THE HOSPITAL ENGINEER

THE JOURNAL OF THE INSTITUTE OF HOSPITAL ENGINEERING

VOL XXII No 7
JULY 1968

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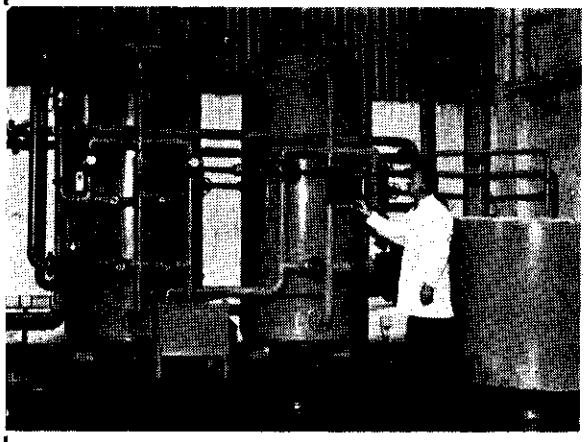

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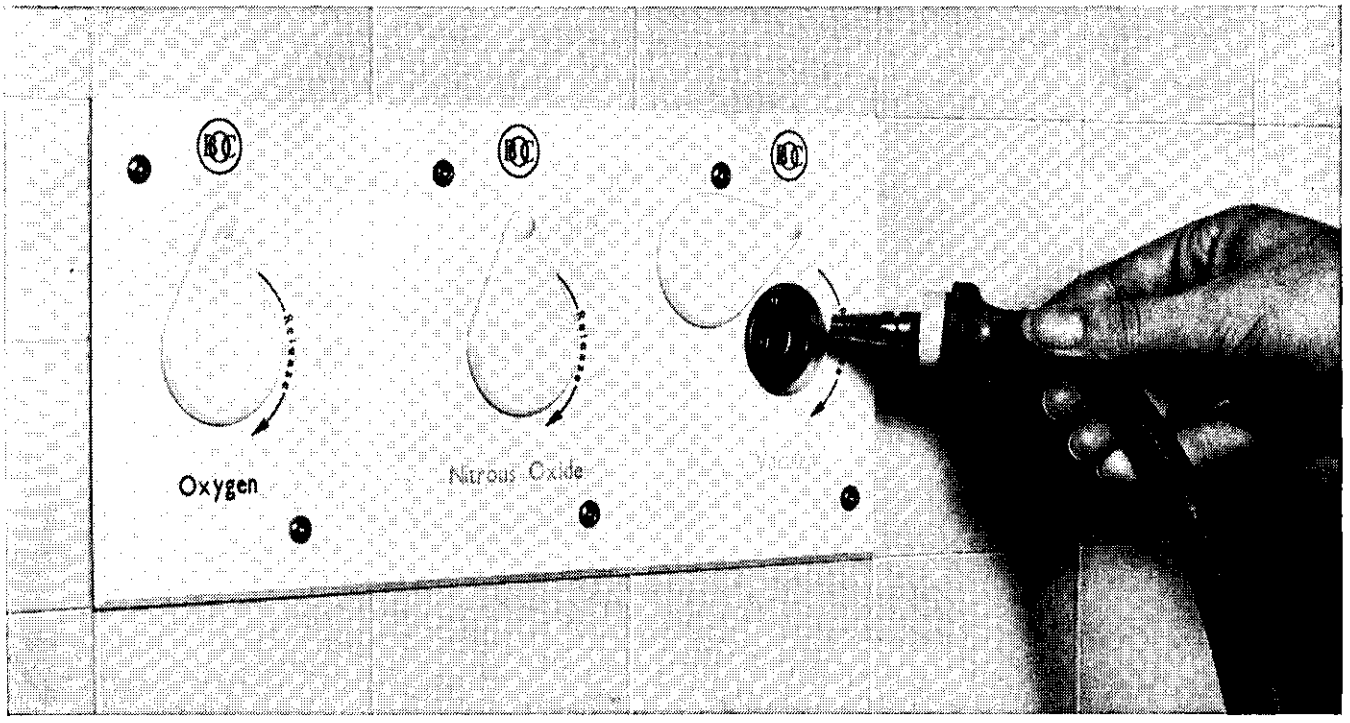

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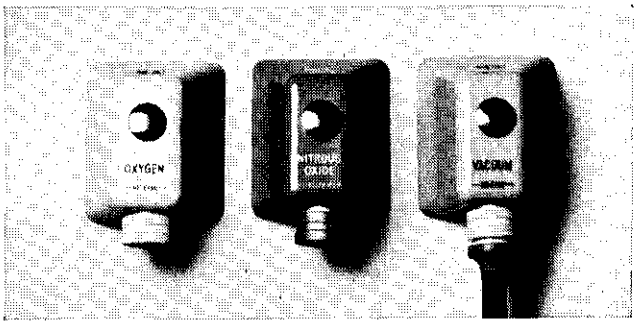

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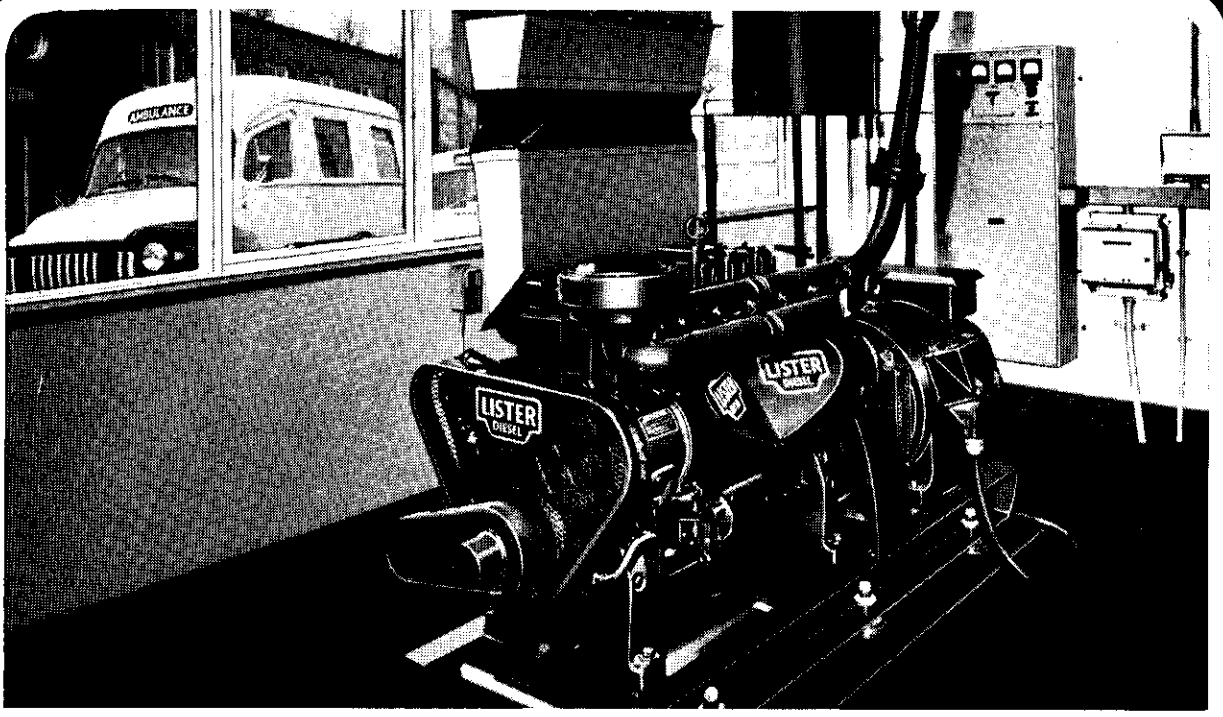

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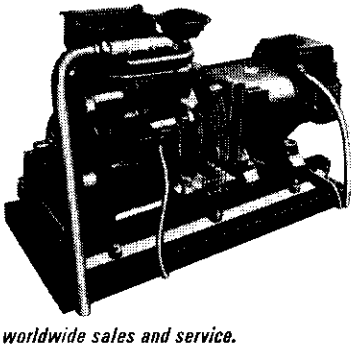

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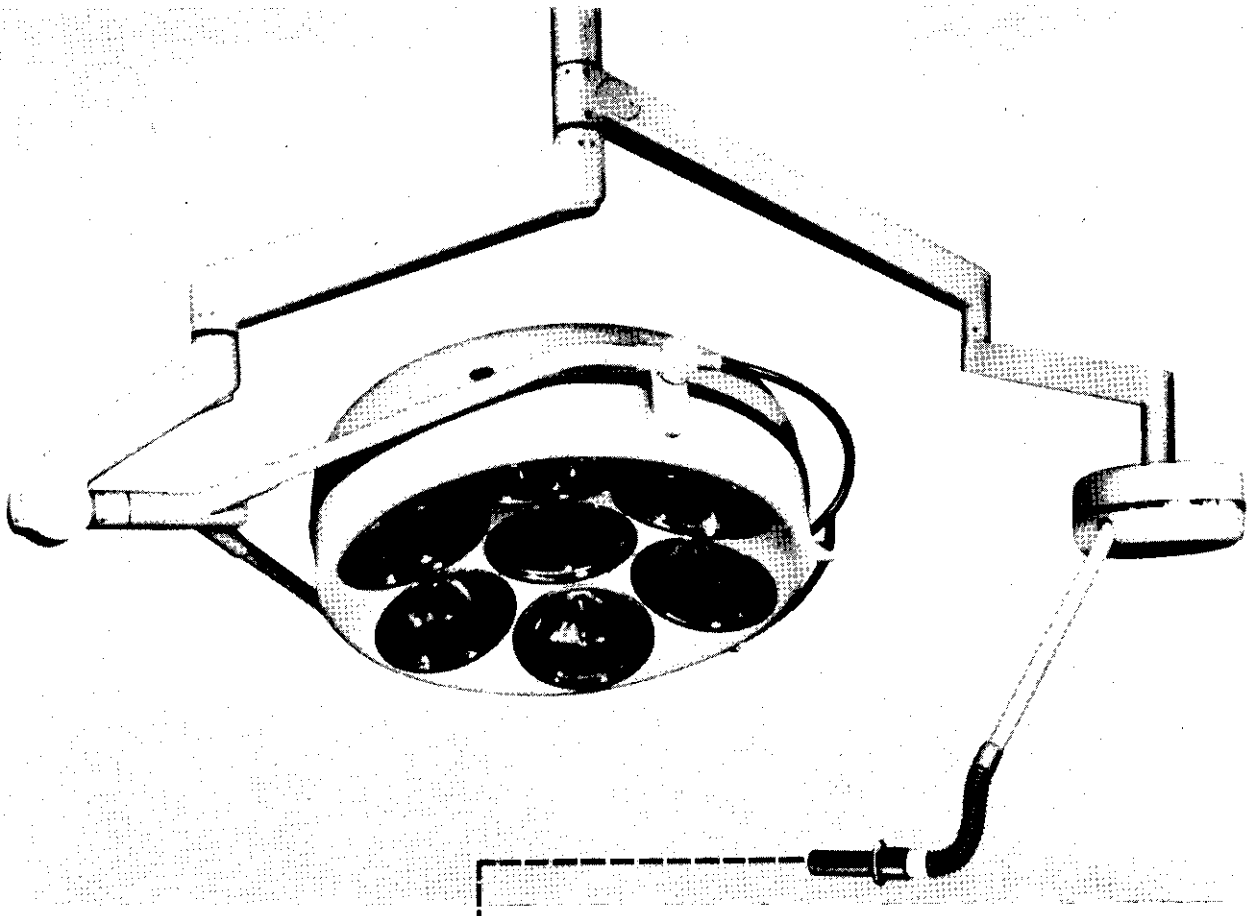

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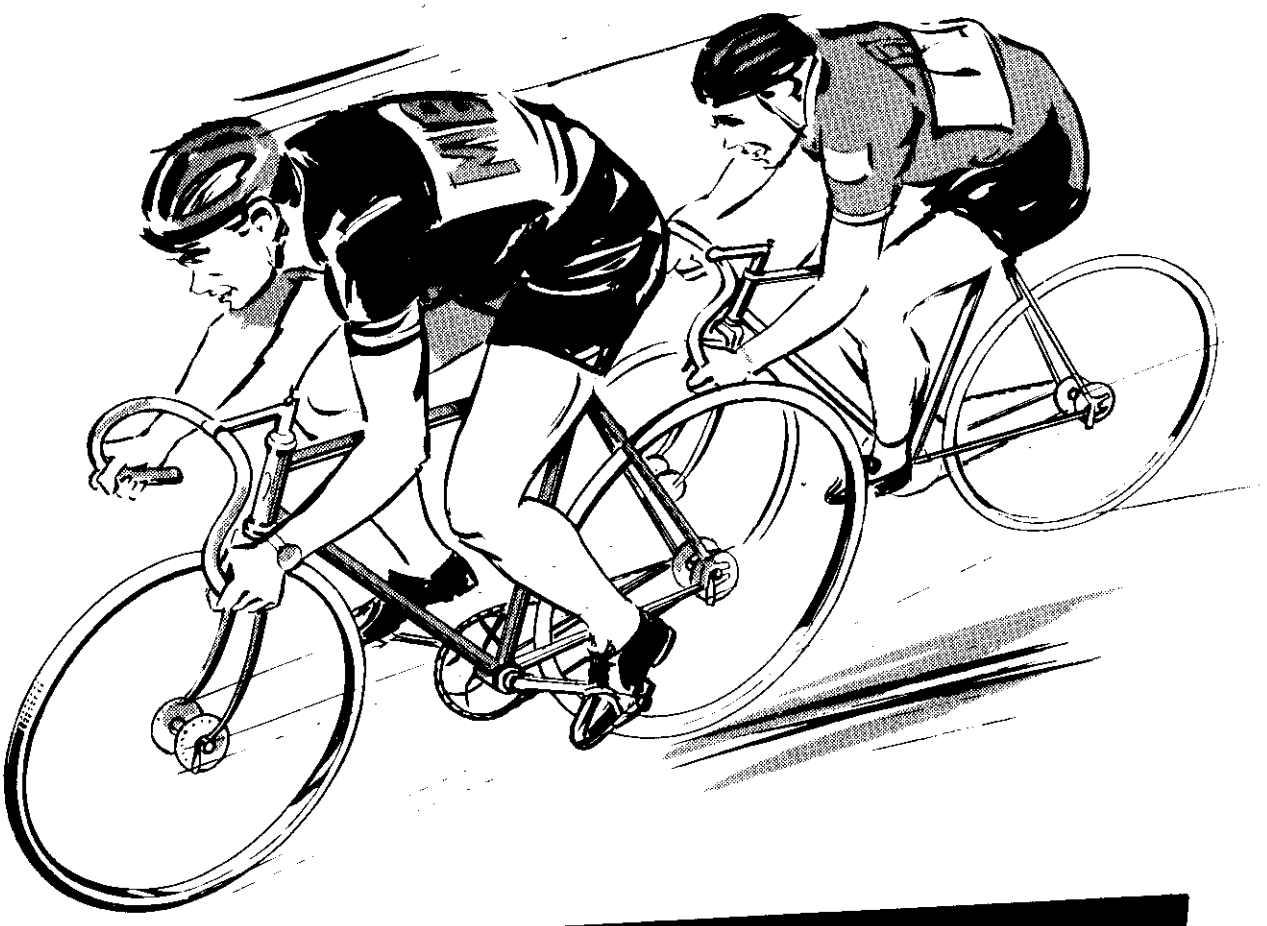

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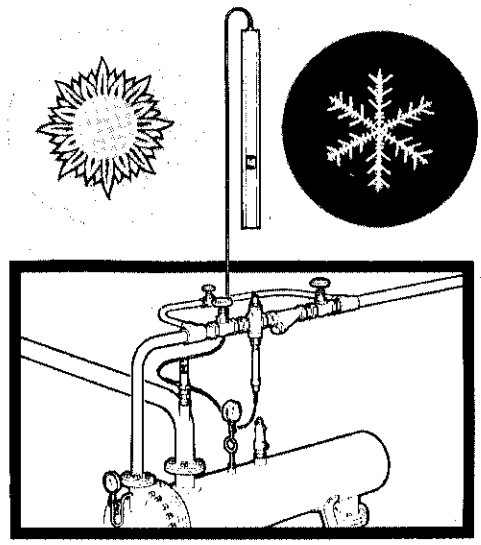

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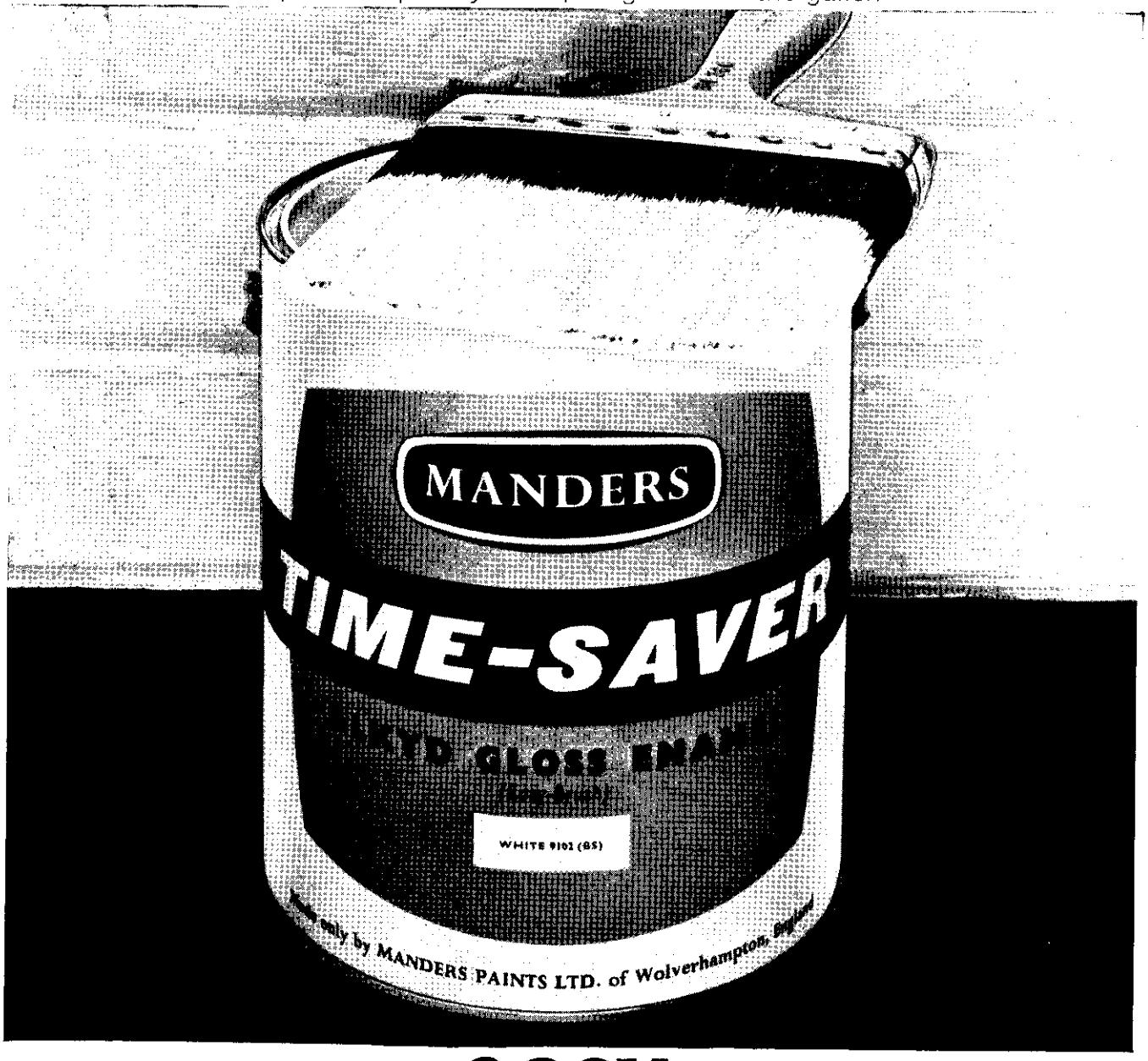

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Maintaining Heat Transfer in Hospital Heating and Air Conditioning Systems

By B. W. Downham, Managing Director, Aquastat Ltd.

