straight away after completion of the new theatre block to which it will be directly linked. Planning of the 50 bed medical block proceeded, the site for which is adjacent to Wards 1 and 2.

Gateforth Hospital continued to provide the main number of beds for medical chest cases from the Pontefract and Castleford areas and for post acute cases from Killingbeck Hospital.

Orthopaedic Services

The increasing number of babies being admitted to the Marguerite Hepton Hospital has produced a number of problems, the main ones concerned with feeding and educational activity.

A reorganisation of classes in the hospital school by the West Riding Education Authority left the babies' ward without supervision in respect of educational advancement. Various ideas for overcoming this problem have been pursued and it is hoped that the services of a Play Leader will eventually prove to be the best solution.

Paediatric Services

In June the paediatric ward at St. James's Hospital was closed following the plan of developments and an additional paediatric ward at Seacroft Hospital was opened. The admission arrangements for reception of medical acute cases were arranged on an alternate day, alternate weekend basis with the Leeds General Infirmary. The outstanding problem has been the question of children's acute surgery; such cases continue to be admitted to St. James's Hospital on the appropriate days in rotation with the General Infirmary.

A limited number of beds in the surgical unit were allocated for children's G.U. surgery and cases were admitted from October onwards.

E.N.T. Department

The work of this department at Seacroft Hospital has now become established and when staffing considerations have been agreed will become one of the main centres in the region for this type of work. A Registrar appointment was created and an additional Consultant post was recommended to the Ministry.

The waiting list for tonsil and adenoid cases remained basically unchanged but some progress was made in reducing the waiting list for other types of E.N.T. surgery.

Although a considerable amount of new equipment had been provided for the department the previous year in connection with the capital developments, it became evident that additional items would have to be estimated for future years to keep pace with the development of work in the department.

Geriatric Services

The long term planning arrangements in regard to geriatric beds continued to be discussed, particularly the adequacy of the ratio of beds to population as envisaged under the Hospital Development Plan.

The building of the rehabilitation block at St. George's Hospital was well advanced by the end of the year. This will enable day patients to be brought for special instruction as well as improved facilities for treatment of both in- and out-patients.

Technical Departments

The plans for the new Group Laboratory to be built on the Seacroft site have now been approved and the first phase of the work, i.e. to provide a new haematological department, will commence in December, 1967. The Respiratory Function Laboratory in the medical block at Killingbeck Hospital was completed and the staff were able to resume working in normal conditions again in the late summer.

The X-ray departments in the Group are now receiving detailed consideration from the point of view of radiation control following the setting up of the Regional Committee for implementation of the Code of Practice on Ionising Radiations. Visits were paid by the Regional Adviser to Seacroft Hospital in connection with the establishment of a second x-ray room and to Marguerite Hepton Hospital as a routine visit. Following the visit to the latter department, it was apparent that existing apparatus needed to be used with extreme care and to be replaced at the earliest opportunity.

A junior rapid processing unit was installed at the Leeds Chest Clinic and this has greatly facilitated the dark room

work though there have been problems with ensuring satisfactory ventilation. An Xomat processing unit was installed at Killingbeck Hospital. A second Xomat machine is to be provided in the Cardiological Investigation Unit.

The general condition of the Group Pharmacy remained unchanged though it was possible to add a small building to improve storage arrangements.

The new rehabilitation department at St. George's Hospital will greatly facilitate the work of the physiotherapists in the training of both geriatric in-patients and day patients but had not been completed by the end of the year.

At Marguerite Hepton Hospital the hydrotherapy pool has now had a new handrail fitted and the bath is in use continuously.

Maintenance Services

The provisions of the Clean Air Act and the extension of smoke control areas continues to affect plant considerations in the Group. As was reported last year, Meanwood Park and Crooked Acres Hospitals have been for some time within smoke controlled areas. Temporary provision had to be made to modify suitably the installations but consideration has been given, in conjunction with the Regional Hospital Board, to more satisfactory permanent arrangements.

At Crooked Acres Hospital, the installation of a central heating oil fired plant is under consideration, whilst at Meanwood Park Hospital, a proposal has been approved to eliminate the individual coke fired boilers which serve the Villas and departments. The plan is to provide seven oil fired boiler units which could be converted to gas at a later stage if this ultimately proved more economical. The main boiler plant serving the laundry and kitchen would remain as at present. St. George's and the Haigh Hospitals have now come within the smoke controlled areas and, at each, readjustment has had to be made. Eventually, at St. George's Hospital, it is intended that the whole of the heating and hot water services should be renewed, so that adequate heating on the wards can be given without recourse to solid fuel, apart from the main boilerhouse. At the Haigh Hospital, extensions of the oil fired plant to serve Ward 1 were made and gas fires installed in the administration block. The boilerhouse chimney at the Haigh Hospital was found to be defective and is having to be replaced.

As far as the mechanical plant was concerned, the main item undertaken was the replacement at Seacroft Hospital of the No. 2 economiser. A further phase of the rewiring programme at this hospital was also carried out. At Killingbeck Hospital, following a report by the British Oxygen Company, it was decided to install a liquid oxygen supply which could be piped as required through the hospital and installation was commenced in February.

The Group Fire Safety Officer made continuous inspections each month of the premises and gave lectures and demonstrations to staff. One unusual fire occurred in the Group Laundry in a hydro extractor through self ignition of damp dry clothes. Fortunately the fire was noticed before any serious consequences resulted.

Some new equipment was purchased, including a lathe for the fitters shop at Seacroft and St. George's Hospitals and a planing machine in the Group Joiners' Shop. At Gateforth Hospital, following a successful trail with one unit for regulating the coke feed into the boilers, all boilers have now been fitted with similar units.

Ancillary Services

The Group Laundry Manager was able to report by the end of the year that the hospital laundries were able to cope with an increased amount of work and so the number of articles being sent out for commercial laundering was reduced. Laundry work is sent out from Meanwood Park and Marguerite Hepton Hospitals. In reviewing the laundry services of the Group, the Committee decided in principle that the long term aim should be for the Meanwood Park Hospital laundry to be upgraded and for it to be run as a laundry, as it no longer played a significant part in the training of female patients at the hospital. Increased demands on the Seacroft Hospital laundry will occur through developments at Killingbeck Hospital and it is felt that with improved plant the capacity here could be increased to take on an additional load of 8,000 to 9,000 pieces per week.

Most of the kitchens in the Group had new or improved equipment during the year but no actual major alterations were made. A scheme for enlarging the kitchens and dining rooms at Killingbeck Hospital is now under active consideration and the Regional Catering Adviser has surveyed the areas involved.

SOUND EQUIPMENT AND AUDIO MODULES FOR MOORFIELDS EYE HOSPITAL

Elcom (Northampton) Ltd. announce that they have received an order for complete sound equipment and audio modules from the Institute of Ophthalmology.

This equipment includes Microphone Amplifiers, Type M501, and Line Amplifiers, Type M508, mounted in a 19 in. frame assembly. A complete three-channel sound mixer with quadrant fader will also be supplied.

NEW CENTRIFUGAL FAN CATALOGUES

Keith Blackman Ltd. have published a completely revised edition dealing with their established range of Keith and EK forward bladed centrifugal fans.

The catalogue covers all standard sizes up to 72 in. diameter and describes the EK fan for air conditioning and ventilation.

Keith Blackman also announce a completely revised edition of their "Aristocrat" centrifugal fan catalogue dealing with indirect driven fans with forward bladed impeller from 6 to 18 in. sizes. This range of fans is for clean air general ventilation applications where competitive first cost is of prime consideration.

