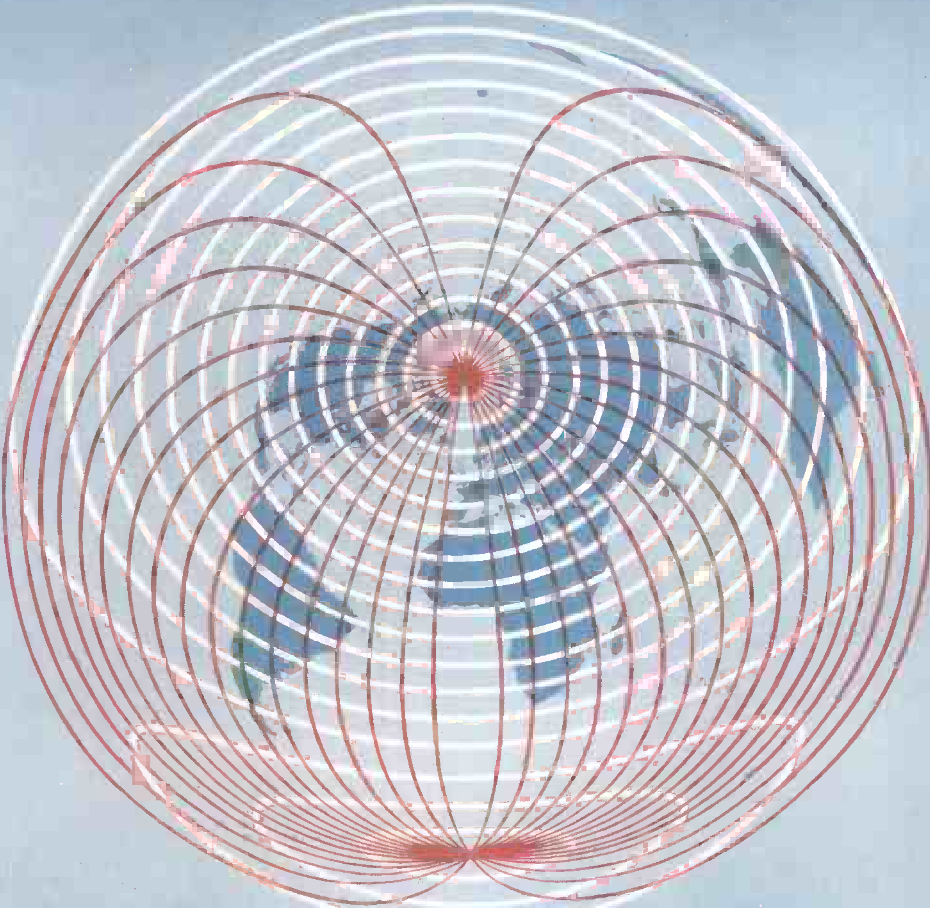
Wireless World

RADIO AND ELECTRONICS



Vol LVI No 11 Two Shillings November 1950

Wireless World

RADIO AND ELECTRONICS

November 1950

40th YEAR OF PUBLICATION

In This Issue

EDITORIAL COMMENT 381
SIDELIGHTS ON LOUDSPEAKER CABINET DESIGN. By *D. E. L. Shorter* 382
PICKUP INPUT CIRCUITS. By *R. L. West and S. Kelly* 386
SHORT-WAVE CONDITIONS. By *T. W. Bennington* 391
NEW BOOKS 392
VARIABLE FILTER TUNING—2. By *A. B. Shone* 393
WORLD OF WIRELESS 399
TOLERANCES AND ERRORS. By "*Cathode Ray*" 403
LONG RANGE TELEVISION. By *T. W. Bennington and R. Morris* 407
PHASE-SHIFT OSCILLATORS. By *W. G. Raistrick* 409
COMMUNICATION ON 460 Mc/s. By *E. G. Hamer* 412
THE HALL EFFECT 415
DARK-SCREEN TELEVISION 417
RADIO IN GERMANY 418
MANUFACTURERS' PRODUCTS 419
UNBIASED. By "*Free Grid*" 420
LETTERS TO THE EDITOR 421
RANDOM RADIATIONS. By "*Diallist*" 424

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 6s. 0d.; U.S.A. and Canada, $4.50

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

Wireless World

VOL. LVI. No. 11. NOVEMBER 1950

Valve Symbols

BRITISH Standard 1409:1947 "Letter Symbols for Electronic Valves," issued some three years ago, was stated to be "*based* on proposals prepared . . . with a view to standardizing the letter symbols used by valve manufacturers in their catalogues and other technical literature." At the time, *Wireless World*—not unreasonably, we hope—took the publication of this specification as implying a desire that the symbols proposed should be generally adopted by a wider circle. So, in spite of typographical difficulties, we accordingly used the symbols as far as was practicable.

Having gone thus far in the interests of uniformity, it comes as something of a shock to us to see the revised specification B.S. 1409:1950, just issued.* This publication, under the same title as its predecessor, carries on its cover the prominent statement "Mainly for use in valve catalogues and similar technical literature." That seems to put forward a highly undesirable principle: are we to have a state of affairs where users of valves (which means all of us) are to learn two languages—one for use in dealing with manufacturers and another in reading (or writing) technical journals?

Stereophony

OUR correspondence columns bear witness to the widespread interest that exists in stereophonic broadcasting. Stereophony will no doubt attract still more attention next year, as we believe the multi-channel principle is to be used in the sound-reproducing equipment to be installed at the Festival of Britain. That being so, it is a pity that a plea for B.B.C. experimental transmissions on a binaural system, made in this journal last March, was so uncompromisingly turned down. The B.B.C. Chief Engineer, in a letter published in our April issue, pointed out the admitted complications of the system, and expressed doubts as to whether the Corporation would be justified in spending money on a specialized service of interest to a relatively small number of listeners. The French broadcasting authorities were, however, less pessimistic about stereophony, and staged an experimental transmission a few months later.

We are certain that interest in this subject is greater than the B.B.C. imagines, and venture to suggest the Corporation should make another attempt to find ways and means of staging experiments in which listeners can participate, as they did in France.

Too Many Bosses?

THOUGH the uproar provoked by the withdrawal of the political play "Party Manners" from the B.B.C. television programme was a regrettable and unworthy episode that by now has been largely forgotten, it raised a matter of principle that will, we hope, be borne in mind when the B.B.C. Charter comes up for renewal next year. *Wireless World* does not concern itself with details of programme organization, but we deplore anything that tends to reduce the status of British broadcasting.

As we see it, the B.B.C. attitude over this matter betrayed that weakness against which the Corporation should be most strongly on its guard—timidity. This point of view was admirably expressed in a leading article in *The Times* of 10th November: "The listening public will always be behind them [the B.B.C.] in refusing to turn broadcasting into a colourless bore for the sake of this or that crank or fanatic. There would be no intellectual or aesthetic worth in broadcasting if it were controlled to please every shade of minority opinion. Censorship by timidity can be as effective as the blue pencil of a dictator." As things are, the organization of the B.B.C. tends to favour the timorous. Heads of "Programmes" should have sweeping powers, and be discouraged from passing on the responsibility for awkward decisions to higher authority.

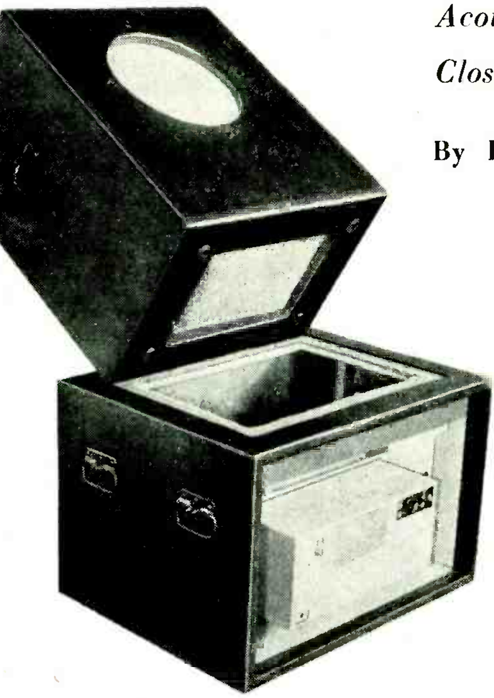
[* British Standards Institution, 28 Victoria Street, London, W.1. Price 2s. The revised specification includes a considerable number of extra symbols.]

Sidelights on

Loudspeaker Cabinet Design

Acoustical and Electrical Damping in Closed-cabinet Loudspeakers

By D. E. L. SHORTER,* B.Sc.(Eng.), A.M.I.E.E.



Experimental two-section vented cabinet with top half tilted back to show sound-absorbing material covering the communicating window.

IT is not the purpose of the present article to enter deeply into the mathematical treatment of the problems of loudspeaker cabinet design, since this field has already been covered in standard works on applied acoustics as well as in a number of articles in the technical press. Instead, it is proposed to discuss certain aspects of the subject which do not always receive full attention in the literature, and to illustrate these by a few experimental results obtained in the course of development work on cabinets during the period 1938–1947.

Standing Wave Effects

The subject of loudspeaker cabinet design is usually approached by a simplified theory, in which the mechanical properties of the cone unit and the acoustic properties of the enclosure are represented by a set of inductances, capacitances and resistances. Equivalent circuits containing these elements can then be drawn and the basic features of the design calculated.

Clearly, this simplified theory is only valid at frequencies so low that the wavelength of the sound is large compared with the dimensions of the cabinet. At higher frequencies, at which this condition is not fulfilled, the cabinet volume does not behave as a lumped acoustic capacity, and standing wave effects may appear unless the enclosure is adequately damped by sound absorbent material.

Unfortunately, the performance of a cabinet at these higher frequencies cannot be readily calculated, and in the absence of facilities for response measurement the degree of damping actually achieved is often in doubt.

The full extent of the standing wave effects in loudspeaker cabinets is not always appreciated. Cabinets intended to give good response down to 50 c/s generally have at least one dimension which is equal to a half wavelength of sound in the frequency range 125 c/s to 250 c/s. Moreover, as some recently published work[1] has shown, that the acoustic impedance presented by the cabinet to the cone may change from a capacitance to an inductance at a frequency of which the wavelength of the sound is some seven times the maximum dimension of the enclosure. In some cases, therefore, the simple theory based on lumped constants may break down even below 100 c/s. Reference to a table of absorption coefficients will show that the effectiveness of any sound absorbent lining of practicable thickness falls off below 500 c/s. It will thus be seen that the frequency band within which standing wave effects are to be expected may extend over some two octaves in an important part of the audio-frequency spectrum.

A practical example will illustrate the foregoing discussion. An experimental closed cabinet (the so-called "infinite baffle" type) was required for a 10in. cone unit; the resonance frequency of the unit with the cabinet volume was not to exceed 45 c/s.

The suspension of the cone unit had been experimentally modified to give the maximum compliance consistent with mechanical stability, but even so a volume of 8 cu. ft. was found to be required to meet the specification. For reasons connected with high-frequency distribution, the axis of the present loudspeaker was required to be about 3ft. from the floor and this consideration led to the adoption of a design 4ft. high.

Fig. 1(a) shows the free-air axial frequency response obtained with this cabinet, the cone unit being driven by an amplifier of low output impedance. The curve was taken with the cabinet lined with

---

* Research Department, B.B.C. Engineering Division.

[1] "The Acoustical Impedance of Closed Rectangular Loudspeaker Housings" by Meeker, Slaymaker and Merrill, *Journal of the Acoustical Society of America*, March 1950.

absorbent material of conventional type. Standing wave effects are nevertheless apparent at low frequencies, showing that the internal damping is inadequate.

Damping by Partitions

The ineffectiveness of sound absorbent linings at low frequencies is due to the fact that all the absorbent material lies within a small fraction of a wavelength of the inner wall, which is, of course, a velocity node. Without motion of the air particles, or of the material itself, acoustic power cannot be absorbed and dissipated. Consideration of these facts suggests that the best position for damping material would be somewhere out in the space inside the cabinet, where the standing waves could be caught "on the wing." Theoretically, the material would have to be divided up into many parts, so disposed that at any one frequency there should be an absorbing element in the neighbourhood of a velocity antinode. In practice, however, such a complication has been found unnecessary and effective low frequency damping can be achieved by concentrating the absorbent material into one or two partitions strategically placed across the cabinet. Fig. 1(b), for example, shows the response of the loudspeaker previously referred to when a single sheet of ¼-in carpet felt was stretched horizontally across the inside of the cabinet at right angles to the longest dimension; the reduction in standing wave effects can be clearly seen.

In this system[2] of damping by partitions, the cabinet can be regarded as being divided into sections, each so small that any standing wave effects occur at high frequencies, at which the sound absorption of a lining of the conventional type is adequate. It may further be noted that those sections of the cabinet which are separated from the cone by one or more sound absorbing partitions receive little sound at the high frequencies and therefore require very little "acoustic treatment."

The principle of subdivision can be applied in a number of ways to suit different cases. The photograph, for example, shows part of an experimental vented cabinet constructed in two separate sections. The lower of the two sections houses the power amplifier and takes the form of a plinth on which the upper section stands. In the illustration the upper section is tilted to show the underside which has a window communicating with the plinth and covered with carpet felt.

Impedance Test

Reference was made earlier to the strategic placing of absorbent partitions. This operation would appear at first sight to require facilities for measuring the overall frequency response of the loudspeaker. Fortunately, however, it is possible to make the necessary experimental adjustments by quite rough impedance measurements. Fig. 2 shows the circuit used for this purpose. R_1 is the resistance of the speech coil of the loudspeaker which is fed at constant current from an audio-frequency oscillator though a

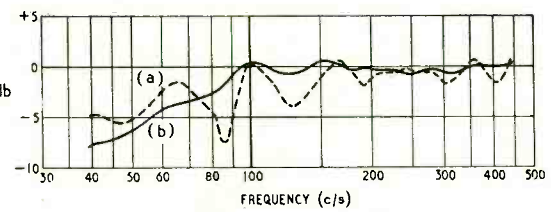


Fig. 1. Axial response below 500 c/s of 10-inch speaker in closed cabinet (a) inner surface lined with absorbent material in conventional manner; (b) with the addition of an absorbent membrane stretched horizontally across the cabinet at right angles to the longest dimension.

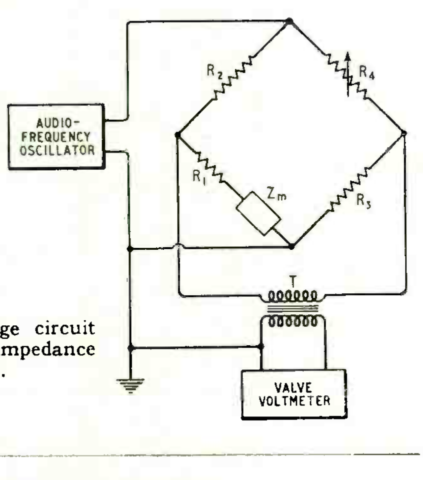


Fig. 2. Bridge circuit for motional impedance measurements.

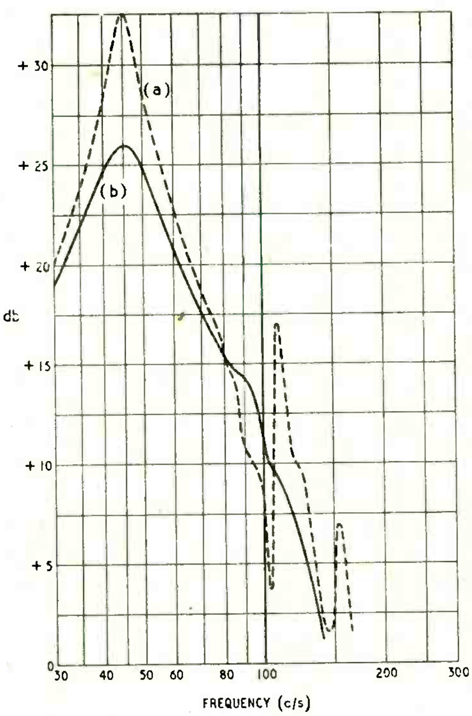


Fig. 3. Typical response curves obtained with the circuit of Fig. 2. Curve (a) is for an undamped cabinet and (b) for the same cabinet with internal damping partition.

---

[2] Patent Application No. 24528/49

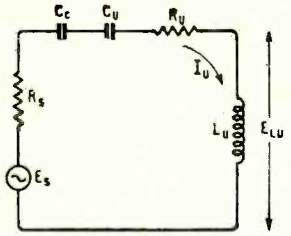


Fig. 4. Equivalent electrical circuit of acoustic elements in a closed-cabinet loudspeaker at low frequencies.

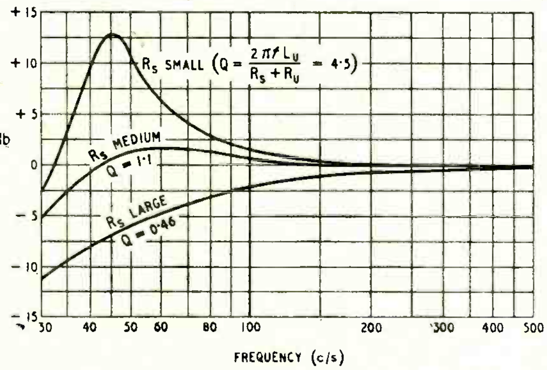


Fig. 5. Response of closed-cabinet loudspeaker for various valves of the effective damping resistance R_s.

relatively high resistance R_2. Z_m is the motional impedance of the loudspeaker, so that the voltage developed across Z_m represents the back e.m.f. generated by the motion of the speech coil when driven by a constant current. Since we are dealing only with the frequency range in which the cone moves as a whole, this back e.m.f. is a measure of the cone velocity. The cone aperture is the only outlet from the cabinet; any internal resonances can only influence the sound output from the system by modifying the motion of the cone, and must therefore reveal themselves by irregularities in the curve of motional impedance against frequency.

In general, the resistance R_1 will tend to swamp all but the largest of these irregularities so that the total impedance of the loudspeaker is not a very sensitive index of cabinet performance. In the circuit of Fig. 2, therefore, the effect of R_1 is roughly balanced out. Resistance R_3 is made approximately equal to R_1, and the variable resistance R_4 approximately equal to R_2, the whole circuit forming a bridge, the output of which is taken off through the isolating transformer T to a valve voltmeter. The primary impedance of T should be high compared with the maximum speech coil impedance at low frequencies, a requirement which is generally easy to meet.

To make a test, the speech coil is temporarily prevented from moving, either by disconnecting the loudspeaker field supply or, in the case of a permanent magnet, by carefully inserting small wedges into the gap so as to grip the coil. Assuming complete clamping of the movement, Z_m will now be zero, and in this condition, the bridge is balanced at some convenient frequency, preferably in the 200/300-c/s region, by adjusting the value of R_4 and using the valve voltmeter as a null-indicator. The speech coil is then released and the bridge output, which now represents the voltage across Z_m (i.e. the back e.m.f. of the speech coil) is read direct on the valve voltmeter and plotted against the frequency of the oscillator. A typical curve of this kind is shown in Fig. 3(a) which was obtained in an ordinary live room with a completely undamped cabinet. The radiation efficiency of the loudspeaker is too low for any room resonances to affect the curve but the internal modes of the cabinet are clearly apparent. Fig. 3(b) shows how these modes are affected by the introduction of a felt partition.

It will be noted that in this test, the speech coil is being driven with constant force. If the cone were mass-controlled, i.e. if the compliance of the suspension were infinite and the effect of the cabinet nil, the speech coil would move with velocity inversely proportional to frequency. In this hypothetical case, the curves of Fig. 3 would be straight lines having a slope of 6 db per octave; and it is sometimes convenient to use such a slope as a standard of reference. If desired, an equal and opposite slope can be introduced into the response of the test circuit (for example, by interposing in the input of the valve voltmeter a small series condenser). With this compensation, the valve voltmeter readings will be confined to a much smaller range, and may be plotted to a more open scale. Small irregularities in the curve may thus be better observed; and the reference line representing the condition of mass control becomes horizontal.

The method of test described above has been used successfully up to about 300 c/s and the accuracy, though limited by the difficulty of ensuring complete clamping of the cone movement, is sufficient to disclose the more troublesome internal cabinet resonances, so that these can be dealt with without recourse to free-air response measurements.

Effect of Source Impedance

Returning to the response characteristic shown in Fig. 1, it will be seen that although the fundamental resonance frequency of the system is at 45 c/s, the acoustic output begins to fall away well above this frequency. For an efficient loudspeaker, driven by an amplifier of low output impedance, this type of response is in accordance with theory. The mechanism of the effect can be explained in the following way.

At the lower end of the audio-frequency band, the wavelength of the sound is large compared with the diameter of the cone, while the polar distribution of the sound output varies only slightly with frequency. It can be shown that in these circumstances the sound pressure produced is proportional to the product of the cone velocity and the frequency. Thus, constant sound pressure will be obtained if the cone moves with a velocity varying inversely as the frequency, while constant cone velocity will give a sound output falling towards the bass. If the cone unit is very efficient, its motional impedance at low frequencies will be high, or, in other words, practically the whole of the voltage across the loudspeaker terminals will be accounted for by the back e.m.f. generated by the motion of the speech coil. If, in addition, the impedance of the driving source is low, the back e.m.f. will be nearly equal to the source voltage, and must therefore remain nearly constant with frequency. In these circumstances, the cone must be moving with nearly constant velocity, and the sound output will therefore fall at the bass. Regarding the matter from a slightly different viewpoint, we may say that the rise in impedance of the speech coil at lower frequencies produces an electrical mis-match which so reduces the efficiency of power transfer from amplifier to loudspeaker that, however efficient the electro-acoustic power conversion of the system may be, constant overall efficiency cannot be obtained. The higher the magnetic flux density, the further up the frequency range does this effect extend, so that the "infinite baffle" may give disappointing results with the better class of unit. This does not, of course, mean that high efficiency in a cone unit is a bad thing, but that in some cases it is difficult to make full use of it.

It is sometimes suggested that one can never have too much electrical damping of a loudspeaker. The present case, however, appears to suggest the contrary, and in view of the general interest in the subject, it may be worth while to study the electro-acoustic system from yet another view-point.

Fig. 4(a) is a simplified electrical equivalent circuit of the acoustic system of the loudspeaker. For reasons which will appear later, the circuit elements are not placed in quite the usual order. L_U represents the cone mass plus the effect of radiation reactance, R_U the small radiation resistance (which unlike most other resistances, varies with frequency), C_C and C_U respectively the acoustic capacitance of the cabinet volume, and the equivalent capacitance of the cone suspension. R_s is a very important quantity which, nevertheless, is frequently omitted from these equivalent circuits. It represents the effect of the electrical circuit of the loudspeaker and driving amplifier reflected into the acoustic circuit of the loudspeaker in a similar way to that in which the motional impedance is transferred into the electrical circuit. At low frequencies,

$$R_s \propto \frac{B^2}{r_a + r_c}$$

where B is the flux density in the gap, r_a is the output impedance of the driving amplifier (assumed resistive) and r_c is the d.c. resistance of the speech coil. Any internal frictional resistance in the cone suspension system can, for simplicity, be lumped with R_s which, together with an equivalent constant voltage generator E_s, represents the source of power.

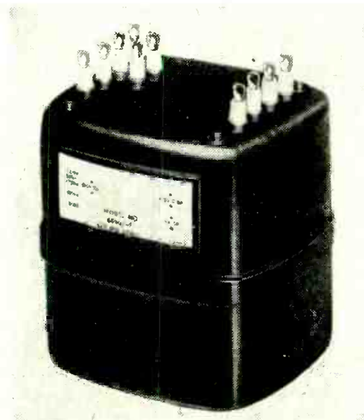
It has already been remarked that at low audio frequencies, the pressure response of the loudspeaker is proportional to the product of cone velocity and frequency. In the equivalent acoustic circuit of Fig. 4 the current I_U represents the alternating air current produced by the cone and is thus proportional to the cone velocity. Hence the acoustic response of the loudspeaker will be proportional to $I_U f$. The voltage E_{LU} is $2\pi f L_U I_U$. Thus E_{LU} is proportional to $I_U f$ and the variation in this voltage with frequency for any one value of L_U gives the frequency response of the loudspeaker. Over the frequency range for which the equivalent circuit is valid and the wavelength is large compared with the size of the cone, the loudspeaker can be reduced, as far as frequency response is concerned, to a half-section, high-pass filter working into open circuit. Small values of R_s, resulting from low flux density or high amplifier output impedance give a resonance peak and bad transient response, while large values of R_s, corresponding to high flux density and low amplifier output impedance can give a serious loss of bass.

The range of possibilities is illustrated by the three curves shown in Fig. 5, showing the variation of E_{LU} for a resonance frequency of 45 c/s with different values of R_s. Curve 3 will be recognised as approximating to the curve of Fig. 1(b), and it will be seen that when standing wave effects are disposed of, the response of the loudspeaker approaches the form predicted by simple theory. Curve 3 corresponds to a Q of 0.46, only slightly less than the figure of 0.5 required for critical damping. Whether critical damping is really necessary is another matter, to which we shall have occasion to refer later; but in the meantime it should be noted that this condition can only be achieved at the expense of a drooping frequency characteristic.

(*To be concluded*)

Standardized Components

THE Admiralty announce that their range of hermetically sealed transformers and chokes are the first type to qualify as fully Inter-Service Type-Approved Standards. The design comprises "C" core assemblies accommodated in deep-drawn steel cases, and owing to the many technical improvements which have been incorporated, the new transformers and chokes are as much as 40% smaller and give up to 50% reduction in external magnetic field compared with their counterparts using orthodox laminations.



Hermetically sealed power transformer to Admiralty design.

The contour for each size has been carefully determined to provide the maximum strength, and construction is such as to withstand the severest conditions of vibration and shock, as well as extremes of climate.

Thirty-two sizes are available covering a range of power transformers from 5-VA to 2-kVA, also a range of audio-frequency transformers and power chokes to suit all normal requirements. Thirty-one of these sizes have tapped fixing holes at each end, thus permitting upright or inverted mounting at will.

Although the design of this range is Admiralty property, it may be used freely for commercial purposes by any manufacturer who so desires. Where firms do not wish to tool the range for themselves, they can obtain supplies of cases, internal fittings, etc., from commercial sources. More than twelve firms have already taken advantage of this arrangement, and as their production increases so a greater flow of these standardized transformers and chokes will reach the home and export markets.

Pickup Input Circuits

Compensating for 78 and 33⅓ r.p.m. Recording Characteristics

By R. L. WEST, B.Sc., A.M.Brit.I.R.E., and S. KELLY

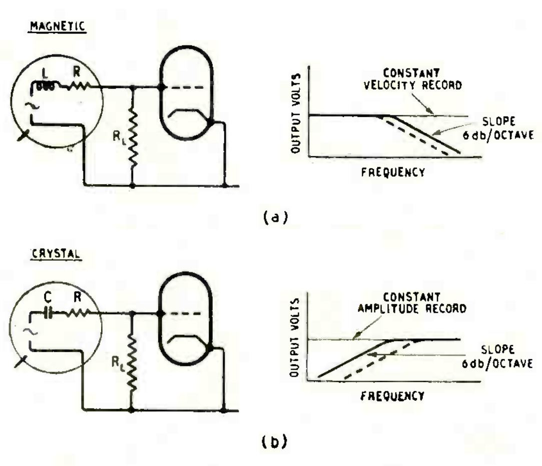
MUCH disappointment can be avoided by a simple understanding of the principles underlying the design and selection of input arrangements for standard 78 r.p.m. and 33⅓ r.p.m. long-playing records. An exhaustive treatment is not intended, but it is hoped that this article will help the beginner to avoid the commoner pitfalls.

Most pickups fall into two main types—crystal (or piezoelectric) and magnetic—the latter covering ribbon and moving coil, as well as moving-iron armature and "variable reluctance" types. Crystal pickups are always of high-impedance; they are thus suitable for more or less direct connection to a grid circuit. Magnetic pickups are sometimes wound with a large number of turns of wire to generate the relatively large voltage required for the grid circuit; this can introduce electrical resonance (of self capacity and inductance of coil) unless great care is taken in the design. For high-fidelity pickups it is normally more convenient to use fewer turns (only *one* in the ribbon) these produce very small e.m.f.'s but are capable of delivering a much larger current. Since it is voltage and not current that matters at the grid circuit a suitable step-up transformer is normally used. The following remarks assume the use of a transformer where necessary and apply mainly to the high-impedance (secondary) side.

Effect of Load.—The input impedance of a valve is usually very high compared with the generator impedance and can be neglected; the value of the grid leak will therefore be dictated by the load impedance requirements of the pickup.

Magnetic pickups have internal impedance which is principally L and R in series, whereas crystal types are principally C and R in series and R is usually very small. Fig. 1 shows the effect of load resistance and assumes constant output voltage on open circuit. In each case the dotted characteristic represents the effect of a lower value of load resistance.

Fig. 1.—Effect of resistance on output from magnetic and piezoelectric pickups.



Incidental Capacitance.—(i) *Screened lead between pickup (or transformer secondary) and amplifier.*—Again the internal impedance has to be introduced (see Fig. 2). By way of simplification the small resistive component has been omitted from the crystal case but should be included in the event of using very high cable capacities. The slight peak shown in the magnetic case is seldom noticeable since the internal R and the external R (not shown) damp it very thoroughly.

(ii) *Screened lead after the volume control.*—This is a common trap for beginners and is often overlooked by those who should know better! The Fig. 2 (c) shows the effective circuit, and the resulting top loss with intermediate settings of the volume control, which can be very considerable, particularly if a high-value volume control is used. The effect disappears as the slider approaches the "bottom end" and turns into an example of the previous type when the slider approaches the "top end." The use of a compensating condenser C_C as shown sometimes helps a little, but note that a capacity varying between C_L and $C_L/2$ is now permanently across the input, and only when the slider is half way (electrically) is the "compensation" correct! Far better, if enough gain is available, to use circuit of Fig. 2 (d). Here the very low output resistance will "swamp" the capacity of most normal screened lead requirements.

Pickup Resonances.—Low resonances, say under 1,000 c/s, include those due to the tone arm torsional resonance and the effective mass of the whole pickup resonating with the armature mounting compliance. If these are excessive within the working range, the pickup can be considered unsatisfactory, since it will be found that very heavy tracking pressures are necessary to keep the needle in the groove at these frequencies, with consequent increase in record wear. Electrical correction is no remedy.

The most noticeable high-frequency resonance is where the stylus and/or armature flexes. This ranges from about 3,500 c/s in the older pickups to well above audibility in some modern ones. The "height" of the resonance varies, from 12 db or more in the case of an undamped system, down to a barely perceptible rise if sufficient damping is added and in the right place. This is the resonance which, if within the audible range, considerably augments needle scratch. Above this resonance, the output usually falls off very rapidly (see Fig. 3a).

A simple treatment for magnetic types is to use a rather lower load than normal, and so produce top

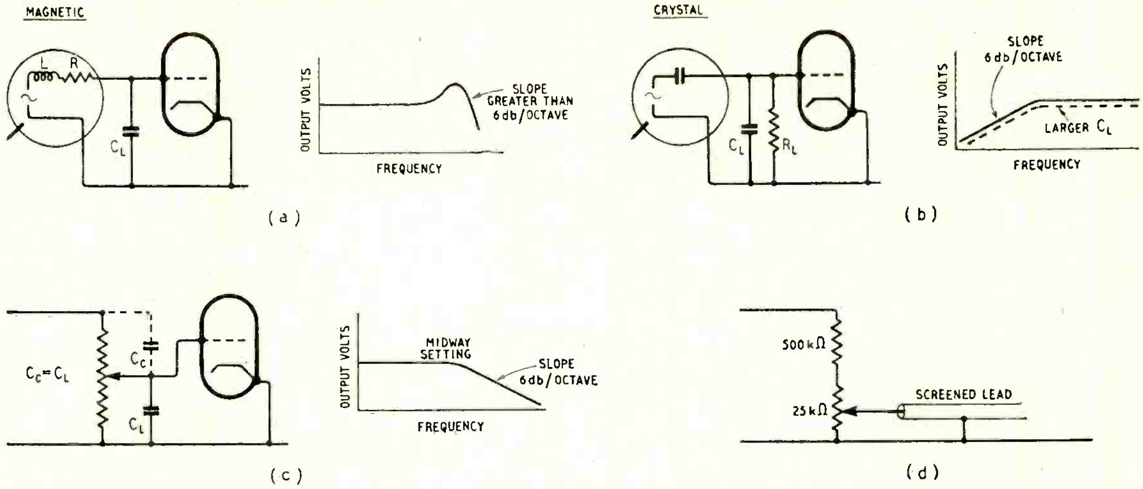


Fig. 2.—Illustrating the effect of external capacitance on the response of magnetic and crystal pickups.

attenuation at the rate of 6 db per octave. This improves the general balance—Fig. 3(b)—and assists the electromagnetic damping.

A more elaborate circuit uses a tuned series filter—Fig. 3 (c). R is seldom needed as the pickup impedance is usually sufficient. As a rule R_2 can likewise be dispensed with since there is some resistance in the inductance. It is better to over-emphasise the correction in order to reduce to a minimum surface noise due to the armature resonance. "L" can be an air-cored or dust-cored choke of between ¼ and 1 henry. An ordinary laminated core usually exhibits a marked change of inductance with signal strength at these very low operating levels.

The older crystal types usually had an overall output of the type shown in Fig. 3 (d). Here it will be seen that the overall balance is sufficiently good for average domestic use.

Results can be improved by a tuned filter, a parallel-tuned (rejector) circuit is the simplest to use. In Fig. 3 (e), "L" would be the same component as in the magnetic case.

Choice of Load.—In general, the higher the load resistance, the greater the voltage developed by the pickup. For magnetic types the load can be several megohms if the top resonance frequency is very high, the grid circuit capacitance low and no top attenuation desired at this point. The makers' recommendations will have taken these factors into consideration.

For the older crystal types it is usually necessary to use a load under one megohm in order to attenuate the bass response somewhat—unless one is trying to get bass from a small cabinet! Values of ½ megohm to 100,000 ohms are most common.

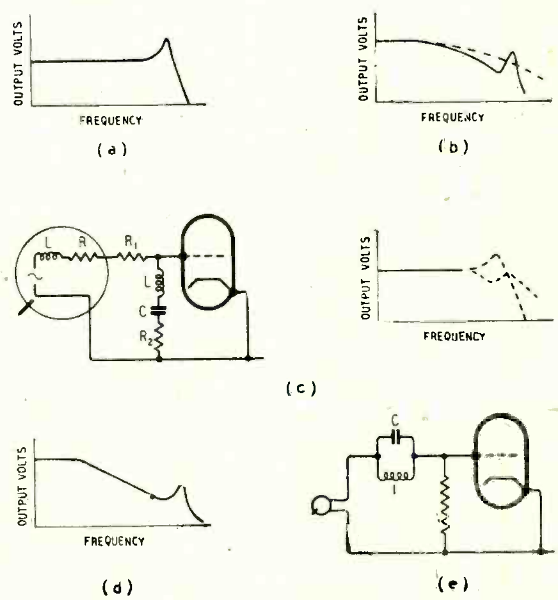
Hum—Causes and Cure.—There are two main sources of hum—by induction from an alternating magnetic field such as from the mains transformer or gramophone motor, and by electrostatic induction from wiring and components usually connected to the mains or other high voltage a.c. sources.

Magnetic hum introduced into the leads and wiring represents only a very small e.m.f., since only one complete turn is involved. This can be troublesome when a step-up transformer follows the lead in question, how troublesome depends on the transformer turns ratio and the e.m.f. generated by the pickup.

The best treatment is to twist tightly these low-impedance leads all the way from the pickup coil itself right up to the transformer input terminals. For the secondary connections, ordinary screened leads are sufficient, but it is advisable to keep all these leads as far from stray magnetic fields (including heater wiring) as possible. The transformer hum problem is dealt with later. On the high-impedance side the magnetic and crystal types experience mainly hum from electrostatic induction. The cure is simple—just plain good screening *everywhere*, and this precludes mains switches on volume controls, unless they are well shielded.

Rumble.—This consists usually of vibrations originating from the motor, with the main com-

Fig. 3.—" Top " resonances in magnetic and crystal pickups.



ponents between about 5 to 30 c/s. Magnetic pickups are seldom troubled with rumble since their output is proportional to velocity which falls with frequency for a given amplitude—hence very little output occurs at these low frequencies.

Crystal pickups, on the other hand, usually show up the motor deficiencies on this score, since the output voltage is proportional to amplitude. In a recent design (Acos GP20) a velocity type characteristic has been introduced below about 30 c/s and the trouble is considerably reduced.

Where necessary, a simple high-pass filter, such as that shown in Fig. 4, gives useful rumble attenuation without spoiling the bass response. This attenuates at 12 db/octave and gives a more rapid rate of fall at small values of attenuation than the more usual circuit, having equal capacities and equal resistances. Using the circuit shown, values of $C = 0.01\,\mu F$ and $R = 0.5\,M\Omega$ have proved satisfactory.

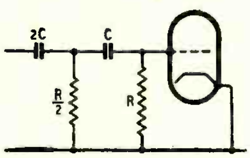


Fig. 4.—Simple " rumble " filter.

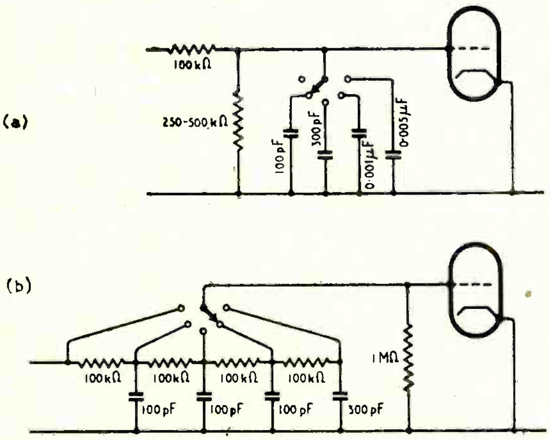
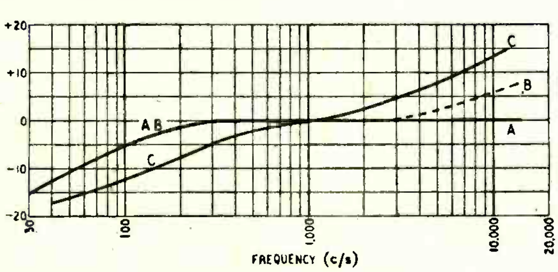


Fig. 5.—Top boost controls (a) with variable cut-off frequency, (b) with variable attenuation slope.

Fig. 6.—Principal commercial recording characteristics plotted on the basis of equal velocity at 1,000 c/s. A, standard 78 r.p.m. ; B, Decca FFRR, 78 r.p.m. ; C, Decca long playing.



Pickup Transformers.—(*a*) *Step-up ratio.*—In general, as high a step-up ratio as practical is used. Suppose the grid leak-cum-load has been chosen as 1 MΩ, then the actual load on the pickup will be $10^6/N^2$ where N is the turns ratio. The larger N, the smaller is the load, so one must not make N too large by trying to increase the output voltage too far, or severe top loss will occur. If the d.c. resistance of the pickup is, say, 25 ohms, then its impedance at 1,000 c/s we know must be more than this, say 50 ohms, and the load should be much greater still, say, 100 ohms if minimum top loss is desired. This makes N equal to 100. If top loss is definitely desired N could be increased to, say, 200. This will not quite double the output voltage since the lower load will cause a larger voltage drop (at all frequencies) in the resistive component of the pickup impedance.

(*b*) *Choice of primary turns.*—For any given ratio and core, two few primary turns, i.e., low inductance, will lead to loss of bass.

At the lowest frequency involved the primary reactance must be equal to or greater than the pickup impedance or load, whichever is the larger. A rough and ready rule, which is liable to err only on the generous side is to put the same number of turns on the primary as there are in the pickup coil, be it one or many.

(*c*) *Core Material.*—In the interests of minimum distortion (due to hysteresis), at the very low signal levels involved, a nickel alloy such as Mumetal is by far the best material. Not much will be needed, a ¼-in square core section should be ample for any design.

(*d*) *Screening.*—Enclosure in any earthed metal can will look after the electrostatic component. From the magnetic point of view the best method is to select a spot as far as possible from the mains transformer, smoothing choke and motor. Use a Mumetal can, which should be earthed, care being taken to prevent the transformer core from touching the can, and remembering that the magnetic properties of Mumetal deteriorate if the material is stressed by cold working in any way. Any residual (magnetic) hum can be reduced by orienting the transformer in the can, or the can as a whole. In severe cases, a second Mumetal can, to enclose without touching the first, may be necessary.

