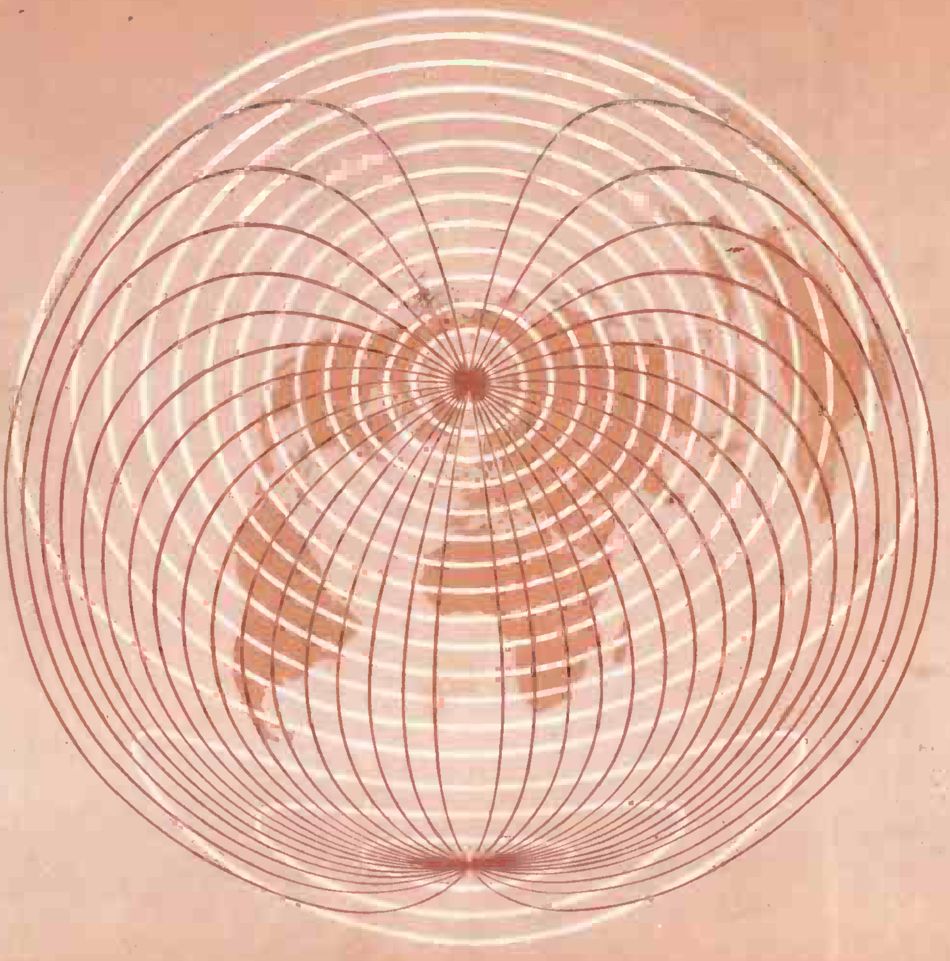
Wireless World

JANUARY 1951 · TWO SHILLINGS



RADIO, TELEVISION AND ELECTRONICS

January 1951

Wireless World

RADIO, TELEVISION AND ELECTRONICS

40th YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK M.I.E.E.

Editor: H. F. SMITH

PUBLISHED MONTHLY: Price 2/- (last Thursday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1. *Telephone:* Waterloo 3333 (60 lines). *Telegrams:* "Ethaworld, Sedist, London."

ANNUAL SUBSCRIPTION:
Home and Overseas, £1 7s. 0d., U.S.A. $4.50, Canada $4.00

BRANCH OFFICES:

Birmingham: King Edward House, New Street, 2.
Coventry: 8-10, Corporation Street.
Glasgow: 26B, Renfield Street, C.2.
Manchester: 260, Deansgate, 3.

In This Issue

Wireless World

JANUARY 1951 VOL. LVII. No. 1.

Fire and Shock

IT would be unwarrantably alarmist—indeed, quite untrue—to suggest that domestic broadcast and television receivers are serious sources of electrical dangers to their users. On the contrary, by their nature and method of use they are probably responsible for fewer fires and cases of shock than any one of half a dozen household electrical appliances. However, it seems well established that fires ascribed to receivers are on the increase. Though the actual number may be trivial, the curve is rising very steeply. Further, the fire risk due to television is disproportionately large as compared with sound-only sets. One of the reasons for the increase, no doubt, is that the average age of sound receivers is increasing; many are over 10 years old. Television troubles may be partly due to the newness of the design technique.

Electrical engineers in the old-established branches are apt to express disapproval at the absence from radio receivers of the protective measures to which they are accustomed, but, when pressed to go into details and to make constructive suggestions, they are generally forced to concede that methods applicable to other appliances would be either impracticable or ineffective. Perhaps, though, there is a grain of truth behind these strictures; some designers in the rapidly growing radio art, concerned mainly with fundamental developments, may feel inclined to take safety precautions in their stride. Others may still be influenced by the practices of an earlier epoch when radio equipment was designed for operation entirely by those trained in its use, and not by the ordinary householder. There was a day when transmitter h.t. bus-bars were unguarded and when the user depended entirely on his nose for warning that something should be done to check an incipient fire.

Be that as it may, all designers are now well aware of the problems involved, and it is all to the good that they should be freely discussed, as there is still divergence of opinion as to which precautions are most effective. An article printed on another page describes the general nature of fire and shock risks, and also deals with some of the more widely accepted protective devices and methods of attack.

Of these devices, the so-called temperature fuse is the most interesting. The conventional electrical fuse, depending for its protective action on the passage through it of an excessively heavy current, has a distinctly limited application in radio equipment. The temperature fuse, which can be arranged to interrupt an electrical circuit when the temperature of a component to which it is attached (or of the surrounding air) reaches a dangerously high level, overcomes many of the disabilities of the older method. Some of these disabilities can, however, be overcome by using time-delay fuses which are not "blown" by surges. In its cheapest and simplest form the temperature fuse consists of a short conductor of low-melting-point alloy, but a number of rather more complicated arrangements are possible.

Devices of this kind have been used for some time and are standard articles of commerce. Some temperature fuses can be reset by the user, but we imagine the kind favoured for domestic radio sets will require attention from the service technician, who will at the same time investigate the cause of the rise in temperature that caused the fuse to "break."

Fortunately, the extra precautions that meet with favour are not unduly costly, nor are they likely appreciably to increase the susceptibility of a receiver to develop faults in normal service.

Information as to the precise causes of fire (and to a lesser extent shock) brought about by domestic receivers is hard to come by. We suspect in many cases the associated section of the domestic wiring is as much to blame as the radio equipment proper. For instance, judging by correspondence and our own observation, it is all too common to find electrical outlet sockets switched in the "dead" lead. However, that is no reason why radio sets should not be as far beyond suspicion as all reasonable precautions can make them. None of us want a state of affairs to arise where the reporters of the lay Press, instead of ascribing the causes of a fire to the classical "fusing of an electric wire," decide there is more news value and modernity in fires caused by "a faulty television receiver."

Safety Precautions

Reducing Fire and Shock Risks in Domestic Receivers

By F. C. CONNELLY, Ph.D., A.M.I.E.E. (Murphy Radio)

DURING the past two or three years there has been considerable interest, both in this country and internationally, in the safety aspects of domestic electrical equipment. Radio apparatus has naturally been included in the discussions and a considerable amount of work on the problem has been carried out in the industry. It should not be assumed from this that radio receivers have been found to be a serious source of danger; they are, in their normal state, probably much less likely to cause accidents than many other domestic appliances. Nevertheless there have from time to time been fatalities from shock or fire, nearly always due to mishandling by the user or to deterioration of components within the receiver. Because of this several organizations representing the various interests connected with radio and television have been attempting to reduce these already small risks to even smaller dimensions.

In this country the British Radio Equipment Manufacturers Association has taken an active part in investigating possible causes of trouble and the British Standards Institution is in the process of redrafting BS415 to accord with current developments. In some countries, notably the Scandinavian ones, compliance with the national safety specification has to be certified by the official testing laboratory before a receiver or other domestic appliance can be marketed. Naturally there has been a tendency for each country to decide upon slightly different requirements and this has hampered international trading; in consequence several meetings of the radio-communication committee of the International Electrotechnical Commission have been devoted to discussion on the points of divergence and at the recent I.E.C. meeting in Paris a very large measure of agreement was reached. Representatives of both the testing institutes and the manufacturers are present at these meetings so that a balanced solution can be found.

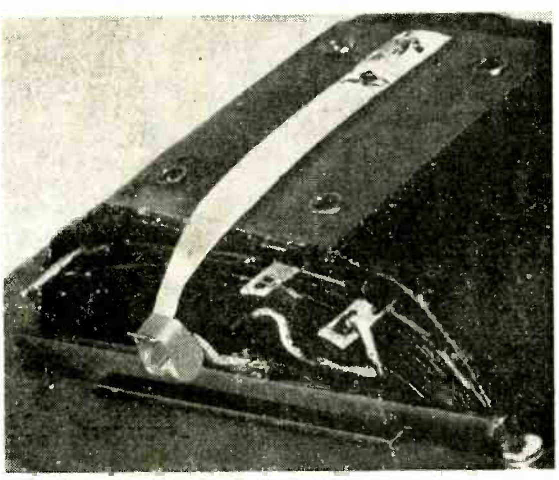
In Britain the electrical supply organizations have favoured the earthing of exposed metal parts on electrical appliances of all kinds as an important measure of safety. To meet the earthing requirements portable apparatus has usually to be installed with three-core cables and three-pin plugs, although certain exceptions are permissible. From safety considerations it would appear to be desirable that radio receivers, too, should be installed with three-core leads to ensure the efficient earthing of exposed metal parts, including (as regards mains frequencies) the aerial and earth leads, pickup, loudspeaker, etc. Unfortunately the requirements of safety and reduction of man-made interference are likely to be in conflict here and some alternative to the earthing technique would be desirable. On the continent, earthing of domestic appliances is not the usual practice and little reliance is placed on it. As probably the majority of users of radio sets even in this country have no facilities for connecting their apparatus to an earth continuity conductor in their house, earthing can at best only be regarded as an additional precaution rather than a primary method of ensuring safety.

Possible Dangers.—The principal electrical dangers which can arise in a receiver are shock from touching some live part of the apparatus and fire from overheating. The reason why so much thought has been given to these hazards in receivers is not the frequency of their occurrence but the fact that the circuits of these devices are much more complicated than those of most other domestic apparatus. Straightforward fuse protection, for example, is often impracticable owing to the large current surge which occurs when a set is first switched on. Again, the rise in input current due to a fault in one part of the circuit may be too small to ensure operation of a fuse in the mains circuit and yet the consequent overheating in that part may be sufficient to start a fire. Fires in radio equipment, particularly television, are actually a greater cause of anxiety than shock risks and much of the recent work has been concerned with means of minimising the effects of overheating following the breakdown of insulation.

The most important development in the pursuit of an improved standard of safety is the recognition that certain components or methods of construction may become faulty during the life of a set in such a manner

A typical temperature fuse fitted to a mains transformer. The primary circuit is completed through the replaceable stirrup joining the two contact strips. The inner strip of copper is inserted between the windings when the coil is wound and if the temperature becomes excessive the stirrup, which is joined together by low-melting-point alloy, flies apart under the action of the outer spring strip.

Courtesy Mullard Electronic Products



as to endanger persons using it. According to this principle a receiver cannot be considered to be completely safe unless it remains free from danger even when these components have failed. The faults which are expected to occur are mostly breakdowns of insulation such as that of an electrolytic capacitor, or between the electrodes of a valve; when a short-circuit occurs at any or all of these doubtful points, the equipment should either remain safe or protective devices must come into operation to disconnect it from the supply mains. It is convenient in what follows to describe an apparatus as operating under "normal conditions" when it is in the state in which it was designed to be used and under "fault conditions" when artificial short-circuits (or in some cases open-circuits) have been applied to any or all of the points specified as being of doubtful insulation (or liable to disconnection).

"Normal Condition."—Taking first of all "normal conditions," so long as a receiver remains in the state in which the designer intended it to be the risk of an accident is very small. Naturally no designer would knowingly turn out a model in which he thought there was a risk of contact with live parts or in which excessive temperatures were reached. It is, however, somewhat a matter of opinion as to what is, for example, the highest permissible operating temperature for a particular kind of material and also exactly what degree of protection is required against contact with live parts—it would no doubt be possible to get a shock from almost any mains-operated device if one were sufficiently ingenious in poking knitting needles and such things into it! To arrive at a uniform standard of safety in respect of contact with live parts it is necessary to adopt standardized contact devices which are applied to different parts of an apparatus to see whether they can be made to touch dangerous points. For most situations an artificial "standard finger" is used (Fig. 1); this is 12 mm diameter and 80 mm long, tapered and flattened at the end to represent the general shape of a human finger and provided with two joints which can be set to any angle assumed by a real finger. In addition to this general test, certain parts such as control shafts on sets with live chassis are checked for accessibility with special test devices, such as a 2 mm flexible cord.

On the fire risk side the temperature rises of the working parts of reputable receivers under normal operating conditions are nearly always well below the danger point, but, again for uniformity, maximum working temperatures for different classes of materials are laid down in test specifications as well as the highest allowable temperatures for external parts such as control knobs, cabinet, etc.

"Fault Conditions."—As already indicated, compliance with the requirements for "normal operation" involves few departures from usual practice and most current production receivers satisfy these conditions. It is in providing the protective arrangements to ensure safety from shock and fire under fault conditions (when any part which cannot be reasonably considered completely reliable has broken down) that most of the ingenuity is required.

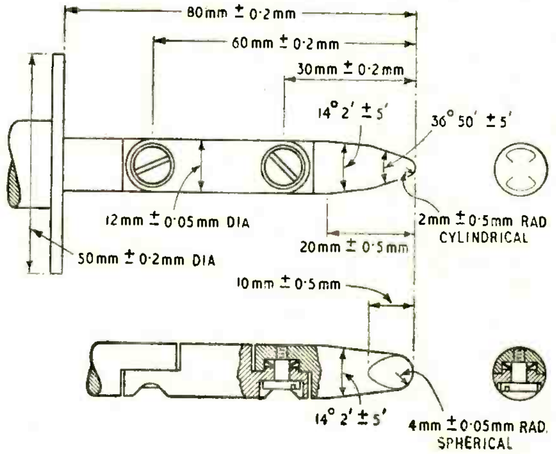
The parts which are generally considered to be liable to breakdown, besides the electrolytic capacitors and valve electrode clearances already mentioned, include rectifiers of any type, variable and air-dielectric capacitors, varnish or enamel layers (except as inter-turn insulation in coils) and any creepage or clearance distances in air or in vacuo less than certain figures laid down. To prevent danger when a failure occurs in one of these parts the designer has several courses open to him: he can avoid the use of the components in question, arrange that no danger is present even if they are short-circuited, or, thirdly, employ fuses or other overload devices to disconnect the circuits. The first method—refraining from using the parts named—is hardly practicable in all cases. It is sometimes not difficult, as in the case of an output transformer subjected to a large current because the output valve electrodes are short-circuited, so to proportion a part that it can take the overload without reaching dangerous temperatures or failing in primary-secondary insulation, but usually the designer has to apply the third method of finding a way of providing protection by some form of cut-out.

It must not be forgotten that safety from shock as well as fire risks is involved under fault conditions. For example, the clearance distances between any live parts and any accessible metal parts must never be less than the specified distances, nor must paint or textile material be used as the sole insulation for live parts; these would have to be short-circuited during the fault test. Aerial, earth, loudspeaker and pickup sockets must, in principle, be considered as accessible parts, even if the sockets are so recessed as to prevent contact with the standard test finger, because the user is liable to connect bare, or lightly insulated, leads to these points when installing his receiver. In consequence of this, the insulation between high-voltage points and these circuits must not depend on air-dielectric or variable condensors nor must it be possible for a breakdown between any pair of valve electrodes to put an unsafe voltage on these sockets. The case of an output transformer already mentioned is a more complicated one, involving, as it does, both fire and shock considerations. Generally speaking, however, fire is the most likely contingency which has to be met under fault conditions and some typical problems and their solutions will be examined.

"Isolated Apparatus."—Take first of all an A.C. receiver supplied from the mains through a double-

Fig. 1. A "standard finger" for checking whether live parts are sufficiently guarded against contact. This device has been standardized internationally.

Courtesy British Standards Institution



wound transformer—an "isolated" receiver as it is described in "safety" terminology (see Fig 2). Short-circuits in the heater or pilot lamp circuits or in the h.t. rectifier, reservoir capacitor or perhaps even in the smoothing capacitors are bound to increase the current through the mains transformer primary to an appreciable extent and it might at first sight have been considered satisfactory to deal with these faults by inserting a fuse in the primary circuit. Unfortunately, this is not such a straightforward method as might have been expected, because at the moment of switching on a very large current surge may occur. The magnitude of the peak current reached depends on the instant in the applied voltage cycle at which the switch made contact, completion of the circuit near a voltage zero resulting in a large current surge and at a voltage maximum little or no excess current. Special fuses having a long time-delay can sometimes be used satisfactorily in these conditions, but a more sensitive method of discriminating between faults and switching surges is to fit a cut-out which depends for its operation on the temperature of the transformer windings themselves. The transformer itself is, of course, rendered completely safe by this means because it can never attain a dangerous temperature as the current is cut off before this happens. One way of constructing the thermal cut-out uses a low-melting-point alloy to bridge a pair of sprung contacts in the primary circuit whilst another incorporates a bi-metallic strip. The latter method can be arranged to permit resetting by means of a button—this may or may not be advantageous.

There seems to be little doubt that the heat-fuse method is the most satisfactory way of dealing with potential short-circuits in both l.t. and in the good-regulation sections of the h.t. circuits in "isolated" receivers. The low-current circuits supplying the screens and anodes of early stage valves, however, remain unprotected, and unless other precautions are taken there is a danger of fire due to overheating of the feed resistances if the electrodes concerned become connected to, say, the cathode or suppressor grid. The resistance involved can, depending on its value, either be made of such a rating as to be able to withstand the full voltage of the h.t. supply without danger of fire, or it can be of a type (such as "wire wound") that it burns out without risk of setting fire to surrounding components or wiring. If this latter alternative is adopted care must be taken in the location of the resistor; e.g., it may be mounted on fireproof supports above the chassis. This is a convenient way of dealing with smoothing resistors used in the simpler types of receiver instead of smoothing chokes. They are usually of the order of 2,000 ohms and cannot therefore be made capable of withstanding the full h.t. without considerable expense. Smoothing chokes, if used, are likely to have a good margin of safety from the temperature rise point of view, as they are generally designed to have a low voltage drop. It may therefore be possible to short-circuit a smoothing capacitor on the output end of such a choke without causing the temperature rise to exceed a safe figure; if not, an h.t. line fuse may be required. Connected in series with an inductive element there is little likelihood of spurious operation due to current surges when charging up capacitors as the set warms up. Summing up, the greater part of the "isolated" type of radio receiver can be protected by the provision of a thermal device built into the mains transformer, whilst fire risks in the remainder can usually be dealt with by suitable positioning of feed resistors.

"Non-Isolated" Sets.—The "non-isolated" (or a.c./d.c.) type has problems of its own and requires different methods of treatment. Even to meet safety requirements under normal conditions of operation current practice may have to be modified in some respects, notably in the amount of attention which is paid to the isolation of aerial, earth and pick-up sockets from the mains. It has now been established that well over 90 per cent of persons can feel a current of 0.5 mA (r.m.s.) at mains frequencies and it is obviously desirable that it should not be possible to draw currents exceeding this figure from any accessible point on an equipment. In that connection the sockets for aerial, earth, pick-up and loudspeaker should be regarded as accessible even if the terminal points themselves are recessed or otherwise protected since the user may connect bare or lightly insulated wires to them. Limitation of the permissible current to 0.5 mA, however, may involve serious restrictions in the design of the signal- and audio-frequency portions of a receiver circuit: as numerous tests have shown that currents up to at least 5 mA can be passed between the hands or hand and foot without producing cramping of the muscles and consequent inability to let go, currents up to about 2 mA are probably not dangerous although quite unpleasant. This does not apply to the aerial terminal, as window cleaners, painters and others may come in contact with the aerial wires when perched precariously on ladders, etc. Under these conditions, of course, only a very slight shock may cause a fall with serious consequences. As it is usually possible to restrict the mains frequency current through the aerial to figures well below 0.5 mA without prejudicing the R.F. performance, a blocking capacitor of approximately 0.001 μF should be inserted in series with the aerial terminal, or other similar measures adopted (see Fig. 3).

Non-isolated receivers are usually dependent on capacitors for the isolation of accessible parts from the mains so that great care has to be exercised in the choice of suitable capacitors and in the provision of reliable mounting and wiring to ensure that the capacitor is not short-circuited externally. An important development in recent work has been the recognition that a capacitor having an extremely long life when subjected to a particular d.c. voltage may fail at a very early stage when used on a.c. having a peak voltage no higher than this d.c. value. Paper-dielectric capacitors having solid impregnants (e.g., waxes) have been found to suffer rapid deterioration under a.c. stresses whereas oil impregnation gives excellent results. Mica, once specified as the height of perfection in dielectrics, is also liable to breakdown under a.c. operation at voltages much lower than would have been expected from its performance on d.c. The trouble is due to the formation of minute voids within the dielectric. The electrical stress at these points is high due to their lower s.i.c. and ionization occurs with rapid deterioration of the material. Fluid or semi-fluid impregnants are naturally much less likely to allow voids to form. Because of these possibilities of failure it is obviously essential for the designer to specify isolating capacitors of a type which have been proved to have an indefinitely long life under a.c. mains voltage conditions.

Live shafts on non-isolated equipment are a potential danger of shock. Even if the knobs are really securely fixed (and this is not always the case) there may be sufficient space between the back of the knob and the cabinet to allow metal objects to fall through and touch the shaft. A tube of insulating material or an extension of the knob within the cabinet is advisable to prevent trouble here.

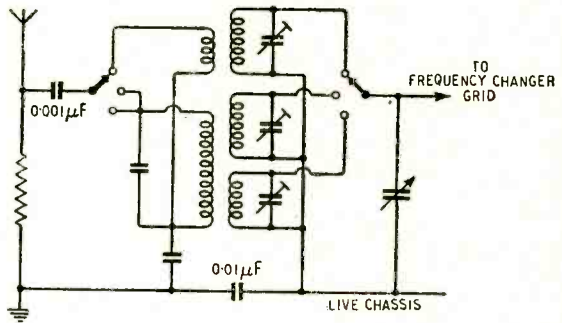
Another feature of present-day non-isolated sets which may require attention in order to comply with the standards which are now laid down in several European countries is the aerial circuit switching arrangements. Creepage distances between adjacent contacts or between certain contacts and the frame of many of the wafer-type switches in general use are decidedly less than the requirements demanded for the insulation of parts at mains potential. As the frame of the switch is usually connected directly to the chassis by the mounting bush and in addition some of the contacts may also be connected to chassis (which is in turn connected to one pole of the mains) arrangements will have to be made to ensure either that the aerial coupling winding contacts are adequately separated from the danger points or that the coil circuit is itself isolated from the aerial and earth sockets.

When we turn to the safeguarding of non-isolated models against fire under "fault conditions" we come up immediately against the fact that there may be no central power source corresponding to the transformer in an isolated set and consequently we cannot base our protection on a thermal release located between the windings. Receivers employing auto-transformers are, of course, classed as non-isolated and in their case the thermal release is applicable but true a.c./d.c. apparatus has to be dealt with by current fuses. The occurrence of heavy surges at the moment of switching on a set (as in the heater circuit when starting from cold or in the h.t. circuit when switching on again soon after switching off whilst an indirectly heated valve rectifier is still hot) will often present problems. It is seldom possible to secure full protection with one fuse; the heater and h.t. circuits have to be treated separately. A long time-lag fuse is necessary in the heater circuit and this may be used as a main input fuse as it can often be chosen to deal with short-circuits in the rectifier or reservoir capacitor. Breakdowns in the smoothing capacitors are, however, unlikely to cause a sufficient increase in the current to cause the main fuse to blow, owing to the limiting effect of the smoothing chokes or resistors. A sub-fuse should therefore be used which carries only the h.t. current; as this can be connected in series with the choke or resistor, surges are, by the nature of the smoothing circuit, avoided and plain fuses are usually satisfactory

As in isolated receivers, the feed resistors of anode and screen circuits are best dealt with by choosing wattage ratings which will withstand the full h.t. without risk of catching fire, or, alternatively, positioning them so that there is no danger of adjacent components such as waxed coils or capacitors becoming overheated.

Television.—Although the foregoing paragraphs refer primarily to sound receivers, the principles are directly applicable to television sets. The guarding of live parts to prevent shock, for example, follows the same technique as for radio equipment. At first sight it might have been expected that more stringent precautions would have been required owing to the existence within the receiver of voltages up to 12 kV or more. When it was the standard practice to obtain e.h.t. from a winding on the 50-c/s transformer through a rectifier these fears would have been justified, not only because of the relatively high current

(Below) Fig. 2. The power supply and audio stages of an "isolated" receiver showing some of the points which have to be short-circuited during a fault test. No danger should result if points having corresponding letters; e.g. BB, are connected together. Short-circuiting AA, BB or CC would result in the operation of the temperature fuse. Joining DD or FF would cause the smoothing resistor to over-heat, but if suitably located no harm would result. It is quite practicable to choose the wattage of the anode coupling resistor so that joining GG does no harm. Short-circuiting HH has little effect on the current distribution.



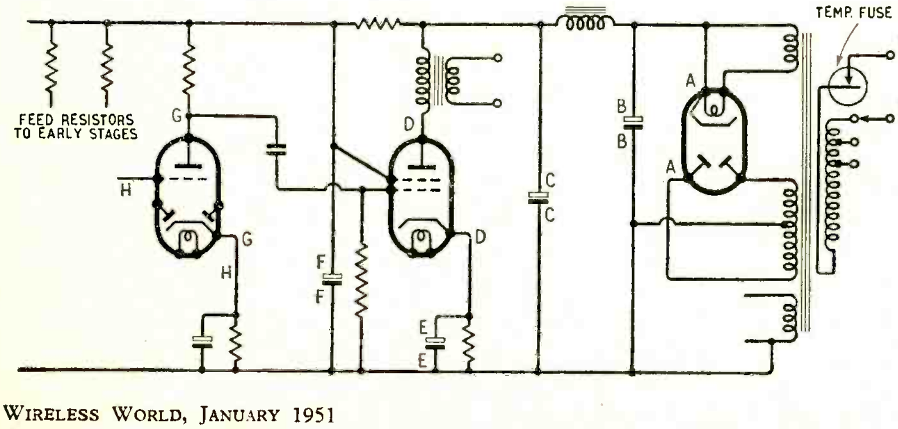


Fig. 3. The aerial circuit of a non-isolated receiver. During a fault test many wafer-type switches would have to be short-circuited because their clearances are less than those specified. This involves blocking capacitances in aerial and earth connections. A leak should be provided from aerial to earth to drain away static charges which may accumulate.

which could be drawn from these supplies but also on account of the large smoothing capacitors which could remain charged after the set had been switched off unless discharge resistors were fitted. Now, however, fly-back systems of obtaining the accelerating voltage for the c.r.t. are very frequently used and neither of these considerations applies; it is very unlikely that a dangerous shock could be obtained by touching the e.h.t. supply when a set is working.

External connections to a television receiver are usually confined to the aerial feeder so that isolation difficulties, even on a "live-chassis" set are not troublesome. The feeder cable itself is usually covered by a layer of PVC or similar material, so giving an additional measure of protection should the isolation fail within the receiver.

Fire risks, on the other hand, require more attention—not only are there about three times as many stages to give trouble, but also the technique is less well established and breakdowns of insulation are consequently more likely to occur. The line scan circuits, for instance, often develop several kilovolts, apart from any step-up winding on the transformer for the specific purpose of obtaining e.h.t. supplies. The necessity for low values of self-capacitance in the line scan windings restricts the designer to small physical dimensions and increases the difficulties of insulating the coils adequately. The use of better materials and newer methods is overcoming these weaknesses, but there are potentialities for trouble in this part of the receiver.

When a mains transformer is used the temperature fuse can be used to deal with many of the possible breakdowns in electrolytic capacitors and rectifiers. The older technique of obtaining e.h.t. from a winding on the transformer was apt to present difficulties in arranging the temperature fuse because a winding of this kind had necessarily to be well insulated electrically. As good electrical insulators are practically always good thermal insulators it was difficult to avoid overheating of the e.h.t. coil before the heat was conducted to the temperature fuse. The fly-back technique has eased matters here as well as on the shock side. H.T. line fuses are commonly fitted to deal with failures of components in the circuits fed from subsidiary smoothing filters where the effect on the main h.t. current would be small. As in radio receivers, careful placing of feed resistors liable to overheat if short-circuits develop in valves or tuned windings is essential to avoid the rapid spread of flames. The use of PVC-covered connecting wire is another important contribution, as this material does not continue to burn of its own accord, whereas rubber coverings form easy channels whereby fire may spread from one part of a set to another.

Conclusion.—The recognition that we cannot hope to ensure in an apparatus as complex as a radio or television receiver that no component ensuring freedom from shock or fire risks will ever fail, is bound to lead to an improved standard. Protective devices are being developed in various quarters to implement the proposals that every set should be able to deal safely with failures of insulation in components such as electrolytic capacitors, valves and switches.

NERVE COMMUNICATIONS

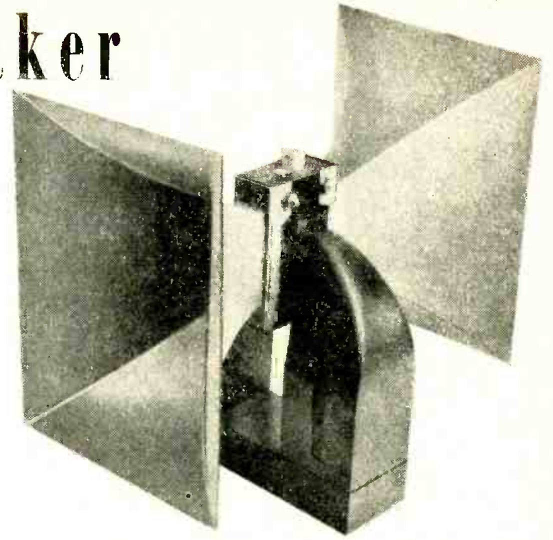
THERE are so many striking resemblances nowadays between electronic devices and the human body that it has become fashionable for medical men and engineers to look for analogies in each other's work as a means to the better understanding of their own. Neurologists in particular are tending to regard the nervous system, which conveys information about the body, as a vast communications network, and are hoping that the knowledge of communications engineers will prove valuable in studying the complex "circuitry" of this network on a more scientific basis.

This method of approach was perhaps influenced by the fact that information is actually conveyed along the nerve fibres of the body by electrical impulses. Furthermore, these impulses are transmitted by sensory organs, such as the eyes and ears, and received by motor organs, such as muscles and glands, all of which have obvious electrical counterparts. The complex groups of nerve cells or ganglia existing in the spinal cord and brain can similarly be compared with telephone exchanges or the "brains" of electronic control devices.

Analogies of this sort, however, cannot be taken too far, as there are some important differences to be considered. For instance, the impulses are not conducted along the nerves as they would be along wires, but move comparatively slowly (about 80-100 metres per sec) as a kind of "travelling breakdown" of the polarizing voltage that exists between the inner core and outer sheath of a nerve fibre. Furthermore, since the process of breakdown and restoration takes time to complete, there is a limit to the rate at which the impulses can be transmitted and the nerves do, in fact, "cut-off" like a filter at a repetition rate of about 500 per second. This latter point was raised at an informal discussion on "The Nervous System as a Communication Network," held at the I.E.E. on 20th November, 1950, when one of the speakers asked how was it possible, in these circumstances, for us to hear frequencies up to about 15 kc/s. In reply, the lecturer (Dr. J. A. V. Bates) said that the frequency discrimination of hearing was not done in the nervous system at all but in the inner ear. This had a resonant structure which responded at different points corresponding to different frequencies, and since the endings of the auditory nerve fibres were spatially distributed over this structure they could identify the frequencies by their position and convey the result to the brain. The actual repetition rate of the impulses along a nerve was merely a measure of the intensity of the stimulus, in this case sound.

Discrimination by position occurs in a similar way in the other sense organs, the spatial distribution of nerve fibres being repeated at the far end of the "line" by a corresponding distribution on the brain itself. To carry the information in this fashion, a large number of individual channels are required, and in the optic nerve of the human eye, for example, there are something like a million separate fibres.

Ribbon Loudspeaker



Principles of Design and Constructional Details of a High-frequency Unit Making Use of a Magnetron Field Magnet

By P. L. TAYLOR, M.A.

THE unit to be described has given excellent results and is comparatively simple to make. The basis of the design is a Government-surplus magnetron magnet; but these vary in dimensions, gap widths and flux densities, and to enable the home constructor to modify the design to suit any particular magnet, some elementary theory is given which will serve as a guide to the orders of magnitude of the quantities involved and to the effect of changes in the design on the final results.

It is well known[1] that when a sound is propagated through air the air particles, normally at rest, are set in vibration longitudinally, i.e., along the direction of propagation. This movement of the particles gives rise to the variation of air pressure, above and below atmospheric, that constitutes the sound wave. At a particular point in the medium, whenever the particles are moving forward (in the same direction as the sound) the pressure is above atmospheric, and when they move backwards the pressure is below atmospheric. It can be shown that, if p is the pressure excess and v the *particle* velocity (not the velocity of the sound wave) the ratio p/v is a constant determined by the characteristics of the medium. This constant is known as the unit area impedance of the medium, and denoted by Z_u. We have therefore

$$\frac{p}{v} = Z_u \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (1)$$

For plane waves in air, if p and v are measured in c.g.s. units (dynes/cm², and cm/sec respectively) $Z_u = 41.2$ c.g.s. units. This is only true if the waves are plane; for diverging and converging waves the relation between p and v is more complicated, but need not be considered here.

Consider a ribbon carrying a current in a magnetic field (Fig. 1). It will experience a force tending to move it in a direction at right-angles both to the direction of the field and the direction of the current. This movement will be communicated to the air, and if the current is alternating the movement will also be alternating, giving rise to the radiation of a sound wave. But at high frequencies the inertia of the ribbon will prevent it moving as much as it should, and the radiated power will fall off. Obviously, for good high-frequency response as light a ribbon as possible is called for; but the matter is not quite as simple as that.

Using the symbols given in Table I, we can write:

$$F_1 = BaI \text{ dynes} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (2)$$

$$F_2 = 2pab \text{ dynes} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (3)$$

(the factor 2 allows for the two faces of the ribbon;

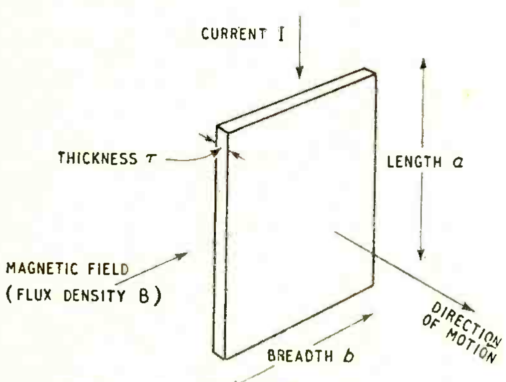


Fig. 1. Relevant dimensions of ribbon in a magnetic field.

TABLE I

Quantity	Symbol	Unit
Magnetic flux density	B	gauss
Length of ribbon	a	cm
Breadth of ribbon	b	cm
Thickness of ribbon	τ	cm
Density of ribbon material ...	ρ	gm/cm³
Mass of ribbon	$M = ab\tau\rho$	gm
Resistivity of ribbon material	q	ohm/cm
Air pressure excess	p	dyne/cm²
Air particle velocity	v	cm/sec
Displacement of ribbon from rest position	x	cm
Current through ribbon ...	I	e.m.u.
Electromagnetic force on ribbon	$F_1 = BaI$	dyne
Acoustic force on ribbon ...	$F_2 = 2pab$	dyne

[1] See, for example, "Acoustics," by Alexander Wood (Blakie and Son)

when there is a pressure excess on one side of the ribbon there will be a pressure deficit on the other, so that the force on the ribbon will be twice that on one face.) Making the assumptions that the air particle velocity is equal to the ribbon velocity, and that the radiated waves are plane, equation (1) holds and substituting this in equation (3) gives

$$F_2 = 2abZ_u v$$
$$= 2abZ_u \cdot \frac{dx}{dt} \quad \ldots \quad (3a)$$

The resultant of F_1 and F_2 will cause acceleration of the ribbon, and, assuming that it moves as a whole and has negligible stiffness at its supports, we can write :

$$F_1 - F_2 = M\frac{d^2x}{dt^2} \quad \ldots \quad (4)$$

Substituting equations (2) and (3a) and the mass of the ribbon as given in Table I we get :

$$IBa - 2abZ_u\frac{dx}{dt} = \rho ab\tau\frac{d^2x}{dt^2} \quad \ldots \quad (5)$$

But the voltage V across the ribbon is given by

$$V = aB\frac{dx}{dt}$$

and therefore $$\left.\begin{aligned}\frac{dx}{dt} &= \frac{V}{Ba}\\ \frac{d^2x}{dt^2} &= \frac{1}{aB}\cdot\frac{dV}{dt}\end{aligned}\right\} \quad \ldots \quad (6)$$

Substituting equations (6) in (5) gives

$$IaB = 2Z_u ab\,\frac{V}{aB} + \frac{\rho ab\tau}{aB}\cdot\frac{dV}{dt}$$

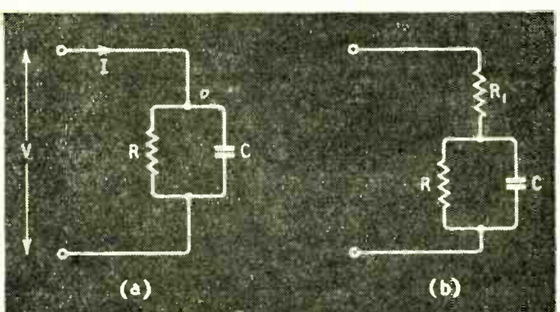
or $$I = V\Big/\frac{aB^2}{2Z_u b} + \frac{\rho b\tau}{aB^2}\cdot\frac{dV}{dt} \quad \ldots \quad (7)$$

Fortunately it is not necessary to solve this equation, which connects the voltage across the ribbon with the current through it, i.e., represents the electrical impedance between the ends of the ribbon due to the fact that it is moving. This impedance is called the "motional impedance" of the ribbon.

TABLE II

1 ampere	=	0.1 e.m.u.
1 volt	=	10^8 e.m.u.
1 ohm	=	10^9 e.m.u.
1 farad	=	10^{-9} e.m.u.
1 henry	=	10^9 e.m.u.

Fig. 2. (a) Equivalent circuit of motional impedance of ribbon, and (b) with the addition of R_1, the d.c. resistance.



We may find it by comparing equation (7) with the equation of current and voltage in the circuit of Fig. 2(a).

$$I = \frac{V}{R} + C\frac{dV}{dt} \quad \ldots \quad (8)$$

Equations (7) and (8) are of exactly the same form, so the motional impedance is evidently a resistance and capacitance in parallel, where

$$R = \frac{aB^2}{2Z_u b} \text{ e.m.u.}$$

$$C = \frac{\rho b\tau}{aB^2} \text{ e.m.u.}$$

These electromagnetic units must be converted to practical units (Table II) and we get :

$$R = \frac{aB^2}{2Z_u b} \times 10^{-9} \text{ ohm} \quad \ldots \quad (9)$$

$$C = \frac{\rho b\tau}{aB^2} \times 10^9 \text{ farads} \quad \ldots \quad (10)$$

But Fig. 2(a) does not represent fully a practical ribbon ; for the voltage V in equations (7) and (8) is the back e.m.f. produced by the motion of the ribbon which in the practical case is much less than the e.m.f. *applied* to the ribbon by a generator. The difference is due to the voltage drop in the normal electrical resistance of the ribbon (and strictly speaking also in the inductance of the ribbon and the leads to it : but for the moment we may ignore this). The equivalent circuit of a practical ribbon is therefore Fig. 2(b) where R_1, the d.c. resistance of the ribbon, is given by

$$R_1 = \frac{\sigma a}{b\tau} \text{ ohms} \quad \ldots \quad (11)$$

From this figure we can see that when an alternating voltage is applied part of the energy is absorbed uselessly by R_1 and part is radiated as sound ; this radiated energy is represented by that absorbed in the "radiation resistance" R. As the frequency increases the radiation is decreased by the effect of the mass of the ribbon, represented by the shunting of R by a capacitance C.

Two considerations enter into the design of a ribbon loudspeaker : first, the efficiency, i.e., the fraction of the total energy supplied to the ribbon that is actually converted to sound, and second the frequency response.

Fig. 2(b) shows that, at a low frequency where the effect of C may be neglected, the efficiency η is given by

$$\eta = \frac{R}{R + R_1} \quad \ldots \quad (12)$$

and the radiated power will fall by 3db at a frequency at which the voltage across R falls by 3db. This is determined by the time-constant T of the circuit which, assuming it to be fed from a low-impedance source, is the product of C and the parallel combination of R and R_1, i.e.,

$$T = C\frac{RR_1}{R + R_1} \quad \ldots \quad (13)$$

and the radiated power will fall by 3db at a frequency given by

$$f_{-3db} = \frac{1}{2\pi T} \quad \ldots \quad (14)$$

It is difficult to see immediately from the foregoing equations which are the most important variables to be fixed at the outset in attempting a design, as T and η are obviously closely related, and changing one by altering the design will affect the other. We may therefore introduce the idea of a "figure of merit" given by the fraction η/T, which must be as large as possible since we require η to be large and T small. From equations (12) and (13),

$$\frac{\eta}{T} = \frac{1}{CR_1} = \frac{B^2}{\rho\sigma}$$

which makes the problem look much simpler, as all the dimensions of the ribbon have disappeared. This equation shows that only two quantities are prerequisites of a good design: the flux-density and the material of which the ribbon is made. B must be as high as possible, and even a small improvement is worth striving for as the figure of merit is proportional to the square of B. It is interesting that it is not ρ and σ separately that are important, but their product. Table III gives the values of $\rho\sigma$ for various metals; magnesium seems an obvious choice with aluminium a close second. In practice aluminium is used as it does not tarnish and is readily obtainable in the form of foil.

Having obtained as high a value of η/T as possible, design procedure is then to choose the ribbon thickness so that η is about the same as that of the main loudspeaker with which the unit is to be used; this in turn fixes T and the frequency response. As an example, the figures in Table IV apply to the aluminium ribbon used in this design. It is interesting also to calculate the results that theoretically could be achieved using the best magnet materials that are at present commercially available, and a thinner aluminium ribbon. Assuming B = 15,000 gauss, $\eta = 0.2$, we find that f-3db = 20.6 kc/s and τ = 0.00012 in.

Horns.—The fundamental assumption was made above that the ribbon would be radiating plane waves so that we could equate the ribbon velocity and the acoustic pressure with Z_u (equation (1)). But

TABLE III

Metal	Density ρ (gm/cm^3.)	Resistivity σ (ohm/cm.)	$\rho\sigma$
Magnesium	1.74	4.35×10^{-6}	7.57×10^{-6}
Aluminium	2.7	3.21 ,,	8.67 ,,
Copper ...	8.93	1.78 ,,	15.85 ,,
Silver ...	10.5	1.66 ,,	17.4 ,,
Zinc ...	7.1	6.1 ,,	43.2 ,,
Gold ...	19.32	2.42 ,,	46.8 ,,
Tin ...	7.29	11.3 ,,	82.5 ,,

TABLE IV

B	12,500 gauss	R	7.6×10^{-3} ohm
a	1.5 inches	C	3.3×10^{-3} farad
b	0.375 inch	η	0.31
τ	0.0003 inch	T	1.7×10^{-5} sec
R_1	17×10^{-3} ohm	f_{-3db}	9.3 kc/s

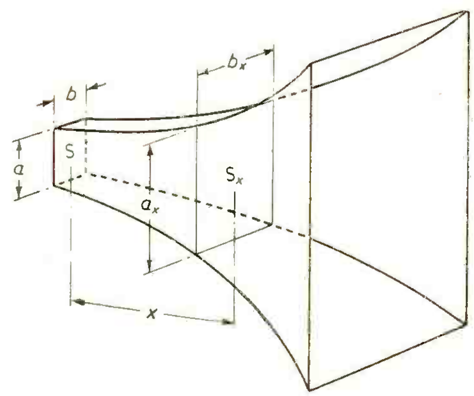
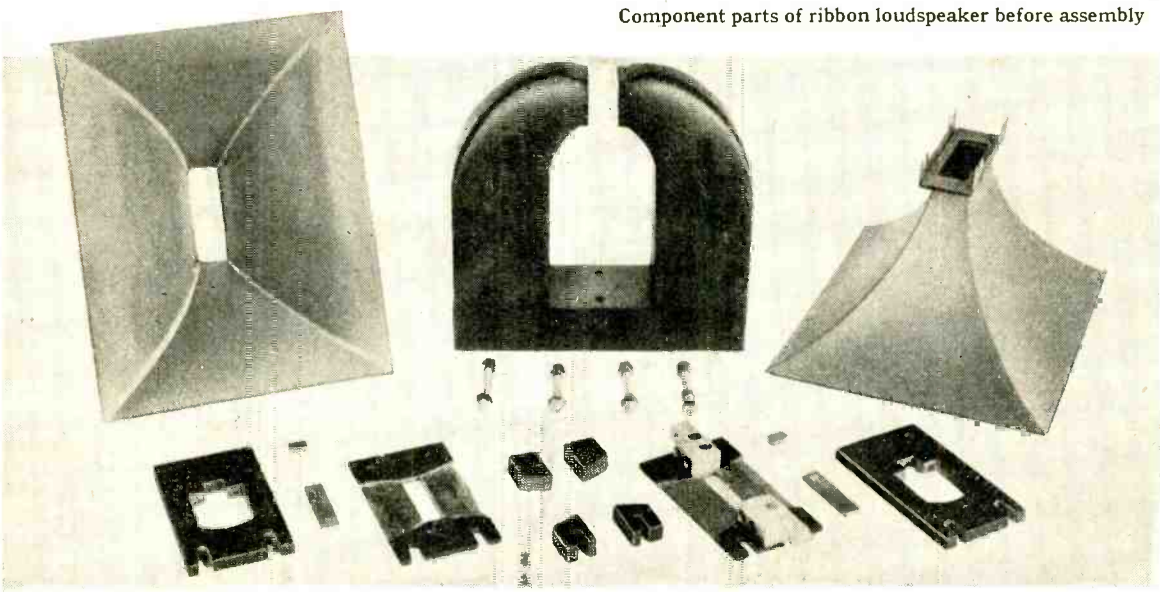


Fig. 3. Illustrating the development of an exponential horn.

Component parts of ribbon loudspeaker before assembly



for a ribbon in free air this assumption is by no means justified, and in practice horn loading is generally considered necessary. To quote from p. 120 of the reference given earlier "The primary purpose (of a horn) is to load the diaphragm at the narrow end by increasing the pressure against which it has to work and to deliver the energy it receives to the atmosphere over an area sufficiently large to avoid reflection back into the horn with consequent stationary vibration and resonance." In other words, a horn is a device for matching the diaphragm (in this case the ribbon) into the air and so ensuring efficient radiation.

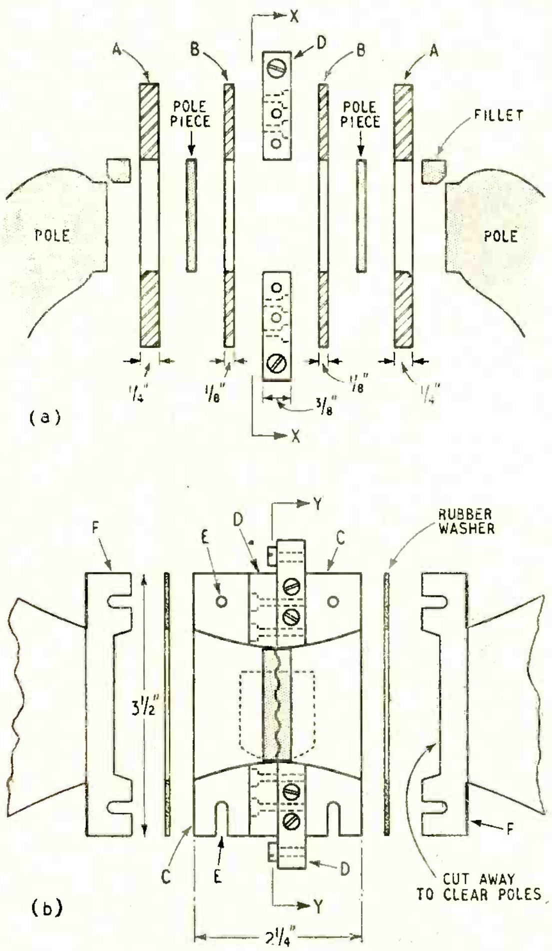
The usual form of a horn is "exponential" (Fig. 3) in which the area S_x at a distance x from the small end (the throat) is related to the throat area S by the equation

$$S_x = Se^{mx} \quad \ldots \quad (14)$$

In designing the horn two decisions have to be made; the value of m (i.e., the rate of flare) and the total length of the horn.

It can be shown that an exponential horn only

Fig. 4. Details of ribbon mounting and horn supports. (a) expanded section at Y-Y, and (b) partly expanded section at X-X.



behaves as required above a critical frequency f_c which is determined by m; in fact,

$$m = \frac{4\pi f_c}{c} \quad \ldots \quad (15)$$

where c is the velocity of sound (13,500 inches per second, since we shall be working in inches for the horn dimensions). Below this critical frequency no radiation occurs, and the less rapid is the flare (i.e., the lower is m) the lower the critical frequency. But the ribbon unit must not be allowed to work at too low a frequency, even if space for a large horn can be found, as the thin ribbon is easily overdriven. Most of the power in music and speech lies below a frequency of about 1,000 c/s so it is wise to arrange by means of a crossover network that a normal moving-coil loudspeaker which is reasonably satisfactory up to this frequency handles the range up to, say, 2,000 c/s and the ribbon unit the higher frequencies. The horn can then be designed for a critical frequency of 1,000 c/s (giving an m of 0.93 per inch) which ensures that the lowest frequency it has to handle (2,000 c/s) is well within its working range. At the same time, the flare is not so rapid as to lead to practical difficulties in cutting and bending to the right shape the horn material, and yet the horn is reasonably small.

The length of the horn is determined by considerations of the dimensions of the mouth. As pointed out above, these dimensions must be "sufficiently large to avoid reflections back into the horn . . ."; within reason the larger the mouth of the horn the better. A practical criterion is that the sides of the mouth should be about one wavelength at the lowest frequency. For the figures given above this is about 12in., leading to a horn about 6in. long.

It is not essential that the horn should be of the same cross-sectional proportions all the way along; starting from a long narrow ribbon this would give a horn of an awkward shape. Instead, the rates of flare m_a and m_b of the a_x and b_x dimensions may be different; but

$$S_x = a_x b_x = ae^{m_a x} \times be^{m_b x}$$
$$= abe^{(m_a + m_b)x} = Se^{mx}$$

and therefore $m_a + m_b = m$. In the present design $m = 0.9$ giving a mouth area of about 50 square inches with a length of 5 inches. The a_x dimension expands from 1.5 inches to 8 inches in this length, so that $m_a = 0.335$ and therefore $m_b = 0.565$.

Practical Details

Construction.—The magnet used originally produced a field of 9,700 gauss across a ⅝in gap between poles 1in by 1¼in; this was increased to 12,500 gauss by fitting pole-pieces 1½in by ⅜in by ⅛in of mild steel strip. Mild steel fillets were fitted where the pole-pieces project beyond the original poles to even the field distribution.

It is obvious that a powerful magnet is necessary to produce the required flux density in such a large volume, together with the inevitable stray field. Watches and ferrous tools must be kept well away from it, and all assembly work should be done away from the normal work-bench where iron filings might enter the gap. The keeper should not be removed and replaced more often than is necessary.

The ribbon and horn supports (Fig. 4) are made of synthetic-resin bonded paper board ("Paxolin," "Tufnol," etc.). Five pieces (two A, two B and one C) of the appropriate thicknesses are cut approximately to the right dimensions and the bolt-holes E carefully drilled. They are then bolted together and filed to size, and the bottom holes slotted as the magnet somewhat obscures them and the bolts have to be put in sideways. The pieces A are filed out to fit snugly over the poles and fillets, with the inner faces flush with the faces of the poles. Pieces B have $1\frac{1}{2}$in by $\frac{3}{8}$in holes for the extra pole-pieces, and are filed towards the edges to the contour of the horn. The centre piece is cut into four pieces C, shaped to the other horn section, allowing room for the ribbon clamps D. These are pairs of aluminium blocks of $\frac{3}{8}$in square cross-section ; one block of each pair is screwed to one of the pieces B and extends to form a terminal post. The butting faces of these blocks are smoothed down on emery cloth on a flat surface, to ensure good contact to the ribbon.

The ribbon was obtained from a tubular paper capacitor—some search was necessary before one containing thin enough material was found ! Once obtained this is cut to the correct width, but considerably longer than the final length, before removing the last layer of paper. After washing in carbon tetrachloride to remove grease, it is smoothed out on a sheet of clean glass. (The ribbon has a tendency to curl up, and fixing a piece of transparent sticky tape to each end greatly facilitates handling.) It is corrugated slightly by winding turns of 16 s.w.g. enamelled wire on a flat former, and pressing the ribbon on to the turns with a finger.

The two horns are made of about 26 s.w.g. tinplate, to the calculated dimensions, allowing for the fact that the initial part of the horn is formed by parts B and C of the ribbon supports. (Of course, the shapes to which the tinplate has to be cut are not the same as the axial cross-sections of the horns ; the method of developing the required shapes is shown in Fig. 5.) After bending and soldering along the corners the small ends are soldered to channel pieces F in which appropriate rectangular holes have been cut. The sides of the channels are slotted to pass under the bolts in the main structure.

Assembly.—This is quite straightforward. All the parts of the main structure are assembled on the magnet, with the exception of the smaller clamping blocks and the shaped pieces C covering them. The magnet is then laid on its side and the two bolts which are now underneath temporarily inserted. The ribbon is placed in position and held by the adhesive tape on its ends while the small clamps are screwed down ; excess ribbon can then be torn off. The remaining pieces C are inserted and one of the horns bolted in place, after which the other bolts can be loosened and the second horn fixed. Rubber washers cut from a car-tyre inner tube are placed between the horns and the main structure. Only brass nuts and screws should be used throughout.

General.—Since the ribbon impedance is so low the leads to the matching transformer must be stout and twisted together to reduce inductance, but should not be less than a foot long to allow the transformer to be mounted well away from the magnet. Also, the transformer secondary must have a low resistance and leakage inductance. As a guide, a transformer to match the above unit into 15 ohms was wound as follows :

Core : square stack of Mumetal laminations (Pattern 178, Magnetic and Electrical Alloys).

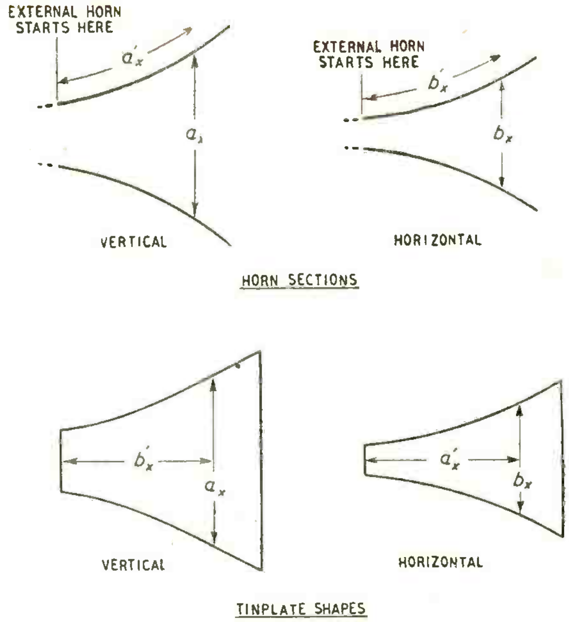
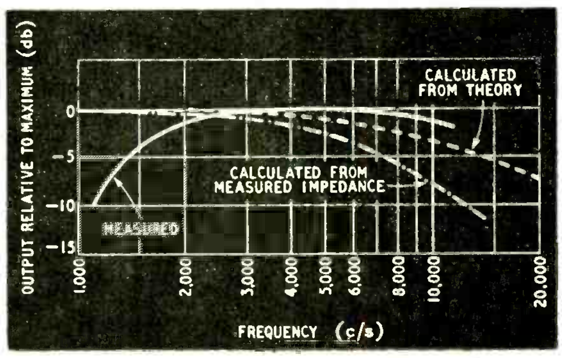


Fig. 5. Method of marking out sides of horn for cutting from flat sheet.

Fig. 6. Calculated and measured frequency response curves.



Primary : 4 layers of 10 turns each of double 20 s.w.g.

Secondary : 1 turn of 1in wide copper strip between each primary layer (total 3 turns).

The cross-over network can be designed using basic formulae[2] or more simply from abacs[3] and should be based on a frequency of 2,000 c/s.

Results

Impedance Measurements.—Measurement by a bridge method showed that for all frequencies above about 3,000 c/s the impedance of the unit was substantially that of Fig. 2(b) with the addition of an inductance L in series with R_1, where $L = 6.9 \times 10^{-7}$ henrys, $R_1 = 2.7 \times 10^{-2}$ ohms, $R = 6.6 \times 10^{-3}$ ohms, $C = 3.4 \times 10^{-3}$ farads. Below 3,000 c/s the horn is

[2] F. E. Terman, " Radio Engineers Handbook," p. 249. (McGraw-Hill.)
[3] Beatty and Sowerby, "Radio Data Charts" p. 81. (Iliffe and Sons).

operating near its cut-off frequency, the effect of which is that Z_u is not entirely a real quantity and the impedance of the ribbon differs from that given above. But above this frequency the agreement of the figures for R and C with theory is good. The importance of short leads is evident from R_1, and L also becomes important at the higher frequencies.

Frequency Response—Three curves are plotted in Fig. 6; one from the simple calculated impedance of Fig. 2(b), one from the measured impedance, and one measured with a calibrated microphone. The latter shows well the effect of the horn. It is not extended above 12,500 c/s as the microphone was not calibrated above this frequency, but aural impressions indicate that the response continues to fall smoothly without either peaks or a sharp cut-off. The curve for the measured impedance is somewhat misleading; strictly, it does not apply below 3,000 c/s but should fall rapidly. Allowing for this, and raising the general level of the curve so that its highest point is at 0 db, it would show closer agreement with the measured response. Otherwise the correlation between the curves is reasonable considering the experimental errors and the various assumptions made. It may therefore be concluded (a) that it is important to design the horn for a cut-off frequency at least an octave below the cross-over frequency, and (b) provided values of B and τ as given by the simple theory are used, good results may be expected. In calculating τ from B and η a value for η of about 0.2 should be used. In a practical unit the resistance of leads and of the connection to the ribbon itself lower the efficiency to something more nearly approaching that of a normal 12in moving-coil unit. Even so, it may be necessary to pad down the ribbon unit to match the other as has proved the case with the writer's combination; particularly as it may not be possible in practice to obtain thin enough ribbon.

Aural Impressions.—The improvement in high-frequency response with the ribbon unit over the writer's 12in speaker (itself considered to be good) is most marked, and has been commented on by a number of people, both technical and non-technical, musical and non-musical. Results compare very favourably with two commercial units which the writer has heard.

PROFESSIONAL SOUND RECORDING

IN his Presidential Address at the Royal Society of Arts to the Association of Professional Recording Studios on December 5th last, the Earl of Harewood spoke of the value of direct recording to musicians as a medium for self-criticism, and of his own experiences with recording apparatus. The craft of producing good recordings was one which had to be learnt, and one essential was that the mechanism of recording should not obtrude on the performer's preoccupation with his art. Having spent large sums on initial training for his career as a musician, he would not begrudge the few pounds necessary to secure a record of his progress under the comfortable conditions of a professional recording studio. In America recording was now accepted as a routine part of orchestral rehearsals; there was ample scope for the expansion of professional recording activities in this direction in this country.

C. E. Watts (President of the British Sound Recording Association) followed with a demonstration of recent progress in disc recording in which he played some remarkably fine piano recordings, made with no restriction on lateral acceleration of the groove. Unfortunately the life of such records was limited to about a dozen playings, even with modern lightweight pickups.

The future of commercial broadcasting was the topic chosen for the address by the Vice-President of the Association, Derek Faraday. After drawing a careful distinction between "commercial" and "sponsored" types of programme structure, he showed, with examples from recent B.B.C. features, how a sponsored system might be introduced without any obvious change in the character of B.B.C. programmes as at present constituted. Such a change would open up a wide field for independent professional recording studios.

Particulars of the Association of Professional Recording Studios, and the services offered to members are obtainable from the General Secretary, M. K. Howells, 14, Wynchgate, Harrow Weald, Middlesex.

MANUFACTURERS' LITERATURE

Schools Radio equipment briefly described in leaflets from Audix B.B., Ltd., Hockerill Works, Bishop's Stortford, Herts.

Car Radios made by Ekco; short specifications for the complete range of models from E. K. Cole, Ltd., Ekco Works, Southend-on-Sea, Essex.

Components and accessories in a catalogue from A. F. Bulgin & Co., Ltd., Bye Pass Road, Barking, Essex.

Radiogramophone, Model FG50 described briefly in a specification from Kolster-Brandes, Ltd., Footscray, Sidcup, Kent.

Batteries for all purposes, including accumulators, catalogued in a booklet from Pertrix (Holsun Batteries, Ltd.), 137, Victoria Street, London, S.W.1.

Loudspeakers and accessories catalogued in an illustrated brochure from Wharfedale Wireless Works, Bradford Road, Idle, Bradford, Yorks.

Relays for various applications described in leaflets from Londex, Ltd., Anerley Works, 207, Anerley Road, London, S.E.20.

Valve Data and price list of Osram valves from The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

Sound Level Meter, type 1400 portable instrument described in a leaflet from Dawe Instruments, Ltd., 130, Uxbridge Road, Hanwell, London, W.7.

"Always in the Picture," an illustrated booklet describing the television activities of Pye, Ltd., of Cambridge.

Geiger-Muller and **Cathode-Ray** tubes; data sheets and a price list from 20th Century Electronics, Ltd., Dunbar Street, West Norwood, London, S.E.27.

Multi-way Connectors by Kabi described in a leaflet from Precision Components (Barnet), Ltd., 13, Byng Road, Barnet, Herts.

Catalogue of radio and electronic equipment from Holiday and Hemmerdinger, Ltd., 74-78, Hardman Street, Deansgate, Manchester, 3.

Output Transformer complying with the "Williamson" specification in a technical data sheet from Partridge Transformers, Ltd., Roebuck Road, Tolworth, Surrey.

Long-playing Turntable, an attachment for converting normal radiograms, described in a leaflet from Chancery Precision Instrument Service, Ltd., 64, George Street, London, W.1.

Sound Equipment; numerous applications covered in an illustrated brochure from G.E.C., Magnet House, Kingsway, W.C.2.

Temporary Vision Aerial

Wide-band Folded Dipole of Unusual Design at the London Television Station

By F. D. BOLT, B.Sc., A.M.I.E.E. (Eng. Div., B.B.C.)

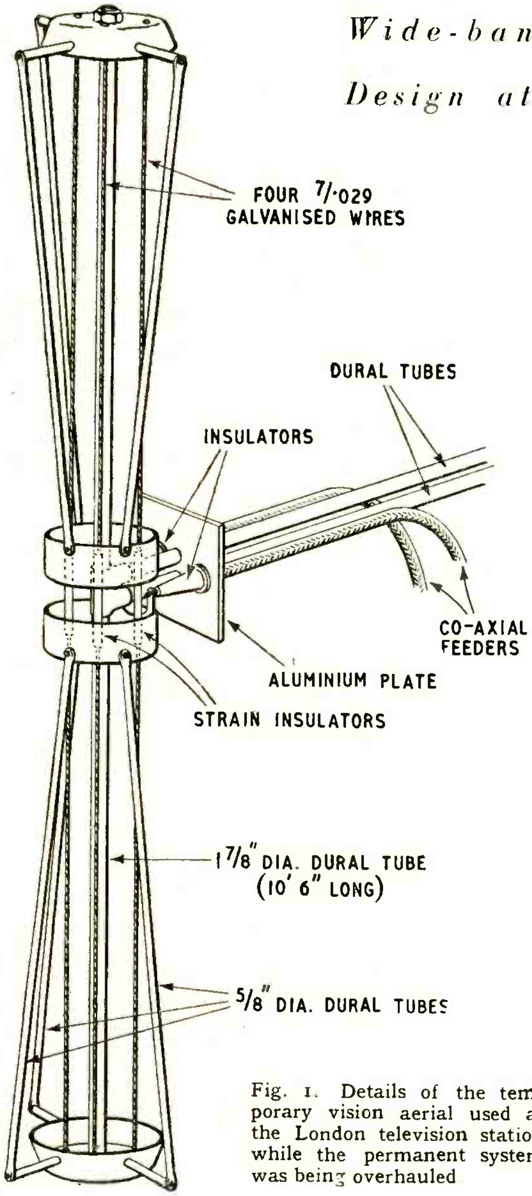


Fig. 1. Details of the temporary vision aerial used at the London television station while the permanent system was being overhauled

DURING last summer it became apparent that after nearly 14 years in service the Alexandra Palace vision aerial and feeder system was in need of an overhaul. This could not be done conveniently or thoroughly in the intervals between transmissions, and so it was decided to erect a temporary aerial in order to free the original installation completely. Accordingly, after two months' experimental work a simple form of folded dipole aerial was designed, constructed and erected on the top of the Alexandra Palace mast, and the service was transferred to it on 16th October for a period of six weeks, during which the main feeder was overhauled.

When conductors of equal size are used in a folded dipole (the usual arrangement) the impedance at the centre of the driven element is approximately four times that of a single straight half-wave aerial, namely 300 ohms. By using conductors that are unequal a useful range of impedances can be achieved, and this can be extended by arranging one element so that it partly shields the other. Bandwidth is dependent on the effective diameter/length ratio of the whole aerial, and for a folded dipole it is greatly improved by the inherent reactance correction.*

Recent advances in the manufacture of v.h.f. cables have resulted in the production of a cable which will carry nearly 5 kW at 45 Mc/s with an attenuation of 0.2 db per 100 ft. The velocity factor of the cable is 0.9. The mean power output of the Alexandra Palace vision transmitter during the transmission of an average picture is about 7.5 kW, the peak white power being 17 kW. The temporary aerial was designed to be centre fed by two cables arranged as a "binocular pair," the feed point impedance being made equal to the characteristic impedance (2×84 ohms) of the pair in order to avoid the mechanical difficulty of inserting matching devices.

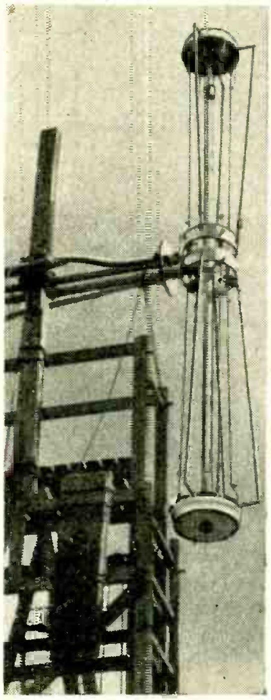
Construction

A central element of aluminium scaffold tubing surrounded by three driven elements was used to give a driving point resistance of 168 ohms at 45 Mc/s deviating by not more than ± 10 per cent between 42 and 48 Mc/s. The variation of parallel reactance increases the impedance variation to ± 20 per cent over this frequency band. Control of the resistance value is obtained either by changing the number (coarse control) or the diameter (fine control) of the driven elements. The reactance can be varied by auxiliary connections between inner and outers near the ends of the dipole, but no improvement results from such a connection because the inherent parallel stub formed by the two elements is shorter than the optimum length. Fig. 1 gives the dimensions finally adopted, and Fig. 2 shows the aerial as it was set up during the testing period.

The vision transmitter output at Alexandra Palace is arranged for driving into a 50-ohm co-axial feeder. At some point the two 84-ohm cables had to be joined to work in parallel by making one a half wavelength longer than the other. Technically this would best be done close to the aerial in order to avoid differen-

* *R.C.A. Review*, Vol. 4, p. 168, October 1939.

Fig. 2. The temporary aerial set up for testing.



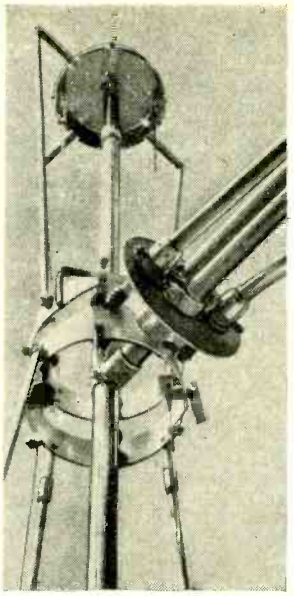


Fig. 3. This view of the temporary aerial gives some idea of the general arrangement and the manner in which the two binocular feeders are joined in.

tial phase changes along the 400-foot route due to imperfections in the cable characteristics, but mechanically it is far easier to accommodate the extra half wavelength at the transmitter end. In actual fact the cables were so little dissimilar that the mechanically easier way was adopted after trials of both.

Test transmissions produced pictures which were almost as good as those from the original aerial, the field strength over an arc from southwest through south to east being within a few per cent of that of the usual service. In the north to east direction the field strength was slightly below normal, owing to the effect of the vertical feeders. Elsewhere it closely approached that of the original system and when the aerial first came into temporary service the change-over was hardly noticed in most areas. The centre of the temporary aerial was some 30 ft higher than the old.