POLYORC B P.V.C. PIPE FITTINGS BROCHURE

This publication gives full details of the range of injection-moulded or fabricated p.v.c. fittings available from Yorkshire Imperial Plastics Ltd. for use with "Polyorc B" p.v.c. pipe to B.S.3505 and B.S.3506. These lightweight, but high-strength fittings cater for almost all combinations of pipeline installation.

"Polyorc B" p.v.c. fittings are designed for a maximum working pressure of 173 lbf/in^2 at 20°C. For connecting p.v.c. pipes to cast-iron, copper or lead pipe work, union adaptors can be supplied.

Also included in the brochure are details of a range of p.v.c. and non-ferrous metal fittings specifically designed for small bore p.v.c. installations.

A review of new equipment and materials and their development

SCREW-DOWN GLOBE VALVES

The well proved range of screw-down globe valves manufactured by **Enots Ltd.**, the fluid engineers, for compressed air and hydraulics systems, has been rationalised and the larger units redesigned to achieve considerable reductions in cost. These valves are available in nine sizes to suit tubes having an outside diameter of from $\frac{3}{16}$ to $1\frac{1}{8}$ in.

Enots screw-down globe valves are of entirely non ferrous construction, having hot stamped brass bodies and handles, and bronze spindles sealed with one or two O-rings.

All-metal valve faces are employed on all the valves except the $1\frac{1}{8}$ in. unit, which has a PTFE face working against a metal seat to provide high resistance to a wide range of acids, alkalis and solvents over a wide temperature band.

The female tube terminations provided are designed to employ Enots solderless tube fittings which are available in great variety.

Although all these valves are designed primarily for base mounting, brackets are available to enable customers to panel mount valves in the $\frac{3}{16}$ to $\frac{1}{2}$ in. sizes.

A leaflet, freely available from Enots Ltd., Aston Brook Street, Birmingham 6, provides further data.

TEMPERATURE RECORDING IN A BOILER HOUSE

Particularly useful in providing a 24 hour or seven day paper chart recording of the temperature within an industrial boiler is the inexpensive Bikini Temperature Recorder produced by **Fielden Electronics Ltd.**, Manchester, 22. This recorder can effect economies in fuel consumption by using the recording to anticipate supply and demand, and manipulating the control valves to suit. Alternatively, when two fully adjustable control arms are fitted these can be set to predetermined high and low temperature levels to initiate the automatic control of valves when the recorded temperature rises to or falls below the set levels.

Recorders can be supplied to function from either thermocouples or resistance bulbs. With a thermocouple input, automatic cold junction compensation is included in the instrument.

Transistorised throughout, it presents a compact, maintenance free recording instrument which is easy to install, occupies the minimum of panel space (less than $\frac{1}{2}$ ft.^{2}), can operate with a considerable distance between itself and its sensing element, and is mains operated.

INDUSTRIAL POLYTHENE BUCKETS

KABI (Electrical & Plastics) Ltd., of Cranborne Road, Potters Bar, Herts., are now marketing, as part of their range, the Dohm industrial bucket.

Moulded in non-corrosive, toughened polythene, and resistant to most chemicals, it has many advantages. It is easy to clean as most contents (including plaster and cement) do not stick to polythene. Its resilience means that it will not damage paint work or floors and, at the same time, ensures its own freedom from damage over a long working life. It is silent in use, producing no metallic clatter.

Supplied in red, white or grey, the Dohm bucket has a capacity of $3\frac{1}{4}$ gallons, it weighs $2\frac{1}{2}$ lbs., and is priced at 10s. 6d.

NEW COLOUR CODED DRAWING PENCILS

L. & C. Hardtmuth, an associate of Eagle Pencil Co. Ltd., have introduced a unique drawing pencil that has different coloured dipped ends to indicate the degree of hardness.

In the past, a draughtsman using 3 or 4 different degrees of pencil on a drawing has had to read the actual printing on the pencil to choose the right one. Now, with the Hardtmuth Koh-I-Noor pencil, he can recognise the degree at once by the colour on the end. HB—for lettering—is dark brown, 2H—for general work—is dark green, 4H—for fine detail work—is yellow and so on.

Using a new resin bonding process, the makers have now virtually welded the lead into the wood, making it impossible for it to slip out. The lead formula has been improved to give a far stronger point.

There are 17 degrees—6B to 9H including F which is a particularly suitable degree for shorthand. Retail price 1s. each.

A NEW FLOORING—DUNLOP MODERNA

Dunlop Semtex Ltd. announce a new, unique floor covering, Dunlop Moderna.

This new product is a long length inlaid flooring available in six foot wide sheet. Whilst it has a high vinyl content and complies fully with BS.3261:1960, the price structure of Dunlop Moderna is such that it may possibly be the best value in the field of high vinyl floorings. It is available in ten colourways—five subtle shades of grey and five brightly contrasting colours.

Dunlop Moderna is available in sheet form only, 6 ft. (1,83 m.) wide and in a gauge of 0·080" (2,02 mm.). It has an impact sound reduction of 10–12 decibels (transmitted) and because it is a resilient flooring, it is said to resist strongly damage by surface loading or trafficking. A fully effective damp-proof membrane must be incorporated in direct to ground concrete subfloors. Due to its flexibility, Dunlop Moderna can be laid over normal level and smooth wooden sub-floors without expensive and elaborate preparation.

NEW TEMPERATURE REGULATOR

Sir W. H. Bailey & Co. Ltd. (incorporating Whites-Nunan Ltd.), members of the Yorkshire Imperial Metals Group, have now introduced their type G4T temperature control regulator as a logical extension to their existing type G4TP temperature/pressure control regulator.

The new unit, which is designed to control steam supply to equipment such as heating and hot water service calorifiers, feed water and unit heaters, radiant panels, heat exchangers,

kilns, curing ovens, etc., is available in bore sizes ranging from ½ in. to 2 in. (screwed or flanged bronze) for inlet pressures up to 250 lb./in.², and 2½ in. to 4 in. (flanged cast iron) for inlet pressures up to 190 lb./in.² The Bailey type G4T provides accurate temperature control throughout its operating range—a variation of only 5°F./3°C. being sufficient to move the valve from the fully open position to a tight shut off. Thus, under normal operating conditions, the regulator can modulate the steam supply within ±2½°F./1·5°C. of the set temperature.

The flow through the regulator is controlled by the position or lift of the main valve which forms part of the standard G4 main body, this valve being opened by inlet steam acting on top of a piston and closed by a spring loading. The actual steam pressure on the piston is governed by a pilot valve which is itself controlled by the position of a spindle attached to a thermal unit bellows.

A small bore capillary tube connects the bellows assembly to a sensing phial which contains a charge of pressure sensitive liquid, the phial being installed at the point of temperature control. A variation in temperature at the phial causes a corresponding variation in pressure within the bellows which then expand or contract, thus opening or closing the valve. The point at which the movement in the bellows takes place can be varied by altering the loading of the opposing spring by means of a notched ring.

It is entirely self actuating and does not require any external power source such as electricity or compressed air.

NEW PRESSURE SWITCH RANGE

Ward Brooke & Co. Ltd., members of the Norcros Group, Loudwater, Nr. High Wycombe, Bucks, announce a new range of pressure switches for industrial use.

Designated type 15/2, the switches can be fitted in any position and are available with interchangeable, screw-in sensing elements, permitting operation within any of eight pressure ranges from 0·25 to 5,000 lb./in.² Sensing elements are of the diaphragm, bellows or piston type, depending on the pressure range and application.

Type 15/2 switches are robustly constructed with hardened knife-edge bearing surfaces to minimise frictional errors and mechanical wear and are designed to give trouble-free operation for a minimum of 1 million cycles to a consistent accuracy with ±½% of the full scale. The units are capable of withstanding pressures of not less than 200% in excess of the rated full scale pressure, giving ample protection against surges. Restrictors can be fitted, if required, to cater for abnormal conditions.