Mechanical Feedback.—On occasions, when the loudspeaker is in the same cabinet as the turntable, mechanical feedback will occur when the pickup stylus is in contact with the record. This is usually due to flimsy cabinet construction or to attempting a very large low-frequency output. Each case must be treated on its merits, but trouble of this nature emphasises the desirability of a separate speaker. When this is not practicable cases may be dealt with by rubber or felt mounting for the whole baseboard, stiffening the baseboard, tightening or slackening slightly the motor mounting, or even reducing the bass response at the extreme low frequencies.

Simple Pickup Measurements.—Very little apparatus is necessary to carry out useful checks on frequency characteristics. A standard frequency record, preferably the type with bands of fixed frequency ranging from, say, 30 c/s up to 14,000 c/s or more, a fixed resistor of 5 to 10-watt rating equal to the nominal speaker load, an a.c. voltmeter (rectifier type) of range 0 to 5 V or 0 to 10 V.

Most modern amplifiers employ sufficient feedback to be virtually flat over the audio range, so, with a resistive load in place of the speaker and the voltmeter across that, they make a very nice valve voltmeter, provided the volume control is not disturbed after the initial setting.

A response curve can then be obtained quite easily by converting voltage ratios to the voltage at, say, 1,000 c/s into decibels by the usual formula: Decibels = 20 × log. ratio—or by referring to decibel tables or abacs if these are available.

Be careful not to overload the amplifier when taking these readings. Knowing the maximum power output of the amplifier and remembering that Watts = V^2R calculate the highest reading V you can allow to be seen on the voltmeter.

In the absence of an LP test record, the circuit can be checked satisfactorily using a 78-r.p.m. standard frequency record, run at 78 r.p.m. and using the correct stylus. To the readings obtained, when converted to decibels, add the bass-cut figures quoted on the record, then the final curve should look like the inverse of curve C in Fig. 6 if equalization is correct. This method is quite accurate except for the top resonance, if any.

Controls for a Pickup.—Two controls are really sufficient—a top attenuator, preferably switched in 4 or 5 stages, to cover age, origin, and condition of 78-r.p.m. records, and a changeover switch to effect the major 78—LP change. A three-position switch is useful, in the form 78—LP—Radio. The more ambitious might like to expand it to:—78 NORMAL—78 FFRR—LP—Radio, but the extra top of the Decca FFRR can be dealt with quite adequately by the normal top control.

Two top cut circuits are shown. Fig. 5(a) is the conventional one with 6 db/octave attenuation, starting higher or lower in the scale according to the capacity chosen. With the values given attenuation starts, according to the switch position, at frequencies in the neighbourhood of 10, 6 and 3 kc/s and for really bad records at about 300 c/s. Fig. 5(b) varies the slope from 5 to 20 db/octave, with a little variation of the starting point, which is in the region of 1,000-2,000 c/s.

A 78/LP changeover is suggested, rather than using the top and bass controls; this enables the changeover to be made with a single operation. Further, exact equalization of LP recordings is not possible with simple cut/boost controls, and it is in any case desirable that the whole of the variable top and bass control range should be available for special conditions.

78 r.p.m.—(i) *The recording characteristic.*—Fig. 6 shows (A and B) the two recording characteristics produced in this country in terms of velocity against frequency.

(ii) *Correction circuits.*—The magnetic types require a bass-lifting circuit of the type shown in Fig. 7(a). In reality it "attenuates-everything-but-the-bass," a matter of 10 times for both sets of values given, so that adequate gain must be available in the amplifier.

The circuit of Fig. 7(b) for the crystal type is similar in this respect. With the older crystal types it must be used with discretion, though, on account of the rather large high-note resonance. An elaboration of this circuit which was recommended for use with the Acos GP12 is shown in Fig. 8. This pickup followed closely the theoretical amplitude operation of piezo crystals.

With the later types of crystal pickup, such as the Acos GP20, the high-frequency response does not follow this law, but has an internally-compensated response which approximates to a velocity law at high frequencies when terminated by a resistive load. For those who would like to improve the response, a circuit is shown in Fig. 9.

R_1	R_2	R_3	C
100kΩ	10kΩ	≥ 500kΩ	0·05μF
200kΩ	20kΩ	≥ 1MΩ	0·03μF

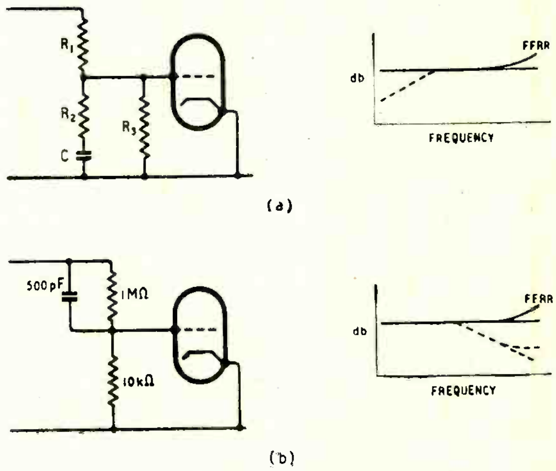


Fig. 7.—Simple compensating circuits for 78-r.p.m. recordings (a) magnetic (velocity) pickups, (b) crystal (amplitude) pickups. The dotted curves indicate voltage output before correction.

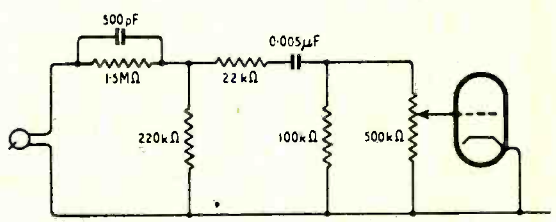


Fig. 8.—Correction circuit for the Acos GP12 pickup on 78 r.p.m. records.

Fig. 9.—Correction circuit for Acos GP20 pickup on 78 r.p.m. recordings.

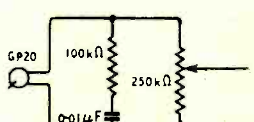
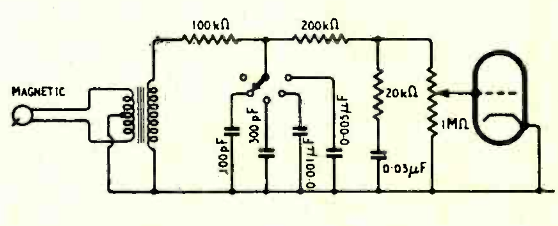


Fig. 10.—Complete compensating circuit (78 r.p.m.) for magnetic (velocity) pickups.



None of these circuits include top correction for the difference between standard and FFRR characteristics, but this will be covered by the suggested top control.

A complete circuit for a magnetic pickup is shown in Fig. 10, and for an Acos GP20 in Fig. 11. This latter includes the anti-rumble circuit of Fig. 4.

Long-playing ($33\frac{1}{3}$ r.p.m.).—The successful adaptation of standard pickups for microgroove recording is dependent on the recognition of several factors. If the pickup will not track standard 78-r.p.m. test recordings satisfactorily at 14 grams or less, it is improbable that the same pickup (with a correct radius

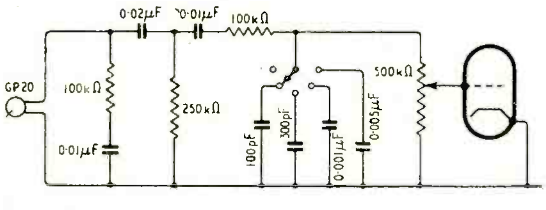
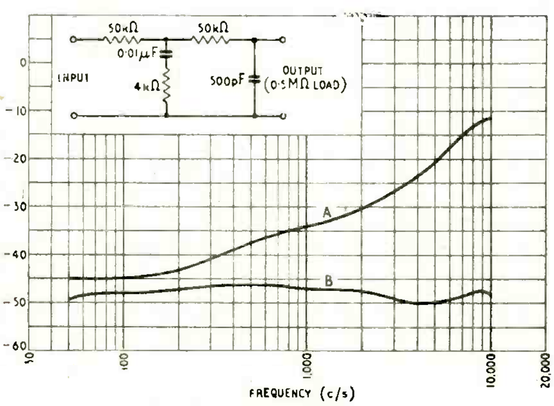


Fig. 11.—Complete compensating circuit (78 r.p.m.) for Acos GP20 pickup.

Fig. 12.—Output of high-impedance Decca Model D2 (3-pin type) moving-iron pickup on $33\frac{1}{3}$ r.p.m. test record ; A, without correction ; B, with equalizer circuit shown inset.



stylus, of course) will track long-playing records at 7 grams. The tracking problem is not only important at the low frequencies, but also at the extreme high frequencies, where the velocity of the microgroove recording approaches that of the standard record, although the tracking weight of the pickup is considerably less and mechanical impedance of the armature is rising rapidly.

Assuming, however, that the pickup is satisfactory in this respect, there is no reason why it should not give satisfactory results on microgrooves, providing it is correctly equalized. It should be noted that the effective resonance frequency of the armature system is usually decreased by about half an octave on microgroove compared with standard records, so that if any resonance is at all apparent in the upper register on standard records it will, in general, be more prominent and at a lower frequency on microgrooves.

Frequency correction.—As examples, two high-fidelity magnetic pickups and a similar type crystal pickup are presented herewith. The open-circuit response characteristic of the Decca Model D2, 3-pin type, magnetic pickup is given in Fig. 12(A). It will be seen that this response, in the mid and lower registers, approximates to the recording characteristic, Fig. 6(C), but in the higher frequencies rises rather more steeply because of the lowered resonant frequency of the armature system. The electrical network, shown inset, corrects the response of the pickup and gives the overall response shown in curve B. Although this final response is not in the "straight line from d.c. to infinity" beloved by the pedants, it is well within ±2 db. The components in question were radio-tolerance units. It may be pointed out that the 500 pF terminating condenser and the 4,000-Ω resistance may have to be varied with individual pickups to get a satisfactory balance between the middle and upper frequencies. This equalizer has been successfully used with a variety of pickups of up to 5,000 ohms impedance (connected direct or taken on the secondary of the coupling transformer) which normally require a load resistance of quarter to half megohm.

The best of the moving-coil pickups show a resonance of at least 20 kc/s on standard 78-r.p.m. records and even when played on microgroove records the resonance is seldom lower than 15 or 16 kc/s and the pickup response is very nearly that of the record. With care the low-frequency resonance can be below 30 c/s and the low-frequency response will also be

Fig. 13.—Low-impedance Leak moving-coil pickup and transformer on $33\frac{1}{3}$ r.p.m. test record ; A, without correction ; B, with equalizer circuit.

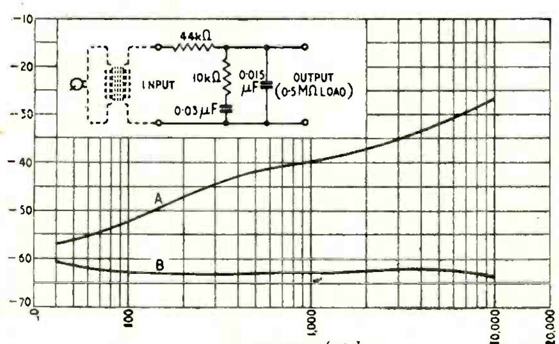
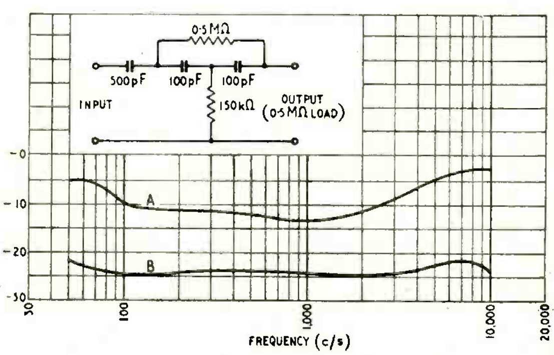


Fig. 14.—Cosmocord GP20 crystal pickup on $33\frac{1}{3}$ r.p.m. test record ; A, without correction ; B, with "bridged T" equalizer circuit.



very nearly that of the recording characteristic. The Leak moving-coil pickup and its transformer are shown as being representative of this type of instrument. The open-circuit response is given in Fig. 13(A); when connected with the appropriate equalizer network the response shown at B is obtained. The high-frequency "roll-off" is controlled by the 0.015-μF condenser; decreasing it to 0.01 μF will increase the 10-kc/s response by about 4db. This condenser can be adjusted to meet individual requirements. If the low-frequency end is considered excessive a condenser can be inserted between the transformer secondary and the 44,000 Ω resistor. A value of 0.25 μF will give a reduction of about 6 db at 50 c/s. The "roll-off" at low frequency can be adjusted to suit conditions by varying the value of this condenser, lower values increasing the attenuation.

The case of the crystal pickup is shown in Fig. 14, the unequalized response being shown at A and the equalized at B. It will be seen that a modified "bridged T" network is used, and, within reason, the equalizing is independent of the pickup impedance. In all cases the terminating resistance should be 0.5 MΩ. If the input impedance of the amplifier is other than this value, a simple potential-divider matching arrangement should be used.

It may be found, especially with cheaper type turntables or units that have been modified from 78 r.p.m., that motor rumble is excessive. Should this be the case, the high-pass filter unit described earlier may be used successfully, but should be connected between the equalizing unit and its load resistance.

In conclusion, the authors are indebted to Messrs. Decca Radio and Television, Cosmocord and H. J. Leak & Company for information regarding characteristics of records and pickups.

SHORT-WAVE CONDITIONS

October in Retrospect : Forecast for December

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

DURING October the average maximum usable frequencies for these latitudes increased very considerably during the daytime, and decreased considerably during the night. These variations were in accordance with the normal seasonal trend.

Daytime working frequencies for long-distance communication were fairly high, though not so high as had been expected. The 28-Mc/s band was sometimes, but not often, usable to the U.S.A., though it was frequently usable in more southerly directions. The failure of the working frequencies to increase as much as was expected was probably due, in part, to the large amount of ionospheric disturbance, and in part to the rapidly decreasing solar activity. Night-time working frequencies were also low, being generally below 9 Mc/s. There was a small decrease in the rate of incidence of Sporadic E, and not much communication on high frequencies occurred by way of this medium.

Sunspot activity was, on the average, slightly higher than during September, but the general level has now fallen by well over one-third since sunspot maximum.

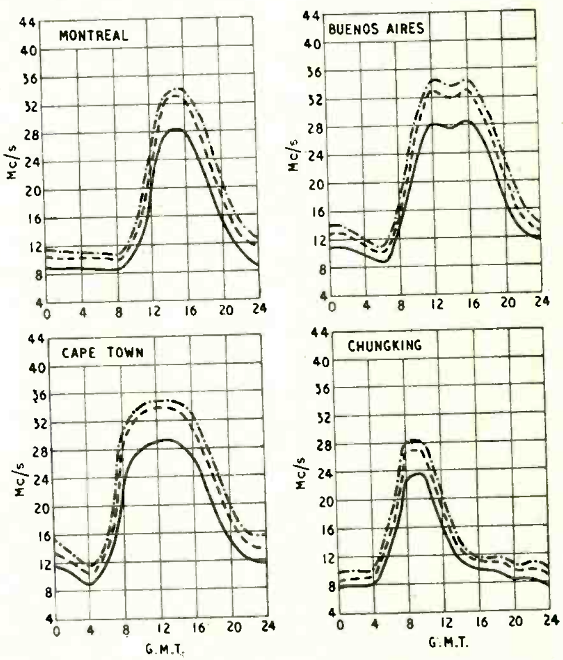
Several severe ionospheric storms occurred during the month, the most disturbed periods being 1st to 8th, 14th to 18th, 23rd to 24th and 28th to 31st. No Dellinger fade-outs have, as yet, been reported.

Forecast.—There may be a small decrease in the daytime m.u.fs for these latitudes during December, as compared with those for November. Night-time m.u.fs should also decrease and perhaps reach their lowest values for the present winter season.

As a result of these variations, the long-distance working frequencies should be rather high by day, though the higher frequencies will be usable only for relatively short periods daily. It is doubtful whether 28 Mc/s will be regularly usable over most circuits, though it may well be so on those running in southerly directions. The medium-high frequencies will provide the main means of daytime communication in most directions, and at night 6 to 7 Mc/s should be the highest regularly usable frequencies.

Sporadic E is not likely to be very prevalent and medium-distance communication on high frequencies by way of this medium should be very infrequent. Ionospheric storms are not, as a rule, particularly common during December, but those which do occur are likely to be troublesome, particularly at night.

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



——— 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

NEW BOOKS

Aerials for Centimetre Wavelengths (Modern Radio Technique Series). By D. W. Fry and F. K. Goward. Pp. 172+x, figs. 65. Cambridge University Press, 200, Euston Road, London, N.W.1. Price 18s.

THIS is a book of interest primarily to engineers concerned with the design and development of specialized aerials for radar applications at centimetric wavelengths. The authors themselves were concerned at the Telecommunications Research Establishment in much of the early design of aerials of this type. The treatment is not elementary, and a considerable knowledge of transmission lines, wave-guides, and general aerial and radiation theory on the part of the reader is assumed. Nevertheless, the mathematical aspect is not unduly laboured, and mathematical expressions are confined to the minimum necessary for the purpose of theoretical design.

It is in no sense a practical designer's handbook. It describes and catalogues the various types of aerials which have been used or are used for particular radar work, and it discusses in considerable detail the analytical methods of designing a radiating system so as to obtain a specified radiation pattern. Generally a centimetric aerial comprises two principal parts—a primary radiator, such as a dipole or an open-ended wave-guide, which feeds the energy to the secondary radiator, the latter being a reflector, a lens or a horn: primary and secondary radiators are dealt with in separate chapters, which are sub-divided according to the various distinct types.

A large part of the work is concerned with means of scanning, that is, causing the radiated beam to explore continuously a particular area in space. It is shown to be a valuable feature of centimetric aerials that scanning can usually be accomplished at the primary radiator which leads to simpler mechanics and higher scanning speeds than if displacement of the secondary radiator were necessary.

The close resemblance between centimetric work and optical theory is well brought out, and the application of optical methods to the design of centimetric reflectors and lenses is described. Both dielectric and metal plate type lenses are treated, and a note on errors and aberrations in optical systems is given in an appendix.

There are liberal references in the text to relevant literature, all the references being grouped in the form of a valuable bibliography at the end of the book. Printing and production are alike excellent, and the book is a worthy addition to the publishers' "Modern Radio Technique" series.

C. G.

Super-Regenerative Receivers. By J. R. Whitehead, Ph.D., A.M.I.E.E. Pp. 169+xiii. Cambridge University Press, 200, Euston Road, London, N.W.1. Price 21s.

BEFORE the war the super-regenerative receiver had gained a reputation for being a tricky and unpredictable device that sometimes gave wonderful results. Published information was considerable in quantity, but generally evasive when it came to clear-cut questions such as: how its signal/noise ratio compared with that of a superheterodyne; how one would design it for a given selectivity; how much gain could be obtained, and what factors determined it; what was the optimum quench frequency and waveform; how the shape of the frequency response curve compared with those of other types of receiver; and so on.

The answers to these and other questions are given in clear and definite terms in the book under review—the first to be devoted exclusively to the super-regenerative receiver. Although it has resulted from work that was done in developing radio and radar equipment for the war, it is by no means a one-sided account of specialized development. On the contrary, the author has started by getting down to the essential core of any super-regenerative circuit; in fact, of any oscillator—a parallel combination of inductance, capacitance, and conductance. The special feature of super-regeneration—periodical variation of the conductance each side of zero—is then considered. The treatment is therefore perfectly general, and the influence of particular conditions and modes of operation are only brought in when the more general results have been fully established.

The treatment is mathematical and makes use of fairly advanced techniques, but, even if the reader is insufficiently adept to follow all the steps, he should have no difficulty in making use of the results, for the author has arranged his work admirably and has expressed the results clearly in words and in formulae that can be directly applied in design. An appendix contains valuable graphical design data, and the final chapter is devoted to a representative selection of practical circuits, complete with component values.

Most of the pre-war knowledge and use of the super-regenerative receiver were in its logarithmic mode, in which oscillations are allowed to build up to saturation, resulting in strong a.g.c. action, and distortion of deep modulation. So it is only reasonable that special prominence should be given to the linear mode, in which at the cost of some complication of the equipment the distortion is avoided and greater selectivity obtained. The differences between this and the logarithmic and self-quenching modes are adequately coverd.

The proof of this attractive-looking pudding was in the remarkable reliability and consistency in performance of 200,000 IFF receivers (to mention only one item of super-regenerative equipment) during the war. The approximations which the author has had to make in order to get anywhere at all with his mathematical treatment seem to be fully justified by the results, within the limits laid down. Confidence in the diagrams is reinforced by a number of excellent oscillograms from actual receivers, in which the various conditions are clearly exemplified.

Errors appear to be confined mainly to incidental results of last-minute changes in the book; for example, what appears as Appendix 2 was presumably at one time No. 3, for several of the references are so numbered. Similarly with Fig. 3.3. And a paper which on p.67 is described as "in the Press" has, by the time one reaches the Bibliography, been published. These are trifling slips. One would wish that every technical book treated its subject so satisfactorily.

M. G. S.

How to Become a Radio Amateur is a 58-page American publication, now in its eleventh edition, and its aim is to show the beginner how to make a start in amateur transmission. It opens by giving a very brief account of basic radio theory.

The main body of the book is devoted to the choice of apparatus for the beginner with emphasis placed on construction as being the surest way of getting to know how things work. The most ambitious receiver described is a 4-valve communications superhet. V.H.F. apparatus is included.

The book, which is published by the American Radio Relay League, West Hartford, 7, Connecticut, U.S.A., is well illustrated with diagrams and photographs and in the U.K. is obtainable through the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1. It is delivered direct from the U.S.A. in from four to five weeks and the price is 4s.

Variable Filter Tuning

(Concluded from p. 358 of the previous issue)

2.—Design Procedure for R.F. and I.F. Stages

By A. B. SHONE, B.Eng., A.M.I.E.E.

IN the earlier part of this article we established in Fig. 3 the general shape of the receiver response characteristic at which we intend to aim.

It is possible to obtain such a response in the long-wave band by any of the three alternative circuits which were given in Fig. 9. Considering the case of the long-wave Droitwich station, the response required is shown in Fig. 10, i.e., sensibly flat from 195 kc/s to 205 kc/s and heavily attenuated at 191 kc/s and below and at 209 kc/s and above. Using filters, this would require sections introducing a heavy attenuation at 1.02 times the cut-off frequency (i.e., 209/205 kc/s). As will be seen in the curves given later, this is quite practical.

In the medium-wave band it is not really practical to obtain such characteristics directly by any of the three methods compared, and a superheterodyne type of circuit becomes almost essential.

It is in choosing a suitable intermediate frequency that the filter-tuned receiver begins to depart from normal practice. If the delineation of the response is to be divided between the high-frequency filter and the intermediate-frequency filter, then it is reasonable, if not axiomatic, to suppose that the minimum number of sections will be required when the work is shared equally between the two filters.

Referring to Fig. 11: If f_k represents the carrier frequency of the wanted transmission and f_i and f_l the extremes of its sidebands, if f_p represents the carrier of the second channel and f_o and f_s its objectionable sidebands and if f_c represents the intermediate frequency with f_b and f_d being the sidebands it is desired to receive unattenuated and f_a and f_g being the adjacent stations carriers it is required to reject, then we can set down this equation if the two filters are to be of equal sharpness:—

$$\frac{f_o}{f_l} = \frac{f_g}{f_d}$$

or

$$\frac{f_k + 2f_c - 5\ \text{kc/s}}{f_k + 10\ \text{kc/s}} = \frac{f_c + 9\ \text{kc/s}}{f_c + 5\ \text{kc/s}}$$

Taking the worst positio in the medium-wave band i.e. when $f_k = 1{,}500$ kc/s, w get $f_c = 56$ kc/s approxi mately. This intermediate frequency will require filters whose sharpest sections introduce a heavy attenuation at 1.06 times their cut-off frequency $\left(\text{i.e., } \frac{56\ \text{kc/s} + 9\ \text{kc/s}}{56\ \text{kc/s} + 5\ \text{kc/s}}\right)$ and the high-frequency filters will require sections of equal sharpness.

Bearing in mind that the high-frequency filter has to be variable over the medium-wave band, i.e., from 600 kc/s to 1,500 kc/s, whereas the intermediate-frequency filter is a fixed filter (or, at the most complicated, a filter with small percentage changes to give the variable characteristics found desirable in Fig. 3), it may be desirable to reduce slightly the high-frequency filter and, at the same time, increase the intermediate frequency filter by raising the

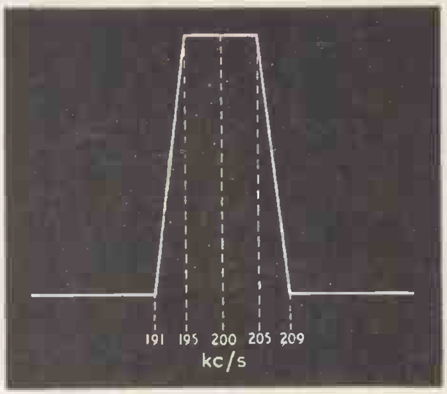
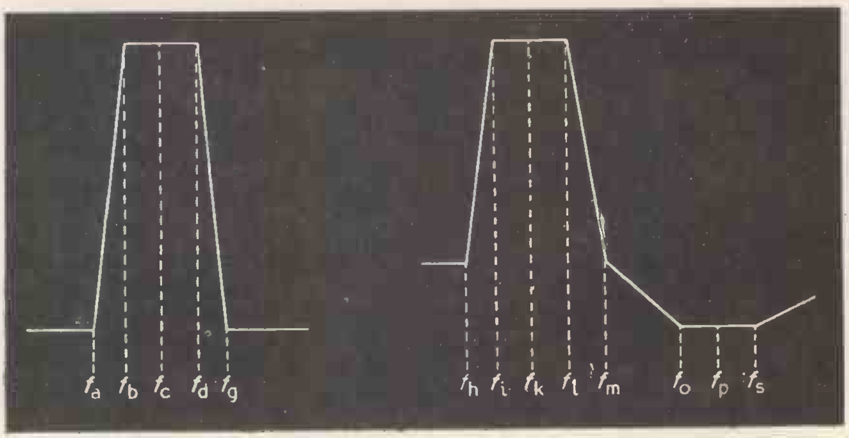


Fig. 10. Wanted and unwanted bands in the Droitwich long-wave case.

Fig. 11. Wanted and unwanted bands in the superheterodyne case.



intermediate frequency slightly. If it is increased to 80 kc/s, the sharpest sections in the high-frequency filter become 1.09 $\left(\text{i.e., } \frac{1{,}500 \text{ kc/s} + 160 \text{ kc/s} - 5 \text{ kc/s}}{1{,}500 \text{ kc/s} + 10 \text{ kc/s}}\right)$ while the sharpest sections in the intermediate frequency filter are correspondingly reduced to 1.047 $\left(\text{i.e., } \frac{80 \text{ kc/s} + 9 \text{ kc/s}}{80 \text{ kc/s} + 5 \text{ kc/s}}\right)$. However, as will be seen below, this process should not be carried too far as the very sharp filter sections become relatively inefficient.

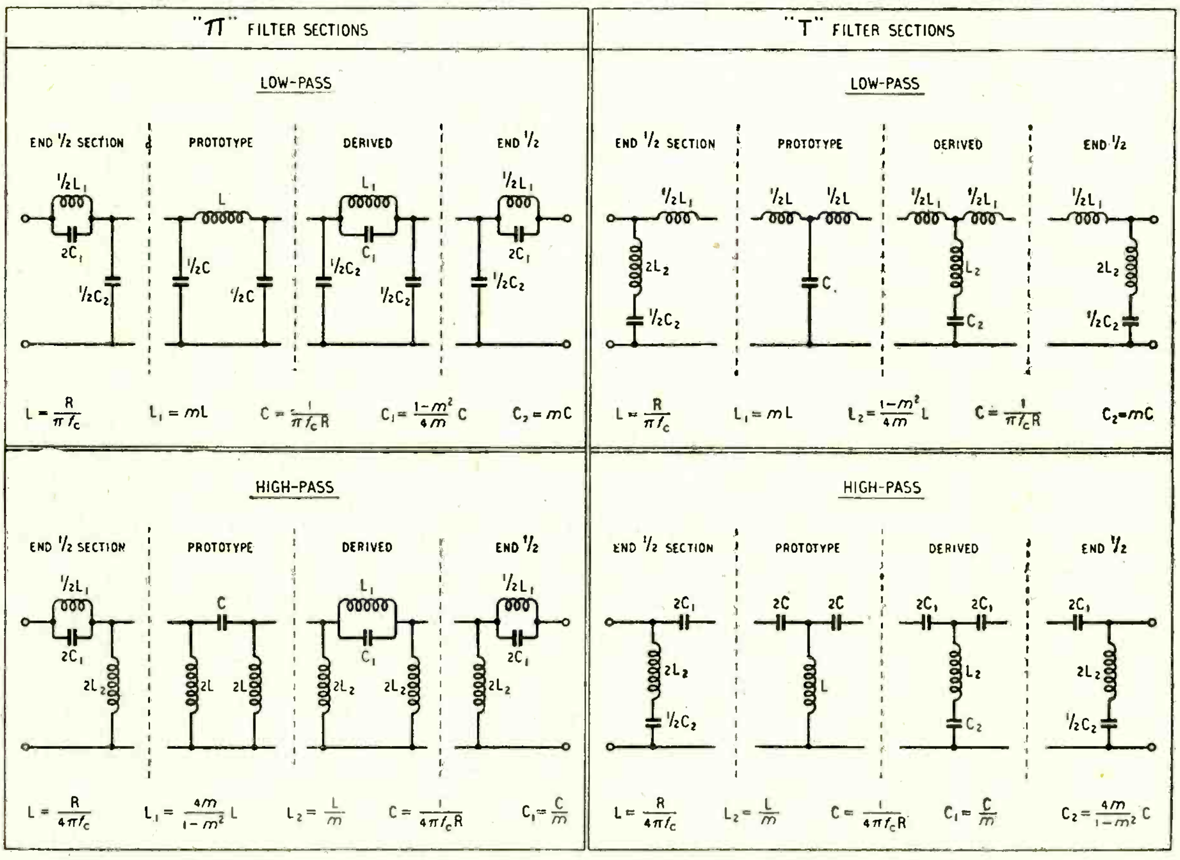
Considering now the actual filter sections available, the filters can be built in the form of high- and low-pass filters in tandem, the former having a lower cut-off frequency than the latter. Taken together, they jointly form a bandpass filter. This arrangement, although requiring a few more components than conventional bandpass filters, is preferable as the component values are in general much more convenient.

The sections we can use are tabulated in Fig. 12, together with the relevant formulae for calculating component values expressed in terms of R the terminal impedance of the filter, f_c the cut-off frequency, and a term m. The latter term is evaluated by the formula $m = \sqrt{\frac{a^2 - 1}{a}}$ where a is the ratio of the frequency of maximum attenuation to the cut-off frequency of the filter section. We can use either the "π" form of the section of the "T" form, whichever is the more convenient. As we want to keep the variable condensers down to a minimum, we shall in general use the "T" form of the low-pass filter and the "π" form of the high-pass filter.

In each case there are two main sections, the prototype sections and the derived sections. (In each case the filter ends in half a derived section.) The prototype section begins to attenuate at the cut-off frequency and continues with steadily increasing attenuation all the way to infinite frequency in the case of the low-pass filter (or to zero frequency in the case of the high-pass filter). The derived sections, however, are arranged to give their maximum attenuation at some frequency between infinite frequency (in the case of the low-pass filter or zero frequency in the case of the high-pass filter) and cut-off frequency. Between these limits we can make the frequency of maximum attenuation of a derived section what we like, and we describe the section by the ratio of this frequency to its cut-off frequency in the case of the low-pass filter or the inverse in the case of the high-pass filter. This ratio is usually known as the "a" of the sections and a is always greater than 1. (We can, in fact, now describe the prototype section as being merely a special case of the derived section where a = infinity.)

The attenuations obtainable with sections having various values of a are shown in Fig. 13 where f_c is the cut-off frequency. In these curves it is assumed that the coils used have a ratio of reactance to resistance (Q) of 100 which should be quite practical at

Fig. 12. Filter design formulae.



these frequencies. (The coils should be either wave-wound or wound on dust cores using formers with at least four slots in order to keep down their capacitance.)

The characteristic impedance of various sections—by which is meant the impedance looking into such a section when terminated with an infinite train of similar sections—will vary with frequency, and only equals the value R at zero frequency in the case of the low-pass and at infinite frequency in the case of the high-pass sections. For all values of a the derived sections quoted in Fig. 12 have the same characteristic impedance as the prototype sections, and therefore the two types can be connected together without introducing any impedance mismatch. But the mid-section impedance of a derived half-section, when correctly terminated with its characteristic impedance, will not be equal to the characteristic impedance of the whole section, but will vary with a as is shown in Fig. 14 where the mid-section impedance is expressed in relation to R. For certain values of a around 1.25 the ratio is constant over a large portion of the pass band of the filter. Such a half-section is therefore very useful for terminating a filter, as its mid-section impedance is approximately a constant resistance.

An inspection of the curves of Fig. 13 shows the relative inefficiency of the sections having low values of "a," for not only do they put in less attenuation at their resonant frequency but they require to be used in conjunction with other sections of higher value of "a" if the filter is to maintain its attenuation in the stop range. For instance, it becomes necessary to follow a section having $a = 1.02$ by a section of $a = 1.09$, if the attenuation is to be maintained beyond the cut-off frequency. Similarly, a section of $a = 1.09$ will require to be followed by a section having an "a" of about 1.6 and so on. There are, of course, an infinite number of values of "a" which might be chosen, but as it is impossible to give a complete set of filter tables in an article such as this, the above values for "a" have been chosen as being representative. These particular values are advantageous because $a = 1.02$ gives $m = 0.2$, $a = 1.09$ gives $m = 0.4$, while $a = 1.6$ gives $m = 0.8$. As these three values of "m" are each double the previous value, it will be seen from the formulae given in Fig. 12 that using such values there will be a great deal of similarity in the component values of the various sections. Similarly $a = 1.06$ gives $m = 0.33$, $a = 1.35$ gives $m = 0.66$ and $a =$ infinity gives $m = 1$, and again using these sections together we may expect to get a certain similarity in component values.

A further inspection of the formulae in Fig. 12 will reveal that in the formulae for the prototype low-pass filter

$$L = \frac{R}{\pi f_c} \text{ and } C = \frac{1}{\pi f_c R}$$

Eliminating R we get,

$$LC = \frac{1}{(\pi f_c)^2} \text{ or } f_c = \frac{\sqrt{LC}}{\pi} \quad \ldots \quad \ldots \quad (1)$$

From this we see that we can vary the cut-off frequency by altering either L or C or both.

Eliminating f_c we get,

$$\frac{L}{C} = R^2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

From equations (1) and (2) we see that if we alter both L and C maintaining the ratio $\frac{L}{C}$ constant, we can alter the cut-off frequency of the filter and at the same time keep R constant, and this is, in fact, what is generally done.

If, however, we are prepared to let the value of R vary according to equation (2), then by equation (1) we can vary the cut-off frequency by altering either C or L. In practice it is easier to alter C, as ganged condensers are readily available commercially.

Considering the medium-wave band, the frequency range is from about 600 kc/s to 1,500 kc/s, or a ratio of 2.5. By equation (1) this will require a change of L or C by 2.5^2 and this in turn will cause R to alter by a ratio of 2.5. To be absolutely correct we could make the termination of the filter a variable resistance and adjust it to the right value for the particular cut-off frequency. In practice this is not necessary, and if it is made a fixed resistance of $\sqrt{2.5}$ its correct value when the filter is adjusted for a cut-off of 600 kc/s, then the error introduced is not serious and we need not worry about it.

If it is chosen to alter the cut-off frequency by varying C (keeping L constant), then the "π" type

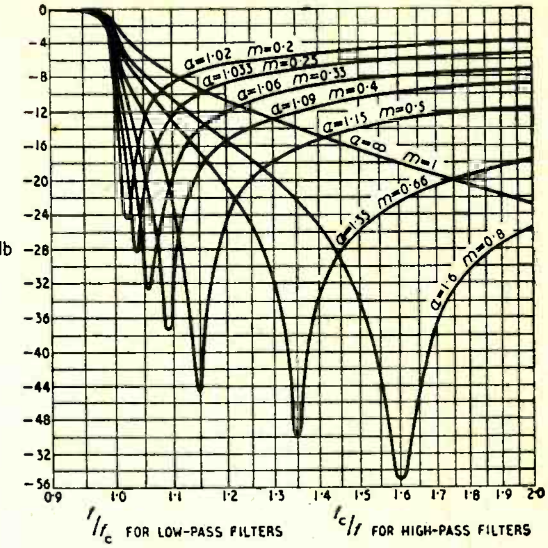
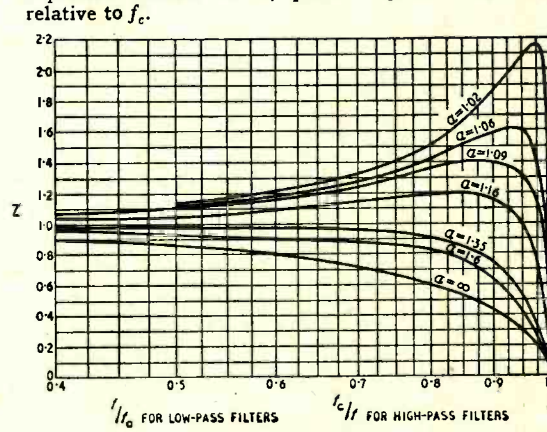


Fig. 13. Attenuation curves of typical filter sections.

Fig. 14. Mid-section impedance of derived sections expressed relative to R, plotted against frequency relative to f_c.



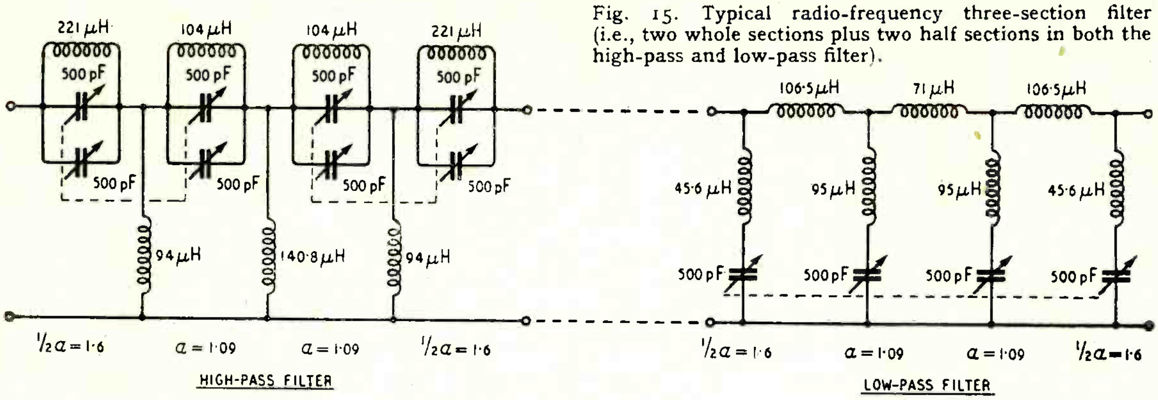


Fig. 15. Typical radio-frequency three-section filter (i.e., two whole sections plus two half sections in both the high-pass and low-pass filter).

of low-pass filter and the "T" type of high-pass filter should be avoided, as the derived forms of these sections call for two variable condensers of different value, which are not readily available in ganged form.

By way of an example, let us consider the design of a high-frequency filter with a cut-off ratio of 1.09. Using the "T" form of the low-pass filter, we can keep all the condensers to the same value if all the sections are derived and the half sections at the end have an "m" of double the middle sections, i.e., if the middle sections are $m = 0.4$ ($a = 1.09$) and the half sections at the end are $m = 0.8$ ($a = 1.6$), then all the condensers in the filter are 0.4 of the value of the condenser in the prototype section, which is

$$C_{lp} = \frac{0.4}{\pi f_{lpc} R} \quad \ldots \quad (3)$$

where f_{lpc} is the cut-off frequency of the low-pass filter.

Again, using the "π" section of the high-pass filter, we can keep all the condensers in the filter to the same value if all the sections are derived and if the half sections at the end have an "m" of double the middle sections. Again, using $m = 0.4$ ($a = 1.09$) for the middle sections and $m = 0.8$ ($a = 1.6$) for the half sections at the end, the condensers are $\frac{1}{0.4}$ of the condenser for the prototype section, which is

$$C_{hp} = \frac{1}{4\pi f_{hpc} R} \times \frac{1}{0.4} = \frac{1}{1.6\pi f_{hpc} R} \quad \ldots \quad (4)$$

where f_{hpc} is the cut-off frequency of the half-pass filter.