Aerial Improvisations

A good deal of improvisation was exercised in the construction of the aerial in order to expedite the job. Scaffold tubing and clamps were used where possible and aluminium saucepan blanks were found to be ideal for end fittings and centre connections. The only erection difficulty was in connecting the v.h.f. cables to the aerial after it had been mounted on the pole as it was not convenient to assemble them before the aerial was erected.

The two cables were hauled up the mast with little trouble and cleated to a steelwire rope.

Fig. 3 is a close-up view of the aerial when mounted on its pole (not shown) and seen also is the circular aluminium plate to which the feeders and stand-off insulators are secured.

AMPLIFIERS FOR DISC RECORDING

Lecture-Demonstration at the B.S.R.A.

SOME useful criteria for the specification of amplifiers for high-quality recording were given by H. D. McD. Ellis, M.A., M.I.E.E., at a meeting of the British Sound Recording Association in London on November 24th last.

The frequency response of B.B.C. recording amplifiers was 50 to 10,000 c/s $\pm$ 1 db with a gradual rather than a sharp cut-off. Transformers were the limiting factor and the economic upper limit of 10 kc/s was dictated by the characteristics of "music" land lines. Any reduction of frequency response should be made at both ends of the scale; the product of high and low frequency limits should approximate to 500,000 with a centre in the region of 700 to 800 c/s. Distortion was best assessed by calculating the r.m.s. sum of harmonics in per cent, with each (nth) harmonic weighted by multiplying by $n^2/4$. On this basis a figure of 5 might well represent the borderline between high and medium quality.

High-quality transducers (microphones and cutter heads) were usually insensitive and overall power gains of the order of 120 db were necessary. At this level of amplification, noise was a major problem with Johnson thermal noise as the limiting factor. In general, hum level up to 6 db worse than Johnson noise could be tolerated; hand-picked valves were necessary to ensure adequate freedom from microphony.

The output required for disc recording was considerable—of the order of 100 VA in the B.B.C. Type D equipment. Cutter heads with high inductance presented matching difficulties and called for low voltage and high current at low frequencies, high voltage and low current at high frequencies. It was better to express the output in volt-amperes rather than in watts.

After discussing the limitations of feedback, Mr. Ellis went on to show how it could be applied with advantage to include distortions in the recording cutter head In the B.B.C. Type B head a second coil monitors the rate of change of flux in the magnetic circuit and provides a voltage which is fed back to an intermediate stage of the amplifier to compensate for distortion of the flux waveform. This gives a close approximation to the ideal of feedback controlled by the actual motion of the cutter point.

Volume compression was necessary in order to reduce actual sound level changes to the range of 45 db, which could be accommodated in disc recording. Manual control by a skilled operator was preferable to automatic compression, since some distortion was inherent in the non-linear characteristic required for instantaneous control. The virtue of manual control was intelligent anticipation, but some safeguard for carelessness was necessary, and in the amplifier used in the Type D equipment an auxiliary circuit, biased to cut-off at normal operating levels, was arranged to provide automatic overload prevention for excessive peaks.

After a general description of a typical B.B.C. recording channel, Mr. Ellis gave a demonstration of some high-quality piano recording, and showed the merits of the latest type of volume indicating meter.

WORLD OF WIRELESS

Beveridge Report ✦ New Governors ✦ European Broadcasting Problems ✦ B.B.C. Television Policy ✦ Steel C.R. Tubes

Broadcasting Inquiry

THE last meeting of the Broadcasting Committee, which was appointed in 1949 to consider, under the chairmanship of Lord Beveridge, the constitution and control of the United Kingdom broadcasting service, was held on December 15th for the signing of the report. It is understood that this report, which will summarize the oral and written evidence obtained from a considerable number of witnesses and give the findings of the eleven members, will be presented to the Government soon after the Christmas recess.

B.B.C. Governors

TWO new Governors of the B.B.C. have been appointed—I. A. R. Stedeford, who was a member of the Beveridge Broadcasting Committee and was previously a member of the Television Advisory Committee, and Francis Williams, who, during the war, was Controller of News and Censorship at the Ministry of Information. Their term of office is for one year only; the B.B.C. Charter ends on December 31st, 1951. Their appointment brings the number on the Board of Governors, which controls B.B.C. policy, up to eight.

Lord Tedder, who was appointed a Governor last year, has been made vice-chairman of the Board in succession to the Dowager Marchioness of Reading, whose term of office has ended.

I.F. Problems

THE problem of the choice of intermediate frequencies for superhets, created by the introduction of the Copenhagen Plan, which was dealt with by G. H. Russell in our September, 1949, issue, has been tackled by the Technical Centre of the European Broadcasting Union (U.E.R.).

In the November issue of the U.E.R. *Bulletin* in which there is an article on the subject, it is stated that the members of the Union are, so to speak, "manufacturers and suppliers" of modulated waves, and as such they need not, in principle, concern themselves with what their "customers" chose ultimately to do with their products. If, on the other hand, it can be shown that a judicious arrangement of broadcasting stations in Europe results in reception with a minimum of "whistles," then it is considered by the Union that its members should not dissociate themselves entirely from the problem.

With a view to undertaking a closer study of the problem the Union has sent a questionnaire to associations representative of receiver manufacturers in Belgium, France, Italy, Switzerland and to B.R.E.M.A. in this country.

Italian F.M.

LIKE Germany, where in each of the three Western Zones there has been established a f.m. network to alleviate the congestion in the medium-wave band, the Italian broadcasting service (Radio Audizioni Italiano) has introduced a chain of eight f.m. stations to radiate the country's Third Programme. To meet the needs of those outside the service areas of the eight transmitters the programme is also being radiated on four wavelengths in the short-wave band with amplitude modulation.

The new transmitters, which operate on frequencies ranging from 90.9 to 99.9 Mc/s, are located in Bologna, Florence, Genoa, Milan, Naples, Rome, Turin and Venice.

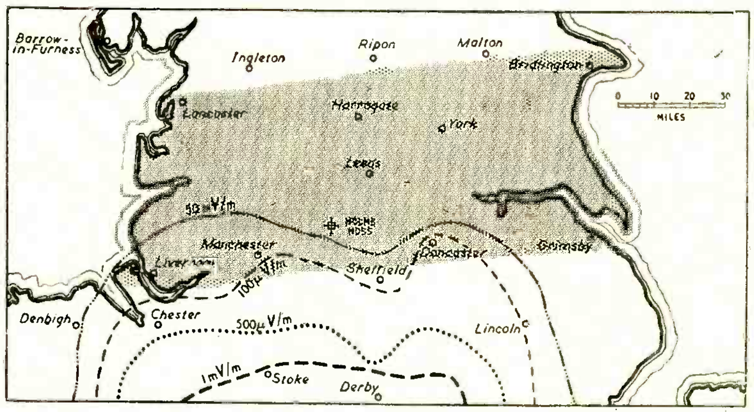
Television Progress

WHEN outlining the B.B.C.'s policy regarding television at a recent conference, the Director General, Sir William Haley, quoted figures showing the increased amount of capital expenditure on the service—from £74,000 in 1947-1948 to £914,000 in the current financial year and an estimated £1,202,000 next year. He estimated that 60 per cent of the Corporation's income in the next three years will be devoted to the development of the television service.

On the question of the international exchange of programmes, it was learned that a television transcription service, similar to that already existing for sound broadcasting, is being introduced by the B.B.C. to provide British programmes for other European countries.

When dealing with the question of the transmission of the Test Card at times suitable for home constructors to test their sets, it was stated that the main difficulty is the shortage of camera equipment and studios, which are used for rehearsals out of transmitting hours. The difficulty is so acute that the telecine camera is not infrequently used for the present Test Card transmissions.

The progress report on the building of the Holme Moss transmitter shows that at the end of December the mast—which, like that at Sutton Coldfield, will incorporate a slotted v.h.f. aerial "in case a v.h.f. transmitter for sound broadcasting is installed"—has risen to some 600ft—it will eventually be 750ft. A stand-by mast, 150ft high, with a smaller aerial, is being erected in case there is trouble with the main mast.

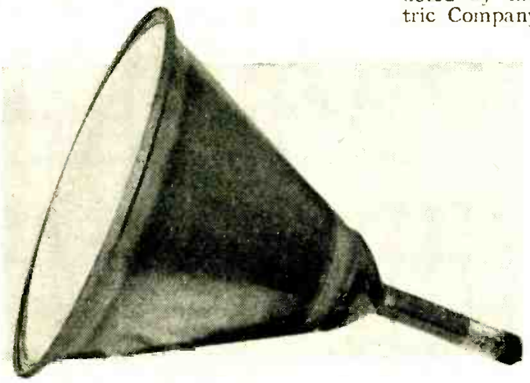


NORTHERN TELEVISION.—The B.B.C. states that the area within which reception of Holme Moss can be relied upon is expected to be roughly rectangular, as indicated on this map. To show the probable overlap of the Midland and Northern service areas some of the field-strength contours of the Sutton Coldfield transmitter are included.

Medium-power stand-by vision and sound transmitters are also being installed as a precautionary measure, and as a further precaution, the power supply for the station is coming from two sources. As already announced, the station will receive the London transmissions from Sutton Coldfield by coaxial cable.

The 35-kW Marconi vision transmitter will operate on 51.75 Mc/s and the 12-kW sound transmitter on 48.25 Mc/s.

The second of the converted film studios at Lime Grove, Shepherd's Bush, West London, has been brought into use by the B.B.C. It has a floor area of 5,500 sq ft and is equipped with four Pye Photicon cameras. All the control gear and ancillary equipment for the sound and vision channels and the telecine camera are in two adjoining rooms. The permanent wiring from the Apparatus and Control Rooms to the eight camera socket outlets conveniently disposed around the studio has been carried out in special cable provided by B.I. Callenders' Cables.



The English Electric 16-in cathode-ray tube, with steel body fused to glass face-plate and neck, has been designed for large-scale production.

Scientific Instruments

THIS year's Physical Society's exhibition of scientific instruments and apparatus—the 35th—will occupy two buildings—the main building of the Royal College of Science and the nearby Huxley Building, South Kensington. It opens on April 6th, when the morning session will be for members of the Society, and on the 7th, 9th, 10th and 11th for holders of admission tickets obtainable from the Physical Society, 1, Lowther Gardens, Prince Consort Road, London, S.W.7. These tickets, supplies of which will be sent to learned societies, are valid for either the morning or afternoon sessions but not for a specified day. The morning sessions will be from 10 a.m. to 1 p.m and the afternoon from 2 to 9 p.m., with the exception of the 7th and 11th when the exhibition will close at 5 p.m.

A handbook of the exhibition containing full descriptions of the exhibits will be obtainable from the Society early in March.

Steel C.R. Tubes

CATHODE-RAY tubes with spun-steel conical bodies and glass face-plates and necks are now being manufactured by the English Electric Valve Company. It is claimed that the new tube is lighter but at the same time more robust than its all-glass counterpart, and above all, that the design lends itself much better to modern mass-production techniques. The face-plate is nearly flat, thus increasing its effective area.

One size only—16 in—will be available. The tube is being marketed by the parent English Electric Company.

Science Centre

FOR some years negotiations have been going on for the establishment of a centre in London which would provide adequate accommodation for the learned societies. In the House of Commons on November 21st the Lord President of the Council announced that it had been possible to overcome the remaining obstacles for the adoption of the proposals originated by the Royal Society for a British Science Centre in London.

Provision will be made for accommodating in the Centre the Patent Office and its Library, the D.S.I.R. and other Government scientific organizations as well as providing new quarters for many of the leading scientific societies.

The actual site has not been announced.

International Acoustics

AS a result of the proposal put forward at an international acoustical meeting in Marseilles some months ago, a new journal, with the title *Acustica*, is being sponsored jointly by the Acoustics Group of the Physical Society in this country and similar organizations in France and Germany.

The journal, which will cover musical, architectural, physiological and biological acoustics, will be published in Switzerland in either French, German, or English with abstracts in the other two languages. The British representative on the Editorial Board is Dr. E. G. Richardson, Physics Department, King's College, Newcastle-on-Tyne, 2.

Television Cables

OUR oft-repeated claim that the British 405-line television system, with a bandwidth of 3 Mc/s. is the only one that is suitable for transmission over the existing international telephone cables, was reiterated by a sub-committee of the International Telephone Consultative Committee (C.C.I.F.) at a recent meeting in Geneva. It was emphasized that it would be necessary to double the number of repeaters for the "European" 625- and French 819-line systems.

East African Communications

AN experimental v.h.f. beam radiotelephone link between Nairobi and Nakuru which has been in use for more than a year has proved so successful that the East African Posts and Telegraphs Department plan to install similar equipment linking the major towns in Kenya, Uganda and Tanganyika. During this year radio equipment will be installed linking the telephone systems of Kampala and Jinja, Jinja and Nakuru and Tanga and Dar-es-Salaam. By 1952 Nairobi will be linked with Mombasa, Mombasa with Tanga, and Dar-es-Salaam with Dodoma.

A team of radio engineers is at present carrying out a survey in the coastal sector of East Africa, the results of which should add much to the knowledge of v.h.f. propagation in the tropics. Both the experimental gear and field survey equipment—which is mounted in motor vehicles to enable tests to be undertaken in any part of East Africa—were provided by Marconi.

G.R.S.E.

THE need to educate the public to the fact that radio servicing is a highly skilled job and also to eliminate "the dabbler and self-styled expert" is stressed in the recently produced prospectus of the Guild of Radio Service Engineers.

There are four classes of membership of the Guild, the main objects of which are to improve the status of those engaged in the "repair and maintenance of radio, television and similar electronic apparatus"; they are: (a) Full Member—who must be over 21, hold an approved certificate or have served for five consecutive years as a service technician; (b) Associate Member—who, although over 21, has served for less than five years; (c) Apprentice—serving under indenture; and (d) Improver. Membership is not open to principals or partners of firms or to those trading upon their own account.

Particulars of the Guild, which is registered under the Trade Unions Acts and has branches in Northern Ireland, Scotland, N.E. and N.W. England, are obtainable from the Honorary General Secretary, H. Hill, 2, Stevenson Street West, Accrington, Lancs.

It may be remembered that the G.R.S.E. is joint sponsor with the Radio and Television Retailers' Association of the Radio Service Trade Register.

B.B.C. Appointments

ANOTHER rearrangement of executives and departments in the Engineering Division of the B.B.C. is announced. A newly formed group—composed of the Planning and Installation Department and the Designs Department—is to be known as the Engineering Projects Group. F. C. McLean, who has been Head of the Engineering Services Group for the past 18 months, becomes Head of the new group and is succeeded by E. L. E. Pawley, who was his assistant. Mr. McLean joined the Corporation in 1936 after 11 years with Standard Telephones and Cables and was largely responsible for the erection of many of the B.B.C. transmitters built during the war. Mr. Pawley has been with the B.B.C. since 1931.

T. C. Macnamara, who had been with the Corporation since 1923, and who had, since 1947, been Head of the Planning and Installation Department, has resigned from the Corporation (see "Personalities") and is succeeded by A. N. Thomas, his assistant. Mr. Thomas joined the Research Department of the B.B.C. in 1926 and in 1938 became assistant to the Superintendent Engineer (Transmitters).

PERSONALITIES

T. C. Macnamara, who, as announced above, has resigned from the B.B.C. where he was in charge of the department responsible for planning, commissioning and installing all the equipment used by the Corporation, has joined Scophony-Baird as Director of Engineering and Production. During his 27 years with the B.B.C. he was largely concerned with the establishing of transmitting stations, including Droitwich, Alexandra Palace and Ottringham. He was Secretary to the 1943 Television Committee under the chairmanship of Lord Sankey.

T. C. MACNAMARA

Air Comdre. B. D. Nicholas, who has been appointed Air Officer Commanding No. 27 Group, R.A.F. Technical Training Command, has, since 1946, successively held the posts of Inspector of Signals, No. 90 Group; Deputy Director of Radio at the Air Ministry and Director of Signals (Organization).

Percy Good, C.B.E., who had been Director of the British Standards Institution since 1939, died on December 2nd at the age of 70. He was appointed Assistant Secretary of the British Engineering Standards Association—now the B.S.I.—in 1913 and was president of the I.E.E. in 1947.

IN BRIEF

Synthetic Radio and radar equipment is used in the training of air traffic control officers at the Ministry of Civil Aviation's A.T.C. School at Hurn Airport, in addition to normal courses on telecommunications and radar. Comprehensive training on all aspects of air traffic control is given both to new recruits and established M.C.A. officers, and since 1948 when the school opened 479 British and 23 Overseas officers have passed through it. Arriving at Hurn by air, *Wireless World* was safely and efficiently "talked down" on to the runway by pupils who were gaining actual operational experience of radar in the Airport's G.C.A. van.

Iceland's new 5-kW transmitter at Eidar—operating on 611 kc/s—was provided by Marconi's who supplied the original 1-kW installation which it replaces. The Iceland State Broadcasting Service has now placed an order with the company for a 5-kW transmitter for a new station at Akureyri which, under the Copenhagen Plan, shares the 737-kc/s channel with Spain, Palestine and Poland. Iceland has also ordered a 20-kW long-wave transmitter for erection on the same site as the existing 100-kW long-wave station at Reykjavik.

S.W. Listening.—The annual short-wave listening competitions organized by the International Short Wave Club will be held in February. In the first of these, contestants have to log between February 4th and 18th South and Central American and West Indian stations operating on c.w. or 'phone in the 14- and 28-Mc/s bands. In the second contest competitors have to log, during the four weekends in February, short-wave broadcasting stations in the same areas. Entrance forms and full details are available from I.S.W.C., 100, Adams Gardens Estate, London, S.E.16.

Yachtsmen among our readers may like to know of the introduction of the *Yachting World* Diary issued for our associated journal *Yachting World* by our Publisher, priced 9s 2d, including purchase tax. The material in the 52 pages of reference data ranges from the International Code of Signals in full colour to the London Underground System and includes the morse code and the times of B.B.C. weather forecasts.

INDUSTRIAL NEWS

A South African Company is being formed jointly by E.M.I. and H. Polliack & Co. of South Africa and a factory is being erected in Johannesburg for the manufacture of gramophone records. It is understood that it is intended at a later stage to extend the factory to include the manufacture of other E.M.I. consumer goods, including broadcast receivers and radio-gramophones.

U.N. Television.—Tenders for television equipment, presumably to American standards, called for by the United Nations Headquarters, Lake Success, include three complete mobile camera chains and vision control equipment. Details are available from The Commercial Relations and Exports Department (Industries Branch), Board of Trade, Room 1080, Thames House North, Millbank, London, S.W.1 (Reference C.R.E.(IB)72118/50).

New studios for the broadcasting service in Hong Kong—the technical side of which is the responsibility of Cable and Wireless—are to be equipped with seven Marconi control consoles.

Marconi International Marine Communication Co. has acquired new premises at 36, Broad Street, Peterhead, from which all Marconi marine business in the port will be conducted (Tel.: Peterhead 376).

A.B. Metal Products, Ltd., have found it necessary to extend their works at Ynysboeth, Abercynon, Glamorgan, into which they recently moved, and the factory now covers an area of 72,000 sq ft.

MEETINGS

Institution of Electrical Engineers

Radio Section.—Discussion on "How Reliable is a Radio Valve?" to be opened by G. H. Metson, Ph.D. M.Sc., B.Sc.(Eng.), at 5.30 on January 22nd at Savoy Place, London, W.C.2.

Cambridge Radio Group.—"The Use of Saturable Reactors as Discharge Devices for Pulse Generators," by W. S. Melville, B.Sc.(Eng.), at 8.15 on January 16th at the Cavendish Laboratory.

South Midland Radio Group.—Informal lecture on "The Operation and Maintenance of Television Outside-Broadcast Equipment" by T. H. Bridgewater at 6.0 on January 29th at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Reading (Berks) District.—"Trends of Development in Radiocommunication" by Professor Willis Jackson, D.Sc., D.Phil., at 7.0 on January 22nd at the Great Western Hotel, Reading.

British Sound Recording Association

"Design Requirements for Magnetic Recording Tape" by P. T. Hobson at 7.0 on January 19th at the Royal Society of Arts, John Adam Street, London, W.C.2.

Television Society

Leicester Centre.—"Television from Calais" by W. D. Richardson (B.B.C. Television Service) at 7.0 on January 10th at the Leicester College of Technology, The Newarkes, Leicester.

Radio Research

Report of the Radio Research Board

IT is seventeen years since a report on the activities of the Radio Research Board has been issued as a separate publication, so that the one covering the period 1933 to 1948, which is just published by the Stationery Office (price 2s.), is of particular interest.

"Radio Research 1933-1948," as it is called, includes in its 60 pages not only the official report of the Board, of which Sir Stanley Angwin is chairman, but also a survey of the investigations carried out under the direction of the Board between 1934 and 1947 ; the report of the Director of Research—Dr. R. L. Smith-Rose—for 1948 ; and appendixes giving the membership of the Board, the papers emanating from the Radio Division of the N.P.L., and the constitution of the Board's various committees. For the sake of continuity with the earlier reports, the Board gives a brief account of its activities from 1933-1945, but the major part of the publication is devoted to a more detailed survey of the post-war period.

The report records that a considerable amount of time is devoted to the study of the ionosphere and that this part of the Board's work is being extended. This work has been centred on the Radio Research Station, Slough, where these measurements have been conducted for many years past. In addition, however, regular observations of a similar type have been made at the sub-stations at Fraserburgh in Aberdeenshire, and at Port Stanley in the Falkland Islands; while during the latter part of 1948 preparations were made for a similar ionospheric observatory to be set up at Singapore.

Following the recommendation of the British Commonwealth Scientific Official Conference in 1946, the possibility of installing ionospheric recording stations in Graham Land has been explored and an observatory is to be established on Deception Island.

The present research programme includes an investigation of the communication possibilities of the shorter wavelengths now being used for radio-telephone relay links and television, and valuable data have already been accumulated.

Research into the characteristics and sources of atmospheric noise has been developed into a world-wide survey in co-operation with Australia and the United States of America. Sixteen Service and commercial stations now make a schedule of hourly observations over the frequency band 2.5-20 Mc/s. The investigation is being extended to the low-frequency range of 15 to 500 kc/s, and a network of observation stations covering this range of frequencies is being established.

Horn Loading

THE potentialities of horn loading were demonstrated at a lecture by R. L. West, B.Sc., A.M.Brit.I.R.E., on "Progress in Loudspeaker Design" given to the British Institution of Radio Engineers on December 18th last, when a $2\frac{1}{2}$-in diameter unit of the type often used for monitoring purposes in communication receivers was coupled by an extension piece to an early Voigt tractrix horn with 4ft square mouth. Remarkably good quality of reproduction with a full round bass response resulted, and a comparison of the same unit as a direct radiator bordered on the ludicrous.

This was, of course, a rather special case, and the more advanced types of direct radiators among the thirty-odd loudspeakers demonstrated gave a very good account of themselves, particularly when mounted in acoustically designed cabinets. Starting with a pleated-diaphragm loudspeaker of pre-1930 vintage, the principal developments in loudspeaker practice were traced—moving coil drive, twin diaphragms, multiple units, duode drives and concentric horn and cone loudspeakers for wide-range reproduction.

The distribution of high frequencies was discussed in some detail and the use of multi-cellular horns, solid reflectors of the Voigt and Mordaunt type, and slot diffusers were demonstrated. The latter consists of a vertical slot aperture in a baffle placed in front of the cone and the diffraction of sound from a saturated diode source, normally exhibiting a well-marked beam in the upper register when reproduced through a simple cone unit, was one of the most striking experiments of the evening.

The discussion which followed produced questions on many aspects of sound reproduction including the probable magnitude of the Doppler effect in causing intermodulation between high and low frequencies when radiated by a single diaphragm. Mr. West thought that this effect was often exaggerated and that before amplitudes which might make it aural were reached, other distortions due to non-uniformity of field in the magnet gap would have made their appearance.

Piezoelectric Pickups

A PROPHECY that in five years time ceramic aggregates of the strontium-barium titanate type might displace Rochelle salt as the principal material for making crystal pickup elements was made by S. Kelly in a lecture to the British Sound Recording Association on December 20th last. Much work remained to be done before a piezoelectric ceramic of adequate stability could be put into production, and means devised for safeguarding it against fracture. He compared its inherent strength to a piece of fur from the lining of a kettle and pointed out that because of its high mechanical impedance elements of only 0.005in thickness could be used in pickup movements. The chief advantages of this material over Rochelle salt were resistance to humidity changes and high dielectric constant.

Recent advances in crystal pickups were reviewed and a design described in which a narrow crystal torsion element, free at both ends, is embedded in a plastic gel of optimum viscosity to give an evenly distributed load, presenting to the needle point the equivalent of a properly terminated transmission line. The reflected mechanical impedance at the stylus point was reduced by the use of a cantilever mounting and record wear had proved to be remarkably low. The pickup had given very good results with long-playing records in which the problem of tracking was made more difficult than on 78-r.p.m. records because of the limitation of downward pressure imposed by the new plastic materials used, and the higher relative velocity of recording at high compared with medium and low frequencies—about 10db between 1,000 and 10,000 c/s.

Societies and Clubs

List of Radio Groups in the British Isles

IT is now nearly three years since we last published a list of amateur societies and, as the number of such organizations on our records has almost doubled, it is considered opportune to issue a revised list. Arranged in alphabetical order under towns, the name of the club, and in some cases the club call sign, is followed by that of the secretary from whom details of the society's activities may be obtained. Clubs which are affiliated to the Radio Society of Great Britain are indicated by an asterisk. We shall be pleased to receive details from the secretaries of active societies which may have been inadvertently omitted from this list.

ABERDARE.—Rhigos and District Radio Club (GW3FFE).—F. Hamer, 7, Neath Road Bungalows, Rhigos, Aberdare, Glam.

ABERDEEN.—Aberdeen Amateur Radio Society* (GM3BSQ).—G. M. Jamieson, 66. Elmfield Avenue, Aberdeen.

ASHTON-UNDER-LYNE.—Ashton-under-Lyne and District Amateur Radio Society*.—N. H. Brown, 13, Corporation Road, Audenshaw, nr. Manchester.

AYLESBURY.—Aylesbury and District Radio Society*.—J. G. Penrice, 31, Prebendal Avenue, Aylesbury, Bucks.

BALDOCK.—Baldock and District Radio Club* (G3AXP).—E. W. Edwards, 164. Icknield Way, Letchworth, Herts.

BARNSLEY.—Barnsley and District Amateur Radio Club.—J. J. Rose, 21, Swift Street, Barnsley, Yorks.

BASINGSTOKE. — Basingstoke and District Amateur Radio Society.—L. S. Adams, 16, Bramblys Drive, Basingstoke, Hants.

BATH.—Admiralty Electronics Society* (G3BPU).—D. Houston, D.E.E. Dept., Admiralty, Bath, Som.

BELFAST.—City of Belfast Y.M.C.A. Radio Club* (GI6YM).—S. H. Foster, 31, Belmont Park, Belfast.

BERWICK-ON-TWEED. — Berwick-on-Tweed Radio Club.—W. Baker, 4, Devon Terrace, Berwick-on-Tweed, Northumberland.

BIRKENHEAD.—Wirral Amateur Radio Society*.—A. H. Watts, 38, Sandymount Drive, Wallasey, Ches.

BIRMINGHAM. — Birmingham and District Short-Wave Society.—W. V. Shepard, 174, Gristhorpe Road, Selly Oak, Birmingham, 29.
Kynoch Radio and Television Society*.—G. E. Nicholls, 20, Merrions Close, Great Barr, Birmingham, 22A.
Midland Amateur Radio Society*.—H. B. Bligh, 52, Norman Road, Birmingham, 31.
International Radio-Controlled Models Society.—G. F. Golding, 32, Beechfield Road, Smethwick, Staffs.
Slade Radio Society*.—C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

BLACKPOOL.—Blackpool and Fylde Amateur Radio Society.—H. D Ashworth, 5, Albion Avenue, Blackpool, Lancs.

BOGNOR.—West Sussex Short-Wave and Television Society.—R. D. Holland, "Maybury," Aldwick Gardens, Bognor, Sussex

BOLTON.—Bolton and District Radio Society.—N. Moorcroft, 3, Beaconsfield Street, Bolton, Lancs.

BOURNEMOUTH. — Bournemouth and District Amateur Radio Club* (G3AYG).—T. C. White, Chester House Hotel, Chine Crescent, Bournemouth, Hants.
Bournemouth Radio and Television Society* (G3FVU).—F. G. Hamshere, 55, Maclean Road, West Howe, Bournemouth, Hants.

BOVINGDON.—Bovingdon Airport Club Amateur Radio Section.—J. D. Lord, Police Station, Bovingdon, Herts.

BRADFORD.—Bradford Amateur Radio Society*.—V. W. Sowen, "Rushwood," Grange Park Drive, Cottingley, Bingley, Yorks.

BRIGHTON.—Brighton and District Radio Club*.—L. Holden, 17, Hartington Road, Brighton, Sussex.
East Brighton Short-Wave Club.—W. Jardine, 52, Kipling Avenue, Woodingdean, Brighton, Sussex.

BRISTOL.—Bristol and Bath Television Club.—C. J. Floyd, "Leagarth," Margaret Road, Bishopsworth, nr. Bristol, Glos.
Bristol and District Short-Wave Listeners' Club (G3GIS).—N. G. Foord, 71, Brynland Avenue, Bristol, 7, Glos.

BURNHAM.—Burnham and Highbridge Amateur Radio Society.—T. N. Carter, c/o Post Office Radio Station, Highbridge, Som.

BURTON-ON-TRENT. — Burton and District Radio Society.—E. B. Hardy, "Hill Cottage," Dunstall, nr. Burton-on-Trent, Staffs.

BURY.—Bury and District Radio Society (G3BRS).—R. H. McVey, 46, Holcombe Avenue, Elton, Bury, Lancs.

CAMBRIDGE.—Cambridge and District Amateur Radio Club.—T. A. T. Davies, "Meadowside," Comberton, Cambridge.
Cambridge University Wireless Society*.—F. S. Williamson, 42, South Road, Histon, Cambs.

CANNOCK. — Cannock Chase Radio Society.—D. M. Whitehouse, 69, Church Street, Cannock, Staffs.

CARLISLE.—Carlisle Amateur Radio Society.—J. Ostle, 2, Outgang, Aspatria, Carlisle, Cumberland.

CATTERICK.—Catterick Amateur Radio Club* (G3CIO).—L/Cpl. Phelps, Catterick Amateur Radio Club, c/o 2, Sqn., 1st T.R., Loos Lines, Catterick Camp, Yorks.

CHATHAM.—Medway Amateur Receiving and Transmitting Society* (G2FJA).—S. A. C. Howell, 39, Broadway, Gillingham, Kent.

CHELTENHAM.—Cheltenham Amateur Radio Society* (G3GPW).—F. W. Humphries, 136, Whaddon Road, Cheltenham, Glos.

CHESTER. — Chester and District Amateur Radio Society* (G3GIZ).—W. Lloyd, 124, Tarrin Road, Chester.

CHIPPENHAM. — Chippenham and District Short-Wave Club.—W. A. Henson, 12, Filton Way, Chippenham, Wilts.

CLECKHEATON.—Spen Valley Radio and Television Society*.—N. Pride, 100, Raikes Lane, Birstall, nr. Leeds, Yorks.

COVENTRY.—Courtaulds Amateur Radio Group*.—W. P. Stevens, Courtaulds, Ltd., Foleshill Road, Coventry, Warwick.
Coventry Amateur Radio Society* (G2ASF).—K. G. Lines, 142, Shorncliffe Road, Coventry, Warwick.

CRANWELL.—R.A.F. Amateur Radio Society* (G8FC and G3DBQ).—N. Davis, 57, North Parade, Sleaford, Lincs.

DERBY.—Derby and District Amateur Radio Society* (G3ERD) —F. C. Ward, 5, Uplands Avenue, Littleover, Derby.
Derby Wireless Club.—A. W. Elliott, "Chilvern," 46, Robin Croft Road, Allestree, Derby.

DONCASTER.—Doncaster and District Amateur Radio Society* (G3CBM).—H. Flintham, 50, Burton Avenue, Balby, Doncaster, Yorks.

DORKING.—Dorking and District Radio Society* (G3CZU).—J. Greenwell, 7, Sondes Place Drive, Dorking, Surrey.

DUBLIN.—Irish Radio Transmitters' Society.—Capt. A. C. Woods, 17, Butterfield Crescent, Rathfarnham, Co. Dublin.

DUNFERMLINE. — Dunfermline Radio Society*.—D. Leah, 14, Hillwood Terrace, Rosyth, Fife.

EASTBOURNE.—Eastbourne and District Radio Society*.—R. F. Nugent, Field House, Windmill Hill, nr. Hailsham, Sussex.

EAST GRINSTEAD.—East Grinstead Radio and Television Society.—E. C. Cooper, "Heatherlea," Cranston Road, East Grinstead, Sussex.

ECCLES.—Eccles and District Radio Society* (G3GXI).—E. Rayson, 11, Hartington Road, Winton, Lancs.

EDINBURGH. — Edinburgh Amateur Radio Club* (GM3HAM).—A. G. M. Bruce, 89, Marchmont Road, Edinburgh, 9.
Lothians Radio Society.—I. Mackenzie, 41, Easter Drylaw Drive, Edinburgh, 4.

EXETER.—Exeter and District Radio Society.—E. M. Wills, "Moor View," Wreford's Lane, Exeter, Devon.

FALMOUTH. — West Cornwall Radio Club*.—R. Trewarvis, 10, Trevethan Rise, Falmouth, Cornwall.

FARNBOROUGH.—R.A.E. and Farnborough District Amateur Radio Society*.—J. St. C. T. Ruddock, 80, Byworth Estate, Farnham, Surrey.

FORFAR.—Forfar and District Amateur Radio Club* (GM3GBZ).—A. F. Ferguson, 3, Osnaburg Street, Forfar.

GATESHEAD.—Gateshead and District Amateur Radio Club*.—L. Blackie, 109, Brighton Road, Gateshead, 8, Co. Durham

GERRARDS CROSS.—British Amateur Television Club.—M. W. S. Barlow, Cheyne Cottage, Dukes Wood Drive Gerrards Cross, Bucks.

GILLINGHAM.—Gillingham Telecommunications Society.—R. A. Lucas, 38, Junction Road, Gillingham, Kent.

GLOUCESTER.—Gloucester and District Amateur Radio Society.—J. W. Dean, 100, Stanley Road, Glos.

GRIMSBY.—Association of Grimsby and District Radio Engineers.—H. Crampin, 268, Victoria Street, Grimsby, Lincs.
Grimsby Amateur Radio and Television Society (G2CNX).—W. Atkinson, 43, Sidney Road, Grimsby, Lincs.

GUILDFORD.—Guildford and District R.S.G.B. Group*.—H. C. Spencer, 1, Shepherds Hill, Stoughton, Guildford, Surrey.

HALIFAX.—Halifax Experimental Radio Society.—L. Blagbrough, 39, Fountain Street, Sowerby Bridge, Yorks.

HARROGATE.—Harrogate and District Short-Wave Radio Society*.—F. Walker, 99, East Parade, Harrogate, Yorks.

HAWICK.—Hawick Radio Society.—W. McMahon, 10, Drumlannig Place, Hawick, Roxburghshire.

HEMSWORTH.—Hemsworth and District Radio and Television Society.—E. Baddeley, 49, Regent Street, Hemsworth, nr. Pontefract, Yorks.

HULL.—Hull Radio Group.—G. L. Fish, 81, Park Street, Hull, Yorks.

ISLE OF MAN.—Isle of Man Amateur Radio Society* (GD3FLH).—H. Grist, Broadway House, Broadway, Douglas, I.O.M.

JERSEY.—Jersey Radio Society.—E. Banks, 7, Royal Crescent, Don Road, St. Helier, Jersey.
QUA Club.—Miss V. Hunt, "Woodshiel," Millbrook, Jersey.

KENILWORTH.—Kenilworth Radio and Television Society (G3HAD).—A. T. Davis, 8, Lower Ladye's Hill, Kenilworth, Warwicks.

KETTERING.—Kettering Radio and Photographic Society*.—I. L. Holmes, "Miami," The Close, Headlands, Kettering, Northants.

KIRKCALDY. — Kirkcaldy Amateur Radio Society (GM3GOL).—J. Taylor, The Pharmacy, Methilhill, Kirkcaldy, Fife.

LEEDS.—Leeds Amateur Radio Society* (G3BEW).—E. Sollitt, 20, Conway Place, Harehills, Leeds, Yorks.

LEEK.—Leek and District Radio Society.—B. Cordon, 93, Shirburn Road, Leek, Staffs.

LEWES.—Lewes Amateur Radio Club.—C. H. E. Moore, 2, Old Stone House, Friars Walk, Lewes, Sussex.

LINCOLN.—Lincoln Short-Wave Club.—G. C. Newby, 10, Addison Drive, St. Giles, Lincoln.

LIVERPOOL.—Liverpool and District Short-Wave Club.—R. A. Hogg, 39, Southmead Road, Allerton, Liverpool, 19.
Merseyside Radio Society.—C. M. Johnstone, 6, Flawn Road, West Derby, Liverpool.

LONDON AREA†.—Babcock and Wilcox Staff Association Radio Society* (G3GKM).—L. E. J. Manders, 207, French Street, Sunbury-on-Thames, Middx.
Barnet Amateur Radio Society.—M. R. Jenkins, 1193a, High Road, Whetstone, N.20.
Barnet and District Radio Club* (G3FFA).—C. J. Spencer, 31, Byng Road, Barnet, Herts.
Brentwood and District Amateur Radio Society* (G3FSM).—J. F. Moseley, 45, Geoffrey Avenue, Harold Park, Brentwood, Essex.
British Television Viewers' Society.—L. G. Pace, 140, Fairlands Avenue, Thornton Heath, Surrey.
British Two-Call Club.—G. V. Haylock, 63, Lewisham Hill, S.E.13.

† Based on the G.P.O. London Telecommunications Region.

City and Guilds College Radio Society* (G5YC).—F. H. Steele, The Radio Society, C. & G. College, S. Kensington, S.W.7.
City of London Phonograph and Radio Society*.—R. H. Clarke, 12, Grove Road, N. Finchley, N.12.
City of London Signals Amateur Radio Club* (G3CFN).—R.S.M. Edwards, H.A., Signal House, Atkins Road, Clapham, S.W.12.
Clifton Amateur Radio Society (G3GHN).—W. A. Martin, 21, Brixton Hill, S.W.2.
Cray Valley Radio Transmitting Club.—G. Miles, "Cotswold," Modingham Lane, S.E.9.
Cromwell Radio Club.—E. W. Jordi, 103, Gloucester Road, South Kensington, S.W.7.
Edgware and District Radio Society* (G3ASR).—R. H. Newland, 10, Holmstall Avenue, Edgware, Middx.
Enfield Radio Society (G3GEP).—F. A. Tickell, 10, Cowdrey Close, Enfield, Middx.
Grafton Radio Society* (G3AFT).—W. H. C. Jennings, Grafton L.C.C. School, Eburne Road, Holloway, N.7.
Gravesend Amateur Radio Society* (G3GRS).—R. E. Appleton, 23, Laurel Avenue, Gravesend, Kent.
Grays and District Amateur Radio Club*.—C. Mundy, 68, Chesunt Avenue, Grays, Essex.
Hounslow and District Radio Society*.—A. H. Pottle, 11, Abinger Gardens, Isleworth, Middx.
Ilford and District Radio Society* (G3QU).—C. E. Largen, 44, Trelawney Road, Barkingside, Essex.
International Radio-Controlled Models Society.—M. A. Ayres, Carlton Lodge, Princes Risboro', Bucks.
Islington Radio Club.—G. E. Lazell, 49, Hungerford Road, Islington, N.7.
Kingston and District Amateur Radio Society*.—R. S. Babbs, B.Sc., 28, Grove Lane, Kingston, Surrey.
London Short-Wave Club (G2CLR).—R. Lisney, 6a, Ongar Road, Fulham, S.W.6.
North Kent Radio Society* (G3ENT).—L. E. J. Clinch, 8, Windsor Road, Bexleyheath, Kent.
North West Kent Amateur Radio Society.—B. A. M. Herbert, 18, Leamington Close, Bromley, Kent.
Plumstead, Woolwich & Abbey Wood Radio Group.—D. Halls, 48, Raglan Road, S.E.18.
Queen Mary College Electronics and Amateur Radio Society* (G4RG).—R. W. A. Scarr, Queen Mary College, University of London, Mile End, E.1.
Radio Society of Harrow* (G3EFX).—S. C. J. Phillips, 131, Belmont Road, Harrow Weald, Middx.
Ravensbourne Amateur Radio Club* (G3HEV).—J. H. F. Wilshaw, 4, Station Road, Bromley, Kent.
Richmond and District Radio Society.—W. Crossland, 1, Spring Grove Road, Richmond.
Romford and District Amateur Radio Society*.—F. A. W. Wisdom, 90, Gubbins Lane, Harold Wood, Essex.
St. Albans Radio Society.—A. Read, "Ottershaw," Upton Avenue, St. Albans, Herts.
St. Pancras Radio Society*.—H. Brown, 84, Blenheim Gardens, N.W.2.
S.E. London Technical College Radio Society* (G3CMQ).—Lewisham Way, S.E.4.
South West Essex Radio and Scientific Club.—K. R. Goodley, 34, Blenheim Avenue, Valentines Park, Ilford.
Surrey Radio Contact Club*.—S. A. Morley, 22, Old Farleigh Road, Selsdon, South Croydon.
Sutton and Cheam Radio Society* (G3GFA).—F. J. Harris, 143, Collingwood Road, Sutton, Surrey.
Thames Valley Amateur Radio Transmitters' Society*.—K. A. H. Rogers, 21, Links Road, Epsom, Surrey.
Walworth Men's Institute Radio Club.—J. Gibbs, 22, Caspian Street, Camberwell, S.E.5.
Wandsworth and District Radio Club.—M. M. Wallace, 13, Auckland Hill, S.E.27.
Wanstead and Woodford Radio Society*.—R. J. C. Broadbent, Wanstead House, The Green, Wanstead, E.11.
West Middlesex Amateur Radio Club* (G3EDH).—P. F. Blomfield, 213, Harrow View, Harrow, Middx.
Willesden Radio Club (G3BFZ).—M. Taye, 51, Dudden Hill Lane, N.W.10.

LONDONDERRY.—North West Ireland Amateur Radio Society (GI3CFH).—A.T.C., 11, Pump Street, Londonderry, N. Ireland.

LOUGHBOROUGH.—Beaumanor Amateur Radio Society (G3BMR).—E. Pethers, Beaumanor Park, Loughborough, Leics.
Garats Hay Radio Club—Royal Signals* (G3CHR).—Cpl. Hudson, 10, W.T.S. Royal Signals, Woodhouse, Loughborough, Leics.

LUTON.—Luton and District Radio Society* (G3EJU).—H. S. E. Radford, 37, Wilsden Avenue, Luton, Beds.

MAIDENHEAD.—Maidenhead Amateur Radio Club*.—R. F. Woodruff, "Oaklands," College Road, Maidenhead, Berks.

MALVERN.—T.R.E. Amateur Radio Society*.—B. H. Briggs, House 5, T.R.E., Great Malvern, Worcs.

MANCHESTER.—International Radio-Controlled Models Society.—T. F. Sutton, The Lodge, Manchester Grammar School, Manchester, 13.
Manchester and District Radio Society*.—H. Marshall, 14, Greenway Close, Sale, Cheshire.
South Manchester Radio Club* (G3FVA).—E. Taylor, 12, Manton Avenue, Didsbury Park, Didsbury, Manchester, 20.
Whitefield and District Radio Society.—E. Fearn, 4, Partington Street, Newton Heath, Manchester, 10.

MANSFIELD.—Mansfield and District Radio Society* (G3GQC).—A. W. Fowler, "Windsor," Cowpasture Lane, Sutton-in-Ashfield, Notts.

MIDDLESBROUGH.—South Bank and District Amateur Radio Society.—H. Stubbings, 11, Station Road, South Bank, Middlesbrough, Yorks.
Tees-side Amateur Radio Society.—J. H. Davies, 85, Cobden Street, Thornaby-on-Tees, Yorks.

MINEHEAD. — West Somerset Radio Society*.—T. C. Bryant, 16, The Parks, Minehead, Som.

MONTROSE.—Montrose Radio Club*.—Miss J. M. Steers, 182, High Street, Montrose, Angus, Scotland.

NEATH.—Neath, Port Talbot and District Amateur Radio Club (GW3EOP).—W. R. Petheram, 7, Tynyrheol Avenue, Tonna, nr. Neath, Glam.

NEWARK.—Newark and District Radio Society.—J. R. Clayton, 160, Wolsey Road, Newark, Notts.

NEWBURY.—Newbury and District Amateur Radio Society.—A. W. Grimsdale, 164, London Road, Newbury, Berks.

NEWCASTLE.—North East Amateur Transmitting Society*.—J. W. Hogarth, 4, Fenwick Avenue, Blyth, Northumberland.

NORTHAMPTON.—Northampton Radio Society.—B. Sykes, 114, Wellingborough Road, Northampton.
Northampton Short-Wave Radio Club* (G3GWB).—V. R. Hartopp, 22, Purser Road, Northampton.

NORTHWICH.—Crescent Radio Society.—W. Houseman, 15, Snowdon Street, Barnton, Northwich, Cheshire.

NOTTINGHAM. — Guilford Secondary Girls' School Amateur Radio Club (G3FYN).—S. Read, Guilford Secondary Girls' School, Nottingham.
Nottingham and District Radio Society.—B. H. Singleton, 13, Tithby Drive, Sherwood, Notts.
Nottingham and District Short-Wave Club (G3EKW).—D. C. G. Johnson, 16, Lorne Grove, Woodborough Road, Nottingham.

OLDHAM.—Oldham Radio Society.—E. Hulme, 20, Parkway, Chadderton, Oldham, Lancs.

OSWESTRY.—Oswestry and District Radio Society*.—A. D. Narroway, "Lamorna," Pant, nr. Oswestry, Salop.

OXFORD.—Oxford and District Amateur Radio Society*.—J. Hickling, 47, Banbury Road, Oxford.

PAISLEY.—Paisley Short-Wave Club.—J. MacArthur, 9, East Buchanan Street, Paisley, Renfrew.

PENZANCE. — West Cornwall Radio Club*.—R. V. A. Allbright, "Greenacres," The Lidden, Penzance, Cornwall.
West of England Amateur Radio Club.—C. Richards, 18, Clarence Street, Penzance, Cornwall.

PETERBOROUGH.—Peterborough Radio and Scientific Society (G3DQW).—S. Woodward, 72, Priory Road, Peterborough, Northants.

PONTEFRACT.—Pontefract and District Amateur Radio Club (G3FYQ).—C. H. Gould, 51, Pontefract Road, Ferrybridge, Yorks.

PONTYPOOL.—Pontypool and District Radio Club.—W. F. Chew, Bryn Cottage, Pontrepoid, Mon.

POOLE.—Poole and District Amateur Radio Club.—J. Loader, 5, Highwood Road, Parkstone, Dorset.

PORTSMOUTH.—Portsmouth and District Radio Society* (G3DIT).—R. Short, 76, Roman Grove, Portchester, Hants.
South Hants Radio Transmitting Society*.—H. G. Martin, 184, Kirby Road, North End, Portsmouth, Hants.

PRESTON.—Preston Radio Society*.—J. Hamilton, 48, Queen's Road, Preston, Lancs.

RAMSGATE.—Thanet Amateur Radio Society.—J. Barnes, 18, Grange Road, Ramsgate, Kent.

READING.—Reading Radio Society*.—L. A. Hensford, 30, Boston Avenue, Reading, Berks.

REIGATE.—East Surrey Radio Club*.—L. Knight, Radiohme, Madeira Walk, Reigate, Surrey.

RETFORD. — Retford and District Amateur Radio Club.—H. White, 39, Trent Street, Retford, Notts.

ROTHERHAM.—Rotherham and District Radio Club.—R. A. Watson, 147, Fitzwilliam Road, Rotherham, Yorks.

ROYSTON.—Royston and District Radio Club (G2GIT).—F. A. M. Ashton, 115, Melbourn Road, Royston, Herts.

ST. HELENS.—St. Helens and District Radio Society.—J. K. Birch, 19, Knowsley Road, Rainhill, St. Helens, Lancs.

SALISBURY.—Salisbury and District Short-Wave Club (G3FKF).—V. G. Page, 32, Feversham Road, Salisbury, Wilts.

SCARBOROUGH.—Scarborough Amateur Radio Society (G4BP).—P. B. Briscombe, 31, St. John's Avenue, Scarborough, Yorks.

SHEFFIELD.—Sheffield Amatur Radio Club*.—E. Walker, 11a, Welwyn Close, Sheffield, 12, Yorks.
Sheffield University Radio Society*.—G Holder, Leavy Greave, Sheffield, 3, Yorks.

SHEERNESS.—Sheppey Amateur Radio Society.—J. Thomas, 27, Holmside Avenue, Halfway House, Sheerness, Kent.

SLOUGH.—Slough and District Radio Society.—P. R. Baldwin, 6, Pitts Road, Salt Hill, Slough, Bucks.

SMETHWICK.—Smethwick and District Wireless Society.—G. A. Swinnerton, 23, Hawthorn Croft, Quinton, Birmingham, 32.

SOLIHULL.—Solihull Amateur Radio Society.—G. Haring, 121, Bradbury Road, Olton, Birmingham.

SOUTHAMPTON.—Southampton Radio Club.—J. H. Sillence, 80, The Drove, Coxford, Southampton, Hants.

SOUTHEND.—Southend and District Radio Society* (G5QK).—J. H. Barrance, M.B.E., 49, Swanage Road, Southend-on-Sea, Essex.

SOUTHPORT.—Southport Radio Society*.—F. H. P. Cawson, 113, Waterloo Road, Southport, Lancs.

SOUTH SHIELDS. — South Shields Amateur Radio Club* (G3DDI).—W. Dennell, 12, South Frederick Street, South Shields, Durham.

STOKE-ON-TRENT. — Stoke-on-Trent Amateur Radio Society* (G3GBU).—J. R. Brindley, 45, Rosendale Avenue, Chesterton, Newcastle-under-Lyne, Staffs.

STOURBRIDGE.—Stourbridge and District Amateur Radio Society*.—W. A. Higgins, 28, Kingsley Road, Kingswinford, nr. Brierley Hill, Worcs.

STROUD.—Stroud and District Amateur Radio Club.—K. D. Ayers, 1, Victoria Villas, Whitehill, Stroud, Glos.

SUNDERLAND. — Sunderland Radio Society* (G2CSR).—C. A. Chester, 38, Westfield Grove, High Barnes, Sunderland, Co. Durham.

SWINDON.—Swindon and District Radio Society (G3FEC).—W. T. Dodd, 89, Hythe Road, Swindon, Wilts.

TORQUAY. — Torbay Amateur Radio Society*.—K. J. Grimes, 3, Clarendon Park, Tor Vale, Torquay, Devon.

TREDEGAR.—Tredegar Radio Society.—K. Bryant, Glan Howy, Park Place, Tredegar, Mon.

TROWBRIDGE.—Trowbridge Amateur Television Society.—H. L. Pepler, 8, West Ashton Road, Trowbridge, Wilts.

TUNBRIDGE WELLS. — West Kent Radio Society*.—L. King, "Glenise," Maidstone Road, Pembury, nr. Tunbridge Wells, Kent.

WADEBRIDGE. — West of England Amateur Radio Club.—C. Richards, St. Issey, Wadebridge, Cornwall.

WAKEFIELD.—Wakefield and District Amateur Radio Society.—W. Farrar, Holmcroft, Durkar, Wakefield, Yorks.

WALSALL.—Walsall Technical College Radio Amateurs' Club.—Miss D. Ward, 40, Willows Road, Walsall, Staffs.

WARRINGTON.—Risley Radio Society (G3CIC).—F. W. D. Rouse, 3, Derwent, Damhead Hall, Warrington, Lancs.
Warrington and District Radio Society* (G3CKR).—J. Speakman, Davyhulme Cottage, Dark Lane, Higher Whitley, Warrington, Lancs.

WATFORD.—Watford and District Radio and Television Society*.—R. W. Bailey, 32, Cassiobury Drive, Watford, Herts.

WELLINGTON.—Wrekin Amateur Radio Society.—J. C. Tranter, 78, New Street, Wellington, Salop.

WEST BROMWICH.—West Bromwich and District Radio Society*.—W. G. Johnson, 22, Lynton Avenue, West Bromwich, Staffs.

WEST HARTLEPOOL.—West Hartlepool and District Radio Club.—A. R. Donald, 18, Stockton Road, West Hartlepool, Durham.

WESTON - SUPER - MARE. — Weston-Super-Mare Radio Club.—W. C. Holley, "Waverley," Worlebury Hill Road, Weston-super-Mare, Som.

WEYMOUTH.—Weymouth Radio and Television Club (G3GNU).—R. Figg, 4, Dorset Place, Weymouth, Dorset.

WHITTINGTON. — Whittington Radio Club.—W. Watson, 44, Handley Road, New Whittington, Chesterfield, Derby.

WIGAN.—Wigan and District Amateur Radio Club (G3BPK).—H. King, 2, Derby Street, Spring View, Wigan, Lancs.

WISHAW.—Wishaw and District Radio Club.—A. R. T. Williamson, 14, Coronation Road, New Stevenston, Motherwell, Lanark.

WOLVERHAMPTON. — Wolverhampton Amateur Radio Society*.—H. Porter, 221, Park Lane, Fallings Park, Wolverhampton, Staffs.

WORCESTER.—Worcester and District Amateur Radio Club* (G3GJL).—J. Morris Casey, 4, Kennels Lane, Station Road, Fernhill Heath, Worcs.

WORTHING.—Worthing and District Amateur Radio Club*.—F. H. Betteley, 41, Annweir Avenue, Lancing, Sussex.

YEOVIL.—Yeovil Amateur Radio Club* (G2CMH).—D. L. McLean, 9, Cedar Grove, Yeovil, Som.

YORK.—York and District Short-Wave Club.—G. W. Kelly, 123, Kingsway West, Acomb, York.

Vector Diagrams

1.—Beginning with the Circuit

By "CATHODE RAY"

SOME readers seem to have found "Miller Effect"* rather heavy going when it came to the vector diagrams. It was pointed out to me that not everybody knows how to apply vector diagrams to valve circuits, nor even where to find simple instructions, and could I do something about it.

Always willing to oblige, I started off—and found I had used up something like the month's ration of paper before valves came into it at all! For on considering the matter I became convinced that at least half the trouble had to do with vector diagrams themselves rather than with their application to valve circuits. True, I could see one possible difficulty connected with the valves—I hope to get on to that eventually—but the first thing seemed very definitely to be the removal of possible misunderstandings about vector diagrams as such, applied to circuits using only ordinary circuit components. Looking through a good selection of electrical and radio books, I was surprised to find how few made any serious attempt to explain to the uninitiated how to represent the conditions in a circuit by a vector diagram without risk of ambiguity.

Off I went to a fresh start, then—but again I found the roots of the matter lay deeper. A particular vector diagram shows, shall we say, that at the moment under consideration a certain voltage marked V_1 is positive. What exactly does this mean? Presumably we also have the corresponding circuit diagram, on which V_1 is marked; does that help at all? Suppose Fig. 1 is the part of the diagram concerned. The two arrows show that V_1 exists between two wires, which we shall label *a* and *b*. The vector diagram, if it is drawn to scale, may tell us how many volts V_1 is. It wouldn't need a vector diagram just to say that. The main object of the vector diagram is to show the directions or phases of the quantities represented by it. But even when it does this, by telling us that V_1 is positive, how much wiser are we? Does it mean that *a* is positive compared with *b*, or the other way about?

* *Wireless World*, August 1919, p. 307.

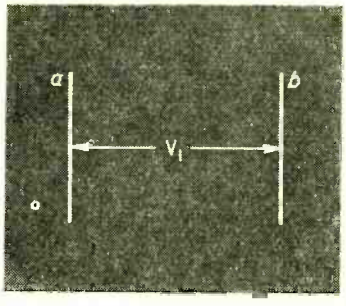
It does seem, then, that it would be a waste of time to talk about vector diagrams before we have cleared up questions like these, concerning the circuit. They are questions of *convention* rather than of fact. The *fact* in our example is a tendency for electrons to move from one wire to the other. Suppose that actually they tended to move from *a* to *b*. That fact could be conventionally expressed by marking either wire "+" and the other "—." Perhaps the most sensible convention would call *a* the positive wire. But the most important thing about a convention is not so much that it should be sensible as that everybody should stick to the same one. If it can be sensible too, so much the better. Conventions are like the rules of a game. If you are playing a game with people who have different rules from yours there is likely to be some unpleasantness, sooner or later. As it happens, the convention that has been universally adopted (unluckily, perhaps) would in this case put the "+" label on *b*.

What is Meant by a Positive Voltage?

We still have to take care with such a label, not to forget that it refers to *b* in relation to *a* and does not necessarily hold good with reference to another wire, say *c*, towards which *b* might be negative. But for the present let us consider V_1 only. It might be as well to attach the "+" label to the *b*-ward arrow associated with V_1, rather than to the wire.

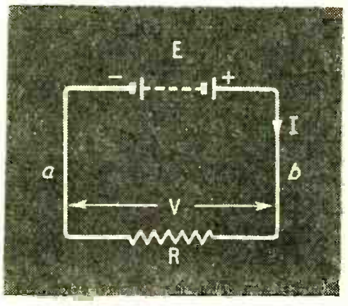
If the positiveness of *b* were permanent there would be no need for the vector diagram; + and — signs on the circuit diagram would do. But we are assuming that V_1 is variable and reversible, and we need to know what a positive value for it means. A negative value will then automatically be the opposite.

If one of the wires, say *a*, happened to be connected to earth, then the accepted convention that potentials are reckoned relative to earth (unless the contrary is stated) would lead one to guess that a positive V_1



Left: Fig. 1. Example of one common method of labelling a voltage. Unfortunately, knowing whether the voltage is positive or negative does not tell one which (*a* or *b*) is positive with respect to the other.

Right: Fig. 2. Considering these additional circuit details may help one to decide on the best way of indicating the polarity of a voltage.



would mean that b was more positive than a. But perhaps neither a nor b is earthed. What then?

A neat way of indicating the two points and the direction between them is to use the notation "V_{ab}" in place of "V_1." It is generally agreed that this means "the voltage in the direction a to b," and V_{ba} is the voltage in the opposite direction. But as regards polarity or sign, it could mean either "the voltage of a relative to that of b" or "the voltage change in the direction a-to-b." According to the former convention a positive value of V_{ab} would mean that a was more positive than b, and the latter would mean just the opposite.

The few books I have seen that make use of this "double-subscript" notation seem mostly to adopt the first of the two conventions, so that a positive V_{ab} would mean a more positive than b. In other words, it reckons *falls* of potential as positive.

In Fig. 1 we assumed, if you remember, that b was more positive than a. According to the convention just stated this could be expressed by saying either that V_{ab} was negative, or that V_{ba} was positive.

Now try applying this to Fig. 2, in which some of the circuit details have been filled in. The voltage originally called V_1 is now seen to be due to an e.m.f., denoted by E, which tends to drive current (I) from its positive to its negative terminal, through the resistance R, in the clockwise direction indicated by the arrow alongside "I." (If you prefer to call the direction of the current the same as the direction of electron flow, your arrow will point the opposite way. You may have logic on your side, but you will run the risk of being misunderstood. To the person who knows what he is doing, all conventions are lawful, but—as St. Paul said—not all are expedient). Because the circuit is closed (itself a confusing description, I always think), and there is no stronger opposing e.m.f., current actually must flow as indicated. As a result there is a voltage drop across R, denoted by V. The current automatically flows at the strength that makes this voltage exactly equal to the e.m.f. (resistance other than R being neglected).

If we replace "V" and its rather non-committal pair of arrows by "V_{ba}," then the fact that V_{ba} is positive would appropriately be indicated by an arrow pointing from b to a, as in Fig. 3. So far so good. But what about E? The direction of current flow through the battery is from a to b, and according to the assumed convention V_{ab} (or E_{ab}, if you prefer) is negative. This follows in another way, if we remember that the convention regarded falls in potential as positive; here we have a rise in potential, which must accordingly be negative.

This idea of regarding E as negative in the direction from a to b seems to follow inevitably from the convention being considered, but it doesn't appeal to me. The only natural way for me to draw an arrow connected with E is in the direction in which E tends to drive current; in this case, clockwise, from a to b. If this clashes with the convention, so much the worse for the convention.

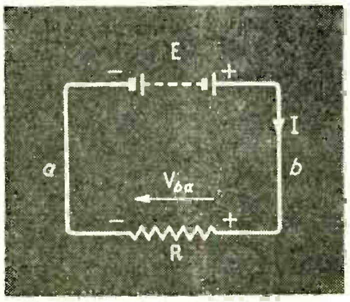
The defender of the convention may tell me I have got it wrong—I am mixing up e.m.fs and p.ds I ought to know that an e.m.f. drives current from + to − through the external circuit and from − to + through itself, so of course it must be treated differently.

Well, it is all very nice to be able to discriminate between e.m.fs and the rest in this way, but (as we saw last month) even the authorities differ on what is and what is not an e.m.f., and busy people have no time to argue it out every time they analyse a circuit. Moreover, it would mean discriminating as regards voltage convention between impedances that are resistances (which have no e.m.f.) and impedances that are reactances (which are sources of e.m.f.).

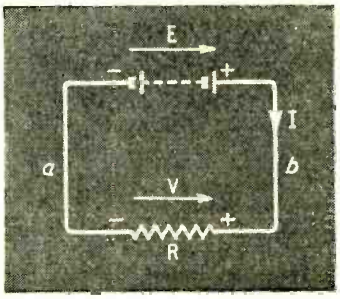
Reckoning voltages as falls in potential thus gives a result that I for one find unnatural. How about reckoning them as rises? Then E in Fig. 3 is positive in the direction of current flow, which makes sense of Fig. 4. The double-subscript notation for E, which would be E_{ab}, being positive, would have to mean the change in voltage on moving from a to b. V_{ba} (across R) would on the same principle be negative. So the appropriate direction for the arrow alongside V is against the current (Fig. 4). Some people disagree with that, because it makes V look as if it were an e.m.f. But surely it fits the facts? If you push a table across the floor it moves in the direction in which you exert the "table-motive force," and the table presses against your hands equally in the *opposite* direction. If the circuit impedance were a reactance, its opposition would be an e.m.f., and there would be no doubt about its being opposite in direction to the applied e.m.f. Although a resistance has no e.m.f. it seems reasonable to treat the voltage drop across it as an opposing voltage.

Provided, therefore, that we can persuade everybody to interpret "V_{ab}" as "the change in potential on moving from a to b," the result is a useful convention that fits in well with other generally accepted or acceptable ideas.

Many people may dislike this system because it makes the voltage across the resistance, V_{ba}, negative; that is to say, opposite in phase to the current. One is taught that the current through a resistance is in phase with the voltage across it. But "the voltage" here means the voltage driving the current. So the objection can be overcome by reckoning the voltage across the resistance as the one that includes the e.m.f.—the voltage between a and b *through the source*, which is V_{ab} (or E_{ab}), and positive.



Left: Fig. 3. The double-subscript notation (example, V_{ba}) shows the direction in which the voltage is being considered (in this case, from b to a), but an understanding is necessary as to whether a positive value means a rise or a fall in potential. Here it is used to mean a fall, but that leads to awkward results when it is applied to E.



Right: Fig. 4. Here the arrows indicate the directions of rising potential.

There is still one possible cause of confusion to clear up. I have spoken of V in Fig. 4 as being opposite to E. " But," you may say, " the arrows are pointing in the *same* direction, from *a* to *b* ! " It is surely a serious matter for one person to say one thing and another person the opposite. Before long they may be calling one another liars. If two people, represented by A and B in Fig. 5, were to face one another and discuss a piece of string, *xy*, Mr. A might well declare that *x* was the right-hand end of the string, and Mr. B might be equally sure it was the left-hand end. Mr. C, asked to adjudicate, might say " Nonsense ! It is neither to the right nor left of *y* ! " The plain man (as he likes to call himself) is so apt to assume that if one statement is true the diametrical opposite must be untrue. But a simple example like Fig. 5 shows the fallacy of this. It all depends on the point of view. I haven't actually heard Messrs. A and B in the course of their particular heated argument (" Man ! Don't you know your right hand from your left ? "), but I have heard heated arguments that were just as futile, because based on the same fallacy.

Electrical Point of View

Reverting to Fig. 4, anybody who sees E and V as being in the same direction should consider Fig. 6, which shows exactly the same circuit. The only difference is that the drawing is laid out a little differently, which you will surely agree can have no effect whatever on the actual voltages in the real circuit. Yet I have actually read an article in which the author confused himself over this very thing. It is the point of view again. The way Fig. 4 is drawn tends to suggest a parallel circuit, whereas Fig. 6 looks more like a series circuit. Either series or parallel (or both) may be right, depending on circumstances and the way one is considering the circuit. The particular way the circuit diagram is arranged does not necessarily decide the matter, though admittedly diagram layout is a useful method of suggesting the point of view the drawer intends.

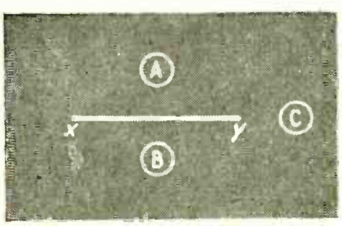


Fig. 5. Three people, situated respectively at A, B, and C, would have different views as to whether *x* was to the right or left of *y*.

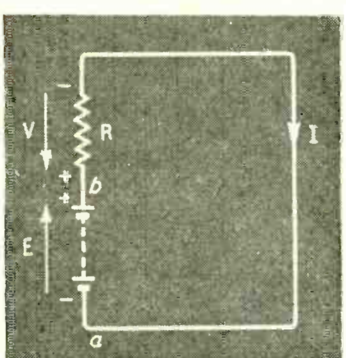


Fig. 6. This circuit is identical with that in Fig. 4 ; only the drawing is different.

Sometimes it is convenient to reckon voltages with reference to a particular point in the circuit (usually an earthed point) ; at other times they are reckoned round the circuit.

This is where a sound system of notation is necessary. As far as voltages are concerned, it should indicate clearly the two points between which the voltage exists, and the direction in which it is being reckoned between those points. This does not necessarily mean the direction in which it is actually operating. E in Fig. 4 is operating from *a* to *b*, if one judges by the fact that it is driving or tending to drive current in that direction. But we can reckon it in either direction, as E_{ab} or E_{ba}. In this case E_{ba} would be negative.

The double-arrow notation used in Figs. 1 and 2 is very good for showing the terminal points of the voltage, but fails to distinguish one direction from the other. The single-arrow system (Figs. 4 and 6) certainly shows the direction but leaves one to guess the points. Moreover I suspect that it is commonly used to show the direction in which the voltage acts, so using it to show the direction of reckoning may cause confusion. The double-subscript notation —V_{ab} and so forth—states quite definitely both of the points and a direction between them. I think it is universally agreed that the direction is from the first subscript letter to the second.

Whichever point of view one takes, this notation fits in with familiar electrical axioms. If you consider the voltage of one point relative to another, then you have the fact that the voltage between two points is the same regardless of the path you take between them. The voltage from *a* to *b* is called V_{ab} and, in Fig. 4 for example, is inevitably the same whether one reckons clockwise or anticlockwise. If you take the rotational point of view, then the principle is that no point can be at two different voltages, so if you go round any circuit the sum of the voltages must be zero. Round Fig. 4 we have $V_{ab}+V_{ba}$, and as V_{ba} means $-V_{ab}$, there can be no doubt about the total being zero.

It is a matter of convenience which way round one reckons a closed circuit. Some people tend to go clockwise round the diagram. But it must be remembered it may mean either way round the actual circuit, depending on the particular way the circuit diagram is drawn. Although Fig. 7 represents exactly the same circuit as Figs. 6 and 4, taking it clockwise would reverse all the signs. They would still be correct relative to one another, of course. Another custom is to adopt the direction in which the current is flowing. If that is unknown it doesn't matter ; a " wrong " guess will merely result in a negative value for the current, which just means that it is flowing the other way. The important thing is to mark the assumed direction of current on the diagram.

So far, our example has for the sake of simplicity been a d.c. circuit, on which + and − signs have been marked, taking care that they are clearly arranged in pairs so as to show which point is negative with respect to each positive. Although with a.c. the signs are periodically reversing, it is allowable and sometimes convenient to mark them on a circuit diagram, on the clear understanding that they refer, say, to the first half of each cycle. During the second half all will be reversed, so *relative to one another* will be the same. This rather unorthodox practice is useful for quickly working out the relative signal polarities in a multi-stage amplifier, as when finding whether a proposed connection will give negative or positive feedback ; but of course one has to take care to keep the a.c. signs quite distinct from the various d.c. polarities. Except for very rough work it is far better to use vectors, because they cannot be confused with the d.c. symbols, and (much more important) they are not restricted to only two phase relationships—0° and 180°.

So next time we shall deal with vector diagrams. Meanwhile Fig. 8 is an example for giving some practice in the use of the notations we have just been considering. Try working out the values of all the voltages, before looking at the answers in the table. Because the circuit is linear (i.e., subject throughout to Ohm's Law) the d.c. and a.c. can each be calculated separately just as if the other didn't exist.

Here is a summary of the notations :

(1) A voltage between two points can be identified on a circuit diagram by a numbered V with a pair of arrows marking the points, as in Fig. 1.

(2) If the points are labelled (say a, b, etc.) an alternative to (1) is the double-subscript notation (V_{ab}, etc.) which has the advantages

(i) that it is not necessary to mark the voltage symbols and arrows on the circuit diagram, and

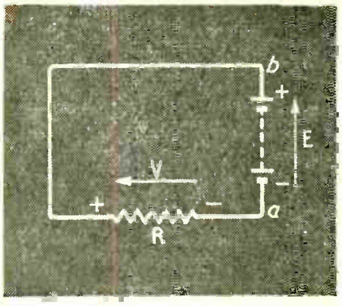
(ii) that the voltages in the opposite directions are distinguishable as V_{ba}, etc., thus enabling one to keep the *relative* polarities throughout the circuit right.