Each unit is fitted with an approved type single pole, change-over micro switch, rated at 15 amps. at 125, 250 or 480V. a.c., ½ amp. at 125V. d.c. and ¼ amp. at 250V. d.c. If desired, a second similar switch can be accommodated in the unit housing for actuation by the same pressure sensing element. Both the actuation pressure and the differential between switch "make" and "break" are readily adjustable over wide pressure ranges. The actuation pressure adjustment screw is mounted externally for ease of access and the setting is indicated on an easily read scale. The differential adjustment screw is located within the housing to discourage tampering. A major feature is a switch position indicator which is incorporated to show when the switch is tripped. The aluminium die cast housing measures 3½ in. × 3½ in. × 2½ in.

Optional extras available include stainless steel bellows for use with corrosive fluids, heavy duty electrical switches, tamper-proof, explosion-proof and fire-proof enclosures and a selection of NEMA housings, including types 4, 7, 8, 9 and 12.

"INTEGRATED SERVICING"

Armitage Ware & Formica Ltd. have combined forces in a new venture to simplify the task of specifying and installing sanitary equipment. They are offering a prefabricated plumbing wall which will drastically reduce fabrication work on site.

The plumbing wall consists of Formica Beautyboard, accurately machined to accommodate Armitage sanitary fittings and all associated plumbing and fixings.

The Beautyboard panels can be faced with any Formica colour or pattern, including the British Standard Colour range, and delivered on site with holes ready drilled and fixings, such as catches, magnets, budget locks, gaskets, etc., in place ready for the final connection. In addition, Armitage Ware sanitary fittings, many of which are featured in the Ministry of Health compendium, are tested by compressed air to any required water pressure, before leaving the factory.

Plumbing, such as cisterns and other built-in equipment, is fixed into a duct space and plumbed in ready to receive the plumbing wall. In this way unsightly plumbing is entirely hidden although pipes are easily accessible for maintenance and servicing by means of the Formica Beautyboard access panels, which are either flush fitting, secret or face fixed.

NEW LABORATORY FURNITURE RANGE

Matthews & Yates Ltd. (incorporating Turner & Brown), of Bolton, Lancs., have produced a new, interchangeable range of laboratory furniture for use in laboratories. Known as the Turbo Cyclone laboratory furniture range, it has been specially designed and manufactured to comply with the latest hospital and university regulations, and has now been patented.

Benches can be made up to any length from a variety of modular units. For instance, one assembly has double cupboard and single cupboard units either side of a stool seating area. The central raised service unit, which divides the two working sides, is fitted with two water taps, two gas points and four electric points.

Drawers in the cupboards have a novel design which allows them to be reversed to serve as shelves. Removable nylon slides enable them to be positioned at any height or removed entirely where cupboard units only are required.

The use of preformed Warerite laminate tops makes them suitable for radio-active applications. Producing cheaper work tops than the teak equivalent, Warerite has the advantages of being easily wiped clean and a resistance to most known stains. Even concentrated acids spillage will leave no marks if wiped up quickly. The radiused upstand and dished surfaces which are produced by the preforming process, enable far more thorough wash-downs than do timber constructions with corners, and make the range particularly suitable for hospital applications.

NEW FULLY ADJUSTABLE PAKSHELF LIBRARY UNIT

A new cantilever library shelf unit, providing maximum stability and yet easy to erect or dismantle, has just been introduced by **Pakshelf, Ltd.**, Pakshelf House, Woodside

Road, Amersham, Bucks. Two models are available—a double-sided free-standing unit, and a single-sided unit for fixing to the wall. Both are styled on modern lines, and are of attractive appearance. Units—made to a standard width of 36 in.—are offered in heights of 36 in., 48 in., 60 in. and 72 in. All shelves are fully adjustable.

The new Pakshelf units can be used singly, or bolted together to give a continuous length of shelving. As no join lines are visible, a continuous run of shelving gives the appearance of a single unit.

A strong framework gives the unit great rigidity. It comprises two uprights, constructed in strong weld-free steel box section and reinforced with bracing bars top and bottom. The shelf support brackets are styled left-hand, right-hand and centre, while end-plates are fitted to retain books in position on the shelves. Metal plates can be fixed to the shelves to facilitate identification of books.

Adjustments in the height of shelves is effected simply by sliding the brackets up or down the uprights and securing with a locking screw. Adjustment is thus made without the need to dismantle the shelves.

Units have a free-standing metal base, with adjustable feet to compensate for uneven floor surfaces. Standard finish is black stove enamel, but other finishes can also be supplied.

NEW GREASING EQUIPMENT WITH DETACHABLE GUN

A new portable lubricator which is designed for working in conjunction with 28 lb. tins of grease, is to be marketed throughout the U.K. by **Lawrence Edwards & Co. (Engineers) Ltd.**, of Stourport Road, Kidderminster, Worcs.

The equipment consists of a hand-gun, connecting hose and housing fitment which incorporates a plunger.

Main feature of the equipment is its portability. The pistol-type gun can be disconnected from the supply line at a special leak-proof snap-coupling and will continue to operate for over 100 shots before the need for re-connecting. The gun operates at a pressure of 6,000 lb. per sq. in.

Method of operation is simple. The housing is put on top of the opened tin of grease and held by three thumb screws. The plunger is depressed with the air bleed open. After bleeding, it is tightly closed and the gun is ready for operation. Each plunger stroke gives approximately 100 shots at the gun.

Safety testing includes a pre-production pressure test on the hose to ensure that it will withstand over double the 6,000 lb. operating pressure. Also the gun is tested to withstand grease build-up without nozzle waste.

Known as the Lube-ette Major, it will cost £15 10s. carriage paid.

NEW CONTAINER FOR SOLID CARBON DIOXIDE

The Distillers Company (Carbon Dioxide) Ltd. are introducing a new insulated cylindrical container to hold four 25 lb. blocks of Cardice solid CO_2. The container will reduce evaporation losses to about 7% by weight per 24 hours and is being offered to those who will benefit from the greatly extended storage life made possible by efficient insulation.

The container has a diameter of 23 in., is 22 in. high and has a net weight of 25 lb. The outer casing and lid are manufactured of glass fibre reinforced plastic which has been selected to withstand extensive use. The lid is secured by three toggle action hinges and two handles are provided for lifting. The inner insulation jacket is made of an expanded plastic material, shaped to take four 25 lb. cylindrical blocks. Further information from Cedar House, 39 London Road, Reigate, Surrey.

THE COLUMBUS DIXON D.3 SCRUBBER-POLISHER

The **Columbus-Dixon** D.3 scrubber-polisher, with its wide range of attachments, can maintain any floor surface. Used as a polisher it waxes, burnishes and buffs: fitted with the Dixon scrubbing tank (capacity 2 gallons) it becomes a scrubber-polisher which can deep-shampoo carpets as well.

Once the machine is switched on and the two rubber-tyred wheels have been "trip-released", concentrated weight is automatically thrown forward onto the rotating brush. The 440 watts split-phase start motor, with crown wheel and pinion drive, is saddle-mounted directly above the head to ensure maximum power transference.

Attachments include 13" cleaning, waxing, burnishing, scrubbing and carpet shampooing brushes and a driving disc assembly for use with nylon buffing, scrubbing and stripping pads. Further information from Lancelot Road, Wembley, Middlesex.

(*Continued from page 120*)

The heating is generally by low pressure hot water radiators fed from the calorifiers. Where heater batteries are used, these are hot water in preference to steam heater batteries.