Bearing in mind (Fig. 3 of previous instalment) that we required f_{hpc} to be 0.8 of f_{lpc}, we get

$$C_{hp} = \frac{1}{1.6\pi\, 0.8 f_{lpc} R} = \frac{0.8}{\pi f_{lpc} R} \text{(approx.)} \quad \ldots \quad (5)$$

From the above it will be seen that we have now got all the condensers in the low-pass filter the same and all the condensers in the high-pass filter equal to and double the value of those in the low-pass filter. This was another important reason in the choice of these particular values of "a" as it means that standard condensers can be used throughout, the only difference between high- and low-pass filters being that each condenser in the former is built by putting two condensers in parallel.

The above completes the design considerations for the high- and low-pass filters except to give an idea of practical values. If a commercial $0.0005\mu F$ ganged condenser is made the basis of the design, then putting $C_{lp} = 0.0005\ \mu F$ when $f_{lpc} = 600$ kc/s in equation (3), we get R = 400 ohms at 600 kc/s.

As already explained, a

Fig. 16. Calculated characteristic of radio-frequency filter as in Fig. 15 for position where all variable capacitors are set to $0.0002\mu F$.

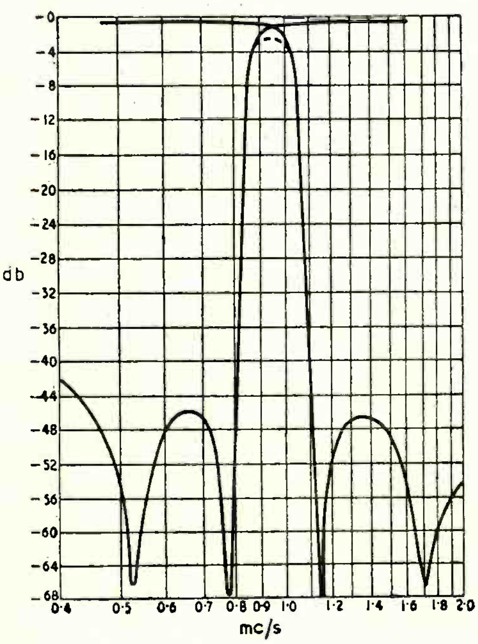
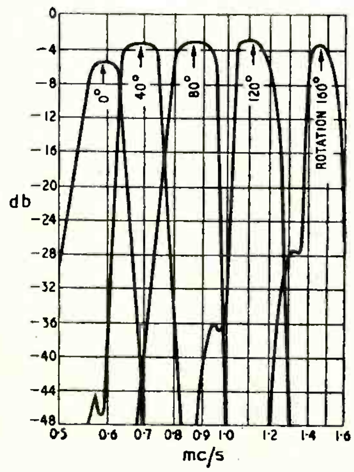


Fig. 17. Measured attenuations for various capacitor settings of radio-frequency filter as in Fig. 15.



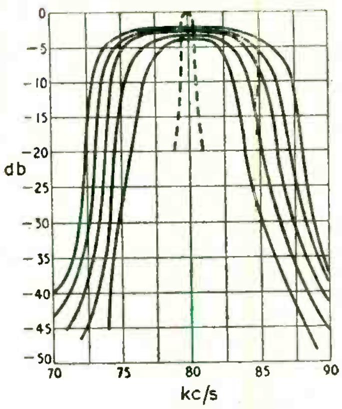


Fig. 18. Measured characteristics of variable intermediate-frequency filter for various capacitance settings.

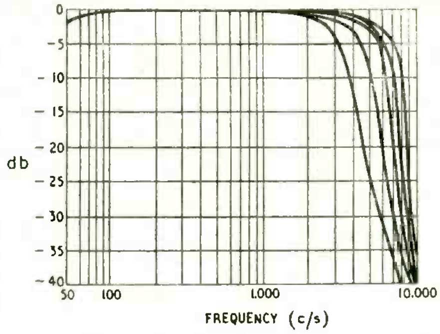


Fig. 19. Overall a.f. response of the receiver for various positions of the variable i.f. filter.

suitable mean terminating resistance would be this value multiplied by $\sqrt{2.5}$, i.e., 650 ohms.

The circuit of the above filter is given in Fig. 15, its calculated characteristic is given in Fig. 16 and its measured characteristic at various points on the medium-wave band is given in Fig. 17.

The above is a typical r.f. filter. The i.f. filter follows on similar lines but from consideration of component values and in order to work at a suitable intervalve impedance, it is designed with a characteristic impedance of 12,000 ohms. In addition the condensers are not made completely variable, but consist of a fixed portion and a 10 per cent variable portion: further the variable portions in the high- and low-pass sections of the filter are connected in opposition in such a way that the cut-off frequency of the one rises as the other falls and finally the ratio of the high- and low-pass variable condensers is chosen to be such that for any movement of the condensers both filters change their cut-off frequency by the same amount in cycles per second.

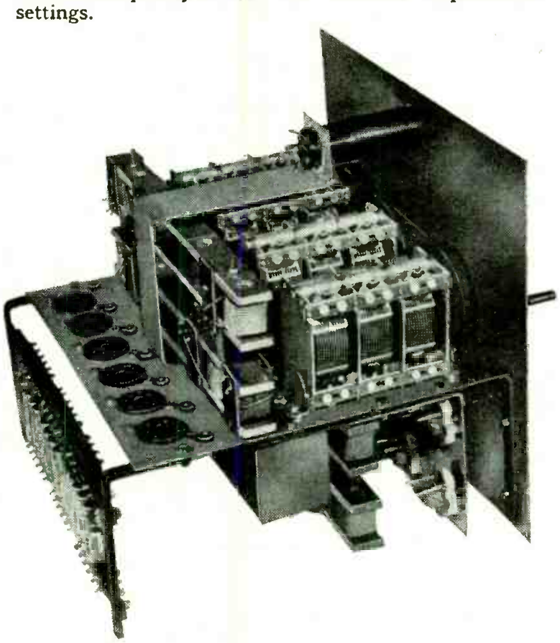


Fig. 20. Practical layout of a filter-tuned receiver as seen from the back.

Overall A.F. Response

The measured characteristic of this filter for various positions of the condenser shaft is shown in Fig. 18. (The dotted curve represents the characteristic of a sharply-tuned circuit which is in the "magic eye" circuit and enables the receiver to be tuned to the centre of its i.f. characteristic—an important requirement in such a receiver as this.) The audio-frequency response of the receiver for various positions of the i.f. condensers is shown in Fig. 19.

In its simplest form the practical design of such a receiver is shown in Fig. 20 which is a back view. It contains five sub-chassis namely :—

(1) The decoupling resistor and condenser assembly.
(2) The valveholder assembly.
(3) The r.f. filter assembly.
(4) The screened coils assembly.
(5) The i.f. filter assembly.

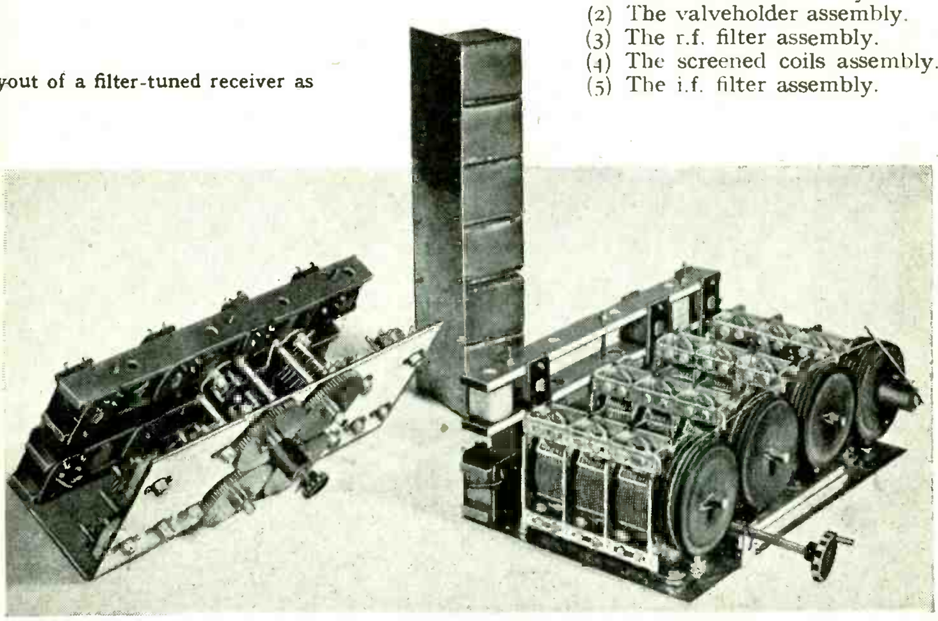


Fig. 21. The three main assemblies. (Left) the i.f. filter, showing the ten fixed capacitors (air-spaced trimmers are used for convenience) and the eight variable condensers (four "split stator" condensers were used for convenience) connected by gears. (Centre) the screened coil assembly and (right) the r.f. filter showing the wire and drum drive.

The last three assemblies are shown removed in Fig. 21 which indicates the method of ganging the condensers in the r.f. and i.f. filters. In the former case a wire and drum drive is used, and as two of the condensers are above earth potential they are mounted on a sheet of Paxolin and the drums are made of ebonite: no difficulty is experienced in ganging the condensers if the grub screws in the drums are tightened when all the condensers are maximum. The condensers are not likely to get out of gang if suitable wire is used, but if they should they can quickly be re-ganged by slackening off the grub screws, setting all the condensers to maximum and then retightening the screws.

In the case of the i.f. filter, air dielectric trimmers have been used for the fixed portion of the capacitances and the variable portions are coupled together by means of gears, though a wire and drum drive could equally well have been used.

Space has precluded giving complete details of the receiver design but it is hoped that enough has been given to show the general lines of approach. The resulting receiver has much to recommend it, particularly its relative freedom from noise and its variable i.f. filter, which can be adjusted continuously and without introducing clicks or noise of any kind until the best position is found. It is, however, a complicated design and cannot be built without adequate test equipment. Furthermore, when built it is still only a compromise solution. In the author's opinion, it is the best compromise possible in modern listening conditions.

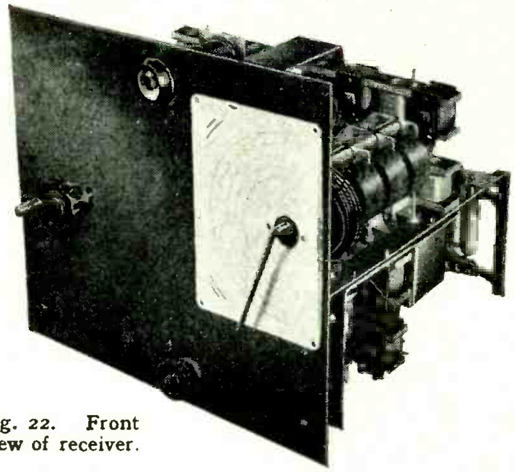


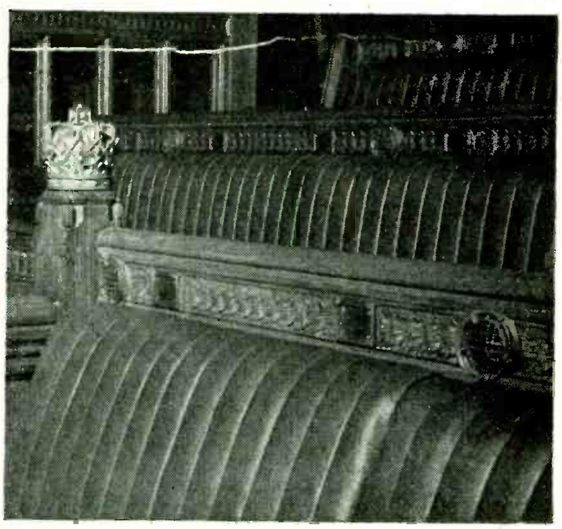
Fig. 22. Front view of receiver.

HOUSE OF COMMONS S.R.E.

APART from the general interest in the sound reinforcing system in the new Chamber of the House of Commons this low-intensity installation is of particular interest in that it has been designed to ensure that all members can hear and, if desired, be heard without having to leave their seats.

To achieve this a large number of low-intensity loudspeakers have been installed in the woodwork at the back of the seats—one unit for two members—and six uni-directional microphones have been suspended from the ceiling over the front benches and three each side, mounted on cantilever arms, over the back benches. The selection of the microphones during debates and the general supervision of the installation is undertaken by an operator in a cubicle overlooking the chamber.

Loudspeakers behind bronze grilles in the carved oak rail above members' seating in the new House of Commons.



To obviate "howl" caused by acoustic feedback when microphones and loudspeakers are in close proximity, the reproducers are arranged in groups which are co-related with the pick-up area of the microphones. When a microphone is brought into circuit the reproducers in the immediate vicinity are muted and in certain cases the input to those in adjacent areas is attenuated.

The main equipment comprises fourteen microphone pre-ampifiers with stand-by units. After pre-amplification, frequency and volume correction, the signals are passed through a "buffer" amplifier to raise the level sufficiently to energize the power amplifiers. There are eighteen of these, plus spares, and each one provides power for one loudspeaker zone, the input to which is connected through two relays and attentuators to provide, automatically, the correct degree of muting or volume reduction associated with the microphone employed in each particular zone. Separate amplifiers are provided for operating db volume indicator meters, which provide visual indication of output signals at the main operating position and at the alternative control position below the floor of the House. A periscope is provided at this position to enable the operator to view the chamber and select the appropriate microphone.

In addition to the microphones and loudspeakers already referred to there is a microphone above the Speaker's chair and another on the Table of the House. It should be pointed out that the reproducers on the tables in the Press Gallery and in other galleries are operated at a constant level.

The entire installation was undertaken by Tannoy Products (Sound Rentals, Ltd.).

WORLD OF WIRELESS

International Vision Standards ◆ Short-Wave Broadcasting ◆ R.T.E.B. Exam. Results ◆ Training Opportunities ◆ Television Relay Service

European Television

DETAILS of the standards drawn up by the Television Study Group of the International Radio Consultative Committee (C.C.I.R.), following the investigation of systems at present in use in France, the U.S. and the U.K., have been published by the European Broadcasting Union, and we give below a summary of them:—

The width of the channel is to be 7 Mc/s (U.S. standard is 6 Mc/s and the British 5 Mc/s) with the vision carrier 5.5 Mc/s below the sound carrier—in this country, of course, it is 3.5 Mc/s below.

There are to be 625 lines per picture with interlaced scanning. The line and frame recurrence frequencies are 15,625 c/s and 50 c/s, respectively. The British line frequency is 10,125 c/s. The aspect ratio of the picture is that now used in this country—4:3, horizontal to vertical.

The lower sideband of the vision channel is to be partially suppressed, and, as in the U.S., negative modulation will be used. The pedestal level (normal black level) will be represented by a definite carrier level independent of light and shade in the picture, and this will be transmitted at 75 per cent—with a tolerance of $\pm 2\frac{1}{2}$ per cent—of the peak carrier amplitude. Peak white will be at least 10 per cent of the full carrier amplitude.

It is recommended that frequency modulation be used for the sound transmission. No reference is made in the recommendations to the polarization of the transmissions.

H.F. Broadcasting

WHEN the Hague Radio Conference, due to have opened in September, was called off (see page 318, September issue) the delegates to the International High-Frequency Broadcasting Conference, which had been in session, first at Florence and then Rapallo, since April 1st, decided by 39 votes to 13 (with 4 abstentions) to conclude their deliberations. This was on August 19th. The main reason for discontinuing all work on preparing a plan for h.f. broadcasting was that such a plan, based on the new bands allocated at Atlantic City (1947), could be implemented only if another Conference, such as that planned for the Hague, made available other frequencies to the services at present occupying these bands.

The Conference was convened to draw up plans for the allocation of frequencies (between 5.95 and 26.1 Mc/s) to the world's short-wave broadcasting stations on the basis of time sharing and simultaneous channel sharing. These plans were based on the various phases of the sun-spot cycle.

Being unable to produce the plan envisaged, the Conference, at its final meeting, made a number of recommendations which are included in the September 15th issue of the European Broadcasting Union *Bulletin*. To encourage the use of the higher frequencies for broadcasting and thereby reduce the congestion in other sections of the h.f. band, it is recommended that the frequency coverage of receivers should be extended to include the upper limits of the band.

Servicing Examinations

THE result of the first Television Servicing Certificate examination held last May by the Radio Trades Examination Board, which was restricted to the London area, shows that of 30 entries 16 passed and 12 were referred in the practical examination. Of the 264 candidates who entered for the Radio Servicing Certificate examination, also held in May, 137 were successful and 45 were referred in the practical tests.

Application forms for the next examinations, to be held in May, 1951, may be obtained from the R.T.E.B., 9, Bedford Square, London, W.C.1. The closing date for entries for the Television Certificate is January 15th and that for the Radio Certificate is February 1st.

Frequency Control

THE need for a simple method of quoting frequency stability was stressed by C. F. Booth, the new chairman of the I.E.E. Radio Section, in his inaugural address on "The Evolution of Frequency Control." A proposed method, that he felt was worthy of consideration, is to express frequency stability in terms of the common logarithm of the reciprocal of the frequency variation when the latter is expressed as a fraction; for example, an oscillator subject to frequency variations of 1 in 10^6 would have a stability of 6 stability units, or, say, 6 S.U.

Technical Experience Abroad

OF the 1,672 University and College students who, through the International Association for the Exchange of Students for Technical Experience, gained experience in industry overseas during the summer vacation this year, 353 were from Great Britain, 204 from France, 197 from the Netherlands and 184 from Sweden. Twelve countries, including, for the first time, the U.S.A. and Germany, took part in the exchange scheme. Great Britain and Sweden headed the list of countries receiving students with an intake of 368 and 344 respectively.

The third Annual Report of the Association records that there was an increase of 436 on the exchanges made in 1949. About a dozen British radio firms received overseas students under the scheme.

Particulars of the Association, which, it is stressed, organizes these exchanges on a reciprocal basis, are obtainable from the General Secretary, J. Newby, Imperial College, South Kensington, London, S.W.7.

B.B.C. Changes

FOLLOWING the much-talked-of resignation of Norman Collins as Controller of B.B.C. Television, the politics of which we will not enter into, George Barnes, who has been B.B.C. Director of the Spoken Word since the creation of the post in 1948, has been appointed to the new post of Director of Television. Norman Collins has stated that he has left the Corporation because of the principle which was being adopted in the development of television—its merger "into the Colossus of sound broadcasting."

T. W. Chalmers, Controller of the Light Programme, has been seconded for three years to become head of the new Nigerian Broadcasting Service (see "In Brief") and has been succeeded by Kenneth Adam.

Electronics Scholarships

TO meet the growing need for technicians in the research and design sections of E.M.I. a scholarship scheme for a special four-year course in electronics has been provided by E.M.I. Institutes.

The scheme provides for a grant of £50 p.a. to each successful applicant towards the £400 course and a maintenance grant of at least £50 p.a. Candidates, who must be between 16 and 18 years of age, and preferably of Higher School Certificate standard in science, must enter the company's service for four years after the satisfactory completion of the course.

Application forms and particulars of the course, which provides for three years at the Institute and one year's practical experience in the company's factories and workshops, are obtainable from the Principal, E.M.I. Institutes, 10, Pembridge Square, London, W.2. The first course commences on January 17th.

It is stated that, in normal circumstances, students will receive a deferment from National Service during the period of the course.

News in Morse

SINCE the publication of the schedule of the morse transmissions of the London Press Service in our May issue, a number of changes have been introduced, and we give below a revised list. In addition to the morse transmissions listed, the speed of which is between 20 and 27 w.p.m., a large number of bulletins are transmitted by Hellschreiber.

G.M.T.	Call	Freq. (Mc/s)	Areas
0030–0130§ ...	MIK	9.725	1
	GPJ	10.885	2
0045–0230* ...	MIK	9.725	1
	GPJ	10.885	2
0130–0230§ ...	MIK	9.725	1
	GPJ	10.885	2
0130–0300* ...	GDI	7.780	3
	GAH	8.065	4
0130–0300 ...	GCX	8.920	5
0945–1045* ...	GCV	19.365	6, 8.
1100–1200‡ ...	GCV	19.365	6, 8.
1115–1215‖ ...	GAG	17.105	7
1200–1300‖ ...	GCF	19.005	5
1215–1315‡ ...	GAG	17.105	7
1600–1700* ...	GCF	19.005	5
	GBI	10.865	6, 8.
1600–1800* ...	GIB	11.980	7
1700–1800‖ ...	GBI	10.865	6
1815–1930 ...	GBG	9.395	7
	GBI	10.865	6, 8.
1845–1945* ...	GIM	12.957	3
	GBO	13.665	4
1945–2215* ...	GDT	8.925	6, 8.
	GBG	9.395	7
2045–2200† ...	GBG	9.395	7
	GDT	8.925	6, 8.
2100–2200* ...	GBO	13.665	5
2251–0030* ...	GPX	11.645	1
	GPJ	10.885	2
2330–0030† ...	GIB	11.980	5

* Weekdays only.
† Sundays only.
§ Mondays only.
‡ Mondays and Saturdays only.
‖ Alternate Fridays.

The number in the fourth column of the table denotes the area for which the transmissions are destined: 1, N. America; 2, S. America; 3, Distant Europe; 4, Middle East; 5, Africa; 6, N.E. Asia; 7, S.E. Asia; 8, Australasia.

There is no restriction on the reception of these transmissions, which are radiated by Post Office stations, and the use of their contents outside the United Kingdom.

National Exhibition

THE Radio Industry Council has announced the date of next year's National Radio Show—August 28th to September 8th. As already stated, the show—the 18th in the series—will be at Earls Court, London, and not Olympia, so that the well-established title Radiolympia will not be applicable.

Greenwich Time Signal

A MEAN time signal is now being transmitted twice daily from the Royal Greenwich Observatory, Abinger Common, Surrey, in addition to the present rhythmic signal. The schedule is:—

G.M.T. h m s	
09 54 00 to 09 54 45	*Preamble*: "GBR GBR TIME" (4 times) followed by tuning dash.
09 55 00 to 10 00 00	*Mean time signal*: Seconds dots, lengthened to dashes at the minutes.
10 01 00 to 10 06 00	*Rhythmic signal*: Dots spaced 61 to the minute, lengthened to dashes at the minutes.
10 06 05 to 10 06 15	*Tuning dash.*

This sequence is repeated from 1754.

The morning transmission is radiated by GBR, 16 kc/s; GIC, 8,640 kc/s and GIA, 19,640 kc/s, and the evening transmission by GBR, 16 kc/s; GIC, 8,640 kc/s and GKU3, 12,455 kc/s.

The duration of each dot is approx. 0.1 sec, and that of the dashes at the minutes is approx. 0.6 sec. The beginning of each dot or dash is the timing reference point.

Hotel Television

A TELEVISION relay service has been installed in each of the 940 bedrooms in the Cumberland Hotel, London, W.1. The hotel was already equipped with an a.f. distribution system giving a choice of four programmes, and the same wiring is used for television.

A four-element aerial is employed on the roof of the building to minimize the pick-up of interference and its output is fed to seven amplifiers, of which one is a spare. With a maximum gain of 55 db they provide an output of 2 V r.m.s. in 75-ohm feeders.

The audio wiring of the hotel is carried out in 63 vertical ducts each feeding about 16 rooms. The r.f. television signal is fed by 75-ohm balanced cable to the tops of these ducts, each amplifier feeding 9-12 ducts. They are there connected by resistance hold-off pads to the audio wires which are used in a quad phantom circuit. A $\lambda/4$ stub is connected a quarter-wavelength beyond the junction to prevent r.f.s. passing back to the a.f. source.

Resistive stopper pads are included at the loudspeaker for the audio channel to divert the television r.f. signal to the outlet socket. Standard television receivers are used and the hotel charges 3s a night for the service.

The equipment was installed by British Relay Wireless.

Television Components

IN preparation for the expected demand for television receivers when the projected stations open in Montreal and Toronto, the Canadian Government has authorized the release of U.S. dollars to fifteen Canadian set manufacturers for the purpose of buying components in the U.S.A. Attention having subsequently been drawn to the availability of television components in the U.K., the Canadian Department of Trade and Commerce has agreed, in principle, that where practicable the components should be secured in this country. British manufacturers who are represented in the Dominion, and wish to bring their components to the notice of the Canadian set manufacturers, should send catalogues and price lists in duplicate to E. J. McWilliams, Assistant Director, Emergency Import Control Branch, Department of Trade and Commerce, Ottawa. Firms without agents in Canada may like to use the services of the Board of Trade to secure representation, in which case communications should be sent to the Commercial Relations and Export Department, Thames House North, Millbank, London, S.W.1, quoting reference C.R.E. 5902/50.

IN BRIEF

Consol.—The second edition of the Ministry of Civil Aviation publication "Consol—A Radio Aid to Navigation" (M.C.A.P. 59), which has been published by H.M. Stationery Office, price 1s 6d, contains complete details of the service and coverage of the existing Consol stations at Bushmills, Stavanger, Lugo and Seville and also of the service to be provided by the new station at Plonéis, near Quimper, Finistère (France), which will be brought into use in the near future.

Amateurs and Distress Calls.—In contrast with the facilities provided by American amateurs for a network of stations in cases of emergency, such as forest fires, floods, etc., which were tested during a recent nation-wide exercise, the Ministry of Transport has declined the offer made by the Radio Society of Great Britain for British amateurs to place themselves at the disposal of the appropriate authority for receiving distress messages from vessels at sea.

M.F. Air Navigation.—It is pointed out by the Ministry of Civil Aviation that, while every effort is made to assign to m.f. navigational facilities frequencies from the aeronautical bands (255 to 285 kc/s and 315 to 405 kc/s), it is not always possible to do so because of the congestion within those bands. Use is, therefore, made of broadcasting stations as non-directional beacons and of other non-directional beacons operating on frequencies outside the aeronautical bands but within the limits of 200 to 1,750 kc/s.

Netherlands F.M.—According to information issued by the European Broadcasting Union, the Netherlands Government is planning the erection of a network of 12 f.m. stations operating on frequencies between 92.5 and 94.7 Mc/s.

Suppressing the ignition system of motor vehicles is dealt with in one of the chapters of the fourth edition of "Automobile Electrical Equipment," by A. P. Young and L. Griffiths, which is issued by our Publishers for our associate journal *Automobile Engineer*. This 386-page book, which deals exhaustively with electric lighting, starting and ignition as applied to the internal combustion engine, costs 25s.

Multitone.—The results of investigations, using the "Optimeter," in the volume requirements of five hundred hearing-aid users are given in the article "How Loud Should I Listen?" included in the first issue of *Hearing Aid News* which will be issued at irregular intervals by the Multitone Electric Co.

Hearing Aids.—The National Institute for the Deaf has issued a booklet, No. 481, giving approved lists of manufacturers and suppliers of hearing aids in the United Kingdom. Makers of mechanical as well as electronic aids are listed and those supplying group hearing aids are indicated.

Christmas lectures "adapted to a juvenile auditory," which will again be given at the Royal Institution this year, will be on "Waves and Vibrations," by Prof. E. N. da C. Andrade, D.Sc., F.R.S. This 121st course of six lectures, the fee for which is 10s 6d for children between 10 and 17 years of age, will be given on December 28th and 30th and January 2nd, 4th, 6th and 9th at 3.

"The Use of Radar at Sea" is the provisional title given to a textbook on the operational use of marine radar, which is in course of preparation by the Institute of Navigation. The book will contain contributions by twelve authors and will deal with every aspect of the subject. This is announced in the annual report of the Institute for the year ended June 30th, 1950, in which it is reported that the membership is now over 1,100.

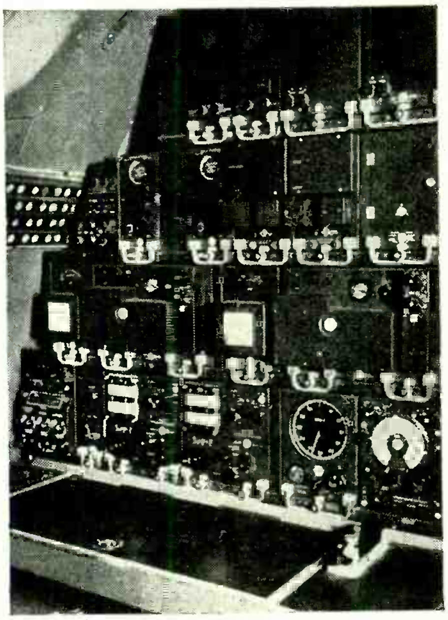
"Decca News" is the title given to the recently introduced journal of the Decca Navigator Company, which at present is issued bi-monthly. Descriptive articles on both radar and Decca Navigator installations are included.

Post-graduate Training. — Twenty-eight university graduates and technical college students recently commenced a special training course at the New Southgate Works of Standard Telephones and Cables. The course, which lasts a year and is the fourth since the commencement of the company's present post-graduate training scheme, is designed to provide opportunities for candidates to relate their theoretical and practical training to the whole field of activities within the Standard organization.

Convention Cancelled.—The Radio Section of the I.E.E. had proposed to hold a convention covering "Current Researches in Electron Valves" during the Festival of Britain, but having been advised that to hold such a convention in prevailing circumstances might not be in the National interest, it has been decided not to proceed with the arrangements.

Interference Suppression.—The television-conscious motorist who fits Lucas suppressors to his car ignition system will be easily identified by a transparency bearing the words "This car has been suppressed," which is being fixed to windscreens. At both the recent Motor Shows in London the firm demonstrated the effects on television reception of suppressed and unsuppressed car ignition systems which, according to the Radio Industry Council, are responsible for 85 per cent of the interference caused. Lucas have recently produced a prototype of a distributor incorporating a carbon brush of resistive material which acts as a suppressor.

Nigeria, which at present relies on a wired-wireless distribution system for radio programmes, is to be served by six broadcasting stations to be erected at a cost of about £350,000, which is being shared by the Nigerian Government and the U.K.



COMET RADIO.—The Marconi radio installation in the de Havilland "Comet" jet air liner. The equipment shown includes intercom. units, direction finders (duplicate control units for which are in the cockpit) and high-power transmitters.

Instrument Show.—Scientific and industrial instruments are to have an exhibition of their own in London next year. Among the supporting organizations of the exhibition, which will be held at Olympia from July 4th-14th, is the Scientific Instrument Manufacturers' Association.

Television in Industry.—The use of television to permit the remote observation of dangerous industrial processes was recently demonstrated when the English Electric Co. employed it to show the operation of high-power switch gear. Standard 405-line Marconi apparatus was used.

Blind Technicians.—The Report of the National Institute for the Blind records that an experimental training scheme has been arranged with Electric and Musical Industries to ascertain to what extent the blind can be instructed to undertake receiver repairs. This has necessitated the provision of circuit diagrams in relief and Braille-calibrated test equipment.

"Broadcast News," which is published by the Radio Corporation of America and is devoted almost entirely to descriptions of transmitting equipment for sound and vision, is now available to subscribers in this country from RCA Photophone, 36, Woodstock Grove, London, W.12. It is published at two-monthly intervals and the subscription rate is £2 for twelve issues.

Vox Populi.—The International Short-Wave Club has announced the result of a census taken among its members in all parts of the world to ascertain the most popular short-wave broadcasting station. Leopoldville (OTC) comes first with 609 votes, Radio Australia second with 446 and Switzerland third with 435, followed by Canada (419), B.B.C. Overseas Service (401), Hilversum (388), The Voice of America (380) and many other stations with fewer votes.

Sound Letters—magnetically recorded messages on metallized paper tape—have been introduced by the Welfare Council of the Norwegian whaling fleet for use by the men working on the factory ship and their relatives. They are regularly flown to and from the Antarctic whaling grounds.

B.I.F.—Next year's British Industries Fair will be held from 30th April to 11th May, at Olympia and Earls Court, London, and Castle Bromwich, Birmingham.

Institute of Physics announces an increase in its membership of some 200 during 1949.

Airborne Television.—A Marconi image-orthicon camera and 30-watt "suitcase" transmitter were used by the B.B.C. for the first television broadcast from the air which was radiated from the London and Sutton Coldfield stations on October 1st.

BUSINESS NOTES

Rural Radio.—The Persian Government is considering the purchase of 50,000 radio receivers for use in rural areas. They should be battery-operated, six-valve sets, fitted with "magic eye" tuning and covering the 60 to 120-metre and 180 to 360-metre bands. Interested firms should communicate with Esfandiar Bouzourgmehr, Director, Government Propaganda Department, Tehran, forwarding details and prices of their products. It is stated by the Board of Trade that it will be appreciated if copies of correspondence are sent to the Counsellor (Commercial) British Embassy, Tehran.

R.T.S.—We understand that it is only the stock and plant of the *transformer* business formerly operated by R.T.S. Electronics which has been acquired by EARL Services and to which reference was made in our last issue. R.T.S. are continuing the manufacture of the "Motoradio" car set and the "Minicomm" intercommunication equipment.

I.A.L.—Consequent on the withdrawal of the R.A.F. from Hargeisa Airfield, British Somaliland, International Aeradio, Ltd., will provide an Airport Controller for service in the Protectorate.

A contract for the supply of Decca navigational radar gear to be installed in ships of the Royal Navy has been received by Decca. The company states that orders to equip nearly five hundred naval and merchant ships have been received during the past twelve months.

British Radar for Japan.—The first Japanese ship to be fitted with British marine radar equipment is a whale-oil refinery vessel which was equipped by Cossor Radar prior to leaving for the Antarctic.

Marconi Marine Radio gear, including two transmitters, two receivers, direction finder and echometer, is being installed in the new 28,000-ton turbine tanker *Verena* under construction for the Anglo-Saxon Petroleum Company. The radio-communication and navigation equipment installed in the new Argentine liner *17 de Octubre* has also been supplied by Marconi's.

Trawler Radar.—Ten trawlers now under construction in this country for the Icelandic Government are to be equipped with Decca radar gear, Type 159A.

Pakistan.—Seven more ships of the Pakistan merchant fleet are being fitted with radio equipment by the Marconi International Marine Communication Co., Ltd.

Plessey announce the resignation of Wing Commander G. C. Cunningham, O.B.E., who was the company's communications sales manager.

Aerialite, Ltd., of Stalybridge, Cheshire, announce that O. E. Trivett, M.Brit.I.R.E., A.M.I.E.E., has been appointed personal assistant to the Managing Director. Before taking up this appointment he was concerned with the setting up of a plastics extrusion and radio factory in India in conjunction with General Electric of America.

Ersin Multicore Solder is being exported to an increasing number of countries; among the latest are Brazil, Argentina, South Africa, Syria and Mexico. In addition agents have recently been appointed in Iceland and Iran.

Oldham & Son, the battery manufacturers, are to establish a factory in Madras, India, which is to be managed by Oldham & Son, India, Ltd.

Denco announce that, following the recent resignation of D. W. Heightman from the Board, A. W. Allwright has rejoined the company as Managing Director.

I.M.R.C.—The Brazilian Navy training ship *Almirante Saldanha*, recently refitted at Barrow, has been equipped with m.f. and h.f. transmitters by the International Marine Radio Company. The vessel was equipped by I.M.R.C. when built in 1934.

Sobell Model 610, six-valve superhet has been tested by the School Broadcasting Council for the United Kingdom and approved for use in schools.

E.E.G. Exports.—Edison Swan have recently received orders from Spain, Poland, Egypt and Ceylon for their Mark II electro-encephalograph.

E. K. Cole announce that Bentley Jones has resigned from the position of sales manager of the company's radio division. He has joined Thorn Electrical Industries as commercial director of the Ferguson television and radio division.

Dubilier Condenser Co. announce that F. H. McCrea, Managing Director, is undertaking an extensive business tour of Canada and the United States.

The Electrical Apparatus Co., of St. Albans, announce that J. de Gruchy has been appointed Head of the Instrument Department which at present is concentrating on the production of moving-iron and moving-coil meters.

NEW ADDRESSES

British Standards Institution has opened an office at 12, Hilton Street, Manchester, 1 (Tel. Central 4856), where a complete set of British Standards may be consulted and copies purchased.

Marconi's have recently established an Inspectorate at Mombasa providing radio and radar maintenance for vessels calling at ports in the area.

Depots are being opened by Aerialite, Ltd., at 343, Deansgate, Manchester, 3 (Tel. BLA. 3524); and 50, Cathay, Redcliffe, Bristol (Tel. 26130).

Southern Radio Supply, Ltd., have moved from 46, Lisle Street, London, W.C.1, to 11, Little Newport Street, London, W.C.2 (Tel. Gerrard 6653).

MEETINGS

Institution of Electrical Engineers

Radio Section.—"Crystal Diodes," by R. W. Douglas, B.Sc., and E. G. James, Ph. D., and "Crystal Triodes," by T. R. Scott, B.Sc., at 5.30 on December 6th.

Discussion on "Have Post-War Broadcast Receivers taken Full Advantage of Wartime Development?" opened by R. B. Armstrong, B.Sc., at 5.30 on December 18th.

The above meetings will be held at 5.30 at the I.E.E., Savoy Place, London, W.C.2.

Cambridge Radio Group.—"A Review of some Television Pick-up Tubes," by J. D. McGee, M.Sc., Ph.D., and "The Design of a Television Camera Channel for Use with the C.P.S. Emitron," by E. L. C. White, M.A., Ph.D., and M. G. Harker, B.Sc. (Eng.), at 6 on December 5th at the Cambridgeshire Technical College.

North-Eastern Radio Group.—"Electronic Counters and Some Applications," by R. B. Conn B.Sc., at 6.15 on December 18th at King's College, Newcastle-on-Tyne.

Sheffield Sub-Centre.—"Some Electromagnetic Problems," by Prof. G. W. O. Howe, D.Sc., LL.D., at 6.30 on December 13th at the Grand Hotel, Sheffield.

North Lancashire Sub-Centre.—"The General Aspects of Television," by A. J. Biggs, Ph.D., B.Sc., at 7 on December 20th at the Harris Institute, Corporation Street, Preston.

South Midland Centre.—"Generation and Flow of Harmonics in Transmission Systems," by S. Whitehead, M.A., Ph.D., and W. G. Radley, C.B.E., Ph.D.(Eng.), at 6 on December 4th at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Reading (Berks) District. — "Television Engineering," by D. C. Birkinshaw, M.B.E., M.A., at 7 on December 11th at the Great Western Hotel, Reading.

British Institution of Radio Engineers

London Section. — Discussion on "Progress in Loudspeaker Design," opened by R. L. West, B.Sc., at 6.30 on December 15th at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

North-Eastern Section.—"A Survey of Television Development and its Problems," by H. J. Barton Chapple, B.Sc., at 6 on December 13th at Neville Hall, Westgate Road, Newcastle-on-Tyne.

Scottish Section.—"Vacuum Engineering Applied to Electronics," by D. Latham, B.Sc., at 6.45 on December 7th at Heriot-Watt College, Edinburgh.

North Western Section.—"High Fidelity Reproduction," by H. J. Leak, at 6.45 on December 7th at the College of Technology, Manchester.

British Sound Recording Association

"The Application of Magnetic Coatings to Film Stock," by G. F. Dutton, Ph.D., D.I.C., at 7 on December 6th at E.M.I. Studios, Ltd., 3, Abbey Road, St. John's Wood, London, N.W.8 (Joint Meeting with the British Kinematograph Society).

"Modern Recording Technique," by C. E. Watts at 7 on December 13th at the Central Library, Guildhall, Portsmouth. Demonstrations from 5 p.m. (Joint Meeting with the Institution of Electronics).

"The Crystal Pickup With Particular Reference to Long-Playing Records," by S. Kelly at 7 on December 20th at the Royal Society of Arts, John Adam Street, London, W.C.2.

Television Society

Engineering Group. — "Television Transmission for the Amateur" by M. Barlow (Hon. Sec. British Amateur Television Society), at 7.0 on December 14th, at the Cinema Exhibitors' Association, 164, Shaftesbury Avenue, W.C.2.

Institution of Electronics

Midlands Branch.—"Electronic Instruments for Temperature Measurements and Control, and for Safeguarding Combustion," by H. A. Stevenson and C. Smith at 7 on December 5th at the Warwick Room, Imperial Hotel, Temple Street, Birmingham, 2.

Tolerances and Errors

"CATHODE RAY" Explains How They Add Up in the Final Result

SOMEONE has written to me to ask: what about tolerances? And to make his point clear he proceeded to fire a number of diverse examples in rapid succession. Some of these concerned combinations of resistors, and he ended by asking "Is there a 'tolerance arithmetic' for simple series/parallel networks?" To tell the truth, I hadn't given the matter much thought, but after having done so I can answer with a definite "yes."

The subject of errors, even if confined to the field of measurement, is a very large one, and to the mathematically-minded a very attractive one. Large and excessively learned books have been written on it. But they concentrate on the question of *probable* error, which must be clearly distinguished from *maximum* error or, as it is called in engineering, tolerance. The tolerance is so important in connection with radio components that the colour code applicable to them has one unit devoted to indicating it.