Under the control of the Author, his Company has diversified its water engineering services from specialisation in scale prevention into corrosion and algae control, water softening de-ionisation, and portable water production for the export market.

ONE of the commonest causes of misunderstanding between ward staff and hospital engineers comes when there is insufficient hot water for scores of patients to bathe simultaneously or within a short time of each other. In some hospitals patients can get through 12,000 gallons of hot water in 20 minutes. The ward staff tend to expect hot water to be available as easily and as quickly as cold water, whilst the engineers themselves are only too conscious of the heavy demands made upon their heating plant, particularly by large wards served from individual calorifiers.

There are usually two basic problems: the first in maintaining the hot water supply at the required temperature; the second in achieving the minimum recovery time when hot water is used in volume.

Sometimes heating plant may simply be overloaded for the quantities of hot water demanded of it; sometimes older equipment just cannot cope with current operating loads. But in the main there is one single cause: calcium carbonate scale.

When water is heated, soluble salts precipitate and adhere to each other by a combination of polar attraction and physical interlocking. The adherence of these scale particles to metal surfaces is a physical process: fine grains permeate microscopic unevennesses or corrosion pits in the metal and build up as more particles precipitate and coalesce with their fellows.

Calorifiers

Under the punishing conditions of running hospital heating services, the scale problem is particularly troublesome around the calorifier coils, whether steam-to-water or water-to-water, and in many cases the pipework system itself can be affected, as well as auxiliary equipment such as tea boilers.

At Horton Hospital, Epsom, for instance, there are two 2-million BTU calorifiers and twenty smaller units. The water has a total hardness of 285 ppm with a carbonate hardness of 220 ppm and the steam supply is 70lbs psi or 302°F. The calorifiers, heating perhaps four-and-a-half million gallons of water a month, had to be cleaned about once a quarter. Cleaning each calorifier took two days.

Often, the tubes could not even be withdrawn from the calorifier shells because of the bulbous encrustation of rock-hard scale over the copper. Similar problems used to be experienced at Oakwood Hospital, Maidstone: batteries of 12-16 indented calorifier tubes used to scale up solid with half an inch of scale deposit after only 10 weeks running time. Again, at Glenside Hospital, Bristol, at one time a two-week acid soak was needed every three weeks because of the complaints about heat transfer even after just seven days of normal running. Here the tube ends were often three inches deep in scale and spare coils were an essential accessory.

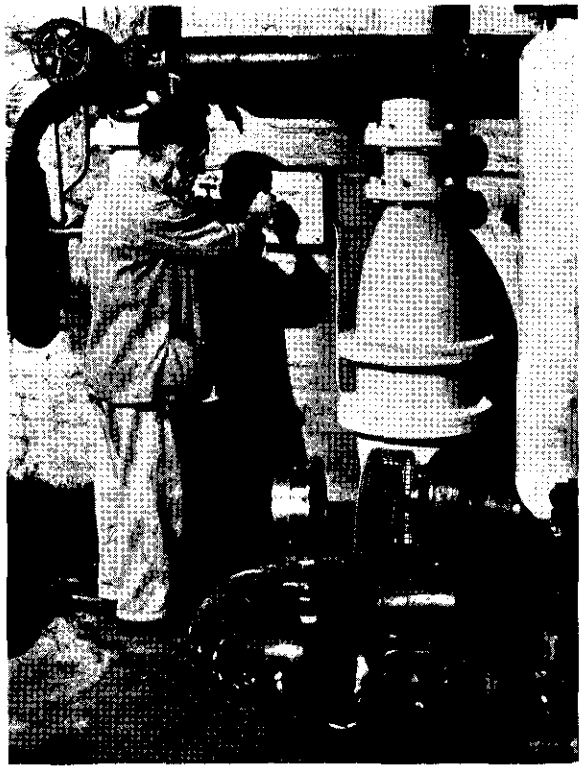

Fig. 1. The only maintenance the Aquastat requires is to check the control box setting. This is a 6in. process unit at Horton Hospital, Epsom with one of the calorifiers showing in the foreground.

It is obvious that, with this kind of scale problem, maintenance costs are going to be high if the hot water services are to be reliable.

Air conditioning

The scale problem is an old one for many hospitals. Others situated in softer water areas escape it, if not entirely, then at least as a significant problem for the Group Engineer. But as modern hospital buildings are built, perhaps only those in completely soft water areas may avoid meeting the problem of treating the water supply.

Refrigerant cooling for new air conditioning systems can be even more prone to scale than calorifiers, and there are more vulnerable points. Cooling water cascading over condenser tubes carrying the gaseous refrigerant is mechanically similar to the calorifier principle except that one is a cooling, the other a heating, process. The outsides, and particularly the tops, of the coils build up scale as heat transfer takes place from cooling water to refrigerant. Where the cooling water passes through the pipes, as in shell and tube condensers, the effect of precipitation can be even more severe, for the tubes are narrow in diameter and are prone to blockage. The cascade trays, compressor jackets and pumps are similarly vulnerable to scale damage.

Treatment groups

For both hot water wasting systems and recirculating cooling systems the methods of treating hard water to prevent scale divide into perhaps three main groups. First there is water softening, which by converting the scale salts into their sodium equivalents, removes the offending sources of scale. Second, there is the use of chemicals introduced into the water, probably by a dosing system, and usually based on phosphates or silicates. Third, and for several reasons this is an attractive proposition for hospitals, physical changes to the scale ions can be brought about without affecting the actual nature or potability of the water.

Hygiene

All three of the hospitals mentioned earlier have used this form of treatment and since the decision have cut maintenance down to a once-yearly routine. Mr. Adams, Group Engineer at Glenside, has said that even at pH 10 and 250° steam, the process—which uses controlled microdischarges—has saved substantial administrative and labour problems and involves no running costs. His view is also that "because the process is purely physical and therefore completely hygienic, it is ideal for hospitals."

An interesting aspect of the treatment is the effect on scale-forming ions. A small control box passes current to

Fig. 2. It took just five minutes to prepare the tubes of this eight-year-old calorifier for the Boiler Inspector after 12 months continuous running with steam-side temperatures at 250°.

Fig. 3.

To obtain these photomicrographs of hard water scale, both at ×800 magnification, heated water samples from a North East Lincolnshire supply were evaporated in the laboratory.
For one, the water had no scale prevention treatment and the aragonite needle crystals were massed into typical scale agglomeration forms.
For the second, the water was treated before heating by imparting controlled micro-discharges of less than a millivolt to the water through an Aquastat process unit. The needles did not show any signs of build-up but were smaller, smoother and evenly dispersed.

an Aquastat process unit, plumbed into the water supply pipeline, so that, as the flow is divided by the perforated electrode fitted in the middle of the process unit, each stream receives micro-discharges of less than one millivolt.

Photomicrographs

Photomicrographs of the same water supply with and without treatment show (at identical magnification of course) substantial physical changes in the scale crystals. In untreated water crystals mass together through a combination of periphery-field attraction and interlocking molecular structure, causing the beginnings of the familiar rock-hard coatings. After micro-discharge treatment however, the crystals show three changes: they are much smaller, they are smoother and they are evenly dispersed without any apparent tendency to coalesce. Thus they will pass through the water system in suspension.

Even where high, steam-raised temperatures are encountered in calorifiers, deposition is only a soft silt or eggshell coating which hoses away and leaves heat transfer materially unaffected. Capital cost is low compared to water-softening and running costs are negligible compared to any chemical method. A battery can be the power supply as an alternative to AC mains, but whichever power source is used the running cost is comparable with that of an electric clock.

A NEW METHOD OF PREPARING CELLS AND PARTICLES FOR EXAMINATION

A NEW instrument for the preparation of powder particles and medical specimens was announced today by National Research Development Corporation who are backing it.

The instrument has widespread industrial applications including particle sampling, and it can also be used as an aid to the arly diagnosis of cervical cancer.

Called tmhe Cytotrack system, it has been designed by Tetronics Research & Development Co. Ltd., of Lechlade Road, Faringdon, Berks.

In preparing powdered materials or cells for visual or automatic examination the problem is to get an even dispersion. This is very difficult to achieve with the normal glass slide preparation. With the new instrument the material is spread uot evenly as a very narrow track on a transparent 35 mm film strip. By passing this strip under the microscope or automatic sensor, the task of examination is greatly simplified.

The apparatus is in two parts, the first of which is a Laying Unit. The sample is first collected in a disposable sachet which is connected to a special disposable pen nib or GRAPHION. When attached to the instrument, the nib 'writes' onto the film a band of particles or cells less than the width of an ink line from a fountain pen.

The other part of the apparatus is the Viewing Unit, which is designed both for visual inspection and for presenting material to automatic sensing equipment.

In the industrial field this method of sampling for quality control gives more uniform results, and simplifies storage of records. Magnetic striping along the film track allows additional information to be carried in parallel with the sample.

In the medical field the system is extremely versatile and can handle not only cervical smears, but also blood, chromosomes, sputum, and urine.

The track width can be adjusted from 1000† down to 100†; within the limitations of the material a high degree of dispersion can be obtained and bimodal distribution of cells or particles according to size can be achieved across the width of the track. The film used has better optical properties than glass slides and the mountant covering the track provides optically suitable protective cover for the material.

The parameters of the track laying can all be pre-set and reproduced and magazine loading in incorporated for routine work.

The viewing unit includes a recall and location system for pinpointing and marking specific fields of view and the in-line presentation of the material greatly simplifies exact recall for both manual operation and sensors.

Materials in Medicine

By D. T. HELM, A.M.I.Inst.E., A.M.I.Hosp.E.
Assistant Engineer, Claybury Hospital

AS long ago as the 16th century, Ambroise Paré the great Renaissance surgeon, invented a series of limbs for wounded soldiers and, as early as 1666, people such as Hieranymus Fabricius were describing surgical operations involving the use of metal wire (iron or gold) as sutures.

Since those days the whole business of spare parts to replace broken or diseased parts of the body has flourished and become a daily event in surgery. The problems now arising are not only surgical but metallurgical and engineering.

For instance, which are the most suitable materials for the job? What are their various reactions under stress, strain and friction, etc.?

Today their are countless numbers of people in the world who depend on a piece of plastic or metal implanted in their body to keep them alive and to be still of some use to society.

The main reasons for plastic or metallic implants are to mend broken or diseased bones, or to replace worn-out organs. It is also possible to replace these organs with living tissue transplants but, due to the body's "frequent" rejection of foreign tissue, the probability of insufficient supply of organs, and ethical questions suggest that mechanical parts should have more and more success.

Artificial parts implanted into the body are numerous. Pacemakers, artificial valves in the heart, hip joints, artificial jaw bones, tubing replacements for diseased aortas, hinged knee joints, plates to fortify fractured thigh bones, to name but a few of many, manufactured from metallic or plastic materials.

Plastics

Plastics are a collection of materials sometimes found in nature, e.g. shellac and gum, but they are mostly manufactured by synthesis of one or more chemicals to form a polymer (a substance whose molecules are composed of large numbers of linked similar molecules).

For the most part they are organic substances, and based on carbon compounds. Rubber is also a polymer but is an elastic material which changes shape under stress and usually returns to its original shape when the load is removed.

Plastics do not behave in this way but, like metals, deform elastically to the yield point by a system of atomic "slip" or "dislocations," then deform plastically, undergoing a permanent deformation.

With plastics this change occurs at much lower load than with metals and at much lower temperatures. At temperatures of 15-100 Centigrade plastics usually yield with moderate loading. This property allows plastics to be worked and shaped at moderate temperature using little, if any, force. The equipment for processing can be kept relatively simple in comparison with the same procedures using metal.

These mechanical considerations render plastics weaker than metals but, as plastics are inert chemically over a vast range of conditions they are very useful in spare part surgery.

The only drawback to their wider use is their inability to withstand abrasion or stresses which are high to plastics, but which may be quite moderate on a similar metal part. Plastic is put to good use in spare part surgery as is explained in the following chapters.

Plastics in the Body

Plastics for medical use have to fit several requirements (as mentioned in the previous chapter) such as: to have the correct shape, strength and other physical properties. They must not change the shape or the properties of the material, they must remain free from infection and they must not set up surrounding tissue reactions.

As already mentioned the body reacts to living tissue implants (in some cases) also, most artificial materials corrode or decompose but some do not. Plastics such as Polypropylene and polytetrafluorethylene (P.T.F.E.) are completely chemically inert and are very useful in surgery.

Heart Valves

The two plastics mentioned, P.T.F.E. and Polypropylene, have been found to be quite good materials for use with heart valves. Silastic (a silicone polymer) has also been used for this purpose. A lot of useful work on the mitral valve has been carried out by the Nuffield Unit of Clinical Physiology at the Post-Graduate Medical School at London's Hammersmith Hospital.

The Nuffield Unit designed a mitral valve which could be produced on an injection moulding machine (Florin Manumold), thus enabling them to manufacture the valves quickly and relatively cheaply. The valve de-

signed was a self-retaining flap valve with low inertia characteristics and with a large ratio between blood flow and retaining ring. The outer edge of the ring had a ring of Polypropylene stockinette "tyre" which could be stitched to the heart wall and, through which, tissue will eventually grow.

The valve flap has three hooked feet which retain it to the ring, the feet being of unequal length to enable the securing action of the blood flow to keep the area free from thrombus (clot in the blood).

Artificial Trachea

The Nuffield Unit at Hammersmith Hospital has also done useful work in producing an artificial trachea using, again, Polypropylene.

The trachea or windpipe is a cartilaginous tube lined with ciliated mucous membrane, extending from the lower part of the larynx to the commencement of the bronchi.

To copy this organ with a plastic implant, the team moulded on their Manumold 15 rings over which they moulded stockinette mesh. The stockinette was stretched over a mould and the rings moulded over the outside.

It was found later that when implanted into the body, the living body tissue grew through the mesh and in time blocked the trachea, so the team had to think again, and remedied this obstacle by inserting a central tube inside the implanted trachea, and left it in for a period of time before removing it to leave a perfect trachea.

Otosclerosis (disease of the middle ear)

This disease is a common cause of deafness in young and middle aged people. Normally the vibrations of the ear-drum are carried by a series of bones to the cells that convert them to electrical impulses. The disease causes one of the bones to become enlarged and to jam the gap through which it passes.

Dr. J. J. Shea of Memphis, Tennessee, devised an operation to replace this bone with a replica made of plastic "Teflon", known in Great Britain as "Fluon", or P.T.F.E. He replaced the bone (the stapes) with the plastic replica, grafting a thin slice of the person's tissue into the gap left, and claimed to restore the hearing of 90 per cent of his patients using this method.

Plastic Tube (arteries, aorta, etc.)

It has been found that living arterial transplants do not survive when put into another body, therefore any other suitable material, e.g. plastics, can do the job. Plastic prostheses can be made either rigid and solid, or porous and pliable; it is known that a disadvantage of a solid and rigid tube is that clots can form at the joint of the living and artificial tube. This may eventually lead to a complete closing of the channel and therefore, the solid tube has been ignored in surgery to a certain extent.

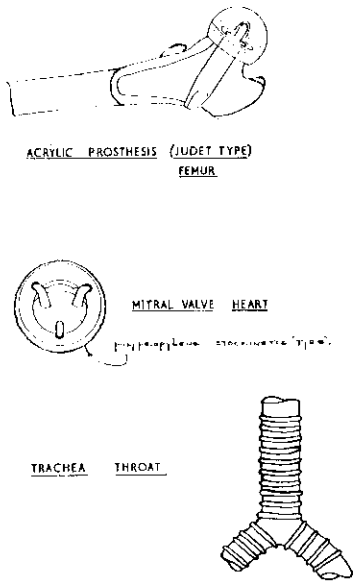

Fig. 1. Plastic implants.

Porous and pliable plastic materials such as nylon (superpoyamide), Orlon (an anacrylic fibre) and Terylene (a polyester product) have been used as tube implants for various parts of the body with good results, the better ones being Terylene and Orlon. The use of Orlon was pioneered by Hufnagel, and in his published results (1955) of work with Orlon prosthesis he said he had inserted Orlon prosthesis into 15 patients over a period of 16 weeks with satisfactory results. A prosthesis of plastic cloth has been used many times for reconstruction of the aorta or iliac arteries in patients. An example of a large aortic aneurism lying within a tuberculous cold abscess was reported in 1955 (Rob and Eastcatt) and is of interest because a homologous arterial transplant would probably have ruptured due to the tuberculous infection, whilst a plastic cloth prosthesis was working well after two and a half years.