Ceiling heating is used in large areas, especially in psychiatric wards. This overcomes the danger to patients by hot pipes. Under-floor heating is used in the antenatal clinic, this was to overcome the difficulty of providing heating surfaces where an architectural feature provides floor to ceiling windows.

Domestic hot water is by standard pumped circulation. It is hoped, in future developments, to use spray taps in appropriate places in order to conserve water.

Fortunately, the cold water supply is of adequate pressure; this has saved expensive pumping equipment. Cold water storage tanks have been provided in the roof of the Stage 1 development. Mains pressure fire hydrants are provided around the site.

Ventilation ranges from normal extract fans to a complete air conditioning plant for the Operating Theatres.

Multi-purpose lifts have been provided in the Gynaecology Block and two goods lifts between the C.S.S.D. and the Operating Theatres. At this stage it has not been possible to provide a grade of lift service for goods and passengers.

Emergency electricity supply is provided by two 150 kW. Diesel generator sets, which are also arranged for Peak-load Lopping and can be run in parallel with the grid. There are facilities that, in the event of a power failure, the generators can back feed the 11,000 volt transformer at St. Woolos and, by means of the HT link cable, the Royal Gwent can be fed with an emergency supply.

Mr. Waite went on to discuss the various steps in the planning of a new hospital from the provisional brief up to final drawings, all of which have to be within the Ministry of Health cost guide.

Notes for Members

ELECTIONS TO MEMBERSHIP

Applications for membership have resulted in the following elections:

Members

AITKEN, A. M., Glasgow; Western Regional Hospital Board.
CLARK, N., Umtali, Rhodesia; Department of Works, Government of Rhodesia.
COLLINS, N., Preston; Building Design Partnership.
DAVENPORT, E., Manchester; Saunders & Taylor Ltd.
EDWARDS, L. A., Banbury; L. A. Edwards & Partners.
MASON, A. D., Bradford; Bradford 'B' H.M.C.
MCKNIGHT, R., Kilmarnock; Northern Ayrshires Hospitals B.O.M.
MORRIS, J. E., Aberystwyth; Mid-Wales H.M.C.
MUNRO, R. R., Vacoas, Mauritius; Ministry of Public Buildings & Works, Mauritius.
RICHARDS, D. T., London; Brian Colquhoun & Partners.
RUSSELL, T., Salisbury, Rhodesia; Department of Works, Government of Rhodesia.
SOLOYE, O., Ibadan, Nigeria; University College Hospital, Ibadan.
STANFIELD, G. N., Nottingham; G. N. & W. Stanfield.
TAYLOR, J. L., Montrose; Sunnyside Royal Hospital B.O.M.
TERRY, T. H. J., Glasgow; Western Regional Hospital Board.
WALTON, S. V., Bristol; Hoare Lee & Partners.

Upgraded to Member

SCOTT, G., Ashington; St. Mary's H.M.C.

Associate Members

ADAMS, P. G., Bristol; Frenchay & Cossham H.M.C.
AYLING, P. J., London; St. Pancras Hospital.
BARBER, R., Manchester; Saunders & Taylor Ltd.
BARTON, J. O., Wroughton; Dewsey H.M.C.
BROADBENT, A., Smethwick; West Bromwich H.M.C.
BROOKES, B. J. E., Kampala, Uganda; Ministry of Health, Government of Uganda.
HEATLEY, E. R., Cardiff; United Cardiff Hospitals.
HOLMES, P. L., Leeds; Pashler & Partners.
LEE, J., Derby; Derby No. 1. Group H.M.C.
MANTON, H., Ramsgate; Isle of Thanet H.M.C.
MILLINGTON, B., Chesterfield; Chesterfield H.M.C.
NUTTALL, E. D., West Bromwich; West Bromwich H.M.C.
PAVITT, W. E., London; Kings College Hospital.
PENGELLY, H. F., Plymouth; Plymouth & District H.M.C.
PITT, J. L., Plymouth; Plymouth & District H.M.C.
SCOTT, D. F. E., Ramsgate; Isle of Thanet H.M.C.
SCOTT, W., Guisborough; South Teeside H.M.C.

Graduates

AITCHESON, G. M., Wigan; Wigan & Leigh H.M.C.
DAVIS, J. C., Louth; Grimsby H.M.C.
HOBSON, D. F. H., London; Royal Dental Hospital.
KENNETT, A. T., West Bromwich; West Bromwich H.M.C.
ROSE, J. C., Barnet; Barnet Group H.M.C.
SIVITER, R., West Bromwich; West Bromwich H.M.C.

Student

TOWNEND, A. R., Harrogate; Leeds Regional Hospital Board.

Associate

WRIGHT, D., Wakefield; Spur Inman Ltd.

Affiliate Members

B.K.R. ASBESTOS & ENGINEERING LTD., Nottingham; Asbestos & Engineering Consultants.
WANDSWORTH ELECTRICAL MANUFACTURING CO. LTD., Woking; Manufacturers of Electrical Equipment.

ANNUAL GENERAL MEETING

The Annual General Meeting of the Institute of Hospital Engineering was held at the Bonnington Hotel, Southampton Row, London, W.C.1 on 22nd April, 1968. The President, *L. G. Northcroft, O.B.E., took the Chair.*

In accordance with the Articles of Association, all Members of Council retired at this meeting.

The Institute is fortunate, indeed, in that Mr. Northcroft has consented to continue in office for a further term.

A this meeting, the results of the ballots for seats on Council were announced. The composition of the new Council is:

President: L. G. Northcroft, O.B.E.

Nominated members: K. J. Eatwell, G. S. Gillard, B. A. Hermon.

General members: H. A. Adams, M.B.E., K. W. Ashton, M. J. M. Bosley.

Area members. England: K. C. Magee, M.B.E. (London and Eastern Counties); D. H. Mellows (East Midlands, Lancashire, North East and Yorkshire); R. G. Smith (Midlands, Southern and South West). *Northern Ireland:* R. Luke. *Scotland:* D. C. Nicolson. *Wales:* V. Riley.

Mr. H. A. Adams expressed the thanks of Council, and of the Members, to the President, for all that he had done during the last twelve months and expressed everyone's pleasure that Mr. Northcroft had agreed to continue as President for a futher year.

Mr. Adams also spoke of the debt due to Messrs. A. C. Barr, H. Fothergill and J. D. Lewis, the retiring members of Council, for all their sterling work over the years.

BRANCH OFFICERS

Elections of Branch Officers have resulted as follows:—

LONDON:

Chairman: E. Peck

Vice-Chairman: R. S. Adlington

Hon. Secretary: P. C. Vedast, 59 Oakfield Gardens, Edmonton, N.18

Hon. Treasurer: W. P. Lawrence.

MIDLANDS:

Chairman: E. F. Austin

Vice-Chairman: S. J. Williams

Hon. Secretary: H. R. Martin, 3, Churchill Road, Hasbury, Halesowen, Worcs.

MID-SCOTLAND:

Chairman: W. Ewing

Vice-Chairman: W. D. Campbell

Hon. Secretary: A. R. Hunter, Schoolhouse, Lethnot, by Brechin, Angus.

NORTH EAST:

Chairman: G. C. Elliott

Vice-Chairman: W. J. Mitchinson

Hon. Secretary: C. R. A. Meyer, 23, Green Acres, Kirkhill, Morpeth, Northumberland.

SOUTHERN:

Chairman: W. J. A. Whiffen

Vice-Chairman: L. R. F. House

Hon. Secretary: J. Finney, 73, Torrington Road, North End, Portsmouth.