So when one buys even such a simple thing as a resistor one must be prepared to answer the question "Yes, sir; what tolerance?"—or look a fool. It is not merely an academic question; it has more to do with the price, apparently, than anything else. The reason lies in the fact that the manufacture of resistors (of the ordinary composition type) is rather like shooting at a target from a considerable distance. The resistances no more come out all exactly the right value than all the bullets go through a single hole exactly in the centre. In the absence of any special trends, the distribution of bullets relative to the centre of the target, and of resistances relative to the nominal value, is found to follow what is referred to in the learned books as a normal (or Gaussian) error curve, Fig. 1. Over a narrow range on each side of the nominal value the quantities are distributed almost evenly. Those falling within 5% of the nominal value are picked out and marked "± 5%." From the remainder, those falling within 10% are picked out and marked "± 10%." Similarly for the ± 20%. Those not within 20% of one nominal value come within 20% of another nominal value and can be marked accordingly. So, on this plan, buyers of ± 10% resistors are unlikely to find them within 5%, and the usual assumptions made by the "probable-error" school of thought fall down.

If all were offered at the same price, the makers would have no sale for the 10% and 20% stocks, so the prices are graduated to equalize the demand.

Generally one does not buy a resistor as a self-contained unit, to be preserved for ever in complete isolation. It is intended to be used in conjunction with other components, to achieve some desired result. Even if it is wanted as a single fixed standard of resistance, the ultimately important matter is not the maximum error in that resistance but the error in the results of measurements based on it. So one ought to have a clear idea of how tolerances in components affect the maximum possible error in the final result. It is because I suspected that one does not have this clear idea that the subject struck me as being just the thing for considering here.

The sort of question one ought to be able to answer can be indicated by an example: We want to pass a current of 50 mA ± 7½% from a 200-V supply and we have a 6.8kΩ resistor with a tolerance of 5%. This resistance is too high, because what is wanted is 4kΩ; but a 10kΩ in parallel would do the trick (within about 1%); what tolerance can this 10kΩ be allowed?

Series Combinations

Let us, then, tackle resistance networks, or at any rate those whose overall resistance can be calculated by the two simple principles of series and parallel addition. Before starting there are one or two things we ought to be quite clear about.

When a resistor is marked "200Ω ± 10%" (read as "200 ohms plus-or-minus 10 per cent") it means that if its actual resistance is anything between 180Ω and 220Ω you have to be satisfied; but if it is outside those limits you can claim your money back. Dimensions in engineering drawings are sometimes marked with unequal positive and negative tolerances; but we shall exclude them, or (if you insist) alter the main dimension so as to divide the tolerance equally. We make this assumption so that we can simplify our calculations by using ± signs for all tolerances, except where a positive overall error is contributed to by a negative tolerance, as for example in the effect of shunt resistance on meter current.

If we had been interested in *probable* errors we would have had to take account of the fact that when two quantities are combined, each having random variations from the nominal value, there is a lucky chance that the errors will tend to cancel one another out, as well as the unlucky chance that they may add up. So the most probable error is less than the sum of the two. But here we are taking a sternly engineering attitude, leaving nothing to chance, and (whatever we may secretly hope) being prepared for the worst. So we shall assume in every case that the tolerances combine in the worst possible way.

If in an unguarded moment one were to be asked

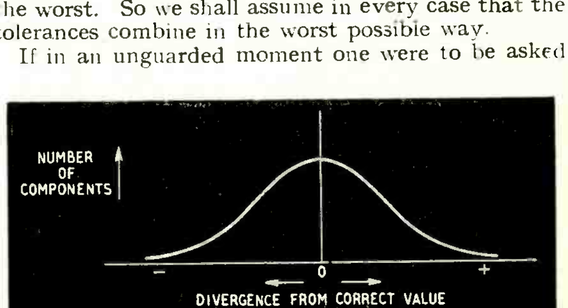


Fig. 1. If the components in a very large batch are arranged according to their departure from the nominal value, their quantities tend (theoretically) to follow a curve something like this.

about the overall tolerance when two equal $\pm 5\%$ resistances are connected in series one might (without thinking) answer "$\pm 10\%$" But this would be confusing percentages (or proportional errors) with absolute errors. If the two resistors were each 1,000 Ω, each would have a tolerance of 50 Ω, so the tolerance in the combination would be 100 Ω, it is true. But relative to the resistance of the combination, 2,000 Ω, this would still be 5%. One can go further and say that in any combination of resistances having equal percentage tolerances the overall percentage tolerance is the same as that of the components. The proof, if one is wanted, will emerge as a special case of the less obvious problem of any-value tolerances.

This problem can be solved by at least three methods: by common sense, by simple algebra, and by differential calculus. I am leaving out of account a fourth method—by arithmetic—because that solves only one example at a time, and I assume that anybody reading this article is more interested in getting to the root of the matter.

The common-sense method is to argue that in a combination of any number of resistors in series the tolerances in ohms add up together, just like the nominal resistances, but when they are expressed as percentages of the whole combination they affect it only in proportion to the individual resistances. For example, if a 20% resistor comprises one quarter of the resistance of the combination, its contribution to the overall tolerance will be one quarter of 20%. Similarly for the other resistors.

Simple algebra reaches the same result by denoting the resistances by symbols and subjecting them to the ordinary arithmetical operations. Suppose there are two resistances, nominally R_1 and R_2 (Fig. 2), and their respective tolerances, expressed in the same units as R_1 and R_2, are r_1 and r_2. The corresponding percentage tolerances, p_1 and p_2, are therefore $100\ r_1/R_1$ and $100\ r_2/R_2$. The nominal value of the combination, which we shall denote by R, is of course, R_1+R_2; and according to the rules we have just laid down the tolerance of the combination (call it r) is r_1+r_2. What we want to find is p, the percentage tolerance of the combination. It is, of course

$$p = \frac{100r}{R} = \frac{100(r_1+r_2)}{R_1+R_2}$$

Since $p_1 = 100r_1/R_1$, r_1 must be $p_1R_1/100$. So

$$p = \frac{100\left(\frac{p_1R_1}{100} + \frac{p_2R_2}{100}\right)}{R_1+R_2} = \frac{p_1R_1+p_2R_2}{R_1+R_2}$$

If we had had three resistances, it would have been

$$p = \frac{p_1R_1+p_2R_2+p_3R_3}{R_1+R_2+R_3}$$

and so on.

This just puts in symbols what we have already said in words. Perhaps this would be made clearer if we rewrote the formula thus:

$$p = \frac{p_1R_1}{R} + \frac{p_2R_2}{R}$$

etc. Example: A 200-Ω ± 10% resistor is connected in series with a 500-Ω ± 5% resistor; what is the overall percentage tolerance and the contribution of each resistor? The first contributes $10 \times 200/700 = 2.86\%$, and the second $5 \times 500/700 = 3.57\%$; total 6.43%.

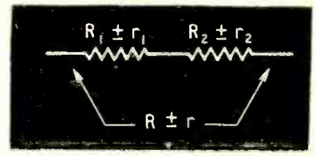


Fig. 2. Two resistances in series, the nominal values being indicated by capital letters and the tolerances by small.

As a matter of fact it is rather silly to give this answer to two decimal places, because the resistor sorters certainly do not work to that degree of precision. Another reason is that in general the accepted methods of calculating tolerances are only approximate. As it happens, however, this simple case of adding two quantities is an exception, thanks to the custom of reckoning tolerances relative to the *nominal* values. You can check this by taking an extreme case: suppose the tolerance of the 200-Ω had been 1% and that of the 500-Ω had been 60%. Then with positive errors the components would have been 202 Ω and 800 Ω respectively, so R_2 would have been nearly four times R_1. With negative errors they would have been 198 Ω and 200 Ω, making R_2 and R_1 almost equal. So it would seem as if the proportions in which each error contributed to the overall result would be greatly influenced by the errors themselves. And so they would, if they were reckoned on the *actual* values, of if the errors interacted on one another (as would be indicated if there were terms containing both p_1 and p_2). Check it with the example if you like; the maximum error (positive or negative) is 302 Ω, which relative to the nominal value of the combination (700 Ω) is 43.15%. The calculated contributions are $1 \times 200/700 = 0.29\%$ and $60 \times 500/700 = 42.86\%$, which add up to 43.15%.

But what about the differential calculus method? In this case it offers no advantage whatever; in fact, it only tells us what we have already accepted as obvious, namely that $r = r_1+r_2$. But it is quite otherwise with more complicated cases, which by simple algebra are usually unbearably tedious.

And Now in Parallel

Even such an apparently simple situation as two resistances in parallel is bad enough. The nominal value R, according to the well-known formula, is $\frac{R_1R_2}{R_1+R_2}$. We can see that a positive error in either leads to a positive error in the combination, so + signs throughout are in order, and the maximum value of the combination is

$$R+r = \frac{(R_1+r_1)\ (R_2+r_2)}{(R_1+r_1) + (R_2+r_2)}$$

and r is obtained by subtracting R from this. As before, $p = 100r/R$. Now you can go ahead and work it out, on the same principle as for resistances in series. But make sure you have plenty of paper! The result, in spite of a considerable amount of boiling down and tidying up, is the rather unpleasant

$$p = \frac{p_1R_2\left(1+\frac{p_2}{100}\right) + p_2R_1\left(1+\frac{p_1}{100}\right)}{R_1\left(1+\frac{p_1}{100}\right) + R_2\left(1+\frac{p_2}{100}\right)}$$

But provided that the tolerance percentages are reasonably small, one can get a sufficiently good approximation by neglecting them where they are divided by 100; thus:

$$p \simeq \frac{p_1 R_2 + p_2 R_1}{R_1 + R_2}$$

This is rather interesting, because it is the same as for resistances in series, except that each tolerance contributes in proportion to the *other* resistance. Which fits in with common sense, because if 100Ω is shunted by 10,000Ω the 100-Ω resistance is thereby affected only very slightly (being reduced to about 99Ω) and the effect of small tolerances in the 10,000Ω is quite negligible. On the other hand, the tolerance in the 100Ω is practically the same as that of the combination. In the parallel connection, then, the two tolerances are not independent of one another; the effect of varying one resistance depends on the value of the other.

Having neglected $p_2/100$ in comparison with 1, we should not expect to find this formula very accurate if applied to our 500-Ω ±60% resistor. In parallel with the 200-Ω±1% resistor, the result is (by exact calculation) 142.8Ω +12.9% or −30.2%. (Note how much smaller the positive tolerance is than when they are in series, because the greater part of the current flows through the 1% resistor. This is much less so with the negative tolerance.) According to the approximate formula, p is ±17.86%.

I have made rather a lot of this difference between the two cases because it forms an interesting analogy with intermodulation in amplifiers. If an amplifier is perfectly linear, then the effect of amplifying two signals at once is equal to the sum of the effects of separate amplification. But if, as is always more or less so, there is non-linearity, the signals intermodulate. And while this may be negligible when the amplitudes (relative to the steady valve current) are small, it will probably not be when they are large. The tolerances or errors correspond to the signal amplitudes.

The differential calculus method is a considerable help with the parallel circuit. Normally, for the benefit of readers who look on it as something much too intellectual, I keep the calculus out of these pages; but this time, for the benefit of those who have learnt the elements of it and are looking around for something not too hard to practise on, I will just stop to point out the way. It is based on the assumption that over the range of variation represented by the tolerance the "curve" is linear. In other words, exactly the same assumption as we make in most valve calculations. Using the same symbols as before, one can write it

$$r = r_1 \frac{\partial R}{\partial R_1} + r_2 \frac{\partial R}{\partial R_2} + \ldots .$$

which means that to find the contribution of r_1 to the overall error one multiplies it by the rate at which R changes when R_1 is varied; and similarly for any number of resistors *connected in any way whatsoever*. One only needs to know how R is related to the component resistances and how to differentiate with respect to each of these.

With two resistances in parallel the result of the differentiation is

$$r = r_1 \left(\frac{R_2}{R_1 + R_2}\right)^2 + r_2 \left(\frac{R_1}{R_1 + R_2}\right)^2$$

and when the substitution has been made for p, etc., the result is the same approximate formula as before.

The more complicated the problem, the greater the saving by using the calculus.

By one method or another we now have formulae for dealing with both series and parallel arrangements, and with these can solve any resistance network that can be reduced to such arrangements. And remembering that capacitances in series are calculated as for resistances in parallel, and vice versa, we can deal with them, too; which is rather useful when designing oscillator circuits for superhets.

In practice, one may have to take into account temperature tolerances as well as manufacturing tolerances; but the methods are the same.

Meter Tolerances

When one comes to meters there is more need to consider the causes of the errors. Meter tolerances are generally stated as a percentage of full-scale reading; in other words, as a constant amount regardless of reading. For instance, if a 0-500 voltmeter is said to have an accuracy of ± 1%, it means that the readings are (or should be) reliable within 5 V. If one tries to read 10 V on such a meter, p is ± 50%, which is not very good. Moral: use a lower range. The only sort of error I can think of that would strictly follow this law is a faulty adjustment of the zero-setting device, and that doesn't count! Most of the inherent errors of the instrument —temperature, lack of balance, non-linearity of field and spring, etc.—have some sort of proportionality to the deflection; but it is not necessarily simple proportion, so to be on the safe side the maker quotes a full-scale error everywhere.

When using multipliers and shunts the plot thickens. Presumably any errors arising from uncertainty in the resistance of the meter are not included in the quoted inaccuracy and have to be added. So the question "A meter ± 1% f.s.r. is used with a shunt ± 2%; what is the accuracy of the reading?" is less simple than it looks. Assuming that the ± 1% refers to the meter used unshunted, we would have to know the maximum error in the specified or measured value of the meter resistance.

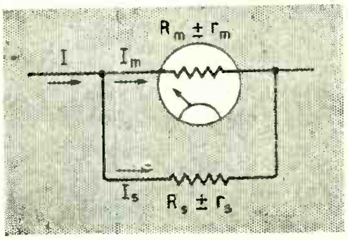


Fig. 3. Symbols used in working out the shunting error due to tolerances in the shunt and meter resistances.

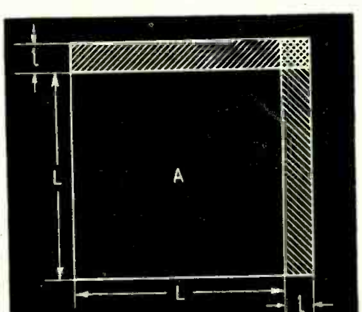


Fig. 4. Showing how a tolerance in a dimension is approximately doubled when the quantity is squared.

This would enable us to calculate the corresponding figure for the meter current in relation to the total current to be measured. We assume that this total current is unaffected by inserting the meter; otherwise that error would have to be calculated, too. The 1% meter error is additional to the shunting error.

The symbols in Fig. 3 are, I hope, self-explanatory. A shunting-error formula can be obtained in much the same way as the parallel-resistance formula, but the starting point is different:

$$I_m = I\frac{R_s}{R_s + R_m}$$

The result, either by straightforward algebra, neglecting terms divided by 100, or by short-cut calculus, is

$$p \simeq \left(p_s - p_m\right) \frac{R_m}{R_m + R_s}$$

This shows that if both meter and shunt resistance are high *or* low by the same percentage, the shunting error is nil (which is what one would expect).

An important thing to know is that if the value of a component has to be squared to give the answer, the overall tolerance is doubled. Similarly, cubing multiplies the tolerance by 3; a square root by $\frac{1}{2}$; and so on. This is another of the rules that is a good approximation for small tolerances only. It is very obvious to anybody who has absorbed the first stages of the differential calculus; and can be demonstrated to others by the simple diagram Fig. 4. The area A of a square is of course equal to L^2. If L is increased by a small amount, l, A increases in the same proportion in two places, plus a little corner piece. If the corner is neglected, the area therefore varies twice as fast as L.

The same sort of game can be played with a cube, but beyond that it is difficult.

If there is still space I would like to refer to a formula quoted on page 358 of Scroggie's "Radio Laboratory Handbook" (5th edn.) as an example of a type that should be avoided for its insidious error-multiplying nature. It refers to the method of measuring the total initial capacitance of a tuned circuit by noting the frequencies f_1 and f_2, to which it resonates when two known capacitances, C_1 and C_2, are added. The formula is

$$C_0 = \frac{C_1 f_1^2 - C_2 f_2^2}{f_2^2 - f_1^2}$$

Unless you have some time on your hands I don't advise working out the maximum error formula for this; but having done so I would like to give a typical example, assuming these values:
$C_1 = 200\text{pF} \pm 0.5\%$; $C_2 = 400\text{pF} \pm 0.5\%$;
$f_1 = 1{,}000$ kc/s $\pm 0.1\%$; $f_2 = 733$ kc/s $\pm 0.1\%$.
Anybody using these figures might imagine that the data were pretty accurate; nevertheless, he would not be justified in relying on the answer to better than 20%. Yes; decidedly a method to be avoided.

Answer to Introductory Example

Apart from the 1% by which the nominal value of the parallel combination fails to fit the exact requirement, the tolerance in the 10-kΩ resistor could be (calculated by substitution in the given formula) 11.2%. So a ± 10% resistor would do.

APPLIED ELECTRONICS

Brit.I.R.E. Presidential Address

"SELLING" electronics to industry, the dissemination of technical information, aeronautical radio and the possibilities of employing vertically radiated transmissions in an endeavour to accommodate more stations within the limits of the h.f. broadcasting bands are some of the matters dealt with by Paul Adorian in his recent Presidential address to the British Institution of Radio Engineers.

He suggested that in order to stimulate interest in, and secure the acceptance of, electronic methods in industry and medicine, papers should be presented, not only to radio engineers but to those engaged in fields of research to which the techniques are applicable.

In regard to the problems associated with broadcasting, Mr. Adorian summarized the difficulties, so far as medium- and long-wave stations are concerned, by saying that, allowing for a 9-kc/s separation between channels, it would be necessary to use each available channel twenty-five times to cover the world's land mass with *one* programme.

On the question of h.f. broadcasting, he outlined a system employing aerials which radiate a large proportion of their power vertically, giving relatively short-range reflections from the Heaviside layer. The system, using the wavelength of 30 metres, has been used in Trinidad since 1947 and has given satisfactory reception throughout the island in daylight, but at night interference is caused by stations operating in different parts of the world on the same wavelength but with aerials radiating considerable power at low angles. Another station using the system has recently been opened in Jamaica.

RCA Receiving Tube Manual

A NEW and completely revised edition of this useful reference book has recently been announced by the RCA Tube Department. It contains general information on valves, ranging from elementary theory to descriptions of the latest applications of receiving valves, and has some new features reflecting developments in electronics. The section on valve and circuit theory has been expanded and includes formulæ and examples for the calculation of power output, load resistance and distortion for several classes of amplification, as well as information on the design of cathode followers. New designs for receivers and amplifiers have also been added, and there is a complete section on resistance-coupled amplifiers.

In addition, the manual provides technical data on more than 460 RCA receiving valves and television picture tubes, including many discontinued types. For quick and easy reference there is a classification chart which groups together the types having similar characteristics and the same filament or heater voltages.

Single copies of this new edition, RC-16, can be ordered from RCA Photophone Ltd., 36, Woodstock Grove, London, W.12, price 5s 6d, post free.

Long Range Television

Review of Propagation Conditions

Prevailing During Reception in South Africa

By T. W. BENNINGTON (B.B.C.) and R. MORRIS (Panorama Receiving Station, S.A.B.C.)

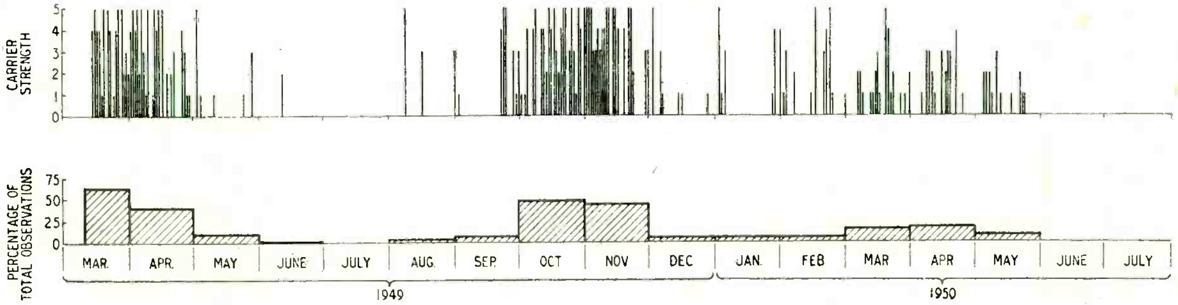
REGULAR reports on reception of the Alexandra Palace 41.5-Mc/s sound channel have been sent since 13th March, 1949, to the B.B.C. from the Panorama Receiving Station of the South African Broadcasting Corporation, near Johannesburg. At this station from 5 to 7 observations are made daily throughout the year on this frequency, covering both the forenoon and afternoon transmitting periods. The results of the observations are reported in a 5-figure code, in which the first figure designates the signal strength on a scale of 0-5, while the remaining figures indicate respectively the fading, noise, interference and overall merit. In this review we are concerned with the propagation conditions and so the signal strength figure only has been used. During all observations when it is not possible to allot a figure of 1, or greater, to the reception, either "Nil" reports are given, or else the designation "BNL" (Below Noise Level) is used, both of which classifications are taken to mean that the signal strength is, in fact, zero.

The reports have here been analysed for the period 13th March 1949 to 31st July 1950. In the upper section of Fig. 1 are shown the days on which reception was obtained. On each of these days the observation giving the strongest signal of the day was taken and the results are plotted as vertical lines on the scale 0-5. During 1949 reception was far more frequent, and signals were, in general, stronger during the months of March, April, October and November than during the other months of the year. It should be noted, however, that had observations been made during the early part of the year, frequent reception might have been had during February. Reception conditions were the most favourable in the early spring and late autumn, though mid-winter produced occasional reception. During the summer conditions were particularly poor and on one day only during June, and on not a single day in July, was reception obtained, though just as many observations were made then as during other months. In 1950 signals were heard on several days during mid-winter, though it again tended to increase towards the vernal equinox. It is again significant that not a single case of reception was obtained between 24th May and 31st July when our record finishes. It is to be noted that reception during the early spring of 1950 was much less frequent than during that of 1949, due, no doubt, to the decreased solar activity and the consequent fall in the ionization of the F_2 layer.

In the lower section of Fig. 1 there are given, in histogram form, the total number of cases of reception at strength 1 or greater, as a percentage of the total number of observations made during the month. Reception on 41.5 Mc/s was most frequent during March 1949, when 65 per cent of the observations produced signals, and it was least frequent during June and July 1949, while June and July 1950 were completely blank months. It will be noted that in the late winter/early spring period reception peaked during the equinoctial month of March, whereas at the late autumn/early winter period the equinoctial month of September did not produce a notable increase in reception, which reached its seasonal peak in the following month. It would be expected that reception would peak just after and just before the mid-winter period rather than at the equinoxes, and it is difficult to assign a reason for this assymmetry in regard to the peak reception months of 1949, particularly as sunspot activity during April and September was at similar levels.

It seems reasonable to assume that the best conditions for reception tended to occur towards both

Fig. 1. Graphical records of reception of Alexandra Palace 41.5 Mc/s sound signals in Panorama South Africa. Day-to-day signal strength is given in the top half, the lower showing the monthly reception as a percentage of the observations made.



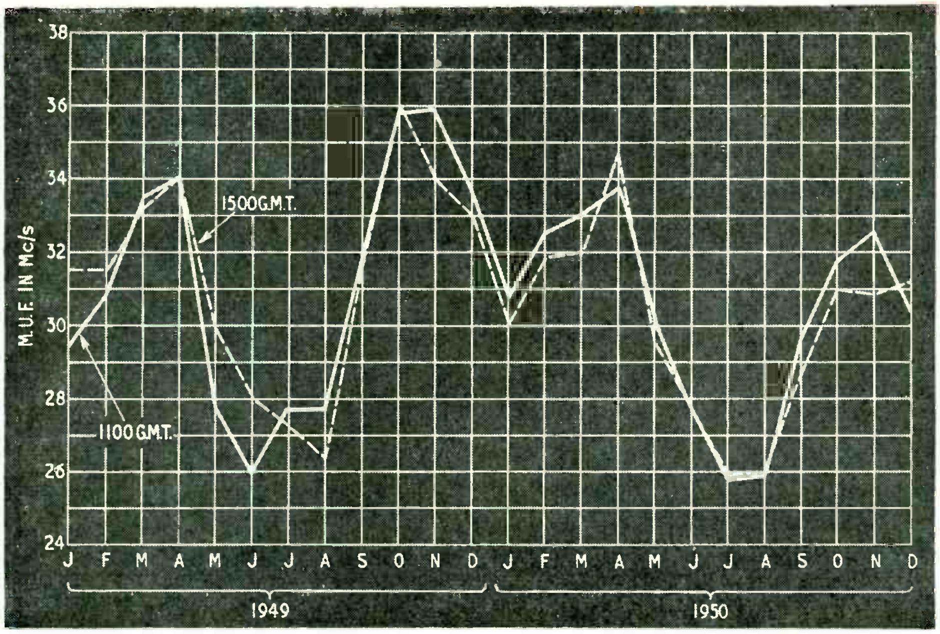


Fig. 2. Predicted monthly m.u.f.s for the Daventry/Johannesburg path at 1100 and 1500 hours G.M.T. during 1949 and 1950.

vernal and autumnal equinoxes. Again in March and April 1950 there occurred an increase in reception, followed by a sharp decrease in June. The level of reception in the spring of 1950 was very much less than in the same months of the previous year, which may be accounted for by the fact that the sunspot activity (as indicated by the monthly sunspot numbers) has decreased by approximately one-third as between March/April 1949 and March/April 1950.

Comparison with Ionospheric Data

It is not feasible to compare these results with any measured m.u.f. (maximum usable frequency) data, because no such charts are published, and there do not exist enough measured critical frequencies over this path on which to estimate the results with the predicted m.u.f. for the path, as obtained from the world ionospheric contour charts, which are compiled on the basis of past measured data supplied by the world network of ionospheric measuring stations.

It is not to be expected that, because reception was obtained on a few days during any particular month, the mean m.u.f. for that month would reach 41.5 Mc/s. It is known that there is a very considerable day-to-day variation about the monthly mean value, and so it might be possible to receive 41.5 Mc/s on several days during the month when the mean m.u.f. for the path was much lower. Nevertheless, when reception was obtained on 50 per cent, or more, of the observations made, it would indicate that the mean monthly m.u.f. for the path must have been near 41.5 Mc/s.

In Fig. 2 are plotted, for 1100 and 1500 G.M.T., the predicted monthly m.u.f.s for the path for 1949 and 1950, as obtained by the use of world ionospheric contour charts. It will be seen that there is a large seasonal variation in the predicted m.u.f. for the path, such that low values are to be expected in the summer, highest values before and after the mid-winter period and medium-high values at mid-winter. The general trend of the seasonal variations in m.u.f. thus agrees exactly with the observed results at Panorama, in that the seasonal periods when no reception was obtained occur when the predicted m.u.f. was lowest, the most frequent reception when it was highest and occasional reception when it was less than the highest expected. It is to be noticed that there is a general fall in predicted m.u.f.s with time, in accordance with the decrease in sunspot activity, so that the late winter/early spring peak in m.u.f. in 1950 is lower than either peak of 1949, and this agrees with the decreased amount of reception in the late winter/early spring of 1950 as compared with the peak reception periods of 1949. Actual values of predicted m.u.f. would appear to be somewhat lower than those which must have prevailed, for during no month did the predicted mean exceed 36 Mc/s, whereas during several months 41.5 Mc/s was received frequently.

In conclusion we can summarize:—

(1) Reception of 41.5 Mc/s over the London/Panorama transmission path was obtained; (a) frequently during the late winter/early spring and late autumn/early winter periods, (b) occasionally during the mid-winter period, and (c) not at all during the summer period.

(2) The seasonal variation thus disclosed is in exact accordance with the expected variation of m.u.f. over the path, as indicated by the predicted m.u.f. values. There is strong evidence, however, that the predicted m.u.f.s were somewhat lower than the actual frequencies for the path, at least during the equinoxes.

(3) Reception during the late winter/early spring period of 1950 was much less frequent than during both periods of peak reception of 1949, due to the general fall in sunspot activity and the consequent decrease in the ionization of the F_2 layer.

INTERFERENCE MEASURING SET

THE Electrical Research Association has recently designed for the Admiralty a portable interference measuring set in conformity with the requirements of BS1597 (suppression of marine installations) and BS727 (general measurement of radio interference). Sets to this specification, which are equally suitable for marine or land use, are being made by E.M.I., though the Admiralty states other civilian organizations may use the design without change. Further information may be had from the E.R.A., Perivale, Middlesex.

Phase-Shift Oscillators

New Circuit Giving Constant Amplitude

By W. G. RAISTRICK (Pye, Ltd., Cambridge)

THE circuits to be described are all based upon the phase-shift oscillator shown in Fig. 1. In order to produce self-sustaining oscillation in this arrangement two conditions must be satisfied. First, the voltage introduced from the output of the amplifier must be in phase with that fed back to the input, and, secondly, the voltage gain in the amplifier must be rather greater than the loss in the resistance-capacitance network.

A further requirement, important when a variable-frequency oscillator is considered, is that the sum of the amplifier-gain and the network loss should be constant over the whole of the frequency range in order that the voltage output may remain constant and the amplifier valve work always on the same part of its characteristic. The success or otherwise of any RC oscillator with low harmonic distortion depends very largely upon how accurately one can maintain the system in a condition when it oscillates only very gently, and in practice most oscillators of this type embody some form of automatic amplitude control. The design of this control is greatly simplified if the amplitude variation in the first place is only slight.

If we make the assumption that the valve-amplifier gives a constant voltage-gain and a constant phase-shift of 180° over the whole range of frequencies to be considered, then we are left with the problem of designing a phase-shifting network which gives a phase change of 180° and a constant loss over the frequency range.

In the circuit of Fig. 1 it is not feasible to obtain a phase shift of more than 60° in each resistance-capacitance section so that the minimum requirement for oscillation is three sections. If the network loss is to remain constant then either all the capacitors or all the resistors must be varied simultaneously and it is this latter feature which has led to the comparative neglect of this type of oscillator for generating variable-frequencies.

Three-gang potentiometers are not easy to obtain, and if the normal type of tuning capacitor of 500-600 pF, is pressed into service then at least two will be required for each section, if frequencies of the order of 20 c/s are contemplated, otherwise the associated fixed resistors become of so high a value that the valve grid is extremely susceptible to hum pick-up. A further consideration is that the loss in the network decreases with the number of sections. It is 1/29 for a three-section network and 1/18 for a four-section one, necessitating valve voltage gains of rather more than 29 and 18 respectively. This is one reason why some of the oscillators described in the past have had as their tuning elements two four-gang capacitors coupled together.

By employing the more elaborate phase-shifting circuit of Fig. 2 it is possible to obtain a phase-shift per stage of approximately twice that obtained with the simpler circuit. As is well-known, the virtues of this particular phase-shifting circuit are that the phase may be changed from 20° to 160° without any appreciable change of amplitude at the output terminals, so long as no attempt is made to draw power from the circuit, and it thus becomes possible to design an oscillator with only two stages of phase-shifting. Also, only one variable element is required although, as will be pointed out later, it is not always advisable to avail oneself of this characteristic.

Phase-splitting Valve

In all the oscillator circuits which have so far been tried by the author the centre-tapped transformer of Fig. 2 has been replaced by a phase-splitting valve. Each phase-shifting section then becomes as in Fig. 3.

For a first analysis we may neglect the effects of the valve anode resistance, the input impedance of the succeeding stage and the cathode-bias resistor.

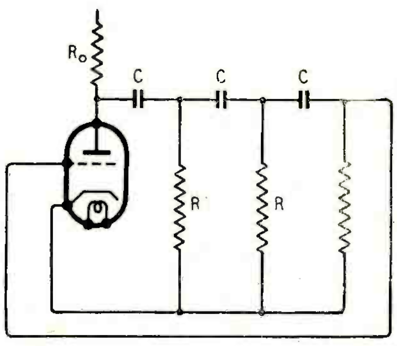


Fig. 1. Conventional phase-shift oscillator.

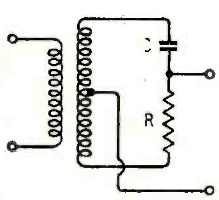


Fig. 2. Constant-amplitude phase-shift circuit with transformer input.

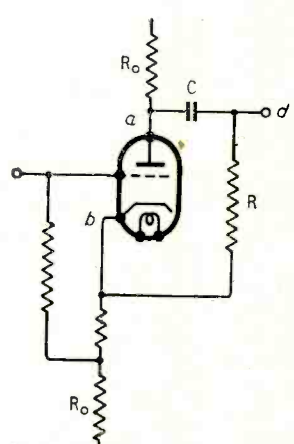


Fig. 3. Push-pull phase-splitting circuit which can replace the transformer of Fig. 2.

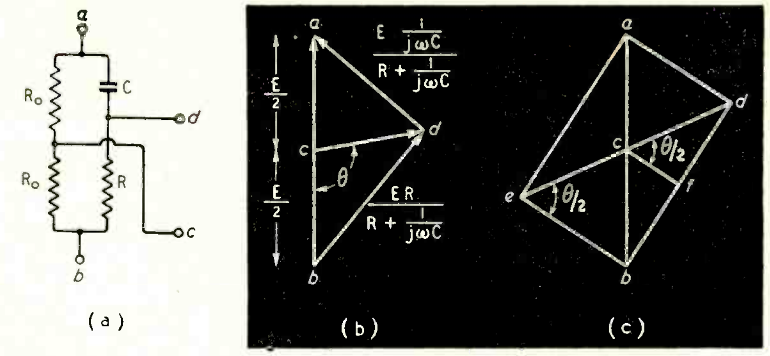
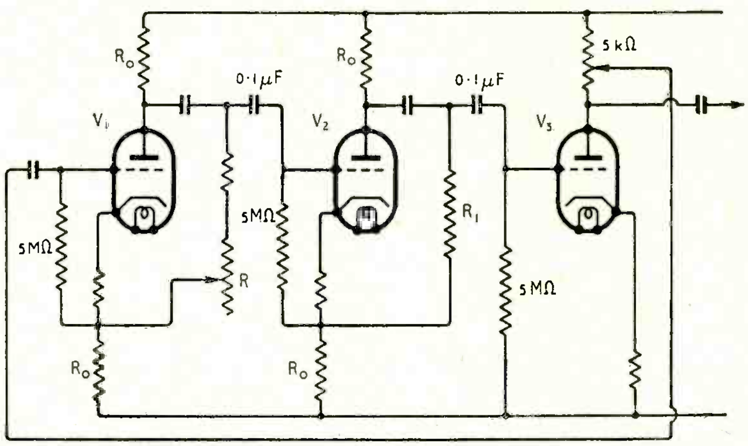


Fig. 4. Basic phase-shift circuit alone (a) and vector diagram of voltages (b). The parallelogram is completed in (c).

Fig. 5. Circuit of complete oscillator with two phase-shift and one amplifier stages.



The equivalent circuit is then that of Fig. 4(a). If now a sinusoidal voltage of amplitude E is applied between terminals *ab*, then the current through the resistive branch becomes $\frac{E}{2R_0}$, and that through the RC branch $\frac{E}{R+1/j\omega C}$. The resulting voltage distribution is shown in the vector diagram of Fig. 4(b); note in this that the angle *adb* will remain a right angle as C or R is varied assuming C to be a capacitor of low power factor, so that the point *d* will describe a semicircle about the centre *c*, and *cd* will always be equal to both *ac* and *cb* since all three are radii of the same circle. The voltage *cb*, the cathode voltage, is in phase with the input voltage to the valve grid, and *cd* is the output voltage, so that the phase angle θ between input and output voltages is the angle *bcd*. By the process of completing the parallelogram, Fig. 4(c), and bisecting angle θ by the perpendicular *cf*, it can easily be seen by inspection that the tangent of half this angle is: $\tan\frac{\theta}{2} = \omega CR$. Now $\tan 2x = \frac{2\tan x}{1-\tan^2 x}$ from which

$$\tan\theta = \frac{2\omega CR}{\omega^2C^2R^2-1} \quad \ldots \quad \ldots \quad (1)$$

Fig. 5 depicts an oscillator constructed by associating two such phase-shifting stages with a valve-amplifier V_3. If we denote the phase shift obtained in the second stage by $\phi = \frac{2\omega C_1R_1}{\omega^2C_1{}^2R_1{}^2-1}$ then oscillation will be obtained when $\theta+\phi = 180°$.

Now $\tan(\theta+\phi) = \frac{\tan\theta+\tan\phi}{1-\tan\theta\tan\phi}$ and substituting from (1)

$$\tan 180° = 0 = \frac{\frac{2\omega CR}{\omega^2C^2R^2-1}+\frac{2\omega C_1R_1}{\omega^2C_1{}^2R_1{}^2-1}}{1-\left(\frac{2\omega CR}{\omega^2C^2R^2-1}\cdot\frac{2\omega C_1R_1}{\omega^2C_1{}^2R_1{}^2-1}\right)}$$

From which $\omega^2 = \frac{1}{RCR_1C_1}$

$$\text{And } f = \frac{1}{2\pi\sqrt{RCR_1C_1}} \quad \ldots \quad \ldots \quad (2)$$

It now can be seen wherein lies the disadvantage in having only one tuning element, for assuming we decide to allow the resistance R to fulfill this function then $C = C_1$ and the expression for oscillation frequency becomes $f = \frac{1}{\sqrt{R}.\sqrt{R_1}C}$; in other words the frequency becomes proportional to $\frac{1}{\sqrt{R}}$ and a linear control will give an extremely cramped scale if a coverage of the order of 10 : 1 for each range is considered. In order to obtain an approximately logarithmic scale then a logarithmic potentiometer will have to be used and unfortunately logarithmic wire-wound potentiometers are not obtainable in large ohmic values.

However, when extreme accuracy and permanence of calibration are not important, quite useful instruments can be assembled around the ordinary carbon-track volume control with a log or semi-log law. A practical design along these lines would proceed somewhat as follows. The minimum value of R should not be reduced below about 5 kΩ, and from (2) it can be seen that the maximum value is equal to $(f_1/f_2)^2R_{min}$ where f_1/f_2 is the ratio between maximum and minimum frequencies on any one range. For decimal scales this ratio is, of course, 10, and R_{max} becomes 0.5 MΩ. R could conveniently be a fixed resistor of 5 kΩ in series with a 0.5-MΩ potentiometer. R_1 should be a fixed resistor equal in value to $\sqrt{\frac{R_{max}}{R_{min}}}.R_{min} = 5\times10$ kΩ, and C would equal C_1, and be simultaneously switched for each range, increasing in capacitance in multiples of 10. It will be found that sufficiently good multiplication will be obtained over the whole frequency range to enable a single calibration to be used, and the range-changing switch used merely as a multiplier, labelled ×1, ×10, ×100, etc., so long as sufficient care is taken over decoupling arrangements at the lower frequencies. The coupling capacitors preceding the phase-splitting stages need not be embarrassingly large even for quite low frequencies as the input impedance of the particular type of phase-splitter used is high. A value of 0.1 μF is adequate for frequencies of the order of 20 c/s.

The anode and cathode load resistors R_0 should be of fairly low value—something between 2 and 5 kΩ will be found suitable. The "gain" of each phase-shifting stage is that which is normal for this type of phase-splitter and should not be less than 0.8 or 0.64 for the two together; thus the gain of the amplifier V_3 need not exceed 1.6 and its design becomes very simple.

No provision for automatic amplitude control is made in the circuit of Fig. 5. The feedback is controlled by the 5-kΩ potentiometer and, once set, it will be found that reasonably constant output will be obtained over the frequency range without further adjustment. When the output is required to be as free from harmonic distortion as possible, then it must be set at the lowest possible setting consistent with reliable oscillation, and under this condition the total harmonic content can easily better 1 per cent.

Readers who prefer to embody some kind of amplitude limiting in their designs can use any of the usual arrangements. In this connection it may be mentioned that both valve-operated control circuits and temperature-controlled devices, such as Thermistors, have been used by the writer with good results. Enough has been said to indicate that the use of the valve phase-shifter* principle makes available a RC oscillator allowing fair flexibility of design. A single- or a double-element control may be used as desired, and this control may be either resistive or capacitive; for instance the circuit of Fig. 5 could have employed a single capacitor as the tuning control with a range of 3.16 to 1, covering the audio-frequency band of 20-20,000 c/s in 6 switch-positions. Alternatively a twin-gang potentiometer can be made to give a range in excess of 30 : 1 in one sweep, and in all cases the output remains constant.

These advantages are secured at the expense of two extra valves, but this is not so great a complication when it is remembered that both phase-shifters can be sections of one of the popular small twin-triodes, and V_3 can be another section of a further valve of the same type. The complete oscillator plus output stage need therefore have no more than two "bottles." With the circuit of Fig. 1 the valve must nearly always be a multigrid type in order to obtain the necessary gain. In addition a cathode-follower is commonly added, so that the RC network may be fed from a low-impedance source, and two glass envelopes are still required, for the oscillator alone.