(3) A further advantage follows if it is agreed whether the reckoning is in falls or rises of potential. If in falls, then a positive V_{ab} means that a is more positive than b ; if in rises, it means b is more positive than a.

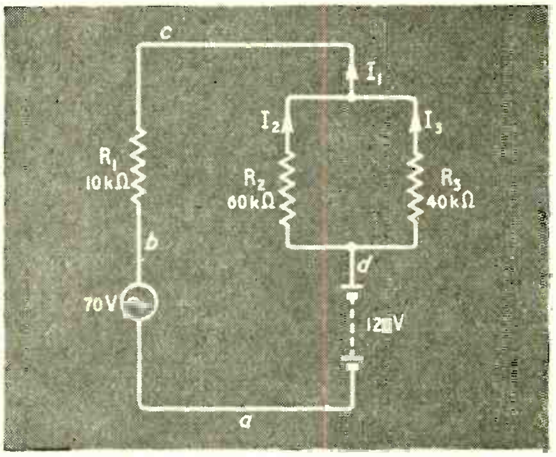
(4) Compared with (3), + and − signs on the circuit diagram may be misleading, because a single point can be both positive and negative, depending on which other point it is being related to. Also their usefulness is very limited in dealing with a.c.

(5) Single directional arrows are sometimes used to indicate the positive direction of e.m.f. or of electric field. But since these are usually opposite there is risk of confusion through doubt as to which is meant.

Fig. 7. Still another version of Figs. 4 and 6, in which the rotation is reversed.



Below : Fig. 8. A circuit for practice in working out, using the double-subscript notation. The a.c. e.m.f. may be taken as positive anti-clockwise.



(6) Whatever method is adopted, in order to give any meaning to polarity (or sign) it is necessary to specify

(i) the direction of reckoning, and

(ii) whether reckoning in rises or falls of potential. If only relative polarities are required, as usually in a.c. circuits, the direction adopted does not matter so long as the same one is used throughout the reckoning.

The following table is the full working-out of Fig. 8 in four different ways, from which you can

	Clockwise				Anticlockwise					How derived
	Rise		Fall			Rise		Fall		
	D.C.	A.C.	D.C.	A.C.		D.C.	A.C.	D.C.	A.C.	
V_{ab}	0	−70.0	0	70.0	V_{ba}	0	70.0	0	−70.0	Given a.c. e.m.f.
V_{da}	−120.0	0	120.0	0	V_{ad}	120.0	0	−120.0	0	Given d.c. e.m.f.
I_1	−3.53	−2.06	3.53	2.06	I_1	3.53	2.06	−3.53	−2.06	R_{23} = 24, so total resistance $R_1+R_{23}=34$
V_{bc}	35.3	20.6	−35.3	−20.6	V_{cb}	−35.3	−20.6	35.3	20.6	$= -I_1 R_1$
V_{cd}	86.7	49.4	−84.7	−49.4	V_{dc}	−84.7	−49.4	84.7	49.4	$= -I_1 R_{23}$
V_{bd}	120.0	70.0	−120.0	−70.0	V_{db}	−120.0	−70.0	120.0	70.0	$V_{bd} = V_{bc} + V_{cd}$; $V_{db} = V_{dc} + V_{cb}$ (either = − e.m.f.)
I_2	−1.41	−0.82	1.41	0.82	I_2	1.41	0.82	−1.41	−0.82	$= -V_{cd}/R_2$ or $-V_{dc}/R_2$ } Together $= I_1$
I_3	−2.12	−1.24	2.12	1.24	I_3	2.12	1.24	−2.12	−1.24	$= -V_{cd}/R_3$ or $-V_{dc}/R_3$ }
V_{ac}	35.3	−49.4	−35.3	49.4	V_{ca}	−35.3	49.4	35.3	−49.4	$V_{ac} = V_{ab} + V_{bc}$; $V_{ca} = V_{cb} + V_{ba}$

Note that the a.c. and d.c. voltages between a and c are opposite in sign.

take your choice. Personally I would scrap the "fall" methods as a general principle; and in this particular case would choose the anti-clockwise rotation because both the e.m.fs are positive that way. Note that the figures are the same in all four reckonings; only the signs differ. And the "clockwise rise" signs are the same as for "anticlockwise fall," and opposite to those of the other two. The rotation selected is indicated by the double-subscript notation: "V_{ab}" implies the direction a-to-b, and V_{ba} the opposite. Remember too that in the "rise" columns a positive V_{ab} means *b* more positive than *a*, and vice versa in the "fall" columns. A.c. is given in r.m.s. values; resistances are in kΩ, and currents in mA. R_{23} means the resistance of R_2 and R_3 in parallel $(=R_2R_3/(R_2+R_3))$. The current is in every case assumed to flow in the same direction as the e.m.f.; that is why voltage drops are *minus* current $\times$ resistance. To avoid this minus sign some people reckon rises and falls separately, and their totals should then be equal; but by reckoning all the voltages as rises (or all as falls) one has the useful check that the total round the whole circuit must always be zero.

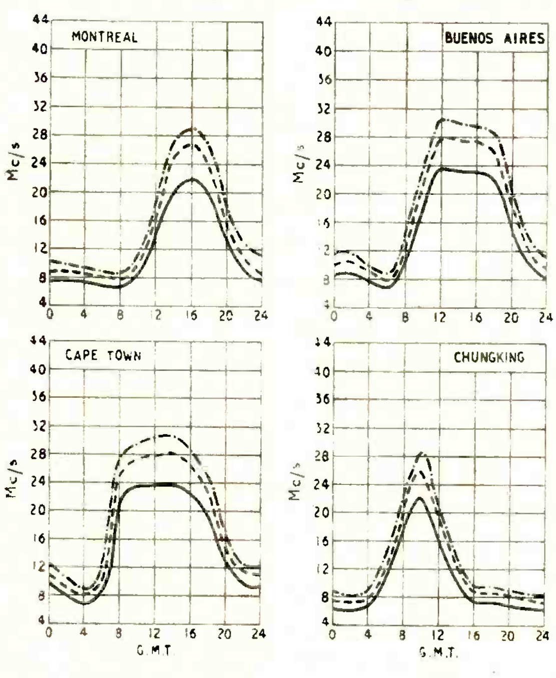
Unfortunately the convenient double-subscript notation cannot be applied to currents: both I_2 and I_3 flow from *d* to *c*. So some other method of identification has to be used.

SHORT-WAVE CONDITIONS

November in Retrospect : Forecast for January

By T. W. BENNINGTON (*Engineering Division, B.B.C.*)

DURING the past three months sunspot activity has been decreasing more rapidly than would have been expected earlier in the year. The result has been that, since September, the maximum usable frequencies for long-distance transmission have been considerably lower than those predicted. The autumnal increase in day-time working frequency has, therefore, been much smaller than was expected, and the higher short-wave frequencies—like the 28-Mc/s band—have never become regularly usable. How long this depression in usable frequencies will last it is impossible to say, but it is unlikely that 28 Mc/s will again become regularly usable over east-west paths during the present sunspot cycle.



——— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS
- - - - - PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY
— · — · — FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

The average maximum usable frequencies for these latitudes during November were somewhat higher by day, and slightly lower by night, than during the previous month, which variation was in accordance with the normal seasonal trend.

Day-time working frequencies were moderately high, but lower than had been expected, whilst those for night-time were relatively low. The 28-Mc/s band was usable on a few occasions, but never for many days in succession, and the highest day-time frequencies were more often of the order of 22 Mc/s. At night working frequencies were generally lower than 7 Mc/s.

Unexpectedly, Sporadic E was more prevalent than during the previous month, though not often of sufficient density to sustain propagation on very high frequencies.

Sunspot activity was, on the average, considerably lower than during the previous month.

There was a considerable amount of ionospheric storminess, and during the periods 1st-5th, 10th-15th and 24th-30th reception was adversely affected by such disturbances. Only one Dellinger fadeout was reported—at 1135 on 28th.

Forecast.—Both day-time and night-time m.u.fs during January should remain about the same as during December.

Long-distance working frequencies should thus be moderately high by day and definitely low by night. The highest regularly usable frequencies by day should be of the order of 22-24 Mc/s, whilst at night-time they will probably be as low as 6 Mc/s over most circuits. Medium-high frequencies—like 15 Mc/s—will be the most useful for long periods during the day-time.

Sporadic E capable of sustaining propagation on very high frequencies is unlikely to be very prevalent. Ionospheric storms, whilst not usually particularly prevalent during January, are likely to be troublesome when they do occur, especially at night.

The curves on the left indicate the highest frequencies likely to be usable over four long-distance circuits during the month.

Close-up of booster unit mounted close to the line-scan output valve.

Flyback E.H.T. Booster

Increasing Tube Voltage in Television Sets

By A. H. B. WALKER, B.Sc. (Hons.), A.M.I.E.E.

(Research Laboratory, Westinghouse Brake & Signal Co., Ltd.)

WITH the present trend towards brighter pictures, aluminium-backed screens, and neutral light filters (i.e., "black screen" receivers), higher e.h.t. voltages have become general practice today. There must be many owners of somewhat older television receivers, whether commercially-built or home-constructed, who would like to improve their picture by increasing the e.h.t. voltage and substituting a modern tube designed for a higher anode voltage. In making such an improvement it is very desirable, in the interests of economy, to retain the existing e.h.t. supply (of whatever type), but to augment its output by about 30 per cent to 50 per cent while still retaining good voltage regulation.

The circuit described here allows this to be done in any conventional receiver, whatever form of e.h.t. supply it now employs, at very reasonable cost and without disturbing or overstressing the existing e.h.t. components in any way.

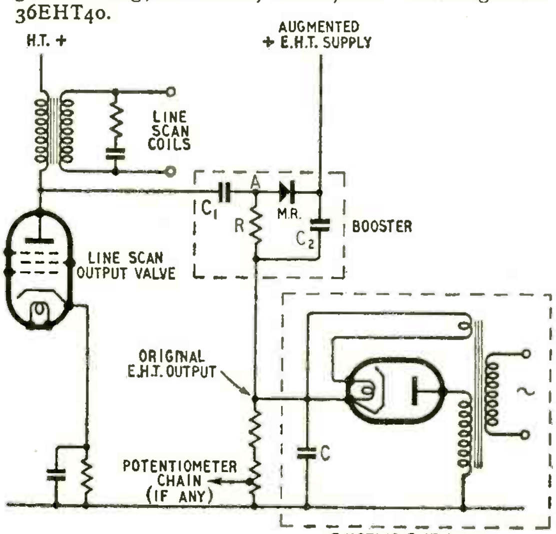
Form of Circuit

In any magnetically-deflected receiver, high-voltage line-frequency pulses are available at the anode of the line-scan output pentode. These pulses usually reach an amplitude of about 2 to 2.5 kV above earth, so that they are of just the right order of magnitude for providing the required boost to the e.h.t. supply, but at first sight it appears a little difficult to persuade them to add on to the existing (say) 5 kV supply without using a double-wound transformer or raising the entire line-scan generator to an uncomfortable potential above earth! Fortunately this can be overcome by making use of multiplier technique, and a suggested circuit is shown in Fig 1.*

The operation is as follows: between line fly-back pulses C_1 charges up to the original e.h.t. voltage through R, and point A therefore reaches (say) 5 kV above earth. When the line fly-back pulse occurs, the valve anode potential increases by (say) 2.5 kV and, since the charge in C_1 cannot change sufficiently rapidly, point A is also carried up an additional 2.5 kV, reaching a total of 7.5 kV. At this instant MR conducts, charging C_2 to 2.5 kV (since C remains steadily charged at 5 kV). No change in the operating conditions of the original e.h.t. unit is therefore caused, all the "boost" voltage being developed across C_2. Any potentiometer chain should be left connected to the original e.h.t. supply output.

If the receiver already derives its e.h.t. supply from the line fly-back the most obvious way of increasing the output is to convert the rectifier from a half-wave circuit to a voltage-doubler. This can easily be arranged but it suffers from two practical disadvantages. The first is that the e.h.t. produced will usually be of the order of 12 kV which is too high

Fig. 1. Fly-back booster applied to an existing mains driven e.h.t. supply unit. $C_1 = 0.001\mu F$ (working voltage equal to original e.h.t. voltage); $C_2 = 0.001\mu F$. 3 kV working; R = 2 MΩ, 1 watt; MR = Westinghouse 36EHT40.



*Virtually the same circuit has been suggested independently by L. J. Hills, who described it in a letter in the November 1950, *Wireless World*, p. 412 [ED.]

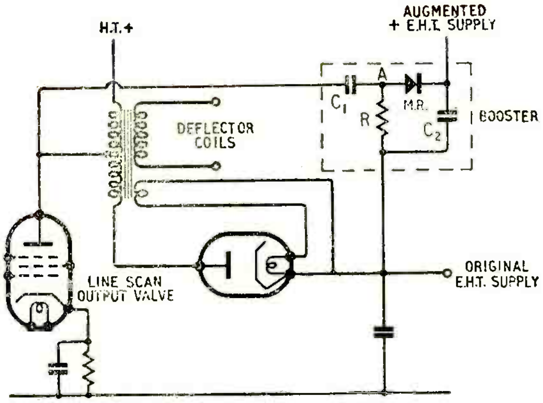


Fig. 2. The booster of Fig. 1 applied to a conventional flyback e.h.t. supply. When the transformer ratio is about 2 : 1 this produces not a doubler but a "1½-er." The booster components are as in Fig. 1.

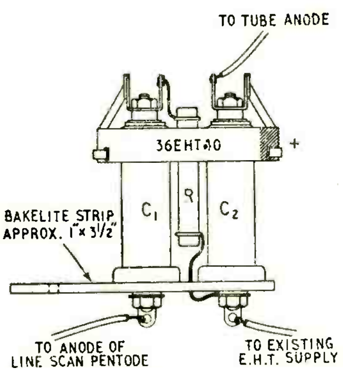


Fig. 3. Constructional details of booster.

to enable the tube to be scanned without redesign of the scanning circuit; and the second difficulty is that the additional current burden on the line-scan transformer, when reflected into the primary, results in somewhat poor regulation. To produce the required increase of, say, 40 per cent in e.h t. voltage it seems that the most useful circuit would be something giving a greater output than a half-wave rectifier, but less than a voltage doubler, in fact a "one-and-a-halfer." This result can be achieved with good regulation by using the pulse at the anode to supply a boost rectifier, and adding the output of this to the original e.h.t. derived from the transformer overwinding. Where the transformer ratio is 2 : 1 this does, in fact, result in about 40 per cent increase in output. The arrangement is shown in Fig. 2, and is basically similar to Fig. 1.

Since the additional rectifier is fed directly from the valve anode through C_1, it adds no burden to the e.h.t. auto-transformer, and its self-capacitance is therefore only added directly to the anode circuit instead of being multiplied by n^2 (where n is the ratio of the auto-transformer winding). By returning capacitor C_2 to the position shown and not to earth, it need only be rated for the amount of the increase in e.h.t. voltage, and not the full new value.

The form of construction adopted depends mainly on the type of capacitors used. Although not strictly essential it is more convenient to use two identical capacitors, and a suggested layout is shown in Fig. 3. This has the merit of being small and very light so that it is easily mounted in the required position.

The booster is best connected in series in the existing e.h.t. lead to the tube anode, a single new lead being taken directly to the top cap (anode) of the line-scan pentode. In most receivers this lead need not exceed a few inches in length (see photograph), but if the line-scan pentode is some distance from the present e.h.t. lead it is preferable to extend the latter and mount the booster near to the valve so that the pulse-feed lead is kept as short as possible.

The components required are only:—One 2 MΩ resistor of 1 W rating, two 0.001 μF, 6 kV, capacitors (such as, T.C.C. type CP55QO) and one metal rectifier of 2.9 kV rating (Westinghouse type 36EHT40).

After increasing the e.h.t. in an existing receiver it is, of course, necessary to increase the output of the line- and frame-scanning amplifiers slightly, and in most cases there will be sufficient output margin to deal with the increase in e.h.t. which this booster will produce. If V_1 is the original e.h.t. voltage, and V_2 the augmented voltage, then the scanning-current output must be increased in the ratio of $\sqrt{(V_2/V_1)}$ to fill the screen again, and this adjustment can usually be made by the height and width controls. If $V_2/V_1 = 1.4$, then the necessary increase in scanning output current is approximately 18 per cent.

The actual increase in e.h.t. obtained naturally depends entirely on the amplitude of the flyback pulse, and this varies considerably between receivers. The rectifier referred to earlier is suitable for any pulse up to 2.9 kV peak, but if the pulse is known to be much less than this a smaller rectifier could be used and the boost obtained would, of course, be smaller. As an example of results the following figures were taken on a receiver using a conventional fly-back e.h.t. system operated from a driven (i.e., not self-oscillating) output pentode. The 'augmented e.h.t.' readings were recorded after the line-scan output had been increased, so that the screen was again filled.

Mean Beam Current	*Original E.H.T. Voltage*	*Augmented E.H.T. Voltage*
10 μA	6.0 kV	8.75 kV
50 μA	5.75 kV	8.45 kV
100 μA	5.5 kV	8.05 kV
Overall regulation,	8.3%	8.0%

The interesting point which is brought out by these figures is that the regulation has not been impaired by the additional circuit, but has actually been slightly improved. This result is partly due to the helpful self-regulating action of the Type 36 EHT metal rectifier. This use of the 'limiting' action of suitable metal rectifiers to improve the regulation of fly-back e.h.t. circuits was proposed by the present writer.[1] and has since been further discussed by Cocking.[2]

[1] "Metal Rectifier Voltage Multipliers." A. H. B. Walker, *Journal Tele. Soc.*, Vol. 5, No. 11.
[2] "Fly-back E.H.T." W. T. Cocking, *Wireless World*, September 1950.

HEAVISIDE CENTENARY VOLUME

THIS book is a symposium of I.E.E. papers read at the Oliver Heaviside centenary celebrations in May last year. Although it contains little of direct interest to radio engineers, one suspects that if the world of radio had not thrust Heaviside into undeniable fame as prophet of the ionosphere, the main body of his valuable work would have remained unsung and there would have been no book. However, the mathematically minded will doubtless find great interest in the papers on Heaviside's Operational Calculus, his contributions to electromagnetic theory and his hitherto unpublished notes. Copies can be obtained from the I.E.E. at Savoy Place, London, W.C.2, price 10s or 4s to members, post free.

Your Loudspeaker

How Many Watts Should it Need and Should the Amplifier be "Flat"?

By THOMAS RODDAM

AN article which appeared in the February 1950 issue of *Wireless World* provoked a letter from Mr. Thomasson, who said that a mean output of 50 mW involved a peak output of 5 watts. I was rather suspicious of this figure, so I have been examining the problem more closely. First of all, there are two references which serve as a useful starting point: one, a paper by Divoire (*L'Onde Electrique*, January 1936), the second by Pawley (*Wireless Engineer*, January 1937).

Divoire measured the instantaneous level of "programme material" and showed that the level, in decibels, followed the normal probability curve. From the figures given I deduce that for chamber music, the level must be 20 db above average for 1 per cent of the time. For 1 per cent of the time, too, it will be 20 db below average. Piano music gives a wider dynamic range, about 50 db instead of 40 db.

This certainly seems to confirm Mr. Thomasson's figure of 5 watts. The only conclusion we can reach is that my figure of 50 mW mean level was wrong, because the output stage, rated at 2 watts for 1 per cent distortion, will produce quite a lot more noise without unpleasantness. What sort of level is really needed for home listening?

To begin with, let us assume that we want the news to be read at ordinary conversational level. This means that the sound intensity should be about 70–75 db above 10^{-10} microwatt/cm². This is only 35–40 db above the miscellaneous household noises, so that the lowest sound level will drop down fairly near to noise.

The Western Electric Company has published some information on the power required to produce a given sound level in rooms of various sizes. A typical small sitting-room is about 12ft. × 15ft. × 10ft. and thus has a volume of 1800 cubic feet. To produce a level of 80 db above 10^{-10} μW/cm², using a not very efficient cone loudspeaker, we need, according to the Western Electric Company, an input power of about 200 milliwatts (+ 23 db/1mW). As we saw above, + 70 db/10^{-10} μW/cm² represents a good mean level, and this corresponds to + 90 db/10^{-10} μW/cm² peak level when the signal has a range of 40 db. The peak power into the loudspeaker must therefore be 10 db higher than the 200 milliwatts mentioned above, or 2 watts. The amplifier is therefore required to deliver a power of 2 watts to give ordinary conversational level.

This 2 watts, however, is a peak power. The amplifier will be tested with a sinusoidal signal, which gives 2 watts peak power when the root-mean-square power, the value we usually measure, is 1 watt. From this it is clear that a 1 watt amplifier will just suffice to give us a suitable level with a dynamic range of 40 decibels.

When we turn to the reproduction of music the question of level becomes rather difficult. My own personal view is that mechanical reproduction, and that goes for radio, too, should only be used for chamber music. Mr. Rudo S. Globus, writing in *Audio Engineering* (February 1950), expresses a different view: he holds that symphony music is better heard from records than in the concert hall, while chamber music and jazz demand a personal contact. But symphony music demands a range of somewhere between 60 db and 100 db. For broadcasting purposes, I suspect that the range is always kept down to 60 db, in which case the peak power, assuming that we keep the mean level constant, rises to 10 watts.

Peak Limitation

The reader will have already noted that our design criterion was the level which is exceeded only 1 per cent of the time. He may ask whether we should not push our peak power up to 100 watts, so that distortion occurs only 0.1 per cent of the time. The answer is simple. Already, earlier in the chain between microphone and loudspeaker, the peaks have been chopped off. A 60-db range for symphony music means that the mean modulation can only be 3 per cent, a pretty low sideband power. The transmitter limits quite firmly at 100 per cent modulation, and if we are worried about distortion the limit is about 20 per cent. Those peaks just don't get out.

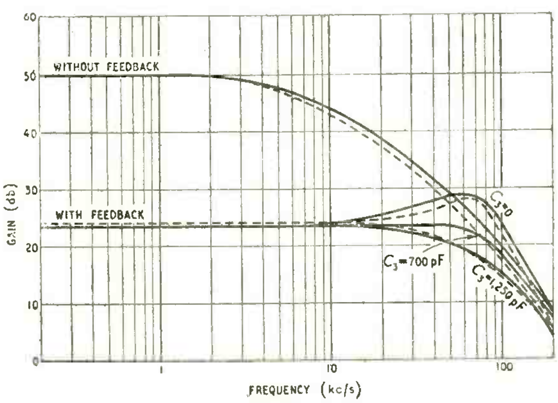
Looking back, we see that the ordinary home, for really good reproduction of symphony music, needs a 10 watt amplifier, but that for speech and chamber music we can get along with only 1 watt. We can also see that my quiet background music is at a mean level of only about 5 mW: it does not seem very much.

The other thing, or one of the other things, about which I get into trouble, is the question of the transient response of loudspeakers. Some writers on this subject always seem to be rather starry-eyed about quality, because they never allow for the imperfections of the earlier parts of the system. Any reader who wants a shot of realism should look at the distortion figures quoted for transmitters and for disc recording.

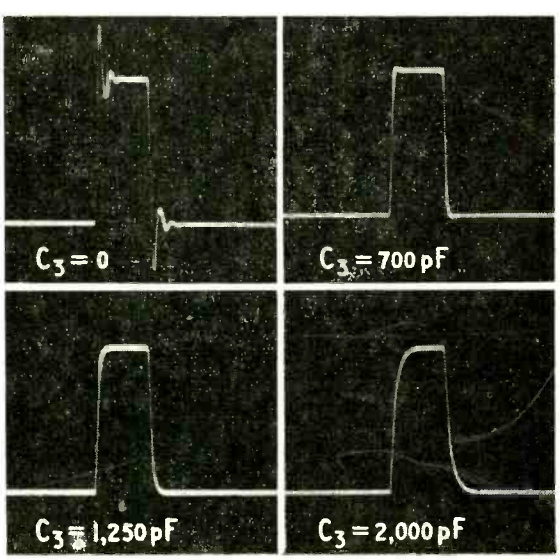
However, I do not want to talk about non-linear distortion, but about transient response. A recent article by Moir (*Wireless World*, May 1950) described what happened when the driving impedance of a loudspeaker amplifier was varied, and showed how reduced impedance affected the over-swing. Unfortunately, there is more in the circuit than a loudspeaker.

At this point I must digress. At various periods of my life I have designed amplifiers for broadcasting administrations. They always ask for a flat frequency response and for low noise. This means that the amplifiers have to be designed to cut off fairly sharply above the permitted top frequency, to keep the noise bandwidth down. There will probably be at least half a dozen such amplifiers in tandem between microphone and transmitter input.

Recently I adopted the policy of using square-wave testing for adjusting a response trimming capacitor in the feedback circuit. The information obtained made it easy to adjust the response to be flat within $\pm$ 0.5 db up to 15,000 c/s, and remember, there is always an input transformer. But to achieve the desired response, it was necessary to provide some overshoot. An analysis of the problem in some detail has recently been published by J. E. Flood (*Wireless Engineer*, July 1950), and two of Mr. Flood's diagrams are reproduced in Figs. 1 and 2. Although these curves are on the wrong scale for audio frequency working, the effect is merely one of scale. It will be seen that by rounding off the response



Above : Fig. 1.—Measured (solid line) and calculated (dashed line) responses for a two-stage resistance coupled amplifier with 26 db feedback. C_3 is in the feedback circuit. Below : Fig. 2.—Response to a 35-μsec pulse of the amplifier with response curves shown in Fig. 1.



with a capacitor in the feedback circuit (C_3 in Fig. 14 of the article referred to), the overshoot can be reduced, and the amplifier can become over-damped. The curve and pulse response for C_3 = 1250 pF represent the critically damped condition, and it will be noted that the frequency response starts to droop relatively early. In an amplifier using transformers the effect is even more pronounced owing to the more rapid cut-off produced by the transformers. A really flat amplifier with input and output amplifiers will have a transient response rather like that shown for $C_3 = 0$.

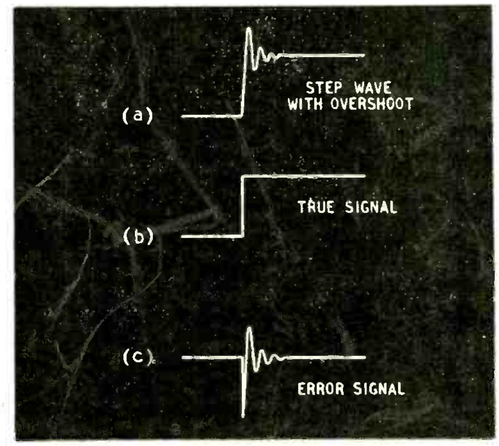
The reverse is also true. If we want a transient response like that shown for C_3 = 1250 pF we must allow the response to droop pretty early. There is thus a conflict between the "flat response" and the "no overshoot" response. Unless the amplifier and loudspeaker are flat up to very high frequencies, when we shall no longer care.

How is this conflict to be resolved ? Let us consider why the response has an overshoot. The square wave contains components of frequencies right up to infinity, in theory, and up to about 1 Mc/s with most square-wave generators. The "error" signal shown in Fig. 3(c) is made up of all the frequency components which do not pass through the amplifier, and we can say that a false signal, made up of all those components with reversed sign, has been generated. But these components are above our top cut-off, and that means that the response can go up to a reasonably high frequency and we shall still not hear the error-signal. So this set of transient responses does not matter : indeed, it shows that we have got a fairly flat response.

The reader may question whether this applies also to loudspeaker resonances, and many suspect that these will produce overshoots which somehow avoid this dependence on frequency response. The answer is that frequency response and transient response are inextricably mixed up, and a flat frequency response means that the only transients can be at the cut-off frequencies. So flatness pays.

This is only one aspect of a problem which can be approached from several stand-points. Coupled with one method used by Olson for loudspeaker design—the network approach—it can, I think, prove helpful.

Fig. 3.—The square wave with overshoot (a) can be regarded as being made up of a square wave (b) shown as the leading edge step, together with an error signal (c).

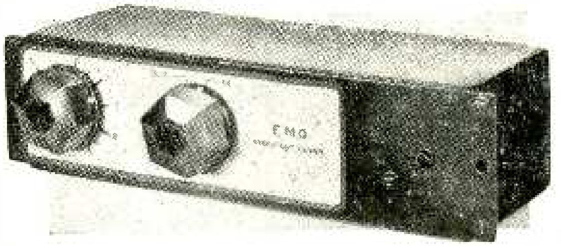


Unusual Ladder Filter

Applications in Audio and Radio Circuits

By F. G. G. DAVEY, M.A., A.M.I.E.E.

(E.M.G. Handmade Gramophones)



E.M.G. steep-cut variable filter for connection between output transformer and loudspeaker.

THE possibilities of the simple ladder filter are by no means exhausted by the classical filter theory. In one sense, any stray collection of reactive components, connected together as a simple ladder, is a filter. It will only lack value for design purposes because the calculation of its performance is laborious and needs to be repeated in full for every fresh case. To be generally useful, a filter must have some regularity in its design which simplifies the formulae and makes them readily applicable to a large variety of particular cases.

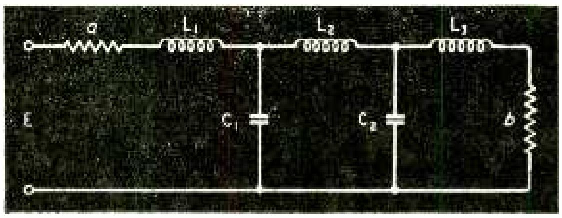
Broadly speaking, in the classical filter theory this regularity is that the characteristic impedance of each section is the same. In the filter which is the subject of this article a different regularity has been chosen, which is that the impedances looking forward and backward from the central element bear a constant ratio to each other with change of frequency and maintain equal phase-angles. This condition leads to quite general formulae which are sufficiently simple for use. It also leads to a filter with some rather unusual properties which are of value in radio design.

In order to fulfil the chosen condition, it is clear that there must be an odd number of reactive elements (i.e., series and shunt arms). It is also clear that all those elements coming before the central element must be proportioned to the input terminal resistance, while all those following the central element must be similarly proportioned to the output terminal resistance. For the sake of a further simplification of the formulae, the central element itself is expressed in terms of the two terminal resistances together—in series if it is a series element and in parallel if it is a shunt element.

Let us take an example. Suppose a low-pass filter is required consisting of five reactive elements working between an input resistance a and an output resistance b, (see Fig. 1). The nominal cut-off frequency will be called f_c. The first inductor has a reactance $2\pi f_c L_1 = ka$, where k is some constant to be determined. The next element, the shunt condenser, must then have a reactance $\frac{1}{2\pi f_c C_1} = ka$. The second inductor, L_2, being the central element, has a reactance $2\pi f_c L_2 = m(a+b)$, since it is a series arm. m is another constant to be chosen. The last two elements will be fixed in the same way as the first two, but using b in the formula instead of a.

First to be considered is the filter obtained by maintaining $m = k$. It is found that varying k alters the shape of the response curve given by the filter. Some typical curves are given in Fig. 2 for a five-element filter, and in Fig. 3 for a three-element filter.

Fig. 1. Five-element mid-series filter.



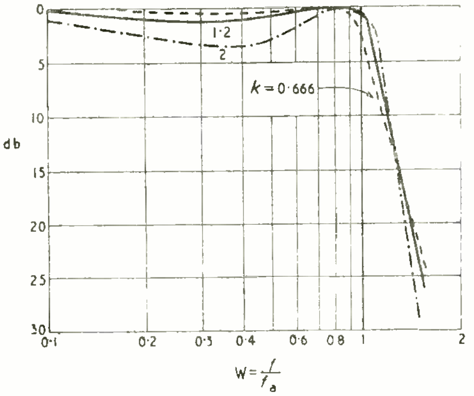
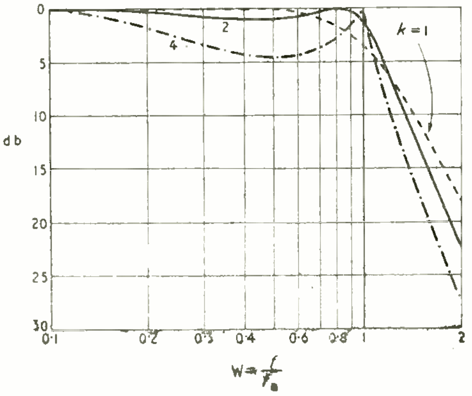


Fig. 2. Response of five-element low-pass filter with varying ***k***.

Fig. 3. Response of three-element low-pass filter with varying ***k***.



It will be seen that the higher values of k give steeper cut-off slopes, but that this is offset by an increasing amount of "sag" in the pass band. Now, in radio work filters are often required to give as level a response as possible in the pass band, with as steep a fall as possible outside it. If a response not more than 1 db down anywhere in the pass band is considered good enough, then this will be given by making $k = 1.2$ for the five-element filter and $k = 2$ for the three-element filter. If the actual cut-off frequency f_a is taken to be the point where the response is 1 db down for the last time, it will be found that this occurs, for the five-element filter, at the frequency $f_a = 1.3 f_c$. In terms of the actual cut-off, then, the design formulae for this performance become:

$$2\pi f_a L_1 = 1.56a$$

$$\frac{1}{2\pi f_a C_1} = 0.923a$$

$$2\pi f_a L_2 = 1.56(a + b)$$

$$\frac{1}{2\pi f_a C_2} = 0.923b$$

$$2\pi f_a L_3 = 1.56b$$

If a mid-shunt filter had been considered (three shunt condensers separated by two series inductors) the central element would have been a shunt arm. An identical performance would then have been given by putting $k = \frac{1}{1.2}$. In this case, therefore, the design formulae would become:

$$\frac{1}{2\pi f_a C_1} = 0.642a$$

$$2\pi f_a L_1 = 1.084a$$

$$\frac{1}{2\pi f_a C_2} = 0.642\frac{ab}{a+b}$$

$$2\pi f_a L_2 = 1.084b$$

$$\frac{1}{2\pi f_a C_3} = 0.642b$$

Fig. 4 shows the response curve for a five-element filter designed to these formulae as compared with a simple filter with the same number of elements designed to the conventional formulae. It will be seen that, apart from the 1 db dip in the pass band which we have allowed ourselves, nothing has been lost in performance—indeed there is an appreciable gain in sharpness of cut-off.

Exactly similar performance curves can, of course, be obtained for high-pass filters, and bandpass filters can also be produced on similar lines.

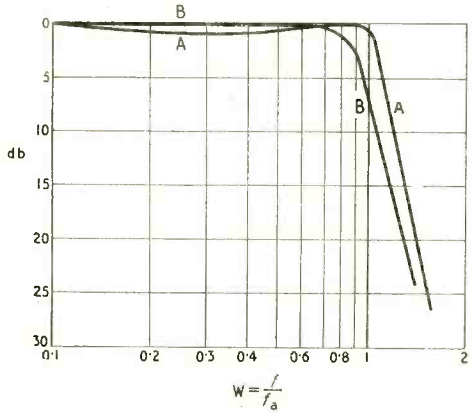


Fig. 4. A, five-element filter with $k = 1.2$; B, five-element conventional filter.

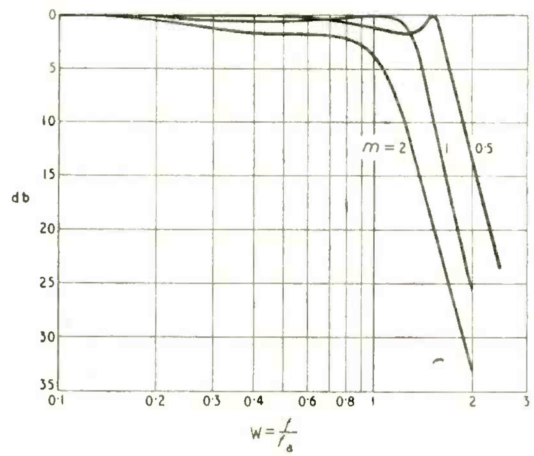


Fig. 6. Response of five-element low-pass filter with varying m. $k = 1$ throughout.

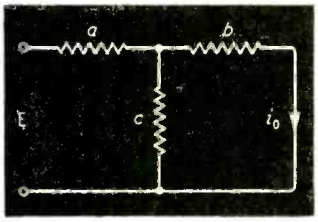
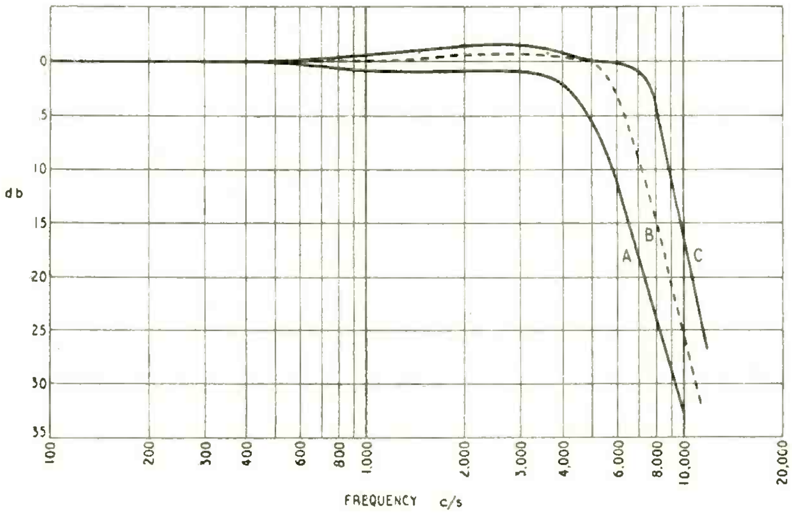


Fig. 5. The output current i_0 is governed more strongly by the central element c than by either of the others.



Right: Fig. 7. Response curve of infinitely variable filter inserted between transformer and Wharfedale "Golden" speaker. Insertion loss 0.75db. A, minimum setting: B, approximately half way, C, maximum setting.

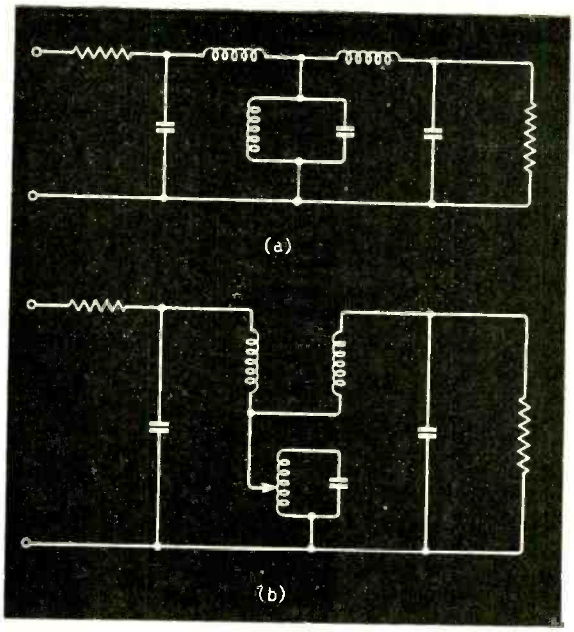


Fig. 8. Bandpass five-element filter (a), redrawn (b) as a three-circuit coupler.

We come now to the property which renders these filters somewhat unusual. It can be shown (see Appendix) that the cut-off frequency is much more strongly controlled by the value of the central element than by any other single element; that is why, at the start, the central element was given a different coefficient m from the other elements. This can be roughly illustrated by taking the simplest possible case, shown in Fig. 5. Here, the current through the output resistance b is $i_0 = \frac{cE}{ab + bc + ca}$ Obviously, changes in the value of c are going to affect i_0 much more strongly than similar changes in a or b. This property remains true even though a and b become more complex networks, so long as the condition defining these filters is retained.

Fig. 6 shows some typical curves that result from varying m while retaining k constant. In this case there is a variation in the pass band of 2 db, while the cut-off at 2 db down has been varied in frequency by about an octave. Better results would have been obtained by using a rather higher k, but these curves show the kind of limits to variation of m that must be expected.

The five-element filter has been used in practice as a variable high-note filter for loud-speakers†. In this application the terminal resistances are not constant but vary quite markedly with frequency. It happens, however, that the variations are generally such as to improve the filter performance. Fig. 7 shows the measured results.

Another rather useful property shows up in this practical case. It follows, from the fact that the central element exercises a more than proportionate control on the performance, that the other components exercise less. Hence they need not be very accurately matched to their theoretical value. Now the filter of Fig. 7 is of the five-element mid-series type such as Fig. 1. The input is the speech transformer and this contains leakage inductance which, it is found, can sufficiently represent L_1; the output load is the speech coil and this also has inductance which can serve as L_3. Only the two condensers and the infinitely variable central inductance have actually to appear in the filter. The curves shown in Fig. 7 are the change in db resulting from cutting these elements in and out of the circuit. The steepness of slope averages about 34 db per octave, showing that all five elements are in fact playing their full part.

† British Patent No. 601531 and patent pending

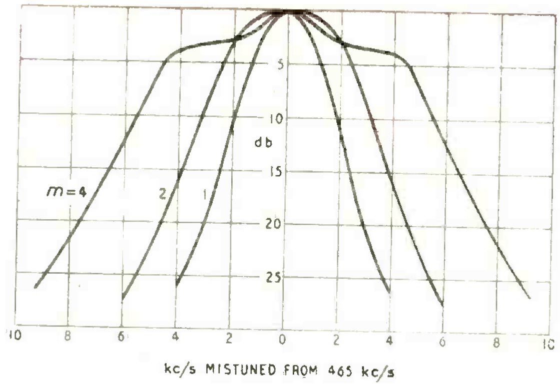


Fig. 9. Response of the circuit of Fig. 8 (b) at 465 kc/s Q of coils = 300. Turns ratio of tapping = Q/m.

The principle of these filters can be usefully applied to the bandpass filter. Here the central element contains both an inductor and a condenser—it is, in fact, a tuned circuit. Fig. 8(a) shows the circuit now being considered. When redrawn as Fig. 8(b) it is instantly recognizable as two tuned circuits bottom-coupled by a third. The tapping is introduced so that the components of the central circuit can be of the same values as those of the outer circuits, and also to give a simple means of varying the impedance which provides the coupling. There are now two independent variables in the central element—its impedance as a coupling and its resonant frequency. Again, these variations of the central element exercise a pre-

APPENDIX

Let E be the input voltage in series with a
Let V be the output voltage across b

Let W be $\frac{\omega}{\omega_c}$

Then the response curve of all filters of this type can be expressed in the form:

$$\frac{V}{E} = \frac{b}{a+b} \cdot \frac{1}{A(B+CA)}$$

where A, B and C are complex expressions independent of a and b. Their values are:

	3-element mid-series filter	5-element mid-series filter
A	$1 + jkW$	$1 - W^2 + j\frac{W}{k}$
B	1	$1 + jkW$
C	jmW	jmW

The mid-shunt formulae are the same with k and m inverted. A always contains a higher power of W than B. The C term, therefore, is always the term containing the highest power of W present in the expression, and this is proportional to m. Therefore variation of m governs the cut-off to a much greater extent than any other factor.

dominating control on the performance. Variation of its frequency shifts the centre frequency of the pass band, within limits, without unduly affecting its symmetry or width, while variation of the coupling impedance varies the width of the pass band without at all affecting its centre frequency. A variation of bandwidth of about 3 or 4 to 1 can be obtained without too bad a shape in the pass band.

This circuit has been used to provide variable selectivity in i.f. couplers†. Typical curves are shown in Fig. 9. The coupler gives the full wall steepness of three tuned circuits, and the effective selectivity of all of them is controlled by only one variable. It follows also that in production these couplers can be satisfactorily ganged up to the desired i.f. frequency with one trimmer on the central circuit only, so long as the outer components are tolerably close to their designed values.

SUNDERLAND RADAR

New Port Installation to be Worked by Pilots

THE application of radar aids to the movement of shipping in the harbours of the United Kingdom was carried a stage further in November last when the Minister of Transport opened a new experimental station at Sunderland.

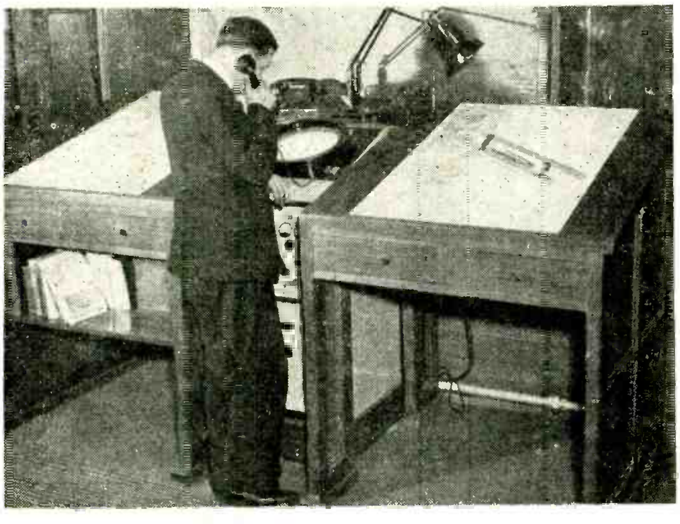
The installation selected is a standard marine radar designed for use on board ship. The navigational requirements at Sunderland are well within its range, and a specially designed system, such as that installed at Liverpool for its 14 miles of narrow channel, is not necessary. Most of the docks are grouped just inside the harbour entrance and the navigational hazards to north and south of the entrance are adequately covered.

A marine-type radar has been in use for some time at Douglas, Isle of Man, but in this case, as at Liverpool, special observers are employed for its operation, and the traffic consists of passenger ships working to regular schedule. At Sunderland there is a big volume of general shipping, and the experiment is being tried of leaving the operation of the equipment in the hands of the pilots themselves, who can decide when and how it can be best used; for example, to help the pilot cutter to locate an incoming vessel, or to assist pilots already engaged in bringing in vessels under conditions of bad visibility.

Communication between pilots and the Pilot House ashore will be maintained by a two-frequency v.h.f. radio-telephone channel, the shore station working on 163.1 Mc/s and the pilots' transmitter-receivers on 158.6 Mc/s. The v.h.f. equipment has been supplied by the Automatic Telephone and Electric Company in association with British Telecommunications Research, and the portable units are similar in design to those employed at Liverpool. Additional coaxial resonant filters have been included in the receiver input feeders to reduce crosstalk between the transmitter of one equipment and the receiver of the other due to the close frequency spacing employed. The shore transmitter (Type PM1A) is rated for 10 watts output and employs amplitude modulation. A similar transmitter provides single-frequency simplex working on the marine International Guard Channel of 156.8 Mc/s, and Sunderland is the first port in the British Isles to be given this facility.

A continuous listening watch is kept by the pilot vessel and a 12-volt battery-operated transmitter-receiver (Type PM1C) is used, the batteries being charged from a generator on the main engine.

The radar installation consists of a Kelvin Hughes Type 1A (Series 2) instrument with 12-in diameter display. The i.f. signal and locking pulse are split after the pre-amplifier to provide a second display in another part of the building for experimental work by the Admiralty Signals Research Establishment—the technical authority for the installation. The scanner unit is mounted at the top of a 50-ft lattice tower, which also carries the coaxial dipole aerials of the communications equipment.



Radar display unit and chart tables in the Pilot House, Sunderland. Communication with pilots on duty is maintained by v.h.f. radio-telephony.

Square-Wave Generator

By O. C. WELLS

Practical Design Giving Three Repetition Frequencies at Low Impedance

A SQUARE-WAVE generator is convenient for testing a.f. amplifiers, as well as being generally useful. By means of an oscilloscope and a sinusoidal input it is possible to see when a stage becomes overloaded and to measure the input amplitude for which it occurs, but in order to measure frequency distortion we need an a.f. source of continuously variable frequency. Using a square-wave input, there is no need to make an extended series of readings, as we can gain some idea of the distortion by examining the output waveform. This method was described on page 6 of *Wireless World* for January 1948, to show the effect of negative feedback on the Baxandall amplifier. There is no need to have a continuously variable repetition frequency, but it is a good idea to have several "spot" frequencies, and so be able to gain an idea of the low-frequency response by means of a low-frequency square-wave, and the top response by means of a higher repetition frequency.

The following, then, is a square-wave generator designed along these lines. Three spot frequencies are available, 80 c/s, 800 c/s, and 8 kc/s, each of which can be selected by a switch. The amplitude is continuously variable from zero up to about 50 volts peak-to-peak, whilst the output impedance is of the order of 150 ohms. The mark-to-space ratio is continuously variable from about 5:1 to 1:3. Two valves are used, both type EF50.

There is a choice of several methods of producing the square wave, of which the multivibrator might seem the most suitable. But to obtain a rapid rise on the square-waves it would be necessary to use at least one cathode follower, and even then we would have to add some sort of limiter. At least two double triodes would be needed. But the main disadvantage of this circuit is that it would necessitate switching two capacitors to change the frequency.

The transitron relay is capable of producing a better square-wave, using a simpler circuit in which only one capacitor needs to be switched.

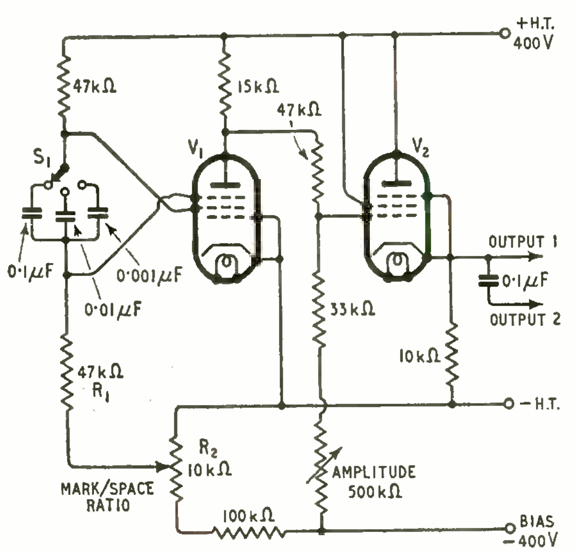
Referring to the circuit in Fig. 1, V_1 is the transitron oscillator, producing a 100-V peak-to-peak waveform at its anode. As a point of interest, this valve, when connected up as shown, is unstable when the suppressor voltage lies between about -5 and -40 volts. If R_1 is returned to a bias outside this range, however, the circuit will not self-oscillate, and will only produce a pulse when suitably triggered.

R_2 alters this suppressor bias, and so controls the mark-to-space ratio—and, to some extent, the frequency. (The repetition frequencies quoted above correspond to an exactly square output.) S_1 selects the spot frequency without affecting the mark-to-space ratio, enabling R_2 to be calibrated directly. If desired R_1 can be made variable to give continuous frequency coverage, but if this is done the frequency and mark-to-space controls will interact. In practice the one control R_2 is sufficient.

The negative half-cycles produced at the anode of V_1 are by no means square, so it is necessary to add some sort of limiting circuit. V_2 is a combined triode limiter and cathode follower, having the double purpose of limiting the negative peaks and providing a low output impedance by its cathode-follower action. An EF50 was used to give a low output impedance. Almost any valve will operate effectively in this position, so if for any reason it was desired to add some additional pulse-shaping circuit, one section of a 6SN7 double triode could be used for V_2, leaving the other section for the new device.

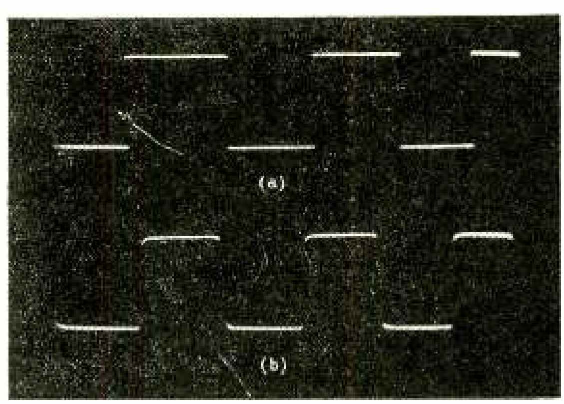
Fig. 2 shows the output waveforms at 80 c/s and 8 kc/s. The 8 kc/s waveform is not so square as the other two, but is nevertheless still useful.

To give a 50-V peak-to-peak output, 400-V h.t. and bias supplies are needed. The circuit will, however, operate from half these voltages at somewhat reduced amplitude.



Left: Fig. 1. Circuit of the square-wave generator.

Fig. 2. At (a) is the waveform produced at a repetition frequency of 80 c/s, and at (b) is the waveform at 80 kc/s.



Manufacturers' Products

New Equipment and Accessories for Radio and Electronics

Wave Analyser

AS an aid to rapid medical diagnosis from electro-encephalographic recordings, the Edison Swan Electric Co., of 155 Charing Cross Road, London, W.C.2, have produced an instrument for automatically analysing a complex waveform in a very short space of time. When dealing with a continuous e.e.g. waveform it provides a complete analysis every 10 seconds and presents this in written form on the part of the record to which it refers. The problem of analysing aperiodic functions is solved by integrating the outputs of pre-tuned frequency selectors over a period of time.

Broadcast Receivers

A FEATURE of the new "Twinvicta" a.c./d.c. mains/battery portable, made by Invicta Radio Ltd., of Parkhurst Road, London, N.7, is the extremely attractive and colourful material covering the cabinet, a new woven plastic called "Tygan," which is claimed to be extremely durable and easily cleaned. The receiver weighs 9lb and costs £14 12s 6d. Two new sets with the emphasis on quality of reproduction are the "Mayfair" radiogram, made by Ace Radio Ltd., of Tower Road, London, N.W.10, and the model "750" receiver by Rainbow Radio Mfg. Co. Ltd., of Mincing Lane and Mill Lane, Blackburn, Lancs. Both use 10-in speakers, and some attention has been given to the acoustic designing of the cabinets.

Aerial Multicoupler

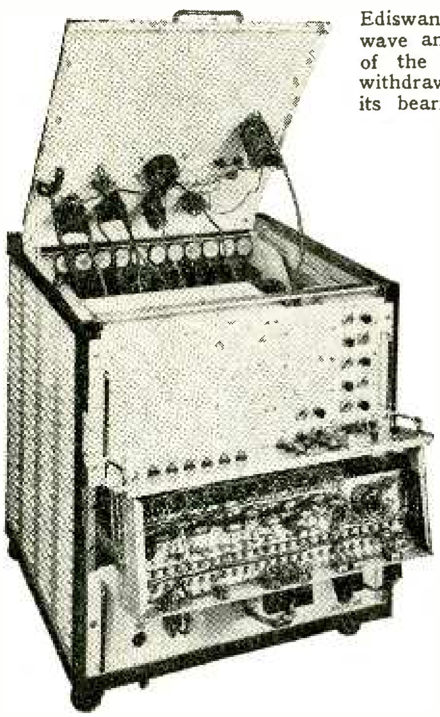
THE purpose of this equipment, introduced by The Plessey Company of Ilford, Essex, is to permit the operation of up to ten communication receivers from a common aerial without cross-modulation effects or loss of individual signal strengths. It consists of a wide-band amplifier with filters, giving a pass range of 2-20Mc/s flat to within ±3db, and this arrangement feeds into ten cathode-follower stages which are designed to work into 75-Ω unbalanced loads. The amplifier will handle signals up to 250mV without overloading or excessive cross-talk, and down to 1μV without the noise becoming appreciable. It is designed to an International Aeradio Specification and is suitable for international rack-and-panel mounting.

Loudspeakers

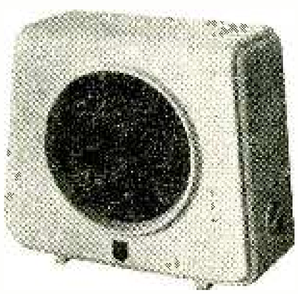
AS a result of the considerable interest shown in their "Stentorian" 12-in Concentric Duplex loudspeaker, Whiteley Electrical Radio Co. Ltd., of Victoria Street, Mansfield, Notts, are now producing this model in an acoustically designed vented cabinet at £32 10s. It stands 3ft high and 2ft wide, and is finished in polished walnut. From E. K. Cole Ltd., of Southend-on-Sea, Essex, comes the Model ES115 extension speaker, an 8-in p.m. dustproof type in a plastic cabinet, at £2 17s 6d. It will handle a 3-watt output and has an on/off and volume control flush-fitted in the side.

Picture-telegraph Equipment

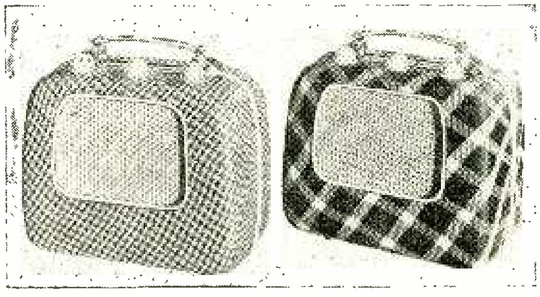
ONE feature of the picture-telegraph equipment now being made by the General Electric Company is that the transmitter can be converted for use as a receiver when required by a simple interchange of



Ediswan Mark II low-frequency wave analyser with top open. One of the chassis sections has been withdrawn and swung round on its bearings for maintenance.



Right: Ekco extension speaker, model ES115. The plastic case can be supplied in either beige or maroon.



"Twinvicta" mains/battery portables, showing two of the patterns available in the new "Tygan" covering material.

parts. At normal transmission speed a 10in × 8in picture can be sent over telephone line, carrier circuit or radio link in 14 minutes, although this time can be reduced to seven minutes at the expense of picture quality.

Definition is the highest possible within the limits prescribed by the C.C.I.T., and the equipment will work in conjunction with any other picture-telegraph equipment which complies with these standards. Pictures can be received as positives on photographic paper for direct viewing or blockmaking, or as negatives when a quantity of prints are wanted.

Miniature Hearing-Aid

GREATLY improved intelligibility is claimed for the new "Micropak II" one-piece hearing-aid, which has a high maximum gain (55db air-to-air) and is provided with optional a.v.c., in addition to manual volume control, to ensure a maintained comfort level and freedom from loud noise. A recessed crystal microphone is used, followed by three stages of amplification, with the output pentode feeding into either air- or bone-conduction receivers. The overall response is sensibly flat, but a bass cut for tone control is introduced when on a.v.c.

Produced by Bonochord, Ltd., 48 Welbeck Street, London, W.1, this model measures $3\frac{1}{4}$in × $2\frac{7}{32}$in × $\frac{3}{4}$in, and weighs only 5oz complete with batteries. It gives 350 hours of life on a 15-V h.t. battery, 10 hours of l.t. life on a standard "pen" cell, and costs less than ½d per hour to run. The price is 30 guineas.

Germanium Rectifier

TO meet the needs of designers who want a low reverse current at a reasonable price, the General Electric Co. Ltd. have introduced the GEX45. This has a reverse current of 10-30μA and costs 16s, as distinct from the 10μA of the GEX55, which costs 30s. The forward current is approximately 8mA at +1 volt and the turnover voltage is greater than 60V.

Miniature Transformer

AN exceptionally small transformer, giving an impedance ratio of 250:1, has been designed by John Bell and Croyden, of 117 High Street, Oxford. It is suitable as an output transformer for hearing-aids and the primary winding can be included in the anode circuit of the output valve, giving an inductance of 28H at 200μA d.c. or 12H at 1mA d.c. There are 5,000 turns of 48 s.w.g. on the primary and 100 turns of 38 s.w.g. on the secondary. Using "F" size laminations and a moulded bobbin, the outside dimensions work out to 0.752in × 0.438in × 0.55in.

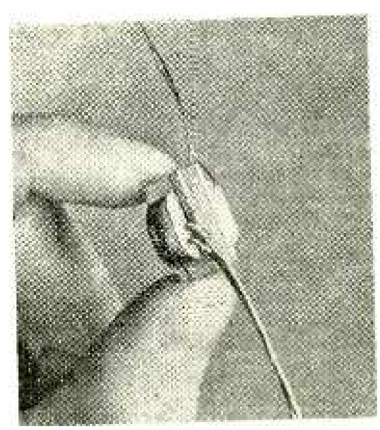
Educational Oscilloscope Units

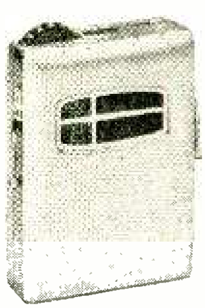
TO meet the needs of schools and colleges for a moderately priced demonstration instrument, the Equipment Division of Mullard Electronic Products Ltd., Century House, Shaftesbury Avenue, London, W.C.2, has introduced a c.r.t. unit B100 and an associated time-base/amplifier unit B101 that together provide most of the features of the modern oscilloscope. Each unit has its own internal power supply. There is a 3-in c.r.t. in the B100, with vertical and horizontal deflection sensitivities of about 0.2 mm/V. If desired, the vertical and horizontal amplifiers in the B101, which have a frequency response of 25 c/s to 30 kc/s, can be used without modification as independent general-purpose amplifiers. The B100 unit costs £12 12s and the B101 unit £15.

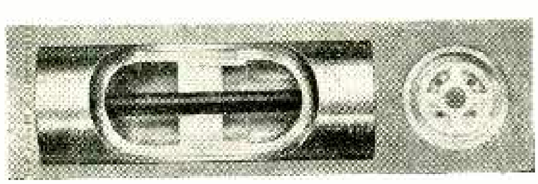
Transmitter Feeder Cable

DESIGNED for handling large amounts of r.f. power, the new Telcon AS.84.A1 semi-air-spaced cable has shown itself capable of carrying 20kW at 45 Mc/s without difficulty. Regarding its propagation characteristics on wide-band transmission, tests on a 280-yard length have shown that the voltage standing-wave ratio would not be worse than 0.98 over a 10 Mc/s band centred at 60 Mc/s. The inner conductor is a solid copper wire of diameter slightly above ¼in, and is supported at intervals by a series of interlocking Telcothene mouldings. The outer conductor is a seamless extruded tube of aluminium. The Telegraph Construction & Maintenance Co. are at 22, Old Broad St., London, E.C.2.

Right: Mullard educational aid; on the left is the time-base/amplifier unit B101 and on the right is the cathode-ray tube unit B100.







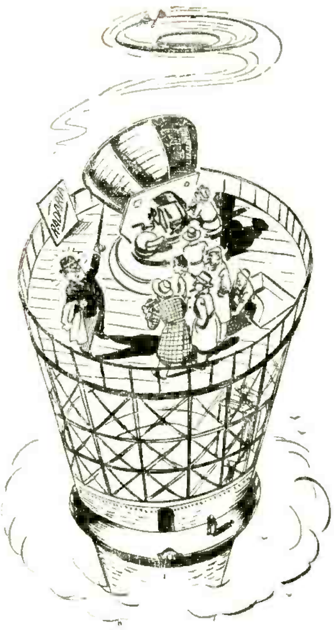
Bonochord "Micropak II" hearing-aid, showing the drum-type volume control, microphone grille and pocket clips.

Belclere miniature transformer for use in hearing-aids, showing its size in relation to the human hand.

Telcon transmitter feeder cable. On the left is a cut-away view to show the interlocking mouldings which support the inner conductor.

UNBIASED

By FREE GRID



Maybe in May

Source of the Saucers

FLYING saucers have taken the place of the Loch Ness Monster, but whereas the monster did no greater harm than to frighten a few Scotsmen out of their wits, thus leading them to forswear further indulgence in the national beverage, this new menace is far more serious. By acting as transient reflectors and so causing intermittent distortion and fleeting ghost images on our television screens, these so-called saucers are proving a very real source of trouble.

At present the trouble is not excessive because these saucers are few in number, but like Hitler, who also began in a small way, they will become uncontrollable unless dealt with promptly. Obviously the first thing to do is to find out whence they come and deal with them at the source; for when plagued by wasps it saves a lot of time if we can locate their nest.

Now it has been suggested that they come from another planet but astronomers insist that their observations show that, with the exception of the Earth, the Sun's satellites are incapable of supporting life, and who am I to disagree with such learned men? But we must not forget, as Mr. Hoyle, the erudite astrophysicist from the banks of the Cam, has reminded us over the air, that we cannot absolutely rule out the possibility that some of the myriad sparkling spheres, with which the heavens are bespangled, may possess some inhabited satellites. This, however, does not take us very much farther for, as Mr. Hoyle also tells us, the nearest stars to us, which for the sake of argument we will assume to possess inhabited planets, are roughly three light-years, or in more homely figures 17,330,476,800,000 miles, distant from us. Now since the observed maximum speed of the saucers is said to be a mere eighteen thousand miles *per hour* it would, leap years included, take them rather more than twenty-two thousand years to do the round trip ("if in doubt, work it out" as the pedagogic maxim puts it, but in the interests of domestic harmony *don't* "Ask your Dad" in this case).

It is clear, therefore, that we must look for a "home-counties" planet in our own Solar System which has so far eluded the eye of the astronomer and I think I have found it by means of radar. Basing my work, like many others, on the speculations of Aristarchus and other ancient Greek philosophers, I have discovered that this new planet travels round the same orbit as that of the Earth but, as it is 180 degrees out of phase and moves at the same speed, it is always on the opposite side of the Sun to us; therefore, we can neither see it nor get a direct radar echo from it. But any of you who are proficient at billiards will readily understand how an indirect radar-echo can be obtained by a simple there-and-back cannon off one of the other planets when it is in a suitable position. I am hoping, therefore, to get the Government to allow me to demonstrate this to the public at the Shot Tower radar installation which is being erected for this year's Festival of Britain. The echo from it will automatically ring the bell and return the money of successful shooters. I propose to give the planet the appropriately commemorative name of Radaria.

Radio Jubilee

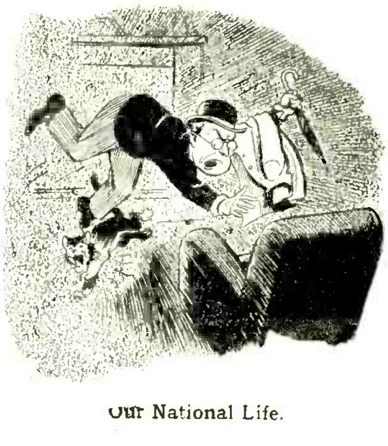
THIS year we enter upon the second half of the 20th century and it would surely be fitting that a section of this year's radio show should be devoted to a review of the tremendous progress made in the past fifty years. The year marks for one thing the jubilee of transatlantic wireless, as it was on December 12th, 1901, that Marconi first linked us with the New World, and it was in 1901, too, that the first British merchant ship, the *Lake Champlain*, was fitted with wireless.

It is, however, rather a difficult thing to stage a suitable review of the past half-century of radio and make it interesting to the general public. It can so easily degenerate into a moth-eaten dry-as-dust exhibition of ancient sets and components. We want to see and hear the things in action and also hear the B.B.C. artists as we heard them nigh on 30 years ago when loudspeakers, driven by output valves as unbiased as myself, bellowed like the bulls of Bashan, and famous public entertainers refused to have anything to do with broadcasting. In other words, we want something that is alive and interesting like the annual run to Brighton of ancient cars when pioneer motorists celebrate their red-flag emancipation day which, like Marconi's first British patent, was an outstanding event of 1896. It is astonishing how few listeners realize how old wireless really is; not many, for instance, know that the valve was invented in 1904.

Perhaps the organizers of this year's National Radio Show will give my suggestions for enlightening the man in the street some thought.

Power-cut Pageantry

I WONDER why no radio manufacturer has yet marketed a set which automatically switches itself over to batteries during a power cut. Such an instrument is a logical development of the battery/mains portable now available. Say what you will, power-cuts have come to stay. At present unavoidable, they will eventually remain as part of the rich pageantry of our national life like the posy which Judges of the High Court still carry on certain occasions even though the combined efforts of the medical and plumbing professions have long since removed the necessity for it. I am surprised, too, that no effort has yet been made to enable an a.c. mains clock to keep itself going during a power-cut; surely the answer is a battery, a vibrator, a transformer and an automatic switching arrangement.



Our National Life.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

A.M. versus F.M.

HAVING been interested in this controversy for a long while, I constructed an a.m./f.m. receiver some time ago, but have only recently had an opportunity to carry out some tests on the Wrotham transmissions, particularly from the fidelity and interference angles. The results have not altogether surprised me, as I knew from experience on television sound that e.h.f. a.m. was capable of very high quality, but prone to ignition interference; however, I was agreeably surprised by the almost complete absence of this virulent interference (and, incidentally, any other kind) on the Wrotham transmissions.

Comparing the a.m. with the f.m., I find little to choose between them as regards fidelity and lack of interference; the a.m. appears to be the stronger signal, though ample pick-up can be obtained on an ordinary indoor aerial from both signals. The fidelity of both seems to be effected by land-line considerations, and much of the programme material shows up badly when used to modulate these high-fidelity transmissions, though occasional "live" studio broadcasts are first-class.

I consider there is a definite future for e.h.f. broadcasting as an unlimited number of low-power transmitters would entirely solve the problem of 100 per cent coverage (which is far from being achieved with the present system) without the disadvantages of sharing frequencies, and would at the same time provide much better quality.

However, to return to the a.m./f.m. controversy, considering the the additional complications and extra cost of the f.m. receiver, which, in my experience, is in no way superior to its a.m. counterpart, I can see no earthly reason for the controversy. Let's have lots of a.m. broadcasting on e.h.f., and those of us with high-fidelity equipment will at last get value for their licence fee!

R. C. BURNELL.
Wallington, Surrey.

Television Load

THE recent extension of the television Children's Hour from Sundays to week-days seems likely, with the present timing, to have unfortunate results in several directions. The highest peak electricity load during the six winter months occurs around 5 p.m. At that time it is the rule rather than the exception in my own district (which is no doubt typical) for the mains voltage to be reduced 15 per cent in order to shed load. This is just the time at which the children's television is put on. To the British Electricity Authority it means that a new load, of the order of 100,000 kW, and growing rapidly, is being placed on top of their highest peak. To the radio industry it means that 6.3-V heaters of valves and cathode-ray tubes are being run at 5.35 V, a drop of rather more than double the safe maximum prescribed in the Code of Practice issued by the B.R.V.M.A., which states that low heater voltages are as much to be avoided as high voltages. To the radio dealer it means that television sets (especially the modern a.c./d.c. type) are likely to go out of adjustment and give poor results generally, so that his customers complain.