SOUTH WEST:

Chairman: F. W. Ilett

Vice-Chairman:

Hon. Secretary: F. P. Smeardon, 27, South Hayes, Eastville, Bristol, 5.

Hon. Treasurer: A. S. Peterson.

WELSH:

Chairman: H. F. H. Dolling

Vice-Chairman: C. R. Davies

Hon. Secretary: P. Jackson, 'Roundway', University Hospital of Wales, The Heath, Cardiff. (F4 4XT).

Hon. Treasurer: N. Coy.

YORKSHIRE:

Chairman: F. K. M. O'Rourke

Hon. Secretary: D. Goldthorpe, 57, Hyman Court, Towngate, Ossett, Yorks.

Hon. Treasurer: A. Duffield.

GLASGOW & WEST OF SCOTLAND:

Chairman: C. Hunter

Vice-Chairman: D. Moir

Hon. Secretary: J. Cadenhead, 5, Glen Lee, St. Leonards 1/2, East Kilbride.

Hon. Treasurer: R. Urquhart.

NATIONAL QUALIFICATION AND TITLE FOR THE NON-CHARTERED ENGINEER

As forecast in February this year, a committee "to consider all matters relating to the introduction and establishment of a National Qualification and Title for the non-chartered engineer (a name to be determined)", had its first meeting at the Council of Engineering Institutions on Tuesday, 14th May, 1968.

The non-chartered engineer referred to is that person defined by EUSEC (Conference of Engineering Societies of Western Europe and the United States of America), as the "engineering technician". However, an acceptable title for this person needs to be found both for use in the U.K. and in Europe.

The Committee, independent and self-financing, has now formally constituted itself and elected Mr. R. Gresham Cooke, M.P. as Chairman. Mr. Gresham Cooke is the Member for Twickenham and a former President of the Institute of Road Transport Engineers.

Sub-Committees, for qualification under the Chairmanship of Mr. D. C. Nutting, Institute of Measurement and Control, and for membership under the Chairmanship of Mr. N. H. Arnold, the National Register of Engineer Surveyors, were appointed.

The Institute of Hospital Engineering is pleased that it has representation on this Committee.

FIVE BRANCH MEETING, OXFORD

A meeting of the five Branches, Midlands, London, East Anglia, Southern and West of England, was organised by the Midlands Branch at the Radcliffe Infirmary, Oxford, on 4th May, 1968.

The meeting was attended by 40 members, who saw two films and listened to two papers which were followed by discussion. Time was allowed in the programme for friends and colleagues in different parts of the country to meet and discuss old times.

Members are indebted to the Board of Governors of the United Oxford Hospitals for making the Radcliffe Infirmary available and for providing such excellent catering facilities.

The programme was as follows:

1130 a.m. Film: "External Cardiac Massage."

This film is particularly interesting in two respects:

(1) With regards to treatment of people for Electric Shock.

(2) It also gives an insight into the need for urgency when treating Cardiac Arrest.

2 p.m. Two Technical Papers:

(1) "Atomic Energy—A further Review" by R. M. Longstaff, Industrial Liaison Officer, United Kingdom Atomic Energy Authority.

(2) "Selling Maintenance" by M. Jarman, M.A., C.Eng., A.M.I.C.E., A.M.I.Mech.E.

LONDON BRANCH

A meeting of the London Branch on 2nd March, 1968 was held at the Westminster Hospital Medical School.

Mr. H. Clarke and Mr. H. Mathieson gave a paper, with films, entitled Natural Gas and the Engineer. The first film detailed the work involved in obtaining and distributing natural gas from the North Sea fields, the second illustrated the task undertaken in converting the whole of the Canvey Island area to natural gas distribution.

The speakers then elaborated on the complexities of changing from town to natural gas, and offered advice on the various courses to be pursued when the various areas came to be converted.

Considerable information on quantities available, distribution and operating pressures, calorific values, etc. were given, together with indications of the large sums to be spent over the next ten years in improved distribution and conversion.

At the close of the meeting, Mr. Turner spoke of the sterling service rendered to the Branch over several years by Mr. Adlington, the retiring Chairman.

EAST MIDLANDS BRANCH

A meeting of the East Midlands Branch was held at Nottingham General Hospital on 9th March, 1968.

Aided by a film, a talk was given to the meeting by Messrs. Boak and Bonsall of Yorkshire Imperial Metals Ltd on Copper for plastic tubing. Mr. Boak mentioned the price factor of copper today, and the reasons for manufacturing three grades of copper tubing, i.e. Class 1, Class 3 and Y.T.W. to BSS 659.

A lively discussion followed.

Later, under "Business" matters, a long discussion took place on Fire Officers' duties. It was agreed by most members that these were the responsibility of the Hospital Engineer and his assistant and they should be covered by a suitable allowance.

SOUTHERN BRANCH

The 127th meeting was held in the New Maternity Department of Saint Mary's General Hospital, Portsmouth on Saturday, 16th March, 1968.

Mr. W. A. J. Whiffen opened the proceedings by introducing the speaker, J. E. Snelgar, B.Sc.

Mr. Snelgar is the Physicist attached to the Radiotherapy Dept. of Saint Mary's General Hospital, Portsmouth and his paper was on the Construction, working and method of application of the various types of equipment used in the treatment of Malignant Diseases, with special reference to the safety precautions, both for patients and staff, incorporated in the equipment and the building housing this equipment. His talk was illustrated with diagrams showing how the various types of X-rays are produced and directed as required. He covered the years from the time of small sets of 40-60 KV up to the present era of Multi-Million KV machines of the "Orbitron" and "Betatron" types.

After a period of question and answer, the audience was conducted to the Treatment Rooms of the Radiotherapy Department where Mr. Snelgar explained and operated the various machines. The "Orbitron", with its cobalt power source, proved of great interest and everyone was most impressed to see how it was used and how the Cobalt power could be focussed on to whatever position was desired and to whatever depth of penetration. The necessity to harness this great power was emphasised and the lead housing and method of construction, and the way the Cobalt was brought into operation from "Safe", was fully explained. Safety precautions for patients and staff for power of this magnitude necessitated the provision of 3ft. thick concrete walls, heavy lead lined sliding doors and a smoke detector fire alarm system with an ultra sensitive detector head with remote alarms. The lead lined doors incorporated a further safeguard in that if they were inadvertently opened during treatment the power was automatically switched off and the Cobalt returned to the "Safe" position. The operator also has the patient in view at all times through a special reinforced window and can also converse via a two-way transistorised speaker unit.

Mr. Snelgar concluded his demonstration by showing the Hyperbaric Oxygen Chamber and explaining how patients were treated whilst in this pressurised vessel. There were many questions asked, particularly on the safety aspect of the various items and, at the conclusion, Mr. Snelgar was warmly thanked for a very interesting and instructive session.

On being appointed to the Chair, Mr. W. A. J. Whiffen spoke in praise of the work done by the retiring Chairman, Mr. W. Hendry, over a period of years both as Secretary of the Branch and then as Chairman. He has been unswerving in his efforts to further the cause of the I.H.E. and had been a real asset to the Branch during his years in Office and especially two years ago when the I.H.E. Annual Conference was held in Portsmouth. A further tribute to his capacity for hard work had latterly been paid to him by the Institute of Plant Engineers who had made him a fellow of the Institute, an honour well deserved. Mr. E. C. Rogers seconded the Chairman's remarks which were endorsed by all present.

WELSH BRANCH

A meeting was held at St. Woolos Hospital, Newport, on 23rd March, 1968.

Mr. J. G. Morgan introduced Mr. F. V. Waite from the Regional Engineer's Department, Welsh Hospital Board.