*British Patent No. 3516/1949.

B.B.C. REPORT FOR 1949/50

A COMPREHENSIVE account of the work and progress in the operation of both the sound and vision services of the B.B.C. during the year ended last March is given in the Annual Report of the Corporation, which is published by H.M. Stationery Office.

After dealing with the engineering developments of the year, the section devoted to the technical aspects of the Corporation's activities, concludes with some notes on the television research undertaken. In order to obtain data concerning the probable mutual interference which would be experienced with synchronized television stations working on the same wavelength (which will, of course, be necessary as there are only five channels available and ten stations are planned) six recording posts were in almost continuous operation during the year and an unbroken record was kept of reception from experimental transmitters over long distances. Recordings were also made of the Alexandra Palace transmissions in Scotland and of the Sutton Coldfield transmissions in the London area.

As a long-term project to appraise the relative merits of different systems, it is stated in the Report that preliminary experiments are being made on systems using higher standards of definition and on colour television. To facilitate work of this kind, a new flexible television transmitter designed to operate at will on standards of definition from 400 to 900 lines, has been constructed for use in the laboratories.

On the financial side, the Report records that although the Treasury retained 15 per cent of the licence revenue —£1,753,926—and the Post Office received £814,111 for expenses of collection and interference investigation, the Corporation's net licence income was £9,938,917—an increase of £494,445 on the previous year. Of this amount £272,747 was derived from the additional £1 charged for the combined sound and television licence. The revenue from the sale of publications was £1,039,464. It is noteworthy that 25.3 per cent of the year's expenditure on the Home and Television Services is classified as "engineering."

One of the best reproductions of an end-of-tube picture —showing Their Majesties at the Royal Opera House, Covent Garden—is among the illustrations in the Report, which costs 3s.

TELEVISION O.B. LINKS.—Six centimetre-wave transmitters, similar to that illustrated, are to be supplied to the B.B.C. by Marconi's to provide radio links for television outside broadcasts.

Communications on 460 Mc/s

Suitability of the Decimetre Waves for Mobile Services

By E. G. HAMER, B.Sc. (Eng.) (Hons.), A.M.I.E.E., Ass.Brit.I.R.E. (G.E.C. Research Laboratories, Wembley)

A FEW years ago it was thought that the frequency spectrum between 70 and 100 Mc/s would be wide enough to accommodate most of the necessary radio services, particularly short-range fixed links and mobile communication. The demand for frequencies in this band for use in essential services such as police work has, however, been so heavy that additional allocations are not now readily available. Higher frequencies were therefore sought for some less essential services, including taxis and the press, and, at the 1947 Atlantic City conference, the International Telegraph Union allocated the band between 156 and 184 Mc/s for this type of user. Here again, since only part of this band is available for commercial fixed link and mobile services, it appears that the congestion in this new band will shortly be the same as it is now between 70 and 100 Mc/s. All the available frequencies are rapidly being allocated and the next logical step will obviously be to move yet higher up the frequency spectrum to the range between 460 and 470 Mc/s, which was allocated at Atlantic City to fixed and mobile stations, and is used in America for "citizens' radio."

Previous work has shown that frequencies in the 700-100-Mc/s band give slightly better results than those between 156 and 184 Mc/s when used for mobile types of service. For frequencies of the order of 460 Mc/s, however, the performance has not been so accurately known. The various conflicting reports made in the past had led to the assumption that the usefulness of such frequencies for mobile communication largely depended on the location of the fixed station aerial.

Mobile Station

In order to obtain more precise information on this point and, further, to investigate the behaviour of the received signals under non-"line-of-sight" conditions, an extensive programme of tests was undertaken in the London area. During these tests, the opportunity was taken of measuring the field strengths received at the mobile station and comparing these measured values with those predicted from theoretical considerations.

The tests were made using various fixed station sites, roughly corresponding to sites in open country, together with a site in the centre of a built-up area. The receiver was installed in a car, which was used as the mobile station and, in some of the tests, the transmitted power and the receiver sensitivity were adjusted to a value likely to be obtained with "walkie-talkie" type of equipment.

The transmitter consisted of a low power r.f. unit giving a frequency modulated signal at a frequency of about 115 Mc/s. This unit was used to drive a series of doubler and earthed-grid amplifier stages. A power output of 30 watts was obtained from the final amplifier and, with the length of the feeder in use, gave a radiated power of 6 watts from a simple vertical dipole aerial fitted with a quarter wave co-axial stub standing wave suppressor. The immense loss of power in the feeder with this arrangement was due to the unavoidably large separation between the transmitter and its aerial. No attempt was made to increase the all-round aerial gain, although at these frequencies an aerial array is very attractive owing to its small physical size.

A normal frequency modulated receiver was used in the car and operated on a frequency of 40 Mc/s. This receiver was preceded by an extra frequency changing unit. Figure 1 gives a block schematic diagram of this arrangement, which consists of a capacity-loaded line connected to a silicon crystal valve used as a frequency changer. The local oscillator frequency is provided by a quartz crystal oscillator, followed by a chain of multiplier valves. An additional stage of amplification at the first i.f. of 40 Mc/s is included between the mixer head and the normal receiver. Such an arrangement gave a minimum receiver sensitivity for an intelligible output of 4 μV input across 70 ohms. A complete receiver designed in accordance with the latest practice might be expected to have a sensitivity of the order of 1-2 μV across 70 ohms. The aerial fitted to the car consisted of a quarter wave whip aerial mounted above a metal sheet acting as an earth plane. Again, no attempt was made to use an aerial array to give an increased gain.

Communication from the car to the fixed station was provided by normal v.h.f. equipment with a transmitted power of 10 watts and a receiver sensitivity of 1 μV across 70 ohms. This circuit was operated at a frequency of 100 Mc/s, so that an indirect comparison with the performance of the 460-Mc/s equipment was obtained by noting the areas in which signals to and from the car could not be received.

The characteristics of the equipment used can be

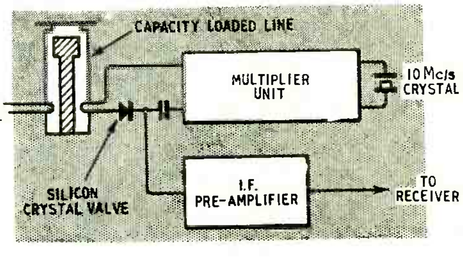


Fig. 1. Schematic layout of the experimental 460-Mc/s receiver.

summarized as follows: (a) transmitter; radiated power 6 watts; peak deviation ±45 kc/s; operating frequency 466 Mc/s; (b) receiver; sensitivity (for usable signal) 4 μV across 70 ohms; bandwidth ±160 kc/s at 3 db points.

For the first series of trials, the fixed station aerial was located on top of a water tower near Ealing, 120 feet above local ground level and some 200 feet above the surrounding terrain. The mobile set in the car was taken to a number of places, including non-"line-of-sight" locations behind near and distant hills. Field strength measurements were also made at selected sites, for subsequent comparison with the calculated values. The non-"line-of-sight" positions can be described as: (a) behind a long range of hills seven miles away; (b) behind a local hill two miles away; (c) behind a large hill four miles away, also partly screened by another hill between it and the fixed station.

The approximate service area for continuous reception had a radius of about eight miles, comparing very favourably with the 100-Mc/s signals. On good receiving sites, of course, much greater ranges were obtainable.

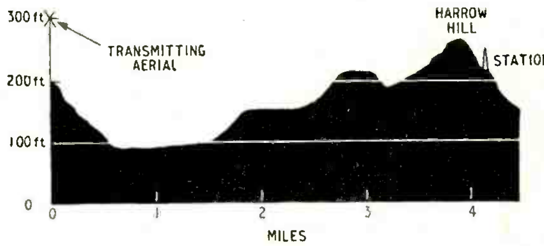
The second series of trials was made with the fixed station in the centre of London, the aerial being mounted 30 feet above roof level, the aerial height above ground level being 130 feet. Mobile tests were again conducted in and about the City of London, and field strength measurements were taken behind Hampstead Hill. Reliable communication in this instance was obtained up to a range of seven miles, and within a radius of two miles the effects due to fading of the signal were negligible.

Some Comparisons

The results obtained in the two series of tests described above gave rise to the following conclusions: communication results obtained during mobile working on a frequency of 460 Mc/s are, in general, inferior to those experienced using a frequency of 100 Mc/s. In isolated instances in built-up areas the 460-Mc/s frequency may give a better service owing to standing wave effect. As is usual with v.h.f. and e.h.f. installations, there is a variation in field strength depending on multi-path propagation and, as a car moves through the resultant field, a fluctuation in field strength is encountered causing the strength of the received signal to vary. The rate of flutter is greater at 460 Mc/s than at 100 Mc/s since the wavelength involved is shorter. When frequency modulated transmissions are used, and provided the receiver has good limiters, the effect on intelligibility is of the same order as when using 100-Mc/s equipment. If, however, the limiting action of the receiver is poor, or the a.g.c. time-constant incorrect, this rapid flutter fading may give rise to an effect which is similar to a superimposed low frequency modulating the speech intelligence. The effect is to mar the speech quality badly and to reduce the intelligibility.

During both trials the equipment operating on 460 Mc/s did not give as great a range as that used on 100 Mc/s. The difference between the two values was, however, usually small, being of the order of 10 to 20 per cent. It was also interesting to observe that, during communication to a heavily wooded country area, the trees appeared to cause more

Fig. 2. Ground contour of typical site used for field strength measurements.



attenuation of the 460-Mc/s signal than of the 100-Mc/s signal. This effect was more pronounced when the trees were wet, although the presence of wet buildings in a built-up area appeared, if anything, to improve the 460-Mc/s communications.

The effect of operating the mobile station under trolley-bus wires and bridges was negligible, unless the bridge was of metal and, at the same time, very low and wide. Even in a town in very heavy traffic, the amount of ignition interference experienced was very small, despite the use of an intermediate frequency of 40 Mc/s and a relatively poorly screened experimental receiver. Good signals were obtained in the centre of the City of London about 2 miles from the fixed station, even in very narrow "canyon"-like streets, and again the effects of passing traffic caused very little alteration in the signal. In particular, it was found that, in these narrow streets, there appeared to be no significant difference in signal level between adjacent streets which were radial and circumferential to the fixed station.

A further series of tests was carried out to simulate the conditions likely to be obtained using "walkie-talkie" type of equipment, and in some instances the receiver used was of the simple super-regenerative type. The transmitted power was 0.25 to 0.5 watt, and the minimum receiver sensitivity for a usable signal was 30 μV across 70 ohms. From a high site the range to the sensitive receiver (4 μV) was $2\frac{1}{2}$ miles in open country and 1 to $1\frac{1}{2}$ miles in a built-up area. With the super-regenerative receiver the range was reduced to 400 yards in a built-up area. In another instance the transmitter aerial was placed about 3 feet above ground level, adjacent to and outside the wall of a brick and steel building, halfway between the two ends of the wall. When using the super-regenerative receiver inside the building the range obtained was between 60 and 100 yards, depending on the type of obstructions inside the building and upon the floor level on which the receiver was used. Outside the building (which was approximately 100 yards square) signals were received along the side where the transmitting aerial was located and along the adjacent sides, but they were not received on the opposite side of the building.

As a general rule the simple "walkie-talkie" equipment gives service, when used in the open, over a range of 200-400 yards, depending on the location of the aerials. When used inside a building the range is reduced to 60-100 yards. It should, however, be remembered that at present it may not always be possible to achieve such performances using filament type battery valves.

An approximate analysis was made of the anticipated field strength in the areas where the field strength had actually been measured This analysis was based on the nomograms published by Bullington.* For the non-"line-of-sight" position, the field strengths were calculated at the crest of the intervening hill to determine whether smooth earth or free space conditions should be used. The appropriate shadow loss and, if necessary, the grazing loss were taken into account.

Figure 2 shows the ground contour of a typical site tested. Allowance is made for the grazing loss over the intermediate hill, and for the shadow loss due to the principal hill. The calculated transmission loss is 119 db, which is in satisfactory agreement with the measured loss of 124 db. A series of some 40 readings were made and the results were found to be consistent for any transmitting station site.

The results obtained with the transmitter on an open site show very close agreement with the results calculated by the Bullington method, the two values usually being within 3 db of one another for a simple non-"line-of-sight" path. This may, to some extent, be fortuitous in view of some of the assumptions made, particularly in regard to the gain or loss of the aerials and feeders. Using identical equipment in a built-up area, it was found that there was an extra loss of some 10 db in the measured values. This loss may be accounted for by the indeterminate extra "grazing" loss due to the roofs of surrounding buildings. Such extra indeterminate losses can be regarded as being a function of the transmitter aerial height above roof level rather than of its actual height above ground level. Small increases in aerial height are therefore likely to give much greater signals, while the converse is also true.

It can therefore be stated that, where a high transmitting aerial is situated in the open, the propagation loss may be evaluated to a fair degree of accuracy, even under non-"line-of-sight" conditions. In a built-up area, however, an extra fixed loss must be added to the calculated loss. This extra fixed loss may vary in any given direction depending upon the heights and types of building near to the fixed station aerial.

The general conclusion drawn from the entire series of tests was that frequencies in the 460-470-Mc/s band could be used for many mobile radio services. A satisfactory service would definitely be obtained, although the service area would be slightly less than when using frequencies in the 70-100-Mc/s band. The service area could be increased by the use of aerial arrays giving omni-directional gain, these aerials being physically small, and might then be comparable with the 100-Mc/s service area. This general statement may not, however, be applicable in extremely rugged terrain so that, as when lower frequencies are used, exploratory tests on the actual site are desirable under such conditions.

* K. Bullington, Radio Propagation at Frequencies Above 30 Mc/s. Proc. I.R.E., 35, 1122-1136 (October, 1947).

Presenting Pickup Characteristics

THE need for a standardized presentation of audio-frequency response curves, to facilitate comparison, has long been recognized, and, as a first step, the Gramophone Equipment Panel of the Radio and Electronic Component Manufacturers Association have recommended their members to adopt a scale ratio of 38 db per octave. Graph paper on this basis (actually 3 inches per octave of frequency and 1 centimetre to 5 db of vertical scale) has been prepared and is obtainable from H. K. Lewis & Co., 136, Gower Street, London, W.C.1. The chart includes a useful ruled panel for relevant data.

Nomenclature: Standard Terms

SEVERAL supplements to British Standard 204 : 1943 ("Glossary of Terms used in Telecommunication") have recently been issued by the British Standards Institution, 28 Victoria Street, London, S.W.1.

Supt. No. 2 : Glossary of Terms used in Radio Propagation.—Terms connected with radio propagation through the ionosphere and troposphere. Price 2s.

Supt. No. 3 : Fundamental Radio Terms.—Definitions of the terms used for the various applications of radio in communication and location, with a chart showing the relation between the various methods. Price 1s.

Supt. No. 4 : Glossary of Terms used in Radar.—Price 2s.

CLUB NEWS

Basingstoke.—The secretary of the Basingstoke District Amateur Radio Society advises us that owing to lack of support it has been decided to discontinue the Club's activities. Sec.: L. S. Adams, "Roslen," 16, Bramblys Drive, Basingstoke, Hants.

Belfast.—Two 150-watt transmitters, one 'phone and one c.w., are now in use at the headquarters of the City of Belfast Y.M.C.A. Radio Club, Wellington Place, under the call sign GI6YM. Morse classes are held on Wednesdays—the club night—and Thursdays. Sec.: S. H. Foster (GI3GAL), 31, Belmont Park, Belfast.

Birmingham.—At the meeting of the Slade Radio Society in the Parochial Hall, Broomfield Road, Erdington, on December 8th at 7.45, W. H. Yeates (G.P.O.) will speak on "Telephone Transmission Systems." Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

Bournemouth.—Meetings of the Bournemouth Radio and Television Society (G3FVU) are held on the first and third Thursdays of each month at 7.30 at the Cricketer's Arms, Windham Road. Sec.: F. G. Hamshere, 99, Elmes Road, Winton, Bournemouth, Hants.

Brighton.—Membership of the Brighton and District Radio Club is now about 80 and meetings are held every Tuesday evening at 7.30 at the "Eagle Inn," Gloucester Road. The club station, G3EVE, is operated on alternate Tuesday evenings on 80 metres (c.w. and 'phone). Sec.: L. Hobden, 17, Hartington Road, Brighton, Sussex.

Chester.—Morse classes are held for an hour prior to the weekly meetings of the Chester and District Amateur Radio Society (G3GIZ) which are held at 7.30 on Tuesdays in the Tarran hut in the Y.M.C.A. grounds. Sec.: R. C. Windsor, 17, Hough Green, Chester.

Coventry.—Fortnightly meetings of the Coventry Amateur Radio Society are held on alternate Mondays at 7.30 at the B.T.H. Social Club, Holyhead Road. On December 4th demonstrations will be given of aids to reception. Sec.: K. G. Lines (G3FOH), 142, Shorncliffe Road, Coventry.

Dorking.—Weekly meetings of the Dorking and District Radio Society (G3CZU) are held at the H.Q., 5, London Road on Tuesdays at 7.30. A lecture on valve technique will be given on December 19th. Sec.: J. Greenwell, G3AEZ, 7, Sondes Place Drive, Dorking.

Gravesend.—Weekly meetings of the Gravesend Amateur Radio Society are held on Wednesdays at 7.30 at the club headquarters, 30, Darnley Road, Gravesend. Sec.: R. E. Appleton, 23, Laurel Avenue, Gravesend.

Malvern.—Meetings of the Malvern and District Radio Society are held on the first Wednesday of each month at 7.45 at the "Foley Arms Hotel." A lecture on "Microphones and Loudspeakers" will be given at the December meeting.

Wakefield.—The Secretary of the Wakefield and District Amateur Radio Society will give members of the club "An Introduction to Frequency Modulation" at the meeting at Service House, Providence Street, at 7.30 on December 13th. Sec.: W. Farrar (G3ESP), "Holmcroft," Durkar, Wakefield.

Walworth.—Meetings of the Walworth (Men's Institute) Radio Club are being held each Wednesday and Friday from 7 to 9 at The Avenue School, John Ruskin Street, London, S.E.5. Sec.: J. Gibbs, 22, Caspian Street, Camberwell, S.E.5.

The Hall Effect

Its Application to the Measurement of the Flux Density of Magnetic Fields

IN Clerk Maxwell's time it was thought that the distribution of current in a network of wires or a fixed solid conductor was unaffected—apart from initial transient induction effects—by the application of a constant external magnetic field. Explanations of the failure of experiments to disclose any movement of the current itself, in spite of the very considerable forces experienced by the conductor, were usually sought in terms of the "incompressible fluid" theories then current. They did not entirely convince E. H. Hall,[1] working in John Hopkins' University, U.S.A., who held that even if the incompressible fluid entirely pervaded the conducting material, a lateral pressure, if not a flow, should be detectable.

His early efforts to detect changes due to a magnetic field in the equipotential points at the sides of metal strips carrying longitudinal current (Fig. 1) were inconclusive until, at the suggestion of Prof. Rowland, he tried extremely thin conductors (gold leaf on glass). These gave positive results and he was able to show that the lateral galvanometer current was, in fact, proportional to the product of the main current strength and the magnetic field. Later the effect was shown to be inversely proportional to the thickness of the material. Thus the lateral change can be expressed $V = RIH/t$. Where R is the "Hall coefficient" of the material, I = longitudinal current in amperes, H = magnetic flux density in gauss and t = thickness of conductor in centimetres.

Theories of Conduction

According to modern theories of conduction in simple metals (e.g., copper and silver), in which the current is due to a drift of electrons from atom to atom under the influence of an external field, the effect is explained if we assume that the electrons travel in straight lines under the electric field, but describe curved paths under the influence of the perpendicular magnetic field. There is a corresponding distortion of the equipotential lines which gives rise to a potential difference at the side contacts. (Fig. 1 (b).)

In other metals and semi-conductors the polarity of the Hall voltage may be of opposite sign, indicating that the current-carrying elements have the equivalent of a positive charge. These elements are not necessarily particles, but may be "holes" in the structure of a crystal lattice which are temporarily unfilled by electrons. When an electron moves into a vacant site, a "hole" is left in an adjacent part of the structure and this vacancy can travel through the material until it reaches the negative point of connection, when it will be filled by an electron. At the other end electrons are extracted, thus keeping up the supply of "holes."

The Hall effect in germanium is very high and the ratio of Hall coefficient to specific resistance, upon which the deflection of any current-indicating meter connected to the lateral terminals will depend, is about 200 times that of copper. G. L. Pearson[2] has shown that it is suitable for the direct measurement of flux densities up to 20,000 gauss, and has described a simple instrument, involving only a $4\frac{1}{2}$-V battery, a

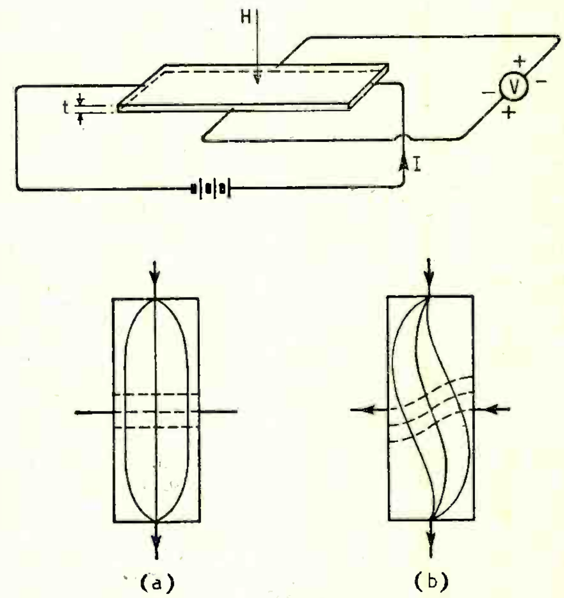
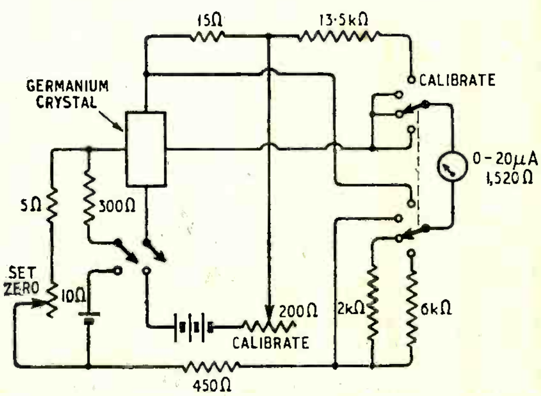


Fig. 1. Illustrating the Hall effect. Current distribution (a) without magnetic field (b) with field perpendicular to the paper. Transverse equipotential lines are shown dotted.

Fig. 2. Typical circuit for measuring field strength by means of the Hall effect in germanium.



[1] *American Journal of Mathematics*, 1879, and *Phil. Mag.*, 1880, Series 5, Vol. 9, p. 225.

[2] *Rev. Sci. Instr.* Vol. 19, No. 4, April, 1948.

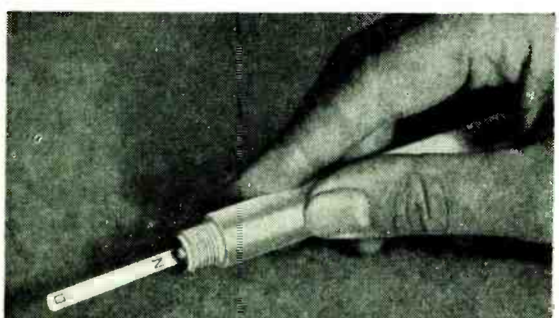
microammeter and resistances, which can be used in conjunction with a thin slip of germanium crystal for measuring, for example, the flux in loudspeaker magnet gaps.

The circuit used by Pearson is given in Fig. 2. Ranges of 5, 10 and 20 kilogauss are provided and the fourth position on the range switch is used to connect the meter across a 15-ohm series resistor to check the main crystal current against a calibration mark. A potentiometer ("set zero") is used to offset any residual lateral current arising from the difficulty of soldering the leads accurately to spots of equal potential.

In Commercial Form

In this country a similar type of instrument has been produced commercially by the British Thomson Houston Company, Rugby, and is known as the Type G gauss meter. A five-way rotary switch gives ranges of 5, 10 and 25 kilogauss and has "Off" and "Calibrate" positions; there are separate calibration and zero-setting controls. The germanium crystal is in the form of a probe and is protected by a non-magnetic sheath having external dimensions of $0.14 \times 0.035 \times 1.25$ inches; longer probes are available. The polarity of the transverse field corresponding to positive meter readings is marked on the probe.

B.T.H. gauss meter, Type G, and (below) close-up of the probe, which is protected by a non-magnetic sheath.



"RADIO LABORATORY HANDBOOK" NEW EDITION

VALUABLE information on all aspects of test and measurement is given in the fifth, revised, edition of this popular book, recently issued from our publishers at 15s. The author, who is well-known as a consulting engineer and as a contributor to *Wireless World*, writes knowledgeably from a long and varied experience of radio. He does so in a way that will appeal to the amateur and to the professional radio man alike, for he is concerned not only with commercial laboratory apparatus but with keeping down expenditure by constructing and improvising one's own equipment. After dealing with the principles of correct measurement, he goes on to describe at length the various types of instruments and how they are used, then makes helpful suggestions on the most suitable apparatus for equipping a laboratory. Considerable space is devoted to particular methods of measurement on components, amplifiers and receivers, and special attention is given to v.h.f. work. There is also a chapter of useful reference information, together with an appendix on the construction of bridges.

This edition has been revised and new material has been added. In particular, the pages on oscillators have been re-written to include the latest developments in RC oscillators, additional information is given on thermistors, valve-voltmeters and cathode-ray oscilloscopes, and the reference section is up to date.

MANUFACTURERS' LITERATURE

Microphones and associated sound equipment described in a set of leaflets from Lustraphone, Ltd., 84, Belsize Lane, London, N.W.3.

Electric Motors of the more popular ratings in an abridged list from Higgs Motors, Ltd., Witton, Birmingham, 6.

Television Aerials and accessories described in an illustrated pamphlet from Validus Aerials, 69, Hornsey Road, London, N.7.

Coilpacks are catalogued and suitable receiver circuits given in a brochure from Osmor Radio Products, Ltd., Bridge View Works, Borough Hill, Croydon, Surrey.

Midget Paper Capacitors, type W99, described in a "Hunt's News" leaflet issued by A. H. Hunt, Ltd., Garratt Lane, London. S.W.18.

Television Components illustrated catalogue, available to manufacturers from the Plessey Company, Ltd. (Components Division), Ilford, Essex.

Communications Receiver, Eddystone "740" general-purpose model described in a leaflet from Stratton & Co., Ltd., Eddystone Works, Alvechurch Road, Birmingham, 31.

"Noise and Vibration in Industry," a booklet dealing with noise-measuring instruments, from A. E. Cawkell, 7, Victory Arcade, The Broadway, Southall, Middlesex.

Sound-level Recorder, high speed, and **pH Meter,** Type 1900, described in leaflets from Dawe Instruments, Ltd., 130, Uxbridge Road, Hanwell, London, W.7.

Schering Bridge specification in a bulletin from Muirhead & Co., Ltd., Beckenham, Kent.

Intercommunication system; the Ediswan Mark II Loudspeakerphone described in a brochure from the Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.

Receivers and Radiograms for 1951; short specifications in a catalogue from Pye, Ltd., Radio Works, Cambridge.

Television Receiver, Model TU142; a descriptive leaflet from E. K. Cole, Ltd., Ekco Works, Southend-on-Sea, Essex.

Sound Heads for magnetic recorders; brief details in a leaflet from Bradmatic, Ltd., Station Road, Aston, Birmingham, 6.

Earth Analyser for detecting earthing faults on electrical apparatus; a leaflet from Runbaken Electrical Products, 71-73A, Oxford Road, Manchester, 1.

Dark-Screen Television

Use of Tinted Implosion Guards

IN a television picture, the "blacks" are actually the colour of the unexcited portions of the phosphors on the face of the cathode-ray tube as they appear in the particular conditions of external lighting which exist at the time of viewing. Consequently, if the external lighting is fairly high, considerable loss of contrast is noted in the picture, because the light reflected from the face of the tube gives a greyish look to the phosphors.

The obvious way of preventing this loss of contrast is to eliminate external light altogether, but this is often impracticable or undesirable. When the picture must be viewed under conditions of high external lighting it is possible to maintain an adequate degree of contrast by using a suitably tinted transparent light-filter in front of the cathode-ray tube to cut down the light reflected from the face of the tube.

Such a neutral-tinted filter in the form of acrylic sheet is now quite often used in television receivers and it fulfils a double function. In addition to improving the contrast of the picture when viewed in a room not completely blacked-out, its strength in the appropriate thickness gives adequate protection to the viewer should the tube collapse.

The increased contrast is due to the fact that external light in the room passes through the filter, strikes the face of the cathode-ray tube and is reflected back through the filter again, whereas the radiations of the tube phosphors pass through the filter once only. This considerably reduces interference by reflected light.

At first sight it would seem that to obtain a picture of comparable brightness when using a filter to that obtained on a set with the ordinary clear guard, the tube brightness would have to be turned up considerably to make up for the light absorbed in the filter. This is true to a certain extent, but in practice the actual colour of the filter is not a true "straight line" neutral and although the overall transmissions of the colours used are on the average about 50-55 per cent, their transmission curves show a considerable increase in transmission in the blue and red ranges. Transmission curves for the three "neutrals" which have been specially developed for this application are given in Fig. 1, and show that the transmission rises in the blue to about 70 per cent and in the red to over 80 per cent. As the visible light from the excited phosphors of the average cathode-ray tube also peaks in the blue and red, the filter transmits about 70 per cent of the phosphor radiations as against only about 50 per cent of daylight or other external lighting.

A further point which must be remembered is that any type of clear guard of glass or plastic transmits at the best only about 90 per cent of the light from the cathode-ray tube falling on it, so that the com-

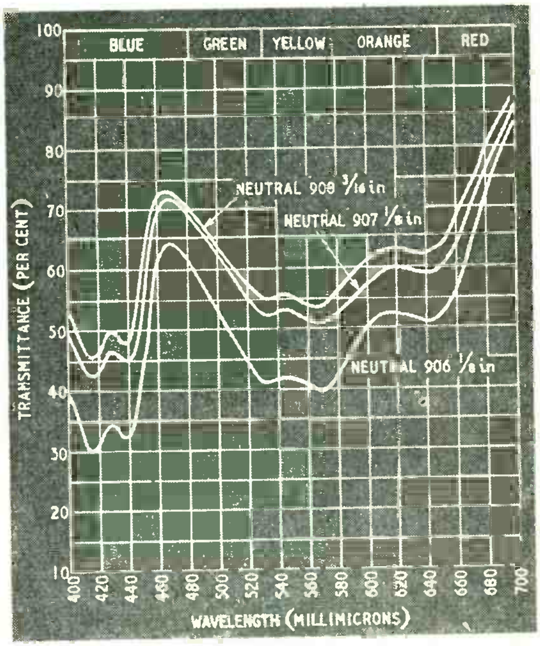
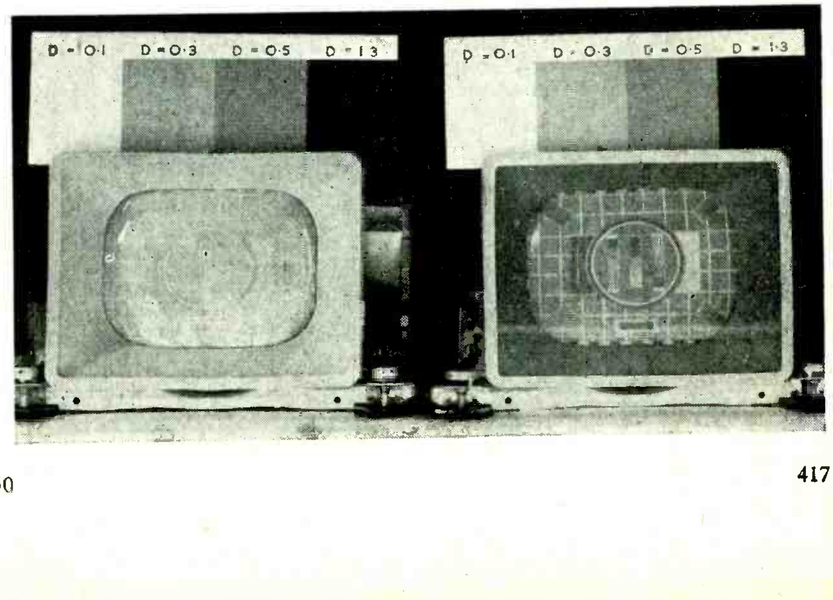


Fig. 1. Light transmission of "Perspex" acrylic sheet television implosion guards. The spectrum colours are indicated approximately against the wave-length scale.

This photograph shows identical sets under conditions of fairly high external illumination. The left-hand set has a clear guard and gives a picture of poor contrast; the right-hand set has a neutral tinted "Perspex" filter and produces a picture of good contrast.



parison of transmission of a tinted to a clear filter is about 70:90 and not 70:100.

A further effect of the coloured filter is that it completely alters the "dead pan" appearance of the cathode-ray tube and mask.

The photograph—taken in the Pye development laboratories, Cambridge—shows two identical sets operating side by side under conditions of fairly high external illumination. The left-hand set, which has an ordinary clear guard, demonstrates a picture of poor contrast. The right-hand set, which has a neutral tinted "Perspex" acrylic filter, manufactured by I.C.I. Plastics Division, England, shows good contrast. Behind the sets are exposure squares ranging in colour from white to black which demonstrate that the photograph shows the effect as nearly as possible as it is observed by the eye. These sets were, of course, individually adjusted to give as good a picture as possible under the existing circumstances.

Radio in Germany

Broadcast Receivers and Sound Reproduction at Dusseldorf

FORMING an opinion of the broadcast receivers on show at the first German post-war radio exhibition, held at Dusseldorf in August, was not made any easier by the scarcity of circuit diagrams, but in spite of this one gained the impression that modern German design techniques are much the same as ours, and no unusual principles are involved. In outward form the sets compare very favourably with models from other countries, and have neat and attractive cabinets without too much emphasis on originality of appearance. At the same time, there is a tendency in some quarters to camouflage receivers as objects of furniture. One superhet, for instance, takes the form of an easy chair, with controls fitted on the arms and a loudspeaker in the back facing outwards. The built-in frame-aerial gives somewhat directional reception, so the chair is provided with wheels to permit easy positioning. Another example is the "Straight Three Bedside Lamp," which has nothing in its outward appearance to reveal that it is a receiver, except that the station names are printed on the shade and a shadow line indicates the station to which the "lamp" is tuned.

Most of the medium-priced German receivers now have an e.h.f. band (86.5 Mc/s to 101 Mc/s approx.) incorporated in the design, and if not, arrangements are made for adding a separate e.h.f. unit by plug-and-socket connection. Some makes also provide for f.m. reception, as there are several f.m. transmitters in use now, in Bavaria and N.W. Germany.

Interest in Tuned Circuits

When judging the merits of a receiver, the German public is interested not only in the number of valves that go with it (usually five or six) but in the number of tuned circuits in the r.f. stages, and this habit of counting tuned circuits (an i.f. transformer counts as two) is reflected in all the sales literature. "Seven tuned circuits" is a sales point, so that a dealer wishing to do business with only three has a difficult time. However, the importance of the properties of the tuned circuits is also appreciated, and quite a few receivers at the exhibition had resonant circuits with adjustable characteristics—variable bandwidth, for instance. With some models, the bandwidth automatically contracts on reception of a weak signal—thereby giving selectivity and an adequate signal-to-noise ratio in exchange for a loss in quality—and then expands again when a strong station is tuned in. Other sets are fitted with a manual bandwidth control, and one manufacturer has combined this with a tone control.

The average price of broadcast receivers in Germany is much the same as in this country, but the lowest prices are well below those charged here. For instance, a straight a.c./d.c. set for reception of local stations can be bought for 65 Deutsch-Marks (just over 5 guineas), whilst the "Straight Three Bedside Lamp" mentioned above costs about the same. These low prices may be partly accounted for by the fact that the number of German manufacturers producing receiving sets has greatly increased since 1939 and competition is more intense.

Unusual Recording System

Among the exhibits of the German Federal Post department, the most up-to-date equipment on show was a telephone amplifier using germanium crystal triodes, or transistors. Compared with the 8 watts of non-utilized power consumed by an equivalent valve amplifier (for heater supplies, standing anode current, etc.) this amplifier required only 0.16 watt—a saving in power or efficiency of 98 per cent.

In the acoustics section, a long-playing gramophone recording system was displayed, giving a smaller average spacing between grooves than is normally possible. With conventional systems of recording, the width of the grooves and the spacing of any two neighbouring grooves is kept large enough to accommodate any sound amplitude—that is, any lateral needle swing—that *may* be necessary in a recording, but in this new system the width and spacing are arranged to be dependent on the amplitudes which actually do occur in the individual grooves and neighbouring grooves. The result of this more economical method of "packing" is that more grooves can be got into the space available, and it is claimed that this gives an average increase in playing time of 100 per cent. Speech recordings would probably allow a greater increase in playing time than would musical performances.

M. L. T.

Manufacturers' Products

New Equipment and Accessories for Radio and Electronics

Miniature Three-Range Coil Pack

A THREE-RANGE coil pack measuring $2\frac{1}{2}$in × $2\frac{3}{4}$in × $1\frac{5}{8}$in and intended for use in small superheterodynes without r.f. stage has been introduced by British Distributing Co., 66, High Street, London, N.8. When tuned by 0.0005-mfd capacitors the three ranges available are: 16 to 50m, 190 to 550m and 1,000 to 2,000m respectively.

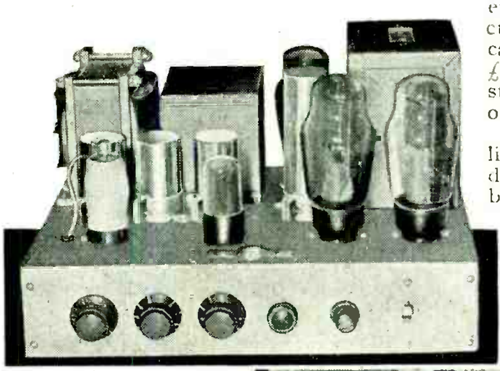
The six coils have dust-iron cores. The pack is inductance-trimmed in the factory, and the only adjustments needed after its assembly in a receiver will be to the six trimmer capacitors accessibly mounted on top of the unit. With the single hole fixing and simple wiring, assembly takes only a few minutes. It is designed for an i.f. of 465kc/s. The Bridisco sub-miniature coil pack is priced at 30s 6d.

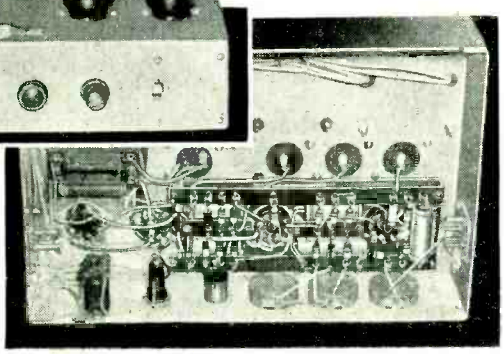
Quality Amplifiers

A RANGE of quality amplifiers costing approximately £1 per watt has been introduced by the Broadcast and Acoustic Equipment Company, Tombland, Norwich. Resistance-capacity coupling is employed with a paraphase-coupled push-pull output stage.

In the 12-watt amplifier, 6V6 or 6L6 valves are used in the output stage and a 120 mV input is required for full output. Feedback is applied over three loops, and the response is flat within $2\frac{1}{2}$ db between 20 c/s and 15 kc/s. Variable bass and treble boost is included with maximum lifts of 20 db. The price is £12 10s, or £8 10s without power pack.

The 15-watt model has 6L6 or 807 output valves and the overall sensitivity is higher, being suitable for use with a microphone or photo cell. The frequency range is 40 c/s to 20 kc/s within 1.8 db. Bass and treble tone controls are included and the price is £15 10s or £10 10s without power pack.





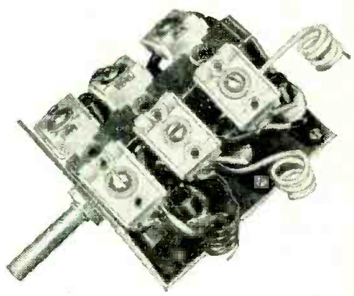
12-watt gramophone amplifier (Broadcast and Acoustic Equipment). The underside shows a simplified sub-assembly for coupling components.