Plastic Repair to Head of Femur

There have been quite a number of operations to treat osteoarthritis of the hip—Smith-Peterson's vitallium mould or cup, Austin Moore's prosthesis and the Judet's prosthesis to name one or two—but it is the last one which again makes use of plastic (Acrylic). The head of the femur (a domed structure shown in Fig. 1) was reproduced in polymethyl methacrylate but the stem, which had to be inserted into a hole in the bone, did not stand up to the bending moments set up around the head when implanted into position.

The plastic stem was then reinforced by a metal pin but frequent fractures still occurred. After these unsatisfactory attempts the upper part of the femur implant was made in a metal (vitallium) which was found to be more satisfactory.

This is just another illustration of the use made of plastics as an artificial body implant, but it is also an

outstanding illustration of where the metallurgist as well as the engineer become involved in surgical work.

This point is very well illustrated by Professor J. M. Zarek in his paper "Biomechanical appraisal of metallic Osteosynthesis" (*Metals and Materials*, May 1967).

Metals for Surgical Implants

Metals for surgical implants have to have certain qualities before they can even be considered for use. For example, they must be chemically inert and free from corrosion, they must be able to stand up to certain stresses and strains depending in which part of the body they implanted and they must also be comparatively easy to work (mould and machine) including the ability to take a high polish and many more qualities.

The metallurgist has done a wonderful job for industry and has come up with a wide range of alloys to serve their needs and is still discovering new materials, e.g. carbon fibres, but the surgical side of metallurgy has been rather neglected.

One reason for this neglect is cost and also the fact that any alloy of metal to be tested usually has to be implanted into animals and requires a long period of time to gather the relevant information, whereas in industry most of the tests can be either done in the laboratory or on machines already in use, with comparatively less cost and time wasted.

Metals used in surgery are quite satisfactory but not perfect for the job. Most have been found to be either unworkable, scarce, costly to produce, or react with the living tissue when implanted into the body.

There are three types of phase from which metallic materials are composed; they are, pure metals, solid solutions and intermediate phases. As a rule pure metals are soft and ductile but low in strength and it is this deficiency which leads to alloying. The pure metals have some use as body implants (gold and silver) as plates used in head surgery where ductility is more important than strength.

However alloys are used quite frequently and give reasonable results in certain implants, they are the non-ferrous metal Tantalum, Titanium and the Co-Cr-Mo range of alloys, but they still have their drawbacks. For instance, Co-Cr-Mo is not easily machined and usually has to be cast, but is used for its corrosion resistance and high hardness properties.

There are many other problems appertaining to the use of metals in the human body which are complex and far reaching, for instance it is known that a piece of metal, when placed in a liquid which contains free ions (an electrolyte), ions of the metal may start to pass into the liquid. As the ions from the metal build up in the liquid next to the surface of the metal an electric potential difference is created, hence dissolving of the metal occurs. It varies, of course, from metal to metal especially if two dissimilar metals are used. How does this affect living tissues? This is one of the many problems which have yet to be solved before a near perfect metal implant is discovered.

In spite of these problems there have been many metal implants used in various parts of the body. A ball and socket replacement of the head of the femur, plates to fortify various fractures, nails to fix together broken bones, hinged elbow and knee joints, and many more plates, screws, nails, pins, etc.

Malleabilty in metal as mentioned in the previous paragraph applies to implant for cranial defects (plate) and wire sutures for repairing tendons which are special cases but, in general, metals used as splints for healing broken bones or to replace worn out or broken bony parts which have to have strength.

The only specifications governing manufacture of metal implant are those of the 1945 report of the Fracture Committee of the American College of Surgeons. They examined 18/8/Mo. and 19/9 passivated stainless steels and vitallium for inertness and physical characteristics and came to the conclusion that 18/8/Mo. and vitallium were suitable for the manufacture of implants. As a result of the report these metals have been extensively used in surgery.

It was found by Key (1941) in experiments that of the two, vitallium and 18/8/Mo. steel, there was little to choose between them from the point of view of inertness but the latter had a superior ability to withstand shock and vibration.

A metal implant in the body tissue has to undergo a series of changes whilst the wound is healing; at first it is surrounded by fresh blood, then by the blood clot, next by tissue and finally by scar tissue, or by osteoid and new bone, depending on the circumstances.

Fresh blood has a high oxygen tension for a while, then, when the clot forms, the oxygen is lost and carbon dioxide accumulates. The metal to be used for an implant must be able to maintain its corrosion resistance in the presence of the varying pH value experienced in the changes from fresh to the clotted blood.

The strength of the metal must be such that it can withstand any of the strains it will encounter whilst implanted without breaking or bending. An implant may have to undergo these strains for long periods of time, e.g. Femoral neck fractures with an ovascular head.

Repairs to the Femur

When the shaft of the femur is fractured the usual method of repair is by an intramedullary pin or plates and screws or both, depending on the condition of the fracture. In the case of fracture of the neck an intramedullary pin with side plates along the shaft is usually used. Use of the pin does not call for such an extensive surgical interference as the plates and screws method.

Also, being a single metal implant, the pin is less susceptible to corrosion or electrochemical reaction than the plates and screws. The selection of pins for the repair (or plates and screws) depends on many situations, namely whether a splint is required or a load-bearing pin.

If weight bearing is to be allowed for not only must the pin be strong enough but the grip it has on the bone and the bone itself must also be strong enough to accept the strain. These and many other problems arise in this complicated operation, and is admirably discussed in "The Hip" by Strange, but are beyond the scope of this paper.

The part that affects the engineer and metallurgist is the construction and composition of various metal parts to be used. For example; the intramedullary nail normally used is the "Kuentscher" type with a clover leaf shaped cross-section. The resistance to bending of such a section varies a great deal from one direction to another and the best position for the nail is only obtained when it is fitted in such a manner that the largest second moment of the area of its cross-section coincides with the action of the largest bending moment which the fractured cross-section of the bone would carry.

Femur (Metal Replacement)

The Judet is the commonest example of metallic-plastic reconstruction of the head of the femur. The original Judet mushroom type replacement head was made of polymethyl methacrylate but the stem was found to be too weak to carry the various loads and bending moments.

To overcome this weakness a metal rod was tried as a reinforcement to the plastic head, but still mechanical failures occurred. The plastic head seemed to be ideal because of its inertness but a satisfactory metal-plastic structure which would stand up to the bending and shear load was found to be difficult to manufacture because of the need to have a good bond between the plastic and metal.

Other types of reconstructed femur heads have been tried, "Moore's" prosthesis, for example, was an all-metal implant made entirely from stainless steel of the 18/8/F.M.B. variety but there again problems arose due to manufacture. It was found that the head had to be machined and the stem cast due to the complex shape of the implant. This gave rise to certain changes in the metallic construction of the materials grain size.

As the cast portion was a coarser grain size than the head, mechanical failures occurred after implantation. Another type of construction in the femur spares range is the "ball and socket" joint. This seemed to be better constructed to withstand the forces which are applied with use. The three joints mentioned were satisfactory to a certain extent but not perfect for the job, which means a lot more mechanical and metallurgical research has yet to be carried out to obtain perfection.

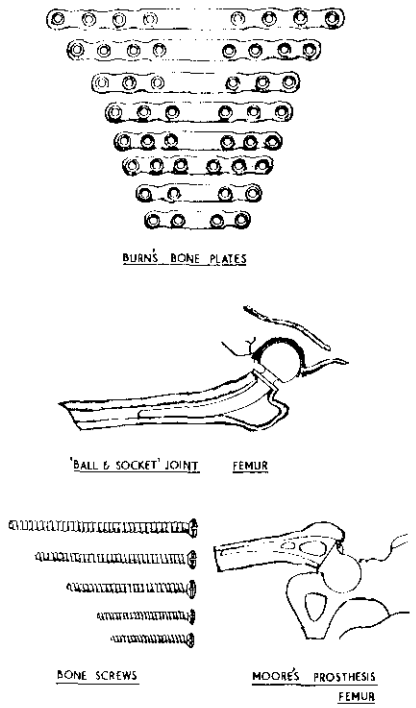

Fig. 2. Metallic implants. The Burn's bone plates are one third full size. The bone screws are one half full size.

Plates and Screws (Metallic)

Metallic plates and screws, mostly used for internal fixation of fractures, are the 18/8/Mo. and vitallium because of their strength and comparative inertness when implanted. Various other stainless steels are also being experimented with but, as mentioned in the previous paragraphs, the metal used must be able to be implanted into the body without setting up corrosion currents. Hardness of the metal should be within the range of 30-35 on the Rockwell C. scale. There is a trend of thought which suggests cold turning to make screw threads is less damaging to the metal structure than rolling. Rolling raises the U.T.S. and hardness, and leaves mechanical strain in the section. Therefore, it is advisable to anneal in order to re-crystallise the grains. The point being that it is supposed to compress the screws structure, so that many of the corrosion resistance properties are lost.

The many small slivers of metal left by the turning process must be got rid of by polishing and reverse plating. The plate or screw must be completed in a highly polished state and free from abrasions to be of maximum efficiency when implanted.

It is suggested in "Modern Trends" by Leon Gillis that trade marks and identification marks be done away with, as they are a source of weakness and a potent source of corrosion.

Vitallium is said to be the most inert alloy in use in surgery and is quite satisfactory for various implants. It is a cast alloy, enabling the plates etc., to be polished

after casting. It is quite critical not to mix this metal with the other stainless steels as body implants or even when being stored prior to use.

The design of plates and screws for fracture repair is also critical because of their load bearing aspect.

Welded joints between metal parts are being discontinued where possible in favour of a complete casting or forging, hence eliminating the weakness of a weld.

Slotted holes are also put into the plates to allow shortening of the bone during the early stages of the fracture healing, e.g. Egger's plates. Coarse threaded screws are now being used which take a deeper bite into the bone; even with circumferential absorption these screws do not generally tear loose as easily as the finer threaded variety.

The use of cross-slotted and Philips headed screws with screw holding screwdrivers is a great help as far as eliminating tool-implant slipping and hence helping to eliminate metal transfer between the two.

There are various types of screw now available for medical implant use, cross-slotted and Woodruff slots, with vitallium Philips headed also available.

The danger of tool implant metal transfer is another problem which is being solved by metallurgists amongst others. It has been found from experimental and clinical implants that when examined, they showed that cellular reaction and iron infiltration occur in the tissue adjacent to the buried metals. This reaction was found to be greatest near the screw and bolt heads which had been handled by tools, and least near unhandled rejoins of the metal implants. It is said to occur in the absence of any concentrated destructive corrosion in the region of contact between the two components or between metal and bone. The mechanical rigidity of the implant will be destroyed within a short space of time by the loosening of the screw in the bone. It is thought that this is not due to corrosion of the metal but to the bone absorption caused by the pressure of the screw; such absorption can be caused by other means, such as the rocking of the implant during the healing process.

In 1956 complete standardisation by the manufacturers in England of the type of stainless steel to be used in orthopaedic surgery was reached and it is now only possible to buy, mostly, 18/8/Mo., which means the field of corrosion due to dissimilar metal implant will gradually disappear as the old stocks are used up or thrown away.

The 18/8/Mo., or molybdenum bearing steel, contains, in addition to the chromium and nickel of austenitic stainless steel, 2 per cent to 4 per cent of molybdenum. Introduced since the Second World War, vitallium on the other hand is not a steel but is of cobalt bulk. This was introduced after 1937.

* * *

This paper has, of course, given only a brief glimpse of the vast and complex subject of "Materials in Medicine". There are many more departments in the field of medicine other than spare part surgery in which plastics and metals play a major role.

The few illustrations mentioned have their drawbacks and problems which must yet be solved before perfection is approached.

The surgeon does a marvellous job with the materials available, but the metallurgist and engineer must help him by spending more time on research into surgery materials rather than profit-making for industry.

As mentioned in the previous chapters the surgeon has also made great advances in the field of spare part surgery using new techniques with the new materials, but he has also experienced many failures due to the existence of metallurgical and mechanical problems.

In the meantime heart valves have to be replaced and fractures have to be repaired to save life and limb, as these are now every-day occurrences which confront the medical world.

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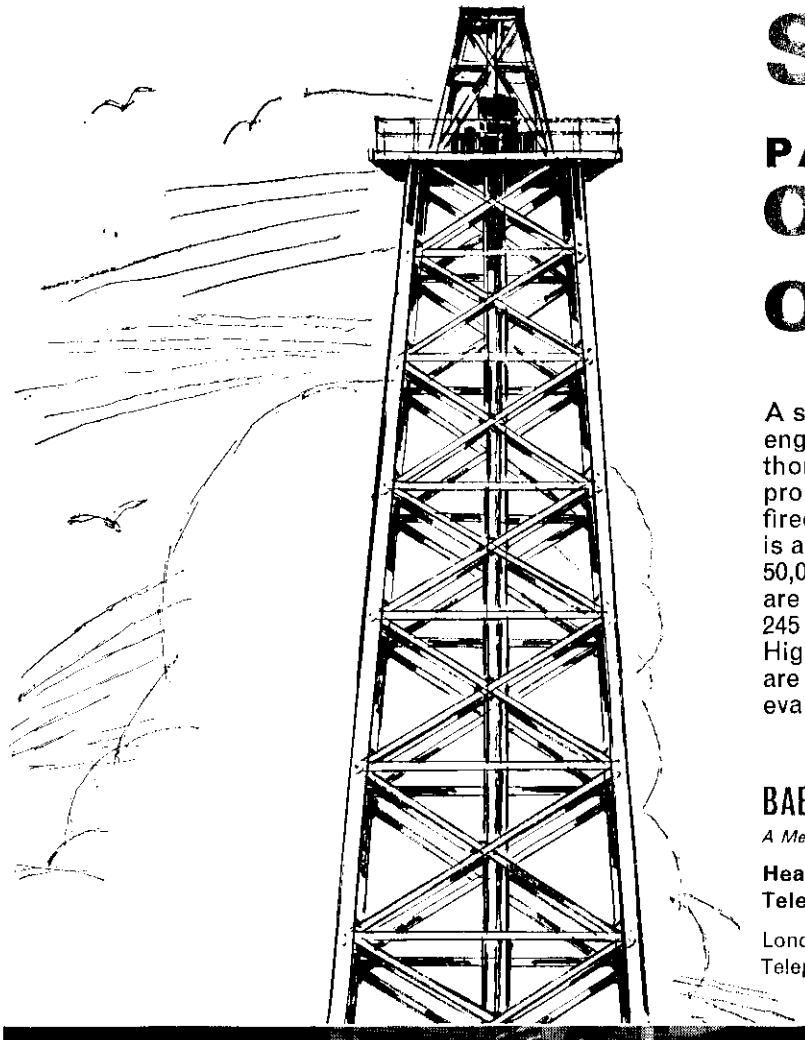

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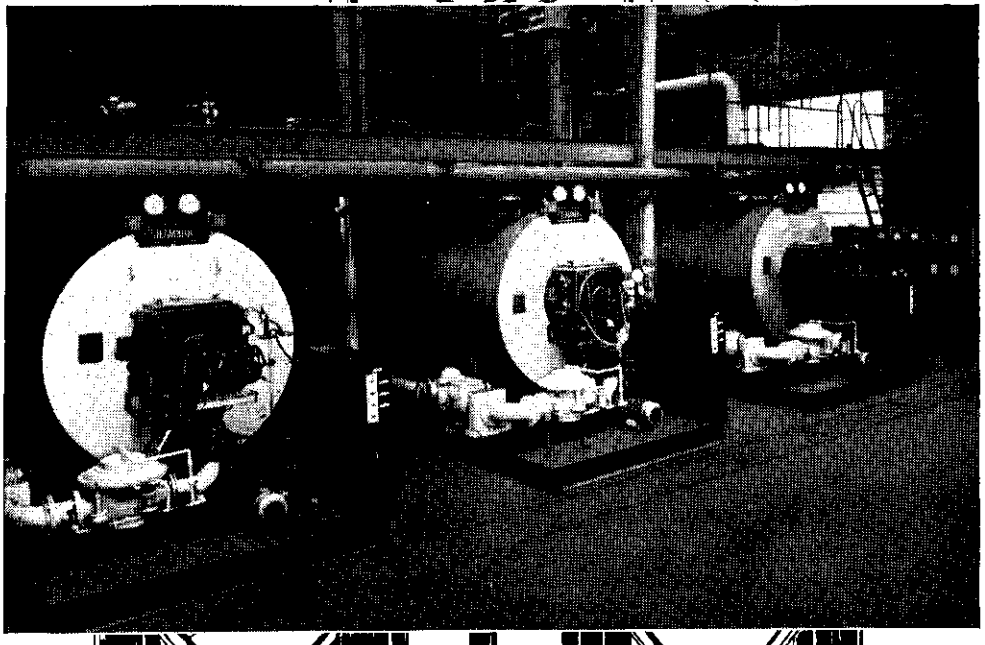

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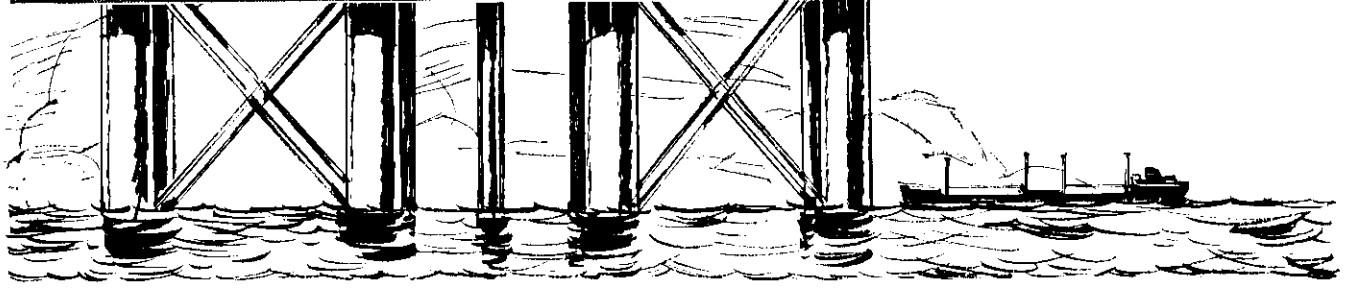

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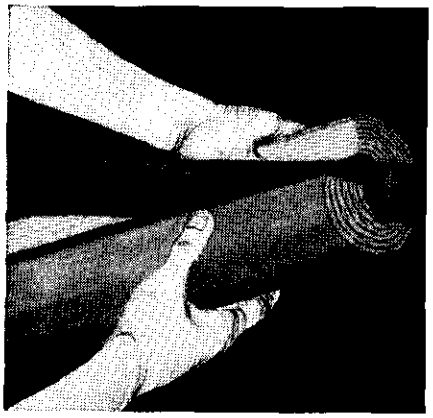

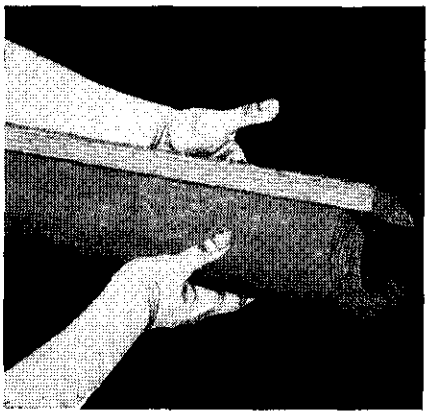

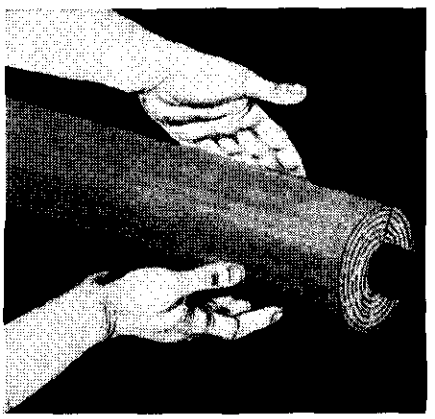

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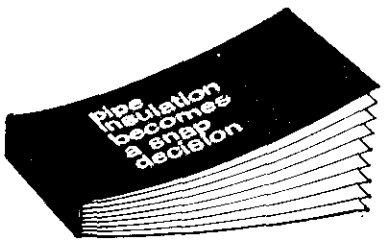

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The Protection of Domestic and Industrial Electrical Installations

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 3

Mystery tripping

Instances are occasionally encountered where voltage-operated earth-leakage circuit breakers trip out for no apparent reason. This may happen either at definite times during the day or at irregular intervals.