The remedy would seem to be to delay the children's television programme on Monday to Friday until, say, six p.m.

M. G. SCROGGIE.
Bromley, Kent.

"Phase Shift Oscillators"

THIS article by W. G. Raistrick in your November issue is of considerable interest in view of the unusual merits of the circuit concerned.

We feel, however, that other work on this circuit is worthy of mention. The principle of the valve phase shifter was described by Dome[1], and an oscillator incorporating this by Villard under the title "Tunable A.F. Amplifier."[2]

Villard's article is particularly valuable in that it mentions the use of the circuit as a selective amplifier by the use of 180 degrees phase change. Villard claims this gives a sharper null than either twin tee or Wien Bridge networks. He also points out a unique feature of the oscillator, namely its ability to produce two outputs 90 degrees apart in phase.

One further point. For successful operation of this circuit it is desirable that cathode and anode load resistors should be fairly closely matched, and also that the im-

[1] *Electronics*, Dec., 1946.
[2] *Electronics*, July, 1949.

pedance of the power supply should be low in comparison. As the loads may only be of the order of a few hundred ohms this may cause trouble at low frequencies.

W. BACON.
D. P. SALMON.
Hindhead, Surrey.

"Curious Effect"

ADDITIONAL experiences with flashes and streaks of light on the screens of cathode-ray tubes after switching off may be of interest to your readers. The tube in question was used in a high-speed oscillograph for transient observation and photography. It was a Du Mont 5RP11A, using a gun voltage of 4 kV and a post-deflection accelerator voltage of 20 kV.

It has frequently been observed that, after switching off, luminous phenomena of various types occurred. These phenomena consisted of any or all of the following.

(*a*) Occasional general illumination over an area of a few sq. inches, which was of low intensity.

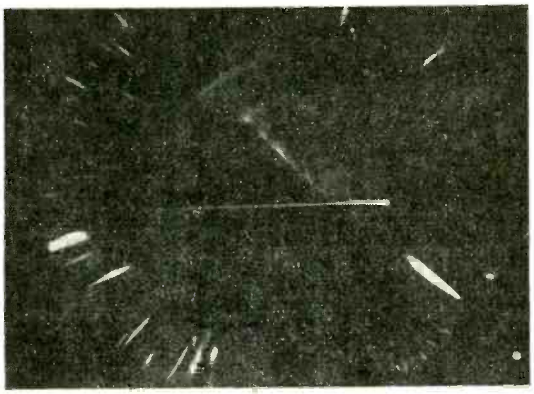
(*b*) Bright spots of varying intensity, some bright and some dim. These were oblong in shape and radial in direction, and have been observed as intermittent flashes, or as moving flashes of a few seconds duration, or more.

(*c*) Occasional small patches of light, which could be moved slightly by rubbing the tube face with the hand or a cloth.

Of these three types (*b*) was the most frequent, and could often be increased in intensity by rubbing the tube face with a cloth or by hand.

These phenomena did not always appear on switching off, the most favourable time for their appearance being when the apparatus was thoroughly warm. However, rubbing the tube face would often produce them if they had not appeared, or increase and intensify them if they were weak. It would also prolong the duration of their appearance.

A voltmeter permanently connected across the e.h.t. supply definitely indicated that such supplies were off. The phenomena appeared sometimes instantly, when it was reasonable to suppose that the cathode was still hot, but at other times they appeared some time after, or persisted for such a time that it seemed unlikely that the cathode would even be warm. The tube did not use any Perspex screen, as has a previous example given in these columns. The electrostatic charges, presumably responsible for these phenomena, seemed either to be on the outer surface of the tube or possibly internally on various parts of the tube itself. The fact that the phenomena appeared most frequently and strongly in summer with a warm, dry day, and when the apparatus had been working for a long time and was thoroughly warm, would seem to indicate that the origin of these flashes was outside the tube rather than inside.



The accompanying photograph, made accidentally owing to a mains failure at the time of exposure, shows some of the phenomena, which must have occurred shortly after the supplies were cut off, as the camera shutter was only open for a few seconds. (Note, the zero line had been previously recorded.) It illustrates equally well the phenomena which occurred much later after switching off, and lasted for a few minutes.

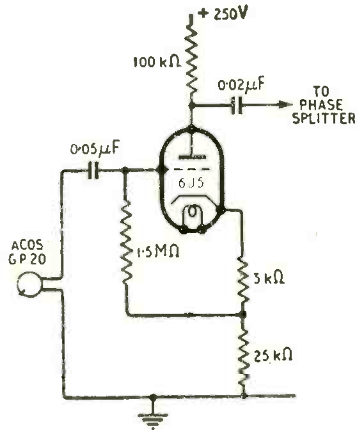
R. RITTER.
RICHARD G. PARR.
Zürich, Switzerland.

Pickup Input Circuit

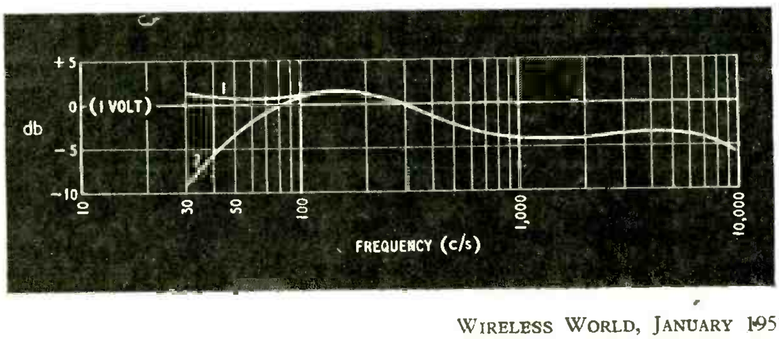
AN additional input circuit for the Acos GP20 pickup may be of interest to readers in view of your article "Pickup Input Circuits" in the November 1950 issue. It is based on the article "Negative Feedback" in the March 1950 *Wireless World.*

I have used this circuit in an attempt to approximate to curve 1 rather than curve 2. The effective input impedance is increased by negative feedback to about 6 MΩ, and a very satisfactory bass response is obtained from 78 r.p.m. records.

J. G. KNAPP.
Nottingham.



Negative feedback applied to increase input impedance and (below) response of GP20 pickup taken with Decca K1804 test record. 1, on open circuit; 2, with 0.5 MΩ load.



Beauty and the Beholder

I WAS interested to read in your October issue the letter on aerials as things of beauty—or otherwise.

As to outdoor television aerials, I doubt if the "Dictators of Town and Country Planning" can control the erection of an outdoor aerial; certainly not an "H" on a short mast, anyway. Multiple elements on 50-foot masts might be a different proposition.

My reasons for this contention may be found in Section 12 of the Town and Country Planning Act, 1947, which exempts from the provisions of the Act (and therefore the dictates of local planning authorities) certain things. One of these is: works for the improvement or alteration of a building which do not materially affect the external appearance thereof. I think the ordinary "H" on a chimney stack (with a short mast, if you like) comes within this provision.

Now, of course, the local planning authority may think otherwise. Very well, let them; the Act also contains, in Section 17a, provision which says: Anyone proposing to do something to a building, and being uncertain whether or not (1) his proposals come within the scope of the Act, and (2) if they do, whether or not they require permission, can apply to the local planning authority to determine these points. This being so, let anyone wishing to erect an "H" and fearing the wrath of the local planning authority apply for a determination, as mentioned above. If the answers to (1) and (2) above are "No," then he may proceed. If the answer to (1) is "Yes" and to (2) "No," then again, unless the local planning authority go to some trouble by using other provisions of the Act (which is, I think, fairly unlikely) he may carry on with his proposal. If the answer to (1) and (2) is "Yes," then the local planning authority can refuse permission.

But in this last case the applicant can appeal to the Ministry of Town and Country Planning on two points: first, that his proposal is not within the scope of the Act, and, secondly, even if it is within the scope of the Act, that permission should be granted. I doubt very much if, on such an appeal, the Minister of Town and Country Planning would refuse permission. I think he would overrule the local planning authority in most cases.

So let some would-be viewer take action on the lines mentioned above; perhaps someone has already done so, in which case, I suggest the result should be of interest to many readers.

W. WILSON.

Sn. .ton Dale, Nottingham.

"Tolerances and Errors"

WHEN (in the November issue) I likened the manufacture of resistors to shooting at a target "from a considerable distance" it was with a certain naughty provocativeness. So it didn't altogether surprise me when a well-known resistor manufacturer reacted. From what he says it appears that the hit-and-miss method I described is no longer practised in the enlightened modern resistor factory.

It seems, then, a good opportunity for a resistor manufacturer to tell us how he does it now. It may be that when making ±5 per cent resistors he stands nearer to the target.

I still suspect that before I bought my ±20 per cent stock someone had picked out the best ones—but perhaps they were made in the bad old days. "CATHODE RAY."

RANDOM RADIATIONS

By "DIALLIST"

Would You Like One?

ONE QUITE OFTEN hears or reads that one of the things mankind most needs to-day is a television equivalent of the crystal set. People who air this opinion not infrequently show a few moments later that they have never stopped to think what they mean by it; for almost in the next sentence they add that much larger images than those now usual must be provided. The great advantages of the crystal set are that it can be bought cheaply, that it is very simple, that almost anyone who wants to do so can make it and that it can be run at next to no cost. Fine! But what does it do? The best that it can furnish is headphone reception of the broadcast programmes at comparatively short ranges. The equivalent television set, were there such a thing, would presumably present its images on a one-inch screen, with headphone reception of the accompanying sound. I cannot see any rush for such an instrument. Can you?

If Wishes Were Horses . . .

If and when you can get them down to brass tacks, you find that what those who say such things really have in mind is that the world is longing for the advent of the high-grade receiver, giving at least a 16 x 12-inch image, at a price well below £25. If that be so, the world, one fears, will go on longing, at any rate for quite a bit yet. Unless—as is quite possible—some entirely new and far simpler method of transmission and reception is evolved, television must continue to be something of a luxury. To my poor brain it seems that home television is an amenity, on a par with a good piano or a home-movie outfit, to be earned, should you desire to have it, by effort and by saving. And what you want to get for your money is a set which can be relied upon to give good results.

There's a Limit to Cheapness

What I'm driving at is that, when you come to buy a television set, you cannot expect to get more than you pay for. The bare facts are that as things are at present it must contain upwards of 15 valves; include a considerable number of circuits capable of being finely adjusted and of staying put, once they are adjusted; and, if you want a big picture, have either a monster c.r.t. for direct presentation, or—if you prefer projection—a small super-brilliant c.r.t. *plus* devices for raising the e.h.t. to 16,000-20,000V, *plus* an optical system, *plus* a separate screen. The set should also be easy to operate and perfectly safe. To provide all these things the maker cannot go below a certain minimum price unless he is prepared to cut his costs in undesirable ways. There may be a real danger in that the cry for cheaper and cheaper television sets may lead to a price war and to the large-scale production of over-cheap sets which not only give a comparatively poor performance when at their best, but develop into constant and expensive sources of trouble.

Valve Symbols

IT WAS MENTIONED in the November Editorial that the revised edition of the British Standards Institution's "Letter Symbols for Electronic Valves" (B.S. 1409: 1950) bears on its cover a most unfortunate statement that the symbols which it lays down are intended for use mainly in manufacturers' catalogues and such like. Myself, I read this statement with a horrid sinking feeling; but I felt a bit better when I had time to think over its implications. If valve manufacturers and other members of the radio industry are going all out for the use of the symbols in their catalogues and other "literature" (and presumably they are, for they played a major part in evolving them), their customers will have perforce to be familiar with them, or they will not be able to follow what they read. The symbols, then, are bound to become established as a kind of *lingua franca* of radio technique in this country. Those who write or publish books and articles would be foolish indeed if they did not use them, knowing, as they must, that these symbols are parts of a language with which all their readers must have at any rate a nodding acquaintance. It would have been far better, admittedly, had the statement in question not appeared on the cover of B.S. 1409: 1950. Better still would have been one recommending the adoption of the symbols by all British writers, teachers, publishers and manufacturers concerned with the advancement of electronics.

International Standards Lacking

Probably the most one can pray for is that the technical terms and symbols used in one's own country may achieve standardization, for we seem to be drifting farther and farther away from the international systems that were once inaugurated with such high hopes. A mathematical friend to whom I said something of the kind promptly pulled me up short. "In my particular branch," said he, "we have been a bit more sensible. *All* the signs and symbols of mathematics, which is a really international language, are completely standardized throughout the world." I pulled an old envelope from my pocket and wrote on it:—

1·432

"What," I asked, "would that convey to a Frenchman or a German?" "Why, one thousand four-hundred and thirty-two, of course." I explained that it would mean one point four three two and that either of them would write the number he had mentioned as:—

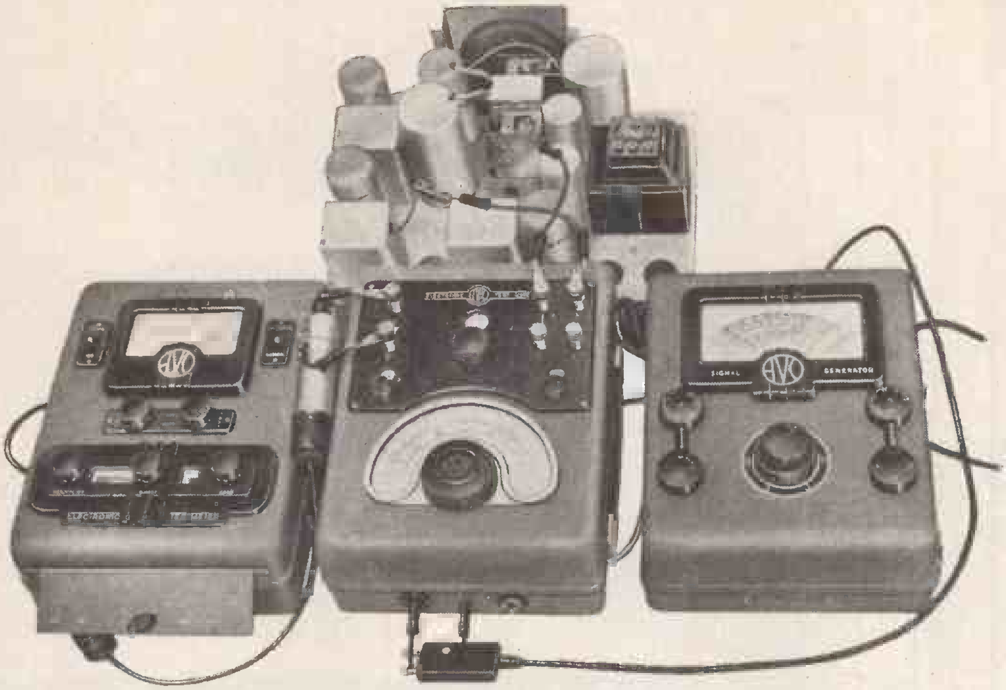
1.432

Electronics, being one of the newest branches of science, probably suffers more than most from lack of international standardization, for each country tends to adopt its own set of terms and signs for advances and discoveries which it makes simultaneously with other countries.

Sunspots Again

ONE DOES NOT ENVY engineers engaged in keeping telecommunications going during disturbances due to sunspot activity, such as we had at the end of November and the beginning of December. World traffic was very heavy at that time and there were longish periods of almost complete blackout, particularly in northerly and southerly directions. All sorts of ingenious expedients have to be adopted. I was told that on this occasion messages to Australia, which normally go direct by radio, were at times sent by cable to America, by radio across that continent and by cable to their destination.

The PERFECT TEST TEAM



The illustration depicts a set of modern " AVO " testgear being used to measure the " Q " of the secondary winding of the second I.F. transformer on a chassis of unknown characteristics—just one of many tests which can be performed by this combination of instruments.

A signal of predetermined frequency from the " AVO " Wide Range Signal Generator is being fed into the Electronic Test Unit, where it is amplified and fed to the secondary winding of the transformer. The Electronic Testmeter is connected across the tuned circuit under test and, from the readings obtained and the controls of the Electronic Test Unit, the " Q " of the circuit can be determined.

The three instruments, shown as a team, cover a very wide field in measurement and form between them a complete set of laboratory testgear, ruggedly constructed to withstand hard usage.

ELECTRONIC TESTMETER

A 56-range instrument combining the sensitivity of a delicate galvanometer with the robustness and ease of handling of an ordinary multi-range meter. Consists basically of a highly stable D.C. Valve Millivoltmeter, free from mains variations and presenting negligible load on circuit under test.

Switched to measure :—

D.C. Volts : 2.5mV to 10,000V.
D.C. Current : .25 μA to 1 Amp.
A.C. Volts : .1V to 2,500V R.M.S. up to 2 Mc/s. .1V to 250V R.M.S. up to 200 Mc/s.
A.C. Power Output : 5mW to 5 Watts.
Decibels : −10db to + 20db. Zero level 50 mW.
Capacitance : .001 μF to 50 μF.
Resistance : .2ohm to 10 Megohms

Operates on 100-130v. and 200-260v., 50-60 c/s. A.C. mains.

ELECTRONIC TEST UNIT

For measuring small values of A.C. voltage, inductance, capacity, and " Q " at radio frequencies. Although designed primarily for use with " AVO " instruments, it can be used with any suitable Signal Generator/Valve Voltmeter combination.

As a **Wide Range Amplifier,** it is capable of an amplification factor of 40 ±2−3db between 30c/s and 20Mc/s

As a **Capacity Meter,** it covers measurements at radio frequency from .5pF to 1000pF. in two distinctly calibrated ranges

As an **Inductance Meter** it gives direct measurements from .5 μH. to 50mH. in six ranges.

As a **" Q " Meter,** it indicates R.F. coil and condenser losses at frequencies up to 20 Mc/s.

Operates on 100-130v. and 200-260v. 50-60 c/s A.C. mains

WIDE RANGE SIGNAL GENERATOR

An instrument of wide range and accuracy for use with modern radio and television circuits. Turret coil switching provides six frequency ranges covering 50 Kc/s. to 80 Mc/s.

Range 1. 50 Kc/s.—150 Kc/s.
" 2. 150 Kc/s.—500 Kc/s.
" 3. 500 Kc/s.—1.5 Mc/s.
" 4. 1.5 Mc/s.—5.5 Mc/s.
" 5. 5.5 Mc/s.—20 Mc/s.
" 6. 120 Mc/s.—80 Mc/s.

Accuracy to within 1% of scale marking. Gives sensibly constant signal of good wave-form, modulated or unmodulated, over entire range. Minimum signal less than 1 μV at 20 Mc/s. and less than 3 μV between 20 and 80 Mc/s. Gives calibrated output from 1 μV to 50mV.

Operates on 100-130v. and 200-260v., 50-60 c/s. A.C. Mains.

Battery-operated model also available.

Sole Proprietors & Manufacturers :—

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD
WINDER HOUSE . DOUGLAS STREET · LONDON . S.W.1 *Telephone: VICtoria 3404-9*

RoLA

One in Ten Million!

For efficiency and fidelity each Rola speaker is indeed "one in a million" but in a more literal sense, every Rola you receive is one in ten million speakers which are proving the superiority of Rola performance throughout the world. So let figures speak for themselves and specify Rola.

Manufacturers Enquiries to:—
BRITISH ROLA
FERRY WORKS, SUMMER ROAD, THAMES DITTON, SURREY (*Emberbrook 3402-6*)

Wholesale Enquiries to—**SOLE DISTRIBUTORS**

LONDON & NORTH:—
CYRIL FRENCH LTD.,
HIGH ST., HAMPTON WICK, MIDDX. (*Kin. 2240*)

SOUTH:—
ROBSHAW BROS.,
10, EXETER RD., THE SQUARE, BOURNEMOUTH. (*Tel.: 5896-7*)

RoLA The Speaker You Know by Ear

LOW FREQUENCY SIGNAL GENERATOR

TYPE 702

THIS Low Frequency Signal Generator employs a resistance-capacity oscillator circuit to provide stable output voltages of pure waveform over the frequency range 30 c/s–30 kc/s.

A screened and balanced transformer is provided to enable balanced, unbalanced and fully floating outputs to be obtained, the source impedance under all three conditions being 600 ohms.

PRICE £75

A single level control enables the output to be set to any desired value, and a 600 ohm constant impedance output attenuator provides steps of 20, 40 and 60 db of attenuation.

The output voltage is monitored by a diode valve voltmeter which is calibrated both in open-circuit volts and in db relative to 1 milliwatt in 600 ohms.

Illustrated descriptive leaflets of this or any other Airmec instrument will be gladly forwarded upon request.

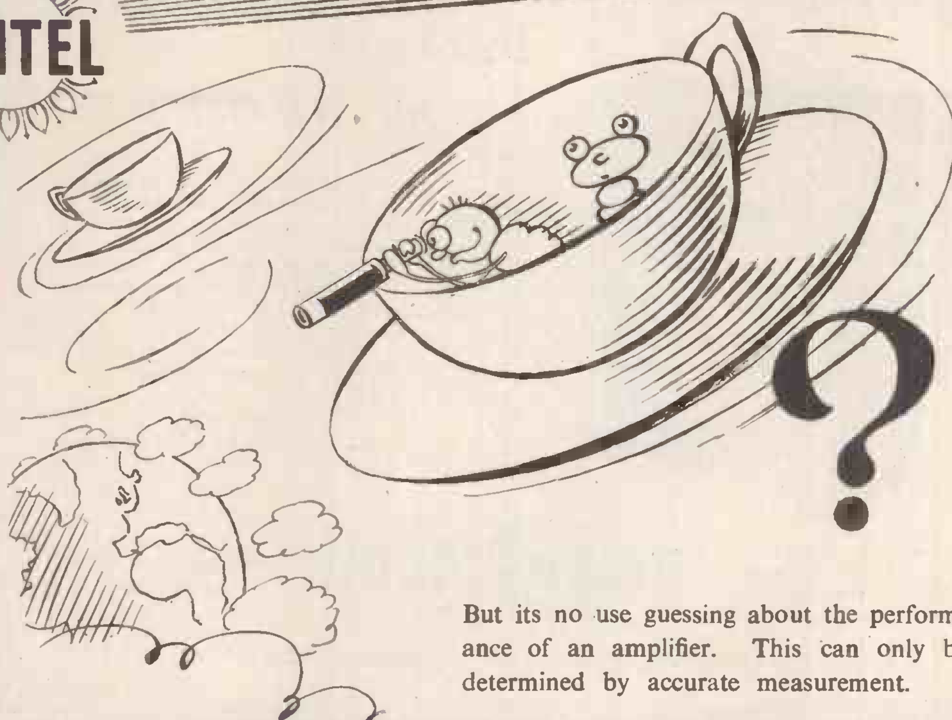
AIRMEC

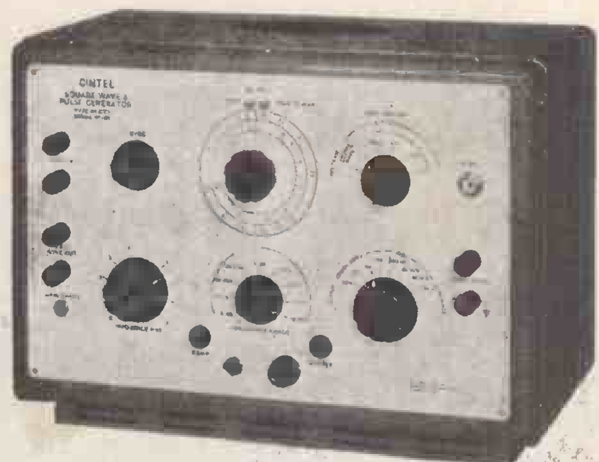
AIRMEC LABORATORIES LTD

HIGH WYCOMBE · BUCKINGHAMSHIRE · ENGLAND

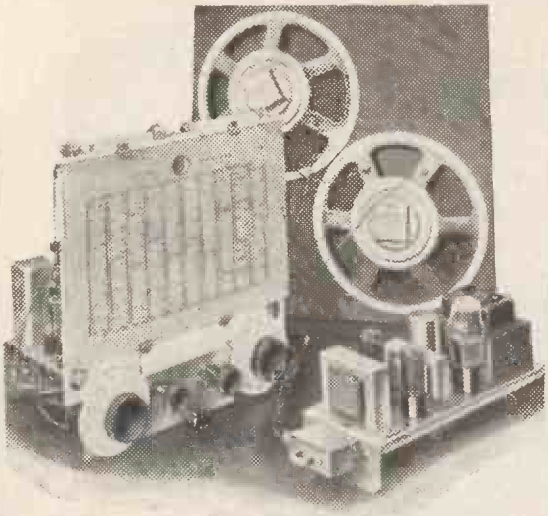
TEL: HIGH WYCOMBE 2060 *CABLES: AIRMEC HIGH WYCOMBE*

A.L.(a)/14





ACE MODEL 600



AVAILABLE IN CHASSIS FORM

An outstanding achievement in radio engineering

- ★ 9 Valves
- ★ 9 Wavebands
- ★ Tuned RF Stage
- ★ Permeability Tuning on Short Waves
- ★ Full Bandspreading on 11, 16, 19, 25, 31, 41 and 49 m Bands
- ★ Plus Trawler and Medium or Medium and Long Bands
- ★ 10 Watts Push-Pull Output
- ★ Twin 10″ Speakers

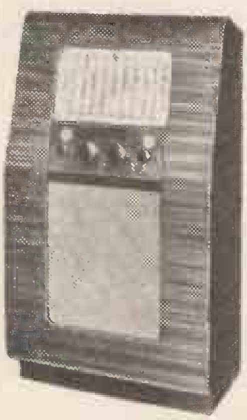
Price £25 0 0 plus £5 11 2 tax

LIMITED QUANTITY ONLY

Model 600 chassis and speakers in magnificent walnut cabinet of special acoustic design

Size:
40 in. × 20 in. × 12 in. (approx.)

Price £30 0 0 plus £6 13 4 tax

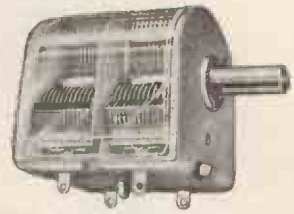


MAJOR DISTRIBUTORS
7-11 CAVENDISH PLACE
LONDON W.1

Tel. : WILlesden 6713

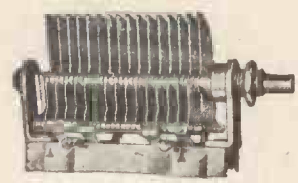
SO SMALL— IT DOES A BIG JOB

REGISTERED TRADE MARK



Miniature in Size, but big in performance. *The M.M. 2 Gang Condenser* has frame dimensions of only $1\frac{7}{16}''$ x $1\frac{19}{32}''$ x $1\frac{11}{16}''$. Complete with dust cover. Cat. No. 4702.

PRICE 10/6



TYPE 604 (illustrated) is a low-loss short-wave condenser suitable for Chassis or one-hole fixing. Brass vanes are soldered to supports and electroplated.

TYPE 603 is a split stator condenser of similar construction.

The S.1 series in both types are particularly suitable for low power transmitters.

PRICES:		
	Type 604 ..	15/3—17/0
	Type 603 ..	16/0—17/6

Replacement Scales calibrated to Copenhagen Plan now available for :—

Airplane Drive	2/3 *retail*
Squareplane Drive	2/6 *retail*
Full Vision Drive	2/9 *retail*
S.L.8 or S.L.5 Drive	4/6 *retail*

PRECISION COMPONENTS BY

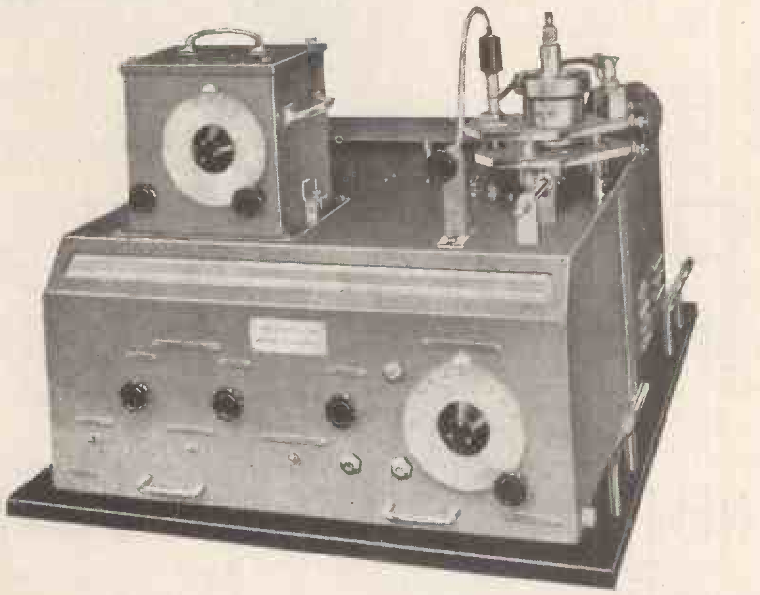
JACKSON
BROS (LONDON) LIMITED
KINGSWAY · WADDON · SURREY

Tel. : Croydon 2754-5 *Grams : Walfilco, Souphone, London*

Introducing the lesser known pages of our catalogue

MARCONI INSTRUMENTS LIMITED

DIELECTRIC TEST SET Type TF 704B

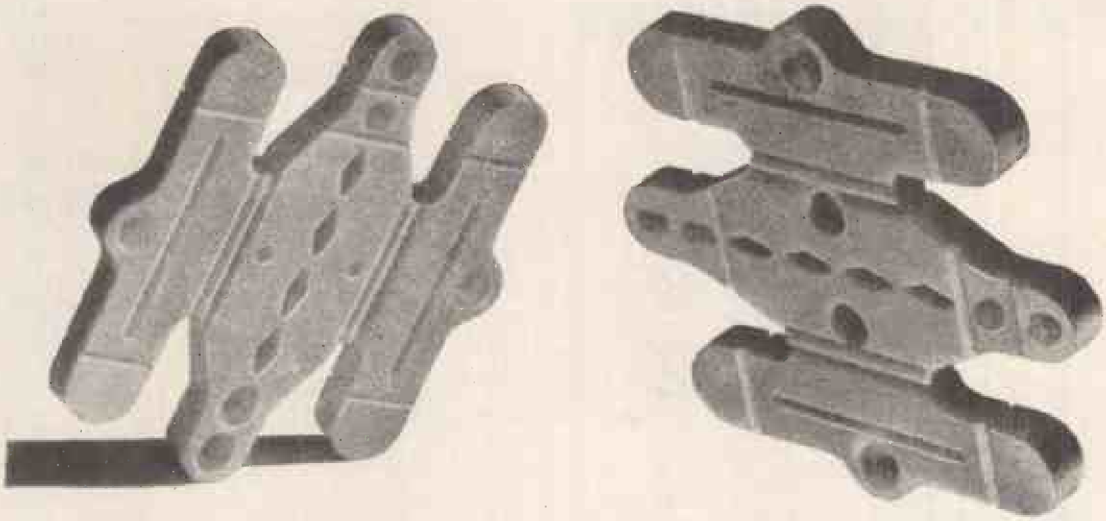


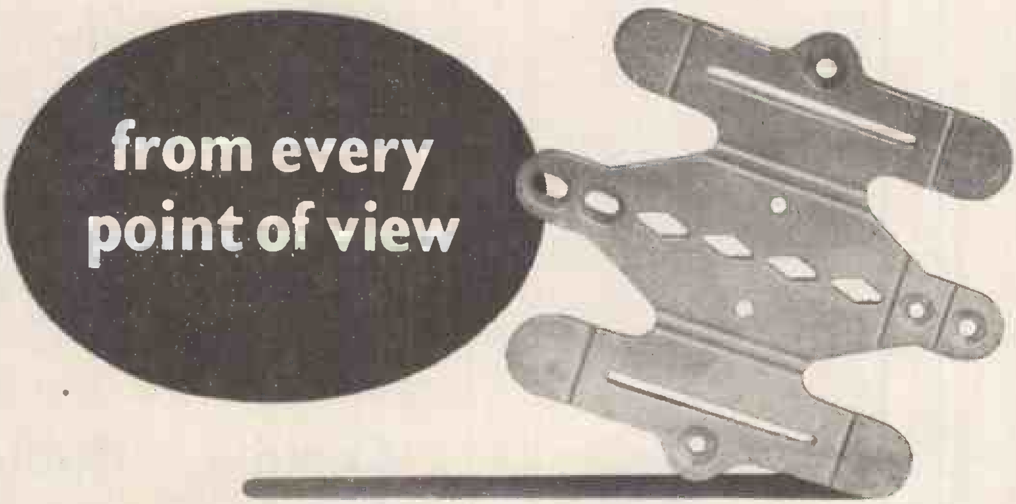
We feel entitled to regard this instrument with the greatest satisfaction although its emergence in present form has not been without setbacks. Based on a National Physical Laboratory design and calibrated by the N.P.L., it is a truly immaculate measuring unit, which although of a quality to be relished by the few, well repays the care lavished upon it. Our one regret is that we have still not retained a Dielectric Test Set for our own laboratories; we succumb in the end to the plea that there are needs greater than our own!

With all the advantages of a self-contained *mains operated* unit, Dielectric Test Set TF 704B determines the permittivity and phase defect of dielectrics in the continuous frequency range 50 kc/s to 100 Mc/s. Capacitance variation in a tuned circuit is the method used, a square-law thermionic mirror voltmeter acting as a resonance indicator. Because frequency is not involved in the calculation, the instrument operates over a very wide frequency range. In addition to its main function the Test Set can be used for determining the properties of high-frequency cables and the radio-frequency performance of capacitors and resistors.

Relentless attention to constructional detail and a perfected measurement technique virtually eliminate all errors even at the high frequencies. Readings are therefore of an exactitude hitherto unattainable.

MARCONI INSTRUMENTS LTD., St. Albans, Herts. Telephone: St. Albans 6161/5



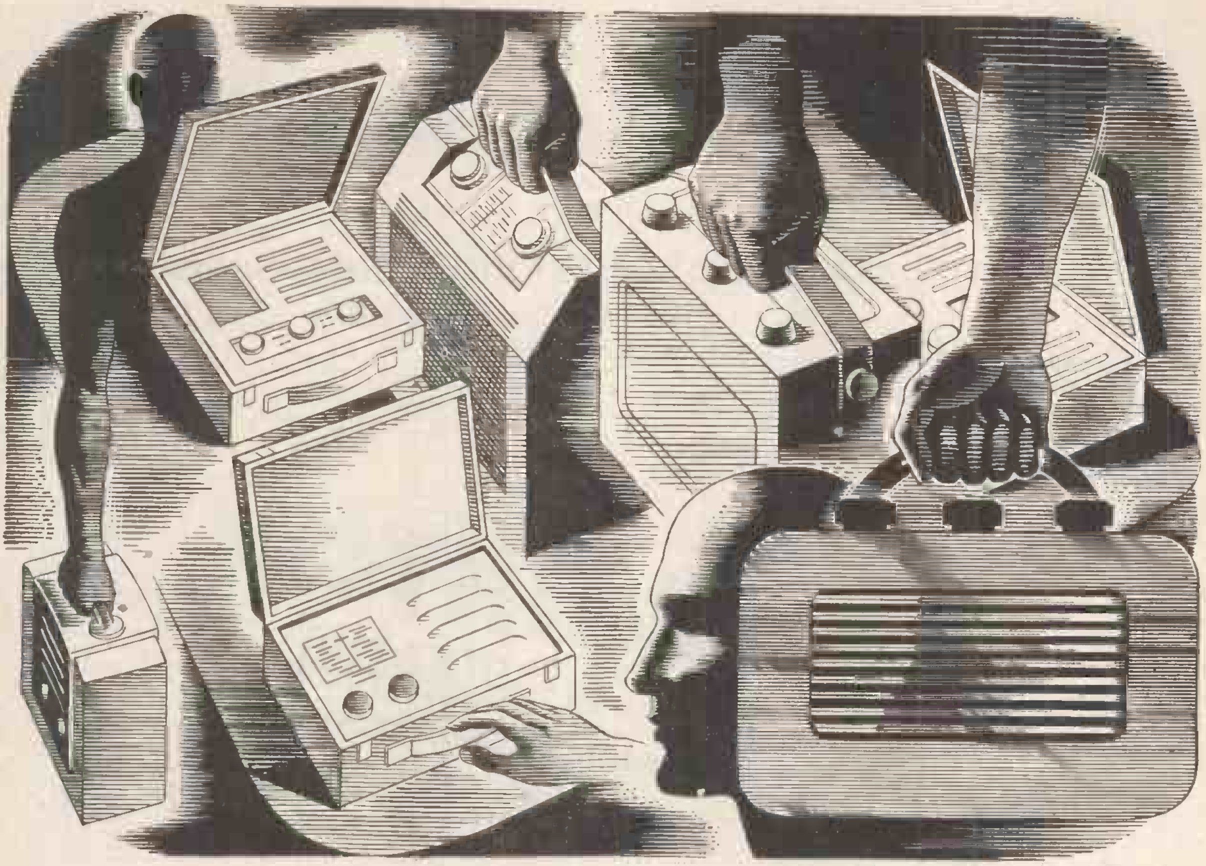


Frequentite is the most suitable insulating material for all high frequency applications. Seventeen years ago we introduced the first British-made low-loss ceramic, and consultation with us before finalising the design of new components is a wise precaution.

STEATITE & PORCELAIN PRODUCTS LTD.

Head Office: Stourport-on-Severn, Worcestershire. Telephone: Stourport 111. Telegrams: Steatain, Stourport

S.P.66



FOR ALL TYPES OF PORTABLES

Ediswan directly heated miniature valves are suitable for miniature battery superheterodyne receivers, or for receivers of the all-mains/battery type.

Particular attention has been paid to the production of valves which are robust enough to stand up to the rougher usage expected with portable receivers, at the same time combining a small physical size and a high performance.

1C1 (American type 1R5) Pentagrid Frequency Changer

1FD9 („ „ 1S5) Diode A.F. Pentode

1F3 („ „ 1T4) Variable Mu-R.F. Pentode

1P10 („ „ 3S4) Output Pentode

1P11 („ „ 3V4) „ „

Complete details and prices on request

EDISWAN

MAZDA

THE EDISON SWAN ELECTRIC COMPANY LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2

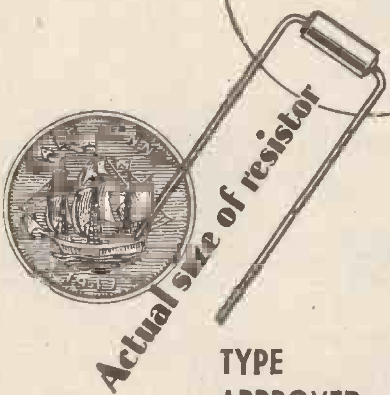
Member of the A.E.I. Group of Companies

RV17

B

MINIATURE VITREOUS ENAMELLED RESISTOR

TYPE M.V.1



RATING 3 watts for 250°C rise.

RESISTANCE RANGE-1-4700 ohms

Full rated watts over the whole resistance range

DIMENSIONS - 15/32" × 13/64"

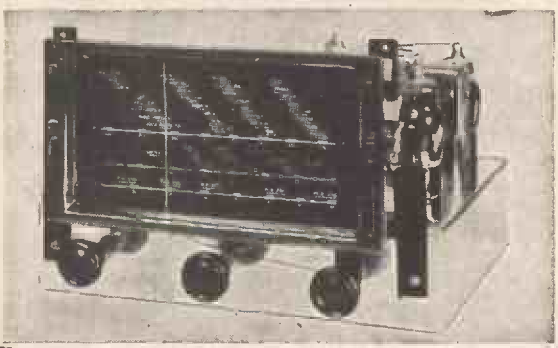
Agents in Belgium: Monsieur Pau Groeninckx, 43 Avenue Jean Stobbaerts Bruxelles.

TYPE APPROVED

PAINTON of NORTHAMPTON

KINGSTHORPE, NORTHAMPTON.

SOLVE YOUR RADIO PROBLEMS WITH



OUR HOME CONSTRUCTION UNITS!

ANYONE can build our handsome FEEDERS !* And the knowledge that the performance will equal that of commercially built units at double the cost, will make you EXTRA PROUD ! As our delighted friends already know the secret is our **ALIGNED TUNING UNITS** comprising the famous 3 band 30 or 40 Coil packs, "MM" I.F.T.'s, new 8in. x 6in. 3 colour Dial and gang—ALIGNED, MATCHED AND SEALED. Price 69/9 (inc.) for 30 or 99/6 for 40. J.B. S.L.8. spin-wheel Tuner 20/9 extra.

*All parts and full construction Sheets available.

NOTE for Connoisseurs :— Our 40 Feeder Unit, with Hi-Fi switching for local stations, and 10w. push pull Quality Amplifier with variable negative feedback is the TOPS ! !

For details, eleven circuits, data, etc., send 1/6 NOW for NEW ENLARGED EDITION (44 pp.) of "Home Constructor's Handbook." All items supplied by Mail DIRECT ONLY from :

RODING LABORATORIES

70, LORD AVENUE, ILFORD, ESSEX

'phone WAN 5486

ICS

HOME STUDY

backs radio experience with sound technical knowledge

MANY men who wished to link their radio experience with a sound technological background have received successful instruction by means of an ICS Course. Its value has been proved not only to amateurs but to men who already have a professional interest in radio and television engineering, including those taking qualifying examinations. It is invaluable, also, to students who wish to prepare themselves for a job in this field. Courses of instruction covering radio and, if necessary, television, include the following :

Complete Radio Engineering . Radio Service Engineers
Radio Service and Sales . Advanced Short-Wave Radio
Elementary Electronics, Radar and Radio
Television Technology

And the following Radio Examinations :

British Institution of Radio Engineers
P.M.G. Certificates for Wireless Operators
City and Guilds Telecommunications
Wireless Operators and Wireless Mechanics, R.A.F.

Write today for our FREE "**RADIO**" booklet which fully describes the above ICS Courses and the facilities for the complete study of Radio and/or Television technology. The ICS Advisory Department will also give free and impartial advice on the need for and the means of instruction.

International CORRESPONDENCE SCHOOLS

Dept. W.L.18, International Buildings, Kingsway, London, W.C.2

Where excellent quality reproduction is essential . .

. . the Metrovick

AUDIO AMPLIFIER

is the instrument to use

This instrument is designed to give excellent quality reproduction with the added advantages of being a self-contained unit, portable and attractive in appearance. Thus it will prove ideal for Public Address work, educational authorities and similar organisations.

SPECIFICATION

Supply : 200/250V 50 c/s single-phase; consumption approximately 170 VA for full output.

Input : Gramophone 0·2V for full output. Microphone 0·02V for full output. The two circuits can be mixed as required.

Impedance : 7 ohms, 15 ohms and 45 ohms.

Output : 20 watts with negligible distortion.

Tone Control : Continuously variable.

Response : $\pm$ 1 db from 30 to 15000 c/s at zero position of tone control.

Controls : These are recessed to avoid damage and are illuminated when in operation.

Dimensions : $18\frac{1}{2}'' \times 8\frac{1}{2}'' \times 10\frac{1}{4}''$.

Finish : The instrument is housed in an attractive steel case, stove enamelled in cream or blue as desired. A leather carrying handle is fitted.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD.

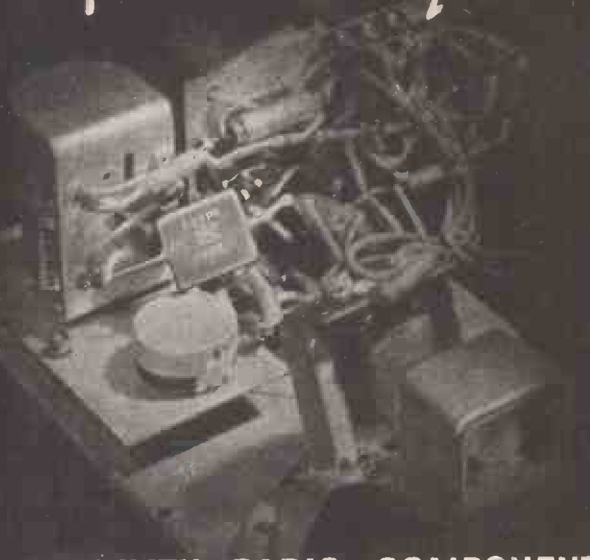
TRAFFORD PARK, MANCHESTER 17

Member of the A.E.I. group of companies

METROVICK ***Pioneers in Radio and Electronic equipment***


VOLUME
BALANCE

For all good Chassis . .



SRC

SILVERED MICA CAPACITORS

STABILITY RADIO COMPONENTS LTD

COMMERCE ESTATE, WOODFORD AVENUE, LONDON, E.18. Telephone: BUCkhurst 6501/2

Some people wind their own coils . .

. . . it takes their mind off the international situation, their failure in the pools, or some other of life's little difficulties. Some people even do it for fun. So it's mainly the hard-headed business type that comes to us. Interested in such things as quick, reliable delivery, unvarying standards and strictly competitive prices, they let us do the worrying.

If you need coils, write to us mentioning types and quantities. The chances are that you, too, will soon be leaving your coil problems to us.

West Hill, St. Leonards, Sussex

PHONE : HASTINGS 471

Moving Parts

The continued expansion in our production of specialised equipment has necessitated our removing from our old premises.

We have acquired modern factory buildings at Kirkby and the removal of all departments will be completed in January 1951.

J. H. BRIERLEY (Gramophones & Recordings) LTD.

KIRKBY TRADING ESTATE, LIVERPOOL

G.E.C.

QUARTZ CRYSTAL ACTIVITY TEST SET

UNSURPASSED AS A SIMPLE & ACCURATE INSTRUMENT

FOR THE MEASUREMENT OF CRYSTAL PERFORMANCE

The G.E.C. Quartz Crystal Activity Test Set measures the equivalent parallel resistance of a quartz crystal when oscillating in a circuit having an input capacity of either 20 pF, 30 pF or 50 pF, the alternative capacities being selected by a switch.

The dial is calibrated and has a range of 4 kilohms to 130 kilohms and is direct reading. No calculation is necessary. Measurements can be made at any convenient amplitude of oscillation up to 10V. R.M.S. at the crystal terminals for crystals of normal activity.

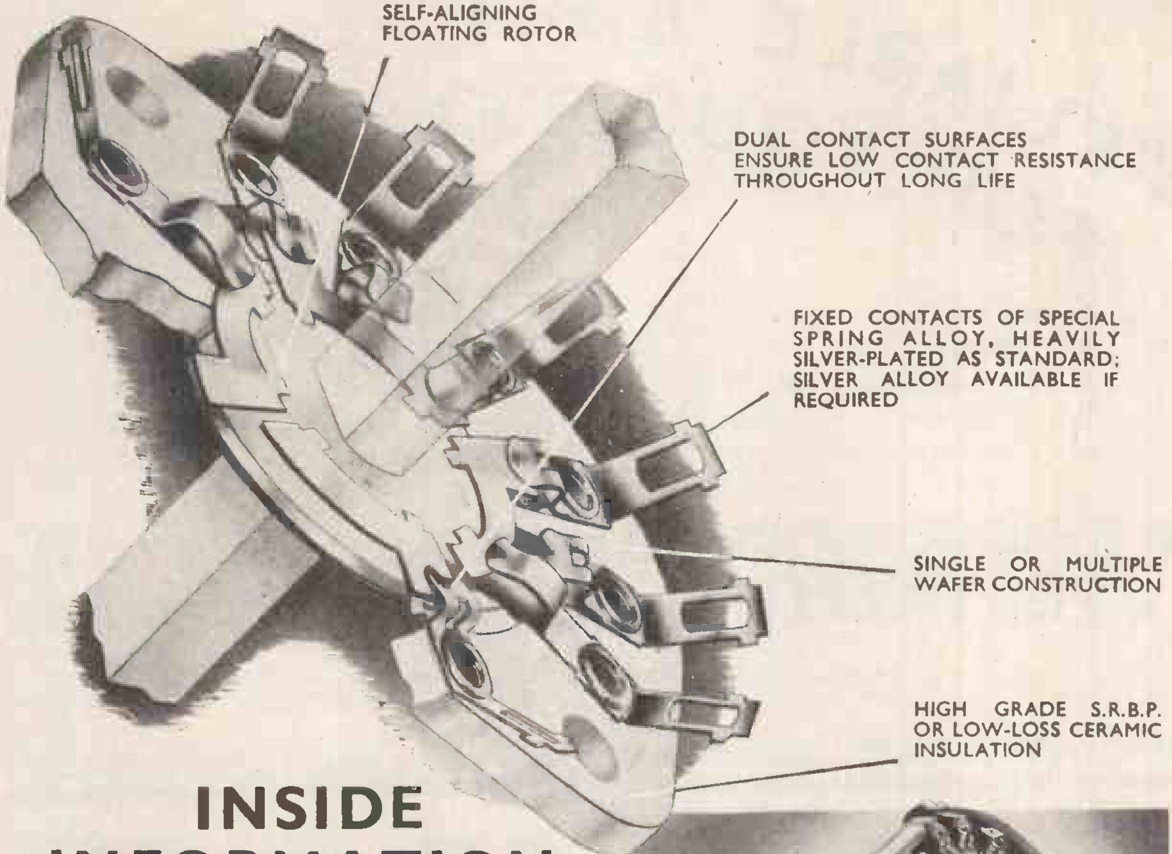
The accuracy of the loss dial calibration is $\pm$ 2%.

WRITE FOR DESCRIPTIVE LEAFLET—

SALFORD ELECTRICAL INSTRUMENTS LTD.

PEEL WORKS : SILK STREET : SALFORD : LANCS.

Subsidiary of THE GENERAL ELECTRIC CO. LTD. OF ENGLAND



INSIDE INFORMATION

—about the switch that is superior

'OAK' switches—both rotary and push button types—are embodied in the majority of British radio receivers.

Throughout the radio world, the time-tested basic 'OAK' principles are recognised and acknowledged as superior. They form the basis for the standard inter-service wafer type switch to Specfication RCS.151 of the Radio Components Standardisation Committee.

The new miniature types, embodying all 'OAK' basic features, bring the range available in line with today's requirements for miniaturised equipments.

Other British N.S.F. Products include:

Cutler-Hammer appliance switches; Carbon and wire-wound potentiometers for television and radio applications.

NSF OAK SWITCHES

OAK PRODUCTS

SOLE LICENSEES OF OAK MANUFACTURING COMPANY, CHICAGO

Licensees of Igranic Electric Co. Ltd., for above products of Cutler-Hammer Inc. Milwaukee, U.S.A.

BRITISH N.S.F. CO. LTD., KEIGHLEY, YORKS. *London Office: 9 Stratford Place, W.1. Phone: MAYfair 4234*

RELIABLE E.H.T. SUPPLY FOR YOUR TELEVISION

Do you want to build your own E.H.T. unit? We can supply instructions for two methods. The "Westeht" balanced voltage multiplier circuit which enables the existing 350-0-350 volt transformer to be used as a source of E.H.T. as well as the usual H.T. supply, and the pulse driven multiplier operating from the line flyback pulses. Both methods incorporate type 36EHT.

WESTINGHOUSE WESTALITE

MINIATURE HIGH-VOLTAGE RECTIFIERS

For a copy of "THE ALL METAL WAY," which also includes valuable information on our H.T., L.T., and H.F. rectifiers, send 6d. in stamps to Dept. W.W.1.

WESTINGHOUSE BRAKE & SIGNAL Co. Ltd., 82, York Way, King's Cross, London, N.1.

"WEYRAD"

B-A-N-D-S-P-R-E-A-D UNITS

DESIGNED FOR HIGH PERFORMANCE UNDER ADVERSE CONDITIONS

FULLY TROPICALISED COILS ON MOULDED FORMERS. AIR DIELECTRIC TRIMMERS

6 EXPANDED RANGES 3 GENERAL COVERAGE
USING 2-SECTION TUNING CONDENSER

STANDARD VERSIONS

B.S.3	B.S.5	B.S.11
13 Metres	13 Metres	11 Metres
16 ,,	16 ,,	13 ,,
19 ,,	19 ,,	16 ,,
25 ,,	25 ,,	19 ,,
31 ,,	31 ,,	25 ,,
41 ,,	41 ,,	31 ,,
13-43 ,,	43-140 ,,	13-43 ,,
43-140 ,,	175-570 ,,	43-140 ,,
175-570 ,,	800-2000 ,,	175-570 ,,

TENTH SWITCH POSITION FOR PICK-UP OPERATION

WEYMOUTH RADIO MFG. CO., LTD.,
CRESCENT STREET, WEYMOUTH, DORSET

T.V. in the FRINGE AREAS

★ A Superior

PRE-AMPLIFIER

By 'RAINBOW'

For use with CO-AXIAL or BALANCED FEEDER

Built-in Power Pack, with Metal Rectifier, E.F.91 valve, exclusive Rainbow Coils. Complete with all Plugs. Crackle Finish. Steel Case $8\frac{3}{8}'' \times 4\frac{3}{4}'' \times 2\frac{1}{8}''$.

Alexandra Palace or Sutton Coldfield Model **Price £5 17 6**

is giving excellent results with Receivers by Bush, Pye, H.M.V., Marconi, Philips, etc.

Also available: 2-valve model for extreme fringe areas **£7 10 0**

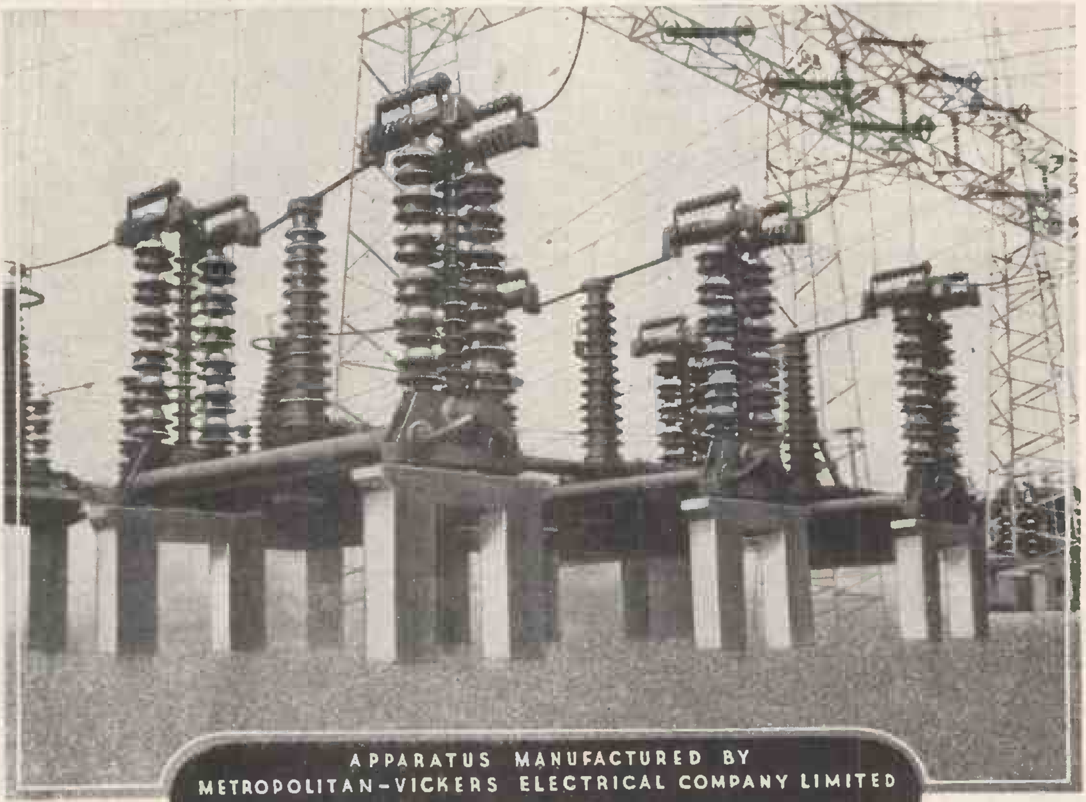
It's to your advantage to write for fuller details.

RAINBOW RADIO MANUFACTURING CO. LTD.
Mincing Lane, Blackburn, Lancs., England

17665

PORCELAIN INSULATORS

for AIR BLAST CIRCUIT BREAKERS



APPARATUS MANUFACTURED BY
METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED
EMBODYING
TAYLOR TUNNICLIFF INSULATORS

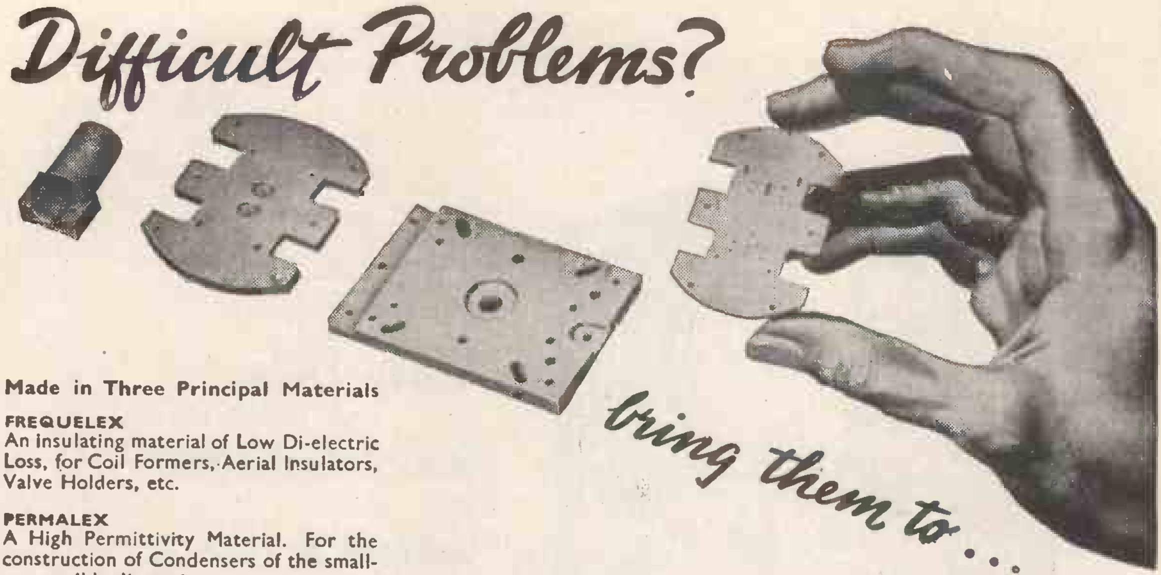
The photograph shows 220kV 3,500 MVA Metrovick air-blast circuit breakers installed in Finland — the first 220kV air-blast breakers made in Great Britain

Taylor Tunnicliff & Co Ltd.

EASTWOOD · HANLEY · STAFFS · *Telephone : Stoke-on-Trent 5272/4*

London Office : 125 High Holborn, London, W.C.1 · Telephone : Holborn 1951/2

Difficult Problems?



Made in Three Principal Materials

FREQUELEX
An insulating material of Low Di-electric Loss, for Coil Formers, Aerial Insulators, Valve Holders, etc.

PERMALEX
A High Permittivity Material. For the construction of Condensers of the smallest possible dimensions.

TEMPLEX
A Condenser material of medium permittivity. For the construction of Condensers having a constant capacity at all temperatures.

Bullers

BULLERS LOW LOSS CERAMICS

BULLERS LTD., 6, LAURENCE POUNTNEY HILL, LONDON, E.C.4
Telephone: Mansion House 9971 (3 lines) Telegrams: "Bullers, Cannon, London"

VARIABLE HIGH VOLTAGE LABORATORY & GENERAL PURPOSE POWER SUPPLY

TYPE 103 PMA

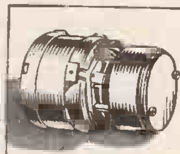
Input - - -	**230 V.A.C. 50 c/s**
Output - -	**500-12,000 V 1 mA maximum**
Meter - - -	**Calibrated 0-12 KV.**
Case - - -	**Blue stove enamelled steel case, 20½" x 10½" x 10½"**

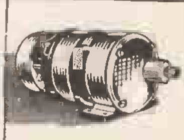
Full details of our standard equipment from 2,000 to 50,000 volts are available.

HAZLEHURST DESIGNS LTD
34a, POTTERY LANE
LONDON, W.11
TELEPHONE: PARK 6955

Drayton

MOTOR UNITS


THE RQG


THE RQH

The Drayton R.Q. is a miniature capacitor induction type motor with a current consumption at 230 volts 50 cycles of 0.09 amps pf. 0.9. It is available:

R.Q.G. GEARLESS for running at 2700 r.p.m. continuously or intermittently in either direction or continuously reversed.

R.Q.R. GEARED for continuous running or reversing at speeds from 27 mins. per rev. to 600 revs. per min.

R.Q.H. GEARED for high final shaft speeds for continuous running, forward or reverse.

Send for List No. N302-1.

RQ 9

for

THE RQR

Drayton Regulator & Instrument Co. Ltd., West Drayton, Mdx. · W. Drayton 2611

LONDON CENTRAL RADIO STORES

Government Surplus – Immediate Delivery from Stock

Another Startling Offer—

PHILCO Reconditioned 5-VALVE RECEIVERS

Long and Medium wavebands. A.C. or A.C./D.C. 200-250 v. Mains energised speaker. In walnut cabinet (slightly soiled), size 19 x 13 x 10in. Every set has been overhauled at our works.

N.B.—There is a shortage of Utility Sets but we have been fortunate in replacing these with the above excellent 2-waveband receivers.

PRICE **90/-** Carr. and pkg. 7/6

PHILIPS 6-VALVE COMMUNICATIONS RECEIVER

AS NEW

16-50 200-550 and 880-2,500 metres. R/F., F/C., 2 I.F.'s D.D.T. Pentode Output. Spin-wheel tuning. In black metal case with built-in speaker Complete with power pack, AC 200-250 v. Can also be supplied with 12 v. D.C. power pack if required. **£16.10.0**

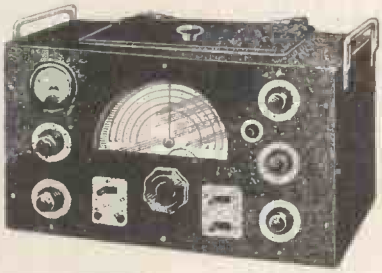
WALKIE-TALKIE (Transmitter and Receiver) Type 38 Mk. II. In perfect working order. Complete with four ARP12, one ATP4 valves, one pair throat mikes, pair headphones and aerial. In metal case. Free circuit diagram—Less batteries. (Carr. & pkg. 2/6). **£3.8.6**

CHARGING BOARDS. Control Panels Only. 24 v. 1,260 watts. Includes five 1¾in. moving coil ammeters (1, 0-40 a., 4, 0-15 a.). One moving coil voltmeter 0-40 v. Five heavy duty sliding resistances, etc., complete in Metal case as shown with fold-back doors. Size 18 × 17 × 8½in. Offered at less than half the component value. Price ... Carriage extra. **£4.19.6**

PHILCO BP.413 DRY BATTERY OPERATED 4-VALVE RECEIVER 4in. P.M. speaker complete with one pair headphones and aerial. In wood cabinet with water-proof cover. Range 1.4 to 4 mc/s. Size 10½ × 7¼ × 7¾in. Working instruction card supplied. Brand new Less Batteries. **£5.2.6**

THE FAMOUS EDDYSTONE 358 COMMUNICATIONS RECEIVER
Great Reduction in Price

Range 31 Mc/s to 90 kc/s, 9 Plug-in coils, 7 valves and rectifier, variable selectivity, B.F.O. stand-by switch, A.V.C. switch. band-spread dial, valve check meter. In heavy black crackle finished steel cabinet with chrome fittings. Complete with 200-250 v. A.C. Power Supply Unit. Carriage and packing 17/6 extra **£20**



TELEPHONE LINE OR UNI-SELECTOR SWITCHES.
4-bank, full-wipers 37/6
6-bank half-wipers 27/6
3-bank half-wipers 19/6

BRAND NEW ACCUMULATORS. Complete in strong case. British made. 6 v. 85 a. Size 12 × 9 × 7in. Weight, 45lb. £3/10/-. Carriage and Packing 5/-.

NEW EXIDE ACCUMULATORS. 2-volt in black bakelite case, 15-20 amps. Size 6in. × 1¾in. square. Weight 26 ozs. Brand new Carr. paid. 5/6.

MICROAMMETERS, 2in. panel mounting, 0-50, 47/6.

NEW INDUCTIVE POTENTIOMETERS 42/6.

TWIN SLIDING RESISTANCES, 120 ohm., 2 amp. 22/6.

EX-ADMIRALTY DOUBLE TWIN SLIDING AND TAPPED RESISTANCES, 0.2 amp. 2,000 ohms. In metal cabinet. 17/6.

VOLTMETERS. Centre zero reading 0-3 and 0-30 D.C. 17/6.

NEW NIFE ACCUMULATORS. 2.5 v. 2½ amp. /hours for 8 hours. Size 3 × 4½ × 1½in. (Flat) 6/6.

EX-R.A.F. NO. 62 VISION UNITS. VCR97 Tube, 12 valves, condensers, resistances, etc. 55/-.

CAMERA MOTORS. 24 v. A.C./D.C., size 3 × 2 × 1½in 8/9.

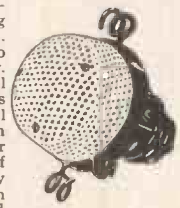
MAP READING TORCH. Powerful magnifying lens, 3in. diam. In bakelite case. Fitted with dimmer switch Takes 2 U2 cells. With bulb, less batteries, 22/6.

2-VOLT VIBRATORS, Type R76C. 7-pin self-rectifying. Output 200 v. at 60 m/a. Made by Electronic Laboratories Inc. 7/6.

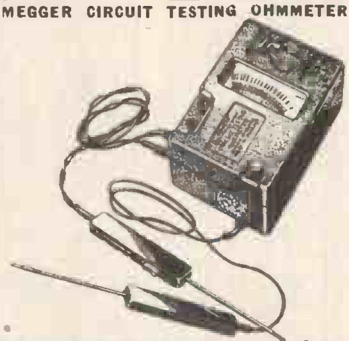
MALLORY TYPE 650, 6 v. 4-pin American base Also 12 v. 4-pin 7/6.

10,000 OHM WIREWOUND POTENTIOMETERS 2/6.

BALL MICROPHONE. Manufactured by Standard Electric. All in perfect condition. Suitable for broadcasting and recording Moving Coil (Dynamic). Omni-directional. No energising necessary. High Fidelity. Coil Impedance 15 ohms and will work very well in conjunction with an ordinary speaker transformer. Is of the type used by many leading bodies, such as the B.B.C. and G.P.O. for high fidelity reproduction. **£4.17.6**



MEGGER CIRCUIT TESTING OHMMETER

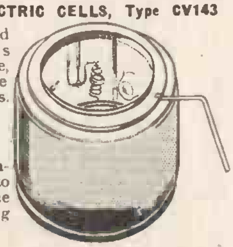


3-terminal type made by Evershed & Vignoles, Ltd. Two ranges: Inner scale 0-1,000; outer scale, .100-200,000 ohms and infinity. Green bakelite case, size 5¼ × 4 × 2¼ins deep Complete with test prods. In solid leather carrying case. Price, less battery **77/6**

VALVE TESTER. By Precision Apparatus Co., N.Y., U.S.A. For all American type valves, 115 volts. **£10.10.0**

PHOTO ELECTRIC CELLS, Type CV143

Small infra-red image glass converter, tube, 50-100v. Suitable for all purposes. **14/6**



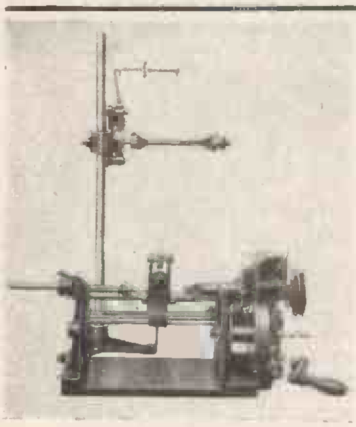
N.B.—We cannot enter into correspondence regarding these cells.

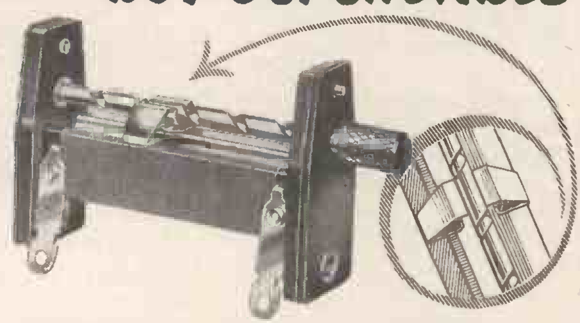
EX-U.S. NAVY TRANSMITTER AND RECEIVER STATION TYPE T.C.S. 12

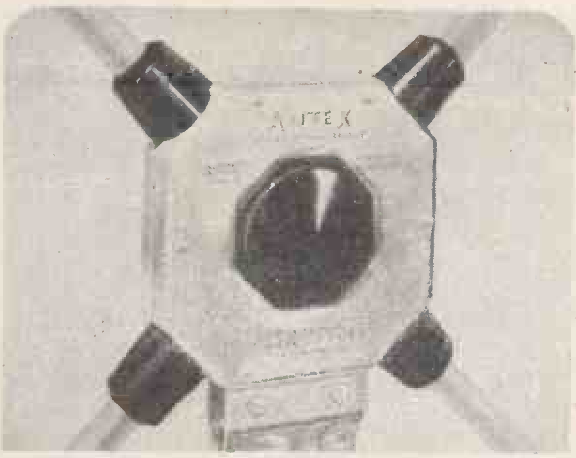
Manufactured by Collins Radio Coy. Output 25 watts telegraph, or 10 watts telephone. Frequency range 1500 kc. to 12000 kc. Complete with Power Packs for 12-24 volts D.C. or 100-250 A.C. mains. Aerials and complete range of spare parts, including meters, valves, Generators, Resistances, Condensers, etc., etc. This equipment is brand new, packed in original cases and ready for shipping abroad. Can be seen at our address.