Breeze Plug and Socket for heavy-duty applications has two 100-amp pins and one 19-amp pilot pin, in a brass housing that is waterproof when screwed together. All three socket inserts and the two 100-amp pins can be removed for soldering. The makers are The Plessey Company, Ltd., of Ilford, Essex.

High-Voltage Adaptor, Model 341, has been introduced by Taylor Electrical Instruments Ltd., 419-424 Montrose Avenue, Slough, Bucks, to extend the voltage range of their Model 170A Electric Testmeter up to 10kV.

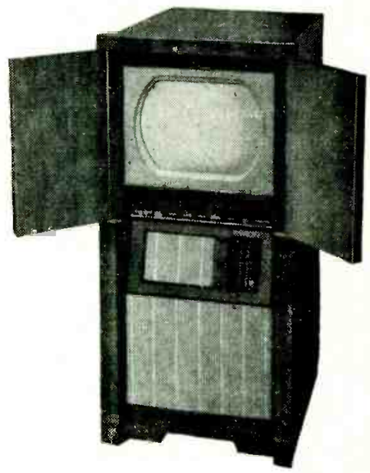
Television Receivers. Suitable for viewing in normal room lighting is the 600A table model projection television receiver produced by Philips Electrical, Ltd., of Century House, Shaftesbury Avenue, W.C.2. It has a flat screen measuring $13\frac{3}{4}$in × $10\frac{1}{4}$in with lenticular rulings on the black face to give a wide horizontal angle of view, and is fitted with safety devices to prevent damage to the projection tube should either of the deflecting circuits fail. In a walnut cabinet, the set costs £91 9s 8d with a tablestand or £88 14s 6d without.

Ferranti, Ltd., of Hollinwood, Lancs, have introduced a new range of sets by adding to their console receiver T1205 two more 12-in models, the T1405 table model, and the T1505 combined radio and television receiver. There will be two versions of each model available, and Ferranti will incorporate converter units, free of charge, in all Sutton Coldfield models which may have to be converted as a result of the forthcoming opening of the Holme Moss transmitter.



Bridisco sub-miniature coil pack.

Ferranti Model T1505 combined radio and television receiver, with self-contained radio aerials.



Two-speed Gram Motor. Coinciding with the recent offer to the public of long-playing records, Small Electric Motors, Ltd., Eagle Works, Churchfields Road, Beckenham, Kent, have produced a two-speed gramophone motor operating at 78 and $33\frac{1}{3}$ r.p.m. The complete motor assembly, which is of the rim drive type, is compact and suitable for mounting direct on to a metal or wooden baseboard. Although at the moment the standard unit is for use only on 50-c/s a.c. mains, a 60-c/s unit can be offered for the export market.

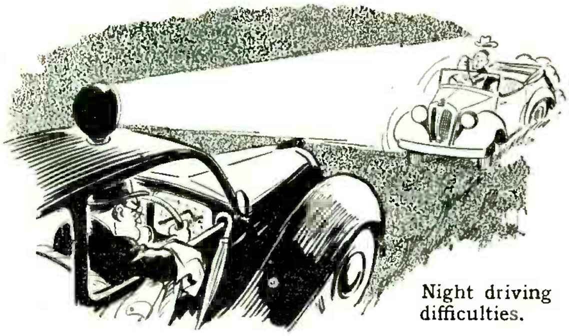
UNBIASED | By FREE GRID

Radio and Road Hogs

RECENTLY I was telling you about a small radio transmitter installed in my car which, without infringing the law, enables me, a mile or so from home, to flood the house with light, warmth, music and the smell of sizzling kippers.

A reader who signs himself "Autophile," which, on the face of it, sounds like another name for Narcissus but probably means a car lover, has written to tell me that there is a far more necessary use for a short-range e.h.f. car transmitter than pandering to the soul-destroying sybaritism in which I indulge. He is apparently troubled by the number of inexperienced drivers and experienced road hogs who hurtle along dark country roads at night with dazzling headlamps which they haven't, respectively, the savvy or the courtesy to dip when passing other road users; in fact, according to him, night driving has become a regular battle of headlights. I cannot confirm or deny his words from my own experience as I am at the present time far too engrossed in trying to navigate my car solely by its radar screen and accordingly I leave lighting and all such matters to Mrs. Free Grid, but possibly my correspondent's information explains the presence of the ex-A.A. searchlight that I notice has recently been mounted on the car roof.

Briefly, my correspondent's idea is that headlamps should all be made illegal and the latest type of overhead lighting installed on all roads throughout the land, the capital cost being met partly by the money saved by not manufacturing headlamps and partly by one of the Chancellor of the Exchequer's once-for-all levies. Running costs, represented chiefly by the huge current consumption, could be virtually wiped out by using radio since the lights on any particular furlong of road would not come on until a radio beam from an approaching car was picked up by a simple fixed-frequency receiver which would operate the necessary switch by a relay.



Night driving difficulties.

Time Gentlemen, Please

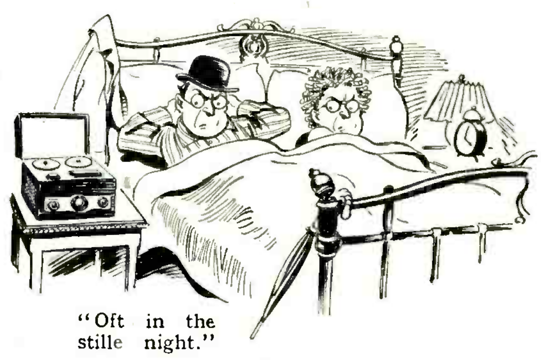
NATIONALIZATION of coal is a burning topic, but, being politically controversial, is naturally barred, together with discussions of other nationalization matters, from the pages of *Wireless World*. I do think, however, that the Editor may make an exception when I call attention to the shameless manner in which the Government's own servants are deliberately sabotaging its most cherished monopolies. I refer to Time, which has had the offices of its control board at Greenwich since vesting day. Wireless, and in particular the B.B.C., has made us all conscious of the boon and blessing of this particular piece of nationalization.

Yet one need only go into any nationalized railway refreshment room to see B.P.T. (British Pub Time) still rigidly observed and the Government's wishes flouted by its own lackeys who fling thirsty electors out on to the cold hard platform five minutes before the legally appointed time. This five-minutes-fast rule must irritate teetotallers also, for after gulping down Government tea and the very aptly named rock cakes, they rush out on to the platform only to find to their chagrin that they have plenty of time to get sedately into the third-class accommodation for which they have paid instead of flinging open the door of a moving first-class compartment and collapsing breathlessly into its cushioned comfort.

Home-bottled Programmes

I AM glad to see that more and more home recorders are coming on to the market, especially those of the self-contained type using a magnetic wire or tape from which the programme can be easily and quickly wiped out when desired. I have for a long time used a home-made one of this type and I make a regular habit of recording certain B.B.C. programmes just for the pleasure of wiping them out without listening to them.

However, as I have said on a previous occasion, the real function of these instruments, in my opinion, is to record programmes which we cannot otherwise hear. Next year during the Festival of Britain when, as we have all been bidden, we are devoting all our energies to enlightening the overseas visitors on "this realm, this England," we shall have still less time to listen. We shall, in fact, have to bottle not only the B.B.C.'s day-time programmes but the evening ones as well for consumption in what we shall with literal truth be able, with apologies to Thomas Hood, to call "The Stille Night."



"Oft in the stille night."

It is possible, of course, to bottle any programme at will by means of an ordinary receiver, a time switch and a recording unit. We can, in fact, select and bottle all our listening for a week ahead for consumption at our leisure. I am able, by this means, to keep a car full of guests cheerful and free from the vice of backseat driving when rolling home in the small hours long after the B.B.C. has closed down.

I have little doubt that by doing this I am not only infringing copyrights galore but also transgressing against the rights of innumerable recording companies; I trust they will all send along the necessary writs to the Editor who will accept service on my behalf. I can only think that it is this question of copyright and recording rights that prevents manufacturers putting forward an all-in-one receiver-cum-automatic recording unit. Can some of you legal luminaries enlighten me?

LETTERS TO THE EDITOR

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

Resistor Colour-coding

IS it not time that the manufacturers of colour-coded resistors made up their minds as to the meanings of the colours? There is great confusion between Black for Nought and Brown for One—I have before me two resistors with orange body and tip, and brown spot; on a bridge they are 33 ohms and 330 ohms respectively! Green Black Black is shown on the bridge to be 50 ohms—how would 5 ohms be marked, then? Among a batch of 50,000-ohm resistors, the honours are about even between Black and Brown for the tip colour. Surely, if Black means Nought, when it appears as body or tip it must mean *Not Even a Nought* (a simple explantation becomes a little Irish, but you must see what I mean).

Worse is to come—with certain high-stability resistors a fourth stripe appears for the tolerance and bears its correct colour (in place of the familiar gold and silver of the humdrum resistor). Some resistors have a black moulded body; here is one with brown tip and yellow spot; it measures 100,000 ohms, using the body colour for the initial ONE. But here is one with black body and two red stripes; it measures 2,200 ohms, showing that this time the black body forms either the intermediate or final colour, according to taste; finally, a brown moulded body with three stripes, Red Red Brown; this measures 220 ohms, showing that the body colour is now disregarded—you have my sympathy if you thought that this was a 1,200-ohm 1 per cent resistor.

No wonder one manufacturer takes no chances and places round his colour-coded product a label bearing the value in clearly printed figures! PETER D. DAW.
London, S.E.1.

Stereophonic Broadcasting

IN your issue of September, 1950, I read an article about improved stereophony in which E. Aisberg started his article with the following words:

"The first broadcast of stereophony, the system in which sources of sound are restored to their relative positions in space, took place in France on June 19th, 1950."

Although I understand the feeling of stating something new, in this case there is a *deus ex machina* in Holland.

On June 15th, 1946, there was a stereophonic transmission with a specially constructed artificial head, equipped with two condenser microphones, that broadcasted a concert given by the Dutch Radio-Philharmonic Orchestra.

Also the manifold publications of our industry—Philips, Eindhoven, about stereophony (Dr. K. de Boer), were not mentioned at all in this publication.

J. J. GELUK,
Netherlands Broadcasting Union.
Hilversum, Holland.

THE article by E. Aisberg in your September number was of considerable interest to me, having had experience of an opposite problem during the earlier stages of the late war with acoustic locational apparatus for aircraft.

In his seventh paragraph he mentions the differential intensity of sound being responsible for the binaural effect. Although the intensity effect exists over short periods with human ears, it was always my experience that it was the phase differential aspect which predominated in any locational exercise or practice. To be equipped with tubes and receiving horns extending the aural sound base from 6in to 8ft and to centre these upon a stationary sound source produced a remarkable effect in that the nodal point of no phase difference travelled recognisably round the back of the cranium. This, of course, operated in one plane only for one "listener."

For perfection we will need a wall in which are positioned 5 loudspeakers (the middle one to take up slack) and two listeners, one sitting normally to recognize what is going on in the horizontal plane, and one prone to follow the vertical movements of those who climb staircases or rise upon piano wire, or to hear, for example, the gravitational descent of "Les Larmes du Diable."

M. F. L. FALKNER.
Holmes Chapel, Cheshire.

YOUR contributor's account (September issue, page 327) of the recent French broadcast over two channels does not, to my way of thinking, make a clear enough distinction between true binaural stereophony (in which two microphones mounted in an artificial head are used at the source, and headphones are used at the receiving end) and other systems which simulate directional effects.

Neither is it true to say that the appreciation of acoustic *depth* is essentially a product of binaural hearing. Distance between sound source and microphone in a studio is readily judged in a single-channel system by the ratio of direct to reverberant sound. The inclusion of a reverberation chamber in the system described suggests that the designers are well aware of these facts, and, together with two-channel control of volume, they have placed at the disposal of producers a versatile medium of expression. I believe that Bernhart and Garrett describe their work as "directed" stereophony, which seems a happy phrase. HENRY MORGAN.

Hindhead.

WITH reference to the article in the September *Wireless World*, I note that there is no reference to the effect of phase displacement in the location of a source of sound.

I had understood that whereas amplitude formed the chief discriminating factor in the case of the high notes, phase discrimination was important in the lower register where amplitude differences are less marked.

(This is physiologically possible since at low frequency the nerve impulses are synchronous with the sound waves. Note that this does not involve phase discrimination between waves of different frequency.)

If this is so Fig. 1 (a and b at least) will preserve the original phase relations intact, provided the channels are balanced, but Fig. 2 ought to introduce a certain amount of distortion unless the faders can be made to introduce the correct phase displacement, a problem of no small magnitude in an electrical circuit.

H. R. A. TOWNSEND.

South Cerney, Glos.

Hint to Manufacturers

WHEN buying a television set its position in the home should be in a room different from that in which a wireless set is kept. This is obviously desirable when only one wireless set is available, as a member of a family may well wish to hear a particular sound programme during television transmitting hours. It is also desirable in these days of flats and small rooms which quickly tend to become overcrowded. At the same time sound broadcasting is sometimes required in the room used for television. The answer, of course, is an extension speaker, but this not only adds to the overcrowding, but is an additional expense. In the television set, however, there is a loudspeaker which is idle for a large part of the day. May it be suggested to television manufacturers that a simple switching apparatus be incorporated in television sets (other than combined sound models, of course) so that the speaker may be used as an extension speaker from a wireless set. The speaker could be wired for use when the television set is installed. D. R. BRAY.

London, N.22.

Raising E.H.T. Voltage

I FEEL the greatly improved brightness and focus of modern receivers is due to using voltages of 6 to 10 kV whereas it was quite common in older types of receiver to use from 3 to 4 kV.

The obvious method of changing the e.h.t. transformer for one of higher voltage might be considered too costly in an old receiver. The only alternative is to use line flyback e.h.t. but it will usually be found that the line output transformer is unsuitable for this purpose and with a simple half-wave system would only provide about 2 to 3 kV. But if this voltage could be added to the existing system the e.h.t. could then be 6 to 7 kV or more. Unfortunately, however, the straightforward connection of a rectifier and condenser would not work as the cathode of the rectifier would be at a higher positive potential than the flyback pulse feeding the anode. The best way of adding the voltages is as shown in my diagram. This circuit might seem a bit puzzling until it is realized that the extra components $V_2C_2C_3R$ are really the top half components of the usual voltage doubler system sometimes used in flyback e.h.t. systems.

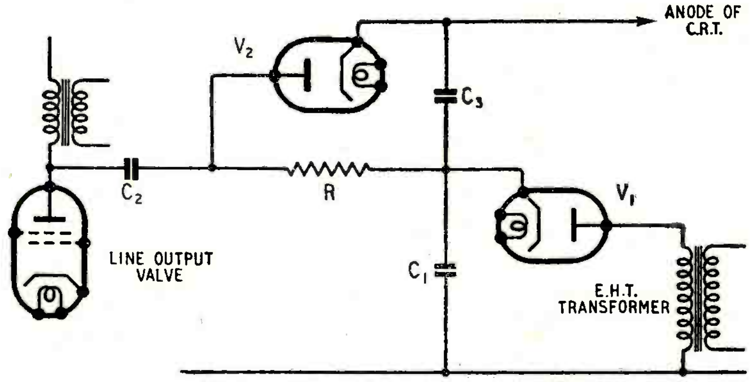
During the forward scan C_2 will be charged up through R to the same potential as C_1. When the flyback pulse comes along these two voltages will be added and will be applied to the anode of V_2, thereby charging C_3 and C_1 to the combined voltage. So therefore with the simple addition of two condensers, a resistor, and a rectifier, almost double the e.h.t. voltage could be obtained. This would naturally mean that increased scanning power would be required and whether this is within the capability of the set is another matter, although I have found this just possible in most cases.

It would be rather more difficult using the voltage doubler system with the existing mains transformer as one side is usually earthed and must remain so. In any case, much larger capacitors would be required whereas with the above method C_2 and C_3 need only be 0.0003 μF; R is 2 MΩ.

It would be better to use a metal rectifier for V_2 and no heater voltage would then be required.

L. J. HILLS.

Belvedere, Kent.



American Insularity

HAVING read with interest the correspondence on the above subject in your journal, I felt it would be interesting to analyse the footnotes and references in a typical American publication. This I have done for the excellent collection of articles entitled "Electronics Manual for Radio Engineers" (Zeluff and Markus; Pub. McGraw-Hill). This book contains 872 pages of text, covering 289 "all-time-great articles" from *Electronics* 1940-48.

The total numbers of separate references are as follows: American, 466; British, 38; others (mainly German), 14; (A few references are of doubtful origin and may have been added to the wrong list). Of the 38 British references, 6 are to O. S. Puckle's "Time Bases," 5 to *Wireless World* and 3 to *Electronic Engineering*, leaving a paltry 24 to represent the remainder of British brains.

A further analysis shows that of 77 pages of microwaves (did we do any radar work in this country?) there are 3 British references, and of 75 pages on television, only 1! In an article on the "Phantastron," although it is admitted that the circuit originated at T.R.E., there are no British references and 3 American references.

It is important to realize that these figures are not taken from one isolated case, but represent the attitude of 270 different authors to the efforts of workers outside their own country.

Although I have not made a similar count in any British publications, a quick check through 3 copies of *Wireless World* and 3 of *Electronic Engineering* shows that more than 50 per cent of references are to American literature.

A. T. COLBECK.
Talgarth, Brecon.

Names and Titles

As an "old timer" in the world of wireless I have been giving some thought to nomenclature and titles.

The first refers to v.h.f. radiotelephony between private vehicles, tugs and the like, offices, etc., with, at present, the unwieldy designation of "Business Radio." It is extraordinary how difficult it is to arrive at a suitable name covering this application of the art. Of course there is R/T, but this encroaches upon service terminology and in any case is still not a word. RADIOPHONY appears to cover it, but it would be interesting to have opinions of your many readers.

My second search has been for a suitable title covering the 1951 Radio Exhibition, observing it cannot be held at Olympia. RADIOSHOW is what it is, but RADIOBRITAIN seems to cover the special occasion. Again, what do your readers think?

H. ANTHONY HANKEY.
London, W.4.

"Television In Your Home," a new booklet written for the layman by W. E. Miller in clear non-technical language, provides all the information a viewer needs to know before and after purchasing a receiver. The confirmed televiewer also will find here answers to some of the questions which may have cropped up during his viewing experience. After describing the television service and sketching the basic principles of television, the booklet gives useful advice on the choice, installation and correct operation of a receiver, and ends with a comprehensive list of questions and answers. Copies can be obtained from all bookstalls, price 2s, or direct from our Publishers, price 2s 2d.

RANDOM RADIATIONS

By "DIALLIST"

Big Tube or Projection?

INTERESTING TO NOTICE that television receivers seem to be developing along quite different lines in this country and in the United States. Viewers in both countries want big images: here the tendency is to provide them by projection methods; on the other side of the Pond they are all in favour of the monster c.r.t. I don't know of any model amongst this year's British receivers with a tube bigger than 15 inches, nor are there many such; but in America there are quite a few with 19-inch tubes and for all I know some may use even larger ones. One reason, I suppose, for our different approaches to the problem of the big image is that America, with an output that runs into quasi-astronomical figures, can turn out c.r.t.s a good deal more cheaply than we can. We, on the other hand, seem to have advanced rather further in the technique of making reasonably long-lived, small, super-brilliant projection-type tubes.

Direct Comparison

Not all comparisons are odious, despite the old saying. I recently had the opportunity of making one that can't have been possible to any vast number of people, and, far from being odious, it was surprisingly interesting and instructive. Briefly, I watched the simultaneous display of a whole television programme by projection and big-tube methods. The images were of the same size—about 16 by 12 inches—and the two screens were side by side. The big tube was provided with optional spot-wobble; that is, the "spot-wobbulator" could be switched on or off at will. The first thing to strike one was that, even at short range, no lininess was apparent in the projected image, though it was very much in evidence in that on the large tube when the spot-wobble was not applied. The reason, presumably, is that in small high-voltage tubes one cannot obtain a focus that is relatively as sharp as that of a high quality tube of large diameter. In other words, the spot on the small tube has sufficient spread to cover up the effects of lininess. One might expect this to lead to a rather poorly-defined image; but I cannot honestly say that it had this effect. My general impression was that though the projected image might be a little lacking in depth when directly compared with the other, it was distinctly more pleasing (and less tiring) to the eyes than an unwobbled image on the big c.r.t.

Passing Thought

It must be no mean job to design and manufacture very large cathode-ray tubes. It wouldn't be so bad if the business end could have a pronounced convex curve, for this would have a much better chance of standing up to the strains resulting from a vacuum within and an outside atmospheric pressure of getting on for 15 lb to the square inch, but the end of the television c.r.t. must be as nearly flat as possible. Take a 20-inch tube to make calculations nice and easy, and you have a surface area for the screen of 314 square inches. That multiplied by 14.5 gives a total air pressure on the screen of 4,553 lb, or a little over 2 tons—the combined weight of 32 average men and women.

Nomenclature

SOMEHOW, I am not attracted by F. B. Rudd's suggestion in the September *Wireless World* that what we now know as the intermediate frequency should be styled henceforward the resultant frequency. For one thing, you could not abbreviate it to r.f., for that is already in use for radio frequency. Our frequency designations are a pretty bad muddle, anyhow. The main reason is that so many of the terms are used sometimes with a relative and sometimes with an absolute meaning. What, for instance, is a high frequency or a low frequency? Glance through disquisitions by various writers on the amplification problems in different parts of the receiving set and you will see what I am driving at. Myself, I would like to see a standardization on the following lines. Let the three main classes of frequency met with in a receiver be named respectively signal, intermediate and audio frequencies—s.f., i.f., and a.f.; divide each of these into three degrees: upper, middle and lower. All the three class terms are relative, for s.f.s may be anything from a few kilocycles to thousands of megacycles, i.f.s have a smaller but similar possible range and a.f.s run from frequencies below the limits of human hearing to those a long way above those limits, but, as applied to the receiving set they are perfectly clear.

Still They Come

THERE CAN BE no doubt that television has caught on as a national hobby. By the time that this is printed the number of licences will probably have passed the half-million mark, which means that, despite raw material shortages and production difficulties, a very considerable proportion of the homes in which reception is possible will have television sets. Between them the London and Birmingham service areas have a population of some 18 millions. Allowing an average of four persons to each household gives a figure of 4.5 million homes in the areas. For one reason or another television reception is probably impossible in at least half-a-million of these. Hence, just about one home in every eight in which reception is possible now has the necessary equipment. What will the saturation figure be? Higher costs—initial, maintenance, running and replacement—will naturally make it much lower than the figure for sound broadcast receivers, which are now part of almost every home. For television I predict it will turn out to be somewhere between one home in four and one home in five.

Terminals

THE TERMINAL (*Americè*: binding post) as we know it to-day and have known it for umpteen years is definitely not a satisfactory electrical device. There are only two main types. In one of these a nut clamps the wire or wires to a non-moving base. In the other the base is again fixed, but the clamping is done by the point of a screw. The trouble in either case is that the moving part of the clamping system rotates and in so doing grinds, bruises and even cuts the wires. We're all only too familiar with defects due to the eventual breaking of wires—particularly flex—at the point of compression in the terminal. What is urgently wanted is a terminal in which a straight push, without any twisting action, is exercised on the wires.

THE *New* AVO

VALVE TESTING MANUAL

FOR USE WITH THE "AVO" VALVE TESTER & THE "AVO" VALVE CHARACTERISTIC METER

The most comprehensive work of its kind available. It is the outcome of months of research and intricate preparation and has been produced in response to a definite demand by Service Engineers for a **quick-reference data book** to facilitate the rapid checking of the multitudinous variety of valves in use to-day.

It contains tabulated data covering more than 3,000 different valves in current use—British, American and Continental — and approximately 1,200 Service and Civilian equivalents.

All owners of the " Avo " Valve Characteristic Meter who have returned the Registration Form supplied with the instrument will receive a copy of this publication free of charge. Future purchasers of the " Avo " Valve Characteristic Meter will receive their copy automatically. As, however, it also contains data and information for use with the original " Avo " Valve Tester and a comprehensive treatise on the technique of valve testing, it has been decided to make the book generally available at 15/- post free.

FREE INFORMATION SERVICE:

An important feature is the FREE INFORMATION SERVICE, to the end of June, 1952, whereby supplementary data, to cover new valves as they are introduced, will be mailed from time to time. These supplementary items will be issued on perforated adhesive sheets so that they can be easily detached and inserted in the book in their correct alphabetical and numerical positions.

CORRECTION

In our advertisement in the September issue of "Wireless World", it was stated in error that the new "Avo" Valve Data Manual is being supplied free with the "Avo" Electronic Testmeter. The Book in question is, in fact, supplied free only with the "Avo" Valve Characteristic Meter.

USE THE COUPON BELOW (OR WRITE IF YOU PREFER) ENCLOSING P.O. OR CHEQUE FOR 15/-

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.

WINDER HOUSE · DOUGLAS STREET
LONDON · S.W.1

Telephone: VICtoria 3404-9

To:—The Automatic Coil Winder & Electrical Equipment Co., Ltd.
Dept. W.20, Winder House, Douglas Street, London, S.W.1.

Please send me a copy of the "Avo" Valve Testing Manual, for which I enclose P.O./Cheque 15/-

Name ....

Address ....

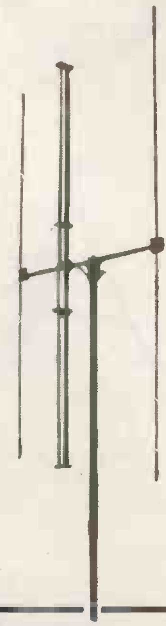
....

VM.1

the finest aerials are made by

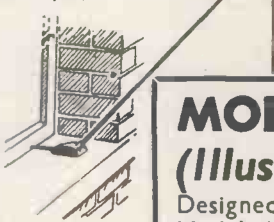
AERIALITE

The demand for "AERIALITE" Television Aerials increases daily—WHY? Simply because Aerialite are alive to the exacting requirements of an aerial under all conditions. Here are a few of the models from our wide range, all proved sellers.



MODEL 67 *(Illustrated)*

This model is another recent addition to the Aerialite range of TV aerials. It is easily adjustable to all channels and gives excellent results. It can be fixed to window-sills or adjacent brickwork and is fully proofed against climatic conditions. **27/6.**



MODEL 55

This is the well-proved and popular Aerialite "H" array. It is robustly constructed, corrosion proofed inside and out and is supplied with a 10ft. x 2in. alloy mast which will withstand 100 m.p.h. gales. Model 55, **125/-.**

Model 55X Aerial only, **65/-.**

MODEL 63 *(Illustrated)*

Designed for fringe areas the Model 63 has broad bandwidth, high gain and directivity. The array comprises a folded dipole, director and reflector robustly constructed and corrosion proofed. Fully tested to withstand the strongest gales.

Supplied complete for **£10.**

MODEL 65 & 66 *(Indoor)*

Two new indoor models for skirting board of window fitting. The 65 has one telescopic and flexible section, whilst the 66 has two flexible sections. Each complete with five yards of coaxial* cable for receiver connection. The range of both these easily fitted aerials can exceed 20 miles. Model 65, **28/6.** Model 66, **16/6.**

* Models 65A and 66A. As above but supplied with balanced twin feeder. (Cat. 387).

MODEL 53 *(Indoor)*

This aerial is intended for erecting in lofts and can be mounted in a variety of positions. It gives excellent results and requires only the connection of the cable for immediate operation. Price **25/-.**

THE AERIAL DE-LUXE FOR THE FRINGE AREAS

Don't Miss Seeing the NEW MODEL 64

(Patent applied for)

This aerial is a development of our Model 63 and has an exceptionally high forward gain. It is specially designed for fringe areas where signal strength is exceptionally low. The aerial is highly directional with a very sharp pattern.

Price with 10 ft. Heavy duty Dual Mast: **£13/10/-.**

SEND FOR CATALOGUE

Showing our full range of Television, Radio and Car Aerials, as well as our aerial accessories, including coaxial cables, plugs, sockets, etc.

AERIALITE LTD. · STALYBRIDGE · CHESHIRE

We recommend this tube

because

It has a specially flat face.

It gives a bright, pleasantly coloured image.

Ferranti reliability ensures long life.

It gives freedom from ion burns.

The price is reasonable.

FERRANTI

FERRANTI CATHODE RAY TUBES

There's a keen demand for this Ferranti T12/44 12" Television Tube, so place your order NOW!

FERRANTI LTD MOSTON MANCHESTER 10; & 36 KINGSWAY LONDON WC2

Presenting

A TRADITION OF EXCELLENCE — FIDELITY — EFFICIENCY

NEW GOODMANS

HIGH FIDELITY — 12" P.M.

TWIN CONE AXIOM 150

£8.8s LIST

This 12in. high fidelity unit has a twin-curvilinear diaphragm (Patent No. 451754). A carefully designed magnet assembly using anisotropic material provides a total flux of 158,000 maxwells on a 1¾in. pole. The back centring device is a dustproof bakelised linen disc with concentric corrugations.

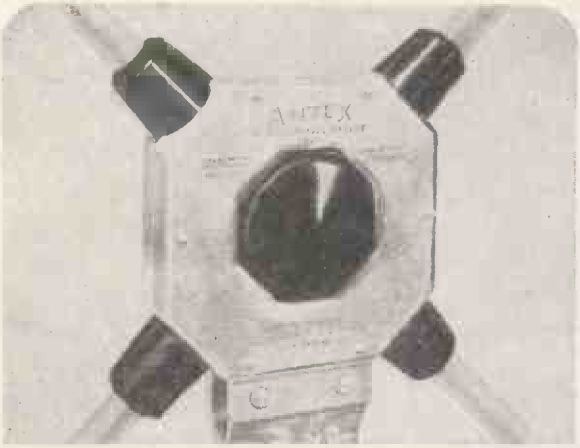
The combination of these features gives this precision built instrument an outstandingly wide coverage from 40 to 15,000 c.p.s. free from bass modulation effects.

An ideal high fidelity reproducer for the record enthusiast and the connoisseur of wide range musical reproduction, it gives exceptionally fine transient and frequency response.

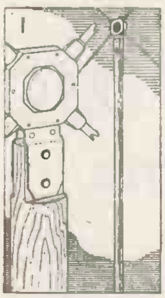
For use with this model we recommend Goodmans High Fidelity Heavy Duty Output Transformer Type H.4. Nett Weight . . . 5 lbs.—2,265 grammes.

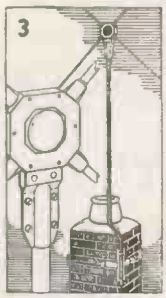
Frequency Coverage	40/15,000 c.p.s.
Overall Diameter	12 15/16in. (31.3 cms.)
Overall Depth	6 15/16in. (17.6 cms.)
Fundamental Resonance	55 c.p.s.
Voice Coil Diameter	1¾in. (4.4 cms.)
Voice Coil Impedance	15 ohms at 400 c.p.s
Maximum Power Capacity	15 Watts Peak A.C.
Flux Density	14,000 gauss
Nett Weight	12 lbs. 13 oz. (5,810 grammes)
Finish	Grey Rivelling Ename

A Bass Reflex Cabinet measuring approximately 30" × 23" × 16" and a corner cabinet have been specially designed for this loudspeaker and working drawings are available.

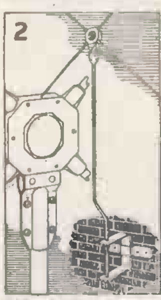


STILL BETTER
T.V. RECEPTION

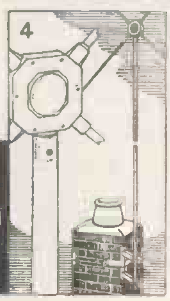




WHEN the new "Antex" was introduced it set a new and higher standard in T.V. Aerial performance. Now the NEW "Antex" comes to provide even better television reception. Its greatly improved construction ensures long service free of trouble.



The NEW "ANTEX"



● **HIGH GAIN.** Approximately double that of a standard dipole. ● **LESS INTERFERENCE.** Front/back ratio is 22 db. Back pick-up below horizontal is eliminated. ● **WIDE RANGE.** For use wherever an 'H' array would be employed. Highly efficient in fringe areas when mounted at adequate height. ● **EASY TO INSTAL.** Rods are fitted after all connections are made. Connections accessible without removing rods. (Pat. No. 630795.) ● **RIGIDITY WITH LIGHT WEIGHT.** Weighs approx. 2 lb. No picture flutter in high gales.

FOUR MODELS to meet every mounting requirement.

POLE MOUNTING	5 FT. MAST MOUNTING		10 FT. MAST MOUNTING
for fitting to wooden or metal masts.	with mast and wall mounting bracket.	with mast and chimney lashing bracket.	complete with 1¼" Aluminium alloy mast and chimney lashing equipment.
Model X2P/✻	**Model X2W/✻**	**Model X2L/✻**	**Model X2M/✻**
£2. 5. 0.	£3. 3. 0.	£3. 15. 0.	£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.

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

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

ANTIFERENCE LIMITED · 67 BRYANSTON STREET · LONDON W.1

Chosen by the Connoisseur

"BAKERS" High Fidelity Loud Speakers are now in constant demand by Acoustical Laboratories, Gramophone Societies, and the true Music Lovers throughout the World. No finer speaker exists today, for over twenty-five years' experience of speaker design renders each model the finest value that money can buy.

12" and 18" "TRIPLE CONE" and "DUPLEX" Models.

Write for Descriptive Leaflet giving full technical details (or better still call for an audition) of :— "BAKERS" SPEAKERS, RECEIVERS AND AMPLIFIERS, ETC. A combination offering the highest possible quality radiogram unit.

BAKERS 'Selhurst' RADIO

Pioneers of Moving Coil Speakers Since 1925

Dingwall Road, Croydon Telephone: CROydon 2271

★ VERY LOW FREQUENCIES
★ HIGH STABILITY
★ WIDE RANGE
★ PURE WAVEFORM
★ PUSH-PULL OUTPUT
★ FREQUENCY INCREMENT SWITCH
★ CONSTANT OUTPUT VOLTAGE
★ OUTPUT ATTENUATOR
★ COMPACT AND PORTABLE
★ STANDARD RACK MOUNTING

THIS is a much-needed oscillator designed specifically for testing, calibration and set-up of biological amplifiers and recorders, strain and vibration recorders, and low frequency wave analysers.

It has a resistance/capacity circuit of special design with automatic amplitude control to ensure constant output and good waveform at frequencies from 1.1 to 5,000 c.p.s. The circuit is remarkably free from trouble associated with change of valve characteristics, ensuring that accuracy is dependent only upon the frequency selective network components.

An incremental frequency switch is included specifically for the measurement of 'Q' in frequency selective circuits of filters or wave analysers.

Further details will be given on request.

EDISWAN

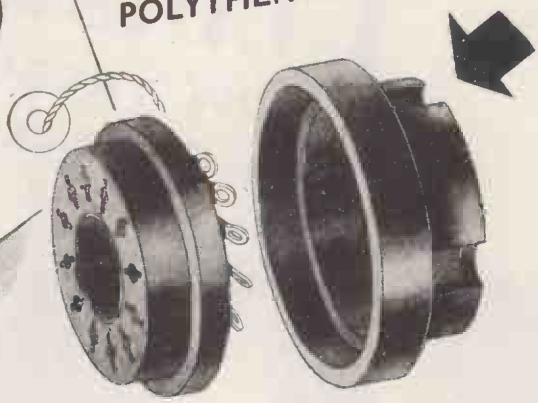
THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2

RA.116

Recognised as the Most Reliable Valveholders

McMURDO Moulded Valveholders

POLYTHENE PUSH-ON COVER



B12A—Duodecal

FOR CATHODE RAY TUBES

Ref. No. **B.12/U.1**—moulded in **Phenol-Formaldehyde**

" " **B.12/U**— " " " " " **with Polythene Cover**

THE McMURDO INSTRUMENT COMPANY LTD., VICTORIA WORKS, ASHTEAD, SURREY · ASHTEAD 3401

ALONG THE WAY...OF TWA

You Can Ship Almost Anything Anywhere by TWA AIR CARGO

ELECTRICAL EQUIPMENT, including radio and television parts, is more and more commonly being shipped, these days, via TWA. Damage to fragile components is minimal because handling is miminised, and because the loading *has* to be skilled. The lighter packing requirement saves time, labour, material and cost on all such cargo.

TWA—The Modern Way to Ship

Big, 4-engined, all-cargo TWA ships depart every week from important industrial centres . . . assure prompt deliveries from these and connecting cities to any point in U.S.A. Low rates. Fast service. Whenever you have a shipping problem . . . ask TWA for help. Get rates, schedules, shipping details today.

See your shipping Agent, or call TWA

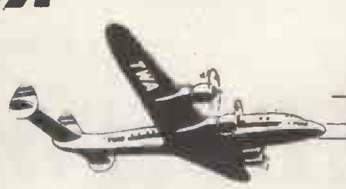
When you Ship via TWA

YOU SAVE MONEY—crating costs, insurance costs, warehouse costs.

YOU SAVE TIME—days, weeks, even months. You get goods to markets safely, at low cost.

YOU SAVE WORK—simplify your shipping problems. Make one call . . . get one air waybill, one invoice. Save filing, paper work, worry

YOU INCREASE SALES—shipments arrive fast . . . ahead of competition . . . in time to benefit from peak buying seasons.



TWA

TRANS WORLD AIRLINES

U.S.A · EUROPE · AFRICA . ASIA

All TWA flights carry Air Cargo and Air Mail

200 PICCADILLY, LONDON, W.1. Tel.: Regent 3211

Estd. **L·R·S** 1925

FOR PROMPT and EFFICIENT SERVICE

CASH or EASY TERMS

ARMSTRONG ALL-WAVE CHASSIS

(including speaker and output transformer)

MODEL EXP 83/3. Cash £18/17/1 or £4/10/- with order and 8 monthly instalments of 40/-.

MODEL EXP 125/2. Cash £47/16/- or £11 with order and 10 monthly instalments of 80/-.

GOODSELL - WILLIAMSON AMPLIFIER and TUNER UNITS

LEAK AMPLIFIER & PRE-AMPLIFIER UNITS

WHARFEDALE LOUDSPEAKERS

MODEL W 12/CS. Cash £8 or 40/- with order and six monthly instalments of 22/-.

MODEL W 15/CS. Cash £12/10/- or 60/- with order and 7 monthly instalments of 30/-.

MODEL SUPER EIGHT CS/AL. Cash £4/5/- or 35/- with order and 3 monthly instalments of 20/-.

"W.B." 12 in. CONCENTRIC DUPLEX SPEAKER

with transformer and crossover net work. Cash £15/15/- or £4/16/- with order and eight monthly instalments of 30/-.

GOODMANS LOUDSPEAKERS

AXIOM 150. Cash £8/8/- or 40/- with order and 7 monthly instalments of 20/-.

AUDIOM 60. Cash £6/15/- or 25/- with order and 6 monthly instalments of 20/-.

BARKER and HARTLEY-TURNER SPEAKERS

For Motorists

The ATLAS H.5 BATTERY CHARGER

Output 5 amps at 6 or 12 volts. A substantially made charger complete with meter. Cash £7/15/- or 50/- with order and 6 monthly instalments of 20/-.

The REMINGTON-RAND ELECTRIC SHAVER

really does give a better, quicker and more pleasant shave than the blade and soap method.

We are so convinced you will agree that we shall be pleased to send either model on **TEN DAYS' FREE TRIAL**, on receipt of deposit.

The "Foursome" (for average beards). Cash price £7/16/5 or 30/- with order and 7 monthly instalments of 20/-.

The "Five" (for stubborn beards). Cash price £8/17/7 or 50/- with order and 7 monthly instalments of 20/-.

Both models are despatched in beautiful silk-lined case per registered post.

Brochure FREE by return from the Electric Shaver Specialists.

All Goods despatched carriage paid.
Descriptive literature available on request. Kindly enclose stamp.

The L. R. SUPPLY CO., LTD

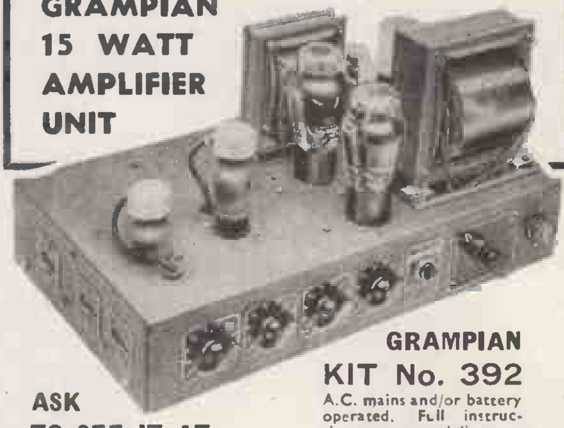
(LONDON RADIO SUPPLY CO.),

BALCOMBE, SUSSEX

CAN YOU READ A CIRCUIT DIAGRAM?