Possible causes of this condition are many and varied, but there are three major possibilities which are usually worth investigating. These are:

(*a*) Transient leakages.

(*b*) Dormant neutral-earth faults.

(*c*) Faults imported into the installation from another installation or another section of the same installation.

The first possibility—that of transient leakages to earth is normally associated with cooker hotplates or similar equipment which may pass sufficient earth-leakage current during the initial switching-on period to trip out the earth-leakage circuit breaker. By using earth-leakage circuit breakers with a minimum tripping current in excess of about 35 mA, this kind of trouble should virtually be eliminated.

If trouble is being experienced on an existing installation, one method of overcoming it is to provide an additional parallel direct earth path for the cooker. This —as discussed under the general heading "Parallel Earth Paths"—should reduce the abnormal sensitivity to leakage currents whilst at the same time maintaining adequate voltage sensitivity. An obvious symptom of this class of fault is that the circuit breaker trips when an appliance is switched on.

The second type of fault—that associated with dormant neutral-earth faults—is often far more difficult to trace. The usual symptoms, however, are that the earth-leakage circuit breaker trips out when a heavy load is applied somewhere on the installation: the heavy load usually takes the form of a motor starting current. The general sequence of events is that, due to the fairly heavy current flowing in neutral, the total voltage drop along the neutral return path, consisting of the supply authority's distributor, the consumers' service feed and the neutral conductor results in the installation neutral conductor attaining a potential to earth in excess of about 20-30 volts. This voltage on neutral is then automatically transmitted to the installation metalwork by way of the fault between neutral and this metalwork. It is thus applied to the trip coil of the earth-leakage circuit breaker and, in consequence, the breaker then trips out. It is worth noting that this condition may often be a very transient condition, persisting only—for example —for the time taken for a motor to start and run up to speed (see Fig. 18).

Another possibility also associated with a dormant neutral-earth fault is that a neutral conductor may be-

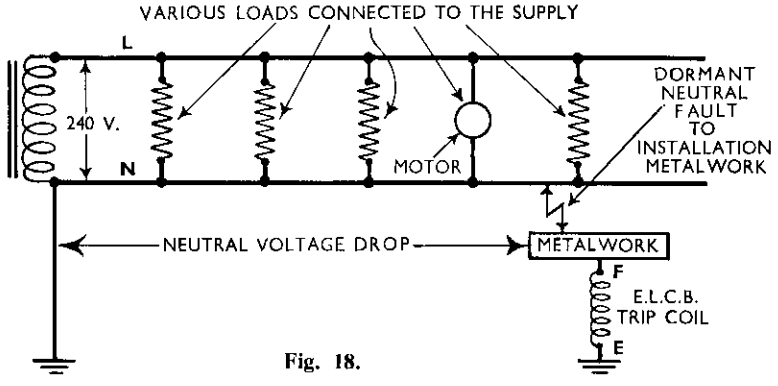


Fig. 18.

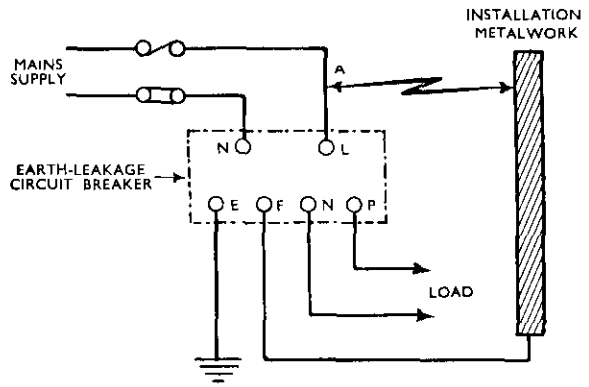


Fig. 19.

come open-circuited or develop a high-resistance joint. In consequence, any load current will then attempt to flow to earth through the earth-leakage circuit breaker trip coil when the appliance in question is switched on, thereby tripping out the circuit breaker.

The final possibility is of faults being transmitted from installation to installation or from one section of the installation to another. This may take the form of a fault in one house bringing out a breaker in a nearby house, the fault travelling along a common water pipe. The only real cure for such a condition is to ensure that the first house is also adequately protected, but in practice it may not be possible to do this. In such circumstances the best course of action is to isolate the installation metalwork in the second house from the common water line.

The problem of selectivity

If two or more voltage-operated earth-leakage circuit breakers are used on the same installation, and selective operation is required, it is necessary to isolate the corresponding sections of protected metalwork one from the other. This is often difficult to achieve in practice, particularly when structural metalwork is involved. A far more satisfactory solution is to use current-operated earth-leakage circuit breakers for this type of application, as these units are inherently selective in operation.

Can a Common Earth-Electrode be Used? When several voltage-operated earth-leakage circuit breakers are being used, connecting all the "E" terminals to the same earth electrode is not normally considered good practice. Preferably, separate electrodes should be used to ensure complete isolation of the various earth circuits.

If a common electrode is used, it must be of relatively low earth-electrode resistance, as otherwise there is a distinct possibility of serious trouble being encountered. The reason for this stipulation is that if, in practice, a number of earth-leakage circuit breakers are all connected to *one relatively high-resistance earth electrode*, there is a possibility of the electrode itself attaining a dangerous potential relative to earth. This is due to the possible build-up of a number of small leakage currents to earth—each in itself less than the minimum operating current of the trip coil through which it is flowing.

As an extreme example, ten such breakers, each passing a current of 20 mA to earth by way of a 500 ohm electrode, would force the actual electrode up to a potential of 100 volts above earth. The "protected" metalwork on each installation would thus rise to about 110 volts to earth, if allowance is made for the voltage drop across the earth-leakage circuit breaker trip coil.

Protecting the trip coil

The trip coil of a voltage-operated earth-leakage circuit breaker is capable of carrying its minimum tripping current indefinitely. Furthermore, it is capable of withstanding the application of full mains voltage for a period of time considerably in excess of that needed to trip the breaker, but it cannot withstand the application of full mains voltage indefinitely.

On a correctly designed installation, of course, this is a condition which cannot arise in practice: normally, operation of the circuit breaker automatically interrupts the flow of current through the trip coil. Unfortunately, however, there are some incorrect installation conditions which could result in a coil burn-out. Basically, they all reduce to an earth fault to the metalwork protected by the earth-leakage circuit breaker, from a source of supply not controlled by the earth-leakage circuit breaker. Fig. 19 illustrates a typical example of this. In poor earthing conditions, such as are usually associated with earth-leakage circuit breaker installations, a fault at point "A" would be most unlikely to blow the main fuse. This fault to the installation metalwork (on the live side of the earth-leakage circuit breaker) results in full mains voltage being applied to the trip coil. The earth fault current thus continues to flow even though the earth-leakage circuit breaker operates: inevitably in these conditions the trip coil would burn out.

This basic condition may arise in several ways. For example, a supply authority's service conductor may develop a fault to the installation metalwork near the supply intake position, resulting in a burnt-out earth-leakage circuit breaker trip coil. A second possibility of trouble arises when common metalwork links several premises—a metallic water pipe being a typical example. Here, an earth fault on one installation can travel along the water pipe, resulting in burnt-out trip coils in earth-leakage circuit breakers protecting the other premises, unless all the installations are protected by earth-leakage circuit breakers.

To eliminate completely all these various possibilities of trouble, it is merely necessary to specify that every voltage-operated earth-leakage circuit breaker should be fitted with an integral coil-shorting switch. This switch is directly and positively coupled to the main moving contacts and is so arranged as to short out the trip coil when the circuit breaker opens—thus connecting the installation metalwork directly to the earth-leakage circuit breaker earth electrode. In this

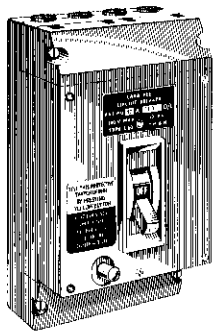


Fig. 20. Triple pole and neutral 60 amp. voltage-operated earth-leakage circuit breaker.

way, the trip coil is completely safeguarded from the risk of coil burn-out, despite these somewhat dubious installation conditions.

Why are All-insulated Enclosures Preferable? When metalclad switchgear is used, an earth fault on the incoming mains side of the protective gear to installation metalwork is an ever-present possibility. Provided that earthing conditions are excellent, the main back-up fuse should blow. If earthing conditions are not quite so good, however, whether direct earthing or earth-leakage circuit breaker protection is being used, it is no longer safe to assume that the back-up protection will operate. For this reason B.S. 842 stipulates all-insulated enclosures for voltage-operated earth-leakage circuit breakers.

Whatever form of earth-leakage protection is used, this type of condition, where a fault on one installation can make another installation permanently "live", is always liable to cause danger. As such, it obviously conflicts with good installation practice.

Lightning. Voltage-operated earth-leakage circuit breaker trip coils, unless they are correctly designed and protected, are very vulnerable to damage from lightning surges. For reliable long-term operation adequate protection is absolutely essential. The leading range of units have a scientifically designed protective lightning discharge gap to protect the coil. In addition, the coil itself is specially constructed to withstand the fierce electromechanical stresses produced by these surges. The efficacy of this particular combination has already been very clearly demonstrated by comparative field tests on house installations under actual lightning storm conditions—conditions which wrecked other units not possessing this high degree of protection.

The Need for Complete Isolation. When earthing conditions on a distribution network are such as to necessitate the use of earth-leakage circuit breakers, it is a wise precaution always to treat the neutral as a live conductor, due to the possibility of a degree of neutral inversion existing on the system. For single phase operation, a double pole (S.P. & N.) circuit breaker should always be used, thereby ensuring complete isolation in fault conditions. Similarly, for three-phase operation a four-pole (T.P. & N.) circuit breaker should always be used (Fig. 20).

Metallic Enclosures for Earth-leakage Circuit Breakers. For certain applications it may be desirable to mount earth-leakage circuit breakers either in sheet-metal or in completely weatherproof enclosures. In such instances, for the reasons outlined above, special precautions have to be taken to guard against the risk of an earth fault to the metallic enclosure on the "live" side of the circuit breaker. The enclosing cases shown at Fig. 21 are therefore supplied with an insulating lining, and care is taken to ensure that no metallic screws, etc., protrude through this protective lining into the interior of the enclosure. Finally, for complete protection the incoming mains should be taken into the metal enclosure through an insulating bush or a length of non-metallic conduit.

Extending the Range. When heavy current single-phase or three-phase earth-leakage protection is required, this may be achieved by using the main contacts of a standard earth-leakage circuit breaker to interrupt the undervoltage release coil circuit of a suitable heavy-current contactor or main circuit breaker. If a metal enclosing case is involved, however, the requirements for such conditions must be watched. (See paragraph on metallic enclosures.)

Universal in Application. From this discussion of voltage-operated earth-leakage circuit breaker protection it will be realised that this method of protection is virtually universal in application. A high degree of shock risk protection is provided and, in ordinary installation conditions, very good fire risk protection is also afforded to the installation.

A most important point that should be noted is that the level of protection afforded is independent of the rating of the back-up fuse. *Thus there is no possibility of the calculations or the tests carried out on the installation being completely vitiated by an arbitrary uprating of the protective fuses.* In this connection, the modern tendency is towards the use of a sealed enclosure for the

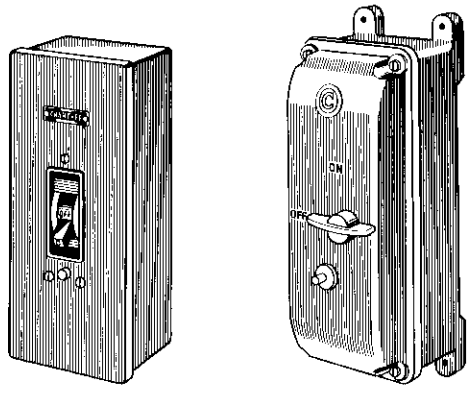


Fig. 21. General purpose (steel) and heavy duty (cast metal) enclosures for earth-leakage circuit breakers.

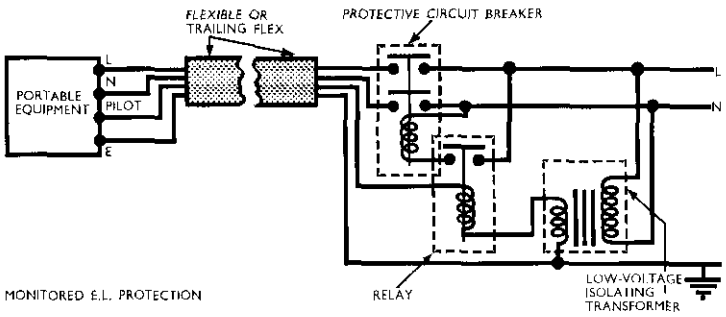


Fig. 22 (*left*)

earth-leakage circuit breaker mechanism, both to prevent interference with the mechanism and also to give protection against the somewhat arduous installation conditions which may be encountered in practice.

Protection by earth monitoring

The various systems of earth-monitoring are primarily intended to guard against the failure of the earth-continuity conductor in a flexible or trailing cable, which is feeding a portable or transportable item of equipment. Most methods incorporate additional features to safeguard against possible complications that may arise in practice, but the basic circuit, and the fundamental theory of earth monitoring, is illustrated at Fig. 22.

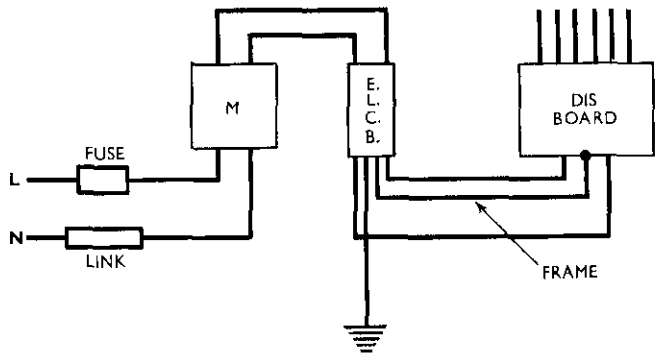
From this diagram it will be seen that the monitoring device incorporates a low-voltage transformer (usually not exceeding 12 volts output); a relay; and a protective circuit breaker. In addition, there are two earth leads to the appliance or portable equipment—the primary earth-continuity conductor, which is bonded to earth in the normal manner, and a pilot conductor.

The low-voltage output from the isolating transformer is used to drive a circulating current—usually not exceeding 3 amp.—around a loop circuit consisting of the primary earth-continuity conductor; a section of the metallic housing of the appliance; the pilot conductor; and the relay operating coil. This circulating current will hold in the relay and so energise the hold-on coil of the circuit breaker—provided that the loop path remains intact.

If, however, the circulating current is interrupted, as it would be if the primary earth-continuity conductor or the pilot conductor failed, the relay will drop out. This, in turn, will interrupt the hold-on coil circuit and so will trip the protective circuit breaker—thereby isolating the appliance or item of equipment it is protecting.

This is the basic theory of operation, from which it will be noted that earth monitoring, as such, only checks the integrity of the earth-continuity conductor: it does not of itself afford any additional form of earth-leakage protection. Most equipment commercially available, however, tends to incorporate extra features to provide additional earth-leakage protection and/or to safeguard against sneak circuits, or fault conditions causing spurious operation of the relay.

Fig 23. (*below*)



Overcurrent and short-circuit protection

One other important feature, which is common to both types of earth-leakage circuit breaker, is that it is normally possible to incorporate protection against overload and short-circuit fault conditions in the same circuit-breaker mechanism, thereby enabling the earth-leakage circuit breaker unit, as shown at Fig. 23, to combine the separate functions of main switch-fuse and earth-leakage trip. This method of connection is quoted in I.E.E. Wiring Regulations as a standard supply intake arrangement: it has obvious advantages from considerations of saving in space, initial cost and installation time.