LONDON CENTRAL RADIO STORES, 23 LISLE ST. (GERrard 2969) LONDON, W.C.2

Closed Thursday 1 p.m. Open all day Saturday and weekdays 9 a.m.—6 p.m.





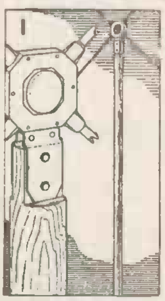


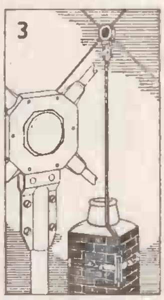
STILL BETTER
T.V. RECEPTION

WHEN the new "Antex" was introduced it set a new and higher standard in T.V. Aerial performance. Now the NEW "Antex" comes to provide even better television reception. Its greatly improved construction, which includes ½" diam. rods, ensures long service free of trouble.

● HIGH GAIN ● LESS INTERFERENCE ● WIDE RANGE ● EASY TO INSTALL ● RIGIDITY WITH LIGHT WEIGHT.

FOUR MODELS to meet every mounting requirement





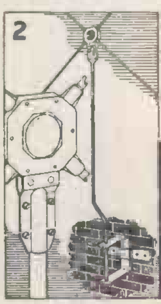
POLE MOUNTING
for fitting to wooden or metal masts.
Model X2P/✻ £2. 5. 0.

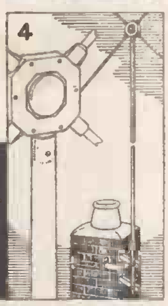
5 FT. MAST MOUNTING
with mast and wall mounting bracket.
Model X2W/✻ £3. 3. 0.

with mast and chimney lashing bracket.
Model X2L/✻ £3. 15. 0.

10 FT. MAST MOUNTING
complete with 1½" Aluminium alloy mast and chimney lashing equipment.
Model X2M/✻ £5. 0. 0.

✻ For Channel served add figure as follows :
1 for London, 4 for Birmingham, 2 for Holme Moss, i.e. X2P/4 is the Pole Mounting type for Birmingham.





The NEW "ANTEX"

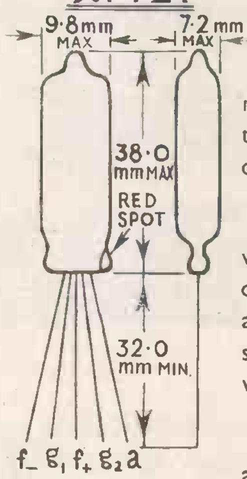
Full details in leaflet E/50/W sent on request.

All Antiference Aerials carry a free 12 months' insurance cover of £250 against lightning damage.

ANTIFERENCE
LIMITED
67 BRYANSTON STREET · LONDON · W·1

12½ mA (Subminiature Output Pentode)

XFY21



The XFY21 is a subminiature output pentode with a filament current of only 12½mA.

It is a robust, reliable valve suitable for the output stages of hearing aids. The output is sufficient for magnetic as well as crystal receivers.

The XFY21 has other applications in small instruments.

TYPICAL OPERATION

Filament Voltage	*1.25v*
Filament Current	*12½mA*
Anode Voltage	*22½v*
Average Anode Current	*0.25mA*
Power Output	*1.75mW*

HIVAC
THE SCIENTIFIC VALVE
BRITISH MADE

**GREENHILL CRESCENT,
HARROW-ON-THE-HILL, MIDDLESEX**

Telephone : HARrow 2655

SOUND REPRODUCING EQUIPMENT

A 100 Watt Amplifier

The outstanding features of this Philips Amplifier include: a high degree of voltage amplification; an output of 100 watts; and very little waste heat, giving cool running and long life. The output is well maintained even at extremes of the audio spectrum, and generous negative feedback taken over the output transformer provides excellent loudspeaker damping.

A Diffuser Loudspeaker

This Philips all-metal central Diffusion Loudspeaker is for ceiling mounting or suspension. It is attractively finished in a pleasing shade of cream that will harmonise well with any type of surrounding. Dimensions are 15in. diameter, 8in. deep. The loudspeaker is fitted to Philips type 9803 unit, and has a 100 volt transformer tapped for 1, 3 and 6 watt operation.

Send for literature covering the full Philips range of S.R.E.

PHILIPS

PHILIPS ELECTRICAL
LIMITED

ALSO MAKERS OF:
RADIO AND TELEVISION RECEIVERS, LAMPS AND LIGHTING EQUIPMENT, ETC.

AMPLIFIER DEPARTMENT, CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2.

A 687 A

YOUR EQUIPMENT CAN HAVE THE PROFESSIONAL LOOK

BY USING WODEN POTTED COMPONENTS

Woden Potted Transformers and Chokes ensure a clean layout with uniform smart appearance. They are used by many leading Radio and Television Manufacturers and this is sufficient testimony to the high standard of efficiency which characterize these components. Available for "Wireless World" Williamson Amplifier, "Electronic Engineering" Home Built Televisor and other popular circuits.

THE EQUIPMENT SHOWN IS THE TOP BAND CABINET TRANSMITTER AS DESCRIBED IN THE "SHORT WAVE MAGAZINE."

SEND FOR ILLUSTRATED LITERATURE AND PRICE LISTS OF OUR COMPLETE RANGE.

WODEN TRANSFORMER CO. LTD

MOXLEY ROAD BILSTON STAFFS

PHONE: BILSTON 41959

J.T.L.

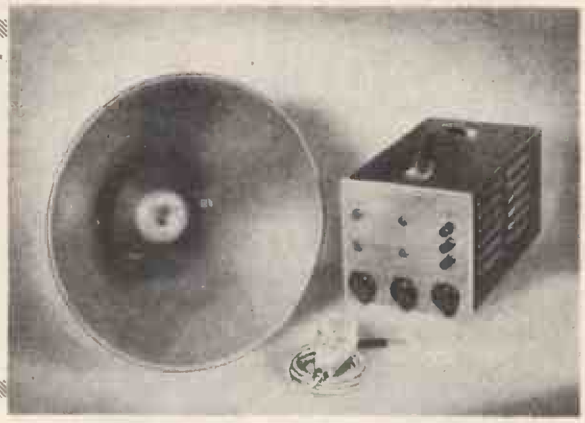
FOR THE DISCRIMINATING PA MAN

PORTABLE BATTERY MAINS AMPLIFIER BM40

An attractive appearance and unique construction combined with first-rate performance give this instrument a hallmark of distinction. Peak power 40 watts, 30 watts undistorted. Designed for both A.C. Mains and 12-volt battery operation. Provision for independent electronic mixing of two microphones and one gramophone channel. Built-in vibrator. Special tone control circuit, with independent bass boost and cut, and treble boost and cut.
These and many other features make the BM40 the most up-to-date amplifier available.
List price £45.

MOBILE CAMPAIGN OUTFIT MA15

An ideal equipment for mobile applications, giving crisp, clear messages. The outfit comprises: 15 watt amplifier for either 6 volts or 12 volts operation; hand microphone type M.C.B., and co-axial weatherproof loudspeaker. A gramophone input and battery-saver switch are incorporated.
List price £42.



30 WATT PORTABLE AMPLIFIER PA30/B

A 30 watt amplifier for public address men. Inputs for moving coil or ribbon microphones and gramophone. Tone control. Illuminated panel and output signal level indicator. Outputs: 7.5, 15 ohms and 100 volt line. Operates from 200/250 volts A.C. mains, or 12-volt battery when used with battery adaptor unit type LT30. An ideal equipment for P.A. vans, general installations and outdoor requirements. Supplied in a handsome portable case.
List price: PA30/B Amplifier, £35.
LT30 Battery Adaptor, £12 10s.

BIRMINGHAM SOUND REPRODUCERS LIMITED
CLAREMONT WORKS, OLD HILL STAFFS. TEL.: CRADLEY HEATH 6212/3

BSR

Wireless World

RADIO, TELEVISION AND ELECTRONICS

January 1951

40th YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK M.I.E.E.

Editor: H. F. SMITH

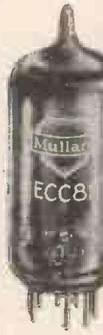
PUBLISHED MONTHLY: Price 2/- (last Thursday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1. *Telephone:* Waterloo 3333 (60 lines). *Telegrams:* "Ethaworld, Sedist, London."

ANNUAL SUBSCRIPTION: Home and Overseas, £1 7s. 0d., U.S.A. $4.50, Canada $4.00

BRANCH OFFICES:

Birmingham: King Edward House, New Street, 2.
Coventry: 8-10, Corporation Street.
Glasgow: 26B, Renfield Street, C.2.
Manchester: 260, Deansgate, 3.

In This Issue



Important trends in

VALVE DESIGN

MULLARD DOUBLE TRIODE ECC81

The double triode ECC81 has, like the nonode EQ80, been included in the Mullard World Series of television valves primarily with a view to meeting the requirements of the television systems of other countries. Although on the British television waveband the choice between a T.R.F. and a superheterodyne circuit is very much a matter of individual preference, for the very much higher frequencies employed overseas there is no alternative to a super-heterodyne circuit.

For the British television band the EF80 pentode is the obvious choice both as an R.F. amplifier and as a frequency changer. For frequencies in the range 100 Mc/s to 300 Mc/s, the performance of triodes in these stages is superior to that of pentodes mainly because of their inherently low noise factor.

The ECC81 is an all-glass double triode on the B9A (Noval) base, and is intended primarily for use as oscillator-mixer or as R.F. amplifier on television sets operating on frequencies between 100 Mc/s and 300 Mc/s.

The provision of two high-quality triodes with separate cathodes in a single envelope ensures maximum circuit economy and flexibility. Normally, two ECC81 valves will be used, one as an R.F. amplifier and the other as frequency changer.

For the amplifier application several alternatives are available. For example, the two triode sections may be used separately for two different frequency bands, or may be strapped together to form a single triode with double the mutual conductance and half the anode resistance. Another arrangement is a two-stage amplifier in which one half of the valve is operated as a grounded-cathode amplifier and the other half as a grounded-grid amplifier. When a balanced circuit is required, the two sections may be arranged in push-pull.

In high-frequency, wide-band receivers, the most important features of the frequency changer are low mixer noise level and high oscillator mutual conductance. The ECC81 fulfils both requirements.

RATINGS AND CHARACTERISTICS

Heater Centre-tapped. Suitable for series or parallel operation, A.C or D.C.

V_h	6.3	12.6	V
I_h	0.3	0.15	A

Capacitances

	Section 1	Section 2	
c_{a-g}	1.45	1.45	μμF
c_{g-k}	2.5	2.5	μμF
c_{a-k}	0.45	0.35	μμF
c_{h-k}	2.5	2.5	μμF
$c_{g'-g''}$	< 0.005		μμF
$c_{a'-a''}$	< 0.4		μμF

Characteristics (each section)

V_a	170	200	V
V_g	−1.5	−1.5	V
I_a	6.5	9.0	mA
g_m	4.8	5.5	mA/V
μ	52	54	
r_a	11	9.8	KΩ

Limiting Values

$V_{a(b)}$ max.	550V
V_a max.	300V
p_a max. (each section)	2.5W
I_k max. (each section)	15 mA
R_{g-k} max.	1 MΩ
R_{h-k} max.	20 KΩ
V_{h-k} max.	90 V
V_h max. during warming-up period	
(For V_h normal = 6.3V)	9.5 V
(For V_h normal = 12.6V)	19 V

Reprints of this article together with additional data may be obtained free of charge from the address below

Mullard

MULLARD ELECTRONIC PRODUCTS LTD.,
TECHNICAL PUBLICATIONS DEPARTMENT,
CENTURY HSE., SHAFTESBURY AVE., W.C.2.

MVM156

ACOS

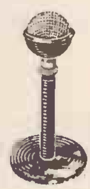
high fidelity

MICROPHONES

FOR PUBLIC ADDRESS, RECORDING, AMATEUR RADIO

TYPE MIC 22

This model incorporates the famous Acos "Filtercel" insert giving extreme sensitivity and high fidelity. Response is substantially flat from 40-6,000 c.p.s. The microphone is vibration and shock proof and is not affected by low frequency wind noises. Two alternative mountings are available for the MIC 22 head :—



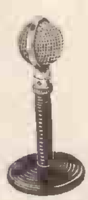
MIC 22-2 is supplied as a complete unit incorporating an attractive desk stand with cable side entry

MIC 22-1 is for fitting to any British or American type standard floor stand and can also be used as a hand microphone.

PRICE £6. 6s. *(Either Model)*

TYPE MIC 16

Incorporates the Acos Floating Crystal Sound Cell giving a response substantially flat from 30-10,000 c.p.s. Performance is unaffected by vibration or shock and low frequency wind noise. As in the case of the MIC 22, two alternative mountings are available for the MIC 16 Head :—



MIC 16-2 is a complete desk stand unit with side cable entry.

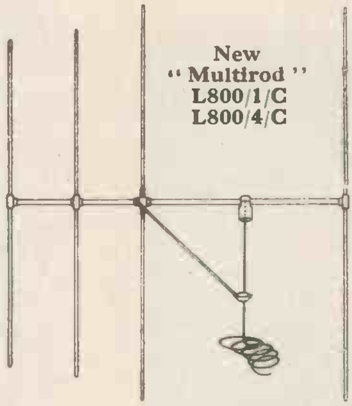
MIC 16-1 is ready for fixing to either British or American type floor stands by means of a knurled ring.

PRICE £12. 12s. *(Either Model)*

COSMOCORD LIMITED, ENFIELD, MIDDX.

THE "BELLING-LEE" PAGE

Providing technical information, service and advice in relation to our products and the suppression of electrical interference



A New "Multirod" Kit

For those customers who require an efficient "fringe" aerial for fitting to an existing 2½-inch diameter wooden mast, we have introduced a new "Multirod" kit. This is made up of a 4-element array a mast head cap and a special clamp for the support brace. 24 yards of low loss coaxial cable *ready connected* to a ¼ wave matching transformer is also included in the kit; this feeder is considered to be of sufficient length for all normal installations.

Coaxial cable is supplied on account of its comparatively low transmission losses.

Where it is desired to operate a receiver with a balanced input, the choice between fitting balanced feeder or coaxial cable with a "Balun" (unbalanced to balanced line transformer) must depend upon whether the length of feeder involved makes the difference between the transmission losses greater or less than the 3 db insertion loss of the "Balun."

In view of the recent change in list numbers of television aerials, this kit will be referred to as L800/1/c (London), L800/4/c (Midland), the first suffix indicating the B.B.C. frequency channel and the second suffix the type of mounting, C for cap.

Matching of "Belling-Lee" "Multirod" T.V. Aerial Array

We were recently taken to task by a more than usually technical dealer who explained that he could generally improve the matching, and therefore the signal, by fiddling the matching transformer on the "Multirod." He was referring to reception in a known difficult area about 80 miles from a transmitter. Now there is nothing surprising about that.

When manufacturing aerial arrays for service requirements to give optimum results, the aerial consists of the collector, matching unit, a known length of feeder to a tight specification, and a carefully designed plug. This is coupled to an equipment whose input characteristics are closely controlled.

Compare the conditions to what happens when a television aerial is set up—it feeds into a feeder of uncertain length terminating in an unknown plug to a receiver which may have balanced or unbalanced input of unknown impedance. Of course any engineer worth his salt can match a "Multirod" to a given receiver in any particular location. All we can hope to do is to supply a factory-made product which will give the best results in the greatest number of installations.

At the time of writing this particular page the preceding one has not appeared in print, but as it deals with one aspect of this all-important matter of obtaining the last ounce from a T.V. aerial we do ask readers to refer back to the last "Belling-Lee" page, and to write to us if we have not made ourselves clear.

The New Liverpool Factory.

This is now turning out a very considerable number of television aerials. The total number being manufactured by both factories and bought is a constant source of surprise.

Ease of assembly, value for money, technical service, are three of the reasons underlying the undoubted popularity of "Belling-Lee" senior and junior range aerials Not only this, but reports have proved that satisfactory results are obtained with nearly every installation, the life of the aerials is exceptional when they are regularly maintained and that high winds do not adversely affect the elements.

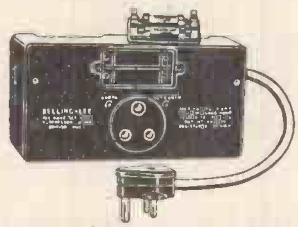
Those erecting "Belling-Lee" aerials experience the greater satisfaction of knowing that a good aerial is being handled, at a competitive price.

They are produced from high tensile light alloy, fully heat treated, with maximum thought given to stability combined with ease of erection and in the case of the junior range, are supplied with lashings and brackets of light materials, and easy run corner plates.

Deliveries.

Although we are despatching aerials direct from our Liverpool Factory there is insufficient staff to deal with orders or enquiries from customers and which would eventually cause delay in deliveries.

It would therefore be appreciated if no correspondence orders are sent to our Liverpool address.



H.F. Interference with television reception.

We are constantly being asked what should be done about this. In fact it is the most common technical enquiry.

Normally our set lead suppressors are of little use at T.V. frequencies as the interference is radiated on to the main lead, aerial circuit, and/or internal wiring of the receiver.

The interference would "skip" any filters in the mains lead. When the source of trouble is known, suppression can generally be applied provided the owner of the offending appliance agrees, and that the actual source is accessible. Short leads are of paramount importance, every unnecessary half-inch reduces the degree of attenuation.

P.S.

Did you know? A motor car can seriously interfere with electronic research and television reception.

Fit a "Belling-Lee" suppressor L.1274 or L.630 to the distributor lead, does not affect engine performance and helps an industry

BELLING & LEE LTD
CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX., ENGLAND

Emidisc

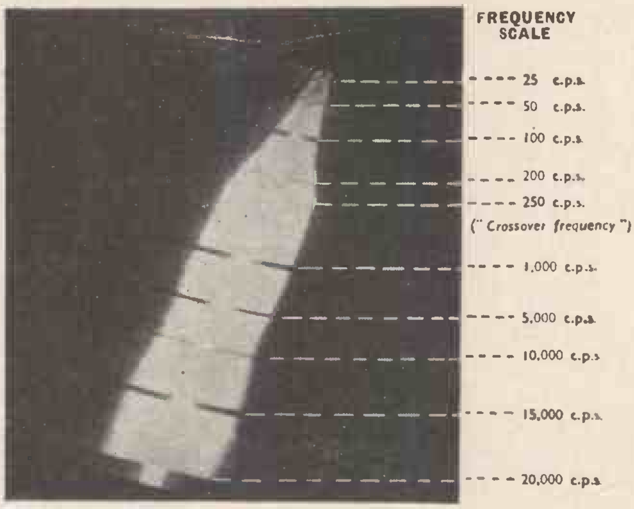
(TRADE MARK)

LACQUER RECORDING BLANKS

THE FINEST FOR LACQUER DISC RECORDING

The "Emidisc" lacquer recording blank fulfils the requirements of the most exacting standards of Broadcasting Authorities, Film and Professional Recording Studios. It may be used with confidence by the critical professional recording engineer and by the owner of the most modest equipment.

Accurate engraving to the limits of the recording equipment is ensured by these essential qualities and characteristics.



Buchmann & Meyer pattern of a gliding tone, 20 Kilocycles to 25 cycles recorded by E.M.I. Studios Ltd., on an Emidisc blank (Actual photograph).

- **SUPERIOR UPPER FREQUENCY RESPONSE** Will record up to 20,000 c.p.s. with appropriate recording equipment
- **LOW NOISE LEVEL**—Average figures:
  -45 db. ref. level 1 cm. per sec. velocity.
  -63 db. ref. level 8 cm. per sec. velocity.
  (Cut at 78 r.p.m., 9½" diameter using sapphire cutter with 16 micron bevel.)
- **ANTI-STATIC** Easy swarf clearance with brush or low power suction systems.
- **LACQUER THICKNESS** Constant over whole recording area.
- **GOOD WEARING QUALITIES**
- **PROCESSING** Mirror-like surface ensures ideal condition for processing (on appropriate sizes of blanks).
- **PACKED IN HERMETICALLY SEALED METAL CONTAINERS** Ensures good shelf life and protection. 10" sizes and upwards have individual air separation of blanks.

Types and Sizes Available for all purposes

GREEN LABEL "Standard" selected direct recording blank—6", 8", 10", 12" and 16" sizes.

YELLOW LABEL "General Purpose" direct recording blank—10", 12" and 16" sizes.

PLAIN LABEL "Audition" direct recording blank for experimental and general testing work—10" and 12" sizes.

SILVER LABEL "Process". The blank for processing—11", 12", 13" and 17" sizes.

Manufactured in Great Britain under exclusive licence from PYRAL S.A.R.L. France.

WRITE FOR FULL PARTICULARS TO :—

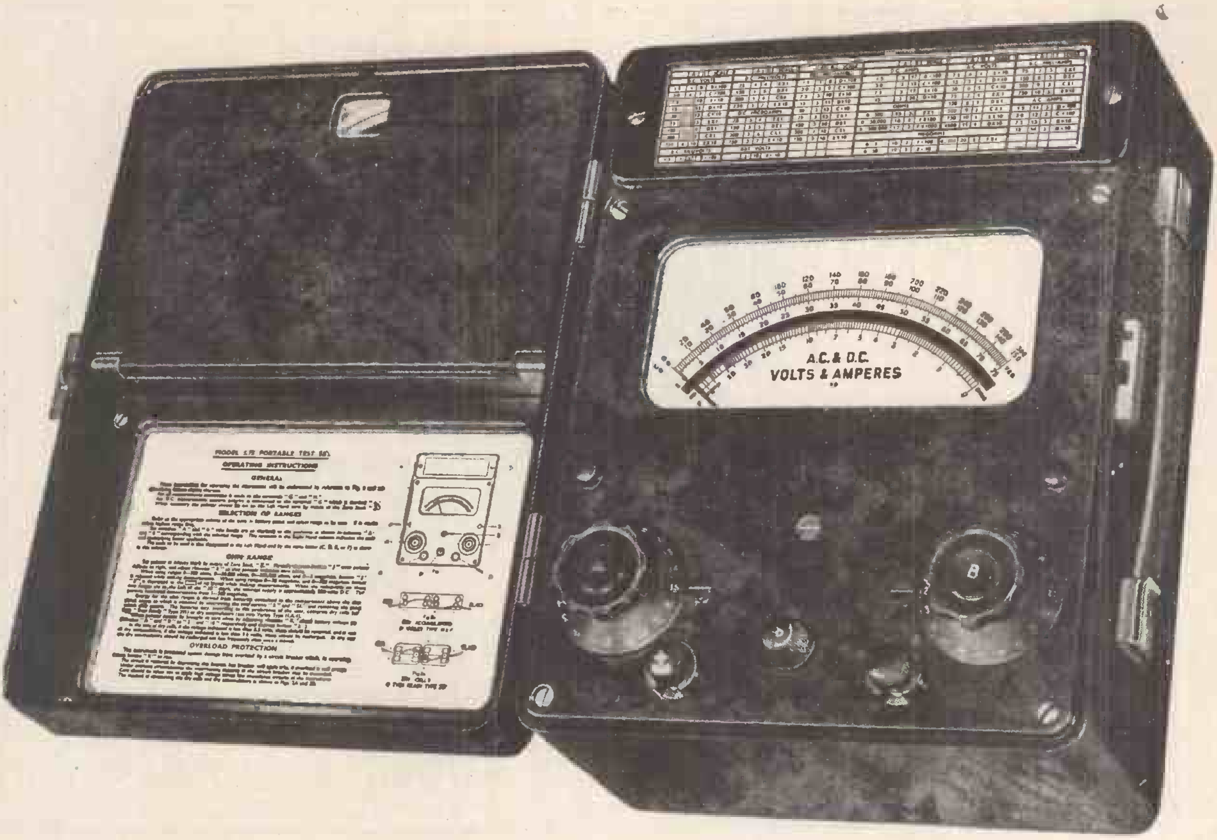
E.M.I. SALES & SERVICE LTD

E.M.I. SALES & SERVICE LTD

CONTROLLED BY ELECTRIC & MUSICAL INDUSTRIES LTD

DOMESTIC RECORDING EQUIPMENT DIVISION

HEAD OFFICE: HAYES · MIDDLESEX · ENGLAND


A.C. & D.C.
VOLTS & AMPERES
OPERATING INSTRUCTIONS
GENERAL
SELECTION OF RANGES
OHMS RANGE
OVERLOAD PROTECTION

NEW RC/PA/U

REMOTE CONTROL PRE-AMPLIFIER

£8 . 15 . 0

For use *only* with LEAK "POINT ONE" AMPLIFIERS

A Leak two-stage feedback tone-control pre-amplifier of negligibly low distortion in which resonant circuits or resonant filters are not used. This pre-amplifier is a complete re-design, electronically, of the original RC/PA and of the modified versions supplied to the U.S. market during the past year. The RC/PA/U will meet world conditions of use, and it embodies not only the best features of the previous models but every refinement suggested by users in Britain and the U.S., with additions considered desirable by ourselves.

Input Control. A five-position switch selects :—

1. Microphone (or other source). Response, level. Sensitivity, 3mV. r.m.s. Input resistance, 200,000Ω.
2. L.P. Records, with built-in equalisation for new Decca and Columbia (U.S.) records. Sensitivity, 15mV. r.m.s. Input resistance, 100,000Ω.
3. 78 r.p.m. Records, with built-in equalisation for British characteristics.
4. 78 r.p.m. Records, with built-in equalisation for American characteristics.
5. Radio (or other source). Response, level. Sensitivity, 50mV r.m.s. Input resistance, 100,000Ω.

Treble Control. A seven-position switch allows the choice of accurately determined boosts and losses on all inputs.

Bass Control. A seven-position switch allows the choice of accurately determined boosts and losses on all inputs.

Volume Control with A.C. ON-OFF switch to permit switching of the remotely placed power amplifier.

Panel Light as a visual reminder.

Total Harmonic Distortion : 0.02% approx.

The sensitivities relate to 10 watts output at 1,000 c/s, with the tone-controls level, when coupled to the TL/12 power amplifier which provides the heater and anode supplies.

These amplifiers are those used by H. J. LEAK when giving the most recent of his demonstrations between a reproduced orchestra and (two minutes later) the live orchestra in the lecture theatre.
The amplifiers can be used for disk recording with the assurance that total amplifier distortion will certainly be no greater than that obtaining in the major studies of the world.

★ FOR YOUR LIBRARY ★

A new booklet by H. J. Leak, M.Brit.I.R.E., describing the above amplifiers and containing much information of technical value to those interested in recording and reproduction in the professional and amateur fields.

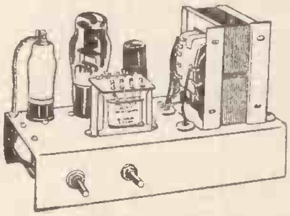
FREE ON REQUEST
FROM YOUR DEALER OR FROM US
BOOKLET W/U

TL/12 12 watt Triple Loop Feedback Amplifier
£25 . 15 . 0

H. J. LEAK & CO., LTD. (Est. 1934)
BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

Phone SHEpherds Bush 1173/4
Telegrams : Sinusoidal, Ealux, London
Foreign Cables : Sinusoidal London

THE M·O·S 'A1' AMPLIFIER KIT



The MOS "A1" Amplifier is complete in every detail, including pre-drilled chassis, pre-wired group board, valves, and all items down to nuts, bolts, solder tags and solder. It is not suitable for use on D.C. mains as the power supply is derived from a mains transformer, ensuring complete isolation of the chassis.

Although of simple design, reproduction is of high quality. Although specifically designed for use with crystal pick-ups (the ACOS, GP20 and GP19 give particularly good results), it can be used with ordinary magnetic types.

The instruction manual is precise and profusely illustrated. It can confidently be stated that the absolute beginner could construct the "A1" Amplifier and be sure of good results.

A1 AMPLIFIER KIT, complete with all components, including valves, pre-drilled chassis and instruction manual £4/2/6

INSTRUCTION MANUAL, if purchased separately 3/6

HIGH QUALITY 10in. Speaker N.B.—This offer is available only to purchasers of the A1 amplifier kit. 15/11

RADIO FEEDER

A specially designed radio feeder for use with the above amplifier available shortly. Write for details.

GUARANTEED SPEAKERS

	s.	d.
2½in. P.M., less transformer	12	0
5in. P.M., less transformer	10	6
5in. M.E., with transformer	15	0
6in. M.E., less transformer	12	6
8in. M.E., less transformer	16	0
8in. M.E., with transformer	21	0
10in. P.M., less transformer	19	6
12in. P.M., less transformer	39	6

For RELIABILITY plus EFFICIENCY you must have a BURGOYNE AERIAL CONNECTOR

This is the ONE and ONLY unit available which enables a really efficient and reliable weatherproof connection to be made between dipole and feeder.

Why continue to worry about your dipole? Come gale or hail, rain in drops or by the bucket, this connector will never let you down.

BRAND NEW IN ORIGINAL CARTONS

12/3 Plus 9d. postage

MOTOR ALTERNATORS

A super Admiralty equipment in grey steel cabinet. With a D.C. input of 24 v., a fully regulated output of 239 v. 50 c/s. A.C. is obtained. The equipment incorporates a starter switch, and the output is metered by means of an A C Voltmeter. A control switch and fuses in both A.C. and D.C. circuits are also incorporated. *Rating 80 watts.* BRAND NEW £4

COME HOME ON A BEAM!

with this 600ft. RANGE American type focusing

TYPE G 13/11 complete Post free **TORCH**

Nickel-plated. Adjustable ring focusing. Three British U2 batteries. Spare bulb contained in base. Pull-out loop. FULLY GUARANTEED.

R.1355 I.F. TRANSFORMER UNITS

Replacement for 7 Mc s I.F. Units for the famous R1355. 4 for 5/- Post Free

ADMIRALTY RECTIFIER UNITS

1204B. A fully stabilised and smoothed power pack for use on 230 v. A.C. with 250v. 170 m/a output. Weight 60 lbs., less valves. only £2.15s.

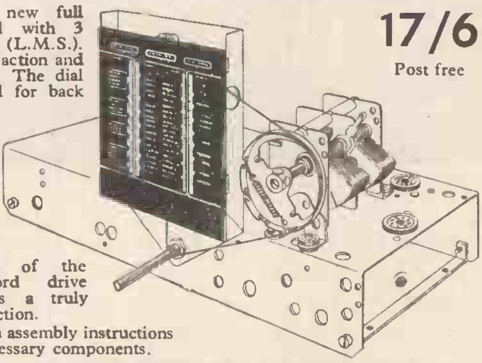
"AMPLION" CONVETTE ELIMINATORS

Converts your battery receiver to A.C. Mains

PRI	For all Personal Sets using B114 or equivalent batteries	£2 . 19 . 6
		£4 . 19 . 6
AD2	For all-dry Portables	
M2V	For sets using dry batteries and 2 v. accumulator. (This model deviates both)	£6 . 16 . 6
VAI	For sets using dry batteries and 2 v. Accumulator to operate without ET battery	£4 . 19 . 6
TRIPLEMASTER	(for all-dry sets). Operate portable off mains, out of doors without batteries. Operate from car, boat, wind-generator, etc.	£6 . 19 . 6
VPA	For use with Vidor portable attache sets using batteries L5512, L5040 or equivalent	£3 . 19 . 6

FULL VISION DIAL ASSEMBLY

17/6 Post free



A brand new full vision dial with 3 wavebands (L.M.S.). Positive in action and non-slip. The dial is arranged for back illumination, printed three colours on unbreakable "Perspex". A clever arrangement of the nylon cord drive makes this a truly non-slip action. Boxed with assembly instructions and all necessary components.

Latest Copenhagen Plan Engravings.

TRADE & WHOLESALE TERMS AVAILABLE on APPLICATION

5/- SPECIAL METER OFFER 5/-

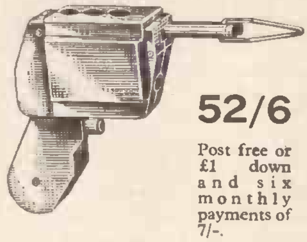
Those who have already purchased the portable test instrument illustrated have a chance to purchase another instrument to provide spares in case of damage to the main meter. The meters offered are new but are defective in one way or another, but can be classed as "repairable."

Repairable PTI, Usually 15/- each. 5/- post free.

Volt-ohm-Milliammeter
0-1.5 v. 0-3 v. 0-60 m/a } D.C. 0-5000 ohms.

The BURGOYNE SOLDER GUN

SAVE TIME on SOLDERING!



52/6

Post free or £1 down and six monthly payments of 7/-.

Just press the button, count seven, and solder, and the bit will remain at soldering heat until you release the pressure, when it cools off instantly. No waiting to warm up or cool down—no element to burn out—no mica to crack or splinter—no risk of shock. Few tools possess so many advantages as the "Seven Second" Solder Gun—and certainly no engineer can consider himself up to date without one.

TAPE & WIRE RECORDER MOTORS by B.S.R.

A small induction motor specially designed for magnetic tape and wire recorders. Absolutely silent in operation and virtually free from vibration. Minimum stray magnetic field .... For A.C. mains 100–250 volts, 50 cycles post free 38/-

COME TO THE RADIO CENTRE

TO SEE BRITAIN'S FINEST DISPLAY OF RADIO, TV & ELECTRIC ALAPPLIANCES

M·O·S MAIL ORDER SUPPLY CO., 33 Tottenham Court Rd., London, W.1 **The RADIO CENTRE**

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

A SELECTION OF PREMIER KITS

PREMIER MIDGET RADIO KIT

Redesigned and easier than ever to build.
Includes an attractive walnut or cream plastic cabinet 12in. × 5in. × 6in.
The valve line-up is 6K7, 6SH7 and beam power output (CV1510) in the A.C. model and 6K7, 6SH7 and 12A6 in the A.C./D.C. model. Both use metal rectifiers and are for use on 200-250 volt mains. The dial is illuminated and the receiver presents an attractive appearance. Medium and long waveband coverage. Complete kit of parts with valves, speaker, cabinet and point-to-point diagrams.
Please state if A.C. or A.C./D.C. is required. **£4.19.6** inc. P.T.

NEW 3-BAND MIDGET SUPERHET KIT. Redesigned to cover the short, medium and long wavebands (16-50, 190-540, 1,000-2,000 metres) A.C. valve line-up, 6K8, 6K7, 6Q7, CV1510 Beam power output. A.C./D.C. valve line-up is the same excepting output valve is 12A6. Both use metal rectifiers and are for use on 200-250 v. mains.
In cream or walnut cabinet as illustrated. Illuminated dial. An attractive and powerful receiver.
Complete kit of parts with Valves, Speaker, Cabinet and point-to-point diagrams.
Please state if A.C. or A.C./D.C. is required. **£6.19.6** inc. P.T.

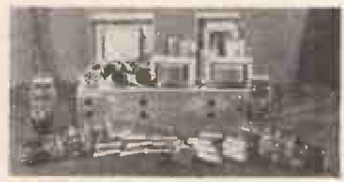
GRAMOPHONE AMPLIFIER KIT.

Consists of Complete Kit of Parts for a 2½ watt, Mains-operated 2-stage Amplifier for use with any type of pick-up. Volume and tone controls are incorporated. Output impedance is 3 ohms.
Cat. No. AMP147. Price complete, 65/-. For 200-250 v. mains with valves and diagrams.

NEW A.C. ALL-WAVE SUPERHET KIT.

7 valves (plus rectifiers) for 200-250 v., 40-60 cycle A.C. mains.
4 Wavebands, 13.6-52, 51-190, 190-540 and 900-2,100 metres.
Pick-up input. Uses 6K7, 6K8, 6K7, 6B8, 6J5 and 2-6V6 in push-pull, giving an output of 10 watts.
Specially designed OP transformer to match 6V6's to 3 and 15 ohm speakers.
Negative feedback is applied over 3 stages giving a high fidelity output. Tone control is incorporated, £14/5/-.
Also available for A.C./D.C. Mains. Specification as above, except that valve line-up is 6K7, 6K8, 6K7, 6Q7, 6J7, 2-KT33C. In Kit form at £13 8/10.

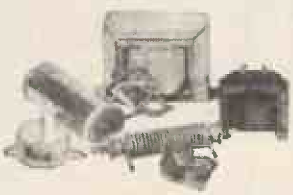
WILLIAMSON AMPLIFIER KIT



We can supply the Kit of Parts for the latest version of this famous amplifier complete in every detail for £10/10/-, with Valves, output and mains transformers.

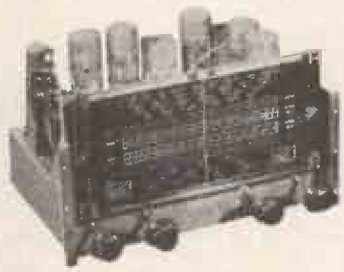
WILLIAMSON AMPLIFIER OUTPUT TRANSFORMERS to specification, 63/-.
Mains Transformers, 45/-.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT.
All parts to construct an eliminator to give an output of 120 volts at 20 mA. and 2 volts to charge an accumulator. Uses metal rectifier, 35/-.



MAINS NOISE ELIMINATOR KIT.
Two specially designed chokes with three smoothing condensers with circuit diagram. Cuts out all mains noise. Can be assembled inside existing receiver, 6/- complete.

METER KIT.
A FERRANTI 500 MICROAMP M/C METER, with separate High Stability, High Accuracy, Resistors to measure, 15, 60, 150 and 600 volts D.C. Scale length 1¾in., diameter 2¼in., 10/- complete kit.



BATTERY CHARGER KITS.
All incorporate Metal Rectifiers, Transformers are suitable for 200-250 v. A.C. 50 Cycles.

Charges 6-volt Accumulator at 1 amp. Resistance supplied to charge 2 v. Accumulator ..	22/6
Charges 12-volt Accumulator 1 amp.	27/6
Output 15 v. 4 A. Variable Resistance and Meter	£3/15/-

TERMS OF BUSINESS

Postage and Packing is free for orders over £2 in value unless otherwise stated. Under this amount, please include 1/- for orders up to 10/- and 1/6 for orders over 10/-. C.O.D. orders cannot be sent under 20/-.

3½in. GOODMANS M/C. P.M. LOUDSPEAKER. Mounted in a cast aluminium case, 6¼ × 4 × 3in. with grille. 15Ω v/coil. Transformer ratio 17 : 1. 15Ω to 4,500Ω. With 100Ω w/w vol./control. 15/- each, plus 2/- carriage and packing.

PERMANENT MAGNET FOCUS POTS. Available for all Tubes, 15/-. Please state Tube used.

MOVING COIL METERS. All 2¼in. outside diameter. 1 mA, 7/6 ; 5 mA., 5/- ; 50 mA., 8/6 ; 150 mA., 6/- ; 20 amp., 7/6 ; 40 amp., 7/6 ; 20 v., 5/9 ; 40 v., 5/9 ; 500 microamps, 7/6 ; All 3½in. outside diameter. 1 mA. 15/11 ; 30 mA., 10/6 ; 200 mA., 8/6 ; 500 microamps, 19/6 ; Thermocouple meters, 2¼in., 2.5 amp., 5/- ; 3 amp., 5/- ; 3.5 amp., 5/- ; 3½in. 2 amp., 8/6 ; Electrostatic 3½in., 2 kV., 25/-. Ditto 5K, 4½in., 50/-.

T.V. WHITE RUBBER MASKS.
We can now supply a specially designed White Rubber Mask for 6in. C.R. Tubes at 7/6 each.
9in. White Masks, 9/6. 12in. White Masks, 16/11.

SUPER QUALITY TELEVISION MAGNIFYING LENS.
To suit 5in., 6in., or 7in. Tubes. Increase picture size considerably, 25/- each.

WELDING OR GROUND HEATING TRANSFORMERS.
Input 230 v. Output 15 v. 60 A. Tapped at 14-13.5-13 volts. 7½ × 7 × 6in. Weight approx. 50 lbs. Price 55/-. Carriage and packing 15/-.

MOVING COIL LOUDSPEAKERS (3Ωv/c.).
2½in. Personal Type (15Ω v/c.), 15/- ; 3½in. J.P., 9/- ; 5in. Truevox, 10/- ; 5in. Rola, 12/6 ; 6in. Truevox, 12/6 ; 8in. Plessey, 14/6 ; 10in. Rola, 23/6 ; 12in. Truevox, 39/6. 5in. Truevox in handsome plastic cabinet (cream or walnut), 6 × 6in. with v./control, 27/6.

E.H.T. TRANSFORMER. Output 1,000 v. at 1 mA., with two 4 v. 1.5 A. LT's. In power supply this will give an output of 1,500 v. halfwave or 2,500 v. Fullwave Price 17/6.

SPECIAL OFFER OF ADMIRALTY REFLEX-RE-ENTRANT P.A. LOUDSPEAKERS. v./coil 7Ω. Matching transformers 4.5-1 and 6-1. Ratios with vol./control at max. Very sensitive and directional. Single unit, 55/-. Twin units, 75/-. Carriage and packing, 5/-.

100 µA METERS. 3½in. O.D. Flush mounting. Scale length 2¼in. Internal resistance 430Ω, 35/- each.

MIDGET 2-GANG CONDENSERS. 2½ × 1½ × 1¾in. For personal portables, 7/6 each.

152-153, FLEET STREET, E.C.4. *Phone: CENtral 2833*—**and at—207 EDGWARE RD., W.2.** *Phone: AMBassador 4033*

207, Edgware Road is open until 6 p.m. on Saturdays.

OUR CATALOGUE PRICE 6d. CONTAINS ALL THE NEWEST RADIO EQUIPMENT.

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

Amazing Offer of NEW BOXED MILITARY SURPLUS VALVES

Type 7193 UHF Triode, 1/6 each, 12/- dozen.
Type E1148 UHF Triode 1/6 each, 12/- dozen.
Type 956 Acorn VMH Pen, 2/6 each, 20/- doz.
Type CV52 UHF Triode, 4/6 each.
Type 1625 12v. 807, 5/- each, 40/- dozen.
Type PT 25H 4 v. 5 watt Pentode, 3/- each, 24/- dozen.
Type CB22 High Powered Thyratrons, 20/- ea.
Type CB71 Neon Tubes, 2/- each, 16/- dozen.
Type 958A Acorn 1.4 v. Triode, 3/- each, 24/- dozen.

ROLA

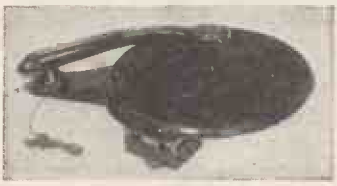
6½in. Energised Moving Coil Loudspeakers. 1140 ohm field, with pentode O.P. Transformer, 15/- each.

PLESSEY

5in. Permanent Magnet Moving Coil Loudspeakers, with extra heavy magnet and pentode O.P. Transformer, 12/6 each.

METAL RECTIFIERS

Bridge Type with 15 volt input will charge 12 volt Battery @ 4 amps, 17/6 each.
E.H.T. Pencil Type, output 650 volt @ 1 mA, 4/7 each.
Output 1,000 volt @ 1 mA, 6/- each.
Outputs given are half wave. Two of either Rectifiers can be used in voltage doubling.



SPECIAL OFFER OF COLLARO ELECTRIC GRAMOPHONE UNITS

The Motor, Tonearm and Crystal Pick up in one unit with automatic stop and start. Induction motor, variable speed. For A.C. only, 100-250 volts, 50 cycles. List price £11/2/2. Limited quantity only at £4/19/6, plus 2/6 carriage and packing.

ELECTROSTATIC C.R. TUBES. New and Perfect

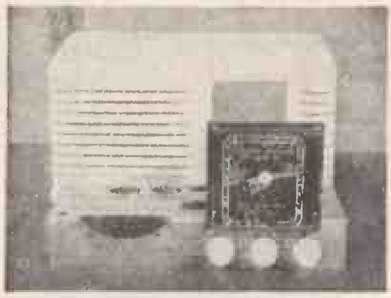
CV1112, 5in. CV1381, 5in.
CV1395, 6¼in. CV1379, 5in.
5/- each to Callers only.

BLOCK CONDENSERS. Jelly Filled

1 mfd 1500 v. working, 2/- each, 18/- per doz.
1 mfd 600 v. working, 1/3 each, 12/- per doz.
2 mfd 800 v. working, 1/9 each, 17/- per doz.

24-VOLT CUT-OUTS

Can be adjusted for use on 12 volts. In Bakelite Cases. Type 5c/721. 2/6 each, 21/- per dozen.

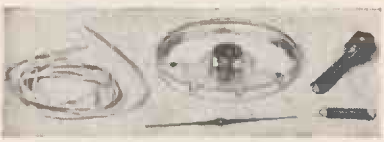


GIVE YOUR HOME-BUILT RECEIVER THAT PROFESSIONAL LOOK

We can supply all the parts to help you.

Bakelite Cabinet (Brown)	17/6
Bakelite Cabinet (white)	17/6
Punched Chassis 3 Valve Plus Rectifier or 4 Valve Plus Rectifier	5/6
Engraved Glass Dial 16-50 and 200-557 metres or 16-50, 200-557 and 700-2000 metres	2/6

Both with station names, new wavebands.



CORD DRIVE ACCESSORIES FOR ABOVE

Drum (2⅜ diam.)	1/6
Drum (4¼in. diam.)	2/6
Driving Head	1/6
Double Pointer	4d.
Spring	3d.
Nylon Cord (yard)	6d.
Dial Back Plate	1/3
Dial Back Plate Bracket	6d. pair

ENAMELLED COPPER AERIAL WIRE

On 1,200ft. Reels, 7/23 swg., 25/- per Reel.

ELECTRIC GRAMOPHONE MOTORS by World Famous Makers

200/250 v. A.C. with variable, speed control 12in. Turntable, Pick-up Arm, Auto Start/Stop. Without P.U. Head, 77/6 each.

HOT WIRE AMMETERS

0-10 amps. 5in. Scale, Projecting type Meter Case, 5/- each.

R.107 RECEIVERS

In partly dismantled condition. A wonderful spares investment for R.107 owners, 50/- each. Only available to Callers.

POWER PACKS

Input 200-250 v. 50 cycles. Output 330 v. 60 mA. 6.3 v. 2.3 a, and 6.3 v. .3 a for 6×5 Rectifier. Mounted on metal chassis approx. 6×6in., fully smoothed. 19/6 each.
6×5 Rectifier, 5/- each.

3-GANG CONDENSERS

Modern Bar Type .0005 mfd, ¼in. diameter Spindle, Ceramic Insulation, 5/-.

WAVE CHANGE SWITCHES

3-Bank, each Bank 2-pole, 4-way, one Bank with shorting Bar, 7/- each.

ROTARY TRANSFORMERS

Input 28 volt, output 1,000 volts at 350 mA. May require adjustment, 20/- each. To callers only.

BALANCED ARMATURE EARPIECES

Type DLR No. 5.IT.BAS.S.
Highly sensitive 60 ohms Earpieces. Make excellent Sound Powered Telephones. Without Batteries or Matching, 1/3 each.

NEW PRE-AMPLIFIER FOR FRINGE RECEPTION AREA

We can supply the complete kit of parts to make this wide band width Pre-amplifier using 2-717A Pentodes. For use with Televisors able to supply 130 v. 20 mA, H.T. and 6.3 v., .3 amps. L.T.
Completely screened. Includes valves, chassis, diagrams, etc., 27/6 each.
Separate Power Supply Unit if required, 21/-.
When ordering Televiser or Pre-amplifier Kits PLEASE STATE IF THE LONDON OR BIRMINGHAM MODEL IS REQUIRED

VITREOUS RESISTORS

50 K ohm 200 watt, 20 K ohm 200 watt, 10 K 50 watt, 12 K x 2 K ohm 75 watt, 75 K ohm 50 watt, 350 ohm 50 watt. Any of the above 1/-, 8/- per dozen.

CATHODE RAY TUBES. ALL NEW AND PERFECT.

CV. No.	Civil'n Bo.	Dia. in inches	Focus	Defin.	E.H.T.	O.K. for T.V.	Price	Rail pkg. and Insce.
254	—	9	E.S.	Mag.	8kv.	Expmtl.	40/-	10/-
279	—	2.75	E.S.	E.S.	1450	Expmtl.	10/-	2/6
600	5CPI	5	E.S.	E.S.	2kv.	Yes	25/-	2/6
601	5BPI	5	E.S.	E.S.	2kv.	Yes	27/6	2/6
817	3EPI	3	E.S.	E.S.	2kv.	Yes	15/-	2/6
1131	VCR131	12	E.S.	E.S.	4kv.	Yes	80/-	12/6
1138	VCR138	3.5	E.S.	E.S.	1200v.	Yes	10/-	2/6
1140	VCR140	12	Mag.	Mag.	4kv.	Yes	90/-	12/6
1379	ACR2	5¼	E.S.	E.S.	3kv.	Yes	15/-	2/6
1381	ACR8	5.25	E.S.	E.S.	3kv.	Yes	15/-	1/6
1384	—	11.5	E.S.	E.S.	4kv.	Expmtl.	40/-	10/-
1395	—	6.25	E.S.	E.S.	3kv.	No	17/6	2/6
1511	VCR511	11.75	E.S.	E.S.	4kv.	Expmtl.	60/-	10/-
1516	VCR516A	9	Mag.	Mag.	5kv.	No	40/-	10/-
1521	VCR521	3.5	E.S.	E.S.	4kv.	No	5/-	1/6
1522	VCR522	1.75	E.S.	E.S.	800 v.	Yes	15/-	1/6
2880	EM14/1	3	E.S.	E.S.	800v.	Yes	17/6	1/6
3776	—	5.25	E.S.	E.S.Mag	4kv.	Expmtl.	20/-	2/6

TRANSMITTING AND SPECIAL PURPOSE VALVES

866A ...	10/-	713A ...	6/6	2E22 ...	7/6
860 ...	5/-	XH1.5	6/6	3B24 ...	7/6
830B ...	10/-	807 ...	6/6	VS69	7/6
878 ...	10/-	4C27 ...	10/-	GDT4C	6/6
705A ...	10/-	2X2	2/6	DET5	10/-
1616 ...	5/-	9002 ...	3/6	282A ...	10/-
8012 ...	10/-	9003 ...	3/6	327A ...	15/-
843 ...	5/-	9004 ...	3/6	958A ...	2/6
1625 ...	5/-	703A ...	10/-	CV1510	6/6

EHTT(CV19)	20/-	MR300E(CV3558)	15/-
VS68(CV1068)	6/6	U19(CV187) ...	6/6
EL266(CV15)	40/-	NS2(CV1199)	5/-
VT30(CV1030)	7/6	GU50(CV1072)	7/6
U17(CV1113)...	5/-	1626(CV1755)	3/6
VU133A(CV54)	6/6	BL63(CV1102)	6/6
ADI(CV1314)	6/6	GU1(CV1262)	6/6
DQP(CV1141)	6/6	V1906(CV20)...	6/6
717A(CV3594)	6/6	E1359(CV76)	40/-
RL18(CV1197)	5/-	931A ...	30/-
HY114B(CV3505)	6/6	Base for 931A...	2/6

ALL POST ORDERS TO: 740 HIGH RD., TOTTENHAM, LONDON, N.17 Phone. Tottenham 5371

CALLERS TO: 152/153, Fleet St., E.C.4. Central 2833.
207, Edgware Rd., W.2. Ambassador 4033.

Edgware Rd. is open until 6 p.m. on Saturdays.

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

PREMIER LONG RANGE* TELEVISION KITS

FOR THE LONDON AND BIRMINGHAM FREQUENCIES

As is usual in all Premier Kits, every single item down to the last bolt and nut is supplied. All chassis are punched and layout diagrams and theoretical circuits are included.

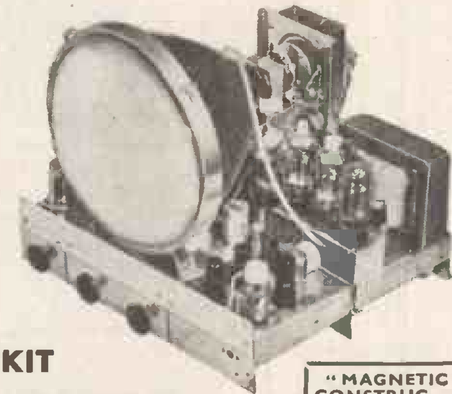
The coils are all wound and every part is tested. All you need to build a complete Television Receiver is a screwdriver, a pair of pliers, a soldering iron and the ability to read a theoretical diagram.

Any of these Kits may be purchased separately ; in fact, any single part can be supplied. A complete priced list of all parts will be found in the instruction book.

THE MAGNETIC KIT using 9" or 12" tubes

£19-19-0 (carriage and packing 15/-). Including all parts valves and Loudspeaker, but excluding C.R. Tube.

Vision Receiver with valves ..	£3 16 0	Carr. & pkg. 2/6.
Sound Receiver with valves ..	£3 1 0	Carr. & pkg. 2/6.
Time Bases with valves ..	£8 5 6	Carr. & pkg. 5/-.
Power Pack with valves ..	£4 16 6	Carr. & pkg. 5/-.



"MAGNETIC" CONSTRUCTION BOOK 3/-

THE ELECTROSTATIC KIT

using VCR97 Tube **£17.17.0**
inc. Tube (carriage and packing 15/-)

VISION RECEIVER with valves, carriage 2/6........	£3 13 6
SOUND RECEIVER with valves, carriage 2/6........	£2 14 6
TIME BASE with valves, carriage 2/6................	£2 7 6
POWER SUPPLY UNIT with valves, carriage 5/- ..	£6 3 0
TUBE ASSEMBLY, carriage and packing 2/6........	£2 18 6

This unit includes the VCR97 Tube, Tube Fittings and Socket and a 6in. P.M. Moving Coil Speaker with closed field for Television.

ELECTROSTATIC CONSTRUCTION BOOK 2/6

* The following sensitivity figures prove that the Premier Televisor Kits are capable of reception at greater distances than any other standard commercial kit or receiver whether T.R.F. or Superhet.

VISION RECEIVER

Sensitivity .. 25 μV for 15 V. peak to peak measured at the Anode of the Video Valve.

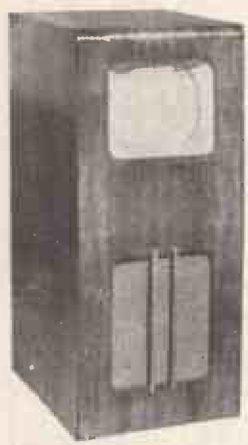
Sound Rejection Better than 40db.

Adjacent Sound Rejection Midland Model. Better than 50db.

SOUND RECEIVER

Sensitivity .. 20μV Vision Rejection better than 50db.

WELL-MADE WALNUT



Finished Pedestal Cabinets are available from stock.

For 6in. Tube....	£5 10 0
For 9in. tube	£6 15 0
For 12in. tube....	£8 8 0

Carriage and packing 7/6.

Fullest details are in our complete Catalogue price 6d.

all postal orders to 740, High Road, Tottenham, N.17. Phone: Tottenham 4723/4/5.

BRANCHES AT:

152/3, FLEET ST., E.C.4. - - - - PHONE: CENTRAL 2833.
207, EDGWARE RD., W.2. - - - - PHONE: AMBASSADOR 4033.

EDGWARE ROAD IS OPEN UNTIL 6 P.M. ON SATURDAYS.

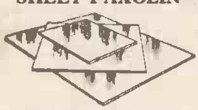
TERMS OF BUSINESS. CASH WITH ORDER OR C.O.D. OVER £1.

ELPREQ SPECIALS

ELECTROLYTICS

	s.	d.
2 mfd. 450 v.	1	4
4 mfd. 450 v.	1	6
8 mfd. 150 v.	1	3
8 mfd. 350 v.	1	6
8 mfd. 450 v.	1	11
8 mfd. 500 v.	2	6
16 mfd. 350 v.	1	11
16 mfd. 450 v.	2	8
16 mfd. 500 v.	3	6
32 mfd. 350 v.	2	8
32 mfd. 450 v.	3	6
10 mfd. 25 v.		10
25 mfd. 25 v.	1	0
50 mfd. 12 v.		10
8 mfd. × 8 mfd. at 450 v.	3	4
8 mfd. × 16 mfd. at 350 v.	2	6
8 mfd. × 16 mfd. at 450 v.	3	6
16 mfd. × 16 mfd. at 350 v.	3	0
16 mfd. × 16 mfd. at 450 v.	3	9
16 mfd. × 8 mfd. × 24 mfd. at 450 v.	4	2
25 mfd. × 25 mfd. at 200 v.	3	11
16 mfd. × 8 mfd. at 350 v.	2	6
16 mfd. × 8 mfd. at 500 v.	4	6
250 mfd. at 12 v.	2	3
16 mfd. × 32 mfd. at 350 v.	3	4
12 mfd. at 50 v.	1	3

SHEET PAXOLIN



Invaluable for when you are experimenting. Size 6in. × 6in., 1/-, Size 12in. × 8in., 2/-, Size 12in. × 12in. 3/6, size 24in. × 12in. 6/-. Average thickness 1/16in.

B.A. SOCKET SPANNERS

Covering sizes 0-6 B.A. and with double ended wrench as illustrated. A really good set which will help you with those nuts in awkward corners, price 5/6 complete.

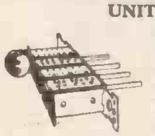
POLISHED B.A. SPANNERS

Covering sizes 1 to 6 B.A., these are so made to have a straight and a right angle end for each B.A. size. 6/- set.

QUADRANT-TYPE SCRIBERS

For marking out chassis these are the ideal tool, normal price 7/6, our price while they last, 3/9.

PUSH-BUTTON SWITCH UNIT



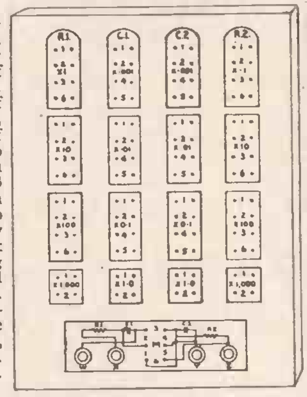
For three waveband and mains on/off complete with knobs. 1/6.

EGG INSULATORS

For all sorts of aerials including T.V. 1¾ long × 1 × 1. 4d. each. 3/6 doz.

EQUIP YOUR LABORATORY

You many times have felt the need of a device which would enable you to put resistance or capacity or a combination of these two quickly into a circuit. We have a small quantity of resistance capacity boxes which, by the simple manipulation of plugs, will enable you to do this. With these boxes you can put in 1 ohm, 2 ohms, 3 ohms, 4 ohms, and so on, in steps of 1 ohm, right up to 6,000 ohms. In a similar way capacity can be put into circuit by small amounts, thus making it simple for you to find optimum working conditions. These boxes made for Government Laboratories are available while they last at 19/6 each, plus 1/6 post and packing. Don't delay—order by return.



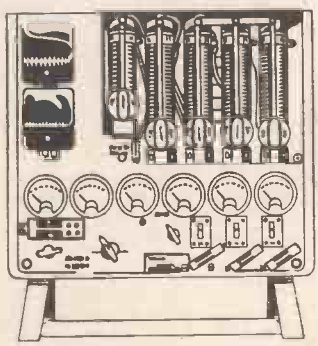
POWER PACK TYPE 392

This is an extremely useful unit which works off A.C. without modification giving an output of 700 v. D.C. adequately smoothed. Here is a list of the components contained in the power unit: Mains Transformer for 200-250 v. 50 cycle, with secondaries of 700-0-700 v. at 70 mA., 4 v. at 2.5 amps., 12.5 v. at 1 amp. (Note these are Admiralty ratings, the transformers will stand at least twice these figures). Also two rectifier valves type CV54, 10-watt resistors, three 4 mfd. 100 v. condensers, L.F. choke, 10 henry 100 mA., 2 slydlok fuses. The power pack is unused and is contained in a louvred case size 12in. × 5½in. × 8½in. Price 67/6.

"SNIPERSCOPE"

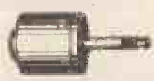
Famous wartime "cats eye" used in conjunction with a lens system and h.t. for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. It follows that as light from an ordinary lamp is rich in infra-red these cells will work: burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments price 9/6 each, or six for 52/6. Data will be supplied with cells if requested.

CHARGING SWITCHBOARD



This contains five high-wattage slider type variable resistors, four flush meters reading up to 15 amps each, and one reading up to 40 amps. In addition there is a voltmeter with a selector switch to permit voltage checking of all circuits, two cut-outs, switches, fuses and terminals. The whole being mounted on a panel and enclosed in a metal case with doors and feet. A source of D.C. fed in will be split up to permit battery charging at varying currents. If used with a generator the field of same and hence its voltage output can be controlled by the first slider. Excellent break-down value, as any one of the sliders would cost much more than we ask for the whole unit. Price 57/6, carriage 12/6.

TELEPHONE JACK PLUGS



As illustrated 7d. each, sockets to suit, 10d. each.

METAL RECTIFIERS

Selenium 250 v. 100 ma., 4/3.

5-WAY PORCELAIN CONNECTOR BLOCKS

Hundreds of useful applications, 1/3.

METAL TRIPOD

Tremendously strong, but not at all heavy. 3ft. high and with brass male and female thread top. Black japanned pressed steel, unused, but may need repainting. 3/6 each, plus 2/6 post and packing.

P.M. SPEAKERS

All speakers are by very famous makers such as Rola, Celestion, Goodmans, etc.

Size	With Trans. s.	d.	Less Trans. s.	d.
2½in.	—		10	6
3½in.	—		10	0
5in.	12	3	10	6
6½in.	12	6	10	6
8in.	13	6	11	6
10in.	18	6	16	6
12in.	—		39	6

I.F. TRANSFORMERS

465 kc/s, iron dust cored very high "Q" fitted in standard size can, 6/9 per pair, 465 kc/s iron dust cored very high "Q" fitted in midget size can, 12/6 per pair. 465 kc/s air cored, medium size can, 6/9 per pair.

L.F. CHOKES

Heavy duty types suitable for power packs and mains smoothing. These are mostly Government Surplus.

	s.	d.
200 mA. 10 henry	10	0
200 mA. 3 henry	5	0
Midget-type inductance unknown	3	6
120 mA. 9 henry	6	6
80 mA. 10 henry	4	6
80 mA. 5 henry	4	0
40 mA. 5 henry	3	6

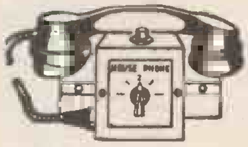
OUTPUT TRANSFORMERS

Midget pentode matching to 3-5 ohms	3	6
Standard pentode matching to 3-5 ohms	3	9
Medium pentode matching to 3-5 ohms	3	3
Standard size multi-ratio	4	6

VOLUME CONTROLS

All have full-length spindle and are complete with fixing nuts. We stock full range of values between 2,000 ohms and 2 megohms, prices are less switch, 2/6 each; single-pole switch 3/9 each.

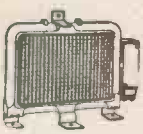
HOUSE TELEPHONES



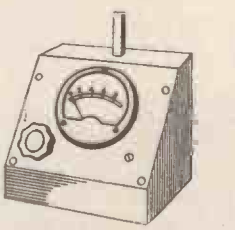
Desk or Wall Mounting

Suitable for intercommunication between offices, workshops, stores, garages, big houses, kitchens, etc. Each station consists of normal size Bakelite handsets and desk or wall mounting cabinet with built-in selector switch, buzzer and push. All stations can communicate with one another independently. Each installation is absolutely complete and internally wired. 3-station installation complete with 50 yards 5-core cable £6/10/-. 4-station installation, complete with 50 yards 6-core cable, £8/10/-. 2-station installation, complete with 25 yards 4-core cable, £3/17/6.

ELECTRIC HEATERS



Heavy cast framework totally encloses the elements, so these are 100% safe even in confined spaces, just right for your radio den, garage, office, shop, etc. 750 watt (heavy) model, 23/6, plus 5/6 carriage. Other models available are: 750 watt, 500 watt 250 watt, all these are 23/6 each, plus 5/6 each carriage. The 250 watt model used as a foot-warmer keeps legs and body warm for less than a farthing per hour.



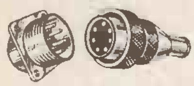
SHORT TURNS COIL TESTER

You know that it is almost an impossibility to test for shorted turns in I.F. Transformers, Coils, L.T. Transformers, etc., with an ordinary ohmmeter. Our mains-operated shorted turns coil tester will reveal these faults in a second. An essential instrument in all coil-winding shops as it will test for continuity at the same speed. £6/10/-.

LIQUIDATOR'S STOCK

Polished walnut radio cabinet size 20 × 12 × 7½in. complete with L., M. and S. dial, size 7 × 6⅞in. and backplate with magic eye cutout, also with drilled chassis and hardboard back. You will find it quite a simple matter to complete this into a very handsome receiver of the £15 class. Limited quantity, price 32/6, plus 2/6 carriage for the 5 items.

PLUG AND SOCKET



This brass cased plug and socket is extremely robust and ideal for P.A. or outside work. Ideal also for taking power to units as it insulates the ends of the wires. Contacts are quite suitable for carrying up to 10 amps. so this can be used for lighting or power. Price 2/6 per pair.

TWO SUPER SPEAKERS

The first is a beautifully made 10in P.M. speaker, a real precision product made by a very famous speaker firm. It is undoubtedly a 10in. which reproduces with all the quality of a 12in. It has three special features (1) a solid diecast frame (2) a special speech coil suspension which gives wider frequency response (3) dustproof cone assembly. Speech coil is normal 2/3 ohms. Price is 16/6 plus 2/6 post and insurance. The second is the 8in. P.M. speaker made by the same firm whose name incidentally we are not allowed to mention but you will recognise it immediately. This again has normal 2/3 ohms coil. Price is 11/6 plus 1/9 post and insurance.

BREAK-DOWN UNIT

At present day prices the spares in this unit would cost at least £5. Here is a list of the main contents:

3 two-metre coils;
3 tuning condensers, split-stator type;
4 two-watt carbon resistors, useful values;
1 tapped 20 watt resistor, vitreous covered;
6 paper condensers, .05 mf. 1,000 v. working.
3 paper condensers, .1 mf. 1,000 v. working;
2 H.F. chokes;
4 paper condensers, .1 mf. 450 v. working;
2 paper condensers, .15 mf.;
5 bakelite moulded mica condensers .001;
1 paper condenser, .01 mf. 3,000 v. working;
24 rubber grommets, assorted sizes;
6 resistors 1 watt, all useful values;
6 resistors ½ watt, all useful values;
40 resistors ¼ watt, all useful values;
40 silver mica condensers assorted values, including: 10, 15, 20, 40, 50, 100, 150, 300, and 500 pf. types;
4 English octal valve holders;
2 English 5-pin valve holders;
1 E.F.50 type valve holder;
3 diode valve holders;
1 louvred casing, size 12 × 7 × 4in.;
1 heavy metal chassis size 12 × 7 × 2in.;
8 condenser clips, assorted sizes.

Also an assortment of nuts, bolts P.K., self-threading screws, tag boards, chassis mounting tag connectors, screened grid caps, plain grid caps, levers, rollers, connecting rods, output sockets, etc., etc. ALL THIS COLLECTION OF PARTS FOR 6/6 only, plus 1/9 postage and packing.

THIS MONTH'S SNIP

TIMED SWITCH MECHANISM. This comprises a beautifully made 8 day jewelled miniature clock or watch movement, which operates two 2 amp contact switches. These switches also are quite suitable for mains use. There are two calibrated dials, one contact adjusts in ¼ hour intervals up to 6 hours, the other one in one hour intervals up to 36 hours. The whole is really precision made to stringent M.O.S. specification. The size of the complete switch mechanism is 3in. long and 2¼in. across. Or if you wish the miniature clock movement can be removed completely and this then measures only 1⅛in. × 5in. The price of the complete timed switch is 27/6. These are brand new still in the manufacturers original sealed boxes.

MAINS TRANSFORMERS

Ordinary—E.H.T.—Special.

All transformers are suitable for 200-250 v. 50 cycle mains, are fitted with primary screens, fully impregnated and complete with all necessary clamps, etc.

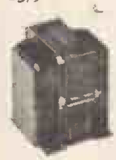
300-0-300 at 80 mA. 6.3 v. at 4 amps. 5 v. at 3 amps. Half shrouded drop through, 14/6.

260-0-260 at 60 mA. 6.3 v. at 3 amps. 5v. at 2 amps. Half shrouded drop through. Price 13/9.

350-0-350 at 80 mA., 4 v. at 6 amps. 4 v. at 3 amps., drop through or upright mounting, a useful replacement type for old-type receivers, 16/6.

350-0-350 at 100 mA., 6.3 v. at 5 amps., 5 v. at 2 amps. Fully shrouded upright mounting, 19/6.

260-0-260 at 60 mA. 4 v. at 4 amps. 4 v. at 3 amps. Half shrouded drop through. Price 13/9.



235-0-235 at 60mA. 6.3 v. at 3 amps., 5 v. at 2 amps. Fully shrouded upright mounting, 15/-. Primary has an additional tap for 110 v.

Filament Transformer, 6.3 v. 1½-2 amps., upright, 6/-.

350-0-350 at 160 mA., 5 v. at 3 amps., 6.3 v. at 6 amps., 6.3 v. at 3 amps. Fully shrouded upright mounting, 36/-.

250-0-250 at 100 mA., 5 v. at 3 amps., 6.3 v. at 6 amps., 27/6.

2,500 v. at 5 mA., 4 v. at 1.5 amps., 202 v. at 2 amps., 25/-.

4 KV. at 5 mA., 2 v. at 2 amps., potted with insulators, 67/6.

Special combined transformer designed to be suitable for Televisor or oscilloscope using a 6in. tube VCR97, etc. 400-0-400 at 150 mA., 2.5 KV. at 5 mA., 6.3 v. at 6 amps., 6.3 v. at 6 amps., 4 v. at 1 amp., 4 v. at 2 amps., 5 v. at 3 amps., 70/-.