—if you can, and if you are reasonably competent in radio assembly work, ***you'll find it easy to build this***

GRAMPIAN 15 WATT AMPLIFIER UNIT



GRAMPIAN

KIT No. 392

A.C. mains and/or battery operated. Full instructions, photos and diagrams 2/6. Complete kit of parts and chassis £24.7.6 (less valves).

ASK TO SEE IT AT YOUR DEALERS

For name of nearest stockist, write to

GRAMPIAN REPRODUCERS LTD

9 Hanworth Trading Estate, Feltham, Middlesex.

Telephone : FELtham 2657/8. *Telegrams : "REAMP," Feltham*

18248

Wharfedale

OUTPUT TRANSFORMERS

The new W.15 output transformer is illustrated below. The inductance is 70 H. with a leakage inductance of only 0.1 H., thus ensuring satisfactory results in wide response circuits with negative feedback. Maximum input 20 watts.

LIST PRICES

O.P.3	3 ratios	6/6
P. Type	4 ratios with C.T.	7/2
G.P.8	8 ratios „ „	11/6
Universal	6 ratios „ „	13/6
De Luxe	6 ratios „ „	22/6
W.12	3 ratios „ „	21/0
W.12	Any ratio to order	25/0
W.15	Any ratio to order	60/0

W.15.

WHARFEDALE WIRELESS WORKS

BRADFORD ROAD, IDLE, BRADFORD

Telephone : Idle 461
Telegrams : Wharfdel, Idle, Bradford

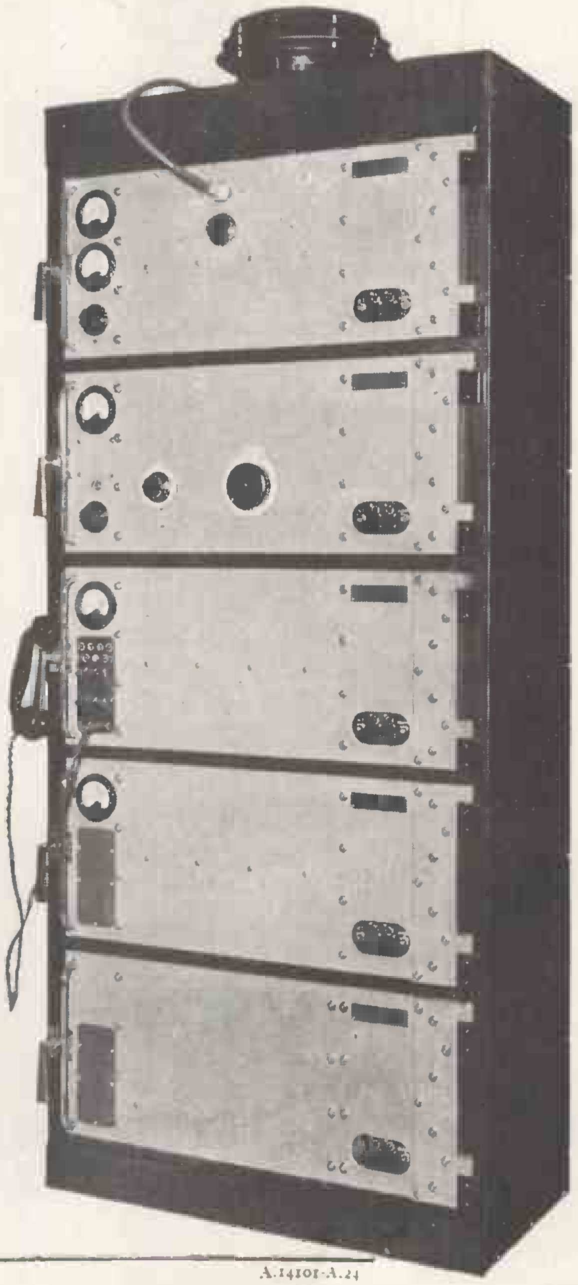
Important development

IN THE DESIGN OF

MULTICHANNEL V.H.F. RADIO TELEPHONE LINKS

The V.H.F. Multi-channel Radio Telephone type VMS which has been designed by Automatic Telephone and Electric Co., Ltd., provides radio links for the transmission of international 12-channel carrier groups. It will handle simultaneously three such groups giving a total of 36 channels.

The equipment can be supplied to cover radio frequencies in the bands, 40-60 Mc/s., 60-90 Mc/s, and 156-200 Mc/s. Under normal conditions ranges of 30-40 miles can be attained between stations and links, up to several hundred miles in length, can be provided by the use of specially designed relay stations.



AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

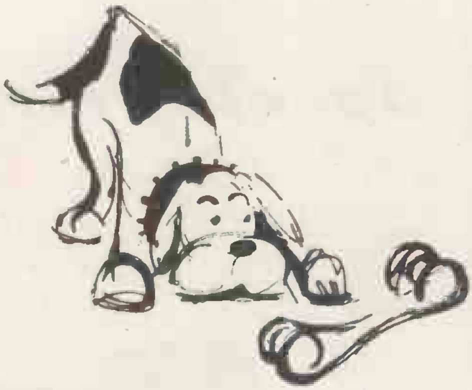
(RADIO & TRANSMISSION DIVISION)

Strowger House, Arundel Street, London, W.C.2.

Telephone: TEMple Bar 9262 Telegrams: Strowgerex, London

STROWGER WORKS, LIVERPOOL, 7.

A.14101-A.24



One dog - One bone

One man - one job

One plant - one purpose

One factory - one plant

Technicians with a background of 25 years' experience, working with single-purpose plant in a factory designed for one object produce nothing but the high standard of transformers that bear the name ...

PARMEKO

PARMEKO *of* LEICESTER

Makers of Transformers for the Electronic and Electrical Industries

A new invention rationalising the detection of intermittent faults

FRANKIE—the Accoustic Fault-Trap

(Patents granted and pending.)

220 V. A.C. — PRICE £19 . 0 . 0

Main Functions: Silent as long as radio is working faultlessly. Gives special alarm-tone regardless of how fast and short-lived the occurring fault is. Fault-Sensitivity variable from ± 0.1 db. to ± 3 db.

Indispensable to the modern Service-Engineer.

Sole agents wanted where not already represented.

FRANCK NIELSEN RADIO

Prinsensgade 46, AALBORG, Denmark

Technical news from France!

FRANCE is playing an increasingly important part in the manufacture of high-quality radio and electrical products for world markets. The latest advances in this field are shown in the new publication *L'Exportation Électricité-Radio*—the only export review of its kind. If *you* are seeking news of these developments, information on the current prices of French radio and electrical equipment, or even a new British Sales or Agency representation, write now for a free copy of this important journal (printed in English, French and Spanish).

Published Quarterly. Annual subscription 10/-

L'EXPORTATION ELECTRICITE - RADIO

E.T.P., 81 rue de la POMPE, PARIS 16e, FRANCE

FIGHTING THE CRIME WAVE... with G.E.C.

QUARTZ CRYSTAL UNITS

The Police "999" emergency call system depends for its successful operation on instantaneous radio communication between Police headquarters and the fleet of patrol cars. Radio equipment in the patrol cars is used under the most arduous conditions but it must be available for instant use 24 hours in the day.

No wonder then that more and more Police authorities throughout the country are using G.E.C. quartz crystals in their radio equipment.

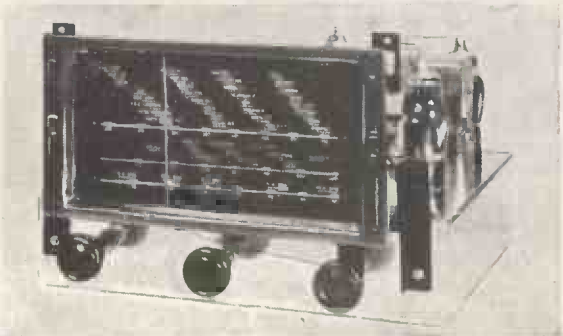
Pioneering research and experience in making over a million units, ensure a product of the highest quality. For all your quartz crystal requirements be sure to specify G.E.C.

Quick delivery service for urgent requirements for experimental or replacement purposes.

Write for our leaflet QC.4904.

SALFORD ELECTRICAL INSTRUMENTS LIMITED
PEEL WORKS · SILK STREET · SALFORD · 3 · LANCS.

A SUBSIDIARY OF THE GENERAL ELECTRIC CO. LTD. OF ENGLAND



17665

To the electrical and radio service engineer . . .

An oscilloscope in miniature . . .

The criterion of usefulness of a cathode-ray tube as an oscilloscope is the ratio of the screen diameter to the diameter of the spot but there is a practical limit to the extent to which the screen diameter can be reduced, even though the spot size is reduced in proportion. One outstanding feature of this oscilloscope is the comparatively large screen for an instrument of such small dimensions. Although the overall dimensions of the case are $11\frac{1}{2}$ in. × $5\frac{3}{4}$ in. × $4\frac{1}{4}$ in., the tube has a $2\frac{3}{4}$ in. screen.

The Miniature Cathode-ray Oscilloscope Type 244

METROPOLITAN-VICKERS ELECTRICAL CO. LTD.

MANCHESTER 17, ENGLAND

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

R/E 901

METROVICK *Pioneers in Radio and Electronic equipment*

LONG PLAYING RECORDS ON STANDARD RADIOGRAMS OR RECORD PLAYERS

THE CHANCERY LONG PLAYING RECORD ATTACHMENT G33 (patents pending) is precision engineered to convert existing equipment (78 r.p.m.) to 33⅓ r.p.m. This is effected by an epicyclic transmission and reduction mechanism, ensuring a constant speed of 33⅓ r.p.m. necessary for true reproduction of long playing records. Elimination of "wow" and waver has been achieved to a remarkable extent.

The G.33 has been designed for simplicity of conversion, having merely to be placed on the existing turntable, and no special fixing is required.

The special Decca Crystal Microgroove Pick-up embodies a sapphire stylus and a lightweight balanced arm, and gives an extremely wide frequency response.

Chancery INSTRUMENT

Price complete
£4 17s. 6d.
(including Purchase Tax)

Price *less* Pick-up
£2 18s. 0d.
(including Purchase Tax)

This instrument is as supplied to the Decca Record Co. Ltd.

CHANCERY PRECISION INSTRUMENT SERVICE LTD.
Sales Department: 64, GEORGE STREET, BAKER STREET, LONDON, W.1

BALDWIN

VISUAL NULL INDICATOR

for A.C. Bridges

Range 40 c/s to 20 kc/s.

The Sensitivity which is adjustable from zero is higher than that of headphones. It is very robust and will withstand considerable overloads — no acoustic shock. Operates on A.C. mains.

BALDWIN INSTRUMENT CO. LTD.
DARTFORD, KENT *Dartford 2989 & 2980*

"POLASPEX"
(Reg. Brit. Pat. Off. 674076)

BLACK SCREEN TELEVISION

Latest scientific development as featured at National Radio Exhibition.

★ **BLACK SCREEN** means real daylight viewing

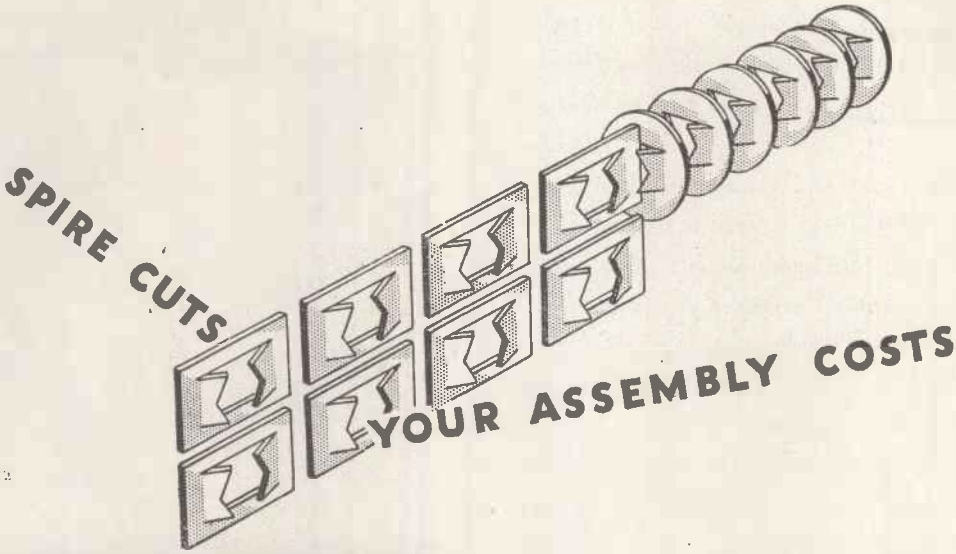
★ **BLACK SCREEN** improves contrast and tones of picture

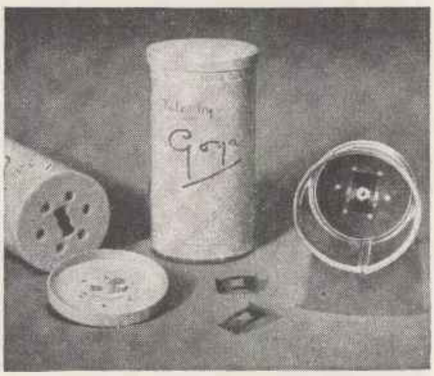
★ **BLACK SCREEN** means no eye strain

★ **BLACK SCREEN** gives a clear black and white picture

YOU, TOO, can have a black screen on your existing receiver. 9 in. tube size 18/-, 12 in. tube size 21/-. Obtainable from your television dealer or direct from manufacturers and patentees:

MAURICE CHESHIRE & COMPANY,
29, SOHO HILL, BIRMINGHAM
NORthern 5128





PROBLEM:

Secure top of talc container so that it can be rotated under spring tension for alignment of sifter holes.

SOLUTION:

Type SFW Spire fix inside container is pressed over integrally moulded stud. Top rotates under spring tension and is permanently secured.

THAT'S FIXED THAT – FASTER, CHEAPER

It just shows how Spire, in one simple operation, can solve what threatens to be an assembly headache. Very few awkward locations or blind assemblies present much of a problem to Spire these days. And once a Spire is on it stays put— the unique double-spring action sees to that. We'd like to know if you think Spire, the fastest thing in fastenings, can help you—will you write to us ?

Spire *Regd.* **SPEED NUTS**

Enquiries to: –

SIMMONDS AEROCESSORIES LTD. BYRON HOUSE, 7-8-9 ST. JAMES'S ST., LONDON, S.W.1

HEAD OFFICE AND WORKS: TREFOREST, GLAMORGAN

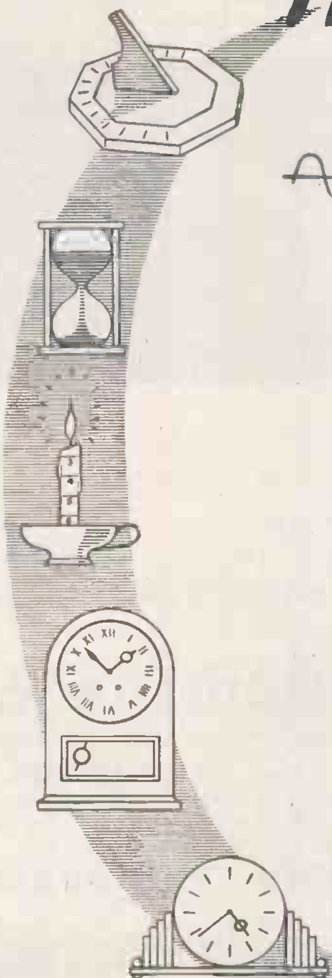
Also BIRMINGHAM · STOCKHOLM · MELBOURNE

17S

CINTEL

TIME CHANGES...

accurately measured



The 'CINTEL' Microsecond Counter Chronometer

Will measure very short time intervals in the range 1 Microsecond to 1 Second with an accuracy of ± 0·005%, ± 1 μ S and 10 Microseconds to 10 seconds with an accuracy of ± 0·005%, ± 10 μ S.

The instrument has many other applications apart from Time measurement including Random Counting, Frequency Measurement, Frequency Division, etc.

For further particulars please write for Leaflet No. MCC1/1.

CINEMA-TELEVISION LIMITED

A Company within the J. Arthur Rank Organisation

FOREMOST IN THE MANUFACTURE OF

• Counters & Chronometers • Metal Detectors • Oscilloscopes • Photo-Electric Cells • Cathode Ray Tubes • Geiger-Muller Tubes • Electronic Instruments

WORSLEY BRIDGE ROAD · LONDON · S·E·26

Telephone: HIther Green 4600

Northern Agents:
F. C. ROBINSON & PARTNERS LTD.
287 Deansgate, Manchester 3

Scottish Agents:
ATKINS, ROBERTSON & WHITEFORD LTD
100 Torrisdale Street, Glasgow, S.2

CINTEL

REGISTERED TRADE MARK

The FIRST HIGH FIDELITY AMPLIFIER with REMOTE CONTROL UNIT

SELLING BELOW £15

Where larger outputs are essential, ask for details of the Felicity 10 Watt MAJOR POWER AMPLIFIER

Also Radio Feeder Units:
Model SH6 3-waveband superhet
£12 10 0d plus £2 15 7d tax
Model PB5 4-station preset push-button TRF
£8 15 0d plus £1 18 6d tax

Start catering NOW for high fidelity with this new amplifier. Incorporates all the essentials for first-class reproduction.

- Wide frequency range, 40-15,000 cps. with adequate variable bass lift and treble cut
- Hum-free at full output
- Harmonic distortion below 1%
- Attractive finish and layout
- £14 17 6d complete
- Immediate delivery

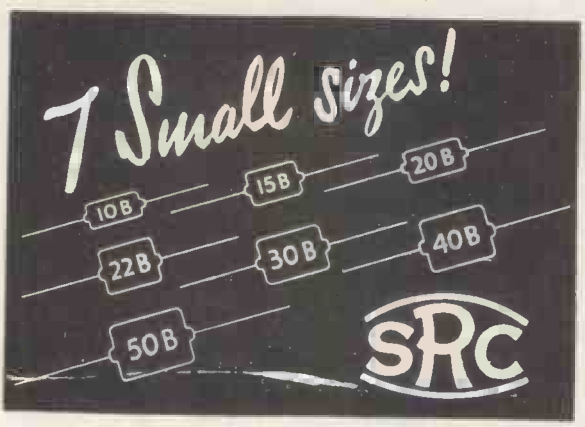
Microphone stage can be supplied as extra at £3 15 0d list

Felicity AMPLIFIERS

Further details and literature from:

FELICITY AMPLIFIERS, 26a, Wadham Road, Putney, London, S.W.15.

Strand



Our Silvered Mica Capacitors are made in all values between 3 pF and 7000 pF. Our aim is to supply these Capacitors with the smallest possible dimensions, and we have a range of 7 sizes which allows us to offer for almost any capacitance a "made-to-measure" type.

STABILITY RADIO COMPONENTS LTD

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

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

A new MINIATURE Voltage Reference Tube

Designers of compact industrial equipments will welcome this new Mullard Miniature Voltage Reference Tube. Built on the small B7G base, it is characterised by high stability and robust construction. It should prove of great value where an extremely accurate and reliable performance, coupled with a maximum saving of space, is required. The larger version of this tube known as the 85A1 built on a B8G loctal base is also freely available.

Working in a constant current circuit, these tubes provide a voltage source of extremely high constancy, and in the majority of applications may be used to replace a standard cell as a built-in source of voltage reference. They may likewise be used as a reference against which to compare or fix the level of almost any physical quantity which is convertible into an e.m.f. Their use in this manner in position control systems, temperature control devices, etc., will thus be apparent.

VALVE DATA

Nominal Operating Voltage	85V
Max. Starting Voltage	125V
Current Range	1-8mA
Operating Current	4·5mA
Internal Resistance at 4·5mA	290 ohms

Mullard

THERMIONIC VALVES AND ELECTRON TUBES

INDUSTRIAL POWER VALVES · THYRATRONS · INDUSTRIAL RECTIFIERS · PHOTOCELLS FLASH TUBES · ACCELEROMETERS · CATHODE RAY TUBES · STABILISERS AND REFERENCE LEVEL TUBES · COLD CATHODE TUBES · ELECTROMETERS, ETC.

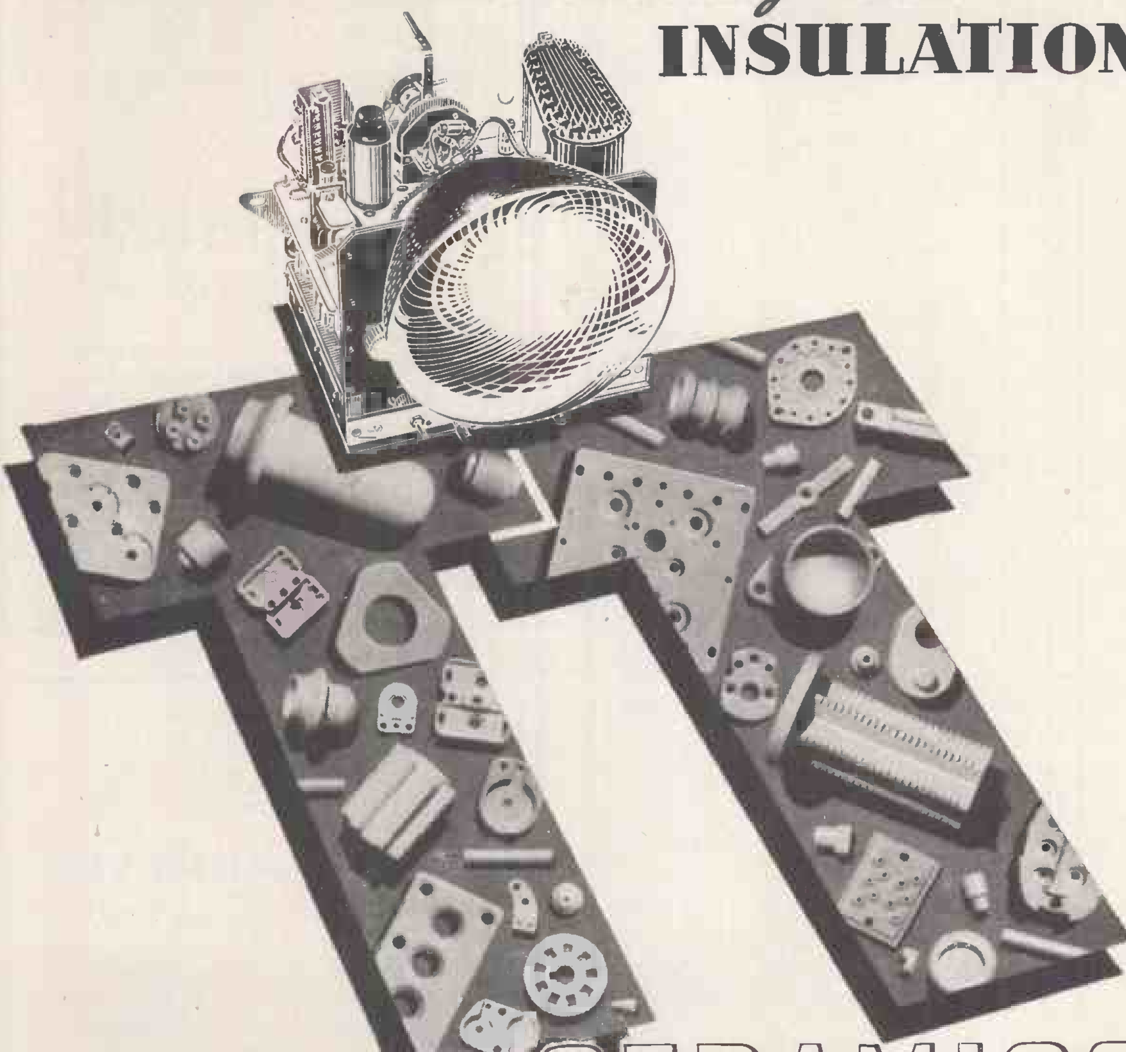
MULLARD ELECTRONIC PRODUCTS LTD., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

MVT84REV

T.V.

like all sound Broadcasting needs **T.T.**

INSULATION



CERAMICS

FOR ALL TELECOMMUNICATIONS RADAR
& TELEVISION TRANSMITTING & RECEIVING
EQUIPMENT

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

SOUND & VISION KIT

21 Valves. Suitable for 9in., 10in. and 12in. Magnetic Tubes. Less Tube, tube holder and Mask. Chassis all stamped out. State whether for Sutton Coldfield or Alexandra Park. Complete with booklet, instructions, etc. £21 12s. 6d. carr. paid.

Pre-Amplifier for Birmingham. High gain, low noise, with built-in power pack, tunable for peak sound and vision. Completely screened. £6 19s. 6d.

MAINS TRANSFORMERS, FULLY INTERLEAVED, SCREENED AND IMPREGNATED. ALL GUARANTEED. ALL PRIMARIES ARE 200/250 v. Half Shrouded.

HSM63. (Midget) Output 250/0/250v. 60 m/a. 6·3v. at 3 amps. 5v. at 2 amps.	15/-
HS63. Output 250/0/250v. 60 m/a. 6·3v. at 3 amps. 5v. at 2 amps.	15/6
HS40. Windings as above. 4v. at 4 amps. 4v. at 2 amps.	15/6
Output	
HS2. 250/0/250v. 80 m/a.	17/6
HS30. 300/0/300v. 80 m/a.	17/6
HS3. 350/0/350v. 80 m/a.	17/6
HS2X. 250/0/250v. 100 m/a.	19/6
HS75. 275/0/275v. 100 m/a.	19/6
HS30X. 300/0/300v. 100 m/a.	19/6
HS3X. 350/0/350v. 100 m/a.	19/6

Fully Shrouded

Output	
FSM63. (Midget) Output 250/0/250v. 60 m/a. 6·3v. at 3 amps. 5v. at 2 amps.	15/6
FS2. 250/0/250v. 80 m/a.	19/6
FS30. 300/0/300v. 80 m/a.	19/6
FS3. 350/0/350v. 80 m/a.	19/6
FS2X. 250/0/250v. 100 m/a.	21/6
FS75. 275/0/275v. 100 m/a.	21/6
FS30X. 300/0/300v. 100 m/a.	21/6
FS3X. 350/0/350v. 100 m/a.	21/6
All the above have 6·3-4-0v. at 4 amps., 5-4-0v. at 2 amps.	
FS43. Output, 425/0/425v. 200 m/a. 6·3v. 4 amps. C.T. 6·3v. 4 amps. C.T. 5v. 3 amps. Fully shrouded	42/6
FS50. Output, 450/0/450v. 250 m/a. 6·3v. 2 amps. C.T., 6·3v 4 amps. C.T. 5v. 3 amps. Fully shrouded	62/6
F30X. Output, 300/0/300v. 80 m/a. 6·3v. 7 amps. 5v. 2 amps. Framed, Flying leads	26/6
F35X. Output, 350/0/350v. 250 m/a. 6·3v. 6 amps. 4v. 8 amps., 4v. 3 amps., 0-2-6·3v. 2 amps. Fully shrouded	59/6
FS160X. Output 350/0/350v. 160 m/a., 6·3v. 6 amps, 6·3v. 3 amps., 5v. 3 amps. Fully shrouded	37/6
FS43X. Output, 425/0/425v. 250 m/a. 6·3v. 6 amps. 6·3v. 6 amps. 5v. 3 amps. Fully shrouded	57/6
HS6. Output, 250/0/250v. 100 m/a. 6·3v. 6 amps. C.T. 5v. 3 amps. For receiver R1355. Half shrouded	24/6
HS150. Output, 350/0/350v. 150 m/a. 6·3v. 3 amps. C.T. 5v. 3 amps. Half shrouded	25/9
F36. Output, 250/0/250v. 100 m/a. 6·3v. 6 amps. C.T. 5v. 3 amps. Half shrouded	25/9
FS120. Output, 350/0/350v. 120 m/a. 6·3v. 2 amps. C.T. 6·3v. 2 amps. C.T. 5v. 3 amp. Fully shrouded	27/6
PRI/1. Output 230v. at 30 m/a., 6·3v. at 1·5/2 amps.	19/6
The above have inputs of 200/250v.	

FILAMENT TRANSFORMERS

F4. Output, 4v. 2 amps.	7/6
F6. Output, 6·3v. 2 amps.	7/6
F6X. Output, 6·3v. 3 amps.	5/-
F12X. Output 12v. at 1 amp.	7/9
F12. Output, 12·6v. tapped 6·3v. at 3 amps.	15/6
F24. Output, 24v. tapped 12 v. at 3 amps.	21/6
F12 and F24 framed with Flying Leads.	
FU6. Output, 0-2-4-5-6·3v. at 2 amps.	9/-
F29. Output, 0-2-4-5-6·3v. at 4 amps.	15/-
FU6 and F29 clamped with Flying Leads.	
F5. Output, 6·3v at 10 amps. or 5v. at 10 amps. or 12·6v. at 5 amps. or 10v. at 5 amps.	31/6
F6/4. Output, four at 6·3v. tapped at 5v. at 5 amps. per winding, giving by suitable series and parallel connections 24v. at 5 amp. 20v. at 5 amp., 18v. at 5 amp., 15v. at 5 amp., 12·6v. at 10 amp., 10v. at 10 amp., 6·3v. at 20 amp., 5v. at 20 amp.	47/6
F5 and F6/4 framed with Flying Leads.	

OUTPUT TRANSFORMERS

MOP1. Ratios 26, 46, 56, 66, 90, 120-1 50 m/a. max. current. C.T. for Q.P.P. Class B, etc. Secondary 2/4 ohms. Top panel and clamped ... each	5/-
OP1. Midget Power Pentode, ratios 30, 60, 90-1, 40 m/a., Secondary 2/3 ohms. ... each	3/2
OP2. Midget Pentode, ratios 45-1, Secondary 2/3 ohms. 40 m/a. per doz.	33/-
OP10. 10/15 watts output. 20 ratios on Full and Half primary	16/3
OP30. 30 watts output, 20 ratios on Full and Half primary	23/9
Williamson's O.P. Transformer to Author's specification	£3/12/6
Chokes for Williamson's Amplifier. 30H at 20 m/a., 15/6 ; 10H at 150 m/a.	29/6
Choke C.4. 60 m/a., approx. 8 H., 350 ohms	4/3
Choke C5. 40 m/a., approx. 5 H., 360 ohms	3/3
Choke C6. 50 m/a., 50 H., 1,500 ohms	18/6
Choke C6. 50 m/a., 50 H., 1,500 ohms	18/6
Belling Lee Co-Axial Plugs. Type 642/F ... each	1/3
Belling Lee Co-Axial Sockets. Type 604/S ... each	1/3

B.I. Condensers, all new. 8 mfd. carton type, 3/2 ea. ; 8×8 mfd., carton type, 4/9 ea. ; 8×8 mfd., can type, 5/- ea. ; clips for same 5d. each

C.W.O. (add 1/- in £ for carriage), all orders over £2 carriage paid. Trade enquiries invited.

H. ASHWORTH (Dept. W.W.)
676 GT. HORTON ROAD, BRADFORD, YORKS

VALVES!! VALVES!!

RECEIVING, TRANSMITTING, MAGNETRONS, KLYSTRONS, CATHODE-RAY TUBES, PHOTO-CELLS, ETC.

LARGE QUANTITIES & GREAT VARIETIES

IMMEDIATE DELIVERIES FROM STOCK

WRITE OR PHONE :—

S. Szymanski

(pronounced SHE-MAN-SKEE)

ELECTRONIC ENGINEER & STOCKIST

95 STRODES CRESCENT
STAINES - MIDDLESEX

TELEPHONE : STAINES 3971

PROBABLY THE LARGEST ACTUAL STOCKIST IN ENGLAND

WHOLESALE & EXPORT ONLY

DURALUMIN

REGD. TRADE MARK

FOR T-V AERIALS

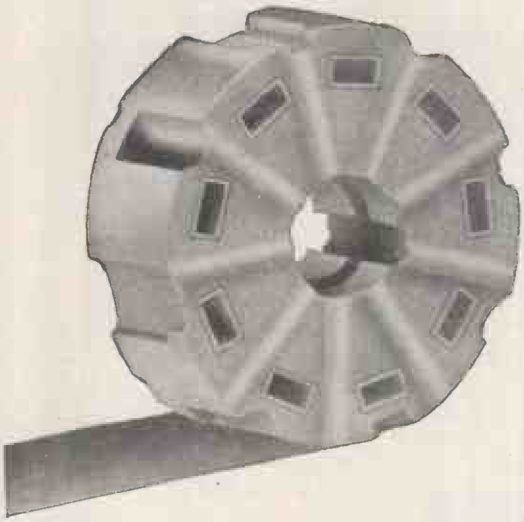
DURALUMIN, the aluminium alloy which combines great strength with lightness, is ideally suitable for television aerials. It is of good appearance, withstands wind and weather, will not rust and is non-magnetic. Moreover, DURALUMIN is easily workable without the aid of special tools.

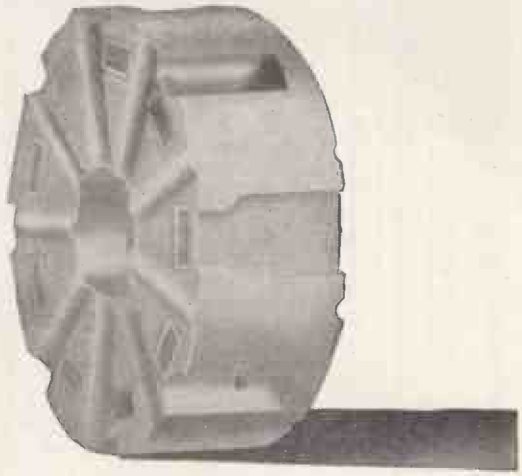
Our range of non-ferrous metals covers every requirement in the wireless field, whether it be aluminium alloys, brass or copper, and is available in a variety of forms including extruded rods and sections, tubes, sheet, strip and wire.

BOOTH

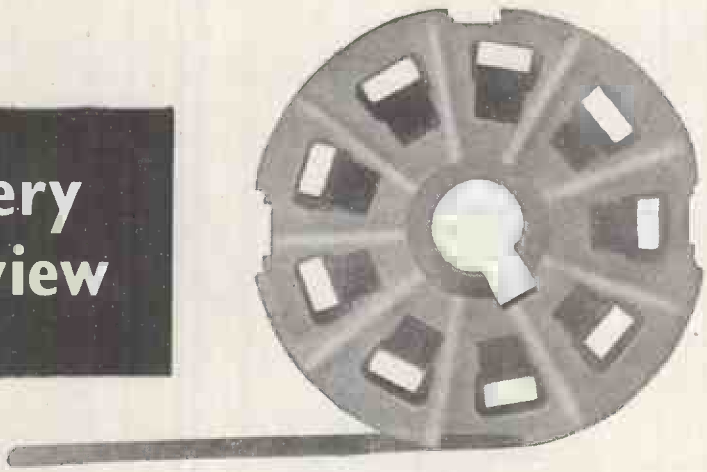
JAMES BOOTH & COMPANY LIMITED
ARGYLE STREET WORKS · BIRMINGHAM 7

W.1





from every point of view

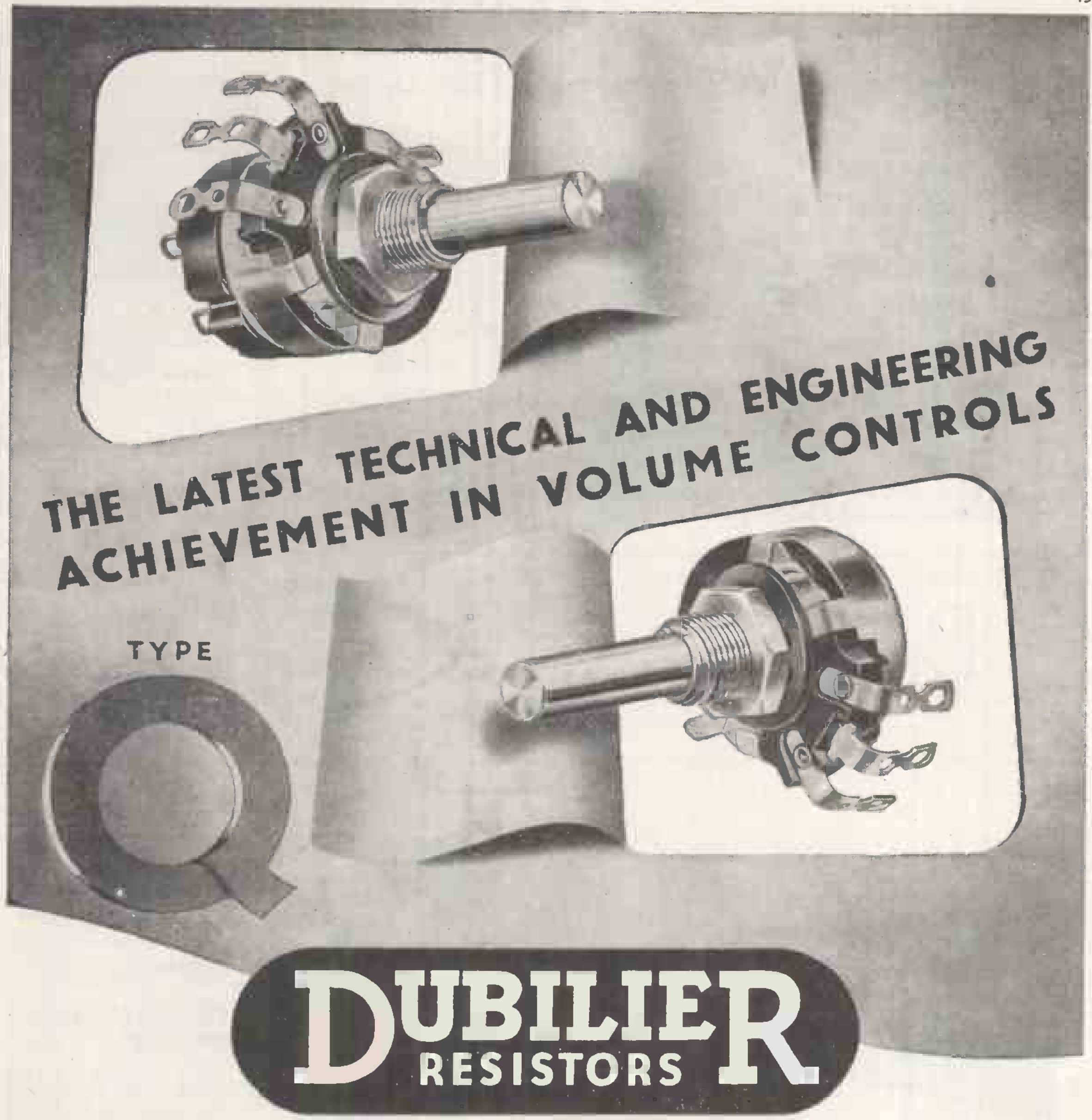


Frequentite is the most suitable insulating material for all high frequency applications. Seventeen years ago we introduced the first British-made low-loss ceramic, and consultation with us before finalising the design of new components is a wise precaution.

STEATITE & PORCELAIN PRODUCTS LTD.

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

S.P.67


THE LATEST TECHNICAL AND ENGINEERING
ACHIEVEMENT IN VOLUME CONTROLS
TYPE
Q
DUBILIER
RESISTORS

THE NEW "Q-MAX" Q5/10X COMMUNICATIONS RECEIVER FOR AMATEUR BANDS

10-Valve Double Superhet, 1·8 to 30 mcs. in 6 bands. 6 degrees of var. selectivity. B.F.O. Automatic noise limiter. "S" Meter. Crystal Gate.

Price : 50 GNS.

"S" METER FOR FITTING TO AR88's
(with backplate) **63/-**

NEW SIZES IN "Q-MAX" CUTTERS
7/8", 1 3/4" round and 1" square.

GRID DIP OSCILLATOR with Built-in Mains Pack.

With one coil, 9½ Gns.

Full range from 1·5-300 Mcs.
8 coils at 3/6 each.

Fully Illustrated Catalogue, 6d. post free

BERRY'S (SHORT WAVE) LTD.

25 HIGH HOLBORN, LONDON, W.C.1
(Tel. : HOLborn 6231)

HENLEY TELEVISION

AERIAL LEAD-IN CABLES *for trouble-free reception*

(L to R): Coaxial ; Balanced Twin Screened (U.K. Pat. No. 559518); Twin Unscreened.

We manufacture a complete range of Television Lead-in Cables for Local and Fringe Area service ; full details sent on request.

In addition we make all types of Polythene and P.V.C. Cables for radio, radar and for all branches of H.F. work. Our long experience enables us to produce cables with specified characteristics and we shall be pleased to put forward suggestions.

**W. T. HENLEY'S TELEGRAPH WORKS CO. LTD.
51-53 HATTON GARDEN, LONDON, E.C.1**

3 WAY PICK-UP FOR STANDARD AND LONG PLAYING RECORDS

Goldring introduces Pickup 150, incorporating the first British Magnetic Cartridge. Cartridge 150X available separately. The movement of this Cartridge is of balanced armature construction, and combines high output with wide frequency range and exceptionally low tracing distortion. Needle armature is easily replaceable by user.