A further point is that the circuit breaker mechanism, as may be seen from the comparative tripping curves at Fig. 24, will give far closer protection against sustained overload conditions than can normally be provided by

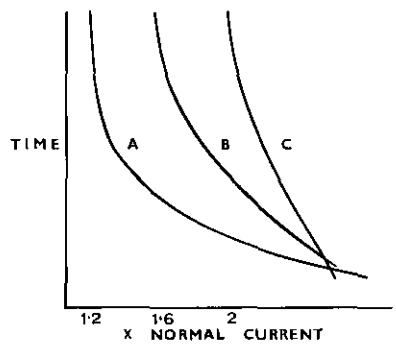


Fig. 24. Typical tripping characteristic curves: (A) Miniature circuit breakers; (B) H.B.C. cartridge fuses; (C) Rewirable fuses.

fuses. The fact that circuit-breakers can give closer protection against dangerous conditions of sustained overloading is now recognised by the I.E.E. Wiring Regulations: the 14th Edition permits a very significant uprating of cables if circuit-breakers to B.S. 3871 are used, as compared with the current ratings applicable if semi-enclosed fuses are used. In turn, this can well lead to useful economies in cable costs—particularly on larger installations.

Finally there are the added circuit breaker features of safety and simplicity in operation as compared to the somewhat dangerous expedients only too often adopted when rewiring both rewirable and cartridge fuses.

P.M.E.: An alternative method of protection

There is one other method of giving protection against earth fault conditions which is of interest. This method, known as Protective Multiple Earthing, or P.M.E., utilises the neutral of the incoming supply as the earth return path.

In this system of earthing, all protected metalwork is connected by means of the installation earth continuity conductors to the neutral service conductor at the supply intake position. By doing this, line-to-earth faults are converted to line-to-neutral faults, the intention being to ensure that sufficient current flows under fault conditions to blow the fuses or trip the overload circuit breaker protecting the fault circuit or sub-circuit.

The Increased Fire Risk. When a P.M.E. installation is functioning correctly—i.e., when neutral is at or about earth potential—the degree of shock-risk protection is the same as that provided by solid earthing and fuses. It is important to note, however, that—as with solid earthing—this method of protection does not detect high-resistance faults. As a result, there is always the possibility of uncleared fault currents constituting a permanent or intermittent fire risk on the installation. Moreover, as the system is deliberately designed to encourage the flow of heavy fault currents, these currents will themselves constitute an obvious fire risk during the time it takes for the protective device to operate. Thus P.M.E. increases both the fire risk and the possibility of damage to delicate apparatus.

With this method of earthing it is essential to ensure that the neutral conductor cannot rise to a dangerous potential relative to earth. *This is because the interconnection of neutral and protected metalwork would automatically extend the resultant shock risk to all protected metalwork on every installation connected to this particular supply distribution network.*

In view of this hazard, stringent requirements are laid down to cover the use of P.M.E. on any particular distribution system, a typical form of approval being given in Appendix 5 to the I.E.E. Wiring Regulations.

Regulations Governing the Use of P.M.E. Among the various requirements the following points are of particular interest:

The neutral conductor has to be earthed at a number of points on the system, and the maximum resistance from neutral to earth must not exceed 10 ohms. In addition, an earth electrode at each consumer's installation is recommended.

So far as the consumer is concerned, there must be no fusible cut-out single-pole switch, removable link or automatic circuit breaker included in any neutral conductor on the installation.

Perhaps the most important point is that every consumer connected to the system must comply with P.M.E. requirements. As a result it is difficult to apply P.M.E. either to existing networks or to extensions to existing networks, due to the amount of work which has to be carried out on the existing consumer's installations. The applications for P.M.E. are therefore virtually restricted to new distribution networks.

The basic reason for this stipulation is shown at Fig. 25. This illustrates conditions which can arise when earthed metalwork on a consumer's installation is not bonded to the neutral conductor. In the conditions shown in the diagram, a direct earth fault would result in a total current of 20 amp. flowing; a current which would probably be carried indefinitely by the 15 amp. fuse. This current, returning to neutral by the distributed electrodes, would force the neutral conductor up to a potential of 200 volts above earth, producing conditions of nearly complete neutral inversion, i.e., line at 40 volts to earth and neutral at 200 volts to earth.

As all accessible metalwork throughout the whole P.M.E. distribution network is bonded to this neutral conductor, all this metalwork would then become live at about 200 volts to earth. The possible results of such conditions—particularly in cowsheds and other farm buildings—are only too obvious.

Unfortunately, while it is always possible to prohibit such installation conditions when a P.M.E. network is first put into commission, it is rarely possible to ensure that such conditions cannot arise in the future. Thus, with P.M.E., there is always the possibility of amateur extensions to existing installations causing both shock and fire hazards on all the other installations connected to the distribution network.

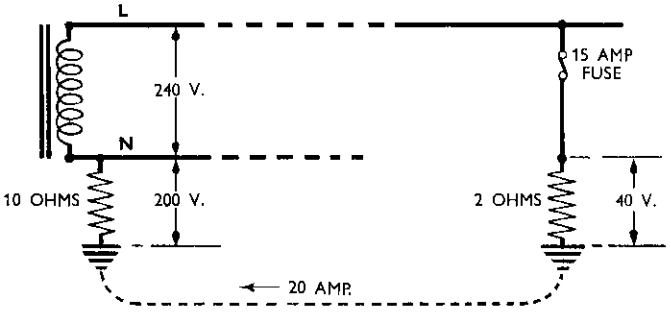


Fig. 25.

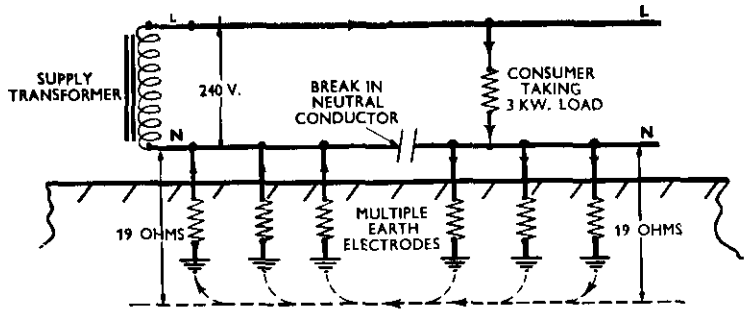


Fig. 26.

The Danger of a Break in Neutral. Most of the other requirements are framed to guard against the danger of a broken or discontinuous neutral conductor, a condition which is liable to cause danger to all consumers connected to the distribution system. Fig. 26 shows in diagrammatic form what happens with a broken neutral distributor. As the current from the 3 kW load cannot return along the neutral conductor it will flow back to the neutral point by way of the various earth electrodes and earth. This will have the effect of making the neutral conductor live to earth on either side of the break, the actual voltage distribution depending on the relative values of the load and the earth electrode resistances of the two sections of the neutral distributor.

In the example shown, the basic 240 volts will split up into about 80 volts across the load and 80 volts between neutral and earth on each side of the break. As a result *all* earthed metalwork on *every* installation supplied from this distribution system would be live at about 80 volts to earth.

High resistance joints on the neutral distributor can have a similar effect, the degree of danger in all cases being governed by the values of the connected load and the various earth electrode resistances.

Where the value of the connected load is high, and the discontinuity in neutral results in one section of the conductor having a relatively high resistance to earth, nearly full mains voltage may be developed on the metalwork connected to this particular section; but whatever the conditions of load and position of break, it is clear that one isolated fault can cause a shock risk to all consumers. In addition, there are obvious fire risks associated with such load currents flowing to and from earth at the various earth electrodes, particularly when these earth electrodes are situated on consumers' premises.

As the alternative earth return path is available, trouble with the neutral conductor may exist for some time without being detected, the only symptoms perhaps being reduced voltages on appliances, lights, etc., and slight to severe shocks from earthed metalwork.

Overhead distribution systems are, of course, particularly vulnerable so far as broken or discontinuous neutral conductors are concerned, and especial care has to be taken during construction to reduce this danger to a minimum.

A further drawback of P.M.E. is the possibility of trouble throughout the system due to a fault to earthed metalwork which has not been bonded to the neutral. This is particularly liable to occur on older installations where the passage of the years has seen the amateur electrician come into his own.

A typical example would be the addition of an electric water pump to provide a piped water supply. Unless the piping is bonded to the main earthed circuit (and what amateur wireman would ever consider it necessary to earth a water pipe?) an earth fault on the pump could easily spread trouble throughout the distribution network. In effect, the condition illustrated at Fig. 25 and described on the previous page will be reproduced. Thus, a condition of partial neutral inversion could arise, which would be particularly dangerous and troublesome if the water pipe had a lower earth resistance than the P.M.E. neutral—by no means a remote possibility.

Part 4 containing the Appendices will be published in the August issue.

INFORMATION CENTRE FOR FLOORING

The National Flooring Centre opened last month at Chesterfield House, Bloomsbury Way, London, W.C.1 with 120 founder exhibitors. Common objectives of the participants are the desire to promote the newest developments in flooring products, techniques, processes and ideas. An Information Bureau and Advisory Service is available.

MIRRLEES WATSON SPARES

Industrial Thermal Services Ltd., Hill House, Hill Avenue, Amersham, Bucks, servicing specialists for all forms of industrial heat exchange equipment, are now acting as spares agents for the complete range of automatic stokers originally manufactured by Mirrlees Watson Co. Ltd., and currently in use in all parts of the U.K.

B.S.I. News

Abstracts of information supplied by the British Standards Institution

NEW BRITISH STANDARDS

B.S. 1000 (624): 1968 UDC 624 Civil and structural engineering in general 20s.

Comprises a systematic schedule with alphabetical subject index for the classification of matter pertaining to civil and structural engineering in general; design, elements and parts of structures; substructures; superstructures. (SBN: 580 00209 8)

B.S. 3861: Electrical safety of office machines 3861: Part 2: 1968 Requirements and tests for machines presenting special hazards 7s.

Requirements for electrical safety of office machines which present special hazards arising from high voltage, the use of fluids, heating elements and carbon arcs, the emission of ultra-violet light and the production of ozone. (SBN: 580 00205 5).

B.S. 4167: Electrically-heated catering equipment 4167: Part 2: 1968 Individual boiling plates and tapered heat plates 15s.

General requirements and tests for radiant and solid boiling plates providing uniform or tapered heating. (SBN: 580 00204 7).

B.S. 4320: 1968 Metal washers for general engineering purposes 8s.

Relates to bright metal and black metal washers for use with ISO metric bolts, screws and nuts. The washers are basically divided into 3 categories of size: 'normal', 'large' and 'extra large' diameter series and the bright washers are further divided by including a 'light range' which have thicknesses approximately 60 per cent of the 'normal range' thicknesses. The bright metal washers cover the range for bolts, M1 to M39 and the black metal washers cover the range M5 to M68. Appendix gives details of sizes greater than 68 mm diameter, up to and including size M150. Nominal sizes have been selected from ISO Draft Recommendation No. 940 and proposals which are at present being considered in ISO/TC 2. (SBN: 580 00215 2).

REVISED BRITISH STANDARDS

B.S. 302: 1968 Wire ropes for cranes, excavators and general engineering purposes 15s.

Steel Wire ropes in tensile grade 180 kgf/mm². 19 different constructions (round strand, triangular strand and multi-strand with fibre core; round strand and triangular strand with steel core). 8 mm to 60 mm diameters. Material, manufacture, inspection, testing, acceptance, certificate and delivery. Tables of weights and minimum breaking loads. Recommendations for selection, use and care of wire ropes, information to be given with the enquiry or order, terminology and definitions. (SBN: 580 00203 9).

B.S. 329: 1968 Steel wire ropes for electric lifts 8s.

Three constructions suitable for suspension and ancillary ropes and two for ancillary ropes only. Size 6.5 mm to 22 mm. Single tensile and dual tensile ropes. Material, manufacture, inspection, testing, acceptance, certificate and delivery. Tables of weight and minimum breaking loads. Recommendations for selection, use and care of wire ropes, information to be given with the enquiry or order, terminology and definitions and comparison of metric and imperial rope diameters. (SBN: 580 00201 2).

B.S. 2919: 1968 Low and intermediate density polythene rod for general purposes 8s.

Composition, colour, freedom from defects, diameters, lengths, tensile strength, heat reversion. Methods of test in the appendices. (SBN: 580 00171 7).

B.S. 3530: 1968 Small wire ropes 8s.

Steel wire ropes in 7 constructions. Overall diameter range is 2-7 mm. Round strand and multi-strand ropes with fibre cord and round strand ropes with steel core. Material, manufacture, inspection, testing, acceptance, certificate and delivery. Tables of weights and minimum breaking loads. Appendices giving information to be given with the enquiry or order and terminology and definitions. (SBN: 580 00202 0).

SPECIAL ISSUE

Addendum packet No. 25 to B.S. Handbook No. 3. Summaries of British Standards for building materials and components 20s.

This packet comprises 9 summaries of standards not previously included, also addendum sheets to cover revisions or amendments issued for 17 standards since the publication of the twenty-fourth addendum packet. The information includes a revised numerical list, alphabetical index and SfB index, and is correct to 1 March 1968. From 1 May the additions and revisions in this and the previous addendum packets will be incorporated in all copies of Handbook No. 3 sold (price 130s (in 2 vols.))*. Holders of Handbook No. 3 who have registered with BSI have been notified of the availability of the new addendum packet.

**Handbook No. 3 is now supplied with the summaries divided between two binders because their bulk exceeds the capacity of a single binder. Separate binders are available if required, price 20s each.*

AMENDMENT SLIPS

Please order amendment slips by quoting the reference number (PD ...) and not the B.S. number.

	Ref. No.
B.S. 196: 1961 Plugs, socket outlets, cable couplers and appliance couplers with earthing contacts. Amendment No. 3	PD 6384
B.S. 888: 1950 Slip (or block) gauges and their accessories. Amendment No. 1	PD 6368
B.S. 1449: 1956 Steel plate, sheet and strip. Amendment No. 3	PD 6346
B.S. 1945: 1953 Fireguards for heating appliances (gas, electric and oil burning). Amendment No. 4	PD 6385
B.S. 2746: 1966 PVC insulation and sheath of electric cables. Amendment No. 1	PD 6372
B.S. 3283: Non-reversible connectors and appliance inlets for portable electrical appliances (for circuits up to 250 v). 3283: Part 1: 1960 13 A connector and appliance inlet Amendment No. 5	PD 6391
3283: Part 2: 1963 6 A connector and appliance inlet Amendment No. 3	PD 6392
B.S. 3601: 1962 Steel pipes and tubes for pressure purposes. Carbon steel: ordinary duties. Amendment No. 5	PD 6381
B.S. 3603: 1963 Steel pipes and tubes for pressure purposes. Carbon and low alloy steel: low temperature duties. Amendment No. 1	PD 6382
B.S. 3346: 1961 Armoured PVC-insulated cables Amendment No. 3 5s.	PD 6418
B.S. 3861: Electrical safety of office machines 3861: Part 1: 1965 General requirements and tests for earthed equipment 3s. Amendment No. 2	PD 6420
B.S. 4182: 1967 Coated carbon steel tubes intended for small bore closed circuit central heating systems. Amendment No. 1	PD 6366

Abstract of Reports

WOOLWICH GROUP HOSPITAL MANAGEMENT COMMITTEE

Report for the years 1965-67

The Report covers the work of the Woolwich Group of Hospitals for the past three years.

Special attention is drawn to that section of the Report which deals with the Group Development Plan. In mid-1967 the Management Committee accepted the Plan which was prepared by the Regional Hospital Board after consultation with the Committee, as a suitable framework within which local hospital services for the future can develop. Although much of the detail arising from the Plan remains to be worked out, the subject is of considerable importance.

Control of Infection Committees, consisting of members of the medical, nursing and administrative staffs, have maintained a close vigilance on all aspects and areas of work which involve risk, namely, wards, operating theatres, kitchens, etc.

This Group is one of several in South-East London which will participate in the services to be provided by an Area Sterile Supply Department which is being established at Hither Green Hospital in the Lewisham Group. This service is not expected to be available to this Group until 1970 at the earliest, and during the interim period some of the local needs will be met by the Sterile Supply Department of the Medway and Gravesend Group.

The period 1965-67 has seen many changes in the Group Laundry which is situated at Brook General Hospital, for it was only in the latter months of the previous period that the final closures of the small laundries at other hospitals in the Group had taken place. The volume of work now dealt with in the one laundry makes a different proposition to the working of previous small units. With the addition of some new machinery, both quality and service have been improved and available labour better utilised.

The section of the Report on Capital Developments records some of the major schemes which have been completed, particularly at the Brook General Hospital, where modern changing rooms are now available for 600 persons, and which are putting this situation right. Other similar provision has been made on a reduced scale at all the hospitals for the improvement of facilities for non-resident staff and providing rest rooms, baths, showers and lockers in the majority of cases.

In August 1966 discussions took place between representatives of the Regional Hospital Board and the Management Committee, as a result of which certain proposals were made for the development of the Group, with a view to the rationalisation of local services. There was general acceptance of the proposed designation of the Brook General and St. Nicholas Hospitals as district general hospitals, of the need to review the maternity services, and of the effect of the increase in population which will be brought about by the Thamesmead development.

The two district general hospitals will be the Brook General and St. Nicholas. Into these two hospitals will be placed the general medical and surgical specialities and, in addition, the Brook General Hospital will continue to provide its various Regional services. With the development of the Brook General Hospital which is now proceeding quickly, it will be possible in approximately eighteen months' time, to begin to transfer the work now carried out at the Memorial Hospital. The accident and orthopaedic service, and part of the general surgical beds, will be transferred to the Brook General Hospital at that time. Further developments will be required at the Brook General Hospital in the years ahead. It is anticipated that the outpatient department at the Memorial Hospital will remain in use in its existing role for some number of years. The development of the Brook General Hospital for its future role is incurring capital expenditure of approximately £200,000 per year, and a considerable sum will still remain to be provided to complete the upgrading process.

The future of St. Nicholas District General Hospital is much governed by the development of the Woolwich and Erith Marshes. In twelve to fifteen years' time it is anticipated that some 60,000 additional people will be living in the vicinity of St. Nicholas Hospital and consequently there must be considerable development of its facilities.

So far as the maternity services of the locality are concerned the development plan envisages the adaptation of the Memorial Hospital to form a maternity unit at the western end of the Group. When complete, this will enable the closure of the British Hospital for Mothers and Babies and the centralisation of other maternity services. At the other end of the Group, Bexley Maternity Hospital will be similarly developed to cater for the needs of that area. When completed it will enable these two latter hospitals to be closed.