SPECIAL

MAINS/AUTO TRANSFORMER

6.3 v. at 2 amps., 60 v. at 200 mA., tapped 200/220, 230/250. 7/6

Orders under £2 add 1/6, under £1 add 1/-. Postable items can be sent C.O.D., additional charge approx. 1/-. Good stock o all items at time of going to press. List 6d.

Telephone: Ruislip 5780

ELECTRONIC PRECISION EQUIPMENT (2) ELECTRON HOUSE, Windmill Hill, RUISLIP MANOR, MIDDX.

GARLAND BROS

AMPLIFIER ACIII : as supplied to Universities, Institutes, Colleges, Factories, and a host of other satisfied users. Specification : 7 valves, including rectifier (6SH7, 6J5, 6J5, 6J5, 2 x 6V6, 5Z4). 10 watts push-pull output to 3 or 15 ohm speaker. High- and low-gain inputs. Separate bass and treble controls. High-quality components, including Varley Mains Transformer and Varley DP47 Hi-fi Output Transformer. Negative feedback. Overall dimensions : 12in. x 6½in. x 7½in. Supply available for tuner unit, etc. Complete kit, including punched chassis, all valves and components, with circuits and instructions, including circuit of suitable tuner unit, £8/10/-. Amplifier, wired and tested, £10/10/-.

"VIEWMASTER" TELEVISION : The ideal televisor for the home constructor. Instructions, including instruction booklet, circuits, photographs and point-to-point wiring diagrams, for London or Midland transmissions (state which), 5/-. Component kits as follows : WB chassis, speaker, transformer, etc., £6/5/-. T.C.C. Condensers, London, £6/15/- ; Midlands, £7. Westinghouse Rectifiers, £3/2/6. Morganite Resistors, London, £1/6/9 ; Midlands, £1/6/-. Morganite Type Q Variable Resistors, 4/6 each. Plessey Transformer, Focus Ring, etc., £5/12/6. Colvern W/W Pots, 19/3. Bulgin Switches, etc., 12/6. Belling-Lee Mains Panel, etc., 7/6. Wearite Coils and Choke, London, £1/2/- ; Midlands, £1/10/-. Individual components included in above kits can be supplied separately if desired.

"Viewmaster" Pre-Amplifier : Wiring diagram, 1/-. Complete kit, 23/6.

"ELECTRONIC" TELEVISION : London handbook, 2/6. Wiring diagram, 2/6. Midlands handbook and wiring diagram, 4/6. Chassis, with valveholders, coilformers, etc., mounted : Vision, 22/6. Sound, 18/9. T/Base, 17/6. P/Unit, 25/-. Gantries, etc., 9/-. Designer-approved components : Coils and Chokes, London, 15/- ; Midlands, 17/6. Focus Coil, 30/-, Scanning Coils, 25/6. Line Transformer, 25/6. Mains Transformer, 90/-. 4 kv. Transformer, 67/6 ; 5 kv. Transformer, 72/6.

"OSMOR" GLASS DIAL ASSEMBLY : 3-colour, 3-wave, 7in. x 7in., with drive mechanism, 25/-.

"OSMOR" "Q" COILPACKS : A selective high-Q coilpack of miniature size (1¾in. x 3¼in. x 2½in.), with easy one-hole fixing. Type HO, Long, Medium and Short, 33/- plus 7/4 P.T. Type LM, Long, Medium and Gram, 28/-, plus 6/4 P.T. Type TB, Medium, Long and Shipping, 35/-, plus 7/10 P.T. Type EX, Medium, Short and Short, 35/-, plus 7/10 P.T. Type B, Long, Medium and Short Battery with frame aerial, 37/6 plus 8/4 P.T., Type T.R.F., Long, Medium for T.R.F. Receivers, 30/-, plus 6/8 P.T.

"OSMOR" H.F. STAGES : Designed for use with above coilpacks, For HO, TB and EX Coilpacks, 15/-, plus 3/4 P.T. For LM Coilpack, 13/-, plus 2/10 P.T.

I.F. TRANSFORMERS : 465 k/c., standard size, capacity-tuned. Made for us by a leading manufacturer. Per pair, 12/6.

T.R.F. COILS : M. and L. wave with reaction winding. Per pair, 6/6.

SUPERHET COILS : Long, Medium and Short Wave, Aerial and Oscillator Coils. Per pair, 9/6.

ELECTROLYTICS : By leading makers. All new and guaranteed, 1/350, 2/6 ; 2/200, 1/- ; 2/350, 1/6 ; 4/200, 1/3 ; 4/450, 2/6 ; 8/350, 2/6 ; 8/450, 3/- ; 8/500, 3/3 ; 16/350, 2/6 ; 16/450 3/6 ; 16/500, 4/- ; 4/9 ; 5/- ; 32/350, 3/- ; 32/450 (T/V), 6/- ; 8-8/450, 3/6 ; 8-8/500, 4/8 ; 8-16/450, 4/6 and 5/- ; 8-16/500, 6/- ; 16-16/350, 4/- ; 16-16/450, 6/- ; 16-32/350, 5/- ; 32-32/450, 6/6 ; 60-100/350, 6/- ; 12/50, 1/9 ; 20/12, 2/6 ; 25/25, 1/9 ; 50/12 1/9 ; 50/25, 2/- ; 50/50, 2/3.

OIL TEMPERATURE INDICATORS : A sensitive moving-coil movement, F.S.D. of which is approx. 120 μA. Centre-tapped moving coil. Calibrated 0-120. Ideal as indicator in bridges, signal strength meter, valve-voltmeter movement, or can be modified as sensitive relay. 3/- each, 30/- per doz.

HIGH-CAPACITY PRECISION MICA CONDENSERS : Brand-new and unused. Made by leading manufacturers for multi-channel filters. Accuracy plus or minus point five (0.5) per cent. Available in following values : 0.205276 mfd., 2/- each ; 0.123750 mfd., 1/9 ; 0.108435 mfd., 1/9 ; 0.087460 mfd., 1/6 ; 0.065350 mfd., 1/6 ; 0.055820 mfd., 1/6 ; 0.048010 mfd., 1/6 ; 0.040710 mfd., 1/6 ; 0.017970 mfd., 1/3. Manufacturers' enquiries invited.

OILFILLED CONDENSERS : 0.05 mfd., 16 kv. wkg., 6½in. x 1¾in. x 3½in., 4/6 each ; 0.15 mfd. + 0.15 mfd., 8 kv. wkg., 6½in. x 1¾in. x 3½in., 7/6 each ; 1 mfd. 1500 v. wkg., 5in. x 1¾in. x 1in., 3/6 ; 1.5 mfd. 4 kv. wkg., 9½in. x 5in. x 1½in., 7/6.

PAPER CONDENSERS : 1 mfd. 400 v. wkg., 2½in. x 2½in. x ½in., 1/- each ; 4 mfd., 1 kv. wkg., 5½in. x 5in. x 1½in., 4/6 ; 8 mfd., 1 kv. wkg., 5½in. x 5in. x 2½in , 7/6.

TAYLOR 50-RANGE METER : Model 70A 1,000Ω per volt Robust moving-coil meter, fitted with 4in scale and knife-edge pointer. Self-contained voltage ranges up to 1,000 v. A.C. and D.C. Self-contained current ranges up to 5A A.C. and D.C. Self-contained resistanced measurements from 1Ω to 1mΩ. Overload protection on all ranges, Buzzer for continuity tests. Price £10/10/-. Particulars of H.P. terms on application.

RESISTORS : ¼ w., 3d. ; ½ w., 4d. ; 1 w., 6d. ; 2 w., 9d. ; Wide range of values in stock.

WIREWOUND RESISTORS : 6 watt, 2, 2.4, 4, 5, 14, 14, 31.5 ohm, 1/- each ; 12/15 watt, 100, 1 k., 7.5 k., 9 k., 11 k., 12.5 k., 30 k. ohm, 1/6 each ; 45 watt, 80 ohm, 18 k., 2/3 each ; 100 watt, 800Ω, 1 k., 10 k., 20 k., 3/- each ; 200 watt, 430 ohms, 4/- each.

HEADPHONES, TYPE DLRI : Low Resistance with headband, lead and plug. New and unused. Special offer at 3/9 per pair, or 42/- per dozen pairs.

HEATER TRANSFORMERS : Pri. 210/230 v. Sec. 6.3 v. 1.5 A., 6/6 each.

AMPLION TESTMETER : 10 Ranges A.C. and D.C. Up to 500 v. A.C. and D.C. Up to 500 mA. D.C. Resistance up to 200,000 ohms., 1,800 ohms. per volt A.C. and D.C. Price £3/17/6.

JUNEERO TOOL : Bends, shears, punches and threads. For all the little jobs that waste your time. As reviewed in this journal. Each 18/6. Xacto Slide Gauge and Protractor. For use with above Juneero Tool, 7/6.

EXTENSION SPEAKERS : Fitted 5in. Plessey P.M. Speaker in bakelite cabinet, with perforated back. Also ideal for intercom. Each 19/6.

AERIAL RODS : Heavily copper-plated steel, one foot long. Fit into one another to make any length aerial. Per doz., 2/-.

PLUGS AND SOCKETS : Pye angle, 1/- ; Pye straight, 1/3 ; B. & L. 5 pin, 1/6 ; B. & L. 7 pin, 1/9 ; B. & L. 10 pin 2/- ; Jones 6 way, 1/6 ; Jones 8 way, 1/9 ; Jones 10 way, 2/- ; Jones 12 way, 2/6 ; E.H.T. Single, 1/-. The above prices include plug and socket in all cases. Octal Plug and Socket (Valveholder), black bakelite, 1/9. Jack plug with Igranic socket, 2/6. Pye T-pieces, 6d. Pye connectors, 6d.

Now in stock : Pye Angle P. & S. to fit ¼in. cable, 1/3 complete.

MOTORISED SWITCH ASSEMBLY : Type 10FB/556. Containing 24 v. miniature motor, 2¾in. x 1½in. x 1¾in., gearing, switch contacts, etc. Ex-govt. Motor only tested. 10/- each.

CONDENSER OFFER : Metal-cased tubular .01 mfd. 1,000 v. D.C. wkg., 6/- per doz., £3 per gross.

AMERICAN RELAYS : 200 ohm. on two bobbins, 4-pole changeover with heavy contacts, 3/6 each.

H.F. CHOKES : 650μH, to pass 1 A., 1/3 each, 12/- per doz.

METERS : 2½in., 0-6 mA. D.C. 250 ohm. Calibrated 0-5,000 ohm., 0-60 mA., 0-1.5 v., 0-3.0 v. The addition of a few resistors and a dry cell makes this a versatile multi-range meter. Each 9/-.

"CLEAREX" TELEVISION LENSES : For 9in. tube, 50/-, with filter, 55/-. For 12in. Tube, 70/-, with filter, 75/-.

"POLASPEX" TELEVISION FILTERS : For viewing in daylight or artificial light without strain. Will fit your set without necessitating any alteration. For 9in. Tubes, 18/- each. For 12in. Tubes, 21/- each.

SOLON SOLDERING IRONS : Deservedly the most popular soldering iron made. Oval bit, 19/6. Pencil bit, 21/6.

VARIABLE RESISTORS : Approx. 50 ohm. at 1.5 A. With very fine screw adjustment. Ex unused equipment, 7/6 each.

TX AND S.P. VALVES : 803, 805, 10/- ; 8012, CV296, QVO4-7, VR136, 7/6 ; VU111, VU120A, CV66, 6/6 ; VU133, CV54, 5/- ; 7193, 3/6.

H/D OUTPUT TRANSFORMER : 45/1 ratio, 60 mA. With hum-bucking tap on primary to obviate necessity for L.F. Choke, 7/6 each.

BALANCED ARMATURE HEADPHONES : Type DLR2. With wide, comfortable double metal headband, lead and plug. The most sensitive low resistance phones made. Boxed. Per pair, 5/-.

TRIMMERS : Miniature ceramic air-spaced 3-30pF. 5d. each, 4/6 per doz. Phillps Concentric type ; 3-30 pF. 6d. each, 5/6 per doz., £3 per gross. Compression Ceramic type : 50pF. 6d. each, 100 + 100pF 9d. each, 250pF 1/- each, 500pF. 1/3 each, 1,000pF. 9d. each.

ALADDIN COIL-FORMERS : Type F804, with iron-dust cores, 5d. each, 4/6 per doz., 48/- per gross.

MAT RESISTORS : 100 ohm 250 watt, 1/6 ; 300 ohm 250 watt, 1/9

VIBRATORS : 6 volt non-synchronous (4 pin UX), 5/- ; 6 v. synchronous (6 pin UX), 7/6 ; 12 v non-synchronous (4 pin UX), 5/-.

NEONS : 85 v. striking, no resistor in cap. With holder, 2/- each, 21/- per doz.

CLIX 5A SINGLE PLUGS : Per doz., 2/6.

RUBY LAMPHOLDERS : To make M.E.S. bulb, 1/- each.

VALVES, B.V.A. AND TUNGSRAM : We can give a 48-hour service on all current production types, and many of the difficult obsolete types, at B.O.T. prices. In each case, order should state if plug-in replacement will suit.

HIGH-QUALITY SPEAKERS : Goodmans Axiom 150, £8/8/-. Goodmans Audiom 60, £6/15/-. Wharfedale Golden 10in., with cloth surround, £4/10/- ; with paper surround, £4.

AMPLIFIER ACII : For those who desire good quality reproduction at low cost. 4 valves, including rectifier. Output 5 watts. Volume, tone, and variable feedback controls. High-grade output transformer. Chassis completely isolated from mains. Complete kit, including punched chassis, all valves and components with circuits and instructions, £4/4/-. Amplifier wired and tested, £5/5/-.

ALL GOODS NEW AND UNUSED UNLESS OTHERWISE STATED. GOODS SHOWN AS EX-EQUIPMENT HAVE BEEN FULLY TESTED AND ARE IN GOOD WORKING ORDER. PLEASE ADD POST OR CARRIAGE ON ALL ITEMS.

We maintain a very complete and comprehensive stock of valves, cathode tubes and components for radio, television and electronics. Our shop hours are 9 a.m. to 6 p.m. on Monday, Tuesday, Wednesday, Friday and Saturday, and 9 a.m. to 1 p.m. on Thursday, during which times we are always pleased to welcome callers. Post orders to Garland Bros., Chesham House; Deptford Broadway, S.E.8.

GARLAND BROS

GARLAND RADIO	ALLEN & GOULD
CHESHAM HOUSE, DEPTFORD BROADWAY, S.E.8	5, OBELISK PARADE, LEWISHAM, S.E.13
TELEPHONE : TIDEWAY 4412/3	*TELEPHONE : LEE GREEN 4038*

CLYDESDALE

Bargains in Ex-Service Radio and Electronic Equipment

THE COMMUNICATIONS CORNER

13 VALVE DOUBLER SUPER

DST100, 13 valve Double Superhet for operation from 1,600 to 10 metres covered in 7 wavebands. This receiver is a double conversion job with communications features : 2 speed slow motion drive 13 : 1 and 156 : 1, R.F., I.F. and A.F. gain controls, with a Regeneration control to increase sensitivity. Variable selectivity switch, B.F.O. and phaser, A.V.C. Noise Limiter, Aerial and Oscillator trimming control. "S" meter and current consumption meter, etc! Valves include 3/6J5, 2/ECH35, 2/EF39, CV31, 6B8, 6H6, 6R7, 6Q7 and 6V6. This receiver requires only 240 v. H.T. and 100 M/a D.C. and 6.3 v. L.T. Contained in an enclosed metal frame 24in. x 15½in. x 13½in.

CLYDESDALE'S PRICE ONLY £7/15/0 CARRIAGE PAID

RECEIVER TYPE 6A

THIS IS A CHANNEL CHECKING receiver working on 49/100 metres which includes 5/VR91 (EF50), 1/6K8, 1/VR55 (EBC33) and 1/VR53 (EF9) valves. Included in the circuit is a terminal switch breaking at 86 Degrees F. Enclosed in a metal case.

CLYDESDALE'S PRICE ONLY 45/- POST PAID

TRAWLER BAND

R1155N is the 1155 model that all operators would like. This superhet communications receiver is complete with valves : 3/VR99 (X66-X65), 3/VR100 (KTW62-KTW61), 2/VR101 (MHLD6-DH63), VR102 (BL63), VR103 (Y63), and fitted with the type "F" geared reduction drive. The frequency ranges are in 5 wavebands 18-7.5 Mc/s (17-40 M.), 7.5-3.0 Mc/s. (40-100 M.), 3-1.5 Mc/s. (100-200 M.), 1500-600 Kc/s (200-500 M.), 500-200 Kc/s. (600-1500 M.). AVC/Controlled R.F. switch, B.F.O., Filter and combined RF/AF gain control. Power requirements : 200 v. H.T./60 m/a and 6.3 v. L.T. Totally enclosed in a metal cabinet in black, 16½ x 9 x 9in.

CLYDESDALE'S PRICE ONLY £14/14/0 CARRIAGE PAID

We supply this receiver modified for L.S. use and complete with A.C. Mains power supply, 8in. speaker.

CLYDESDALE'S PRICE ONLY £21/0/0 CARRIAGE PAID

V.H.F. RECEIVER

THE STRATTON P40 for 2 metres conversion. Crystal controlled 85/95 Mc/s. and includes 1/EF54 (RF), 1/EF54 (MIX), 1/EC52-2/EF54 (Osc. and Mult.), 2/EF39 (IF) 1/EB34 (DET/AVC), 1/6J5 (1st Aud.). 6V6 output. The receiver is enclosed in a die-cast frame with louvred cover 11½ x 5¾ x 4¾in.

CLYDESDALE'S PRICE ONLY £3/19/6 POST PAID

TELEVISION ENTHUSIASTS

VIEWING UNITS

INDICATOR TYPE 6, SERIES H. These units are brand new, in excellent condition, and are all fitted with a VCR97 CRT, the tube which many constructors have put to T.V. use. Valves include 4/VR9 (EF50), 3/VR54 (EB34), plus a host of potentiometers and H.V. condensers, etc. The complete unit is enclosed in a metal box 18 x 8½ x 7½in.

CLYDESDALE'S PRICE ONLY £3/19/6 POST PAID

Please include 10/- for transit case to ensure safe transit of unit. Refunded on return of case.

12.25 Mc/s. I.F. STRIP

H.38 I.F. STRIP by Pye provides a very compact I.F. sub-chassis for use of SP61 valves (not included)—the chassis is wired for I.F. operation and Input leads are tag terminated at rear end of unit. Coax input and output sockets are mounted on the front panel. Dim. 18in. x 5½in. x 4¾in.

CLYDESDALE'S PRICE ONLY 17/6 each POST PAID

VIEWING TUBES

3in. ELECTROSTATIC 3PB1 (E779). This Tube is a compact unit extremely suitable for test work or for small portable equipment where only a 1,000 to 2,000 volt is available. Filament supply required 6 v. The base is diphetal. Brand new in maker's cartons and carefully packed before shipment.

CLYDESDALE'S PRICE ONLY 22/6 each POST PAID

6in. ELECTROSTATIC VCR97 (E351). This tube is very popular with Television constructors and has been universally used. The VCR97 is a short persistence tube employing a 2,000 v. anode and a 4 v. filament. The base is side contact. All VCR97s are tested and carefully re-packed before dispatch.

CLYDESDALE'S PRICE ONLY 35/- each POST PAID

VIEWING UNITS

INDICATOR UNIT, TYPE 62 contains a wealth of T.V. components of interest to any constructor plus a VCR97, 16/SP61s, 2/EB34s, and 2/EA50s, the valves are excellent T.V. tubes for various uses. The complete unit is enclosed in a metal case 18 x 8½ x 11½in.

CLYDESDALE'S PRICE ONLY 67/6 each POST PAID

Circuits are available. Price 1/3 each.

100% COMPONENT VALUE

R.3515 I.F./A.F. AMPLIFIER UNIT comprises numerous components which will be suitable for the TV constructor—plus a 6 stage 12.25 Mc/s IF strip mounted on a detachable sub-chassis. The R.3515 provides relays, condensers, potentiometers and resistors, 10/SP61, 5/EF36, 3/EBC33, 1/EB34, 1/EF39 and 1/EA50 valves. It's too good to miss. Totally enclosed in a metal retainer 18in. x 11½in. x 7½in.

CLYDESDALE'S PRICE ONLY 67/6 each POST PAID

THE I.F./VIDEO AMPLIFIER

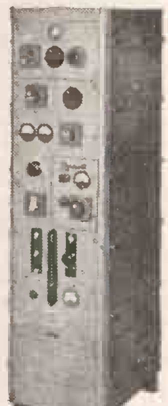
THE R.1355 provides an excellent basis for the vision receiver for your TV and provides 5 stages of I.F. (SP61) plus a detector (EA50) Video amplifier and cathode follower (SP61). The I.F. is 7.5 Mc/s. This unit is designed for use with the RF Units 24, 25, 26 and 27. The R355 can also be used for T.V. sound reception and the installation of integral A.C. Mains power packs is quite easily accomplished. Enclosed in a metal retainer. 18in. x 8½in. x 7½in.

CLYDESDALE'S PRICE ONLY 67/6 each POST PAID

Circuits available at 1/3 each.

RCA TELEPHONY AND TELEGRAPHY TRANSMITTER ET-4336

THE ET-4336 TRANSMITTER operates with a maximum input of approx. 1 KW on Phone (RT) or CW (Telegraphy) with an aerial output of 350/450 watts with respect to the frequency and antenna system used. The frequency range covers 2-20 Mc/s. with either a plug in crystal controlled oscillator unit or an ECO (VFO) unit, these are interchangeable. Features of the ET-4336 are : Built in power supplies for 110/250 v. A.C. mains. 2/813 valves for PA 2/805 valves for class B modulation.



2/813 PA
2/805 MOD
1/807 OSC
1/807 BUFF
4/866 MV
Rectifiers

110/250v A.C.
Mains Power
Supply

1/807 buffer stage 1/807 in each of the Interchangeable osc. units. Separate speech amplifier with self contained 110/250 v. A.C. mains power supply. Valves include 4/6J7 and 2/6L6s—500 ohm match to the TX. All tuned circuits are metered. Safety switches on removable side and rear panels to obviate shock hazards during inspection. The transmitter is supplied complete with both type of oscillator units, valves, speech amplifier, microphone and morse key. Ready for immediate use on RT or CW. Rigidly crated for shipment. Dimensions : TX. 58 x 17 x 24in. Amplifier, 19 x 12 x 8in.

CLYDESDALE'S PRICE ONLY £120 (Carriage Paid) Gt. Britain.

CONSTRUCTING A SET ?

Walnut Wooden Cabinet. H394 ...	£1	5	0
3 W/Band Dial Glasses. H410.........		1	3
Ivory Control Knobs. H403			9
Brown Control Knobs. H404			8
W/Change Switch 3P.4W.2B. H393		4	6
.00035 Mfd. 2 Gang Cond. H399 ...		7	6
16/24 Mfd. 450 v. Wkg. Cond. H401		4	6
8 Mfd. 450 v. Wkg. Cond. H400 ...		2	9
Mounting Clips for H401			3
Mounting Clips for H400			4

Order direct from :—

CLYDESDALE SUPPLY CO. LTD. 2 BRIDGE STREET GLASGOW - C.5

Phone : South 2706/9. Branches in Scotland, England and Northern Ireland.

NEW YEAR OPPORTUNITIES

Every radio and television constructor should take the opportunity of buying goods in 1951 at 1950 prices. When our present stocks are sold, rising costs will mean an increase in selling price, so BUY NOW.

RECEIVER R. 1355 as specified for "Inexpensive Television." Complete with 8 valves VR65 and 1 each 5U4G, VU120, VR92, also a copy of "Inexpensive TV." ONLY 55/- (Carriage, etc., 7/6).

I.F. STRIP 194. Another of the units specified as an alternative for the "Inexpensive TV." A first-class strip giving tremendous amplification, and well recommended for constructors who have built televisors but have come "unstuck" in the vision or sound receiver. Complete with 6 valves VR65, and 1 each VR53 and VR92, and a copy of the book, which gives full details of conversion to both stations. Size 18in. × 5in. × 5in. ONLY 45/- (Postage, etc., 2/6).

"PYE" 45 Mc/s I.F. Strip. Ready made for London Vision channel. Complete with 6 valves EF50 and 1 EA50. ONLY 60/- (Postage, etc., 2/6).

RECEIVER R.3547. This contains the "PYE" Strip, which can be easily removed if desired, and also 15 valves EF50, 3 of EB34, 2 of SP61, and 1 each EA50, EBC33, EF36, also hundreds of resistors, condensers, etc. BRAND NEW IN MAKER'S CASES. ONLY 120/- (Carriage 7/6).

RECEIVER R.3084. A very sensitive unit containing 7 valves EF50, 2 of EF54, and 1 each VU39A, HVR2, EA50, and also a 30 Mc/s I.F. Strip with 4 Mc/s bandwidth. BRAND NEW IN MAKER'S CASES. ONLY 75/- (Carriage 7/6).

10 VALVE 1½ METRE RECEIVER ZC8931. Another very popular superhet for long distance TV reception. Contains 6 IFTs of 12 Mc/s with 4 M/cs bandwidth, and 6 valves VR 65, 2 of VR 92, and 1 each VR 136 and VR 137. Complete with modification data for both stations. BRAND NEW IN MAKER'S CARTONS. ONLY 59/6 (Carriage 5/-).

RECEIVER R.3170. Contains 7 valves EF50, 2 RL37, 1 EC52, 1 HVR2 and 1 EA50, and 30 Mc/s. I.F. Strip. Used but good condition. ONLY 59/6 (Carriage etc., 5/-).

RF UNIT TYPE 25 for use with R.1355 for London reception. ONLY 17/6 (Postage 1/6).

RF UNIT TYPE 26 for use on Sutton Coldfield channels are now all sold, but we can supply one of the other RF Units with full details of easy modification for the TV. **BRAND NEW IN CARTONS.** ONLY 25/- (Postage 1/6).

INDICATOR UNIT TYPE 6 as specified for "Inexpensive TV." Complete with VCR97 CR Tube, 4 valves EF50 and 3 of EB34. BRAND NEW IN MAKER'S CASES. ONLY 90/- (Carriage 7/6). This unit is also specified for the "WIRELESS WORLD," "General Purpose Oscilloscope," full details available price 9d.

INDICATOR UNIT TYPE 62. Another handy unit containing the VCR97 Tube, 16 valves Type VR65, 2 of EB34, 2 of EA50, and shoals of condensers, resistors, etc. ONLY 75/- (Carriage, etc., 12/6).

MAGNIFYING LENS FOR 6IN. TUBE. First-grade oil filled. ONLY 25/- (Postage 1/6). For 9in. Tube, 65/- (Postage 1/6).

TV PRE-AMPLIFIER for weak areas can be easily made from the ex-R.A.F. Amplifier 6046/6050. Contains 2 valves EF50 and gives very high signal to noise ratio. Full details of conversion for both stations supplied. ONLY 22/6 (Post 1/-).

Other items of general interest available this month are :

RECEIVER R.1155. A "must have" for the enthusiast who wants a Communications Receiver of the £100 class. We have a few only of these superb 10-valve sets which cover 7.5 Mc/s to 75 kc/s in 5 wavebands, which are spotless and BRAND NEW IN MAKER'S TRANSIT CASES. Every set supplied with full details of easy modifications for normal mains use. ONLY £12/10/- (Carriage 12/6). For those who would like a ready-made Power Pack with Output Stage, ready to plug on and operate the receiver without any modification, they are available at ONLY £5/5/-.

RECEIVER A.E.W.I. A 5-valve superhet covering 550-1600 kc/s and 6-12 Mc/s in 4 switched wavebands. Operates from 6v. D.C. source through built-in vibrator pack, and has large separate speaker in metal cabinet with 50ft. extension lead. Made for New Zealand Forces Welfare Dept., these sets have 2.5 watts output and are NEW AND UNUSED. Valve line up : 6U7 RF Amp., 6K8 Mixer, 6U7 IF Amp., 6Q7 2nd detector, 1st Audio, 6V6 Output. The set is fitted with a large open slow-motion tuning dial, size 7in. × 3in., and both set and speaker are finished in olive green crackle. An ideal receiver for caravans, coaches, country areas, etc. ONLY £9/19/6 (Carriage, etc., 10/6).

RECEIVER 25/73. Part of the TR1196. Covers 4.3-6.7 Mc/s, and makes an ideal basis for an all-wave superhet receiver. Complete with six valves : 2 each EF36, and EF39, and 1 each EK32 and EBC33, and also modification data. ONLY 22/6 (Postage, etc., 2/6).

OSMOR ALL WAVE COIL PACK recommended for this conversion, 40/4. **RECEIVER 18.** Part of the TR18. Covers 6-9 Mc/s, and only requires normal battery supply to operate. Complete with 4 valves : 3 of VP23 and 1 of HL23DD. ONLY 15/- (Postage, etc., 2/6).

BATTERY SUPERSEDER. A 2 v. vibrator power unit designed for the Canadian Forces, which requires very little modification for use with anything that needs HT Batteries. For the cost of charging a 2-volt accumulator you have a source of constant H.T. Will save the price in a few months. Full modification details supplied. ONLY 60/- (postage 1/6), or with Two 2 v. accumulators in metal case, ONLY 90/- (Carriage 5/-).

TELESCOPIC AERIALS extending from 15in. to 102in. Just pulls out of a metal tube which is fitted with dust cap for cleanliness. Very strong. ONLY 12/6 (postage 10d.). BRAND NEW.

HEADPHONES AND MICROPHONE SET. As used by Canadian Forces. A pair of first-class high resistance phones fitted with rubber noise excluders, and a high-grade carbon microphone. BRAND NEW. ONLY 12/6 (Postage 10d.).

AMERICAN COMMAND RECEIVERS BC.454. Contains 6 valves : 3 of 12SK7 and 1 each 12K8, 12A6, 12SR7. Easily adaptable for normal use. Specify type required, 33-50 metres 55/- post paid, or 100-200 metres 59/6 post paid.

AMERICAN LORAN RECEIVER APN 4. Contains 16 valves : 3 6B4, 2 2X2, 4 6SK7 and 1 each 5U4G, 6H6, VR 105, 6SU7, 6SL7, 6SN7. Covers approx. 550/650 metres in 4 switched bands. ONLY 69/6 (Carriage, etc., 5/-).

TRANSFORMERS. The following have been specially made for the "Inexpensive TV." Time Base and Vision Transformer 350-0-350 v. 160 mA, 5 v. 3 a., 6.3 v. 6 a., 6.3 v. 3 a. ONLY 36/-. Sound Receiver Transformer 250-0-250 v. 100 mA, 5 v. 3 a., 6.3 v. 6 a. ONLY 27/6. EHT Transformer for VCR97 Tube, 2-0-2 v. 1.1 a., 2-0-2 v. 2 a., 2,500 v. 5 mA. ONLY 30/-. Postage 1/6 per transformer please.

CONDENSERS. 0.1 mfd. 2,500 v. tubular, 2/6 ; 0.1 mfd. 3,000 v. block, 4/6 ; 8 mfd. 450 v. 2/- ; 8 × 8 mfd. 450 v. 2/9 ; or 6 for 15/- ; 8 × 16 mfd. 350v., 4/- ; or 6 for 22/6 ; 16 × 16 mfd. 450 v., 4/6 ; or 6 for 25/- ; 32 mfd. 350 v., 2/9 ; or 6 for 15/-. Postage please under 20/-.

CHOKES. 5 H. 200 mA, 6/- ; 10 H. 100 mA, 6/- ; 20 H. 80 mA, 6/6. (Postage 1/-).

SPEAKERS. ROLA 10in. PM less trans., 23/6; ROLA 6½in. PM less trans., 10/9: 6½in PM less trans., by famous maker, 9/6; TRUVOX 10in. PM less trans., 17/6 ; PLESSEY 6½in. lightweight PM with trans., 12/6 ; PLESSEY 8in. PM less trans., 13/9 ; 3in. PM less trans., 10/-. Postage per speaker, 1/6.

Cash with order please, and print name and address clearly

U.E.I. CORPORATION

Radio Corner, 138 Gray's Inn Road, London, W.C.1. *Phone* : TERMINUS 7937

(Open until 1 p.m. Saturdays. We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross)

For Quality Bargains Always–
Best Buy at BRITAIN'S

COMMUNICATIONS RECEIVER Type R1155. Now world renowned as one of the finest receivers obtainable. For those not familiar with the set we can supply an authoritative "Wireless World" circuit and descriptive leaflet at 9d., post free. All our receivers are air-tested before despatch and are supplied complete with 10 valves. Any receiver gladly demonstrated to callers. The price is **£9/10/-**, and for an additional 10/- the set is despatched in maker's transit case. IN BRAND NEW CONDITION.

A.C. MAINS POWER PACK/OUTPUT STAGE. Made for the R1155 and enables this receiver to be operated direct from A.C. mains. Just plug in! **£3/10/-**, carriage paid.

RECEIVER R28/ARC5. Frequency coverage 100-156 Mc/s. Valve line-up: 4 of 717A mushroom types, 3 of 12SH7 metal, 2 of 12SL7 GT and one 12A6 metal. Complete with tuning motor. Very useful for conversion to 2 metres. BRAND NEW and BOXED. Only **37/6**, carriage paid.

SHIPPING AND TOP BAND. Listeners to these bands will be pleased to hear that we can now offer a Command Set with a frequency coverage of 1.5–3 Mc/s. (100-200metres). These have exactly the same specification as the other types of Command Receivers advertised below, and are supplied complete with circuit diagram. The price is **59/6**, post paid. In brand new condition and contained in black crackle cases.

COMMAND RECEIVER TYPE BC454. A 6-valve superhet covering 3-6 Mc/s. Valve line-up: 3 of 12SK7, 1 of 12K8, 1 of 12SR7, 1 of 12A6—all metal valves. I.F. value 1415 Kc/s. IN BRAND NEW CONDITION. Circuit diagram supplied. Only **45/-**, carriage paid.

COMMAND RECEIVER TYPE BC455. Frequency range of this type is 6-9 Mc/s. and the specification is exactly the same as the BC454 above. The price complete with circuit is **55/-**. In brand new condition and contained in black crackle cases

RECEIVER TYPE 21. A battery operated superhet receiver covering 4.2-7.5 Mc/s and 19–31 Mc/s. Operates as a double superhet on the 10 metre band. Complete with nine 2 v. valves and circuit diagram. In new condition. **45/-**, carriage paid.

6V VIBRATOR PACK. Suitable for use with the above set. Output 150 v. at 40 mA fully smoothed and rectified. Circuit diagram supplied. Cheap at **17/6**, post free.

RECEIVER TYPE 18. A 4-valve battery superhet receiver. Uses standard iron cored 465 Kc/s. I.F. Transformers. Complete with all valves. Frequency range 6–9 Mc/s. Circuit diagram provided. BRAND NEW. A bargain at **17/6**.

OSMOR COIL PACK. Type "B" pack is most suited for use with the 18 set. Wavebands: 15–50: 190–560; 800–2,000 metres. Convert this set into a 3 waveband superhet! Price **£2/5/10**. This is the coil pack for the job.

OSMOR COIL PACK TYPE "Q." This is the pack for use in conjunction with our 25/73 (TR1196) Receiver. Covers the long, medium and short wavebands: 190–520 metres, 800–2,000 metres, 15–50 metres. Price **40/4**, post free.

RECEIVER 3547. Contains 15 of EF50, 1 of VR56 (EF36), 1 of VR55 (EBC33), 2 of VR116, 3 of VR54 (EB34), 1 of VR92 (EA50), AND A 45 Mc/s "Pye" STRIP; also included are 11 pot'meters, a motor with gear box, relays and numerous other small components all mounted on an extremely useful chassis. BRAND NEW IN TRANSIT BOXES. Only **£5/19/6**, carriage paid to your door.

RECEIVER TYPE 159. Valve line-up: 1 of CV66 (grounded grid triode), 1 of EEF50, 1 of VR65 (SP61), 1 of VR92 (EA50), small impulse motor, all in case size 8½ x 4 x 6½in. **12/6**, post paid.

RECEIVER R1355. As recommended by the authors of "Inexpensive Television." In new condition but slightly store soiled. Complete with valves. **49/6**, carriage paid.

RECEIVER UNIT 25/73 (TR1196). Valve line-up: 2 of EF36, 2 of EF39, 1 of EK32 and an EBC33. Easily and rapidly converted to a very fine superhet receiver (see "Radio Constructor" November 1950). Supplied complete with circuit and conversion data. Few only in perfect condition and offered at **25/-**, post paid.

OSCILLATOR TYPE 217. Contains 2 of EF50, 2 micropack condensers 25 mfd. 25 v., heavy duty resistors, 3 relays, 3 pot'meters, etc. A small unit with a large content at less than the price of the two EF50s. NEW AND BOXED. **14/6**, post paid.

45 Mc/s. "PYE" STRIP. A ready made vision receiver! (London frequency). Uses 6 of EF50 and an EA50. Complete circuit data provided. In brand new condition. Less valves, **39/6**, with all valves, **62/6**.

TV PRE-AMP. Small size and complete with 2 of EF50. Easily altered to tune to London or Birmingham frequencies. Only **14/6**, post paid.

AMPLIFIER TYPE 127. A small class "B" amplifier complete with Cossor 220B valve and transformer. With circuit. Only **8/6**, post paid.

AMPLIFIERS. Marconi type 6. Gives 15 watts output. Uses 2 of PX25 and an MHL4. For rack mounting. Completely enclosed in case size 17½ x 16½ x 10½in. Complete with heavy duty power pack for 200–250 volts 50 c/s A.C.-Mains. The anode current of the PX25 is monitored by means of built-in 2½in. panel mounting meter. New condition. Supplied less valves. Only 50/-, carriage paid. Don't miss this very special bargain offer.

INDICATOR UNIT 116H. Brand new and contained in manufacturers' original wooden crate. A more up-to-date version of the famous 6A. Contents include a VCR97 tube, 4 of EF50, 3 of EB34 and very many other useful components. Priced at only **79/6**, plus 7/6 carriage.

AMPLIFIER UNIT TYPE 18/165. A neat and compact equipment incorporating the following valves: 2 of EF36, 1 of EBC33, and 2 EL32. Included are microphone transformers, intervalve transformers, numerous condensers and resistances, etc. Are you looking for something to "break down"? Then here's your chance. An experimenter's gold mine for only **22/6**, post paid.

5CP1 C.R. TUBES. Limited number only Brand new and boxed. **25/-**, carriage paid.

PACKARD-BELL PRE-AMP. Brand new and complete with 2 valves. **12/6**, post paid.

ACCUMULATORS. Heavy duty 6 v. type. Size 12 x 9 x 7in. BRAND NEW. Capacity 85 ampere hours. In teak case. Exceptional value at **59/6**.

CRYSTAL MULTIPLIERS. By Wilcox Gray. Frequency range 2–20 Mc/s. Packed brand new in wooden boxes and complete with 2 type 807 valves, instruction books, spares, etc. **39/6**, plus 3/6 carriage.

HOOVER ROTARY TRANSFORMER TYPE 31. Input 12 v. output 250 v. 125 mA. Brand new condition. Ideal for the Command Receivers advertised by us on this page, car radios, etc. **14/6**, post paid.

MOTORS

ROTARY POWER UNIT 104. In metal case size 8½ x 4½ x 6½in. Input 12 v. D.C., output 250 v. 65 mA D.C. and 6.5 v. 2½ amps. D.C. In new condition. Only **7/6**, post paid.

BLOWER MOTORS. For operation from 12 or 24 v. A.C./D.C. but will run from mains when fitted with suitable dropper resistance. Has many uses—ventilation purposes, hair dryer, etc. AS NEW. Only **12/6**, post free. We also offer a smaller model for operation on 24 v. only—at **6/6**, post free.

SMALL 24 v. MOTOR. Complete with gear box. A.C./D.C. operation. Will also work on 12 v. About 140 to 1 double reduction drive giving very high torque at slow speeds. New condition. Only **12/6**, post paid.

TRANSFORMERS

HEAVY DUTY ADMIRALTY TYPE. 230 v. 50 cps. input. Output 500–0–500 v. at 340 mA. 4 v. 4 a. CT New and boxed. Only **22/6**, plus 3/6 carriage.

MAINS TRANSFORMERS. 350–0–350 v. 80 mA, 6.3 v. tapped 4 v. at 3 amps, 5 v. tapped 4 v. at 2 amps. Top chassis mounting. Fully guaranteed. **18/6**, plus 9d. postage. **250–0–250** v. 130 mA, 6.3 v. at 6 amps., 5 v. at 3 amps. Fully shrouded top chassis mounting. A quality job. Guaranteed. **27/6** each.

E.H.T. TRANSFORMER. For VCR97 or VCR517 tubes. 2,000 v., 4 v. for tube heater and 4 v. tapped at 2 v. for E.H.T. rectifier. Only **30/-**.

COMPONENT MART

LOUDSPEAKERS. Plessey 10in. P.M. type. ALNI magnet. Ideal for TV. Brand new and boxed. **17/6**, post paid.

CHOKES. 6 Henrys, 70 mA, 140 ohms, **3/6**. 20 Henrys. 80 mA, 350 ohms, **6/6**. 3 Henrys, 200 mA, **4/-**. 20 Henrys 250 mA, 150 ohms, **10/6**. Note: Add 9d. post/packing for each choke.

METERS. A.C. voltmeter 0–100 v. Thermocouple. 2½in. dial. In bakelite case size 4 x 4 x 2 in., **12/6**. Pocket voltmeter, 0–250 v. and 0–15 v., **10/-**. 0-20 Voltmeter, 2in. dial, **4/9**. Note: Please add 6d. post/packing on each meter.

G.E.C. MANSBRIDGE CONDENSERS. 4 mfd. 750 v. wkg. All brand new. 6 for **10/6**, post paid.

PUBLICATIONS

THE "EASYBUILT" TELEVISOR. Complete details of a full size magnetic televisor. Comprehensive instructions, wiring diagrams, etc. A mine of information. Only **2/6**, post free.

"INEXPENSIVE TELEVISION" DATA BOOKLET No. 4. Fully revised and brought up to date. Describes the 45 Mc/s "Pye" Strip as well as the R1355 and other well known government surplus units. **2/6**, post free.

Full range of valves, C.R. tubes, Components in huge variety, all at very attractive prices. Many odd items at ridiculous prices for callers.

MODULATOR TYPE 169. Contains 1 of 5U4G, 1 of EF50, 3 small neons, 1 Klystron, 1 of CV85 (trigger), 2 long metal rectifiers, resistors, condensers, etc., all housed in a handsome metal case. Packed brand new in transit cases for the ridiculous price of **22/6**, carriage paid.

RECEIVER TYPE 3170A. A 15-valve receiver which will easily modify for television. Particularly suitable for Birmingham as it is a superhet and almost identical to the R3084. Contains 8 of EF50, 2 of CV66, 1 of EC52, 1 of HVR2, 1 of R3, 1 of EA50, 1 of CV188. Brand new in original transit cases and sold for less than the price of the valves. **59/6**, plus 7/6 carriage.

CHARLES BRITAIN (Radio) Ltd.

11, UPPER SAINT MARTIN'S LANE, LONDON, W.C.2 TEM 0545

3 minutes from Leicester Square Station (up Cranbourne Street)

Shop Hours: 9-6 p.m. (9-1 p.m. Thursday). Open all day Saturday

You're SURE to get it at

STERN'S

ESTABLISHED 25 YEARS

Moving Coil Speakers. All new 2/3 ohms P.M., 3in., **11/6**; Rola **16/6**; 4in., **18/-**; 5in. **10/-**; (with Trans. **14/6**); 6½in. **11/6**; 8in. **12/6** and **17/-** (with Trans., **16/-**); 10in. **23/6**; 12in. Truvox **39/6** and Celestion **75/-**.

Potentiometers. New Centralab: 2K, 5K, 10K, 25K, 50K, 100K, ¼, ½, 1 and 2 meg., less switch, **3/9**, with switch **6/-**. Midget Type **2/6**. Midget with switch, ¼, ½ and 1 meg., **6/-**.

Surplus Potentiometers. All standard size with extended spindles: 5K, 10K, 15K, 20K, 25K, 50K, 100K, 250K, 500K, 750K, 1 meg., **2/-** each.

Coils. Denco Maxi "Q" High "Q" with miniature size Litz wound on Polystyrene Formers with adjustable Iron Dust Cores. Aerial, H.F., or Oscillator for 465 k/c or 1.6 m/c. Range covers all wavebands from 3.6 to 2,000 metres. Wiring diagram. Prices: Chassis Mounting, **3/9** (with React. **4/9**) Octal fitting pin base, **4/-** (with React., **5/-**). Denco T.R.F. Matched pair Medium and Long Waves, **6/6** pair. Weymouth T.R.F. Matched pair M. and L. Waves, **9/6** pair. Superhet Matched pair S.M. and L. Waves, **8/9** or **11/6** pair. All types Wearite "P" Coils, **3/-** each in stock. Weymouth Midget 1¼in. × ½ dia., Iron Core, Aerial, H.F. or Osc., **3/6** each.

Electrolytic Condensers. B.E.C. Midget Can Tubular, 8 mfd. 450 v. (1¾in. × ¾in. dia.), **2/6**; 8-8 mfd. 450 v. (1¾in. × 1in. dia.), **4/-**; 16-8 mfd. 450 v. 1¾in. × 1in. dia.), **4/6**; 32 mfd. 450 v., **5/-**; 16-16 mfd. 450 v. (1¾in. × 1½in. dia.), **4/6**; Dubilier "Drilitic" Card Tubular, 4 mfd. 500 v., **3/6**; 8 mfd. 500 v., **4/-**; 16 mfd. 500 v. **5/6**; B.I. Can, standard size, 8 mfd. 500 v., **3/9**; 8-8 mfd. 500 v., **5/-**; 16 mfd. 500 v., **4/3**; 16-16 mfd. 500 v., **5/3**; 32 mfd. 500 v., **5/-**; All New Stock. Dubilier mica .001 mfd. 5,000 v., **2/6**.

Denco I.F. Liner for accurately lining-up 465 kc/s, or 1.6 m/c I.F. channels. Pre-tuned circuits, battery operated and completely self-contained. Price **42/-** (incl. P.T.).

Coil Packs. Osmor Midget Coil Pack. Size 3¼in. × 2¼in. × 1¼in. covering S. M. and L. Waves. Coils wound on Polystyrene Formers with adjustable Iron Cores, ensures efficient performance. Factory wired and aligned. Price, including full circuits for Superhet 465 k/c. Unit, **33/-**. Plus 7/4 P.T. Weymouth Midget 3½in. × 2¼in. × 1¾in. covering S.M.L. W/Bands, for 465 k/c, employing Matched Iron Cored Coils on each W/Band, **42/10**. Wearite Superhet Type 705 and 706, size 4½in. × 3¾in. × 1½in., covering two Short Wave and one Medium W/Band or S-M-L Wavebands, 465 k/c, employs Iron Cored Coils **37/10**. All of the above Coil Packs include Switching, Padding and Trimmer Condensers.

Output Transformer—Stern's. Midget 1¼in. × ¾in. × 1in. ratio 60-1, **3/9** (or ratio 90-1, **3/9**). Stern's Multi-ratio (over 12 ratios, some C.T.), 5/6 watts **8/6**. Stern's Heavy Duty Multi-ratio, all C/Tapped, handles 13 watts and suits P.X.4s, 6L6s, etc., **29/6** Rola Multi-ratio, 5/6 watts, **10/6**.

L.F. Chokes. Midget 10 henry 250 ohm 40 mA., **3/6**; 20 hny. 250 ohm 60 mA., **6/6**; 20 hny. 300 ohm 100 mA., **11/9**; 5 hny. 50 ohm 250 mA., **18/6**; 20 hny. 250 ohm 120 mA., **18/6**; 9 hny. 250 ohm 120 mA., **8/6**.

Aluminium Chassis. Substantially made of gauge 16 S.W.G. with four sides, 7in. × 4in. × 2in., **3/3**; 9in. × 5in. × 2½in. **4/-**; 10in. × 6in. × 2½in., **4/11**; 10in. × 8in. × 2½in., **5/6**; 12in. × 9in. × 2½in., **6/8**; 14in. × 9in. × 2½in., **6/11**; 16in. × 8in. × 2½in., **7/3**; 16 in. × 8in. × 3½ in. **8/6**.

I.F. Transformer, 465 k/c. New well-known manufacturer's surplus ¾in. × ¾in. × 1¼in. Iron Core, **9/-** each. Denco Iron Core, 465 k/c. or 1.6 m/c., 1¼in. × 1¼in. × 3¼in., **16/6** pair. Wearite Stand Cap, Tuned, 465 k/c., **20/-** pr. New Surplus 465 k/c. Iron Core, 4in. × 1¼in. sq., **10/-** pair.

Meter Rectifiers. Westinghouse 250 micro/amp., **11/6**; 1 mA., **10/6**; 5 mA., **4/9**.

Selenium Rectifiers. H.T./H. wave. 250 v. 50 mA. **5/6**; 250 v. 100 mA., **7/6**; 250 v. 170 mA., **13/9**.

F. Wave Bridge Rectifiers for Battery Charging or Models 2, 4 or 6 v., 1½ amp., **7/6**; 6 or 12 v. 1½ amp., **11/6**; 6 or 12 v. 3 amps., **19/6**; 6 or 12 v. 5 amps., **23/6**; 12 or 24 v. 3 amps., **23/6**.

Variable Resistor to control charging (or model speed) up to 3 amps rating, **13/6**. Suitable METER, **5/9**.

Charger Transformers. Suitable for use with preceding Rectifiers. Each has input of 230 volts. Outputs (a) 24 volts tapped 15 v., 9 v. and 4 v. at 3 amps., **22/9**; (b) 30 volts tapped 15 v. and 9 v. at 3 amps., **23/9**; (c) 15 volts tapped 9 v. at 3 amps., **16/6**; (d) 12 volts, 1½ amps., **11/3**; (e) 15 volts tapped 9 v. at 6 amps., **21/6**; 15 volts tapped 9 v. at 1½ amps., **13/6**. A Battery Charger Wiring Diagram is included with purchase of Charger Transformer and Rectifier.

NEW SURPLUS!! FOSTER TRANSFORMERS. PRIMARY 230 VOLTS. SECONDARY 12 VOLTS 9 AMPS. 21/-.

Filament Transformer. Inputs 230 volts, outputs 6.3 v. 1½ amp., **8/3**; 4 v. 1½ amp., **7/6**; Input 200/250 v., output 4 v. (C.T.) 1½ amp., 4 v. 2 amp., 6.3 v. 2 amp., **19/6**. Input 230 v., output 6.3 v. (C.T.) 4 amp., **16/6**.

Westinghouse Rectifiers. (a) H.T.51. Rated 350-0-350 volts 100 m/a., **35/-**; (b) H.T.52 Rated 350-0-350 v., 200 m/a., **37/6**; (c) H.T.53. Rated 500-0-500 v., 200 m/a., **50/-**; (d) Type 16H.T.56, **17/9**; (e) Type 36E.H.T.25, **11/9**; (f) Type 36E.H.T.35. Rated 2.5 kV, 1 m/a., **17/6**; (g) Type 36E.H.T.100. Pulse rating 5/6kV., **26/8**

Mains Transformers. All New Stock with Primaries tapped for 200-250 volts. Secondaries (a) 250-0-250 volt, 80 m/a., 6.3 v. (Tapped 4 v.) 4 amp and 5 v. (Tapped 4 v.) 2 amp., **18/6** (also available with 350-0-350 volt at **18/6**). (b) Stern's 350-0-350 volt, 150 m/a., 6.3 v. (Tapped 4 v.) 4 amp. and 5 v. (Tapped 4 v.) 2 amp., **38/6**; (b) 350-0-350 v. 250 m/a., 4 volt, 8 amp., 4 v. 3 amp. 6.3 v. (Tapped 2 v.), 2 amp. and 6.3 v. 6 amp., **72/6**, and many to other ratings.

Heater Auto Transformers: (a) Tapped 2 v. 4 v., 5 v., and 6.3 volts 3 amp., **9/6**; (b) 4 v. 3 amp. to 5 v. 2 amp. Reversible **6/6**; (c) 4 v. 3 amp. to 6.3 v. 2 amp. Reversible, **6/6**.

Power Potentiometers. Bulgin adjustable slider type, max. 6 ohms 60 watt, or 14 ohms 60 watt, **13/6** each. Ex-Govt. Rotary Adjustable 50 ohms 60 watt, **5/9**.

A 4-Station Pre-set Tuner. A complete self-contained unit from which any 3 Medium W/Band and 1 Long W/Band Stations may be pre-selected, and then individually selected by turn of Rotary Switch. No Tuning Condenser required only 4 connections are necessary, price **40/-**.

Adjustable Mains Droppers. 1¼in. dia. × 2¾in. (a) .15 amp., 1500 ohms, **5/-**; (b) .2 amps., 1,000 ohms, **4/3**; (c) .3 amp. 600 ohms, **5/-**.

6 Volt Vibrator Transformers, secondary 350-0-350 volts, 85 m/a., **8/6**.

KITS OF PARTS AND CONSTRUCTORS ASSEMBLY OUTFITS

Assembly Instructions and Circuit to build a

MIDGET 4-STATION "PRE-SET" RECEIVER

We now have available a complete set of detailed Assembly Instructions, showing Wiring Diagram, Practical Component Layout, Point-to-Point Connections, and individual Component Price List, for the construction of a **4-STATION "PRE-SET" 4 VALVE SUPERHET RECEIVER.**

This Set is designed to receive three chosen stations on Medium Waveband and one on Long Wave, each station being then selected by the turn of a Rotary Switch, no tuning being necessary. It is of Midget size, being 8½in. × 4½in. × 7in. high, when fully assembled, and can be completely built, including Valves and Matched P.M. Speaker, for approximately **£5/17/6**.

These Assembly Instructions are available for **1/6** (plus 3d. post), and in addition to the normal Wiring Diagram, they include practical layouts to enable the inexperienced Constructor to build the Set.

"MAINS or BATTERY PERSONAL KIT"

A complete **KIT OF PARTS** to build our new **MIDGET 4-VALVE SUPERHET PERSONAL SET,** covering **MEDIUM** and **LONG WAVES** and designed for **MAINS** or **BATTERY** operation is now available.

This 2 Waveband Superhet Receiver is designed to operate on A.C. mains 200/240 volts, or by an "All-Dry" Battery, either method being selected by means of a Rotary Switch. It is so designed that the Mains Section (size 4½in. × 1½in. × 3½in.) is supplied as a separate Kit, which may be added at any time. The kit therefore can be supplied either as an "All-Dry" Battery Personal Set, or as a Midget Receiver for combined Battery/Mains operation.

The circuit incorporates Delayed A.V.C. and Preselective Audio Feedback. A Rola 4in. P.M. Speaker with generous size Output Transformer ensures excellent quality reproduction. Ready Wound Frame Aerial, Fully aligned I.F. Transformers, and a Drilled Midget Chassis are included. Valve line up:—I.R.5 (F.C.) I.T.4 (I.F. Amp.), I.S.5 (Diode Det and Audio Amp) and 3.S.4 (Output Tet).

The Set is quite easily built from the very detailed assembly instructions supplied, which include a practical component layout, with point-to-point wiring, and a circuit diagram for both the Set and the Mains Unit.

Price of **COMPLETE KIT** (less Mains Unit), **£6/13/9.** Price of **COMPLETE MAINS UNIT KIT, £1/17/6. EVER READY Type B114 BATTERY, 10/3.**

An attractive Walnut Finished Cabinet, size 9in. × 5¾in. × 5½in., of the hinged-lid type and suitable to house the combined set is available for **19/9**.

THE COMPLETE ASSEMBLY INSTRUCTIONS mentioned above can be supplied separately for **1/9**.

A Midget T.R.F. Battery Portable "Personal" Kit. A complete Kit of Parts to build a Midget 4-valve All-dry Battery Personal Set. Consists of Regenerative T.R.F. Circuit employing Flat Tuned Frame Aerial, with Denco Iron Dust Cored Coil, thereby ensuring maximum gain for Single-Tuned Stage covering Medium Waveband.

Valve line-up: 1T4 (R.F. Ampl.), 1T4 (Detector), 1S5 (1st A.F.), and 3S4 (output). Includes latest Rola 3in. Moving Coil Speaker, and a Chassis already drilled and shaped. A consumption of only 7 mA. ensures long battery life. The Kit is designed for a cabinet, minimum size 6½in. × 4½in. × 3in. Detailed Building Instructions, with Practical Layout and Circuit included with Kit make assembly easy. Price for Complete Kit, **£3/18/9** (plus **16/7** P.T.). Suitable unpolished Cabinet 6½in. × 4½in. × 3in., **12/9**. Ever Ready B114 Battery, **10/3**. Building Instructions, Circuit, etc., supplied separately, **1/-**.

A Complete Kit of Parts to build a Midget "All-Dry" Battery Eliminator, giving approx. 69 volts H.T. and 1.4 volts L.T. This Eliminator is suitable for any Personal Set requiring H.T. and L.T. voltages indicated above. The Kit is quite easily and quickly assembled and is housed in a Light Aluminium Case, size 4½in. × 1½in. × 3½in. It can therefore be accommodated inside most makes of Personal Sets. Price of complete Kit, **£1/17/6**.

"Wireless World" Midget A.C. Mains 2-Valve Receiver. We can supply all the components, including valves and M/Coil Speaker to build this set as specified in the March issue at a total cost of **£3/5/-**. Reprint of detailed assembly instructions and circuit supplied separately for 9d.

"Wireless World" Midget A.C. Mains 3-Valve Receiver. Covering Long and Medium Wavebands. We can supply all the Components, including Drilled Chassis, Valves, Moving Coil Speaker, etc., to build this Set, as specified in the Feb. 1950 issue at a total, cost of **£4/10/-** including a reprint of the complete Assembly Instructions and Circuit (this is available separately for 9d.) and Practical Components Layout with "point-to-point" connections. An attractive Walnut Finished Cabinet is now available for this W/World 3-Valve Set at **21/-**, or it can be supplied with a complete Dial and Drive Assembly which includes the latest Station Name Dial and Dial Escutcheon, and a Combined Switch/Volume Control to effect very slight modification. Inclusive price, **35/-** (Dial and Drive Assembly with Switch/V. Control supplied separately for **14/-**).

We can supply all the Components, including Valves, M/Coil Speaker, etc., to build a **Midget A.C./D.C. Mains T.R.F. 3-Valve (Plus Metal Rectifier) Receiver** as designed and specified by a popular Technical Magazine, at a total cost of **£4/17/6**. A reprint of the assembly instructions, and layout available for 9d.

An Entirely Complete 3-Valve Amplifier Kit of Parts. Operating on A.C. or D.C. mains 200-250 volts. Has an output of max. 4 watts, with valve line-up 25A6, 6J7 and U31. A matched 6½in. Moving Coil Speaker is supplied. Price, including Wiring Diagram, **75/-** (or less M/Coil Speaker, **59/6**).

"ELECTRONIC" VALVE VOLTMETER. We can supply the **COMPLETE KIT OF PARTS**, including the Valve, Diode and Meter, etc., to build this instrument, as published in the Jan. 1950 issue of "Electronic Engineering," complete with a reprint of the wiring diagram and assembly instructions (supplied separately for 9d.) at a total cost of **£3/15/-**.

TELEVISION!! The **"Viewmaster" Televisor**, assembly instructions showing Wiring Diagram and Practical Component Layout available for **5/-**. We have the specified Components, including the T.C.C.—Bulgin—Morganite—W.B.—Westinghouse—Plessey—Colvern, etc., outfits in stock. We can supply this Televisor by the individual stages (as published with the instructions) or by separate Components. Complete price details can be obtained on application.

THE "EASYBUILT" TELEVISOR. Full constructional data now available in book form showing Wiring Diagram, Practical Component Layout and "point-to-point" connections, make this one of the most suitable Televisors for the Home Constructor to build. The specified Component are all available at very reasonable prices, enabling the set to be completely built for approx. **£20—£23** including Valves, but excluding C.R.T. Price for complete Manual **2/6**.

★ Send 3d. stamp for our NEW STOCK LIST, showing many KITS OF PARTS for Sets and Battery Chargers and "hundreds" of Wireless Components. When ordering please include postage and packing.

STERN RADIO LTD., 109 and 115 FLEET STREET, E.C.4

Telephone: CENtral 5814 and 2280

STILL AVAILABLE !

LASKY'S RADIO
World Renowned for Service & Reliability

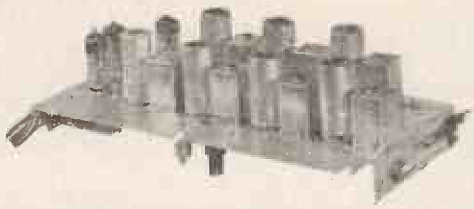
THE TELEVISION SOUND/VISION RECEIVER THAT NEEDS NO CONVERSION

LONDON & BIRMINGHAM FREQUENCIES

Uses 10 of the latest type miniature valves : 6AM6 and 6AL5's.

VALVE LINE UP.

V1.	6AM6.	Sound and vision R.F. amp.
V2.	6AM6.	Sound 2nd. RF. amp.
V3.	6AM6.	Vision 2nd. RF. amp.
V4.	6AM6.	Sound 3rd. RF. amp.
V5.	6AM6.	Vision 3rd. RF. amp.
V6.	6AL5.	Sound detector and noise limiter.
V7.	6AL5.	Vision detector and noise limiter.
V8.	6AM6.	Sound output.
V9.	6AM6.	Sync. pulse separator.
V10.	6AM6.	Video output.



LASKY'S PRICE £6 19 6

Carriage 3/6 extra.

Complete with all valves. NO EXTRAS.

Size of unit : 10in. x 4½in. x 1in.

These units are not ex-Government, but brand new manufacturer's surplus. May be used with any type time base and c.r. tube. The unit is fully assembled and wired, supplied with all valves and ready for fitting. Voltages required : 6.3 v. at 3 amps. and 270 v. at 80 m/a.

Send 6d. for a copy of the full data, circuits and photographs dealing with this unit.

SAVES—SPACE, TIME, CASH.

Sold only at

LASKY'S RADIO

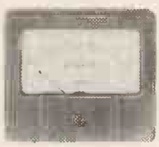
370 HARROW ROAD, PADDINGTON, LONDON, W.9.
(opposite Paddington Hospital)

Telephones : CUNningham 1979 & 7214.

Hours : Mon. to Sat. 9.30 a.m. to 6 p.m. Thurs. Half Day 1 p.m.

THE THREE 'R's

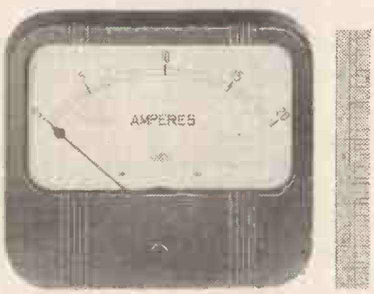
3", 3½", 6" RECTANGULAR INSTRUMENTS by PULLIN



Series 30

Series 35

These three rectangular instruments are designed on symmetrical lines, thus giving a distinctive clear open scale and pleasing appearance. Each size available in all standard ranges. The Series 65 and 36 can be fitted with dial illumination



Series 65

MIP

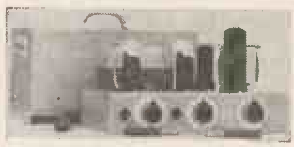
MEASURING INSTRUMENTS (PULLIN) LTD.

Electrin Works, Winchester Street, Acton, London, W.3.

Telephone ACOrn 4651/3 & 4995

PRATTS RADIO

1070 Harrow Road, London, N.W.10
(Nr. SCRUBBS LANE) Tel. LADbroke 1734



MODEL AC10E £9/9/0

AMPLIFIERS. College general purpose units. Model **AC10E** 10 watt 4 valve unit. Neg. feedback. **Separate** mike stage. **Separate** mike and gram inputs with twin faders and tone control. Complete in case with chrome handle. Input for 10 watts output. Mike .002, gram .21 v. Price **£9/9/-.**

Model **AC18E.** 6 valve unit with output of 18½ watts. Push-pull output with feedback over 3 stages. **Separate** mike stage. Complete in case with chrome handles. Input for 18½ watts output. .003 mike and .3 v. gram. Price **£13/19/6.**

Model **U10E.** 6 valve unit for DC/AC mains. Spec. as AC18E. 10 watts output with feedback over 3 stages. **Separate** mike stage. Complete in case with chrome handle, **£11/15/-.** All the above amplifiers have output to match 3, 8 or 15 ohm speakers and are ready for immediate use. Finished in blue stove enamel to ensure long life. No pre-amplifier required. Both inputs high impedance.

MODEL AC4C 105/-

Model AC8C. 5 valve record/radio amplifier. Push-pull output of 8-10 watts, with feedback over 3 stages. Output matches 3, 8 or 15 ohm. Speakers. Supply of 250v. at 20 ma. and 6.3 v. at 1 amp, available for feeder unit etc. Input is high impedance. Price of completed chassis and baseplate, **£9/18/6.**

Model AC4C. A.C. or **U4C** A.C./D.C. 3 valve amplifier chassis for records or radio. 4 watts output to 3 ohms, **£5/5/-.** All amplifier prices include carriage —stamp for list. The above are as supplied to schools, clubs, hospitals, factories, etc. for over four years.

Accessories for use with the above equipment :

COLLARO RECORD PLAYER complete with A.C. motor and magnetic pick-up, **£5/18/6,** with crystal pick-up, **£6/4/4** (tax and carriage paid). **SPEAKERS,** Goodmans Audiom 60, heavy duty 12in. P.M., **£6/10/-.** Rola G12, **£6/10/-.** **MICROPHONES,** Rothermel crystal D.104, **£5/5/-.** **PICK-UPS,** Rothermel S/8, 40/2, tax paid.

All goods new and unused. Valve List available. Nearest Tube, Kensal Green.

C.W.O. or C.O.D. Post free over £1.

E.M.I. TRAINING for the best posts

E.M.I. INSTITUTES, THE COLLEGE BACKED BY THE GREATEST ELECTRONIC INDUSTRY IN THE EMPIRE.

Daytime Attendance Courses

Radio, Television, and other Industrial Electronic subjects. Principles and Practice of Radio—1 year. Telecommunications Engineering—2 years, leading to City & Guilds Final Certificate. Electronic Engineering—3 years (*including one year's practical training in E.M.I. Factories*)—leading to C & G full Technological Certificate.

★ **Next courses commence April, 1951.** ★
Early enrolment is advised.

Moderate terms. Facilities for easy payment.

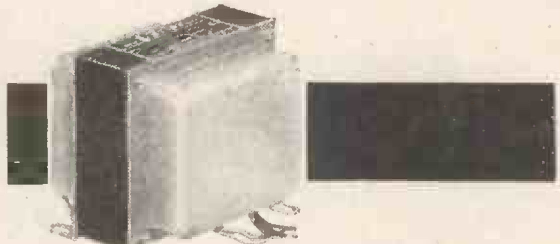
Write for free Brochure to the Registrar, Dept. 16

E.M.I. INSTITUTES

10, PEMBRIDGE SQUARE, NOTTING HILL GATE, LONDON, W.2. TELEPHONE: BAYSWATER 5131/2

Associated with "H.M.V." MARCONIPHONE COLUMBIA ETC.

I 18



MAINS Varley

REGD. TRADE MARK

TRANSFORMERS & CHOKES

All "Varley" products are manufactured from the highest quality materials.

Transformers, etc., are individually wound and have interleaved windings with ample insulation, ensuring freedom from breakdown.

The comprehensive range of Shielded and Open type Transformers available meets the requirements of every circuit. Write for list, etc.

MADE BY

OLIVER PELL CONTROL LTD

CAMBRIDGE ROW · WOOLWICH · S·E·18
Telephone: WOOLWICH 1422

Instruments for Research and Industry

Model 44 SUBSTANDARD
MULTI-RANGE METER

A self-contained precision instrument for general laboratory use and for calibrating first grade single or multi-range meters. The accuracy on the 44 range is Substandard on D.C. and within ± 0.5% on A.C.

★ *These meters are made with the greatest care and have been supplied for a number of years to the leading laboratories at home and abroad.*

ELECTRONIC INSTRUMENTS LTD

17, PARADISE ROAD · RICHMOND · SURREY · ENGLAND

R.C.A. TRANSMITTER

ET4336 COMPLETE

NEW AIR TESTED

Available in quantity for export.

SPECIAL TERMS TO LICENSED AMATEURS.

FREQ. METERS BC 221 few still available.

TRANSMITTING TUBES — ALL TYPES.

SQR 522, VHF Trans/Rec.

BC 375E TUNING UNITS

New, with cases, TU 7/8/9/10 and 26B. 12/6 each, + 2/- carriage.
TU 5 and 6, 22/- each, + 2/- carriage.

Send for details of our compact EX/TX F-U-40. 40 watts.

(HALLICRAFTERS)
McELROY-ADAMS MFG. GROUP LTD.

46 GREYHOUND ROAD, LONDON, W.6.
Cables: Hallicraft, London. Phone: FULham 1802.

THIS G.E.C. ADVERTISING MEANS NEW BUSINESS FOR YOU

The advertisement on the left for G.E.C. Sound Systems is appearing in FACTORY MANAGER, MAKER UP, MASS PRODUCTION, TAILOR AND CUTTER. Follow up this advertising by 'tying up' with your own local publicity . . . and take full advantage of G.E.C. technical co-operation

THE GENERAL ELECTRIC COMPANY LIMITED
MAGNET HOUSE, KINGSWAY, LONDON, WC2

ALEC Davis SUPPLIES Ltd.

DEPT. W.W.