Mr. Waite opened his talk by pointing out that the design staff are always striving to improve the design of future hospitals by the study of design notes issued by the Ministry of Health, by inspecting installations that have been completed and by referring to the feed back information from engineers in the field.

The Newport Hospital complex consists of the Royal Gwent Hospital and the St. Woolos Hospital. Except for the Boiler House on the St. Woolos site and the recently completed Stage 1 Buildings on the Royal Gwent site both sites will be completely redeveloped. There are considerable difficulties in rebuilding a hospital on an existing site because of the need to keep the hospital in full use. When the development is complete there will be a District Hospital of 700-800 beds on the Royal Gwent site and a 200-300 bedded hospital on the St. Woolos site.

With the aid of drawings Mr. Waite described the lay-out of the energy distribution on both sites. There is a walkway duct between the two sites. The heat distribution is by steam, feeding to local and central calorifiers for heating and domestic hot water supplies.

The electricity supply is taken at 11,000 volts at the St. Woolos Sub Station. There are now two separate incoming supplies from the Electricity Board, and each supply is fed from a different ring main. The St. Woolos Sub Station provides for transforming down to 415 volts to feed St. Woolos Hospital but the distribution between the St. Woolos Sub Station to the Royal Gwent is at 11,000 volts where it again is transformed down to 415 volts.

The existing boiler house which replaced the two original boiler houses is fitted with three Richardson Westgarth Economic oil fired boilers, each rated at 17.500 lbs/hr. There is also provision for a fourth boiler to be installed in future stages of development.

The Laundry is on a restricted site and is nearing the end of its economic life. The development of the laundry services will therefore be a difficult problem and meanwhile minor capital developments will be carried out to cope with any increased load.

The Central Sterile Supply Department is a new department located under the Theatre Block of Stage 1 development on the Royal Gwent Site.

The kitchen is designed to provide 1,500 main meals, although not all the equipment has been provided at Stage 1. The food distribution is by bulk food to the wards and a cafeteria for the staff. A central wash-up provides for the washing of all crockery except that required for hot beverages.

At present, the steam is raised to 100 lb/sq. in., but there are provisions for this to be raised to 120 lb/sq. in. Steam is distributed to calorifiers at boiler pressure and the provision of reducing valves at local points provides the low pressure steam for cooking equipment, sterilizers, etc.

("*Notes for Members*" *is continued at the foot of page 116*)

Published for The Institute of Hospital Engineering by John Marchant Publications, Ltd.
Printed by The Hillingdon Press (King & Hutchings Ltd.), Uxbridge, Middlesex.

SITUATIONS VACANT

ST. JAMES' HOSPITAL MANAGEMENT COMMITTEE PORTSMOUTH

Applications are invited for the post of HOSPITAL ENGINEER at St. James' Hospital, Portsmouth (950 psychiatric beds) which will become vacant on 1st October, 1968, following retirement of present holder. Candidates must have a sound knowledge of steam-raising plant, heating and domestic hot water services; have served an apprenticeship in mechanical or electrical engineering and possess:—

(a) 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

(b) 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

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

The successful candidate will be directly responsible to the Group Engineer for the engineering services. A semi-detached house is available within the hospital estate. Salary scale £1,270 p.a. rising by annual increments to £1,500 p.a. plus a special units responsibility allowance of £25 p.a.

For application forms and further details please apply to the Group Secretary, St. James' Hospital, Portsmouth.

WYVERN HOSPITAL MANAGEMENT COMMITTEE BRADWELL GROVE AND COTSHILL HOSPITALS

Applications are invited for the post of HOSPITAL ENGINEER at Bradwell Grove Hospital, Burford and Cotshill Hospital, Chipping Norton.

These two Hospitals have a combined bed complement of approximately 500 beds for the care and treatment of mentally sub-normal patients.

Applicants must have a sound knowledge of the principles and practice of the efficient operation of solid fuel and oil-fired boiler plants, have a wide experience of mechanical and electrical engineering services and should hold one of the following qualifications or an equivalent qualification approved by the Minister of Health:—

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

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

(3) Ministry of Transport First Class Certificate of Competency if it includes an Ordinary National Diploma or Ordinary Certificate.

Salary (qualified applicants) £1,192 rising by annual increments to a maximum of £1,400 per annum, plus an allowance of £25 per annum for special responsibilities. From the 1st September, 1968 the salary will be £1,270 rising by annual increments to a maximum of £1,500 per annum. The salary scale for candidates not so qualified will be abated by £150 per annum.

A three bed-roomed house situated within a reasonable distance of Bradwell Grove Hospital will be made available for rental if required.

Applications giving age, full details of qualifications and experience, together with names of two referees, to the Secretary, Wyvern Hospital Management Committee, Burderop Hospital, Wroughton, Swindon, Wilts., to be received by the 7th July 1968.

PETERBOROUGH AND STAMFORD HOSPITAL MANAGEMENT COMMITTEE

STAMFORD AND RUTLAND HOSPITAL

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

Stamford and Rutland Hospital, Stamford

St. George's Hospital, Stamford

Group Central Laundry, Stamford

Bourne Chest Hospital, Bourne

Bourne Butterfield Hospital, Bourne.

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

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

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

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

National Health Service Whitley Council Conditions of Service; present salary scale £1,192-£1,400 per annum. The scale will be increased to £1,270 to £1,500 on the 1st September, 1968. Special responsibility allowance will be paid.

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

TOTTENHAM GROUP HOSPITAL MANAGEMENT COMMITTEE

Second Advertisement

Applications are invited for the post of Hospital Engineer for The Prince of Wales's General Hospital, N.15, and other associated units.

Applicants should be suitably qualified in accordance with the terms of P.T.B. Circular 191. Salary £1,292 to £1,500 (£1,370 to £1,600 from 1st September, 1968) plus Long Hours Gratuity. The salary of an officer not holding an approved qualification is abated by £150 p.a.

Application forms and full particulars obtainable from The Group Secretary, Tottenham Group Hospital Management Committee, The Green, Tottenham, N.15.

ST. JOHN'S HOSPITAL, LONDON ROAD, LINCOLN

HOSPITAL ENGINEER

required at this psychiatric hospital with 1,174 beds. A large and developing area laundry is situated at the hospital. The post also includes supervisory responsibility for the Lawn Hospital, Lincoln, (129 beds).

Applicants should be familiar with planned maintenance procedures and must have had wide experience in the management of mechanical and electrical engineering plant and must hold the H.N.C. or H.N.D. in Mechanical or Electrical Engineering with appropriate endorsements or the City and Guilds Mechanical Engineering Technicians Full Technological Certificate.

Salary £1,279 to £1,492 (£1,370 to £1 605 with effect from 1st September, 1968) plus a special responsibilities allowance of £50.

The successful applicant will be expected to live within the hospital grounds and a house or single accommodation will be made available.

Detailed applications, naming two referees, to the Group Secretary, Lincoln Heath Hospital Management Committee, Group Headquarters, Cross O'Cliff Court, Bracebridge Heath, Lincoln, by 28th June, 1968.

SITE INSPECTORATE

ST. THOMAS' HOSPITAL, LONDON, S.E.1

Rebuilding of the hospital is continuing with a further stage at an approximate cost of £10 million. The engineering services comprise approximately 40 per cent of the contract. Work is expected to start early in 1969 and will run for about 5½ years.

Applications are invited for the following posts:—

(a) RESIDENTAL ELECTRICAL AND MECHANICAL ENGINEER.

Salary scale £2,010 to £2,355, including London weighting. Appointment to this post will be made as soon as possible after 1st July, 1968.

(b) DEPUTY RESIDENT ELECTRICAL ENGINEER AND DEPUTY RESIDENT MECHANICAL ENGINEER.