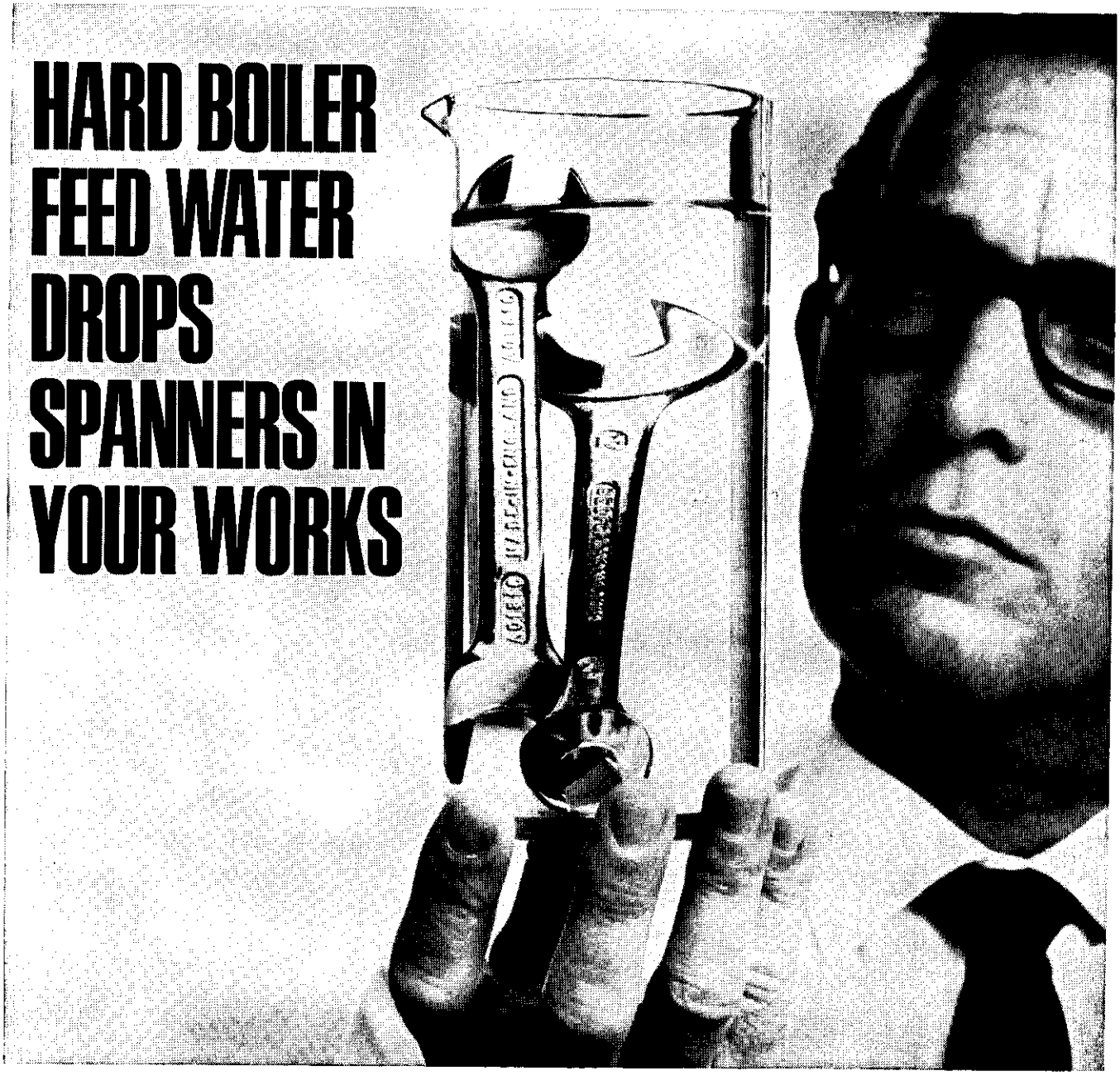
The future roles of the general practitioner hospitals at Eltham, Erith and Bexleyheath, will be as a close association with the respective district general hospitals.

It was recorded in the last Report that there had been an important development in the Regional Thoracic Surgical and Cardiac Unit so that "open heart" operations could be undertaken. This work has been proceeding steadily during the past three years and such operations are taking place regularly at the Brook General Hospital.

Maintenance of Buildings, Plant and Grounds

The continued growth of developments within the Group and the ever increasing demand for higher standards has made it necessary in recent years to cast off the out-dated concept of hospital maintenance and to take up the ideas and techniques of modern industrial practice. This state of change is most evident. Qualified men are now required to manage the building and engineering services and to be supported by skilled technicians. It is most gratifying to report that, during the period under review, steady progress has been made towards this end. Advantage has been taken by senior engineering personnel to attend management study courses, and engineering maintenance staff have been able to obtain technical instruction from the manufacturers of highly specialised hospital equipment.

HARD BOILER FEED WATER DROPS SPANNERS IN YOUR WORKS



Untreated boiler feed water can drop spanners into the works in the shape of constantly growing deposits of calcium and magnesium salts. These deposits steadily lower efficiency, increase operating costs and finally demand an expensive de-scaling operation.

Packaged boilers, in particular, are critical in their water requirements. As the most experienced company in this field, *Permutit* are able to provide the right water treatment equipment to team up with any type of packaged boiler, to build an integrated system, easy to operate and economical in use, which needs no de-scaling and constantly operates at peak efficiency.

One firm alone manufactures both ion exchange resins and ion exchange plant in Great Britain. Avoids divided responsibility to produce highest quality water for any purpose, in any quantity, simply and economically. Combines comprehensive research, development, design and production resources with country-wide installation and service facilities, and outstanding experience of all water treatment problems.

This is PERMUTIT

The first name in Water Treatment

THE PERMUTIT COMPANY LIMITED Pemberton House, 632/652 London Road, Isleworth, Middlesex. Phone: 01-560 5199. Telex: 24440
Cables: Permutit, London. Subsidiary Companies in United Kingdom, Australia, Canada, India and South Africa.

In other directions the programme of **planned replacement and upgrading of plant and services** is beginning to take effect, although this is a problem of immense proportions. New boilers and ancillary plant have been installed in various hospitals to improve the production of steam and hot water for heating and odmestic purposes, and modern high speed equipment has been introduced into the laundry.

At St. Nicholas Hospital, operating theatre sterilising has been upgraded by the installation of high efficiency/high speed autoclaves and other equipment replacing the conventional sterile water sets and hot water strilising equipment. The main lift at the Memorial Hospital was rebuilt and its shaft enclosed. At St. Nicholas Hospital, advantage was also taken, upon the installation of the additional lift in the surgical block, to modify and overhaul the existing lift in that section of the hospital.

New X-ray equipment has been installed at the Brook Genrela, Memorial and Erith & District Hospitals, which involved considerable upgrading of electrical services. As in previous years, major upgrading of mains water, gas and electrical services has taken place, and further nurse/patient call systems and fire alarm systems have been installed. At the Brook General Hospital a new ventilation plant has replaced the system in the neurosurgical operating theatre, and in the bronchoscopy theatre the installation of packaged air conditioning units completely overcame a high temperature condition that had existed for many years.

Much has been done to improve the roads and the car parking facilities in the Group: unfortunately the difficulties of maintenance are becoming more acute due to the increase of road traffic. As the age of the hospitals and buildings in the Group increases more money has, by necessity, to be devoted to the upkeep of fabric. Expenditure has risen on the repair of boundary fencings, and on other fundamental needs such as drainage, roof covering, gutters and downpipes, waterproofing of brick work, and the replacement and repair of window frames.

A large proportion of maintenance monies, as in previous years, has been apportioned to the painting and washing down programme; the results of this consistent effort are now most apparent. The environmental conditions of both patients and staff have been much improved in this respect now that the amount spent each year is approaching £20,000.

ULSTER HOSPITAL AIR-CONDITIONED BY THERMOTANK

THE latest section, the Main Ward Block, of the Ulster Hospital at Dundonald near Belfast, has recently been completed. The first part of the Hospital to be built was begun in 1957. The result is now what is claimed to be "the most modern hospital in the United Kingdom". The Hospital contains a total of 533 beds.

The architects for the Ulster Hospital are Frederick Gibberd and Partners acting on behalf of the Northern Ireland Hospitals Authority. The main contractors for the Main Ward Block were F. B. McKee and Co. Ltd.

The designing of services for the Hospital was done by Murland and Partners, Consultant Engineers for Mechanical and Electrical Services, of Belfast, and the installation of air conditioning for the Main Ward Block was carried out by the Land Contracts Division of Thermotank Limited, Glasgow Office, for the Pipework Engineering Department of Stewarts and Lloyds Limited, who were nominated mechanical sub-contractors.

Many different and highly controlled environments were needed for the various units and facilities which the Hospital provides.

Th installation included air conditioning of four operating theatres and their associated rooms and one burns theatre suite. Ventilation systems were also installed to serve the isolation unit, the intensive care unit, the pharmacy and the central sterile supply department, as well as certain rooms in the general ward units.

The main operating theatre suite consists of two pairs of theatres. Each pair is served by a common sterile lay-up room and wash-up room. Each theatre has its own scrub-up room, anaesthetic room and exit and transfer room.

The whole building is served by four plant rooms, one located at ground level, one on the first floor and the other two on the roof.

The ground floor plant room contains six air handling units working in conjunction with six exhaust fans. The combined capacities of this installation serve the four operating theatres and their associated rooms on the first floor immediately above, together with the conditioned areas at ground level.

Air for the ground floor plant room is drawn in from atmosphere to a filter house. Having left the filtration chamber, the air passes over a cooling coil/heating coil, a steam evaporating type humidifier, silencers, and along high pressure ductwork to attenuator boxes. The air then travels along low pressure duct work to be discharged into spaces through ceiling grilles and distributors.

Exhaust fans have a similar system of ducting, silencers, grilles and attenuator boxes from which all air is discharged to atmosphere.

The plant room on the first floor contains an air handling unit and exhaust fan and serves the adjacent burns theatre and associated rooms.

The other two plant rooms on the roof, although smaller, are designed along similar lines. They serve the remainder of the Main Ward Block.

Control of the installation is fully automatic.

Over five miles of ducting carry and return the conditioned air throughout the building.

MANLOVE SERVICE AWARDS

At a presentation ceremony held on 21st June, 25 years long service awards were presented to four Manlove employees, by Mr. E. S. Hale, Managing Director.

The four recipients were Mr. W. Quinn, Mr. R. Bray, Mrs. E. Tucker and Mr. S. Bridden.

VITAL COMPONENTS FOR MEDICAL MONITORS

Increased facilities introduced by Plessey Components Group

THE Wound Components Division of the Plessey Components Group at Titchfield, Hampshire, has increased its development and production facilities in order to supply vital components for specialised equipments such as medical monitors now being used in hospitals all over the UK and on the Continent.

In the last decade the application of electronic techniques in many diverse fields has resulted in the design and manufacture of a multitude of monitoring devices. The equipment used in the warning, or the predicting, of a course of events may take various shapes or forms, each usually tailor-made for a specific purpose.

During this period, the accuracy and reliability of such equipments have become of paramount importance, and one criteria for the display type of monitor is the dependability of the deflection systems involved. The diversity of application and nature of function has given rise to a necessarily wide range of deflector assemblies, and it is in order to meet these requirements that Plessey has expanded this field of its activity at Titchfield.

In the field of medicine the measurement of physiological parameters is commonplace, either by direct means or by the derivation of two or more other functions. The use of an oscilloscope is an ideal method of measuring these parameters.

Consultation with major hospitals in this country established a positive need for display systems, giving immediate and accurate measurement of a patient's condition. This has led to the introduction of medical monitoring systems for ward, intensive care units and operating theatre usage. Thus, by use of oscilloscopes, slave monitors and remote control units, a comprehensive build-up of vital information may be readily made available to nursing staff and doctors, instigating immediate remedial action, and in extreme cases, prevention of death.

Characteristic of the thorough approach to this problem was that carried out by Lan Electronics Ltd. (Slough) to produce a multi-channel, remotely-controlled, patient monitoring system, capable of high reliability and sensitivity. The design of a large screen oscilloscope using silicon, solid state devices was undertaken. The choice of a 110° display tube, with its large screen area, direct viewing facility and small back-to-front dimension, was of distinct advantage over the currently available 70° and 90° equipment, although this in itself presented power and deflection sensitivity problems.

For medical application it was necessary for the oscilloscope to have an input sensitivity of not less that 10 mv/cm from d.c. to 20 kc/s on any one of four channels, with incremental beam switching at a 4 kc/s rate. This, coupled with a beam slewing rate of 5 micro sec. per cm., gave rise to the fastest magnetically scanned 110° system yet seen. To give the equipment added versatility, facilities for reversing the polarity of X and Y inputs were desirable. Having established these basic requirements, the Plessey Wound Components Division was asked to produce two prototype deflector assemblies for approval.

The type TLA. 20240 series deflector assembly was ideally suited for the tub deflection to be used. The low impedence of the X and Y amplifiers, although not a serious problem, was a difficulty in that to produce the required line inductance, a four-strand wire had to be used and the fill factor and field distribution taken carefully into account. To facilitate the reverse polarity requirement and output circuit arrangements, both line and field coil windings were split, and termination brought out separately to the tag board.

During the manufacture of this type of assembly, great care is taken at every step of the process to ensure high standards of performance. Initially, the ferrite cores used are checked for physical dimensions and permeability to gain the maximum sensitivity in the finished component.

The two halves of the core are then mounted on the same winding machine and the field coils wound simultaneously, eliminating any errors in the angle of winding, number of turns, number of layers and final resistance figures. Calculated displacement of the windings in relation to the core halves reduces the effects produced by the earth's magnetic field to a minimum.

The two line coils are similarly cared for, being wound on the same mandrel, resulting in a matched pair whose number of turns, flare angle and inductance measurements are closely compatible. Prior to removal from the mandrel, each coil is shaped by an hydraulic press (0-40 lb/sq in) and bonded in shape by passing d.c. current through the coils for a predetermined period of time.

It is now that the two sets of coils finally come together and are assembled as a complete unit before further checks are carried out. Now the tag board is fitted and lead out wires soldered into place. At this stage the field and line coils are measured for mutual inductance and the position of the field coils adjusted in relation to the latter to give a satisfactory coefficient of coupling.

The deflector assembly is then ready for picture testing. This is carried out using a tube of which the performance characteristics have been carefully measured against a standard deflector assembly. The assembly under test is first checked for orthogonal distortion, the X and Y axis being adjusted if necessary to be $90° \pm \frac{1}{2}°$ to each other. This being done, picture geometry errors are measured against a graduated graticule whereby the performance specifications may be checked. Small adjustment of picture geometry may be produced by the use of magnets situated around the periphery of the front end mouldings of the deflector assembly and, for this particular application, four magnets were provided to allow adjustment to be made when the coil and tube are in situ. Picture shift rings are then fitted to the rear end moulding and the production cycle of the deflector assembly is complete.

Since the production of the two prototypes and their subsequent approval, many hundreds of these oscilloscopes have been installed in hospitals throughout this country and the Continent, providing medical monitoring to a high degree of accuracy and reliability. At this moment they are actively engaged in safeguarding patients' lives.

On the Market

A review of new equipment and materials and their development

HOVAL THERMOSTATIC RADIATOR VALVES

A completely new fully-automatic thermostatic radiator valve, fitted instead of an ordinary radiator valve and designed to maintain room temperature at the level set on the control knob, has just been introduced by **Hoval Boilers (U.K.) Ltd.**, Northway House, High Road, Whetstone, London, N.20 ('phone 01-445 0454/7). This makes it possible to select and to maintain, accurately and automatically, the required temperature in each individual room where a central heating system is installed.

Available in ½ in. and ¾ in. straight or elbow pattern, the valve consists of three basic components. The valve itself has a screwed brass body, and incorporates a brass valve disc and stainless steel spindle. All visible surfaces of the valve body are nickel plated.

The thermostatic regulating equipment, which screws on to the valve body, is fitted with a graduated white plastic control knob to allow room temperature to be regulated and maintained at between 5°C. and 25°C. (41°F. to 77°F.) as desired. This regulating equipment also incorporates a sensitive chromium-plated device which safeguards against faulty reading due to other heat sources, and a thermostat with safety equipment to avoid damage through overheating. The third component is a protective cover.

ADVANCE IN ELECTRO-HYDRAULIC LIFTS

A major step forward in the design and capabilities of electro-hydraulic lifts has been announced by **Becker Equipment & Lifts Ltd.,** Rosemont Road, Alperton, Middlesex. The new advance—a long-travel high-speed lift—embodies a series of patents.

Well designed and properly installed electro-hydraulic lifts can be extremely smooth in operation. This advantage springs from the use of oil as the operating medium which allows slowing motion, on approaching or leaving floors, to be a standard feature instead of a costly addition.

Electro-hydraulic lifts level very accurately and Becker guarantee a standard accuracy of ¼ inch. This feature generally eliminates the need for relevelling motors.

Power is supplied to the lift ram cylinders by an electro-hydraulic pump unit which, together with the control equipment, is housed in a compact area at ground level, eliminating a costly and unsightly penthouse motor room. Only a minimum of headroom is required above a Becker lift, and only a shallow pit below it. The lift shaft need only be a light structure as all loading is transmitted by the hydraulic rams direct to the foundations.

The modern electro-hydraulic power unit is extremely quiet and, to ensure complete silence in the car, can be hydraulically muffled. The unit can be sited well away from the shaft in a low cost area of the building.

SPECIAL AIR DUCT HEATERS EX STOCK

In order to give virtually ex stock delivery service of special air heaters, Eltron have introduced a new standard range of open coil air duct heaters. The heater cases are of standard sizes but the kW. loading, voltage and switching arrangements are varied according to individual requirements. All heaters have a stove enamelled casing with flanges on each end, drilled for connecting to the ducting. The elements are mounted on a removable plate so that they may be withdrawn for inspection or maintenance without dismantling the ducting. Safety cut-outs and terminal boxes are fitted as standard. Where any special size of casing is required, i.e. square or rectangular, they can be manufactured on a 3/4 week delivery.

A general catalogue and further details of these heaters or of the sheathed Eltrofin duct heaters can be had from **Eltron (London) Ltd.,** Strathmore Road, Croydon.

G.T.D. GENERATOR SETS

A range of new ligh'weight portable electric generator sets has been introduced by the **Generator & Tooling Development Co. Ltd.,** 53 57, Tudor Road, Leicester.

Three basic models are available with outputs of 1,000, 1,500 and 1,750 watts. These are offered as either 240 V. or 115 V. units, while the 1,500 set is also available for dual voltage. Power is provided by a Norton Villiers 147 c.c. four-stroke air cooled petrol engine, having a single cylinder, 65 mm. bore × 44 mm. stroke, and fitted with a hand operated automatic rewind starter.