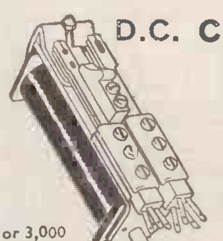
18 TOTTENHAM COURT ROAD, LONDON, W.1

Tel.: MUSeum 2453 Tel.: MUSeum 4539

Shop hours : Monday-Friday 9—5.30 Saturday 9—1

FULL MAIL ORDER FACILITIES. Please add postage

RELAYS (EX-MINISTRY)



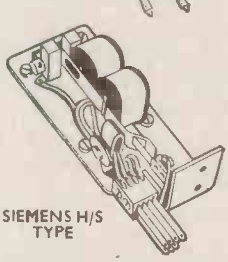
600 or 3,000 TYPE

D.C. COIL RESISTANCE

3,000 TYPES : 1.9 ohms to 42,000 ohms.

600 TYPES : 100 ohms to 9,200 ohms.

ALSO LARGE STOCKS OF DOUBLE & TRIPLE-WOUND AND SLUGGED COILS.



SIEMENS H/S TYPE

CONTACTS

3,000 TYPES : up to 8 sets.

600 TYPES : up to 4 sets.

3,000 TYPES : Make (M), Break (B), in Twin-silver, Twin-platinum, Dome-silver (2 amp.), Tungsten (5 amp.), and Flat-silver (8 amp.) : Change-Over (C), in all but Tungsten : Make-Before-Break (K), in Twin-silver and Twin-platinum.

600 TYPES : (M), (B), and (C), in Twin-silver and Twin-platinum.

NEW ARRIVALS: SIEMENS HIGH-SPEED RELAYS 3,400 OHMS D.C. RESISTANCE

TRANSFORMERS

L.T. TRANSFORMERS	
4 v. 2 a. Tapped Pri.	7/6
4. v. 3 a. „ „	18/0
5 v. 3 a. „ „	10/6
6.3 v. 1.5 A. Tapped Pri.	7/6
6.3 v. 3 A. „ „	12/6
12 v. 1 A. „ „	10/6
MAINS TRANSFORMERS	
300-0-300 v. 60 mA. 6 v. 2 A. ; 5 v 2 A.	22/6
Elstone MT/MI 250-0-250 v. 60 mA, 5 v. 1.5 A. 5 v. 2 A.	23/-
250-0-500 v. 10 mA. 6.3 v. 9 A. 4 v. 1 A.	17/6
350-0-350 v. 100 mA. 6.3 v. 4 A., 5 v. 3 A.	33/9
Eltsone MT/100EA. 350-0-350 v. 100 mA, 0-4-6 v. 4 A, 0-4-5 v. 2 A.	36/-
350-0-350 v. 150 mA, 6 v. 6 A, 5 v. 3 A.	39/6
350-0-350 v. 250 mA. 6.3 v. 5 A, 0-2-6 v. 2 A, 4 v. 8 A., 4 v. 3 A.	89/-
Elstone MT/9, 500-0-500 v. 250 mA, 6 v. 6 A., 6 v. 3 a., 5 v. 3 a.	67/6
4KV 5 mA, 2 v. 2 a., or 4 v. 1 A.	67/6
5 KV., 1 mA., 2 v. 2 A. or 4 v. 1 A.	72/6

WE OFFER THE FOLLOWING BARGAIN PARCEL OF GOVERNMENT SURPLUS COMPONENTS IN BRAND NEW CONDITION

1 Mains Suppressor.
1 200K Potentiometer.
2 50 mfd. 12 v. Condensers with Bases.
4 International Octal Valveholders.
2 10 Mc/s I.F. Transformers.
4 Knobs.
1 1000 mfd. 12 v. Condenser.
1 Single Pole Toggle Switch.
1 1mfd. 500 v. Paper Condenser.
1 0.1mfd. 600 v. Paper Condenser.
1 1mfd. 750 v. Paper Condenser.
1 M.E.S. Holder.
1 0.03mfd. Paper Condenser.
6 Yard Lengths Assorted Coloured Sleeving.
3 Dozen Grommets—3 sizes.
1 5/way Push-Button with 8 Change overs on each Switch.
1 2mfd. Paper Condenser, 1,000 v. D.C. Test.

THE ENTIRE PARCEL AS LISTED FOR **ONLY 21/-** carriage free (Ireland 22/6)

Wireless World Classified Advertisements

Rate 6/- for 2 lines or less and 3/- for every additional line or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World," Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components which may be offered for sale through our columns carry no manufacturers' guarantee: Many of these components will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such components purchased.

NEW RECEIVERS AND AMPLIFIERS

UNIVERSAL ELECTRONIC PRODUCTS, 36, Marylebone High St., London, W.1. Welbeck 4058.

SPECIALISTS in the design and manufacture of high fidelity reproducing equipment from 5-100 watts for domestic or industrial purposes. Our new twin channel amplifier (type U.E.57), with independent bass and treble outputs, provides the most satisfying standard of reproduction we have yet experienced. It is now being demonstrated in our showrooms daily (we close Thursday 1 p.m., Saturday 4.30 p.m.), and we invite those who seek perfection from recorded music to hear this superb instrument. We also offer tuning units or complete chassis designed and constructed to individual requirements.

9 KC Rejector, effectively removes the 9 kcs whistle, rejection at 9 kcs better than 35 DB; price 65/- each; response curve on application.
ROGERS DEVELOPMENTS Co. (M.O. Dept.), 116, Blackheath Rd., S.E.10. [6316

12-watt high quality amplifiers, bass and treble boost; £12/10; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0065

BERNARDS, makers of television, radio, amplifier equipment, available for early delivery; television time-base chassis and E.H.T. supply combined, 5 valves, completely wired, tested, only new components used; £7/12/8.
BERNARDS, 12, Chelverton Rd., Putney, London, S.W.15. Put. 7538. [0097

CHARLES AMPLIFIERS, Ltd., are now able to produce amplifiers, radio units and electronic equipment to specification; enquiries invited for development work and for short production runs.—Charles Amplifiers, Ltd., 40, Kensal Rd., W.10. [0173

MIDLAND RADIO COIL PRODUCTS offer a service for the production of high quality amplifiers and radio equipment to specification; list of standard products is available; suppliers of audio and radio equipment to the Northamptonshire Education Authority.—Enquiries to 28 Winstanly Rd., Wellingborough. [6336

OUR model SL.35 radiogram chassis is now available; a 5-valve all-wave superhet, complete with valves and p.m. speaker, large fully illuminated glass dial in attractive colours; aerial tested ready for installation; really remarkable value at £12 with 8in speaker, or £12/10 with 10in speaker; 2½d stamp for illustrated leaflets; trade enquiries invited.—Bayly Bros., 46, Pavilion Drive, Leigh-on-Sea, Essex.

C.J.R. ELECTRICAL & ELECTRONIC DEVELOPMENT, Ltd., Hubert St., Birmingham, 6 (Aston Cross 2440), the Midlands specialist manufacturers of high fidelity sound reproduction equipment, for the world-famous Williamson amplifier and associated accessories including tone control stages, loudspeaker crossover units, distortionless contrast expanders and radio feeders; send for details and prices. [0105

CONNOISSEUR'S receiver, acclaimed by its users as the finest receiver for the enthusiast and the only one with the following facilities: 9-1,500-metre, world-wide results on highly sensitive 10-valve receiver, comparable with any good communication set, or by change of switch, maximum fidelity reception of local stations on non-superhet receiver with high quality 2-PX4 push-pull amplifier incorporating all refinements, bass and treble tone control (boost to cut), whistle filter and gram input, etc.; basis rebuilt R1155; write for details or call for demonstration.
FEEDER units as above, or use with external high-quality amplifiers; R1155 specialists, receivers repaired and re-aligned, also modified as above, or to your requirements; R1155 circuit and values 2/- post free.—R.T.S., Ltd. 5, Gladstone Rd., Wimbledon, S.W.19. Tel. Lib. 3303

TELRAD ELECTRONICS, 70, Church Rd., Upper Norwood, London, S.E.19.—Designers and manufacturers of Telrad quality amplifiers; established as the most outstanding value in high-quality amplifiers, thanks to faithful reproduction at unrivalled price, these unique amplifiers are the first choice of the enthusiast; built to satisfy the discriminating ear; bass and treble independent controls, providing widest possible variation to suit all recordings and varying acoustic properties of one room with another; £18 complete; full details on request.—Write, call or 'phone Livingstone 4879. [0019

Partridge News

—for the WILLIAMSON AMPLIFIER

THE widest possible audio range—the lowest possible distortion and an output of 20 watts . . . these critical demands of the designer of this now famous Amplifier implied the finest that technical skill and craftsmanship could provide for every component. From the inception of the Williamson Amplifier in 1947 Partridge have specialised in transformers and chokes. The all-important output transformer was the special care of Partridge, and this "Williamson specification" component is now available for a varied range of impedance. Secondary windings are brought out as eight separate sections of equal impedance. Stock types comprise 0.95 ohm, 1.7 ohm, 3.6 ohm and 7.5 ohm sections.

The Partridge "Williamson" Output Transformer is acknowledged the most efficient of its type

FULL DATA ON REQUEST

PARTRIDGE TRANSFORMERS LTD
ROEBUCK ROAD, KINGSTON BY-PASS
TOLWORTH SURREY
Telephone: ELMbridge 6737-8

NEW RECEIVERS AND AMPLIFIERS

TELEVISION receiver, built to special order of client moving to Scotland; selects three pre-tuned channels; many other special features; uses 9in tube but could be changed to 12in; brand new; highest offer secures.—Write for details to J. Mort, BCM/HIFIDEL, W.C.1. [6142

MANY people strive after quality reproduction but in most cases the price of associated equipment makes this impossible; however, with the R.T.M.C. Williamson amplifier you can attain your ideal at a reasonable price as superb quality can be obtained with reasonably priced speakers and pick-ups and there is no need to use expensive apparatus; the R.T.M.C. version of the now world-famous Williamson amplifier (which incidently cannot be improved upon and is still pre-eminent in its class) is still the best reproducer you could possibly buy and before purchasing a quality reproducer we invite you to hear the Williamson but it must be a R.T.M.C. model; superb quality parts only used with outstanding finish and results; many have tried to equal the Williamson and extravagant claims are made but seeing and hearing are the best advertisement and we therefore offer you the opportunity of coming to actually hear the R.T.M.C. version of this wonderful amplifier which is superlative in its class; you are, however, quite safe in ordering by mail and the results obtained will astound even the most critical; 7-valve model £23/10, 9-valve model with built-in pre-amp £28/10 (ex covers); tuners, etc., supplied; write for details (3d stamp) to—R.T.M.C. (Ealing), Ltd., 141, Little Ealing Lane, W.5. Tel. Ealing 6962.

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

LANCASHIRE Constabulary.—Sale of surplus radio equipment.
THE following radio equipment will be available for inspection at the County Police Office, Northumberland Rd., Old Trafford, Manchester, 16, from Monday, January 22nd, 1951, to Friday, January 26th, 1951, inclusive between 9 a.m. and 5 p.m.:—
146 NATIONAL type 1-10 superregenerative receivers.
82 FERRANTI 12volt vibrator power packs for National type 1-10 receivers.
28 MASTERADIO 12volt vibrator power packs for National type 1-10 receivers.
34 V.H.F. telephony mobile transmitters, type S.440, by Stratton & Co.
12 V.H.F. telephony mobile transmitters, type S.440C, by Stratton & Co.
16 V.H.F. telephony mobile transmitters by Stratton & Co.
6 V.H.F. telephony mobile transmitters.
THE equipment is for sale in bulk and no guarantee attaches to the equipment which is bought as seen and inspected.
ALL offers for the above equipment, in sealed envelopes endorsed "Quotation for Radio Equipment," must be delivered to me not later than the 5th February, 1951.
R. ADCOCK, Clerk of the Standing Joint Committee, County Offices, Preston. [6297

SEVERAL radio-tuned amplifiers for disposal, in spotless condition, some unused; offered at fraction of original cost; s.a.e. details.
RADIO UNLIMITED, Elm Rd., London, E.17. [0063

HALLICRAFTER BC614 speech amplifiers complete all tubes, perfect condition: £18.
BENDIX BC221 frequency meters, complete, perfect; £25.
SCR 522 freq. 100-156 mcs, complete transmitter/receiver in new condition with all tubes: £30.
TUNING units, types TU6 to TU26B, new with covers, 12/6; BC610 tuning units, P.A. coils and spares available. WS19 Mk II and installation kits, spares, etc., large quantities.
EXPORT enquiries for ex-Govt. American spares promptly attended.
McELROY ADAMS MFG. GROUP, Ltd., 46, Greyhound Rd., London, W.6. Tel. Fulham 1802. Cables, Hallicraft, London. [0194

HALLICRAFTERS communication receiver S38, unused.—Offers to Dr. Morey, Grove, Lincoln. [6285

BUSH T.91 console T/V (London), perfect condition.—Offers over £40 to Mrs. E. Bush, The Haven, Dersingham, Norfolk. [6287

HRO Rx's and coils in stock, also AR88, BC348R, CR100, etc.—Requirements please to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0053

SEVERAL amplifiers for sale from £10 each, mainly G.E.C. 14watt, 30/60watt, with or without frame turntables; also exponential horn speakers, £4; mikes from £3; rotary converters, £10; or would sell the lot, best offer for quick sale.—Box 7624. [6293

TWO R1355s plus RF26s, mod. Midland, sound and vision, built-in 250v 50c/s power packs £7/10 for both; or with IND VCR97 e.h.t and T-bases, p.m. speaker, £13 for the outfit, working 85 miles, cash or cheque.—J. Draper, 4 Empress St., Accrington. [6238

10 valve G.E.C. Twin speakers 10-2000m, 25; Ecko 8 valve motor tuned press button, 18gns; Transmitting gear; Walky Talky complete, 45/-; all wave receivers from 95/-; open daily; terms, exchanges.—Autospares, 180, High St., Tooting, S.W.17. Balham 5596. [6244

THE HARTLEY-TURNER 215 SPEAKER

As foreshadowed in our last advertisement the price of the 215 Speaker must be raised. For some time the price of £9 has been subsidised out of our past earnings, but we cannot do this indefinitely. As from January 1st, 1951, the price will be £10 10s. 0d. but this will also include a greatly improved and stronger cone cradle. Until this is ready and while our present stock of cradles lasts we will still accept orders at £9, but there aren't many available at this price. At £10 10s. 0d., however, the 215 is still cheapest in terms of "cycles per shilling."

H. A. HARTLEY CO. LTD.
152 HAMMERSMITH ROAD
LONDON, W.6. *RIVerside 7387*

SOUTHERN RADIO'S WIRELESS BARGAINS

R.3515 TELEVISION UNITS. 21 valves with 6-stage 14 m/c. I.F. strip, recommended for ideal T.V. conversion by all experts. Brand new in original wooden cases. **£3/10/-.**

R.1355 RECEIVERS. Brand new and unused, as specified for Inexpensive Television. **£3/5/-.**

T.R.1196. 6-valve superhet receivers. Perfect and guaranteed. With circuit. **22/6, plus 1/4.**

BENDIX COMMAND RECEIVERS. B.C.454 (49-100 metres), B.C.455 (39-49 metres). Complete with 6 valves. Perfect condition, **35/-** each, plus 1/4.

THROAT MICROPHONES. With Lead and Plug—Magnetic, **4/6.**

CONTROL CABLES, 14 ft., with adaptors or B.C.453/4/5 **9/6** each.

SPEAKERS. Celestion 2½in. P.M. moving coil, 3/5 ohm. **17/6.**

R.A.F. BOMBSIGHT COMPUTERS. Complete, brand new, with motors, gyro gears, blowers, etc., etc. Ideal for model maker, etc. The best component value ever offered. **55/-** each, plus 5/-.

LUFBRA HOLE CUTTERS. Adjustable from ⅞in. to 3½in. for use on wood, metal, plastics, etc. **5/6.**

CONTACTOR TIME SWITCHES. By Smith or Venner. 10-hour movement with the thermostatic control. 2 impluses per second. Complete in soundproof case. **10/-**, plus 1/4.

HAND GENERATORS. 6 volts at 5 amps. Complete with crank. **20/-.**

RADIO COMPASS INDICATORS, with internal Selsyn motor. 3in. dial, **13/6**; 5in. dial, **15/6.**

INVERTER UNITS, Type (PE 206A) 206-A D.C. input 27 volts at 38 amps., 6,000 r.p.m. A.C. output, 80 volts, 800 cycles. Complete brand new with spares. **£3/10 -** each.

CHANCERY LONG PLAYING ATTACHMENT G33. For using L.P. Records on radiogram or Record Player with high fidelity Decca Pick-up, **£6/5/-**, including carriage and packing.

Full list of **RADIO PUBLICATIONS**, 2½d.

Please Note New Address:

SOUTHERN RADIO SUPPLY LTD.
11 Little Newport St. London, W.C.2
GERrard 6653

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

MARCONI CR100 12-valve communication receiver; £28.—Sevenoaks 4568 evenings, Box 7718. [6337

HALLICRAFTER S.X.25 receiver, condition as new, range 540k/cs to 42m/cs, bandspread, Xtal filter, S. meter, noise limiter, B.F.O. 2 R.F. and 2 I.F. and two stages audio DX plus, a joy to any ham; first remittance for £40 secures.—A. Cross, c/o Rediffusion, Hull. [6272

NEW DYNAMOS, MOTORS, ETC.

NEW motor-alternators 1,500 cycles, 80v, 25a. —B.E.R., 69, Church Rd., Moseley, Birmingham. [6119

BATTERY chargers, 4 models, 2-6-12v, 1-2-4 amp D.C.; any mains voltage; also larger types special transformers, chokes, test gear, interior car heaters, etc.—The Banner Electric Co., Ltd., Hoddesdon, Herts. [0122

JANETTE d.c. to a.c. rotary converters, 200/250 volts d.c. input, 200/250 volts, 50 cycles, 1-phase, a.c. output at 300 watts, new, £20; 500 watts, £23; complete with smoothing for television and radio.—Johnson, 319, Kennington Rd. London, S.E.11. Reliance 1412-3.

ALL types of rotating electrical machinery up to 20kva available, including rotary converters, rotary transformers, motors, petrol and diesel-engined generating plants, alternators and d.c. generators. We are also in a position to quote for power transformers; as actual manufacturers we will be glad to quote for any quantity for home or export.

DIESEL Electric generating plants, 3kva, 230v with push-button remote control, starting equipment, ready for use; £195.

ROTARY transformers, input 20v d.c., outputs 6.5v d.c. and 300v d.c., permanent magnet field, 20/-; ditto, input 28v d.c. and 1,200v 70ma d.c. output; energised field, 35/-; ditto input 12v d.c., output 500v, 90ma d.c., energised fields, 35/-.

PETROL eletcric generator plants, comprising a J.A.P. No. 2a single cyl. engine coupled by vee rope drive to an alternator, giving an output of 230v 50 cycles, 400 v.a., with screened ignition and filtering on generator, eminently suitable for operating television and radio on farms, etc., price £40; such plants can be supplied with various outputs, a.c. or d.c. for other applications.

CHAS. F. WARD, Lordscroft Works, Haverhill, Suffolk. Tel. 253. [0039

DYNAMOS, MOTORS, ETC.—SURPLUS AND SECONDHAND

LIGHTING plants, etc., please note items 1 and 2 are not surplus but current products of well-known British manufacturer.

ALTERNATOR, 230/1/50, belt driven, by Petters, very latest type diesel engine, governor controlled, self energised auto voltage control, starter hand or press button, also remote control, stop and start unit supplied; extra remote controls, £1; complete with H.D. starter battery and separate charger, engine covered by Petters inspection service, tested on full load, supplied ready for use, £195, del.

230/1/50 alternator, 400 va, 3,000 rpm, self energised clock and anti-clock with voltage reg., £18 delivered.

ONAN 24 or 30v lighting plants, press button start and stop, with remote control stop, ammeter, cut out, etc., used but good sound, condition, tested for start, 1st or 2nd push from cold, tested on full load, 1,250 watts; £18 delivered.

One only Villiers 2.5hp coupled gen., 220v 6.8 amp d.c., self start, 1,800 rpm, fitted radio suppressors, condition very good, few hours' use only, with spare piston, valves, etc., can be converted to T.V.O. running; £27/10 delivered.

NEW uncharged, unfilled batteries, 6v 72 amp. hr., 65/-; 86 amp. hr., 70/-; 100-125 amp. hr., 85/-, del.

HEAVY flexible rubber covered cable, 100 amp.; 2/- per yd.; H. D. sliding resistances.

NO lists, please state exactly your requirements; see displayed advert. page 92, for S.T.C. rectifiers including just available new high voltage disc E.H.T. rects.; terms, c.w.o., pro forma invoice, or c.o.d. (post goods only).

PEARCE, 66, Great Percy St., W.C.1. Nr. Angel. [0014

ADMIRALTY pattern, Lawrence Scott and Electromotors converter, 220v d.c., 230v 50 cycles a.c., 200w, very good condition.—Box 7319. [6215

ROTARY convertors in silence cabinets, 240 d.c. to 220 a.c., .183 amps, and 110 d.c. to 220 a.c., .546 amps; any offers.—W. Christie-Miller, Swyncombe, Henley-on-Thames. [6283

NEW LOUDSPEAKERS

SPEAKER cabinets with slight alteration, ideal for bass reflex type, heavy construction; bargain at £2 each

LOCKWOOD & Co. 67 Lowlands Road, Harrow.

BARKER model 150 £18/18; model 148A £15/15; Goodmans Axiom 22 £12/13; Axiom 150 £8/8; Wharfedale Super 12/CS/AL £12/10; W10/CS or CSB £7/10; Golden £4/5; Golden CSB £4/15; Super 8 £3/10; 8 CS £4/8; CS/AL £4/5; WB Concentric Duplex, with O.T. £7/7; without O.T. £6/6; high grade Bass Reflex and Corner loudspeaker cabinets, illustrated leaflet on request; all speakers post free.

ROGERS DEVELOPMENTS Co., (M.O. Dept.), 116, Blackheath Rd., S.E.10. [6315

LOUDSPEAKERS—SURPLUS AND SECONDHAND

WHARFEDALE W15/C.S, £7/10; W10/C.S. £4, all £16, with Briggs reflex cabinet and cross over unit; Garrard R.C.70A, £8 (Decca head); 2 R.F. straight R.X.-16 Kc/s b'width, £5; superhet feeder, £4; Williamson T.C. unit, £5; Williamson amp.-separate pwr. supply deal additionally all above, £10; above superb chain of equipment £40 complete.—Oakhurst Court (2), Tilburstow Hill, S. Godstone. [6230

THE "FLUXITE QUINS" AT WORK

"I say, where's the fire!" shouted EE.
"Right dead ahead! Can't you see?
No soldering's right
Minus good old FLUXITE,
Now look at our precious T.V.!"

See that **FLUXITE** is always by you—in the house — garage — workshop — wherever speedy soldering is needed. Used for over 40 years in Government works and by leading engineers and manufacturers. Of all ironmongers—in tins, 10d., 1/6 and 3/-.

TO CYCLISTS! For stronger wheels that will remain round and true, here's a time-tested tip. Tie the spokes where they cross with fine wire AND SOLDER. It's simple — with FLUXITE — but IMPORTANT.

The **FLUXITE GUN** puts **FLUXITE** where you want it by a simple pressure. Price 2/6, or filled, 3/6.

FLUXITE

SIMPLIFIES *ALL* SOLDERING

Write for Book on the Art of "SOFT" Soldering and for Leaflet on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE. Price 1d. each

FLUXITE LTD. (Dept. WW), BERMONDSEY STREET, LONDON, S.E.1.

DUKE & CO.

H.T. BATTERIES. 150 volt guaranteed minimum, tapped 21-90-111 1½ L.T. All-dry. All are tested before despatch. 5/6. Allow 1/6 post.

SPEAKERS. 2½in. including midget trans.. **16/6.** Also, New, but slightly damaged, **12/6.** 5in. less trans., **10/-.** 5in. with. **12/6.** 6in. with. **15/6.** 8in. less. **14/6.** 10in. less, **19/6.** 12in., **35/6.** 6in. Elliptical, **19/6.** All new.

CHOKES. 10 Henry, 80 mill., 250 ohms, **9/-.** 10 Henry. 100 mill., 300 ohms, **9/6.** Also well known make midget, 300 ohms, 10 Henry, 50 mill., 1/- each.

T.V. LENSES. **50/-** or "Filter" filled, **55/-**, 8in., 9in., 10in. only.

VALVES. Full range at only B.O.T. wholesale prices. All guaranteed.

MOTOR BLOWER. Easily rewound from 1/3 H.P. 110 A.C. to 230, or will work from transformer or resistance. Forge type blower, 3½in. dia. outlet. Motor is 2850-3450 R.P.M. ⅜in. spindle, **50/-** to clear. Carr. extra.

DUNLOPILLO. Small supplies still available in sizes 34 × 18 × 2in. flat, or 34 × 16 × 3in. wedge, **12/6** plus post.

EXTENSION SPEAKER. New, 5in. in cabinet, **14/6.** 1155 and 1154 (receiver, A.C.) (Transmitter not converted), **£15** the 2.

SUPER-PRO-HAMMALUND. 22 valve all-wave super radio receiver, that has everything, and can get anything on the air. Set includes speaker and power pack. Sacrifice. **£40.**

WALKIE-TALKIE. A few left only at **17/6.** Only one valve (ATP4) and switch (send-receive) short, **FREE** set of drawings supplied with each one.

FREE OFFER of phones with No. 18 superhet receiver, Short Wave, complete and working. Frequency range easily changed (I.F.465). To clear. **17/6.** Instructions and drawings included.

DOMESTIC RADIO KIT. In bakelite cabinet, 4 valve T.R.F. Universal or A.C. for only **£4/15/6.** Or in Ivory cabinet 6/- extra. Assembled **30/-** extra. New and improved circuits included.

PHILIP'S CHARGER. 200-250 A.C. 24 v. at 6 amps., 3 bank, variable current, individually metered. Bargain. **£7/10/-.**

Money back guarantee if not satisfied. Cash with Order please, and allow sufficient to cover postage. Stamps ONLY for lists.

219 ILFORD LANE, ILFORD, ESSEX. *ILFord 0295*

A WINDOW WORTH LOOKING INTO

Type 25/73 Receiver Units. With 465 I.F. coils and 6 valves: two VR53, two VR56, one VR55, one VR57. Very easily converted into A.C. mains superhet. Brand new, 22/6 each.

Meters. 0-200 microamp, 2½in. flush panel mounting, 17/6 each; 0-3,500 volt m/c., 3½in. face, 22/6 each; 0-5 m/a, 2in. face, m/c., 4/9 each.

Accumulators. Unspillable, 2 volt 7 amp., 4¾in. x 3½in. x 1½in., lead acid, brand new, 6/6 each; 6 volt 85 amp., lead acid, brand new, very limited number only available, 59/6 each.

Television I.F. Strips. 45 m/cs 3 meg. band spread, using 5 stages of T.R.F. (EF50s) Diode Stage (EA50) and Cathode follower (EF50). Brand new, the finest Television Strip yet made, complete with all valves, 62/6 each. Ditto less valves, 37/6.

Condensers. Mansbridge, 6 M.F.D., 1,000 volt working, 2,000 volt test, very limited number only, 2/6 each. Don't miss this special bargain.

Condensers. Bias 25 x 25, cardboard, 4/6 per dozen. Special Serviceman treat.

Television "Trouble Free" High Voltage Condensers. Oil filled, Mansbridge type. .1 mfd., 3,000 volt, 4,000 volt and 5,000 volt, all at 2/9 each.

Television. Brand new R1355 Receivers, complete with valves as used in the "Inexpensive Televisor" for both Sutton or London wavelengths, 52/6 each.

Television Combine Power Packs. Complete Television Power Supply. Input voltage 230 volt A.C., Output voltages 2,500 volt 5 m/a., 350-0-350 volt at 250 m/a., L.T. supply 6.3 volt at 15 amps, completely smoothed throughout and complete with all valves, 92/6 each whilst they last.

Blower Motors. 24 volt A.C./D.C., English 6/- each, ditto American midget 9/6. Ideal for conversion for Hair Dryers, Fans and many other uses.

Chokes. L.F., 3 henry, 200 m/a. resistance 100 ohms, 3/6 each. 5 henry, 200 m/a., resistance 100 ohms, 3/6 each. 20 henry, 80-100 m/a. resistance 360 ohms, 6/6 each.

Cut Outs, 12 volt, boxed, new, 3/6 each.

Rotary Convertors. 12 volt D.C. input, 230 volt A.C. output, 200 watts, complete in wooden case, with A.C. volt meter and resistance for variable control output, brand new, £4/10/0; ditto 24 volt input, £3/5/0 each.

Paxolin. We hold a very large stock of sheet rod and tube all different sizes and lengths, one example 16 gauge, 2 feet square, 3/9 per sheet.

"Q" Fiver, Bendix Command Receivers. Brand new and boxed, complete with valves, 62/6 each, limited number only available.

?Have you visited our new Branch at No. 34 Lisle Street. Bargains by the thousand.

Open all day Saturday.

G. W. SMITH & CO.
(RADIO) LTD.
3, LISLE STREET, LONDON, W.C.2
Phone: GERrard 8204.

NEW TEST EQUIPMENT

AVAILABLE for early delivery, two-beam switch unit, 6 valves, self-contained power pack, variable switching frequency, provisional price, £10/14/6, enables two separate traces to be displayed on standard oscilloscope.
BERNARDS, 12, Chelverton Rd., Putney, London, S.W.15. Put. 7538. [0098

VALVE voltmeters.—Prof. R. Kital design, an inherently robust and simple instrument, ranges 1, 5, 25, 100v at 300 Mcs to 5 Kcs, with probe, 20 Kcs to 20 cps, internally, and direct current, input R=50M.ohms, all ranges linear, same scale for a.c. and d.c., no zero reset, voltage stabilised, no meter overload, accuracy 2% FSD; a remarkable specification for an inexpensive instrument: uses 6Q7, 6V6, 6X5, 2 EA50, VR90, VR150: 0-1 M.A. meter: kit, less valves and meter, with punched chassis, £9/9.
BEL SOUND PRODUCTS Co., Marlborough Yard, London, N.19. [0186

TEST EQUIPMENT—SURPLUS AND SECONDHAND

UNUSED Oscillograph, model No. 339 by Cossor: £50.—Wills, Station Approach, Gravesend. [6143

COSSOR 339 double-beam oscillograph, spare C.R. tube and complete set of valves; £30.—Box 7678. [6300

AVO valve tester £9; Mullard B100 'scope £5; cut-outs 6-24v 60a, 7/6.—Whish, Point Quay Devoran, Truro. [6253

OSCILLOSCOPE (R.T.S.) single beam, 2 inputs, cost price £45; hardly used; £20 for quick sale.—Tel. Windsor 1248. [6308

AN all-wave directly-calibrated modulated Sig. Gen. for 30/-; cost about 10/- to complete; £1 apiece; circuit, photos, 5/-.—Box 7626. [6295

ADVANCE Sig. Gen. model E1, 100 Kc/s-60 Mc/s, new condition, little used, with accessories; £14.—G. Raynor, Kabin Rd., New Costessey, Norfolk. [6260

SIGNAL generators, oscilloscopes, output meters, valve voltmeters, frequency meters, multi-range meters in stock; your enquiries are invited.—Requirements to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0056

NEW GRAMOPHONE AND SOUND EQUIPMENT

MAGNETIC Tape.—Emitape on 1,200ft spool, 25/-; G.E.C. A tape, 30/-; blank recording discs, 10in d/sided, 3/-; all from stock; full trade terms available.
SOUND DISCS (SUPPLIES), Ltd., 178, Bispham Rd., Southport, Lancs. Tel. 88153. [5335

INFINITE baffle corner deflectors, scientifically designed acoustic chambers for 8 to 15in speakers; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0064

GOOD quality 33⅓ r.p.m. motors, including turntable and rubber mat, £4/11, from stock; Decca 3378 playing desk £16/16; Decca 33B and 33C playing-desks £12/1/6; despatched post free.
ROGERS DEVELOPMENTS Co. (M.O. Dept.), 116, Blackheath Rd., S.E.10. [6317

TRANSFORMERS, tone control and loud speaker filter chokes for all "W.W." circuits; special designs promptly made.—R. Clarke, 30, Langland Crescent, S. Stanmore, Middx. Wor. 5321 [5976

EXPORT only. BSR 2-speed gram motors, 33⅓ and 78rpm for microgroove or standard records, simple speed change, 10in turntable, 100-120/200-250v 50c/s, tax free price £3/10 including packing and postage to any part of the world.
FRITH RADIOCRAFT, Ltd., Churchgate, Leicester. [0024

GRAMOPHONE AND SOUND EQUIPMENT—SURPLUS AND SECONDHAND

MAGNETIC recording, stainless steel wire, .0036in diam, 8oz spools, 14,000ft, 15/-; 12oz spools, 20/-; post free.—H. Wilson, 17, Berwood Farm Rd., Sutton Coldfield. [5985

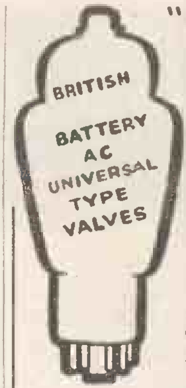
B & H Type A wire recorder, completely reconditioned by makers this year, with new reel of wire; £98.—Levin, Lavender Corner, Bereweeke Rd., Felpham, Bognor Regis. [6259

MAGNETIC sound recording wire, stainless steel, temporary wooden spools, approx. 1½ hours' running time at 2ft per sec.; 14/- per spool.—A. Smart, 40, Grange Rd., Halesowen.

M.S.S. double channel RT4, comprising 2 recorders, recording amplifier, 3-channel mixer, preamp, loudspeaker, 2 S.T.C.4021 microphones, 1 hand stand, 1 floor stand, cables, etc.; £165.
B.S.R. double channel, comprising 2 recorders with speakers, recording amplifier, 2 ribbon microphones and transformers, 1 floor stand, 1 desk stand, cables, etc.; £145.
WANTED, 2 dual speed 17¼in recorders, console or motor plates only.
NORTHERN SOUND SERVICES, Ltd., Broad Chare, Newcastle on Tyne, 1. Tel: Newcastle 26304-5. [6306

GARRARD automatic record-changing unit, type RC 60/D16, complete with lightweight pick-up, brand new, boxed, £15; Avo model 40, 10gns; Avo valve tester complete with rotary selector panel, £8/17/6; Evershed 500volt megger and ohmeter (2 units) in leather case, complete with leads and instruction books, £12/10; Cossor 343 ganging oscillator and wobbulator, £17/10; 339 oscillograph, £35; FHL beat frequency oscillator, 0-10,000 cycles calibrated dial, push-pull output 50volts into 10 or 600 ohms, £25; Muirhead thermionic voltmeter; offers invited for any of the above; wanted tape or wire recorders.—Haynsons, 14, St. Mary's, Bedford. Tel. 5568

"DEMOBBED VALVES" MANUAL



giving details of Service valves and their commercial equivalents — 2/9, post free. Manual giving also British, American and Continental types.

If yours is a valve problem—Bulls are the people to solve it.

Send stamp for FREE comprehensive Valve Lists. Please enquire for any new or obsolete types. Order C.O.D.

C.R.T.: MAZDA 9in. CRM91; MULLARD 9in. MW22/14; 9in. MW22/18; 12in. MW31/17; 12in. MW31/23; G.E.C. 9in. 6504A

TAYLOR ON EASY TERMS

EASY TERMS up to 10 months—and very near Cash Price on all TAYLOR meters. Catalogue FREE.

THE TAYLOR BUZZER

For many applications. 500 cycles p.s., 3 v. 100 mA., also 4 v. A.C. 50 cycles. **5/6**

TRIMMER TOOL SET

THE TRIMMER KIT which no Amateur or Professional Radio or Television Engineer, or Service Man, can afford to be without. Contains:
1 End Trimmer, 1 Side Trimmer;
1 Yaxley Switch Contact Adjuster;
1 Low Capacity Trimmer, 1 Screwdriver;
1 Set of Feeler Gauges;
1 Set of six Box Spanners from 1 to 8B.A.;
1 Set of four Spanners from 0 to 8B.A.
In durable black crackle finish metal case **25/6**

AMPLION TEST METER

1,800 ohm per volt on all D.C. and A.C. ranges. 10 v., 100 v. and 500 v. D.C. and A.C., 50 mA. and 500 mA. D.C. Resistance up to 200,000 ohm (3,000 ohm centre scale) with self-contained battery. 5,000 volt range with a separate H.T. test prod. (9/6 extra). Supplied with test prods. Multi-colour scale easily readable **£3.17.6**

SPEAKER MATCHING TRANSFORMERS

ex-Govt. Surplus, only ...... **1/9** each

SERVICE SHEETS, the one you require on FREE Loan if you buy one dozen assorted at 10/6.

RESISTOR Colour Code Discs, 1/-.

Wearite "P" Coils, 3/- each.

WIRELESS WORLD back numbers, 12/- dozen (one of your choice included if available).

2in. balanced Armature Tel. Inserts, 4/-.

MORSE Tappers, ex-Govt., 2/-.

1 foot Aerial Rods, ex-Govt., doz. 6/-.

HYDROMETERS iron-break type, 6/-.

"PENCIL" Type Electric Soldering Irons for use with Transf. or Car Battery, 6 v. 24 watts, 10/6 only.

ELECTROLYTIC Condensers. 25 mfd., 25 v. 1/-; 5 mfd., 35 v. 1/-.

TEST PRODS, Superior Product, 3/6.

ERIE Resistor Kits, containing 96 ¼ watt insulated Resistors, all clearly marked, in metal cabinet, £2.

Kindly mark envelope W.W.

RADIO BULLS VALVES
246 HIGH ST. HARLESDEN NW10

THE
BRITISH NATIONAL RADIO SCHOOL
ESTD. 1940

Wish all readers the Compliments of the Season

* * *

NOW IN OUR 11th YEAR AND STILL

NO B.N.R.S. STUDENT HAS EVER FAILED

to pass his examination(s) after completing our appropriate study course!

NOTHING SUCCEEDS LIKE SUCCESS

and what we have done a thousand times already, for others, we can do again, for YOU!

A.M.Brit.I.R.E. and CITY and GUILDS Radio and Telecommunications Exams., etc., etc.

Six months' trial period without obligation to continue.

Please mention this advt. and send for free booklet and sample lesson to:—

STUDIES DIRECTOR
BRITISH NATIONAL RADIO SCHOOL
66, ADDISCOMBE ROAD, CROYDON
Phone: Addiscombe 3341.

Pitman Books

Antenna Theory and Design

2 VOLS.

By H. Paul Williams, PH.D., A.M.I.E.E., Sen. M.I.R.E.: *Head of Electronics Dept., The Fairey Aviation Co., Ltd.*

An important work giving a complete account of the theoretical basis of antenna design, followed by comprehensive guidance on the practical aspects. Illustrated.

Vol. I. (Foundations of Antenna Theory) 21/- *net.*

Vol. II. (The Electrical Design of Antennæ) 63/- *net.*

Product Development and Design

By A. W. Willsmore. Illustrated. 12/6 *net.*

"Mr. Willsmore assembles for the first time in one volume all the factors contributing to the successful development of a saleable product—commercial considerations, technical research, protection of inventions, market research, product design, production planning and inspection . . . the book should act like a breath of fresh air to industry."—MASS PRODUCTION.

PITMAN

Parker Street, Kingsway, London, W.C.2

GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

BAIRD tape recorder, still under makers' guarantee; £45 with microphone.—Box 7613. [6256

WIRE recorder constructional details, 1/3; stainless steel recording wire, 3,600ft reels, 5/6.—12, Rossendale Ave., Blackley, Manchester, 9. [6229

NEW Wearite tape deck, list price; two 360 deg. diffusion l/speakers, 8 watt each, £5/10, cost double; £10 two.—Theatrical Sound, 90, Grestone Ave., Birmingham, 20. [6329

NEW COMPONENTS

HANNEY OF BATH offers:—

WIRELESS World T.V. superhet, complete set of 20 coils wound exactly to designers' specifications; 45/-.

POLYSTYRENE formers, 1½in×⅜in, tapped 0 B.A. for slug, with fixing hole, 1/-; 2¼in×⅜in, 8d.

PAXOLIN formers, 1½in×¾in, tapped 0 B.A. for slug, 9d; 1½in or 2in×½in, 8d; 1⅝in×¾in, 9d; polystyrene varnish, large bottle, 1/10; 0 B.A. screwed rod, copper 2/- ft, brass 1/- ft; Eddystone 583 split stator, 8/3; B.T.H. CG1-C crystals, 11/3; H4/200 rectifiers, 28/-; co-axial cable, 1/3 yd; Dubilier type 680 condensers, 0.001 6/6 each, 0.002 7/-; Reliance pots, all values, type TW, 5/-, type SG 5/6 each; Erie resistors, ¼ and ½ watt, largest stock in the West, 4d each; also T.C.C. condensers, Dubilier drilitics, valves, tube masks, Belling-Lee and J-Beam aerials, etc.; Mullard tubes ex-stock, MW22-14C £11/6/9, MW31-14C £15/2/5.

WILLIAMSON amplifier and pre-amplifier, matched pairs of resistors, 47K 2 watt 3/-, 22K 1¼ watt 2/- per pair; Dubilier high stability resistors, all specified values, ½ watt +5% 1/3, ±1% 2/3, ¼ watt ±5% 1/-, ±1% 2/-; silver mica condensers, finest quality only, no surplus, 25 to 500 pfd, +5% 1/-, ±1% 1/3, 1,000 pfd ±20% 1/-, 4,000 pfd 2/-; 5-bank 6-position switch, a few left at 7/6; matched pair KT 66 valves, 36/6; PX 4 ditto, 36/6; 6V6G ditto, 31/8; KT 63 ditto, 31/8.

BAND-PASS converter coils (Oct. W.W.), set of 4, 10/6; Eddystone 739 split stator, 7/9; wobbulator coils, 5/6 pair; also 16 HT 28 rectifiers, resistors and reliance pots, etc., for the above 2 designs.

GOODMANS audiom 60, 135/-; axiom 150, 168/-; Wearite "P" coils, 3/- each; Denco type "C" TRF coils, 6/6 pair; "Lewcos" enamelled copper wire, ¼lb to 7lb reels, all gauges; nuts, bolts, washers, studding, systoflex, etc.

ALL Avo and Taylor instruments supplied, list on request. We supply everything for WW, PW, EE, and Bernards designs . . . get our quotation, retail only; send 3d stamp for all lists.

L. F. HANNEY, 77, Lower Bristol Rd., Bath. Tel. Bath 3811. [6330

TELEVISION-WW S'het, the long-range receiver; trade supplied.

COIL sets complete, reduced to 42/6; RF chassis in copper, inc. 11 screening cans and V/H, 52/6; complete chassis sets, angles, clips, V/H, power unit, 98/-.

SCANCOILS, mounted set, 35/-; focus coils, potted 37/6; mains trans, heavily made, 77/6; chokes, 50/-; blocking trans, 1:1, 15/-; line trans, 42/-; E.H.T. sub-chassis, assembled, 70/-.

CONDENSER kits, latest types, Germanium Xtals, 22/- pair; Westhet recs, 16/6 each; booklets, 5/- each; alignment, 25/-.

WOBBULATOR, set 2 iron cored coils, 7/6; 10m convertor, set of 4, 12/6; Williamson tuner coils, 7/6 pair or wound to order at 4/6 each; Polysterene rod, tube, ⅝in, 6 and 8mm coil-formers, Belsol Poly cement, 1/10; L.M.S. s'het coils, on 2 miniature formers, iron cored, 9/6; SW, MW s'het coil packs, few only, unwired but assembled cct supplied, 13/6.

BEL SOUND PRODUCTS Co., Marlborough Yard, London, N.19. [0183

CRYSTAL microphone inserts (Cosmocord Mic-6), guaranteed brand new, 15/6, post free.

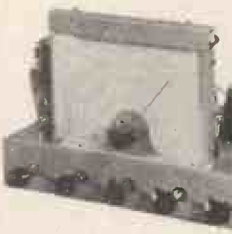
RADIO-AID, Ltd., 29, Market St., Watford. Tel. Watford 5988. [0036

G. A. RYALL, "Utopia," Mayfield Rd., Herne Bay, Kent, offers post free bargains, all new and unused.

INSTRUMENT boxes, metal, thick gauge, black finish, size 8½×7½×3½ deep, with paxolin lid quarter inch, with fixing lugs for wall or bench, and corner sockets for panel fixing, 6/9 each; minature instrument switches, SB.2P.6 way, 1/3; meters, good make boxed, 2½in or 3¼in overall, 0-30ma, 5/9; meters 2in square front 0-300 volts, separate series resistance, FSD 5ma, 5/9; both m/c and flush panel front fixing; Paxolin panels 12×12 and 12×8 quarter inch, 4/- each; also strips about 1ft×5in, Govt. quality, about three-eights thickness, 1/9; switches, Yaxley pattern 2B 3P 3w, 1/6; 2B 2P 6w no stop, 1/3; 3B 2P 6w, five poles only, 1/6; four gang condensers, 0.0004mf, bridge tested each section, straight type, quarter spindle, 3/10; three gang ditto, 3/10; condensers, tubular 0.1mf 350v, wire ends, metal cased, 5/- dozen; Mansbridge 4mf 400v wkg, terminals and feet, 2/-; 1mf 500v wkg, 1/3; mica types, 0.01mf 350v wkg, wire ends, 3/6 dozen, and 0.004mf 1,250v wkg, 3/6 dozen, insulation and condition perfect; low tension resistors, vitreous, four ohms, no taps, and 3.59 ohms tapped at 2:1 ohms, 0.55, 0.94 and 23 ohms tapped at 13.8 ohms, 1.8, 8.3; and wire wound on porcelain eight ohms two taps semi-fixed, all heavy duty at 1/6 each; large quantities available of most items; full trade list on request. [0204

ALLEN & GOULD, 5, Obelisk Parade, Lewisham, S.E.13. Please see our displayed advertisement under name Garland Brothers on page 66. [0191

The FIDELIA



The 7-valve Fidelia chassis illustrated incorporates all the special features that have made the range so popular. It has a 5-watt triode output stage and electronic tone control circuit suitable for 78s and L.P. records. 3 wavebands—16-50, 190-550 and 1,000-2,000 metres, with tandem coupled variable selectivity and cathode follower detector. Frequency range of audio section is 30-18,000 cycles. Price **£18/5/-**.

Other models include:—**Fidelia Plus**, an 8-valve model similar to the above, but with additional R.F. sensitivity. Price £20/12/-. **Fidelia de Luxe**, 9-valve model with push-pull output and twin triode phase inverter stage additional to above. Price £21/5/-. **Preciton "5."** The smallest unit in our range. 3 wavebands, 3-watt triode output. Price £12/17/6.

Technical Data sheets willingly sent on request. All equipment guaranteed for 12 months, and supplied on 7 days' approval against full deposit.

ELECTRO Acoustic DEVELOPMENTS
18 Broad Road, Willingdon, Eastbourne

M. & J. PEARSON

263, GALLOWGATE, GLASGOW, C.4

Offer the following Clearance Lines:—

0.500 Micro Ammeters, 2½in. Flush Type. New **16/6** each.

0.100 Micro Ammeters, 2½in. Flush Type. Calibrated 0.1500, **16/6** each.

0.20 Volt A.C., 2½ Flush Type, **8/-** each.

0.5 amp. R.F. meters, 2 square, **3/6** each.

0.50 M/Amp., 2½ surface mounting, **6/6** each.

100 k/c. Crystal R.C.A. or Bliley, 12/6 each.

Selenium Rectifiers, 24 volt, 4 amp. full wave, **25/-** each.

Selenium Rectifiers, 12 volt, 4 amp. full wave, **15/-** each.

Choke I.O.H., 650 m/a., totally enclosed, 7×7×7in., weight 30lbs. Made by Parmeko, **25/-** each.

Swinging Chokes, 3.6.4.2H. 250 m/a. Totally enclosed. 4½×4×3½, 7lbs. Parmeko. **7/6.**

All prices include postage.

Cash with Order and please write name clearly.

THE MODERN BOOK CO.

Television Receiving Equipment. By W. T. Cocking. 18s. Postage 9d.

Sound Reproduction. By G. A. Briggs. 10s. 6d. Postage 6d.

Encyclopaedia of Radio and Television. 15s. Postage 9d.

Short Wave Wireless Communication. By Ladner & Stoner. 50s. Postage 9d.

Radio Engineers' Handbook. By F. E. Terman. 50s. Postage 9d.

Radio Servicing. By A. Marcus. 35s. Postage 9d.

Testing Radio Sets. By J. H. Reyner. 22s. 6d. Postage 9d.

Radio Valve Data—compiled by "Wireless World." 3s. 6d. Postage 3d.

Wireless Servicing Manual. By W. T. Cocking. 12s. 6d. Postage 4d.

Ediswan Mazda Valves. 1949-50. 2s. Postage 3d.

Technical Instruction for Marine Radio Officers. By Dowsett & Walker. 60s. Postage 9d.

Radio Receiver Design. By K. R. Sturley. 2 volumes. 28s. each. Postage 9d.

Transmission Lines and Networks. By W. C. Johnson. 42s. 6d. Postage 9d.

Ultrasonics. By P. Vigoureux. 25s. Postage 9d.

We have the finest selection of British and American radio books in the Country. Complete lists on application.

19-23 PRAED STREET
(Dept. W.1)
LONDON W.2
PADdington 4185

NEW ELECTRONIC SUPPLIES Co.

281 LEEDS ROAD, FAGLEY, BRADFORD, YORKS.

MAIL ORDER ONLY.

ALL THE FOLLOWING 200/250 INPUTS VARNISH IMPREGNATED AND HARD BAKED. F = FULLY SHROUDED. S = HALF SHROUDED OR SUNK TYPES. LARGE OR SMALL SPECIALS QUOTED FOR WITHIN 48 HOURS FROM RECEIPT AND MANY OTHER TYPES AVAILABLE

S275. 250/0/250 75 m/A 6.3 v. 3a., 5 v. 2a. at 17/6
*S350 350/0/350 90 m/A .... at 18/6
*S 250 250/0/250 110 m/A .... at 21/-
*S 300 300/0/300 110 m/A .... at 21/6
*S310 350/0/350 110 m/A .... at 22/-
*Above 4 have L.T.s 0-4-6.3 v. 4 a. 0-4-5 v. 2 a.
S315. 350/0/350 150 m/A 6.3 v. 3 a. C.T. 5 v. 3 a. .... at 28/6
F425 425/0/425 200 m/A 6.3 v. 4 a. C.T. 6.3 v. 4 a. C.T. 5 v. 3 a .... at 52/6
F315 350/0/350 150 m/A 6.3 v. 6a., 6.3 v. 3 a., 5 v. 3 a. .... at 42/6
*F350 350/0/350 90 m/A .... at 20/-
*F250 250/0/250 110 m/A .... at 22/6
*F350 350/0/350 110 m/A .... at 25/-
*Above 3 L.T.s 0-4-6.3 v. 4 a., 0-4-5 v. 3 a.
FM63 200/250 in 6.3 v. and 2 a. .... at 8/3
FM126 12.6 Tapped 6.3 v. 3 a .... at 17/3
Above 2 Skeleton Finish.
Williamson O.P.T. to Specification at £3/18/9
10H 20 m/A choke .... at 16/-
10H 150 m/A choke .... at 29/9
B.I. Condensers Carton type 8 mfd. ... at 3/2
B I. Condensers carton type 8+8 ... at 4/9
B.I. Condensers can type 8+8 (clip 4d. extra) .... at 5/-

TERMS: CASH WITH ORDER. CARR. PAID

COMPONENTS—SURPLUS AND SECONDHAND

RADIO CLEARANCE, Ltd.

TELEVISION! A set of 3 components, comprising line output transformer, with width control and E.H.T. winding giving 7kV (using EL38 or 80Y and EY51); line and frame scan coils (both low impedance); focus coil (res. 10,000Ω current approx. 20mA). 42/- the set, plus 1/6 postage; line and frame scan coils (low imp.), as Viewmaster. 12/6, post 1/-.

50w MODULATORS, complete with power supplies, 0-110-200/250v, 50c/s, 8 valves, 6C5 into 6C5's p.p., into 807's p.p., 3 rectifiers, paper smoothing condensers throughout, jacks for key, mike and line; the power unit gives 500v 200mA (d.c. smoothed) and 6.3v 5a, in addition to supplying the modulator; complete outfit with circuit diagram in metal case (21in rack mounting panel) contained in solid oak case no mod. trans., to clear the remainder of our stock at reduced price; £8/10 carr. paid.

AIRCRAFT receivers, C.R.V. 46151, 6-v receivers covering 195kc/s-9,050kc/s in 4 bands, switched R.F., mixer, 3 I.F.'s, det. output, BFO, 4×12SF7, 1-12SA7, 1-12A6, power from 28v dynamotor, supplied with valves and dynamotor, used but O.K., to clear, last few £4/15, carr. paid; a.c./d.c. amplifiers, complete kit for construction of 20w, 8v amplifier, by McMurdo, all first-class components, by Partridge, Gardner, etc., valves 4×CL33, 2×EF37, 2×UR3C, black crackle, chassis and case, isolated from mains, and drilled, circuit diagram supplied, everything complete, £10/19/6, carr paid; television focus coils, for 9 or 12in mag. tubes, res. 10,000Ω, average current 20mA, 7/6, post paid.

PERSONAL receivers, 3 valve T.R.F. using 1T4's, contained in handsome bakelite case with lift-up lid size 7×6½×5in with lid closed, plastic carrying handle, frame AE in lid, these receivers cover the medium waveband and operate from self-contained dry batts., standard types, W1435 and U2, output to a pair of lightweight 'phones (H.R.) controls, SM tuning and reaction, opening lid switches on, supplied brand new, with valves, batteries, 'phones, an ideal set for invalids, hosp. patients etc., these receivers are not Govt. surplus and are offered ready to play; carr. paid, £5/19/6.

CHASSIS Steel 5¼in×5¼in×1½in, drilled, 4-button base holes, 1/9, 5×9×1½in, drilled 7-button base holes, 2/3; ali., 17×9½×2¾in, drilled 7 int. octal and square, open ends, 3/-; E.H.T. trans. 4kv 1mA 2v 2a. secs., primary 230v, 50c/s, gives approx. 5,500v with usual smoothing, 29/6; primary, 0-110-210/240v, 50c/s, sec. 300-0-300v, 80mA, 4v 2a, 6.3v 2.5a, 15/6; primary, 230/250v, 50c/s, secs., 460v, 200mA 210v 15mA 6.3v 5a, 12/6; all trans. post paid; smoothing chokes, 20H 80mA, 350ohm, 6/11; 5H 200mA, 100Ω 5/6; 6H 200mA 100Ω, 6/6; 8H 250mA 50Ω, size 4×5×5, shrouded 10/6; all post pd.; electrolytics, 8mf 450v, 2/3; 16+8 350v Can, 3/-; 32 350v card, 2/-; 32 450v card, 2/6; 60+100mf 350v Can, 3/-; 25 25v, 1/3, 25 50v, 1/3; 50 25v, 1/3; 100 12v, 1/-; 50 12v, 9d; output trans., 2,000/2Ω, 2,500/2Ω, 2,750/2Ω, 3,000/2Ω, 6,000/2Ω, 7,000/4Ω, all at 3/-; 3 ratios, 7,000-3,500-1,750/4Ω, 4/-; switches standard Yaxley, 2p 4w 3b, 2/6; 1p 10w 2b, 2/6; 2p 4w 2b, 2/-; 2p 4w 1b, plus additional wafer with shorting plate, 2/-; all have 3in spindles; superhet coils, ½in×1¾in, formers, M wave, H.F., Ae., Osc. L wave, H.F.Ae., Osc., 1/6 per coil, midget I.F. trans., 465 kc/s, iron cored, size 13/16in dia., 1 13/16in height, 10/- pair.

METERS, metal cased 2in circular, 0-15/600v req. ext. res. 6/6, 0-20A or 0-40A with shunts, 5/-; bakelite, cased 2in square 0/1mA 8/6, 0/5mA 6/-, 0/50mA 7/-, 0-300v series res. supplied 7/-, 0/20v 5/-; bakelite cased 2½in circular 0/30mA 7/-, 0/100mA, 0/200mA 8/6, all meters flush mounting, post extra; visual indicators type 1, crossover needle 2—60 microA movements with common magnet, 3/-; SM dial as on RF26, etc., less cursor 3/11; rotary power units type 104, 12v D.C. input, output 250v 60mA, 6.5v, 2.5A, D.C. P.M. rotary mounted on chassis with supp., 6/-, post paid; Type 87, 24v input, output as 104, 5/6; plugs and sockets, bakelite with keyway, 5, 7 and 10 way, 1/6 pair; 8 way "Jones" plugs and sockets with cover, 1/6 pair; bakelite cases with lid, inside meas. 6×6¼×3¼in without lid, lid 1in deep with former for frame AE, lid requires fixing, ideal for personal sets, meters, etc., 7/6, post paid; extension speaker controls, 10Ω wire wound, ¼in spindle, 9d each.

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London W.1 Tel. Museum 9188 [0015

AMATEURS, dealers servicemen why pay fancy prices? "Be in the know." Send s.a.e today for list that will save you pounds; goods c.w.o. only; money back guarantee; don't delay!

ANNAKIN, 25 Ashfield Place, Otley, Yorks

OSCILLOSCOPE cabinets, 11×9×6½, complete with chassis containing support and holder for VCR 139 tube 2 potentiometers, various resistors, etc.; the cabinet has hinged viewing hood with plate glass window; supplied with full conversion data, 10/- each, plus 1/4 postage; 2in moving coil microphone inserts, 45 ohm, suitable for microphones or miniature extension speakers, 3/- each, plus 4d postage.

VALVE volt meter pocket size, complete kit of parts for home construction which includes black crackle case size 4¼in×3¼in×1¾in already drilled with hinged back, high-class moving coil meter, miniature valve and base, switch, leads, battery, etc., with full instructions; this instrument, when constructed will cover ac, audio and RF test work over the low voltage range of 0-5 volt, price 27/6 and postage 1/-.

TELEKIT SUPPLY COMPANY, 51, Addington Rd., West Wickham, Kent. [6138

RADIO SUPPLY Co.

34, Hanover Street, Park Lane, Leeds.

BRAND NEW GUARANTEED GOODS

MAINS TRANSFORMERS. Fully interleaved and impregnated. Primaries 200-230-250 v. Screened.

Drop through types, with TOP Shroud
260-0-260 v. 70 m/a., 6.3 v. 3 a., 5 v. 2 a. 12/11
250-0-250 v. 70 m/a., 6.3 v. 2 a., 5 v. 2 a. Midget, 2½-3-2½in. 14/11
350-0-350 v. 70 m/a., 6.3 v. 2 a., 5 v. 2 a. 15/9
350-0-350 v. 80 m/a., 6.3 v. 2 a., 5 v. 2 a. 17/9
350-0-350 v. 100 m/a., 6.3 v. 3 a., 5 v. 2a. 19/6
350-0-350v. 120 m/a., 6.3 v. 4 a., 5 v. 3 a. 23/9
350-0-350 v. 150 m/a., 6.3 v. 4 a., 5 v. 3a. 25/9

Fully Shrouded Upright Mounting Types
250-0-250 v. 60 m/a., 6.3 v. 3 a., 5 v. 2 a. Midget, 2½-3-3in........ 15/6
350-0-350 v. 70 m/a., 6.3 v. 2 a., 5 v. 2 a. 16/9
250-0-250 v. 100 m/a., 6.3v. 6 a., 5v. 3a. 23/9
350-0-350 v. 100 m/a., 6.3 v.-4 v. 4 a. C.T., 0-4-5 v. 3 a........ 21/6
350-0-350 v. 150 m/a., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a........ 27/9
425-0-425 v. 200 m/a., 6.3 v.-4 v 4 a. C.T., 6.3 v.-4 a. 4 a., C.T., 0-4-5 v. 3 a. 42/6

ELECTROLYTICS. 8 mfd. 450 v. Small Met. Tubs, 1/11 each; 16 mfd. 350 v. Small Cans, 2/3 each, 18/6 dozen; 8-16 mfd. 450 v. Cans, 3/6 each; 50 mfd. 12 v., 8d. each, 5/6 doz. 4 mfd. 200 v. Tubs, 6/- doz.

SMOOTHING CHOKES. 40 m/a., 10 h., 360 ohms, 3/3; 60 m/a., 15 h. 400 ohms, 4/3 each, 42/- doz.; 80 m/a., 12 h., 350 ohms, 5/3 each, 45/- doz.; 100 m/a., 10 h., 100 ohms, 200 m/a., 5 h., 100 ohms, 7/6 each, 66/- doz.

OUTPUT TRANS. 6V6 to 2-3 ohms (Small), 1/11; Push-pull 10 w. 6V6, PX4, 6L6 to 3-5-8-15 ohms, 15/-. Williamson type, exact to author's spec., 63/-.

MISC. ITEMS. Ex-Govt. Aladdin Coil Formers, slug tuned, 4/- doz. Clix int. Oct. Valve Holders. 2/9 doz. Receiver Cabinets, 16½ x 9½ x 7½in. approx., cut for Dial and Speaker Complete with speaker fabric and back. Cream cellulose finish, 10/6. T.V. Masks. 12in. Cream. 12/9.

TERMS. C.W.O or C.O.D. over £1. Post extra under £2. Full list 3d. Special List for Trade, 3d

★ PUBLIC OPINIONS! ★

Read these extracts from letters requesting a copy of the Candler **"Book of Facts."**

"I have heard such lavish praise from members of the R.S.G.B. and personal friends regarding your methods of teaching Morse that I write for your 'Book of Facts'."

"I am an absolute beginner, but knowing of the efficacy of the Candler Sytsem, I should be glad if you would forward your 'Book of Facts'."

"I am just a beginner of Morse and I would like to improve. I have heard glowing reports of your system and am very interested."

"Kindly send me details of your 'Scientific Code Course for Beginners.' I know enough of your system and its merits not to require any testimonials."

The following extracts are from letters sent us by Candler students—

"I would like to take this opportunity of thanking you, not only for the Course, which I consider to be unbelievable 'value for money,' but also for your kindness and personal attention." *REF.* 3120. *N.H.*

"I have successfully passed the P.M.G. amateur's licence test and have been allotted my callsign. I took it with ease, after completing lesson 3." *REF.* 3301 *V.H.T.*

"Have passed out on the final Morse exam. here with a plain language speed of 30 w.p.m. and code/letter groups mixed at 28 w.p.m. Sending at 30 w.p.m. *REF.* 3601 *E.L.*

"I passed the code test to obtain my Amateur licence with flying colours. The Telegraph Inspector wanted to know where I had learnt to do Morse with such precision and co-ordination. I could do nothing but give all the honours to the Candler System . . . At present I am able to get a good 25 w.p.m. without any faltering." *REF.* 2566 *P.J.L.*

There are
CANDLER MORSE CODE COURSES for Beginners and Operators. Write for the Candler "Book of Facts." Free on request.

THE CANDLER SYSTEM CO.

(Room 55.W)—121 KINGSWAY, LONDON, W.C.2

Candler System Co., Denver, Colorado, U.S.A.

COMPONENTS—SURPLUS AND SECONDHAND

"YOU'LL probably get it at Smith's, Edgware Rd.!" Everything for the constructor, from a 1/10watt resistor to a radiogram cabinet, lowest prices, biggest variety.—Near Metropolitan Music Hall. Pad 5891. [0114

INDICATOR units type 184A, fitted 3in and 6in cathode ray tubes, type A.C.R.10 and V.C.R. 517B, and 17 valves, viz., 6 R.92, 5 V.R.91, 3 V.R.54, 3 V.R.65, metal rectifiers, chokes, transformers, potentiometers, resistances, condensers, etc., £3/10 each, carriage 10/-.

SYNCHRONOUS clock units, self-starting, 200-250v a.c., 50 cycle, fitted Sangamo motors, consumption 2½ watts, size 2¾in diam., 2in deep, geared 1 rev 60 mins friction reset.

IDEAL movements for making electric clocks, time switches, etc., complete with 12 to 1 dial train and 3in hands, price 22/6, post paid.

SANGAMO as above, final speed one rev per min. less dial train, ideal for dark room process time, etc., price 20/- each, post paid.

CRYPTO rotary converters, input 24 volts d.c., output 230 volts a.c., 50 cycles, 100 watts, fitted carrying case, £4/15 each.

H.F. aerial change-over switches, type 78A manual or relay operation, 24 volts, size 5¼in×4in×2in, £1/7/6 each.

COLVERN wire wound potentiometers with switches, sizes 10, 25, 500, 50 and 1,000 ohms, in lots of twelve or more, 32/- per doz.

PERFORMANCE meters type No. 2, fitted standard mains 230v a.c., 50 cycle, power pack, 2 V.R.91, 1 V.R.137, 1 5Z4G, 1 C.V.51, 1 V.R.92, and other useful components, £2/5 each, carriage 3/6.

NEW Klaxon, 200/250 volt, 50 cycle, a.c. motors, capacitator inductance start, 2,700 rpm, 1/40hp, fitted in cradle, condenser supplied, price £2/7/6 each.

NEW ex-R.A.F. English Electric electronic ignition testers, type Ref. No. 5G/447, input 230 volts a.c. 50 cycles, 6/12/24 volts d.c.; £19 each.

STEP-DOWN transformers, input 230v a.c. 50 cys., output 6.3-0-6.3 volts 19 amps; £2/12/6 each.

ADMIRALTY pattern heavy duty l.t. transformers, primary 230 volts 9 amps, secondary 18 volts 108 amps, centre tapped; £12/10 each.

WESTINGHOUSE rectifier sets, style 23B, G.P.O., input 200-250 volts a.c., 50 cycles, output 50 volts d.c., 1½ amps; £3/10 each, carr. paid.

DITTO rectifier sets, output 50 volts d.c., 3 amps; £6 each.

JANETTE rotary converters, input 115 volts d.c., output 110 volts a.c., 50 cy., 150 watts; £4/15 each.

A LARGE assortment of various ex-W.D. radar and radio equipment, relays, power packs, oscillograph units, gears, photographic apparatus available; s.a.e. for lists.

H. FRANKS, 58, New Oxford St., London, W.C.1 Tel. Museum 9594. [0057

COMMUNICATION receivers in stock. Hammurlung Super Pro, H.R.O. Seniors Hallicrafter S.52 C.R.100, A.R.88D., A.R.88L.F., etc., all in perfect order; R.1155 receivers in new condition, complete in original transit cases, your enquiries are invited for rotary convertors and electric motors, most sizes and types available from stock; motor alternators, 110v d.c., input 230v a.c., 50 cycles, 250 watt output, £8; special clearance of F.H.P. electric motors, 35/-, 110v-250v a.c.

UNIVERSAL a.c./d.c. motors, suitable for sewing machines, 40/- each; 12v-15v a.c./d.c. motors with extended spindle, suitable for models, etc., 9/3; 20watt P.A. rack mounting amplifier, new and complete, with heavy duty a.c. power pack, 200/250v, PX25 P.P. output, £4/10, less valves; new moving coil microphones hand type, heavy duty and complete with 12yd screened cable, £3/15; 2 only as new B.T.H Jenson cinema speakers, energised, and twin unit multi-cellular horn unit; 20ft telescopic tubular T/V mast, 15/6 each; large selection of test equipment; multi-range meters, valve testers, signal generators, oscilloscopes, bridge meggers and meggers, etc., all at reasonable prices; hand bearing prismatic compasses with provision for battery in handle, perfect, 40/- each; very large stocks of transmitting valves, Keystones, of all types, send us your requirements; special offer of new, not ex-W.D., mains trainformer, semi-shrouded, 200/250v tapped primary, 250-0-250, 100ma., 5v 3amp 6v 4amp, 20/- each; large stocks of L.T transformers, special sizes and ratings wound to specification; a.c. and a.c./d.c. gram motors and auto-record changers in stock from £10/15; switchboard mounting voltmeters, ampmeters, various ranges a.c. and d.c. available at cheap prices to clear; large stocks of enamelled wire, 28 s.w.g., 18 and 20 s.w.g., DSG No. 15 U.X. base American valves available. Special offer: H.R.O. coils 48-.96 m/c and 180-430 k/c, 45/- each; quantity of litz and nickel chrome wire available; prices do not include postage.

SERVICE RADIO SPARES 4 Lisle St., W.C.2. Gerrard 1734. [0188

RADIO UNLIMITED offer p.m. speakers guaranteed new stock, 3in 10/-, 5in 12/6, 6½in 12/6; output trans, midget 3/1, standard 5/3; condensers, fresh stock, 8 mf 450v 2/3, 8×16 450v 3/6; V/controls, L/spindle, 10K to 2 meg. 2/6; W/sw. 3/9; mains trans. 350-0-350, 6v. 5v. tapped at 4v 80 m/a. 16/6; chokes, 7H 80 m/a. 6/3; M/coil Vmeter, 12-120v, 9/6; 0-500 M/amp meter, 6/6; int/oct V/hldrs. amph. 6/- doz; B7G, 9/- doz; M/coil hand mics. 5/6; new headphones, 5/6; co-ax cable, 80 ohms, 10/- doz yds; bargain parcel, switches, odd lengths flex, resistors, condensers, etc., 5/- post free; type 25 receiver, less valves, 6/9 post free; microphone trans, 3/6; hundreds other bargains; 1d stamp list.

RADIO UNLIMITED Elm Rd., London, E.17. Tel. Key. 4813. Open all day Saturday. [0062

COMPONENTS—SURPLUS AND SECONDHAND

WALTON'S of Wolverhampton.