Salary scale £1,765 to £2,095, including London weighting. Appointments to these posts will be made as soon as possible after 1st October, 1968.

Closing date for applications to all of these posts is 19th July, 1968.

Applicants to all of these posts should have served an apprenticeship in mechanical and electrical engineering and should hold the O.N.C. in mechanical or electrical engineering and have had at least five years experience as a site supervisor for engineering services of large buildings.

Further details and application forms may be obtained from the Personnel Officer

ROYAL BUCKINGHAMSHIRE AND ASSOCIATED HOSPITALS MANAGEMENT COMMITTEE

GROUP ENGINEER

required for this group of eight hospitals. Candidates should be qualified in accordance with P.T.B. Circular 191 and should have a wide practical experience in the management of mechanical and electrical engineering plant, preferably in the Hospital service.

Salary Scale £1,731 to £2,045 (From 1st September, 1968 £1,850 to £2,180) plus special responsibilities allowance, at present £125 per annum.

Further particulars from Secretary, 9, Bicester Road, Aylesbury, to whom applications stating age, qualifications, posts held (with dates) and names of three referees should be sent.

DERBY AREA No. 4 HOSPITAL MANAGEMENT COMMITTEE

KINGSWAY HOSPITAL, DERBY

Applications are invited for the post of Hospital Engineer at the above hospital. The successful candidate will be directly responsible to the Group Engineer for the operation and maintenance of all engineering services at this hospital. Candidates must have completed an apprenticeship in mechanical or electrical engineering and should possess one of the following qualifications or an equivalent approved by the Ministry of Health:—

(a) City and Guilds Technicians Certificate (Part II) which must include Plant Maintenance and Works Service.

(b) City and Guilds Certificate in Plant Maintenance.

(c) Ministry of Transport First Class Certificate of Competency if it includes an O.N.C. or O.N.D. Certificate.

Salary Scale £1,192 to £1,400 (£1,270 to £1,500 with effect from 1st September, 1968) plus a special responsibility allowance of £50 per annum.

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

A house is available at a reasonable rent.

Applications stating age, qualifications, experience and the names and addresses of three referees should be sent to the Group Secretary at the above hospital to be received not later than Saturday, 29th June, 1968.

HILLINGDON GROUP HOSPITAL MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER (over 24½ points) required.

Applicants must have completed an apprenticeship in mechanical or electrical engineering or have otherwise acquired a thorough practical training, be experienced in management of mechanical and electrical engineering plant similar to that of modern hospitals, in control and deployment of maintenance and operational staff, and in preparation of maintenance estimates and reports, and in carrying out directly or by contract small works of engineering construction or renewel.

Applicants should have: H.N.C. or H.N.D. in Electrical or Mechanical Engineering (preferably electrical) with appropriate endorsement in mechanical or electrical engineering, and also preferably with endorsement in Industrial Organisation and Management; or City and Guilds Mechanical Engineering Technicians Full Technological Certificate (Part III) which must include Plant Maintenance and Works Service.

Applications will be considered from persons with suitable experience who do not possess one of the full qualifications set out above.

Salary on scale commencing at £1,279 rising to maximum of £1,492 per annum plus allowance of £150 per annum for special responsibilities and London Weighting of £75 p.a. Salary scale increases to £1,370 rising to £1,605 on 1.9.68. The basic salary scale will be abated by £200 per annum at all points in the case of the appointment of an applicant not possessing the full qualifications.

Written applications with details of education, training, past experience and names and addresses of three referees to the Group Secretary, Hillingdon Hospital, Uxbridge, Middx. by 31st July 1968.

CHELMSFORD GROUP HOSPITAL MANAGEMENT COMMITTEE

Assistant Engineer required at St. Peter's Hospital, Maldon, Essex. Applicants must have completed an apprenticeship in Mechanical Engineering and should have a sound knowledge of the principles and practice of the operation of steam boiler plant and electrical services generally, and must hold an O.N.C. or equivalent qualification.

Salary £917 to £1,192 per annum (from 1st September, 1968, £975 to £1,270).

The person appointed will be responsible to the Group Engineer for the maintenance of services at the above Hospital.

Applications, stating age, present position, qualifications and experience, with names and addresses of two referees to Group Secretary, Chelmsford Group Hospital Management Committee, Bellefield, London Road, Chelmsford, Essex.

LEICESTER NO. 3 HOSPITAL MANAGEMENT COMMITTEE

GROUP ENGINEER

required for this Group of eight hospitals for the mentally ill and mentally subnormal totalling 1,742 beds.

The post, which becomes vacant from the 1st September, 1968, carries responsibility for the operation and co-ordination of the full range of mechanical and electrical services, including a Group Laundry.

Applicants must have had wide practical experience in the management of mechanical and electrical engineering plant and hold at least one of the following qualifications:

(i) H.N.C. or H.N.D. in Mechanical Engineering with endorsements in Industrial Organisation and Management and Principles of Electricity or Electro-Technology, if this was not taken as a subject of the course.

(ii) H.N.C. or H.N.D. 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 there has been suitable practical experience in mechanical engineering.

Conditions of service in accordance with the Whitley Councils for the Health Service. Salary: £1,650 x 55(4) x 60(1) - £1,930, plus responsibility allowance of £50 per annum.

The officer appointed will be required to reside within easy reach of the Towers Hospital and a semi-detached house is available if required on the hospital estate.

Applications, stating full details of posts held and qualifications, together with the names of three referees, to be sent to the Group Secretary, Leicester No. 3 Hospital Management Committee (from whom further particulars can be obtained on application), Towers Hospital, Humberstone, Leicester, LE5 OTD, before 15th July, 1968.

BROOKWOOD HOSPITAL, KNAPHILL, WOKING, SURREY

Applications are invited for the appointment of HOSPITAL ENGINEER in this single Hospital Group (1,705 beds).

The successful candidate will be directly responsible to the Group Engineer and will be required to act for him over the whole range of his duties during his absence.

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

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

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

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

Applications will be considered from suitably experienced Engineers not holding these qualifications.

Salary Scale: £1,279 to £1,492 per annum plus £50 per annum for special responsibility units. Salary to be abated by £200 p.a. if not in possession of approved qualifications.

Applications, giving details of age, training and qualifications, with names and addresses of three referees (one technical) to the Group Secretary at the above address not later than 30th June, 1968.

A house is available on the hospital estate at moderate rental.

PRESTON AND CHORLEY HOSPITAL MANAGEMENT COMMITTEE

DEPUTY GROUP ENGINEER

HOSPITAL ENGINEER

Applications are invited for the above vacancies due to promotion and major developments.

DEPUTY GROUP ENGINEER to act for Group Engineer over whole range of duties, including responsibility for operation, maintenance and co-ordination of all engineering services and activities.

Applicants must have an apprenticeship in Mechanical or Electrical Engineering or a thorough practical training and wide experience in management of mechanical and electrical engineering plant similar to that of modern hospitals employing up-to-date methods of maintenance planning; control and deployment of staff; preparation of maintenance estimates, reports; carrying out by direct labour or contract of minor capital works; a H.N.C. or H.N.D. in Mechanical Engineering, with endorsements in Industrial Organisation and Principles of Electricity or Electro-Technology; or H.N.C. or H.N.D. in Electrical Engineering with endorsements in Industrial Organisation and including (at S.III or O2 level, or with endorsement in) Applied Heat and Applied Mechanics, provided they have suitable practical experience in mechanical engineering; or City and Guilds Mechanical Engineering Technicians Full Technological Certificate (Part III) which must include Plant Maintenance and Works Service; or an approved equivalent qualification.