The generator, direct coupled to the engine crankshaft, is designed and built throughout to B.S. 2613 and B.S. 170. It is of the level compound wound type, continuously rated at 3,000 r.p.m., drip-proof enclosed and fully suppressed. It is constructed with a rolled steel magnet frame and cast iron end brackets, with removable end cover giving full access to commutator, brush gear and voltage control components. All windings are suitably impregnated for operation under tropical conditions.

Both generator and engine are mounted as a single unit within a robust tubular steel frame providing full protection under site conditions. The base plate is secured to the frame with rubber vibration-free mountings preventing creep when operating.

For heavier duty applications, Generator & Tooling Development Co. Ltd. offer a range of both petrol and diesel driven generators up to and including 3 kVA. Prices are from £76.

LOW-COST ELECTRIC SANITARY INCINERATOR

An electric sanitary incinerator being produced by **Osborn Manufacturing Co. Ltd.,** of 211 Conybere Street, Birmingham 12, is believed to be the cheapest machine of its kind on the market, and costs only £24 16s., plus purchase tax. The Prilect incinerator provides completely safe, hygienic disposal of surgical dressings, sanitary towels or similar waste material. It is simple to operate: the action of opening and closing the door switches on the 500-watt element for a minimum of 10 minutes. If further waste is added during this time, the operating period is extended automatically.

Manufactured in accordance with British Standards Specifications, the unit has no "live" parts which are accessible to the

user. Red and green lights show when the mains supply and heating element are switched on.

The Prilect is secured to the wall by just four screws. Finished in white stove enamel, the machine is of compact design and measures only 23 inches high, 11¼ inches wide and 5¼ inches deep. It weighs 20 lbs. It has also been designed for maximum economy and uses electricity only during the 10-minute destruction period.

Where the machine receives a high rate of use, the normal ratio is one Prilect for every 50 women personnel.

FIRE RETARDANTS FOR BUILDINGS

A recent disastrous hospital fire and the increasing building programme for new hospitals and extensions has focussed attention on the flame-proofing of partitions and hospital building components.

The Albi range of fire retardant surface coatings now marketed by the Rentokil Group's **Celcure Ltd.** provide Class I Spread of Flame Protection under B.S.476 for all timber, plywood, insulating boards and similar materials used in construction.

Albi-R is a two component fire retardant most suitable for softboards, Albi-Saf can be used on most building materials and is available in attractive pastel colours, Albi-Clear provides a gloss or matt protection for wood panelling or cladding.

Full details are available from Celcure Ltd., Felcourt, East Grinstead, Sussex.

PUSH-BUTTON COMMUNICATION

A new internal communications system which enables single push-button contact between extensions, and full loudspeaking communications, has been installed in the Pathology Department at Bromley Hospital, by **Modern Telephones (Great Britain) Ltd.**

The system is called the Modernphone "Ringmaster Compact" and is specifically designed to give instant communications between particular groups of people, departments or smaller organisations. Tone and light signals announce an incoming call and the system retains sound qualities, normally associated with much larger systems.

NEW CONTROL VALVE BY ELLIOTT-AUTOMATION

A new design of automatic control valve, which achieves a marked increase in operating efficiency, is announced by **Elliott-Automation,** 34 Portland Place, London, W.1.

The new "fishtail" valve can do the same control job as a butterfly valve which is a third larger in size and requires twice the operating power. It is now in production at the Fisher Governor factory at Cowdenbeath.

In the new valve the flat discs of the normal butterfly design are replaced by a unique hydrodynamic shape. This enables the valve to control flow accurately throughout the whole of its operating range—from the closed to the fully-open position. Standard butterfly valves can only regulate 70% of total flow capacities. This means that the "fishtail" can control a flow as low as 1% of maximum, providing a "turn-down" ratio of 100:1. Butterfly valves can only achieve a "turn-down" ratio of 33:1.

The new design also enables the valve to handle much higher flow rates without causing cavitation and other undesirable hydraulic effects. Forces resulting from the flow are less than one-third of those affecting the butterfly type.

"Fishtail" valves are available in a standard range of sizes from 3 inches to 14 inches diameter.

NEW RANGE OF RELIEF VALVES

Sir W. H. Bailey & Co. Ltd. (incorporating Whites-Nunan Ltd.), a member of the Yorkshire Imperial Metals Group, announce the introduction of a new range of flanged relief valves for steam, oil, air and water systems where protection against undue pressure rises are required.

Designated type 1516, the new units have bodies of cast iron and bronze valves and seats and are available in six different sizes with bore diameters ranging from 2 in. to 6 in. Working pressures are 190 lb./in.^{2} for steam up to 430°F. and 250 lb./in.^{2} for cold water services—maximum back pressure is 150 lb./in.^{2}

One of the main features of the new valve is its totally enclosed spring which is of the low rate type in order to give maximum lift with minimum pressure accumulation. During normal working conditions the valve is pressed firmly into the seat by the spring. Any pressure rise above the set pressure causes the valve to lift and discharge the flow medium through the outlet port, thus ensuring against excessive pressure arising in the pipework system.

For bore sizes up to 3 in. dia. the internal components are interchangeable with the Bailey type 1640 bronze relief valve.

Further details of these units including price and delivery are available on request to the manufacturers at Sharp Street, Walkden, Worsley, Manchester.

NEW FLEXELLO RUBBER TYRED STEEL DISC WHEELS

Flexello's new "WCS" series of steel disc wheels have ribbed rubber tyres which offer low tractive resistance and are capable of withstanding high shock loads. Despite their light weight the wheels have a high load capacity—650 lb. in the case of the largest size.

Wheels of 6, 8 and 10 in. diameter are available with plain or roller bearings. The plain bearing consists of two flanged nylon bushes impregnated with molybdenum disulphide and is completely self lubricating. The roller bearing is of the caged needle type and is retained in the wheel hub by two pressed steel caps. A grease nipple is fitted for future lubrication.

The 6 and 8 in. wheels are also available in Flexello's heavy duty range of swivel and stationary pressed steel castors. Because of their shock absorbing characteristics the wheels are particularly suitable for use on containers and trolleys carrying fragile loads.

Further information from **Flexello Castors & Wheels Ltd.,** Slough, Bucks.

NEW TOUGH EXTRUDED TUBE AND ROD

Richard Daleman Ltd., of Latimer Road, London, W.10, announce the addition of a new range of clear polycarbonate tubes and rod to their range of Evolite extruded clear acrylic tubes.

The Polycarbonate tube is available initially in outside diameter sizes of ½ in., ¾ in., 1 in., 1½ in. and 2 in. in standard 12 ft. lengths, although any special length can be supplied if required. Polycarbonate rods are available in 6 ft. lengths of ¼ in., ½ in. or ¾ in. diameter.

Clear polycarbonate has many distinctive features including an extremely high impact resistance. In a recent demonstration

a nail was hammered through a section of tube without splitting or distorting the tube in any way.

Other features are its high heat resistance of 160°C., resistance to a wide range of chemicals, good electrical insulation, self extinguishing fire resistance properties and, in its natural state, good light transmission. These features, together with the high tensile and compressive strength of the material, make it suitable for a wide range of engineering applications.

Samples and further details are available from the manufacturers.

SPIRAX HILLS SIGHT CHECK

Spirax-Sarco Ltd., of Charlton House, Cheltenham, Glos. have found their range of Spirax Hills sight checks so successful that they have extended it to include a 1 inch size.

The sight check consists of a sight glass, which gives a particularly clear indication of steam trap operation, combined with a check valve. This simplifies installation and reduces fitting costs.

The check valve consists of a phosphor-bronze ball seating in the top of a copper tube. The ball is visible through the sight glass: this makes the sight check an excellent device for use on liquids, where the position of the ball shows when flow is taking place.

The Spirax Hills sight check has a gunmetal body, and is available in $\frac{1}{2}$ in., $\frac{3}{4}$ in. and 1 in. sizes with screwed connections.

NEW RANGE OF PLASTIC WATER PUMPS

James Beresford and Son Ltd., announce an entirely new range of inexpensive plastic centrifugal water pumps, designated the PV range.

They are of simple plastic corrosive resistant construction in ductile material. They are manufactured in high impact resistant polypropylene. Seals are externally mounted face type with a graphited plastic rubbing face and ceramic stationary face.

Prices range from £12 18s. 6d. with capacities from 100 g.p.h. to 4,500 g.p.h. The larger pumps in the range are available with three phase electric supply. Further details can be obtained from the manufacturers, at Ace Works, Kitts Green, Birmingham 33, who will supply a complete catalogue on request.

LARGE DIAMETER OSMA PIPEWORK SYSTEM

The first complete range of large diameter pipework and fittings available in Britain, ex-stock, is now being marketed by **Osma Plastics Ltd.,** of Hayes, Middlesex. The system can be used for industrial rainwater and effluent systems, extract ventilation, ducting etc.

Pipe sizes of 8-inch, 9-inch, 10-inch and 12-inch are manufactured in unplasticised P.V.C. to the requirements to BS.3505: Amendment No. 3 Class 1 (Non Pressure Series).

The fittings are made in glass reinforced polyester resin (GRP) and will withstand the same pressures as the pipework. With 100 patented fittings in the range Osma are able to cater for 99 per cent of all contracts. In addition, the company will manufacture specials for the odd 1 per cent.

The fittings are socketed at all ends, allowing cheaper installation as plain ended pipe can be used between two fittings. Jointing is by the ring seal method using the Osma ribbed neoprene ring which acts as both a sealing joint and an expansion joint. For this reason it is important that an expansion allowance of $\frac{3}{4}$ inch is made at each joint. A similar method of fixing to that used on the Osma P.V.C. rainwater and soil systems is recommended.

TL2 leaflet covers the system and is available on request.

SELF-CONTAINED DIESEL ALTERNATORS WITHOUT FUEL TANKS!

A unique feature of all Dawson Keith Diesel Generator Sets in the output range 15 kVA to 175 kVA is the absence of conventional high mounted fuel tanks. Fuel is carried in the box sections of the base frame so making a more compact unit.

This arrangement reduces overall dimensions, provides greater fuel capacity, lowers the centre of gravity and increases stability and rigidity.

All these sets are skid-ended and fuel level indicators and drain plugs are fitted as standard. Anti-vibration mountings can be fitted if required for siting on a concrete base.

Further information can be obtained from **Dawson Keith Electric Ltd.,** Hillview Works, Hillview Road, Sutton, Surrey.

A NEW RANGE OF DOORS DESIGNED FOR HOSPITALS

A Colchester based company has started to manufacture a new range of wooden sound resistant and airtight doors. With an average sound reduction index of 35 dB, they are suitable for doctors' consulting rooms, hospital wards, audiometry suites and lecture theatres.

The doors are available in a wide range of finishes and can therefore be installed into existing frames where necessary. An interesting feature is a magnetic strip which is incorporated around the edges of the door to ensure a perfect airtight seal.

A further range of doors constructed from steel is also available, giving even better acoustic performance.

Full technical data is available on request from **Sound Attenuators Ltd.,** Eastgates Colchester, Essex.

WEST OF ENGLAND BRANCH

A meeting of the Branch was held at Lyngford House, Taunton on 9th March, 1968. The Chairman commented that there had been a fifteen per cent increase in Branch membership during the previous year. A film on the building of Hinkley Point Power Station followed by another, "Steambloc Package Deal," were shown.

A meeting at Torbay Hospital, Torquay was held on 18th May. Time was well spent with a tour of the new Boiler House, Mr. R. Burnley explaining the various types of controls. The meeting was disappointed that a talk on I.E.E. Rules was unavoidably postponed.

Notes for Members

THE PLACE OF THE ENGINEER IN HOSPITAL MANAGEMENT 1980

You will no doubt have read "What will really be the shape of Hospital Management in 1980?" published in our March 1968 issue and you will have noted the article's comments upon the Report, "The Shape of Hospital Management in 1980?", resulting from the Working Party set up jointly by the King's Fund and the Institute of Hospital Administrators. You may well have read the Report, too!

The Association of Group Engineers of the Metropolitan Regional Boards remarks that it has been studied with dismay by Group Engineers, among others, since its implementation will adversely affect the career structures of all except the non-technical administrators. This, they feel, must in turn adversely affect and harm the ultimate service to the patient.

The Fulton Report on the Civil Service has acknowledged the need for Professional and Technical staff to be able to progress to higher management positions, yet in the National Health Service the pure administrators appear to be seeking to strengthen their own position and hierarchy by reducing erstwhile immediate colleagues to third and fourth levels of management merely because of the latter's professional or technical status.

The Tyler Report on Hospital Engineers, which was largely accepted by the Minister of Health, argued for the observance of the status of the Group Engineer as a Chief Officer as defined in the earlier P.T.B. Circulars. More recent circulars have reiterated this position, and they feel only harm can follow if Professional and Technical Staff, who are required to obtain qualifications in administration, are reduced to insignificance in the formulation of hospital management policies.

The Association says that "The Shape of Hospital Engineering Management in 1980?", which was produced by a Working Party set up by it, and which we include below, sets out their reasons for differing from the conclusions reached by the King's Fund/I.H.A. Group. The Association feels that, although the report published by the King's Fund was apparently intended only to stimulate future discussion on the pattern of management, it may well be presented as an authority for instituting management changes.

THE SHAPE OF HOSPITAL ENGINEERING MANAGEMENT IN 1980?

Introduction

The Association of Group Engineers, Metropolitan and Wessex Regional Boards had discussed the report of a Joint Working Party set up by the King's Fund and the Institute of Hospital Administrators to consider the future pattern of management in hospitals with particular reference to the needs of District Hospitals. They noted that the report included recommendations concerning the management of engineering although hospital engineers were not represented on the joint working party. The Council of the Association of Group Engineers therefore decided to set up a study group to examine the King's Fund document with particular reference to the proposals concerning engineering and to report whether or not the proposals appeared to be in the best interests of the service. The council also noted that engineering was not the only department dealt with arbitrarily but decided that it should confine its consideration to the engineering implications rather than to attempt to set up a more widely based joint working party.

Results of Inquiry

The King's Fund Report recommended that the engineering and works departments should be combined with Supplies and Hotel Services, Personnel Services and Management and General Office Services, under the control of a Director of General Services. Thus the Group Engineer would be separated from the District Hospital Board by the interposition of two senior managers. The joint working party admitted that this recommendation was not in accord with the recommendation of the Tyler Committee.

The Tyler Report was produced as the result of detailed study of the needs of the service and considered evidence from a broad cross section of interested parties, including the Institute of Hospital Administrators, was accepted by the Minister and has had many of its recommendations put into effect. It should not be set aside unless the needs of the service have altered materially since it was written. The King's Fund Report does not show evidence of any such material change. We therefore studied the Tyler Report to see whether or not it remained valid for the modern district hospital.

Both reports stress the importance of engineering in modern hospitals. The Tyler Committee considered the needs of the present hospitals which have an average age of 75 years, at the same time looking forward to the needs of the modern district hospital. Indeed the objective of the Tyler Committee was to provide the right type of engineer for the engineering service required by modern hospitals.

The Tyler Committee recognised that in the past, "the functions of operation and maintenance have not attracted into the hospital service engineers of the calibre necessary for the modern hospital" and their recommendations were aimed at "encouraging men of the required calibre to enter the service". Already the younger engineers with the higher qualifications called for in the Tyler Report, are recruited into the service. Considerable effort is being put into training hospital engineers in both technical and management subjects. Indeed the required qualifications include evidence of formal management training.

The Tyler Report drew attention to the fact that "medical techniques are increasingly dependent on engineering," "not only has the engineer of today to compete with ever-increasing complexity in providing the traditional services of hospitals, but to a growing extent he contributes to the treatment, as well as to the comfort and well being of the patient. He maintains devices essential for the application of medical science and co-operates with the hospital staff in the development of apparatus and techniques". We

believe that the engineering department has a responsibility for the safety and treatment of patients which is not shared by the other departments with which it is grouped in the King's Fund Report.

We feel that with the short time at our disposal we could not hope to draw up a better statement than the following extract from the Tyler Report: —

> "However, the satisfaction to be derived from a job does not depend on interest alone: responsibility and status are equally important. Under the present Whitley Council agreement (P.T.B. Circular 51)* a Superintendent Engineer is defined as "An officer who is fully and directly responsible to a Board of Governors or Hospital Management Committee" for the engineering services; but we are told that there are a number of Superintendent Engineers who can hardly be said to be fully and directly responsible to the Committee or Board since they exercise their responsibility only through the agency of another officer, usually the Group Secretary. In our view this is quite wrong; the Superintendent Engineer should be fully responsible for technical control and management of everything coming within his field, and he should always attend committee meetings when engineering matters, or other matters which may have engineering implications, are being discussed. We realise, of course, that hospital authorities themselves determine which officers should attend the various committee meetings and that in some cases the reason for non-attendance of the Superintendent Engineer may be that he lacks the personality or administrative ability to secure recognition as a chief officer (we hope that implementation of our recommendations will overcome this in the future); nevertheless we recommend that the Ministry of Health and Department of Health for Scotland should take action to ensure that every hospital authority recognises the Superintendent Engineer as a chief officer of the hospital group, and that, as such, he should attend all relevant committee meetings."

In one respect only did we consider that the recommendations of the Tyler Committee were slanted more towards the older hospitals than the modern hospital and that was in the suggested relation between engineering and building. With the modern hospital the two departments are increasingly interdependent and their activities cannot be separated. We therefore welcome the implication in the King's Fund Report that engineering and building should be combined in one department.

Having carefully reviewed the Tyler Report we are of the unanimous opinion that the recommendations of the Tyler Committee are still valid when considering the engineering needs of the District Hospital. One of the main recommendations was that "Action should be taken to ensure recognition of the Superintendent Engineer as a chief officer of a hospital group and his attendance at relevant committee meetings." We could not find any justification for the rejection of the Tyler Report by the joint working party.

Conclusions

Regrettably, absence of Engineer representation in producing the King's Fund document has, in our opinion, produced a biased report which fails to recognise fully the importance to the Hospital Board of properly qualified Group Engineers.

The Engineering and Building Services, representing as they do, a very large capital investment together with considerable revenue expenditure, justify a qualified engineer with full managerial responsibility to remain directly responsible to the governing body.