HAVE you received a copy of our New Year Bulletin? If not, why not send a s.a.e. today? You will be amazed at the value we offer. Here are a few examples:—
5NP1 Cathode Ray Tubes, brand new in makers' boxes, 30/, post 1/-; 931A Photo Electric Cell Units, 20/- each, post 6d; 455KC Crystal Filter Unit in case, 10/- each, post 3d; 1196 Receivers, less valves, 7/6 each, post 1/-; 2 Valve Mine Detector Amplifier Panels, 3/6 each, post 1/-; U.H.F. Transmitter-Receiver with all valves, 79/6, carr. free; steel masts 22ft in 4 sections, 20/-, carriage 3/6; Multi Ratio Mains Transformer (MT.2), 230v input, a large range of outputs from 6, 12, 50, 115, etc., can be obtained; full instructions given, ideal for small motors, chargers, etc., 12/6 each, post 1/-; boxes of assorted screws, nuts, washers, etc., 0ba to 8ba, up to 2lb in weight and approx. 1,000 different items, 3/6 per box, post 6d; Ni-fe accumulators brand new, but store soiled externally, 15 A.P.H. Cap., 12/6 each, post 1/-, 3 for 30/-, post 2/6, 12 for £5; Turns Counter, made by Veeder 0-999 in steps of 1/10, price 5/- each, post 6d.
WALTON'S WIRELESS STORES, 203, Staveley Rd., Wolverhampton (Mail Orders), 48, Stafford St., Wolverhampton (callers only). [0061

MARCONI high-speed morse tape recorders with 230v a.c. motors variable speed control; type U.G.8 (Inker), post-war model, apparently unused; also type 180 (punches holes), with speed indicator to 400 w.p.m.; both types complete, £18 each.—P. B. Crawshay, 166, Pixmore Way, Letchworth, Herts. [6277

MICROPHONE handsets: Carbon 4/6, moving coil 3/6, power (Tannoy) 4/6. Headsets and microphones: Moving coil 8/6. Earpieces single: Moving coil 2/-, electro-magnetic 810 ohms 9d, 4 ohms 6d, electro-magnetic microphones 2/6, electrostatic meters 0/2,000 17/6. PASSINGHAM, North St., Keighley. [0002

NOTICES

BRITISH SOUND RECORDING ASSOCIATION.
THE current lecture season is meeting with great success, membership of the Association has become essential to everyone actively engaged or keenly interested in high quality sound recording and reproduction; lectures and demonstrations on all aspects of electro-acoustics are given at the meetings; reports, papers and other valuable material appear in the journal; a few specimen copies of which are available to non-members, price 2/9 p.f.; the very successful 1950 Exhibition will again be held in 1951 and preparations have already commenced, this will be the outstanding event of the coming year and is free to members; full information is contained in the brochure and other material which, with a Membership Application Form, may be obtained from the Membership Secretary: Harrie J. King, 48, Mount View Rd., North Chingford, London, E.4. [0119

WANTED, EXCHANGE, ETC.

WANTED, OA4-G valves, any quantity; write quoting price.—Box 7623. [6280

AR88, or similar, at sensible price.—Tel. Liberty 4157 or write Box 7679. [6307

WANTED, Magnetophon Tons B, with spares (amplifier not required).—Box 2665. [0198

WANTED, dynamometer a.c. test set, also oscilloscope type 339A, also L050A oscillator.
LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176

WANTED, HRO coils, Rx's, etc., AR88's, BC348's, etc., details to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

WANTED, laboratory test equipment including standard signal generator, watt meter, oscilloscope, bridges, recorders; send price and details to:
HATFIELD INSTRUMENTS, 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779. [0037

SURPLUS stocks of valves and components, must be in perfect condition.—Particulars and price required to Radio Unlimited, Elm Rd., London, E.17. [0070

WANTED, all types of radio equipment, test instruments, radio receivers, personal sets, television, components, etc., etc.; call write, send or 'phone.
MILLER'S RADIO, 38a, Newport Court, Charing Cross Rd., London. [5221

WANTED, surplus relays, impulse switches, sparking plugs, 5-way, push-button units; any condition; large or small quantities; highest prices paid.—Box 4660. [5579

WANTED, new surplus valves of all descriptions, large or small quantities; tubes, type 725A, 723A/B, 829B, 1B24 or 1B22; all types of test instruments; Selsyns, Magslips receivers and transmitters; best prices; immediate settlement.—Write G. Lawrence & Co., 61, Byrom St., Liverpool, 3. [5892

WANTED, Coheres, Fleming valves, Lieben-Reisz relay, Round's type "C," "T," "N" and "CA" valves, Langmuir Pliotron, early Post Office repeaters, Marconi-Osram four-electrode and type M.T.3 valves, Siemens-Halske Schottky tetrode, French Horned or Kamerad, White and Lowe multiple valves, also other early vacuum tube specimens to augment a personal historic collection; full details and price, etc., to—P. Kallus, 4625, Clausen Avenue, Western Springs, Illinois, U.S.A. [6282

Cabinets of Distinction . . .

RADIOGRAM CABINETS
RECEIVER CABINETS
RECORD CABINETS
DRAWER UNITS

Catalogue available on request.

Chassis

A.C., 5-valve 3 w/b Superhet Radiogram chassis. Absolutely complete kit of parts including wiring diagram .... **£10 . 0 . 0**

Or fully wired and tested .... **£11 . 15 . 0**

Amplifiers

Four to fifteen watts output. Wired, or in kit form from .... **£3 . 15 . 0**

Full details of above available on request.

LEWIS RADIO CO.

(DEPT. 151), 322, HIGH ROAD, WOOD GREEN, LONDON, N.22

Telephone - - - BOWes Park 5997

RADIO SALE

Of slightly used and secondhand High Fidelity Equipment by Leading manufacturers.

A.C. & A.C./D.C. Amplifiers, from **£5/10/-.**
Radio Feeder Units, 5 to 12 gns.
Tone Control Units, £3/10/- and £5/10/-.
6 and 8in. M/C. Speakers, 12/6 each. 10 inch **29/6** ; 12 inch from **£3/10/-.**
Two only **Radiograms** fitted with 7 valve push-pull chassis.
Lightweight **Pick-ups,** from **£1** each. **Gram. Motors,** A.C. only, **£2/10/-** each.
Several A.C. and A.C./D.C. **Receivers £10** each. These are new and unused but slightly soiled, costing over double this amount.

During the above sale we will still be holding **Demonstrations** of the following manufacturers' products at usual list prices. **Leak, Goodsell, Sound Sales, Acoustical, Decca, Wharfedale, Goodmans, Tannoy and Armstrong.**

HOLLEY'S RADIO STORES

285, CAMBERWELL ROAD, S.E.5

'Phone: RODney 4988

WANTED, EXCHANGE, ETC.

WANTED, junction boxes JB-70-A and T-50 microphones. PCA radio.—Cambridge Grove, London, W.6. Tel. Riv. 3279. [0080

WANTED, BC-610 Hallicraters transmitter, SX-28; AR-88s receiver and spare parts for above; best price.—Write Box 860, c/o Eplers Service, 69, Fleet St., London, E.C.4. [0081

WANTED, junction boxes for Hallicrafter transmitters JB-70-A, also Antenna tuning units BC-939-A and T-50 microphones.—PCA Radio, The Arches, Cambridge Grove, W.6. Tel. Riv. 3279. [0167

REPAIRS AND SERVICE

MAINS transformers rewound, new transformers to any specification.
MOTOR rewinds and complete overhauls; first-class workmanship, fully guaranteed.
F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 3855.

LOUDSPEAKERS rewound and cones fitted, any make, prompt service.—Model Loudspeaker Service, 34a, Bullingdon Rd., Oxford.

MAINS transformers rewound or constructed to any specification; prompt delivery.—Bede Transformer Co., Ltd., Bedesway, Bede Trading Estate, Jarrow. [3198

TELEVISION, radio and amplifier repairs or modifications; home-built receivers aligned and tested; quotations by return; any type transformer or coil supplied.
BERNARDS, 12, Chelverton Rd., Putney, London, S.W.15. Put. 7538. [0099

REPAIRS to moving coil speakers, cones; coils fitted, field rewound or altered; speaker transformers, clock coils rewound; guaranteed satisfaction, prompt service.
L.S. REPAIR SERVICE, 49, Trinity Rd., Upper Tooting, London, S.W.17. Balham 2359. [0110

AISH rewinds.—No delay transformers, mains, TV, output, chokes, also to your specification; vacuum impregnation, interleaving, new tag panels; our aim—your satisfaction.
AISH & Co. Ltd., Vanguard Works, Poole, Dorset. [6218

REPAIRS.—E.H.T., mains and O.P. transformers, field coils and chokes; also armatures and motors; new transformers designed to any specification; all work fully guaranteed.
WILLESDEN TRANSFORMER Co., Ltd., 781, Harrow Rd., N.W.10. Tel. No. Ladbroke 2846.

RADIO MAINTENANCE SERVICE for guaranteed rewinds and repairs; armatures, F.H.P. motors, vac. units, portable tools, etc.; good deliveries.—139, Goldhurst Terrace, N.W.6. Mai. 6133. [9925

"SERVICE with a smile."—Repairers of all types of British and American receivers; coil rewinds; American valves, spares, line cord. —F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [0112

ELECTRICAL measuring instruments of every make, multi or single range, repaired and standardised; prompt attention.—The Electrical Instrument Repair Service, 329, Kilburn Lane, London, W.9. Tel. Lad. 4168. [3715

A SECOND-to-none rewind service, reliable, neat, return of post service; your television requirements promptly executed, EHT, LHT and heater transformers; stamp for quotations.—R. E. F., 137a, Ashton Rd., Oldham. [3519

METROPOLITAN RADIO SERVICE for rewinds, mains and E.H.T. transformers, chokes and field coils; new transformers designed and manufactured singly or in quantities.—Metropolitan Radio Service Company, 1021, Finchley Rd., London, N.W.11. Tel. Speedwell 3000. [0130

WORK WANTED

DRAUGHTING, tracing and photoprinting services; estimates free; contractors to the Ministry of Supply and the Admiralty for drawing and tracing work to their requirements and specifications; sub-contracting work of this nature undertaken.
DRAWING & TRACING, Ltd., 456a, Ewell Rd., Tolworth, Surbiton. Tel. Elmbridge 7406. [5975

J. MORT, B.Sc., A.M.I.E.E., offers to the trade and amateur a service of technical advice, design and construction of special test gear, receivers and other apparatus, including correction of faults in home-built apparatus.—J. Mort, BCM/HIFIDEL, W.C.1. [5752

MISCELLANEOUS

WALNUT radiogram cabinets; stamp leaflets. —Cabinetware, 1a, Heyes St., Blackburn.

WALNUT radiogram cabinets, stamp details. —E. Wisker, 501, Hale End Rd., Highams Park, E.4. [6298

CABINETS!—Over 85 mixed T.V. and radio table models, £2 each or reduced price for bulk purchase.—Tel. Hol. 1067, after 6 p.m. [6321

DISPOSAL.—American and British service sheets, radio and T.V., Brans, Vade Mecum, assorted technician-radio books and data.—Tel. Welbeck 4893. [6255

QUANTITY double Rayon covered copper wire on makers' reels, in various gauges from 22 to 35 swg, all at 2/- lb.—Humota Ltd., 67, Elwick Rd., West Hartlepool. [6301

SMITH Premier portable typewriter, with teleprinter keyboard and cable type, specially designed for radio work; the very machine for your shack; condition as new and complete with carrying case; £16.—Desco, Ltd., 8, Temple St., Birmingham, 2. [6312

SURPLUS BARGAINS

MANUFACTURERS' & BANKRUPT STOCKS

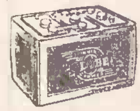
LIMITED SUPPLIES ONLY

We can offer for immediate delivery

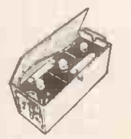
Resistors : $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2 and 3 watt. **ALL VALUES**

16 foot sectional aerial in Canvas carrying bag.

6 v. 140 amp. " GLOBE " Car Batteries.



Receivers : R1155, 1355 and 184 Brand New in original cases. Dinghy Radio Transmitter SCR 578.

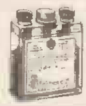


Brand New Accumulators 6 v. 85 a. Size : 12 x 9 x 7in. Weight 45 lb. British Made.

Charging Control Boards with Auto. cut out, 3 amp. 220 v.

2 Volt Accumulators, suitable for Radio or Model Driving, House Lighting, etc. Heavy Mass Type Plates. Pre-charged. **Only need filling.** Size : 7in. x 2in. x 2in.

Storage Secondary Portable Canadian Hart Batteries, 6 v. 100/125 amp.



Celluloid (R.A.F.) Portable 2 v. lead. Acid Accumulators 7 amp. H.R.S. Size : 3¾in. x 3¼in. x 1¼in.

Magnifying Lens, Rubber Mask. Burgoyne Solder Guns. Bakelite Accumulators. Ex-Govt. S.W. Condensers. All types, Meters, Switches, Toggle and Yaxley. Headphones, L/R and H/R. Vibrators, 6 and 12 v. Speakers all types. Volume Controls. Output Transformers. Chokes. Crystals—Valves Type CV.101.

Your enquiries are invited

WHOLESALE AND EXPORT ONLY

For further bargains call at our Counter or write for 12-page Bulletin.

RADIO MERCHANDISE CO. LTD.

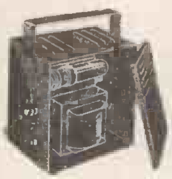
65, Farringdon Road, London, E.C.1.

Telephone : HOLborn 6377.

SELENIUM RECTIFIERS, CHARGER KITS, CHARGERS

New Goods with Full Guarantee

S.T.C. SELENIUM RECTIFIERS up to 300 watts, bridge h.w. or c.t. 40 ma. to 10 amp. A few of our large stock: 2 v./6 v. ½ amp., 4/10; 2 v. ½ amp. with transformer, 13/-; 6 v. 2 amp., 9/-; 6 v. 4 amp., 16/6; 6 v. 10 amp., 22/6; 12/15 v. 1 amp., 10/6; 12/15 v. 2 amp., 13/-; 12 v. 4 amp., 19/6; large finned 12 v. 6 amp., 27/6; 18 v. 4 amp., 26/-. Add postage 8d. to 12/6, 1/- above.



FOOLPROOF CHARGERS AND KITS. "Automat" 6 v./12 v. car or radio cell chargers 220/250 v. a.c. virtually unwreckable, 1 amp. 6 v./12 v., 47/6; 6 lb., 2 amp. standard, 57/6; 2 amp. "Export" with 4in. rect., 65/-; 6 v./12 v. 5 amp. truck charger, £6/15/-; 1 to 20 cell 2 amp. radio store charger, £8/15/-. **KITS.** 2 amp. kit for 2 v., 6 v., 12 v., transformer, selenium rectifier, ballast bulb, 38/6, post 1/7, 1 amp. kit for 2 v./6 v./12 v., 32/6; 6 v. 2 amp. kit, 36/-; 6 v. 4 amp. kit, 46/-. Case for above, 12/6 extra, post 1/7. Heavy duty 3 amp. kit, for 2/6/12 v., 4 amp. rect., 70 watt trans., baretter, fine value at 52/6 post 1/7, wt. 9 lb.

HEAVY DUTY KITS. S.T.C. 12 v. 4 amp. rect., 100 watt trans., slider res., ammeter for 6 v., 12 v., 77/-, post 2/-, weight 14 lb. Ditto but 6 amp., 87/-. Ditto but 18 v. 4 amp., 87/-. For small radio store 1 to 20 cell 2 amp. kit, trans. 150 watt, 2 amp. rect., baretter, £4/15/-. Case, ammeter 6-way switch £3.

ELIMINATOR KIT. For 120 v. 20/30 mA. elim. 20 watt trans., selenium h.t. and trickle rects., 2 x 8 mfds. condensers for 120 v. 20/30 mA. elim. with trickle charge, 35/-, case 9/-, post 1/2.

SELENIUM SMALL SPACE H.T. RECTS., 250 v. 60 mA. 7/6; 250 v. 120 mA. bridge, 12/6; 110 v. 60 mA. for U.S. midgets, 6/6: 350-0-350 v. 80 mA. for A.C. sets, 13/6, post 6d. on all.

NEWBAT, accumulator cell desulphater and conditioner, 1/6, post 4d.

CHAMPION PRODUCTS

43 Uplands Way, London, N.21. Phone LAB 4457

LOCKWOOD

makers of

Fine Cabinets

and woodwork of every description for the Radio and allied trades

LOCKWOOD & COMPANY

Lowlands Road, Harrow, Middlesex. Byron 3704

B. & H. RADIO

EAST STREET, DARLINGTON

BASS & TREBLE SEPARATOR
Enables the use of separate speakers for bass and treble. Permits adjustment of amount of treble relative to bass and also allows speakers of different impedance to be used. Kit of parts £1 9 6.

SCRATCH FILTERS
Give marked reduction of scratch level without serious effect on treble response 15 0

VARIABLE SELECTIVITY I.F. TRANSFORMERS. 465 kc/s.
Give 3 degrees of selectivity.
Per pair £1 0 0

WHISTLE FILTER
Is very simply inserted in the speaker wiring and gives a very sharp, narrow cut which completely eliminates 9 kc/s whistle... £1 13 6

SIGNAL GENERATOR
Is a complete, portable and accurate signal source operating from a 4.5 volt battery £2 10 0

Further particulars on request.
R.F. Coils rewound.

MISCELLANEOUS

ENGRAVING, amateurs and trade could take the opportunity of engraving problems in the future by getting in touch with A. G. Engraving, 19a, Windmill Rd., London, S.W.18. Brass, bronze, erinoid, perspex dials; one knob or repetition equally entertained. [0034

ALLSCREWS, Ltd., for B.A. screws, nuts, washers, studding, grub-screws, bolts, soldering tags, woodscrews, etc., plain or nickel or cadmium plated, one-gross packets or large quantities; stamp for lists.—270a, King St., Hammersmith, W.6. Riv. 7762. [5426

AT last! You can easily motorise your sewing machine at low cost. Send for our small mains motor fitted with pulley wheel and flex to run off 220-240v a.c., price 24/- carriage paid; list available.—Malden Transformer Supplies, Opposite G.P.O., George St., Richmond, Surrey. [0038

COPPER wires enamelled, tinned, Litz, cotton, silk covered, all gauges; B.A. screws, nuts, washers, soldering tags, eyelets; ebonite and laminated bakelite panels, tubes, coil formers; Tufnol rod; headphones, flexes, etc.; latest radio publications, full range available; list, s.a.e.; trade supplied.—Post Radio Supplies, 33, Bourne Gardens, London, E.4. [0138

THE Spencer-West chassis set permits all types of chassis to be manufactured in a few minutes; no holes to drill, holes of any diameter and irregularly shaped holes, squares, rectangles, transformer cut-outs can be punched; expensive punch sets are not required and the tool is suitable both in price and performance for amateur constructors, small manufacturers, laboratories, etc., illustrated leaflet on request.
WE regret delay in deliveries of this chassis set; the position is now much better and a limited number of these sets are available ex-stock.
SPENCER-WEST Quay Works, North Quay, Gt. Yarmouth. [6319

SITUATIONS VACANT

UNIVERSITY of Glasgow.

NATURAL Philosophy Department.
APPLICATIONS are invited for technicians in the above department required in connection with research work in atomic physics. These vacancies arise as a result of the extension of the Department and the erection of the new 300 Me V Synchroton.
SENIOR Technician.—Applicants should have practical experience of the manufacture, testing and operation of electrical generators, rectifiers, switchgear, etc. Minimum qualifications: the Higher National Certificate in Electrical Engineering.
GRADE "A" and "B" Technicians.
(1) ELECTRONICS Technicians. — Applicants should have considerable experience in radio servicing and in the construction and use of electronic devices such as power packs, amplifiers, oscilloscopes, etc. A knowledge of pulse techniques would be an advantage. Ability to design circuits would be expected of candidates for the more senior posts in the "A" Grade.
(2) TECHNICIAN.—Applicants should have a general experience of laboratory crafts such as glass blowing, vacuum techniques and the design and operation of small mechanisms. Grading will be dependent on qualifications and experience.
PREFERENCE will be given to applicants for the above posts who hold appropriate technical certificates. The salaries applicable to the posts are as follows: Senior Technicians, £450×£20 £530 per annum. Grade "A" Technicians, £350×£15×£435 per annum. Grade "B" Technicians, £240×£15×£330 per annum.
APPLICATIONS, stating the post for which application is made, should be submitted to the Senior Administrative Assistant, The University, Glasgow, W.2, giving age, experience, qualifications (if any), and grading expected. [6235

CROWN Agents for the Colonies.

RADIO Inspector required by the Government of Nyasaland Posts and Telegraphs Department for one tour of 24 to 36 months in the first instance. Commencing salary according to age and experience in the scale £620, rising to £865 a year. Cost-of-living allowance between £33 and £120 a year, according to salary and dependents. Outfit allowance £30. Free passages. Candidates (preferably aged 24 to 30 years) should possess a good general knowledge of radio theory, including a knowledge of the theory and operation of both H.F. and V.H.F. equipment, frequency modulation systems and preferably also an appreciation of the principles of operation of multi-channel equipment (both telegraph and telephone) over radio links. They should have had experience in the construction and maintenance of receivers, and low and medium power transmitting equipment; also in the design and construction of antennae systems. They should preferably be Associate Members of the British Institute of Radio Engineers.
APPLY at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M25478B on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [6224

TESTERS for prototype equipment with experience of electronic measurements and radar assemblies, good conditions and good pay for above average men.—Apply in writing giving age and experience and state whether accustomed to work on own initiative to Box 7711. [6333

"You can rely on us"

FOR CLEAN COMPONENTS AT COMPETITIVE PRICES
IMMEDIATE DISPATCH

MIDGET COIL-PACKS

These are an ideal miniature Coil-Pack especially suited where space is limited. They consist of iron-cored miniature coils for both Aerial and Oscillator stages, built-in Wavechange switch and midget trimmers. They are intended for an I.F. of 465 Kc/s and I.F. Transformers type RS/GB 465 (12/6d. per pair) are the ideal companions for a trouble-free superhet.

TYPE "R"
MW/LW/GRAM Ranges 200-550 metres, 800-2,000 metres.
SIZE: Length 2¼in. Width 1¾in. Depth 1½in.

TYPE "S"
MW/SW/GRAM Ranges 200-550 metres, 17-50 metres.
SIZE: As Type "R."

TYPE "C"
LW/MW/SW Ranges 800-2,000 metres, 200-550 metres, 17-50 metres.
SIZE: Length 3¼in. Width 1¾in. Depth 1½in.

TYPE "R" and "S" each 25/-. TYPE "C" each 28/6. Post 6d.

All coils enclosed—All iron-dust cores adjustable. Completely wired, only five connections needed to external circuit.

Catalogue with Data, 3d.

RADIO SERVICING Co.

444, Wandsworth Road, London, S.W.8
'Phone: MACaulay 4155.

77, 77A, Bus; 28, Tram, Wandsworth Rd. S.R. Station.
Open till 6.30 p.m

MAGNETIC TAPE RECORDERS and COMPONENTS
from
WILL DAY, LIMITED
19 Lisle Street, London, W.C.2.
GERrard 7105 and 4476
LIST SENT BY RETURN

LYONS RADIO Ltd.

RECEIVERS TYPE R.1155. Now one of the best-known and most popular of ex-Government Receivers. Frequency range includes 20, 40 and 80 meter Ham Bands, long and medium transmissions. In new unused condition and tested before despatch. PRICE £11/10/0, carriage 7/6. In used condition, PRICE £8/10/0, carriage 7/6.

POWER PACK/OUTPUT-STAGE. Unit to operate the R.1155 Receiver from A.C. mains and to provide for a speaker output. Assembled in an enclosed ventilated metal case 10×6¾×5½in. Employs 5Z4 Rectifier and 6V6 output valves. Fitted with all leads and plugs clearly marked. PRICE £5/7/6, carriage 2/6.

SPECIAL OFFER. R.1155 in new, unused condition, together with P.P/O.P. STGE. £15/15/0. R.1155 in used condition, together with P.P/O.P. STGE., £13/10/0, carriage either condition 10/-.

TEST SET TYPE 74. A special-purpose Oscilloscope that requires but little alteration to convert it into a first-class standard Oscilloscope. Fitted with a built-in 50 cycle Power Pack for 230-volt mains input a 3in. CR Tube (VCR 139) and 11 valves, including VU.120, 5Z4, VR. 65, 6J5, VR. 92, etc., complete in metal case 19×12×8½in. In good condition and tested before despatch. PRICE £6/19/6, carriage 15/- (5/6 returnable on crate).

3, GOLDHAWK ROAD, (Dept. M.W.)
SHEPHERDS BUSH, LONDON, W.12

Telephone: Shepherds Bush 1729

SITUATIONS VACANT

A.E.I. Research Laboratory.
RESEARCH assistants, two required for Nuclear Physics Section; applicants with Higher National Certificate, or equivalent, in Applied Physics, Mechanical or Electrical Engineering preferred. ONE appointment includes supervision of small laboratory workshop; experience of precision engineering and instrument making essential.
APPLICANTS for second appointment should have research experience in physics laboratory, preferably with knowledge of vacuum technique and electronics.
APPLY in writing to Manager, Associated Electrical Industries, Ltd., Aldermaston Court, Aldermaston, nr. Reading Berks. [6341

RUNWELL Hospital, near Wickford, Essex.
RECORDIST for electroencephalographic department required, salary £300 to £350 per annum, according to experience.—Applications should be sent to the Physician Superintendent. [6335

RADIO mechanics are required for service in the Air Ministry Ocean Weather Ships. Voyages are of 27 days at sea, followed by 15 days in port at Greenock.
APPLICANTS must possess a sound knowledge of the principles of radio and radar up to the standard of third-year City and Guilds Telecommunications Engineering. They should have a general knowledge and practical experience in the maintenance of ground radio transmitters, receivers, D/F systems, and radar installations. Duties will include operation of radar equipment. Suitably qualified and experienced ex-service radio mechanics will be given preference.
SUCCESSFUL candidates will be engaged on a non-pensionable basis. The weekly scales of pay on appointment at age 25 and over will be 133/-, rising by annual increments of 5/- to a maximum of 163/-. Entrants aged 21 years and over but under 25 will receive slightly lower rates according to their age. An allowance at the rate of £50 a year is payable to compensate for any excess hours of duty required. Food and accommodation is provided free on board ship. Not less than six days' leave may be granted between voyages.
APPLICATIONS, stating age, qualifications and experience, should be addressed to Air Ministry S.5 (g), Cornwall House, Stamford St., S.E.1. [6271

TELEVISION fault finders and testers required by large radio manufacturers in North London; 3/- to 3/6 an hour according to experience.—Apply Box 7686. [6323

TEST room foreman and testers, Wembley and Ruislip districts, for component and instrument testing; work involves precision measurements and adjustments.—Box 7681. [6309

TELEVISION/RADIO service engineer by progressive retailer, E. London, must be competent and thoroughly experienced; excellent prospects; preferably able to drive.—Box 7621. [6274

TESTERS, senior and junior, required by company producing radio and electronic equipment; fault-finding experience necessary.—Apply with full details of experience, etc., to Box 7617. [6265

RADIO/TELEVISION engineers required by organisation with branches throughout London; good experience essential.—Apply in writing, to W. H. Barnes, Ltd., 36-38, Peckham Rd., S.E.5. [6302

PLANNING and progress engineers required by company producing radio and electronic equipment; prototype and batch experience necessary.—Apply with details of experience, etc., to Box 7616. [6264

WIRING mechanics accustomed to prototype electronic assemblies, experience in Government contract work desirable, good conditions and good pay, London W.1 district.—Apply in writing to Box 7712. [6334

ELECTRONIC engineer required for research development department of old established company in Surrey (Tolworth); apply in writing giving details of qualifications, experience and salary required to—Box 7683. [6313

RADIO mechanic required must have sound technical knowledge, experience of car radio and electrical systems an advantage but not essential.—Apply Service Manager, Allens of Bristol, Berkeley Sq., Bristol, 8. [6327

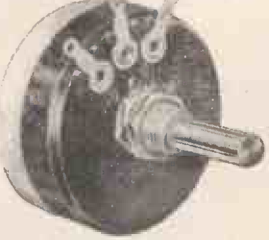
EXCELLENT opportunity in Fleet Street for young man with good basic electronic knowledge; must be conscientious and willing travel if necessary.—Apply in writing, giving brief details experience, to Box 7618. [6266

FOREMAN for assembly of electronic equipment, experience in Government contract work desirable, good conditions and high salary, London, W.1. district.—Apply giving details of experience and salary requested to Box 7709. [6331

PARTNER or manager required for established radio business in North Monmouthshire industrial town, turnover £5,000 p.a., good T.V. prospects, living accommodation can be arranged in future on the premises.—Box 7887. [6324

LARGE company require radio testers and fault finders for all types of radio equipment.—Applications from men with domestic radio, television or V.H.F. experience should be addressed to the Personnel Manager, Box 7615. [6263

POTENTIOMETERS



by

RELIANCE

Wire wound and Composition types, Single, Ganged, Tandem Units.

Characteristics: linear, log, semi-log, non-inductive, etc.

Full details from

RELIANCE

Manufacturing Co. (Southwark) Ltd.

Sutherland Rd., Higham Hill, Walthamstow, E.17

Telephone: LARkswood 3245

TELEVISION COMPONENTS

FOR THE

VIEWMASTER, "P.W." & "E.E."

TELEVISORS IN STOCK

Price Lists of specified and alternative components for "P.W." and "E.E." TV. available.

J. T. FILMER MAYPOLE ESTATE, BEXLEY, KENT. *Tel.: Bexleyheath 7267*

NOW AVAILABLE

GERMANIUM CRYSTAL DIODES

LATEST, SMALLEST, SUPREME CRYSTAL DETECTOR

Midget Size, 5/16in. x 3/16in.
Wire Ends for Easy Fixing.
4/6 each, postage 2½d.

Technical Details and Selected Types available.

COPPER INSTRUMENT WIRE

ENAMELLED, TINNED, LITZ. COTTON AND SILK COVERED

Most gauges available.

B.A. SCREWS, NUTS, WASHERS, soldering tags, eyelets and rivets.

EBONITE AND BAKELITE PANELS, TUFNOL ROD, PAXOLIN TYPE COIL FORMERS AND TUBES, ALL DIAMETERS.

Latest Radio Publications.
SEND STAMP FOR LISTS.
TRADE SUPPLIED.

POST RADIO SUPPLIES
33 Bourne Gardens, London, E.4

SITUATIONS VACANT

SERVICE Engineer required with experience of radio or audio frequency equipment.—Apply Fortiphone, Ltd., 27, Addington Square, Camberwell, S.E.5. [6251

TESTERS for electronic equipment, experience in Government contract work desirable, good conditions and high salary, London, W.1. district.—Apply in writing to Box 7710. [6332

ASSISTANT mechanical engineer required by large, well-known firm to undertake mechanical design of interesting new electro mechanical equipments; the work will be varied and the prospects good.—Apply, quoting Ref. DIH, to Box 7312. [6195

RADIO manufacturers require assistant general manager, must be thoroughly experienced in all departments; excellent position for first class man with initiative and ability.—Write, giving full details of past experience and salary required, Box 7614. [6261

ELECTRO MEDICAL Service (inside and outdoor) engineers required; knowledge of radio and television maintenance desirable; application in writing only, stating particulars of past services and salary required to—Stanley Cox, Ltd., 11, Gerrard St., W.1. [6325

WHIZARDS, of Baker Street and Hampstead, need radio or radio and television engineers of wide experience. Permanence on attractive and progressive terms for really competent men. —Write fully to Service Manager, Whizards, 204, Haverstock Hill, N.W.3. [6288

ASSISTANT aerial research and development engineer required for laboratory at Aylesbury, Bucks; must be capable of designing oscillators and other test equipment; salary from £400 p.a. according to experience.—Write Antiference, Ltd., 67, Bryanston St., London, W.1. [6270

E. K. COLE, Ltd., require car radio sales representatives for North of England; applicants must have experience of motor industry and knowledge of radio technique preferred; submit fullest details regarding experience and salary required.—Ekco Works, Southend-on-Sea, Essex. [6257

A VACANCY occurs for a senior draughtsman of at least H.N.C. standard for layout work on interesting electro-mechanical projects; salary according to qualifications.—Apply to Personnel Officer, Mullard Electronic Research Laboratory, Salfords, nr. Redhill, Surrey. [6252

E. K. COLE, Ltd., require technical representatives for car radio division; previous experience of car radio installations essential; must be prepared to travel and reside near London; submit fullest details regarding experience and salary required.—Ekco Works, Southend-on-Sea, Essex. [6258

SCIENTIFIC or experimental officer required for progressive electronic laboratory; First or Second Class Honours degree in physics or electrical engineering (electronics) preferred.—Write with details of experience to Gordon Dept. Director, Ardente, Ltd., 309, Oxford St., London, W.1. [6311

RADIO and television installation engineer required in service dept. of E. London firm with all leading agencies; must be trustworthy and hold a clean driving licence; salary £8 per week; permanent position.—Apply (references required) to L. B., Leytonia Radio, 828, High Rd., Leyton, E.10. Ley. 1396. [6278

TECHNICAL assistant required for development of electronic test gear for vacuum tube department; qualifications up to Inter. B.Sc. or Ordinary National City & Guilds No. 2 or 3; write, stating age, experience and salary required to—Cinema-Television, Ltd., Worsley Bridge Rd., Lower Sydenham. [6304

A NUMBER of senior and junior vacancies for radio, radar, electronic, television, etc., development, service engineers, draughtsmen, wiremen, testers, inspectors, etc., urgently required 30 television service engineers.—Write in confidence, Technical Employment Agency, 179, Clapham Rd., S.W.9. (Brixton 3487.) [0103

QUALIFIED junior physicist required for experimental work on cathode ray tubes and allied vacuum tubes; age 21-28, previous experience of vacuum work desirable, but not essential, write, stating age, experience and salary required to—Cinema-Telivision, Ltd., Worsley Bridge Rd., Lower Sydenham, S.E.26. [6303

ELECTRONIC engineer required for development work by expanding industrial electronic team of well-known manufacturing company, previous experience of servo mechanisms and industrial process control, together with degree or H.N.C. essential.—Write, giving full details, quoting Ref. GBH, to Box 7313. [6196

RADIO valve engineers; the M.O. Valve Co. have vacancies for qualified engineers in connection with the development, manufacture and application of radio valves; please apply by letter stating particulars and salary required to—Personnel Department, The M.O. Valve Co., Osram Works, Brook Green, Hammersmith.

DRAUGHTSMEN (electrical) with experience of schematic or detail wiring diagrams, are invited to apply for progressive positions in the Drawing Offices of the English Electric Co., Ltd., Liverpool.—Write, giving full particulars quoting ref. 140, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1 [6059

OPPORTUNITIES IN RADIO

Get this FREE Book!
'ENGINEERING OPPORTUNITIES'

reveals how you can become technically-qualified at home for a highly-paid key-appointment in the vast Radio and Television Industry. In 176 pages of intensely interesting matter, it includes full details of our up-to-the-minute home study courses in all branches of **TELEVISION and RADIO, A.M. Brit. I.R.E., City & Guilds, Special Television, Servicing, Sound Film Projection, Short Wave, High Frequency, and General Wireless Courses.**

We definitely Guarantee

"NO PASS—NO FEE"

If you're earning less than £10 a week, this enlightening book is for you. Write for your copy today. It will be sent **FREE** and without obligation.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
388b SHAKESPEARE HOUSE
17/19 STRATFORD PLACE, LONDON, W1

BIET

AUTOMATIC SWITCHES

(RECONDITIONED)

ELECTRIC	CLOCKWORK
1 to 100 AMPS.	7 to 35 DAYS

From **35/-** EACH

All guaranteed for a year.

Write for illustrated lists: **DONOHOE,**
2 UPPER NORFOLK ST., NORTH SHIELDS, NORTHUMBERLAND.

WALTON'S OF WOLVERHAMPTON

The leading Midland Depot for Ex-Government Radio and Electronic Equipment. Are you on our Mailing List? If not, you must miss Bargains. Here are a few recent additions: VEEDER (U.S.A.) COUNTERS 0-999 in steps of 1/10. Special Bargain Price, 5/- each. Post 6d. BOXES of assorted screws, nuts and washers, mainly BA sizes, approximate contents 1,000, 3/6, post 6d. Invaluable to all experimenters. High Grade (U.S.A.) BLOWER MOTORS, excellent for models, etc., 28 volt D.C. 10/6, post 9d., or complete with transformer for use on the mains, 21/-, post 1/-. NI-FE ACCUMULATORS. All are new and have never been filled with Electrolyte, but are slightly store soiled. Voltage 2.5 (2 cells), Cap. 15 A.P.H. Act. size 2¼in. x 2¼in. x 8in. deep. List Price over 50/-. Our Special Price, 12/6 each, post 1/-. 3 for 30/-, post 2/6. 12 for £5.

WALTON'S WIRELESS STORES
203, STAVELEY RD., Wolverhampton
(Mail Orders)
48, STAFFORD ST., Wolverhampton
(Callers Only)

Good Investments

NIFE CELLS. New 12 volt 45 ampere hr. 9 cells in wood crate, £8/10/- each, plus carriage.
MOTOR GENERATORS. A.C./D.C. 2 h.p. 200/250 volt 50 cy. S.P. induction motor direct coupled on C.I. Base to 100 volt 1.4 kW. D.C. Generator, 2,950 r.p.m.
DOWTY LIVE LINE HYDRAULIC PUMPS, 25/- each, carr. extra. Water Pumps, 230 volts A.C., lift 3ft., head 10ft., capacity 100 g.p.h., £5/15/-, carr. 2/-. Rotary Suds Pump only; lift 8ft., head 35ft., capacity 60 g.p.h., £4/10/- each. Post 2/-.
WIRE. Field wire, new D.8 twin, ½ mile drum twin wire, £8/10/-.
G.P.O. Wall type Telephone constructors parts, comprising carbon mike in bakelite case, Transformer, condenser, switch-book and contacts, long magnet bell receiver, magneto bell in box 8in. x 6in. x 3½in., cords, terminal strip, and hand magneto generators, all with wiring diagram, 35/- per pair, plus 5/- carriage charges.
CRYSTAL SETS. The Lesdix Boudoir Crystal Set in black bakelite case fitted diode detector. 17/6. The Ivalex Crystal Set in neat white bakelite case, catwhisker detector, 15/6. Postage on either set 1/6 extra. **Headphones,** new and tested for crystal reception, with headband and cord, 10/- pair, post 9d.
RECTIFIER UNITS. Ex.-G.P.O. 230 volts A.C. 50 cy. input. D.C. output 50 volts 5 amps. 50 volts 1½ amps. 50 volts ¾ amp. 30 volts 8 amps. 30 volts 10 amps. 12 volts 3 amps., all in vent. metal cases, new condition; write for special list "R.U.W."
THE RAYCRAFT KIT, new, comprising 10,000 ohm. relay, light ray cell in bakelite case, megastat, valve holder, condenser, etc., with instruction booklet, 45/-.
PRECISION TEMPERATURE CONTROL OVENS for Quartz Crystals. 230 volts A.C. 50 cy. will give a stability with suitable crystals of better than 2 parts in a million. Fitted precision thermostat and thermometer. Temp. adjustable 40/60 degrees cent., £4/17/6. Carr. 2/6.
VARIABLE SLIDER RESISTANCES. Double tube 150 ohms 2 amps., 30/-.

ELECTRADIX RADIOS
214 Queenstown Road, London, S.W.8
Telephone : MACaulay 2159

SUCCESSFUL SALES! SATISFIED CUSTOMERS!

PENNINE RADIO

THE ALL SEASON SENSATION. ACCLAIMED THE COUNTRY OVER. THE INTIMATE RECEIVER WHICH COMBINES APPEARANCE AND PERFORMANCE. HOUSED IN A BEAUTIFUL WALNUT CABINET. EACH SET FULLY GUARANTEED.

HEIGHT 10", WIDTH 12½", DEPTH 5½"
4 Valve SUPERHET

THE SET THAT SELLS ITSELF!

UNBEATABLE VALUE £11 9 7 INC. TAX.

"THE ROVER"

SUPPLIED ONLY THROUGH SELECTED WHOLESALERS. ILLUSTRATED LEAFLETS AND ATTRACTIVE DISPLAY CARDS.

PENNINE AMPLIFIERS
ELLAND YORKS ENGLAND
TEL. ELLAND 2107

SITUATIONS VACANT

AERIAL installation company requires area manager to open new branch in Manchester district shortly; knowledge of television and radio, experience in aerial installations, current driving licence and administrative ability; excellent prospects; write stating salary required.—Antiference Installations, Ltd., Watford Way, London, N.W.7. [6314

ADMINISTRATIVE engineer with experience of technical correspondence and preparation of contracts required by department of Midlands firm engaged in electronic control equipments and R.F. heating; salary £400-£600 per annum, according to experience.—Write, giving details of age and experience, mentioning reference HBG to Box 7311. [6194

RADIO mechanics; British European Airways require skilled men, preferably with aircraft experience, for existing and possible future vacancies. Radar knowledge an advantage. Basic pay 2/7 per hour. Bonus schemes in operation, sick pay and pension schemes.—Write to Personnel Officer, Northolt Base, B.E.A., Ruislip, Middlesex. [6326

E. K. COLE, Ltd., have vacancies in their electronics division at Malmesbury, Wilts, for senior and intermediate draughtsmen in the Development Drawing Office, for work on radar, communications and electronic projects; previous experience in this field desirable but not essential.—Apply in writing to the Personnel Manager, Ekco Works, Malmesbury, Wilts. [6086

PHYSICIST required by radio manufacturer in London area for work in connection with acoustic problems; applicants must have degree in physics and some development experience; the successful applicant will be required to start up and run new laboratory; state full details of qualifications and experience with age and salary required to—Box 7682. [6310

A NORTH Midlands firm requires electronic engineers experienced in maintenance and design of electronic equipment, to work on the measurement of vibrations of engines, etc.; some mechanical knowledge, strength of materials, etc., an advantage; Higher National Certificate minimum qualification; salary £400 to £500 p.a., according to experience.—Box 6787. [6021

ELECTRICAL component manufacturers, situated in W. London, require intelligent person to take charge of special test section; applicants should possess Inter-B.Sc., or equivalent, have previous experience of test and measuring equipment and be capable of maintaining accurate records.—Write, stating age, experience and salary required, to Box 6796.

RADAR, radio and/or electronics senior development engineer wanted for work on important defence project in special English Electric Co. laboratory; salary £600-£900 p.a. according to experience; write giving details of qualifications and previous experience mentioning reference 456A to—Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham St., London, S.W.1. [6105

RADAR technicians are required by a well-known firm of radio manufacturers for a factory in South Lancashire; experience in the servicing and/or installation of radar equipment is essential; persons who have had experience in this type of work in the Services would be particularly suitable; good salaries, according to experience; write, giving full details, mentioning Reference HAH to Box 6959. [6089

VACANCIES exist at Chelmsford for a rate-fixer with a knowledge of time study for light engineering machine shop, and planning and time study engineers for sheet metal and framework sections.—Write, giving details of age, previous experience and salary required, mentioning reference 445A, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6211

ENGLISH ELECTRIC have vacancies for senior design draughtsmen for employment in the Midland and West London areas; draughtsmen with good light/medium mechanical engineering experience preferably with some knowledge of design for quantity production are invited to apply; these are permanent vacancies offering much scope on new types of electric mechanical equipment.—Write giving full details quoting ref. 156, to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham St., London, S.W.1. [6182

MURPHY RADIO, Ltd., having recently expanded their electrical design department, invite applications from television and radio engineers having good academic qualifications (Honours Degree in Physics or Electrical Engineering) and experience in industrial design laboratories. There are also openings for graduates trained in these branches, but without industrial experience.
APPLICATIONS, giving full particulars of training and experience, should be forwarded to Personnel Dept., Murphy Radio, Ltd., Welwyn Garden City. [6279

ATTRACTIVE and interesting openings for graduate physicists and engineers, aged 21-30, are available at the Research Laboratories, The General Electric Co., Ltd., North Wembley, Middx. in the following fields: (a) radiocommunications and Telephony; (b) waveguides; (c) X-Ray analysis; (d) transmitting and receiving valves; (e) cathode ray tubes; (f) vacuum physics; (g) illumination; (h) domestic heating appliances.
VACANCIES exist for men and women with and without industrial experience since leaving the university; good starting salaries will be paid and prospects will be excellent; candidates should send details of their age, qualifications and record in writing to the—Personnel Officer (Ref. GBLC/124). [6318

SPENCER-WEST

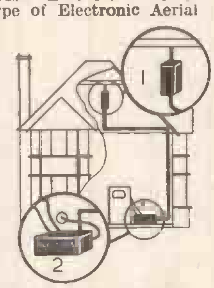
The following Units are available Ex-Stock.

1 TYPES AC/3L (London) and **AC/3B** (Birmingham) Pre-Amplifier. "Unquestionably the best Pre-Amplifier."
Specification includes two triode valves ensuring lowest possible "noise" level, self-contained power supply and interference filter unit.
Price **10 gns.** complete.

2 TYPE AC/4 Convertor Unit. Permits reception of Birmingham on a London-type receiver without alterations or adjustments of any kind. A double mixer stage is employed which is the only method of ensuring correct reception of the partially suppressed side band transmission from Birmingham. Incorporates its own power supply and Pre-Amplifier stage.
Price **15 gns.** complete.

3 TYPE AC/7 Convertor Unit. A new Convertor similar in specification to the above and having the double mixer stage feature incorporated. No Pre-Amplifier stage is included however. Suitable for ranges up to 40 miles from the transmitter. Complete with self-contained power supply unit. Price **£9. 18. 6.** complete.
This Unit can also be supplied less power supply unit. Price and details on application.

4 TYPE AC/6 Loft Aerial Unit. A new type of Electronic Aerial which can be fitted in an hour or so and will give a performance equal to a well installed dipole aerial. No unsightly chimney or roof structures and solves completely the Television Aerial problem.



Types AC/6L, AC/6H. Price complete, **£13. 19. 0.** Fringe Area Types AC/6LF, AC/6BF, AC/6HF. Price complete, **£16. 2. 0.**

Illustrated leaflets, and technical report available on application.

SPENCER-WEST
Quay Works, North Quay,
GREAT YARMOUTH

RADIO UNLIMITED

ELM ROAD, LONDON, E.17.
Telephone : KEY 4813

SPEAKERS. Guaranteed new and boxed, 3in. 10/-; 5in. 12/9; 6½in. 12/6; 8in. 14/9; 10in. 17/6; 12in. 39/6.
TX VALVE. New/Boxed 8012, 7/6.
AMPLION 10-range METER, 77/6.
M/COIL 0-500 M/AMP METER, 6/9.
M/COIL 0-12/120 VOLT METER, 9/6.
RECEIVER 25/73, Spotless Condition, offered less Valves, 6/6, post free.
V/CONTROLS. 10K-2 Meg. Long spindle, L/sw., 2/6; w/sw., 3/9.
HEADPHONES. DLR/2 Spotless. With lead and plug, 5/6 pair.
TWIN COIL BUZZER, adjustable, 3/6.
M/COIL MICROPHONES, new/boxed, 5/6

Detailed Stock List, S.A.E.

SITUATIONS VACANT

ELECTRONIC engineers require production foreman and chief inspector with A.I.D. experience.—Box 7619. [6267

TEST engineers required for design and manufacture of apparatus for production testing of radar, communications and electronic equipment; salary according to qualifications and experience.—Full details to the Personnel Manager, E. K. Cole, Ltd., Malmesbury, Wilts. [6087

AN experienced valve engineer is required for employment at Chelmsford; applicants should be 25-35 years of age, qualified engineers, and preference will be given to those with previous design or production experience of small transmitting valves.—Write, giving full details of experience, mentioning ref. 497C, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6262

A WELL-KNOWN radio manufacturing company in the South require senior experienced radar development engineers to lead teams working on nationally important radar projects; attractive salaries will be offered to suitable applicants; houses will be available for key men; the company has an excellent pension scheme.—Apply giving full details of qualifications and previous experience mentioning ref. DGD to Box 6991. [6122

FERRANTI, Ltd., have vacancies in their radio works at Moston, Manchester, for radio/television design engineers, both senior and junior; generous scale of payment, extending liberally into the four figure range, according to qualifications and experience; permanent staff, appointtients with superannuation benefits.—Forms of application from the Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. Please quote reference R.E. [6190

YOUNG electronic engineers are required for interesting programme of development work near Luton. Applicants should possess Ordinary or Higher National Certificates in electrical engineering and have an interest in radar or radio experimental work. Vacancies also exist for laboratory assistants, and young men and women who have school certificate are invited to apply.—Write, giving full details, mentioning ref. HAE, to Box 7622 [6275

TELEVISION development engineer, with at least four years' laboratory experience in the development of vision and sound receivers, required to fill a vacancy in a new section; applicants should have commercial experience in the design of such equipment for production; apply in writing, giving age, qualifications, details of experience and salary required, to—Cinema-Television, Ltd., Worsley Bridge Rd., Lower Sydenham, S.E.26. [6305

HIGH frequency induction heating applications engineer required by progressive and expanding company specializing in the manufacture of high frequency equipment; experience in induction heating essential and a good knowledge of metallurgy would be considered as an additional qualification; the position offers excellent opportunities for advancement to a really energetic man having the requisite experience; write giving experience and salary required.—Box 7037. [6141

COIL winder required for interesting development work on a wide variety of coils and transformers; the applicant should have had at least 3 years' experience of factory methods on small transformers and wave-wound coils; a knowledge of design and testing methods would be an advantage; staff appointment, salary according to qualifications.—Apply to Personnel Officer, Mullard Electronic Research Laboratory, Salfords, nr. Redhill, Surrey. [6253

INTERESTING vacancies exist with the Nelson Research Laboratories of the English Electric Co., Ltd., for university trained electronic engineers or physicists with an interest in the design of special circuits for computing machines; these vacancies are at Stafford and in the London area and offer scope for original work in this interesting field.—Write giving full details mentioning reference 305A to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham St., London, S.W.1. [6226

SENIOR engineer for experimental work on radar, radio and/or electronics for important defence project in English Electric Company laboratory. Permanent post. Good experience in radar or electronics essential. Honours degree preferable. Married accommodation available. Commencing salary £700-£900 per annum.—Apply, giving full details of qualifications and experience, mentioning Ref. 456B, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [6289

SENIOR engineer for experimental work on servo-mechanisms required for important defence project in special English Electric Company laboratory. Permanent post. Good experience in servo-loop design essential. Honours degree preferable. Married accommodation available. Commencing salary £700-£900 per annum.—Apply, giving full details of qualifications and experience, mentioning Ref. 844, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6290

EXPERIENCED electronic engineers required for interesting development work; qualifications: a good honours degree in physics or engineering, with several years' design experience, including radar equipment or specialised experience on centimetric techniques. The appointments are for permanent pensionable staff and offer good prospects.—Applicants should write, giving full details and quote ED/32 to Personnel Department, E.M.I. Engineering Development, Ltd., Blyth Rd., Hayes Middlesex. [6339

PIONEERS OF LONG-SCALE ELECTRICAL MEASURING INSTRUMENTS

"RECORD" ELECTRICAL INSULATION and TESTING SETS are daily giving a wide range of service for TESTING. Their reliability and accuracy stems from the skill of the "RECORD" Technicians. Other Record Instruments are provided for a variety of purposes.

THE RECORD ELECTRICAL CO. LTD.
BROADHEATH · ALTRINCHAM · CHESHIRE
Phone : Altrincham 3221/2/3
Cables and Grams : "Circscale" Altrincham
London Office : 28 Victoria Street, London, S.W.1.
Phone : Abbey 5148
Grams : "Circscale," Sowest, London
Cables : "Circscale," London

MAGNETIC TAPE

Recording Equipments and Components

OSCILLATOR UNIT. Constructed on small chassis suitable for sub-assembly, provides r.f. for erase and bias at 45 kc/s. Requires 250v. h.t. and 6.3v. for operation. Complete with 6V6 valve, £3.

OSCILLATOR COIL ASSEMBLY. Comprises high "Q" coil and condenser tuned to 45 kc/s. Specially designed to provide highly symmetrical sine wave output for low tape noise. 10/6.

RECORD/REPRODUCE HEAD. Low impedance. High quality response. Totally enclosed. Gap length 1 mil. £2/2/-.

REPRODUCE HEAD. As above but gap length 0.5 mil. (suitable for 2-head systems). £2/2/-.

ERASE HEAD. Capable of erasing new high coercive force tape when used with oscillator unit above. £2/2/-.

TAPE. New high coercive force tape suitable for high fidelity recording at slow speeds. 7in. (1,200ft.) reels. £1/10/-.

Spare reels, 7in., 4/6 each.

11in. (1,000 metre) reels also available.

INPUT TRANSFORMER. Ratio 1/40. Suitable for head to grid step up. Mumetal core. 17/6.

TRADE ENQUIRIES INVITED.

CABOT RADIO COMPANY LIMITED
Electronic Equipment Manufacturers,
28 BEDMINSTER PARADE, BRISTOL 3.
Telephone 64314.

SITUATIONS VACANT

RADIO/RADAR development engineers urgently required, accommodation available. Applications are invited from senior and junior development engineers, preferably with experience of radar or microwave technique, who are capable of developing equipment or components to service specifications. Successful candidates will be employed on work of great national importance.—Write quoting reference CHC(5) to Personnel Officer, General Electric Co., Ltd., Radio and Television Works, Spon St., Coventry. [6336

SERVICE/SALES engineer required by British company distributing radio receivers, refrigerators, office equipment in West Africa; sound radio and electrical knowledge essential; refrigeration experience an asset; preliminary training in other service requirements given before departure; good salary and prospects; first-class passage and free furnished quarters; pension scheme; applicants should state age, whether married or single, give full details education qualifications, National Service and business experience; do not forward original references.—Apply Box 7684. [6320

ATTRACTIVE staff vacancies for draughtsmen exist at Chelmsford and in London with Marconi's Wireless Telegraph Co., Ltd. Continued expansion of the company's work calls for increased D.O. output, and electrical or mechanical draughtsmen are invited to apply for these permanent staff positions on the design and development of radio and radar equipment. Vacancies also exist for young men of at least O.N.C. standard as trainee draughtsmen.—Write, giving full details, quoting Ref. 142B, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6291

MARCONI'S WIRELESS TELEGRAPH Co., Ltd., have vacancies for junior engineers to work on VHF transmitter development and multiplex channelling. Candidates should have a degree in physics or electrical engineering or equivalent qualifications, or should have had good experience on radio development or research. Experience on VHF or multiplex channelling is desirable. Good salaries will be paid, based on qualifications and experience. The company has a staff pension fund.—Apply, giving full details, quoting Ref. 822A, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [6281

IF you are between 21 and 25 years of age, and have at least 3 years' electrical or mechanical engineering workshop experience, the English Electric Group are willing to consider you for training as a draughtsman. This paid training will be up to six months' duration to fit suitable applicants for employment as either electrical or mechanical draughtsmen at Acton, Bradford, Chelmsford, Liverpool, Preston, Rugby or Stafford. Preference will be given to men who have reached O.N.C. standard of technical study.—Apply, quoting ref. 842, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6276

PLANNING engineers required, intelligent and energetic men to assist in the planning of development work on electronic apparatus. One appointment will be as assistant manager in the department. Some practical experience in this field is essential since the duties will include planning, estimating and forecasting. Initiative in investigating all aspects of the work with a flair for lucid presentation of the findings will be important qualities. Adequate salaries will be paid proportional to age and qualifications.—Applicants should send full details of age, education and experience and quote ED/31 to Personnel Department, E.M.I. Engineering Development, Ltd., Blyth Rd., Hayes, Middlesex. [6340

DRAUGHTSMEN are invited to make an appointment with E.M.I. Engineering Development, Ltd., to discuss the several vacancies available at their Feltham Branch. All grades of designers and draughtsmen are required for a wide range of engineering products for which your experience may be suited. Details will be sent by post on request and/or strictly confidential interview arranged without obligation. Posts available offer a maximum of interest, technical information and experimental facilities, and long-term employment prospects with good salary to suitable applicants. Applications considered both for immediate employment and New Year appointments.—Apply giving fullest details of experience, qualifications, etc., to Personnel Department EB/S, E.M.I. Engineering Development, Ltd., Blyth Rd., Hayes, Middlesex. [6296

MARINE radar engineer required by major British oil company for service at a Middle East port; applicants must not be over 35 years of age, and must be Associate Members of the Institute of Electrical Engineers, or possess comparable academic qualifications, coupled with a wide knowledge and experience of post-war Mercantile Marine radar equipment maintenance; general knowledge and some experience of marine radio communication systems would be an advantage; the successful applicant will be required to institute a small maintenance depot capable of offering emergency service to ships fitted with a variety of radar equipments; he would also be required, as a secondary commitment to service marine radio communication systems, including VH/F radio telephone equipment; the post carries an attractive salary commensurate with the above, plus a generous allowance in the local currency; there is a pension scheme, and terms and conditions of service are good.—Write giving personal particulars and details of qualifications and experience, quoting Department F.205, to Box 2908 at 191, Gresham House, E.C.2 [5883

SENSATION ! SENSATION !

We can supply from stock the following wonderful new apparatus :

DECCA LONG - PLAYING GRAM. UNITS. MODEL 33A (33⅓ r.p.m. only), A.C. motor, 10in. turntable, lightweight Crystal pick-up, handsome portable case. Price 9 Gns. **MODEL 33AG,** as above, with change-over switch, for use with existing 78 r.p.m. motor. Price 9½ Gns. **MODEL 3378T,** as above, but for 33⅓ and 78 r.p.m., pickups with reversible head fitted ACOS GP20 Sapphire Styli and automatic circuit compensation. Price 16 Gns.

DECCA LONG-PLAYING RECORDS by Post. Send 2½d. for list of titles and DECCA Dual-Speed Record Players.

No. 2 PUBLIC ADDRESS AMPLIFIER. 12-watt Push-pull output, special negative feedback circuit, gram., mike (separate volume controls for mixing) and tuner inputs 3, 7.5 and 15 ohms output. Transformers, choke and chassis as for No. 2 Symphony. Price 10 Gns. Complete kit with instructions, £9.

SYMPHONY No. 1 (Amplifier) by N.R.S. ! The most versatile domestic Audio Amplifier on the market to-day ! Independent control of Bass, Middle and Top, separate Scratch Cut, negative feedback. For A.C. 200-250 v., input for magnetic, crystal and hi-fi pickups, also Tuner 5-watt output. Price 3-ohm model, £3/19/6 ; 15-ohm model, £9/7/6. Money refunded if not delighted !

SYMPHONY No. 2. Same theme as No. 1 but having 10 watts Push-Pull output : 3, 7.5 and 15 ohms, inputs as No. 1, all provision for Tuner. Built on black-crackle chassis. Woden Mains transformer, Output trans. and Choke. Price 13 Gns.

No. 1 TUNER. Specially recommended for above amplifiers and Leak, Williamson, and other Quality Amplifiers. L. & M. wave T.R.F., neg. feedback detector, virtually distortionless. Price of Complete Kit and Constructional Manual, £4/10/-, or Ready-built, £5/10/-.

No. 2 QUALITY SUPERHET TUNER L.M. & S. waves, special bandwidth, large full-vision Dial Assembly, spin-wheel tuning. As Kit, £7/15/- : Ready-built, £8/15/-.

BASS-REFLEX CABINET KITS incl. all ¾in. patent timber, cut and jointed, screws, felt, etc., only hammer and screwdriver required to build from full instructions, speaker cutout and lower vent, give superb bass response and top. 8in. Speaker model stands 2ft. 6in. high x 1ft. 3in. x 1ft. deep. Price 80/-. 10in. Speaker model 30in. x 16in. x 13½in., 90/- ; 12in. Speaker model 30in. x 17½in. x 16in., 100/-. Any of the above Ready-built for 7/6 extra.

RECOMMENDED HI-FI SPEAKERS : Wharfedale Super 8in. with cloth surround and aluminium speech-coil (giving extra octave of "top"), 85/-. Wharfedale Golden C.S., 95/- and the Vitavox KT10 12in. at £7. Send 2½d. now for new CATALOGUE AND BARGAIN SUPPLEMENT indispensable to all Quality Enthusiasts. TERMS c.w.o. or c.o.d.

NORTHERN RADIO SERVICES,
16 Kings College Road, London, N.W.3
Phone : PRImrose 8314

COVENTRY RADIO

Component Specialists since 1925

SPECIAL OFFER OF

NEW RESISTORS ½ - 1 Watt

A selection of popular values

100 FOR 10/6 POST PAID

(500 for 50/- post paid)

SEND NOW WHILE STOCK LASTS

COVENTRY RADIO,
189 Dunstable Road, Luton, Beds.

SITUATIONS VACANT

VACANCIES exist for electro-mechanical designers, used to engineering the mechanical side of communications and similar projects, and also associated with heavy mechanisms; a good degree in mechanical and electrical engineering or similar qualification is desirable as well as several years' experience in a laboratory or factory design department; salary according to qualifications.—Apply to Personnel Officer, Mullard Electronic Research Laboratory, Salfords, nr. Redhill, Surrey.

MARCONI'S WIRELESS TELEGRAPH Co., Ltd., require an additional lecturer in electronic engineering at Marconi College, Chelmsford; the applicant must be a graduate in physics or engineering, with preferably some experience in one or more branches of electronics and some practice in teaching; duties will include lecturing, supervision of experimental work and development of equipment for the present and future College Courses which are mainly of post graduate standard; salary according to qualifications and experience; good staff pension scheme.—Write giving full details mentioning reference 260 to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham St., London, S.W.1. [6240

B.B.C. invites applications for a post of engineer in the Studio Section (Recording), of Planning and Installation Department, based in London. Applicants should have a good theoretical and practical knowledge of the principles involved in audio-frequency and sound recording work. A university degree in electrical engineering or equivalent qualifications would be an advantage. The successful candidate must be prepared to spend a considerable amount of time away from London, as he will be required to plan and supervise the installation of sound recording equipment at any of the Corporation centres throughout the country. Starting salary £745 p.a. (may be higher if qualifications and experience are exceptional), rising by annual increments on a five-year progression to £965 p.a. The successful applicant will become eligible for consideration for appointment to established staff (contributory pension scheme) after two years' qualifying period. Applications, stating age, qualifications and experience, to reach Engineering Establishment Officer, Broadcasting House, London, W.1, within 7 days. [6338

B.B.C. invites applications for a number of vacancies for Technical Assistants Class II in the Operations and Maintenance Department of the Engineering Division which is responsible for operating broadcasting equipment at transmitter, studio and control room, recording and television centres throughout the country. Candidates must be not less than 21 years of age on January 31, 1951; of British nationality and have completed, or be exempt from, military service. They must be prepared to accept appointments at Corporation centres anywhere in Great Britain and Northern Ireland. The necessary qualifications include (a) education to matriculation standard with particular stress on mathematics and science subjects; (b) possession of a mechanical bent; (c) first-class school, business and personal references. Some experience in electrical or radio engineering is desirable but not essential. Appointments are to the unestablished staff in the first instance. Confirmation of appointment is subject to (a) passing a written examination at the end of a three months' training course (b) a satisfactory two-year probationary period after which staff become eligible for consideration for establishment (contributory pension scheme). Salary on appointment at age 21 or over is £5/15/6 p.w. in a scale rising by annual increments to £8/0/6 p.w. (maximum). It is hoped to fill the majority of these posts by January 31, 1951. Promotion to Technical Assistant Class I (maximum £520 p.a.) is normally subject to four years' service and is governed by merit, suitability and the existence of vacancies. Application must be made on the prescribed form which can be obtained from the Engineering Establishment Officer, Broadcasting House, London, W.1. The closing date for the return of the completed applications is 14 days from the date of this advertisement. [6292

SITUATIONS WANTED

ELECTRONIS engineer, B.Sc. (Hons. Eng.), 27, administrative, drawing office, instrument and electronic development and design experience, seeks responsible post.—Box 7685. [6322

BUSINESSES FOR SALE AND WANTED

DIRECTORSHIP available small radio manufacturing and marketing company in Midlands, due to retirment of present director; preference given to radio engineer with design and production experience.—For full details write Box 7620. [6273

FLOURISHING radio and television business, 4 branches in main shopping centres N.W. and Potteries, completely staffed, service engineers, fully trained and capable of handling TV; 1949/50 vans; large turnover, tremendous scope for extension; principals only apply.—Box 7625. [6294

PAINTS, CELLULOSE, ETC.

PAINT spraying handbook, 3/6, post free; cellulose and synthetic paints and all spraying requisites supplied; catalogue free.—Leonard Brooks, 53, Harold Wood, Romford. [0207

PATENTS

THE proprietor of British patent No. 573313, entitled "Multiple Section Electronic Tube and Method of Making it," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern & Carlberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A [6212

TECHNICAL TRAINING

CITY & Guilds (Electrical, etc.), on "No Pass—No Fees" terms. Over 95% successes. For full details of modern courses in all branches of Electrical Technology send for our 176-page handbook, free and post free.—B.I.E.T. (Dept. 388A), 17, Stratford Place, London. W.1.

TUITION

E.
M.
I.
E.M.I. gave the world electronic television; E.M.I. is now giving the finest home study television courses; moderate terms—facilities for easy payment; free brochure giving full details on application to the—Registrar, Dept. WW6. E.M.I. Institutes, 10, Pembridge Square, London, W.2. Bayswater 5131/2. [0001

WIRELESS operating; attendance and postal courses; stamp for reply to Manager. The Wireless School, Manor Gdns., London, N.7. [5901

NOTHING succeeds like success! What we have done a thousand times we can do again, for you.—See the B.N.R.S. Advt. on page 88. [0172

SEE the world. 600 Radio Officers required; send 2d stamp for prospectus to Britain's leading college; we train most, in shortest period, at lowest cost.—Wireless College, Colwyn Bay.

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, etc., on "no pass—no fee" terms; over 95% successes. For details of exams. and courses in all branches of engineering, building, etc., write for 176-page handbook—free.—B.I.E.T. (Dept. 387B), 17, Stratford Place, London, W.1. [0118

TELEVISION postal course for radio trades Examination Board's diploma; also postal courses for P.M.G. 2nd and 1st class Certificates and Amateur Radio Transmitting licence. —Apply British School of Telegraphy, Ltd., 179, Clapham Rd., London, S.W.9. (40 years' experience in coaching students in wireless telegraphy and allied subjects.) [0124

TUITION

TELEVISION.

THE only school in Great Britain devoted solely to training in television. Postal course prospectus.—Principal, Gothic Television School, 13, North Ave., London, W.13. [0051

RADIO training—P.M.G. exams. and I.E.E. Diploma; prospectus free.—Technical College, Hull. [0111

THE Institute of Practical Radio Engineers have available home study courses in every phase of radio and television engineering, specialising in the practical training of apprentices in the retail trade; enrolments limited, fees moderate.—The Syllabus of Instructional Text may be obtained post free from the Secretary, I.P.R.E., Fairfield House, 20, Fairfield Rd., Crouch End, London, N.8. [0088

BOOKS, INSTRUCTIONS, ETC.

"FUNK und Ton," 1949, "Funk Praxis," 1949; offers.—Box 7677. [6299

WEBB'S 1948 radio map of world, new multi-colour printing, with up-to-date call signs and fresh information on heavy art paper, 4/6, post 6d; on linen, on rollers, 11/6, post 9d.—Webb's Radio, 1-4, Soho St., W.1. Gerrard 2089. [0115

I.P.R.E. Technical Publications: 5,000 alignment peaks for superheterodynes, 4/9 post free; The Practical Radio Engineer, quarterly publication of the Institute, sample copy 2/- post free; membership and examination data, 1/- post free.—Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8. [0089

"BASIC Mathematics for Radio Students." 2nd Edition. By F. M. Colebrook, B.Sc., D.I.C., A.C.G.I. Presents the whole subject in an easily understandable and interesting form. The author deals first in a general manner with the fundamental mathematical processes that are the foundation of all applied science, and then discusses the application of mathematical ideas to radio problems. Size 7in×4½in. 298pp, 77 diagrams. Price 10/6 net from all booksellers, or 10/10 by post from The Publishing Dept., Dorset House, Stamford St., S.E.1.

BOOKS, INSTRUCTIONS, ETC.

"SUPERHETERODYNE Television Unit." A reprint of articles from "Wireless World" giving constructional details for a long-range receiver for reception of Alexandra Palace transmissions, with a map showing the service area of A.P. Size 9½in×7¼in. Price 2/6 net from all booksellers, or 2/8 by post from The Publishing Dept., Dorset House, Stamford St., S.E.1.

"TELEVISION Receiver Construction." Reprinted from articles in "Wireless World," this book contains a full description of constructional details, including special components, of a modern television receiver for the London area. Size 7¼in wide×9¾in. 48pp, with 58 diagrams and illus. 2/6 net, from all Booksellers, or 2/9 by post from The Publishing Dept., Dorset House, Stamford St., S.E.1. [P4

"WIRELESS Servicing Manual." 8th Edition. By W. T. Cocking, M.I.E.E. A reliable guide to which the professional can turn for reference. Essential testing apparatus and logical testing methods are described and the process of deducing and remedying defects explained. Size 7in×4¼in. 328pp. Price 12/6 net, from all booksellers, or 12/11 by post from The Publishing Dept., Dorset House, Stamford St., S.E.1. [P1

"RADIO Valve Data: Characteristics of 1,600 Receiving Valves." Compiled by the staff of "Wireless World." Gives the main electrical characteristics for normal operating conditions, arranged in tabular form, and diagrams showing base connections. Index enables any valve to be found by type designation. Size 10in wide×7in. 80pp. 3/6 net, from all booksellers, or 3/9 by post from The Publishing Dept., Dorset House, Stamford St., S.E.1. [P5

"RADIO Circuits: Step-by-Step Survey of Superhet Receivers." 3rd Edition. By W. E. Miller, M.A. (Cantab.), M.Brit.I.R.E., Editor of "The Wireless and Electrical Trader." Although this book deals mainly with the superhet receiver it is equally applicable to the straight set. The circuit of the superhet is dealt with section by section up to the complete receiver. Size 8½in×5½in. 118pp. 5/- net, from all booksellers, or 5/4 from The Publishing Dept., Dorset House, Stamford St., S.E.1. [P3

INDEX TO ADVERTISERS

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS LTD., Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd., William Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co.