This post is particularly attractive, and it offers a wide range of engineering experience and good prospects. The Group comprises ten hospitals (1,459 beds) including two general hospitals covering a full range of specialties. An additional 145 beds, together with operating theatres are now being commissioned at Sharoe Green Hospital. In 1970, construction will begin of a large new hospital (1,100 beds) on the outskirts of Preston.

Salary scale £1,279-£1,492 over five increments plus special responsibility allowance £200 p.a., to be increased to £1,370-£1,605 from 1st September, 1968.

HOSPITAL ENGINEER, SHAROE GREEN HOSPITAL. Must possess the same qualifications as for above post.

This is a busy general hospital of 375 beds soon to be increased to 531 as part of the developments are brought into use.

Salary scale £1,192-£1,400 over five increments, plus special responsibility allowance of £75 p.a., to be increased to £1,270-£1,500 from 1st September, 1968.

Applications for both posts giving full personal details, qualifications, experience, and naming three referees, to Group Secretary, Royal Infirmary, Preston, PR1 6PS, Lancs., as soon as possible.

HULL (B) GROUP HOSPITAL MANAGEMENT COMMITTEE

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

Commencing salary £1,279 to £1,492 plus £125 special responsibility allowance. New scale from 1.9.68 £1,370-£1,605. Whitley Council Conditions of Service; superannuable post. Candidates must have served an apprenticeship in mechanical or electrical engineering and must possess:—

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

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

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

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

Application forms obtainable from Group Secretary, De la Pole Hospital, Willerby, Hull, to be returned by 3rd July.

LEEDS (A) GROUP HOSPITAL MANAGEMENT COMMITTEE

Applications are invited for the post of DEPUTY GROUP ENGINEER. The successful applicant will act as Hospital Engineer of St. James's Hospital, Leeds (1,354 beds) and be responsible to the Group Engineer, who is also based at the hospital. This is an attractive post as the hospital is going through a major redevelopment by the addition of modern buildings and associated engineering services. There is a wide range of plant and equipment and a system of planned preventive maintenance is being used on all work. Experience required in the management of mechanical and electrical engineering plant and in the control and deployment of staff. Candidates must have completed a recognised apprenticeship in mechanical or electrical engineering, and hold one of the following or equivalent qualifications:—

(1) 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.

(2) Higher National Certificate or Higher National Diploma in Electrical Engineering with endorsements in Industrial Organisation and Management, including Applied Heat and Applied Mechanics, provided he has suitable practical experience in mechanical engineering.

Salary Scale £1,279 to £1,492—i.e. Hospital Engineer 24½ points and over—plus £175 for special responsibility units as applies to the Group Engineer.

Applications stating age, qualifications, experience, together with the names of two referees, to be sent to the Group Secretary, Leeds (A) Group Hospital Management Committee, St. James's Hospital, Leeds, 9.

REDHILL AND NETHERNE GROUP H.M.C.

EARLSWOOD MOUNT, MOUNTVIEW DRIVE, REDHILL, SURREY.

ASSISTANT ENGINEER required at Netherne Hospital, Coulsdon, Surrey. Applicants must have completed an apprenticeship in mechanical or electrical engineering or otherwise acquired a thorough practical training and hold an Ordinary National Certificate in Engineering or a recognised equivalent qualification. Post offers good experience for an engineer willing to take up hospital engineering as a career. Commencing salary according to experience from £917 and rising to £1,192 *plus* £75 *London Weighting*.

Applications stating age, qualifications, training and experience with the names of two referees to Acting Group Secretary.

MISCELLANEOUS

Stethoscopes, Headphones and Pillowphones—For all Repairs and Accessories—Workshops for the Disabled, Northern Road, Cosham, Portsmouth. Telephone: Cosham 76533.

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

LEVELTEX

SCREEDING COMPOUND

is a means of levelling uneven surfaces, i.e., concrete, granolithic, floorboards, tiles, flagstones, brick-paving, etc., to receive floor-finishes such as linoleum, carpets, woodblock, parquet, cork-tiling, etc., with a minimum of thickness, and can be laid from $\frac{1}{16}$" to $\frac{1}{4}$" thickness and can be trowelled to a "feather-edge." Setting time is approximately 5-7 hours and hardening time 12-14 hours according to atmospheric conditions.

Used by many Hospitals throughout the country.

Write for particulars to:

TILE FLOORS
(INDUSTRIAL) LTD.
YEOMAN STREET, LONDON, S.E.8.
Telephone: Bermondsey 3237

nurse call? -cass call!

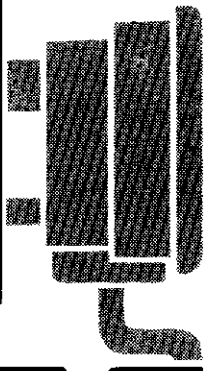
■ *Nurse Call* ■ *Patient Call* ■ *Radio and TV*
■ *Intercommunication* ■ *Wireless Staff Location*

CASSCALL now installed at:
Norfolk and Norwich New Maternity Unit.

For your new Nurse Call System – call in Cass.

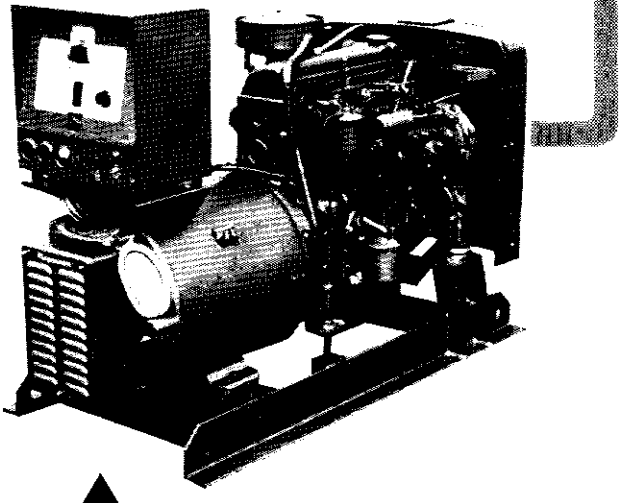
CASS ELECTRONICS LIMITED
Chertsey, Surrey. (Chertsey 3481).

In case of emergency plug in to



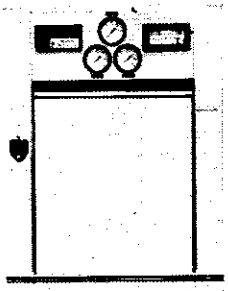
G&M SILENT STAND-BY POWER

The G & M Dieselite DEC and DEF series. Powerful diesel generating sets manufactured to the highest specification —reliable and extremely silent in operation—the finest stand-by power available for hospital use. The engine is the Ford 2701 and 2703 series coupled to a well proven magneciter alternator, resulting in a compact generating set of high power/weight ratio. Output from 25 to 56 K.V.A. all standard voltages available.



G&M POWER PLANT COMPANY LIMITED

MAGNET WORKS, WHITEHOUSE ROAD, IPSWICH, ENGLAND
Telephone: 41795 · Telex: 98216
Telegrams: Greenace, Ipswich



103 or 143

Hi-Speed Sterilizer for complete

safety

SAFETY through having a fully constrained sliding door, **SAFETY** through a built in air leak detecting device. **SAFETY** is the key word, the '103' and '143' are the safest sterilizers yet developed.
Let us send you details.

Manlove Alliott & Co Ltd
P.O.Box No. 81, Bloomsgrove Works, Nottingham
Telephone: Nottingham 75127 (3 lines)
Telegrams: Manloves, Nottingham
London Office: Warwick Road, Hampton Wick,
Kingston-upon-Thames, Surrey
Telephone: TEDdington Lock 3307-8