As automation and more complex equipment is brought into hospitals, higher skills and qualifications are required by engineers. It is unlikely that engineers of such calibre will be attracted to, or remain in the service, unless the senior posts command sufficient responsibility.

We consider that in the modern district hospital the Group Engineer should manage a combined Engineering and Building Department.

Summary

Whatever organisational structure be set up for managing hospitals in the future, we consider that the Group Engineer must remain directly responsible to the governing body as at present and as recommended by the Tyler Committee. Thus if the organisational structure envisaged in the King's Fund Report were to be implemented, we consider that the Group Engineer must be a Service Director in his own right. This is not to be construed as an acceptance by this study group that the King's Fund Report in general is in the best interests of the service.

*Revised Whitley Council Agreement, P.T.B. Circular 179.

LANCASHIRE BRANCH

The A.G.M. of the Lancashire Branch was held at Prestwich Hospital, Prestwich on 30th March, 1968. The Chairman, Mr. D. H. Mellows, summarised the year's activities and the effect upon Branch arrangements arising from the revised shape of the Institute. He stressed the great importance of adequate training opportunities for engineers and described the attempts being made within the area to assist this cause. He then turned to the future and the possibilities that lay in store.

The Meeting concluded with an address by Mr. J. E. Furness who described the progress that the Institute had made since he took office as its Secretary. Members agreed that the future trend of the organisation would be very interesting and well worth while.

The Branch also met on 25th May at Cranage Hospital, Holmes Chapel.

The meeting commenced with the showing of three films "Project Nigeria", "Building as a team", and "Whatever the weather."

The films describe how the varied specialist resources of a modern building, civil engineering organisation, and Heating and Ventilation industry are co-ordinated to undertake large scale industrial contracts, including hospitals.

The discussion on the three films proved to be very lively and many members expressed a view that the major capital works on hospital rebuilding required more consideration to be given to the aspect of maintenance when the design of new buildings was planned. It was regretted that some buildings were completed with very little thought as to how plant and services would be maintained, consequently the service is more costly to run, and also less efficient.

YORKSHIRE BRANCH

The Branch met at Halifax Royal Infirmary on 6th April, 1968, and listened to a paper by V. Whitaker, O.B.E., County Ambulance Officer, assisted by J. Grundy.

The speaker said that the service covered just about everything from steelworks and mines to docks and mountain rescue. 700,000 persons were conveyed per year and this number was continually increasing. 171 vehicles were involved, maintained by a staff of twenty eight. A full-time training school had been established and Group Control was being developed.

Communications were by teleprinter, telephone and V.H.F. radio, the latter showing an annual savings of up to £80,000. The only way to work economically was to keep vehicles working fully and rarely did a vehicle return to base during a shift.

The maintenance aspect was most important and nine vehicles could be serviced at any one time. Vehicles were designed specially for the work and were all fitted with Borg-Warner automatic transmission. Every 5,000 miles an Inspector carried out a check personally and a full workshop check and overhaul was undertaken every 15,000 miles. Exchange units were used extensively and this was a proven economy.

Index to Advertisers

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Classified Advertisements

SITUATIONS VACANT

CENTRAL KENT HOSPITAL MANAGEMENT COMMITTEE

HOSPITAL ENGINEER

Applications are invited for the post of Hospital Engineer to be responsible to the Group Engineer for the satisfactory operation, maintenance and co-ordination of engineering services—mechanical and electrical—at the West Kent General Hospital (161 beds), Kent County Ophthalmic and Aural Hospital (106 beds) and Fant Lane Hospital, Maidstone (20 beds).

Applicants, who must have completed an apprenticeship in mechanical engineering and have acquired a thorough practical training, should possess one of the following qualifications:—

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

(2) City and Guilds Certificate in Plant Engineering;

(3) *Ministry of Transport First Class Certificate* of Competency which includes an Ordinary National Diploma or Ordinary National Certificate

OR

(4) An equivalent qualification approved by the Ministry of Health.

Salary £1,270 rising to £1,500 with a responsibility allowance of £25 a year.

Applications stating age, details of training, qualifications and experience, together with the names and addresses of three referees, to be sent to the Group Secretary, Central Kent Hospital Management Committee, 103, Tonbridge Road, Maidstone, Kent, as soon as possible.

TOTTENHAM GROUP HOSPITAL MANAGEMENT COMMITTEE

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-£1,500 (£1,370-£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.

HUDDERSFIELD HOSPITAL MANAGEMENT COMMITTEE
HUDDERSFIELD ROYAL INFIRMARY

Applications are invited for the post of HOSPITAL ENGINEER to be responsible to the Group Engineer for the services at the above new District General Hospital of 528 beds. Applicants must have completed an apprenticeship in mechanical or electrical engineering or have otherwise a thorough practical training as appropriate to the duties and responsibilities of the post. Applicants must also hold one of the following qualifications or an equivalent qualification approved by the Minister of Health.

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

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

(iii) Ministry of Transport 1st Class Certificate of Competency *if it includes an Ordinary National Diploma or Ordinary* National Certificate.

N.H.S. Whitley Council Conditions of Service. Present salary scale £1,192 to £1,400 p.a. plus a special responsibility allowance of £100 p.a. The scale will be increased on 1st September, 1968 to £1,270 to £1,500 p.a.

The previous applicants need not re-apply as all applications will receive consideration.

Applications with full particulars of age, qualifications and experience, together with the names and addresses of three referees, to be sent to the undersigned immediately.

H. J. JOHNSON, Group Secretary, Huddersfield Hospital Management Committee, Group Headquarters, St. Luke's Hospital, Huddersfield.

ROYAL EARLSWOOD HOSPITAL MANAGEMENT COMMITTEE

An ASSISTANT ENGINEER is required for duty in the above Group of Hospitals for mentally subnormal patients.

The successful candidate will be required to be resident at Farmfield Hospital, Horley, Surrey, where a detached house is available for rental.

Candidates must have served an engineering apprenticeship and hold a recognised qualification, Ordinary National Certificate in Engineering or equivalent.

Salary scale £917 rising to £1,192 per annum (from 1.9.68 £975 rising to £1,270).

Applications giving details of training etc. together with the names of two referees to be sent immediately to:— The Group Secretary, Royal Earlswood Hospital, Redhill, Surrey.

SOUTHEND-ON-SEA AND RUNWELL HOSPITAL MANAGEMENT COMMITTEE

Applications are invited for the post of Group Engineer to the above Hospital Management Committees (joint appointment) covering the following hospitals:—

(a) General Hospital, Southend—268 beds (large extension in progress)
(b) General Hospital, Rochford—620 beds
(c) Runwell Hospital—1,052 beds
(d) Westcliffe Hospital—114 beds
(e) Victoria Hospital—46 beds
(f) Shoebury Hospital—32 beds

Salary scale £2,305, rising to £2,685. Additional gratuity payable (maximum 10 per cent of salary) for hours worked over and above 38 per week. Post vacant early October. Other conditions of service, including training and qualifications, in accordance with those agreed by the Health Service's Whitley Council. Applicants must have had a wide experience in the management of modern mechanical and electrical engineering plant.

Applications, including the names of three referees including one from existing employer, to be forwarded to the Group Secretary of the Southend Hospital Management Committee at the General Hospital, Rochford, Essex, by 12th August, from whom further information may be obtained concerning duties attached to the post.

ROYAL EARLSWOOD HOSPITAL MANAGEMENT COMMITTEE

GROUP ENGINEER required for this Group of 4 Hospitals for the mentally subnormal totalling 1,270 beds.

Post vacant in October 1968 carries responsibility for all mechanical and electrical engineering services and co-ordination of building maintenance.

Applicants must be thoroughly experienced and hold at least one of the following qualifications or an approved equivalent:—

(i) H.N.C. or H.N.D. in Mechanical Engineering with endorsements.

(ii) H.N.C. or H.N.D. in Electrical Engineering with endorsements.

Whitley Council conditions. Salary Scale £1,650 to £1,930 plus special responsibility allowance, at present £25 per annum. A house is available on the Hospital Estate.

Further particulars and application form from: The Group Secretary, Royal Earlswood Hospital, Redhill, Surrey.

ELECTRICAL ENGINEER

MINISTRY OF WORKS

KENYA

DUTIES: To be responsible for entire hospital maintenance including buildings, building services and equipment; liaising with Ministry of Health on hospital design; the training of local staff.

QUALIFICATIONS: Applicants, aged up to 50 years, must be M.I.E.E. or possess a qualification accepted by the Institution as equivalent and have considerable relevant experience.

TERMS: Basic salary, according to experience in scale £Kenyan 975 p.a. rising to £Kenyan 1,791 p.a. (£Sterling 1,138-2,090 p.a.) liable to Kenya income tax. In addition, an allowance, normally tax-free, ranging from £Sterling 752 to £Sterling 958 p.a., will be paid by the British Government direct to the officer's bank account outside East Africa; 25 per cent terminal gratuity; initial contract for 2 years.

Free family passages and medical attention; children's education allowances; accommodation at moderate rental.

Applicants, who should normally be nationals and permanent residents of the United Kingdom or the Republic of Ireland, should write, giving full name, age, brief details of qualifications and experience to:

Appointments Officer,
Room 301,
Ministry of Overseas Development,
Eland House, Stag Place,
London, S.W.1.

quoting Ref. No. RC 210/95/04.

COLDEAST AND TATCHBURY MOUNT HOSPITAL MANAGEMENT COMMITTEE

Coldeast Hospital, Sarisbury Green, near Southampton.

HOSPITAL ENGINEER required at Coldeast Hospital (684 beds —Psychiatric for the mentally subnormal) to be responsible for the engineering and maintenance services of the hospital which includes the Group Laundry.

Applicants should be familiar with planned maintenance procedures and must have a sound knowledge of boiler plant, mechanical and electrical equipment, wide experience in their maintenance and should possess one of the following qualifications:—

(i) C. & G. Mechanical Engineering Technicians Certificate (Part II) to include Plant Maintenance and Works Services.

(ii) C. & G. Certificate in Plant Engineering.

(iii) M.O.T. First Class Certificate, including an O.N.D. or O.N.C.

A house is available if required.

Salary scale £1,192 to £1,400 (£1,270 to £1,500 with effect from 1st September, 1968), plus a special responsibility allowance of £25 per annum.

Applications with details of training, qualifications and experience, naming two referees, to Group Secretary, Loperwood Manor, Calmore, Southampton SO4 2RZ, by 24th August, 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 O.2 level, or with endorsement in) Applied Heat and Applied Mechanics, provided he has suitable experience in Mechanical Engineering.

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

National Health Service Whitley Council Conditions of Service; present salary scale £1,192 to £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 the names of three referees, to be sent to the Group Secretary, Peterborough and Stamford Hospital Management Committee, Memorial Hospital, Peterborough.

BOARD OF MANAGEMENT FOR GREENOCK AND DISTRICT HOSPITALS

ASSISTANT ENGINEER

(based at Greenock Royal Infirmary) required for Sub Group of five hospitals.

Duties are to assist the Hospital Engineer in the supervision and maintenance of mechanical and electrical services in the Sub Group.

Applicants must have served an apprenticeship in Mechanical or Electrical Engineering and hold an Ordinary National Certificate or equivalent qualification.

Salary Scale £917-£1,192 per annum to be increased to £975-£1,270 per annum with effect from 1st September, 1968.

This post offers an excellent opportunity for a young engineer who wishes to enter the field of Hospital Engineering which offers possibilities for technical training and promotion.

Applications, giving details of age, qualifications and experience, together with the names and addresses of three referees, should be sent to the Group Secretary and Treasurer, 47 Eldon Street, Greenock, not later than 26th August, 1968.

QUEEN ELIZABETH II HOSPITAL WELWYN GARDEN CITY, HERTS.

ASSISTANT ENGINEER required. Post will provide good experience for young man seeking to enter the Hospital Service and day release facilities for study may be given.

Applicants should hold the Ordinary National Certificate in Engineering. Commencing salary £917 per annum (from 1.9.68 £975 rising to maximum of £1,270).

Applications stating age, qualifications, experience and naming two referees to Deputy Group Superintendent Engineer, St. Albans City Hospital, St. Albans, Herts.

CHICHESTER AND GRAYLINGWELL GROUP HOSPITAL MANAGEMENT COMMITTEE

1. DEPUTY GROUP ENGINEER

Salary scale £1,279-£1,492 (£1,370-£1,605 from 1.9.68) plus £125 p.a. responsibility allowance.

2. HOSPITAL ENGINEER (ST. RICHARD'S HOSPITAL)

Salary scale £1,192-£1,400 (£1,270-£1,500 from 1.9.68) plus £75 p.a. responsibility allowance.

The first phase of a District General Hospital development has just started within the Group, which comprises 9 hospitals, including General and Psychiatric Units, providing a wide range of engineering experience and good prospects.

Candidates must hold the appropriate qualifications as approved by the Ministry of Health.

Conditions of Service are in accordance with Whitley Council Agreements.

Applications, naming two referees, to the Group Secretary, St. Richard's Hospital, Chichester, Sussex, from whom particulars of duties, etc., may be had.

GLENSIDE AND BARROW HOSPITAL
MANAGEMENT COMMITTEE
BRISTOL

GROUP ENGINEER required for this Group of three Psychiatric Hospitals—Glenside (1,005 beds), Barrow (420 beds) and the Day Hospital. The post carries responsibility for the full range of mechanical and electrical engineering services including an Area Laundry and also control of a large direct works staff for the building maintenance of the Group and the Offices of the Regional Hospital Board.

Applicants must have had a wide experience in the management of mechanical and electrical engineering plant and should hold the following:—

(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.

Salary scale £1,650 to £1,930 plus responsibility allowance of £100 and a special allowance of £100 for maintenance work for the Regional Board. The officer appointed will be required to reside within easy reach of Glenside Hospital. A semi-detached house is available on the hospital estate at a current inclusive rental of £165 per annum if required.

Further information about the post may be obtained from the Secretary, Glenside Hospital, Stapleton, Bristol, to whom applications, including names of three referees, should be sent by 10th September, 1968.

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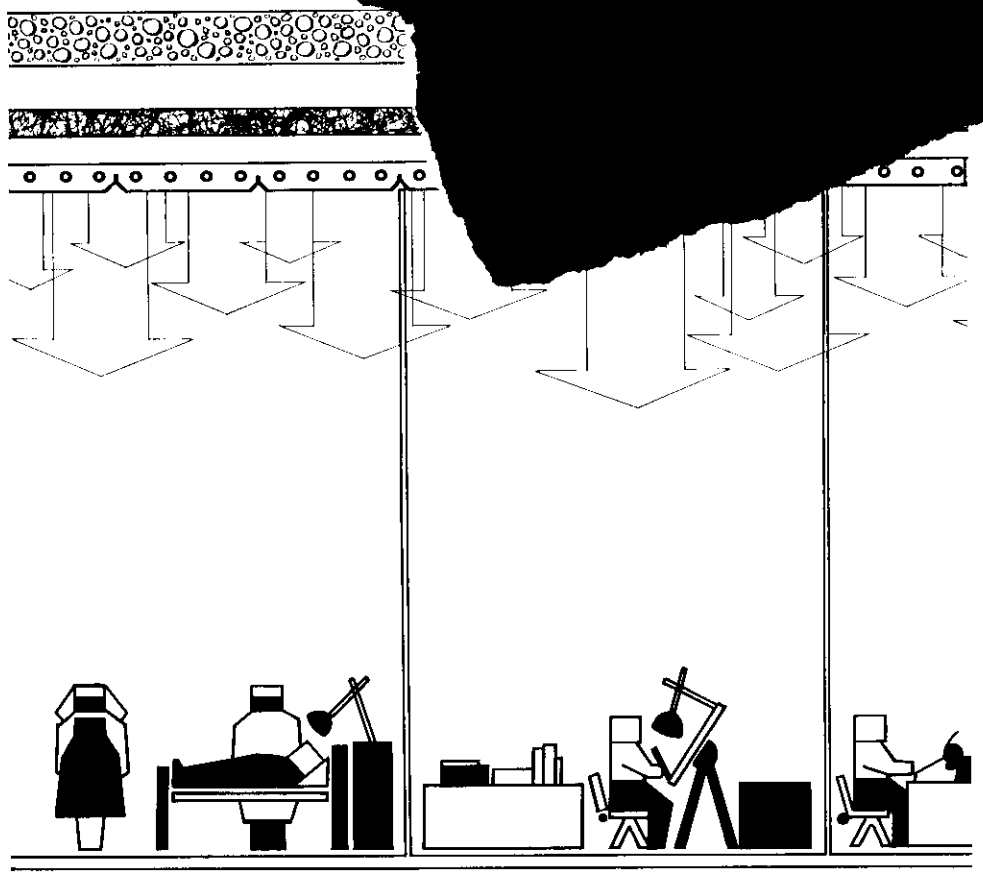

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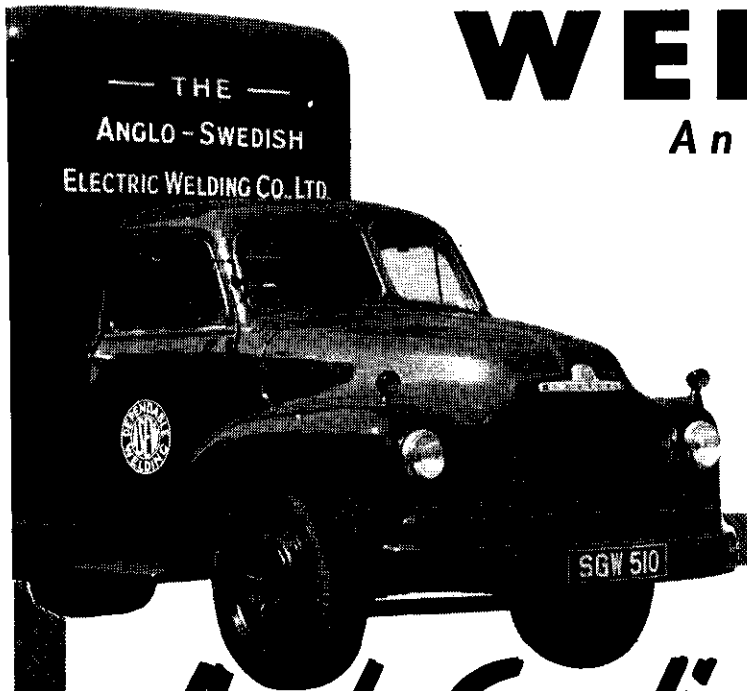

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