Data	78 r.p.m.	45 and 33⅓ r.p.m.
Armature resonance	16 kc/s	9 kc/s
Output	70 mV	Equivalent to 150 mV on 78 r.p.m.
Tracking weight ...	15-20 grms.	7 grms.
Load	30 k Ω	30 k Ω
Stylus	·003 code blue	·001 code yellow

Comprehensive information service on circuitry available to users.

Write for full technical information to :—

ERWIN SCHARF

49-51a, DE BEAUVOIR ROAD, N.1
Telephone : CLIssold 3434

LONDON CENTRAL RADIO STORES

Government Surplus — Immediate Delivery from Stock

DECCA TABLE MODEL RADIOGRAM. 3 Wavebands. 200-250v. A.C. only. *FOR CALLERS ONLY.* £16 . 10 . 0

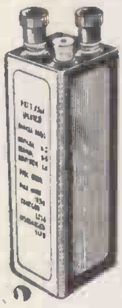
Another Startling Offer—

PHILCO Reconditioned 5-VALVE RECEIVERS

Long and medium wavebands. A.C. or A.C./D.C. 200-250v. Mains energised speaker. In walnut cabinet (slightly soiled), size 19×13×10 ins. 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



NEW EXIDE ACCUMULATORS

2-volt in black bakelite case, 15-20 amps. Size 6in. × 1¼ in. square. Weight 26 ozs.

Brand new Carr. paid. **5/6**

or in lots of six **30/-**

BLOWER MOTORS

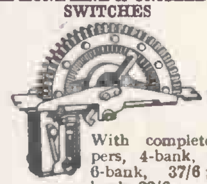
With fan blades. Size 4×3 ins. **10/6**

PHILIPS 6-VALVE COMMUNICATIONS RECEIVER

AS NEW

16-50, 200-550 and 800-2,500 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 200-250v. Can also be supplied with 12v. D.C. power pack if required. **£16 . 10 . 0**

TELEPHONE LINE or UNISELECTOR SWITCHES



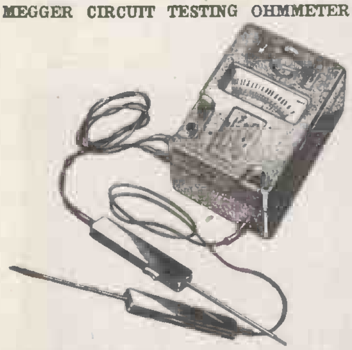
With complete wipers, 4-bank, 37/6; 6-bank, 37/6; 3-bank, 22/6.

Have various applications including automatic tuning, circuit selection, etc. Operates on 25-50v.

ELECTRO-MAGNETIC COUNTERS

Ex-G.P.O., every one perfect, electro-magnetic, 500-ohm coil, counting to 9,999, operated from 25v.-50v. D.C., many industrial and domestic applications. **7/6**

MEGGER CIRCUIT TESTING OHMMETER

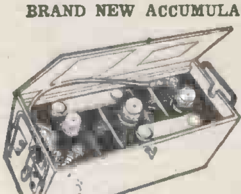


3-terminal type made by Evershed & Vignoles, Ltd. Two ranges: Inner scale 0-1,000; outer scale, 100-200,000 ohms and infinity. Green bakelite case, size 5½×4×2¼ ins. deep. Complete with test prods. In solid leather carrying case. Price, less battery **77/6**

MOVING COIL SPEAKERS

by Film Industries, Ltd., with metal flare. Unit 4½in. dia. Weight 7½lb. **£5 . 10 . 0**

BRAND NEW ACCUMULATORS



Complete in strong case, *as illustrated.* British made. 6 v. 85 a. Size 12 x 9 x 7in. Weight, 45 lb. £3 . 10 . 0 Carriage and packing 5/-.

PHOTO-ELECTRIC CELLS, Type GS16. These cells are the gas-filled type with caesium Cathode. Made by Cintel. Minimum sensitivity 100μA/-lumen, working volts 100 D.C. or peak A.C. Projected cathode area 16 sq. cm. Suitable for 16 mm. Home Cinema Talkie equipment, Safety Devices, Colour and Photo Matching, Burglar Alarms, Automatic Counting, Door Opening, etc. Brand new. In original cartons. **42/6**

MOVING COIL HAND MICROPHONE. 30-ohm voice coil. Complete **5/6**

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

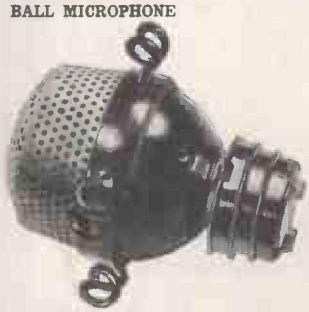
Mallory Type 650, 6v. 4-pin American base **7/6** Also 12v. 4-pin 7/6

FIVE-WAY RUBBER COVERED CABLE. Suitable for lighting and other purposes. Per doz. yds. **6/-**

CO-AXIAL CABLE for T.V., 75 ohms, 12-yard lengths **8/-**

SMALL FRACTIONAL H.P. MOTORS. 24v. A.C./D.C. Double-ended spindle. Size 2in. square. **7/6**

BALL MICROPHONE

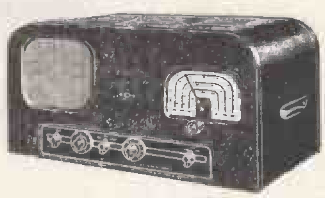


Manufactured by Standard Electric. All in perfect condition. Suitable for broadcasting and recording. Moving Coil (Dynamic). Omni-directional. No energising necessary. High Fidelity. Coil Impedance 15 ohm and will work very well in conjunction with an ordinary speaker transformer. Is of the type used by many leading bodies, such as the B.B.C. and G.P.O. for high fidelity reproduction, **£4 . 17 . 6**

PLEASE NOTE

- We do not issue lists or catalogues.
- Carriage charges relate to British Isles only.

MAGNETA 6-VALVE A.C. RECEIVER



3 wavebands, L., M. and S. Push-pull amplifier output 15 watts, using two 6V6 valves. Connections for gramophone and microphone. In black metal cabinet, crackle finish. Size 21×12×10in. Built-in speaker. Suitable for concert halls, works, etc. Thoroughly overhauled by our experienced staff. Carr. pd. **£15 . 0 . 0**

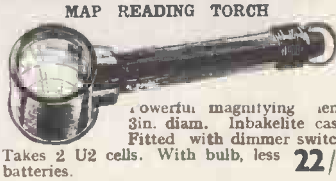
10-VALVE COMMUNICATIONS RECEIVERS. Type 1155. Guaranteed equal to new. Freq. range 7·5 mc/s. 75 kc/s. in five wavebands. Complete with 10 valves including magic eye. Enclosed in metal case. Every receiver is aerial tested. Complete with Power Pack and Loudspeaker for A.C. mains, 220/250v. **£16 . 10 . 0**

RECEIVER ONLY. Equal to new (Carr. and pkg. 10/6). **£10**

(See July issue for illustration)

FREE with each receiver! Complete circuit, description and modifications for civil use, reprinted from "W.W.," July, 1946.

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**

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.

'Let's have "THE GONDOLIERS" AGAIN!'

Whatever your favourite piece of music, the Soundmirror will record it and play it back for you again and again. There is no end to the thrills which this new magic entertainer can bring. It will record the humorous patter of your favourite comedian, the art of the orator, the fun of a party or important family occasions like weddings. It will play them back with perfect fidelity immediately it is recorded and as often as you wish. Unwanted recordings are automatically erased as new ones are made and the magnetic tape used time and time again.

PRICES FROM £62, exclusive of microphone.

Manufactured under agreement with the Brush Development Co. of the U.S.A. Licensed under the Brush Development Co., the Brush Crystal Co., Magnetone Inc., and Thermionic Products Ltd. Patent No. 454595 and others, and patents pending in all the principal countries of the world.

THE Soundmirror MAGNETIC TAPE RECORDER

CALL ON YOUR LOCAL RADIO DEALER AND HEAR YOUR OWN VOICE RECORDED OR WRITE FOR BROCHURE, WHICH GIVES FULL DETAILS, TO THE MANUFACTURERS

THERMIONIC PRODUCTS LTD.

(Division SM/WW)

Morris House, Jermyn Street, Haymarket, London, S.W.1

Telephone Whitehall 6422 (5 lines)

Sales & Service Centres: Manchester, Birmingham, Bristol, Leeds, Glasgow, etc.

THE THREE 'R's

3", 3½", 6" RECTANGULAR INSTRUMENTS by

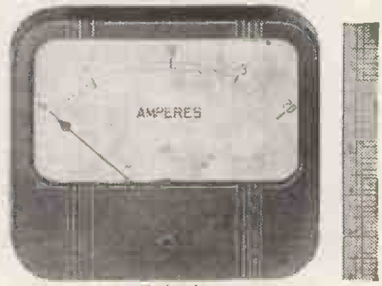
PULLIN

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 35 can be fitted with dial illumination.

MIP



Series 65

MEASURING INSTRUMENTS (PULLIN) LTD.

Electrin Works, Winchester Street, Acton, London, W.3.

Telephone ACOrn 4651/3 & 4595

POINTS OF FUNDAMENTAL IMPORTANCE THAT DISTINGUISH THE RIBBON CARTRIDGE PICKUP

1. The total moving mass is not greater than 2 milligrams—a figure *many times* less than any other pickup made in this country and, so far as we know, in any country.

2. The output E.M.F. is generated by the moving conductor itself flexing. The movement has therefore a very low stiffness factor and requires no extraneous suspension. This is most distinct from other types relying on moving parts that are in themselves rigid and rely on some external device for their suspension.

THESE ARE TWO OF MANY POINTS THAT DISTINGUISH THE RIBBON CARTRIDGE PICKUP

Details of this pickup and our three-speed transcription turntable chassis will be sent on request.

J. H. BRIERLEY (GRAMOPHONES & RECORDINGS) LTD.

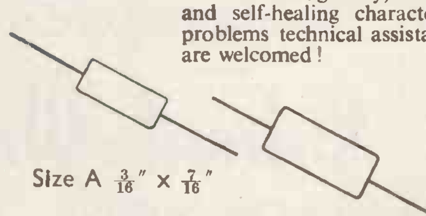
46 TITHEBARN STREET, LIVERPOOL, 2

THRUSTING ASIDE
all preconceived ideas!

THE MIGHTY MIDGET, most recent development in the Radio and Electronic field, embodies more than a complete break away from traditional ideas of size. Type W99 Midget Moldseal Metallised Paper Capacitor has the clean, neat finish of an entirely new type of moulding recently developed by Hunt's. Providing hermetic sealing, this Moldseal capacitor is invaluable for use with compact mobile equipment where risk of encountering more than the usual conditions of moisture is incurred.

Though tiny, W99 has a high insulation resistance and self-healing characteristics! If you have Capacitor problems technical assistance is freely available. Enquiries are welcomed!

Wkg. Voltage	Cap. Range. μF	Size
150 D.C.	0.004 to 0.01	A
	0.02 to 0.04	B
350 D.C.	0.001 to 0.003	A
	0.004 to 0.01	B
600 D.C.	2.5pF to 0.0005	A
	0.001 to 0.002	B
300 A.C.	0.00005 to 0.001	A
	0.002	B



Size A $\frac{3}{16}'' \times \frac{7}{16}''$

Size B $\frac{1}{4}'' \times \frac{9}{16}''$

REGISTERED TRADE MARK

HUNTS CAPACITORS

THE TRADE MARK OF RELIABILITY

A. H. HUNT LTD., LONDON, S.W.18. Tel.: BATtersea 3131. Est. 1901

THE VALRADIO
HEAVY DUTY CONVERTER RANGE

(Famous since 1937)

Will supply A.C. at standard voltage for numerous applications from D.C. supply voltage ranging from 6-250 volts with wattage outputs from 30-300 watts.

Frequency stability at 50, 60 or 75 cycles per second ½ of 1 per cent of dead frequency.

Let us bring to your notice a few listed by us in popular demand, others can be considered on receipt of specification. All hereunder incorporate Radio and Low Frequency suppression from interference.

Type	D.C. Input	A.C. Output	Wattage Load	Price
230/300-A	200/250 v.	200/250 v.	200/300	£16 0 0
230/300/110-A	100/120 v.	200/250 v.	150/300	£16 0 0
230/200-A	200/250 v.	200/250 v.	100/200	£14 0 0
230/200/110-A	100/120 v.	200/250 v.	100/200	£14 0 0
230/200/50-A	50 v.	200/250 v.	100/200	£16 0 0
230/110-A	180-270 v.	200/250 v.	60/110	£10 15 0

Also similar types available to operate from D.C. input voltages of 6, 12, 24, 32 and to order.

All above prices advanced 10 per cent. from July 1st, 1950.

Literature upon request from:

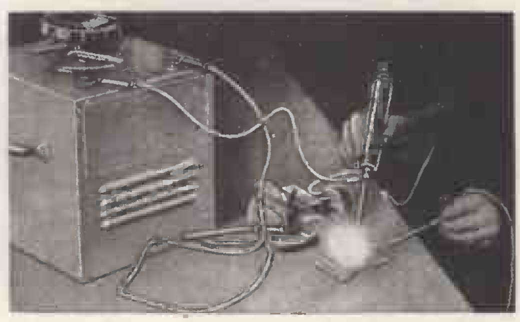
VALRADIO Limited,
57, Fortess Road,
LONDON, N.W.5

'Phone: GULLIVER 5165

PYROBRAZE 2

FOR ALL SOLDERING OR BRAZING WORK

—A.C. MAINS OPERATED—



QUICK - SURE - EFFICIENT

Ask for leaflet

SOLE MAKERS

THE ACRU ELECTRIC TOOL MFG CO. LTD.
123, HYDE ROAD, MANCHESTER, 12

TEL.: ARDwick 4284

its a question of SENSITIVITY

. . . and BANDWIDTH

when considering oscilloscopes. Furzehill d.c. coupled oscilloscopes have been designed with high sensitivity amplifiers having a linear response from d.c. upwards to 3 mc/s.

Furzehill

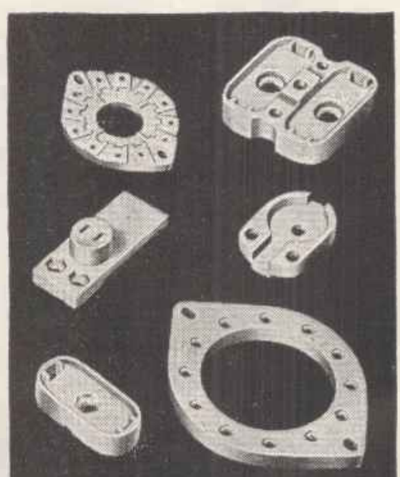
FURZEHILL LABORATORIES LTD., BOREHAM WOOD, HERTS.

Telephone: ELStree 3940

Your designs

LET US BRING THEM TO

LIFE!



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.

the most difficult problems solved by . . .

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"

IGRANIC

ROBSHAW BROTHERS LTD
as Sole Distributors

IN THE U.K. TO THE

WHOLESALE & RETAIL TRADE

OF IGRANIC JACKS, PLUGS, RHEOSTATS, POTENTIOMETERS AND PRE-SET RESISTORS

invite you to write now for fully illustrated catalogue

SERVICE THAT SPANS THE SOUTH

ROBSHAW BROTHERS LTD

TUNBRIDGE WELLS	BOURNEMOUTH	ROCHESTER
4 Mount Zion	10 Exeter Road	232/4 High Street
Tun. Wells 1668	*Bournemouth 5896/7*	*Chatham 3115*
Valvo. Tunbridge Wells	*Valvo. Bournemouth*	*Valvo. Rochester*

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

"You're CERTAIN to get it at ARTHURS!"

★**VALVES:** We have probably the largest stock of valves in the country. Send your enquiries.

AVO METERS IN STOCK

Avo Model 7	£19 10 0
Avo Model 7, high resistance	£19 10 0
Avo Model 40	£17 10 0
Valve Tester	£16 10 0
Test Bridge	£11 0 0
Avo Minor, AC/DC model	£8 10 0
Electronic Test Meter	£35 0 0
Signal Generator	£25 0 0
Valve Characteristic Meter	£50 0 0

★ Demonstrations of Philips Projection Television sets in our showrooms.

LATEST VALVE MANUALS
Mullard 5/- ea.
New Mazda - 2/- ea.
Brimar Teletube & Radio - 4/-
Post 4d. each extra
Send for catalogue

TAYLORS METERS. List on request.

DECCA PICK-UPS	£3 15 5
DECCA HEAD	£2 19 2
ADAPTOR for Garrard	3 8
COSSOR DOUBLE BEAM OSCILLOSCOPE	£85 10 0

"Viewmaster" Television Kits in stock for Birmingham and London areas. Please state which required.

LONDON'S OLDEST LEADING RADIO DEALERS

Arthurs EST. 1919

PROPS: ARTHUR GRAY, LTD. Terms C.O.D. or cash with order

Ou Only Address. **Gray House, 150/152 Charing Cross Rd., London, W.C.2** *TEMple Bar 5833/4 and 4765*

ELECTRICAL, TELEVISION & RADIO ENGINEERS

The Musician and High Fidelity

It has been a puzzle to many high fidelity enthusiasts that some o the sounds which they reproduce fail to satisfy the musician. Having had their equipment measured they conclude that the musician is no judge of quality. It is true that the musician may be over-influenced by interpretation and other factors, but the occurrence is far too frequent and too well known to be so lightly brushed aside.

The fault does not lie with the musician, nor with the measurements. Rather does it lie in the interpretation of those measurements. The output from a gramophone pickup for example cannot wholly be represented by simple combinations of sine waves, neither can it be assumed to represent a near approach to the original sound.

Our Huntingdon laboratories have specialised in sound waves and methods of analysis, from very low frequencies in measuring anti-vibration devices up to ultrasonic equipment for medical research. They have produced the Corner Ribbon loudspeaker, amplifiers and other equipment used by the leading Broadcasting and Recording Companies both here and abroad. Even so, we cannot claim a perfect method of measuring the accuracy of a reproduced complex sound. The limitations imposed by a monaural system even precludes us from laying down an ideal specification.

On this page we mention five points which we know to be of the utmost importance in quality reproduction—points which are usually overlooked or to which insufficient attention is paid.

If you are a technical enthusiast you will find the Q.U.A.D. specification of the utmost interest and second to none. If you are a musician, you will find that the sound you hear bears a closer resemblance to the original sound than any amplifier yet offered to the public.

More about the Q.U.A.D.

It is the only "quality" amplifier which is not embarrassed by the presence of sum and difference tones falling outside the normal feed-back range. (Strong beats in choral works, etc.)

It is the only amplifier which takes into account the inherent quality of the input signal. (The harmonic range is adjustable to provide an inverse characteristic of the distortion rise in the programme signal itself.)

Because of the harmonic control it is the only amplifier which can be used successfully with a very wide range loudspeaker if "average" as well as "picked" recordings are to be played.

It is the only amplifier in which the treble and bass controls can be and are designed to give the correct variations in response at all settings for the conditions under which the equipment is used. The method of setting is definite, simple and no longer haphazard.

Day-by-day adjustments are confined to programme quality and volume controls, a procedure which is simple and accurate and therefore not subject to misuse other than by deliberate intent.

Type Q.U.A.D. 12 watt quality amplifier for A.C. mains. **£33**
Complete in two units as illustrated

ACOUSTICAL
MANUFACTURING CO LTD
HUNTINGDON · HUNTS · TEL : 361

AN AUDIO FREQUENCY RESPONSE CURVE TRACER

On the production line or laboratory bench, or anywhere a response curve in the audio spectrum is required, the Model 1900 Portable A.F. Response Curve Tracer will trace it in seconds on a log log or log linear scale.

The instrument may be set to repetition frequency sweep (variable rate),

or single sweep (variable speed),

or frequency may be set by hand to any part of the response curve for detailed investigation.

Built-in calibration checks are provided.

Calibration drift, harmonic distortion and hum is very low.

* THE CURVE MAY BE PHOTOGRAPHED OR TRACED ON TRACING PAPER.

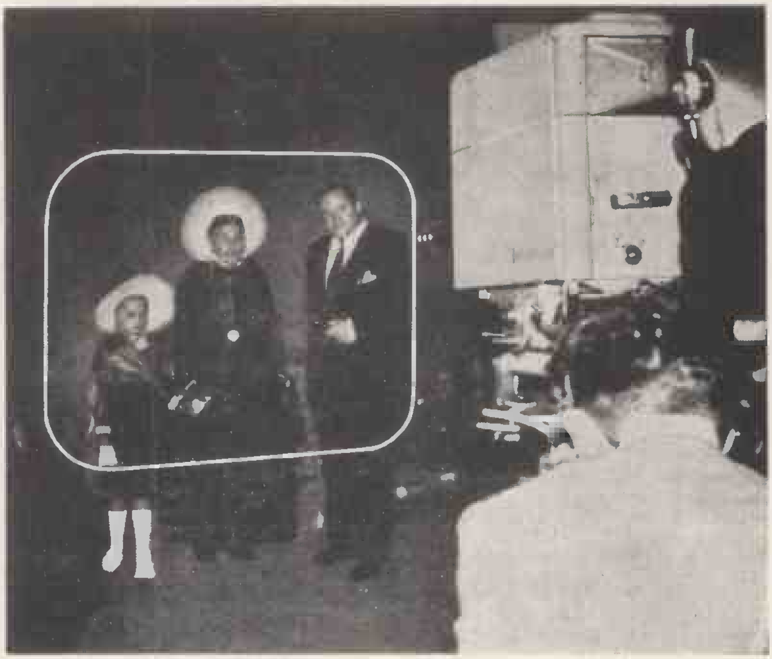
EARLY DELIVERY

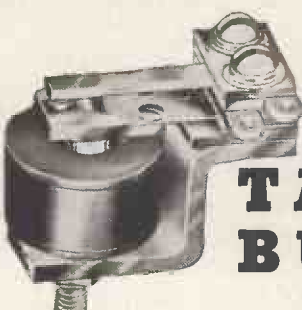
*Camera available

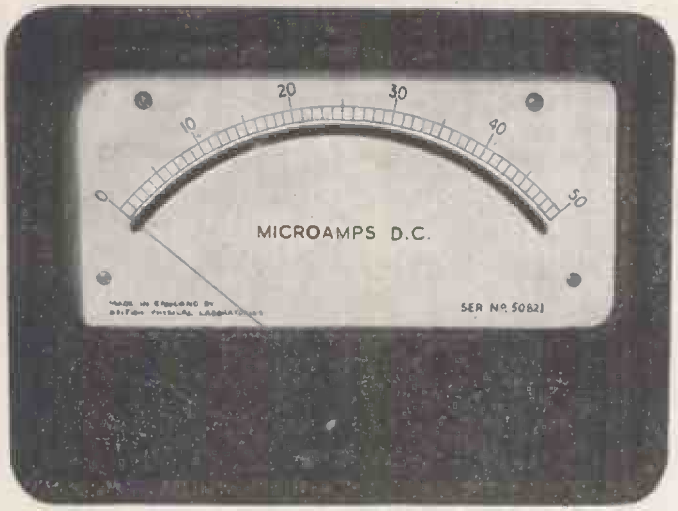
Model 1900 A.F. Response Curve Tracer—*Write for specification.*

INDUSTRIAL ELECTRONICS
99 GRAYS INN ROAD, LONDON, W.C.1

Telephone : Holborn 9873/4







SIZE	2½″	3½″	5″
RANGE	25μA to 50A	10μA to 50A	10μA to 50A
PRICE			
50μA	55/-	61/-	93/-
200μA	45/-	51/-	83/-
1mA	35/-	41/-	73/-

(Export prices on application)

All sizes available with MIRROR SCALE

1st Grade Accuracy

SENSITIVE PANEL MOUNTING METERS

For particulars of these and our full range of measuring instruments write to :—

BRITISH PHYSICAL LABORATORIES

HOUSEBOAT WORKS · RADLETT · HERTS · Telephone: RADlett 5674-5-6

Simple *and* Reliable

IN areas where the cost of installation and maintenance of line communications is prohibitive, the Redifon GR. 49D comes into its own. Many hundreds have already been supplied for small communities, oilfields, forestry workings and similar assignments. Equally suitable for static or mobile installations, the set is a complete transmitting and receiving station and can be used for point-to-point or ground-to-air services with both C.W. and R.T. facilities. Radio Telephony operation is as simple as using an ordinary dial telephone, and the fully tropicalised design ensures low operating costs and complete reliability under the most adverse climatic conditions. Contact Redifon for full details.

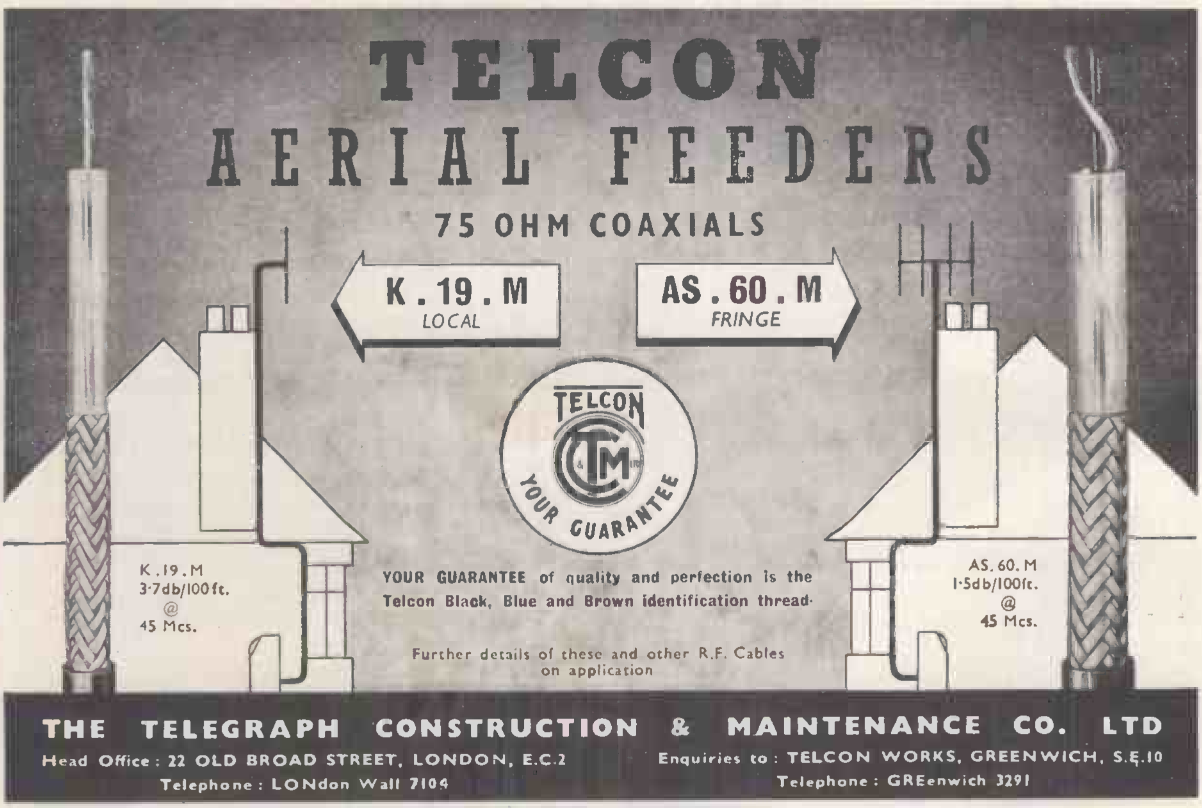
COMMUNICATIONS
Redifon Radio

Radio Communications Division

REDIFON LIMITED, BROOMHILL ROAD, WANDSWORTH, S.W.18

DESIGNERS & MANUFACTURERS OF RADIO COMMUNICATIONS & INDUSTRIAL ELECTRONIC EQUIPMENT Phone: VANdyke 5691

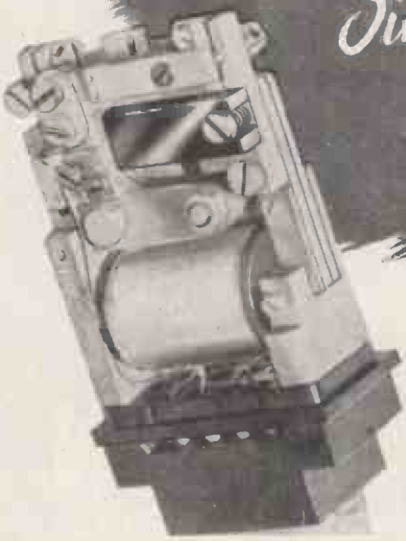

SPRING LOADED TERMINALS
A Positive CONNECTION WITHOUT SOLDER · SIMPLY PRESS & RELEASE
by
PAINTON
PAINTON & CO. LTD · KINGSTHORPE · NORTHAMPTON · ENGLAND


TELCON
AERIAL FEEDERS
75 OHM COAXIALS
K.19.M
LOCAL
AS.60.M
FRINGE
TELCON
TCM
YOUR GUARANTEE
K.19.M
3·7db/100ft.
@
45 Mcs.
AS.60.M
1·5db/100ft.
@
45 Mcs.
YOUR GUARANTEE of quality and perfection is the Telcon Black, Blue and Brown identification thread.
Further details of these and other R.F. Cables on application
THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD
Head Office: 22 OLD BROAD STREET, LONDON, E.C.2
Telephone: LONdon Wall 7104
Enquiries to: TELCON WORKS, GREENWICH, S.E.10
Telephone: GREenwich 3291

SMALL PRECISION

Sintered Magnets

PERMIT DESIGN OF COMPACT RELAY



ALNICO · HYCOMAX · ALCOMAX

This 'Carpenter' Relay produced by The Telephone Manufacturing Co. Ltd. incorporates two 'HYCOMAX' Sintered Magnets. These are essential where Small Complex Shapes, high magnetic efficiency and stability are required.

MUREX LTD. *(Powder Metallurgy Division)* **RAINHAM, ESSEX**

Tel.: Rainham Essex 240

London Sales Office: Central House, Upper Woburn Place, W.C.1

TRANSFORMERS AND CHOKES

SPECIALLY DESIGNED FOR ALL

ELECTRONIC EQUIPMENT

SOUND CONSTRUCTION — EFFICIENT DESIGN

INDUSTRIAL TYPES UP TO 25 K.V.A.

STEWART TRANSFORMERS Ltd.
1021 FINCHLEY RD., LONDON, N.W.11
Tel.: SPEedwell 3000 and 3533

GEE Bros RADIO Ltd

VALVES VALVES VALVES
Transmitting and Receiving

PLUGS AND SOCKETS
Jones, Belling & Lee and (W) Types

VALVEHOLDERS
Ceramic, Amphenol, Paxolin, all types

12-way Screened Flexible Cable, Henley No. 12 14·0076 Flex. Met. **£6/10/0** per 100 yds.

1·3 K, 100-watt Wire-wound Pots, 15/- ea.

12 v D.C. to 230 v A.C. 50 cycles Rotary Converters, 150 watts. Complete with 300 v A.C. Meter and D.C. Input Regulator. **£7/10/0,** plus carriage.

230 v D.C. to 230 v A.C. Rotary Converters, 100 watts. Guaranteed perfect. **£6/10/0,** plus carriage.

Trade and Export inquiries invited

15 LITTLE NEWPORT ST., LONDON, W.C.2
GERrard 6794

Connoisseur Products

TWO SPEED-MOTOR. At the turn of a switch you have two speeds, 33.1/3 or 78 r.p.m. The Turntable is a full 12" diameter: its main spindle precision ground and lapped, runs in phosphor bronze bearings. The synchronous motor is virtually vibrationless and is suitable for playing standard, transcription and microgroove recordings.

Retail price without pickup - - - - - - £13 15 0
Purchase Tax. - - - - - - - - - £5 19 2

SUPER LIGHTWEIGHT PICKUP for standard and microgroove recordings. The interchangeable heads are fitted with an easily replaceable armature system complete with a semi-permanent sapphire. Armature mass 20 milligrams. Extremely low mass at needle point (4/5 m.g. only) allowing for reduction in downward pressure to 10/12 grams for standard recordings, and 5/7 grams for microgroove recordings.

Prices: With one Head - £4 0 0, plus £1 14 8 Purchase Tax
Extra Heads, each - - £2 10 0, plus £1 1 8 Purchase Tax
Spare armature System with Sapphire, 14/8 including Tax.

THE CONNOISSEUR Varigroove Recording Unit. 33.1/3 and 78 r.p.m. 100 to 300 GROOVES PER INCH continuously variable. MOVING COIL CUTTER HEAD of entirely new design. Patented method of suspension allowing use of large magnet system, producing sensitivity and response hitherto unobtainable. All patterning effects eliminated, allowing microgroove recordings to be made with ease.

15 ohms impedance. Frequency response 30 - 15,000 c.p.s
LESS THAN 5 WATTS required to fully modulate.
Price £130 0 0

ALSO HIGH FIDELITY AMPLIFYING EQUIPMENT

A.R. SUGDEN AND CO. (ENGINEERS) LTD., BRIGHOUSE, YORKSHIRE.

WITHOUT A SHADOW OF DOUBT THE BEST

for radio and television

are the miniature high-voltage 36 EHT "Westalite" rectifiers to provide a reliable and economic E.H.T. supply either from the line fly-back or from the 350-0-350 input of the standard mains transformer in a balanced voltage multiplier circuit: "Westalite" rectifiers for H.T. supply, H.T. boost and line fly-back damping, and copper-oxide "Westectors" for sound and vision interference suppression. For full details of

WESTINGHOUSE

METAL RECTIFIERS

Send 6d for a copy of "THE ALL METAL WAY" to Dept. W.W.11.

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


BIRMINGHAM SOUND REPRODUCERS LTD
OLD HILL, STAFFS
MADE IN ENGLAND
B.M. 40
MIC. 2
GRAMO

Wireless World

RADIO AND ELECTRONICS

November 1950

40th YEAR OF PUBLICATION

In This Issue

EDITORIAL COMMENT 381
SIDELIGHTS ON LOUDSPEAKER CABINET DESIGN. By *D. E. L. Shorter* 382
PICKUP INPUT CIRCUITS. By *R. L. West and S. Kelly* 386
SHORT-WAVE CONDITIONS. By *T. W. Bennington* 391
NEW BOOKS 392
VARIABLE FILTER TUNING—2. By *A. B. Shone* 393
WORLD OF WIRELESS 399
TOLERANCES AND ERRORS. By "*Cathode Ray*" 403
LONG RANGE TELEVISION. By *T. W. Bennington and R. Morris* 407
PHASE-SHIFT OSCILLATORS. By *W. G. Raistrick* 409
COMMUNICATION ON 460 Mc/s. By *E. G. Hamer* 412
THE HALL EFFECT 415
DARK-SCREEN TELEVISION 417
RADIO IN GERMANY 418
MANUFACTURERS' PRODUCTS 419
UNBIASED. By "*Free Grid*" 420
LETTERS TO THE EDITOR 421
RANDOM RADIATIONS. By "*Diallist*" 424

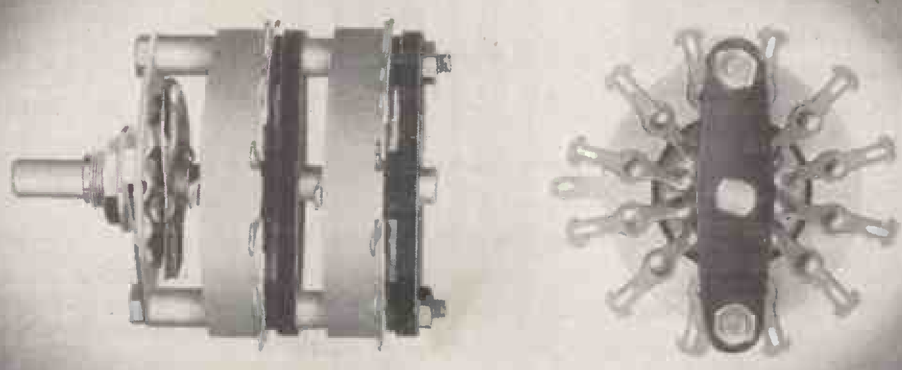
Managing Editor: HUGH S. POCOCK M.I.E.E.

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 6s. 0d.; U.S.A. and Canada, $4.50

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



Important trends in VALVE DESIGN

MULLARD LINE OUTPUT PENTODE TYPE PL81

The line output stage of a television receiver imposes conditions which call for a valve having properties which differ considerably from those of a normal output valve.

The essential requirements for a line output valve are, first, that it shall be capable of supplying a large peak anode current when operated at a low anode voltage, and second, that the insulation of the anode shall be capable of safely withstanding the high voltage peaks, which may amount to 5KV to 7KV, occurring during the fly-back period.

Satisfaction of the first of these requirements is mainly a matter of the geometry of the valve; the second can be assured only by careful mechanical design.

The PL81 is an all-glass power pentode on the B9A (Noval) base, specially designed for use as a line output valve. Its heater is rated at 0.3A, 21.5V, and is therefore suitable for series operation in transformerless receivers intended for A.C. or D.C. mains supply.

It will deliver a peak anode current of 350 mA at an anode voltage of only 70V and a screen voltage of 170V. The efficiency of the valve is thus intrinsically high. By adopting the booster diode circuit whereby the H.T. line voltage is increased, the required output can be obtained at a still lower anode voltage, so that the already high efficiency of the stage is further improved.

The necessary high insulation resistance to withstand a peak voltage of 7KV has been obtained by special internal construction, and by bringing out the anode connection to a top cap so that the use of a specially insulated valve-holder is not necessary. Even so, the seated height of the valve is only 75mm and the overall diameter 22.2mm —dimensions only slightly larger than those of the voltage amplifying pentode in the same range.

The production of a valve of this output and high insulation in so small an envelope may be counted as something of an achievement.

RATINGS & CHARACTERISTICS

Heater Suitable for Series operation, A.C. or D.C.	
V_h	21.5V
I_h	0.3A
Capacitances	
c_{in}	14.3μμF
c_{out}	6.5μμF
c_{a-g1}	<0.4μμF
c_{g1-h}	<0.2μμF
Characteristics	
V_a	170V
V_{g3}	0V
V_{g2}	170V
V_{g1}	-22V
I_a	45mA
I_{g2}	3mA
g_m	6.5mA/V
μ_{g1-g2}	6

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

MVM 149

These Valves make News!

MINIATURE AMERICAN TYPES

for AC/DC EQUIPMENT

A complete range of miniature B7G valves is now available for 110 volt or 240 volt AC/DC equipment. All these valves bear American type numbers.

TYPE 50C5

OUTPUT TETRODE for 110v. Supply

Heater Rating ...	50.0 volts 0.15 amp
Mutual Conductance	7.5 mA/V
Power Output ...	1.9 watts

Price: **15/6** *plus P. Tax*

TYPE 19AQ5

OUTPUT TETRODE for 240v. Supply

Heater Rating ...	19 volts 0.15 amp.
Mutual Conductance	4.1 mA/V
Power Output ...	4.5 watts

Price: **13/-** *plus P. Tax*

TYPE 35W4

HALF WAVE RECTIFIER

Heater Rating ...	35 volts 0.15 amp.
R.M.S. Input ...	240 volts max.
Rectified Current	100 mA. max.

Price: **10/6** *plus P. Tax*

DIMENSIONS:—Seated Height 2⅝" max.
Diameter ¾" max.

TYPE 12BE6

SPECIAL HEPTODE

Supply Voltage ...	110 volts	250 volts
Heater Rating ...	12.6 volts 0.15 amp.	
Anode Impedance	0.5	1.0 meg.
Osc. Mutual Conductance ...	7.5	7.5 mA/V
Conversion Conductance	0.40	0.48 mA/V

Price: **16/-** *plus P. Tax*

TYPE 12BA6

VARI Mu R.F. PENTODE

Heater Rating ...	12.6 volts 0.15 amp.	
Anode Impedance	0.25	1.5 meg.
Mutual Conductance ...	4.3	4.4 mA/V

Price: **13/-** *plus P. Tax*

TYPE 12AT6

DOUBLE DIODE TRIODE

Heater Rating ...	12.6 volts 0.15 amp.	
Voltage Gain ...	33	42

Price: **12/-** *plus P. Tax*

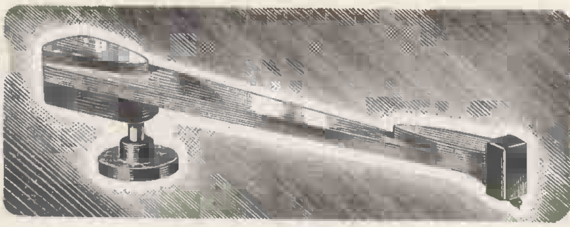
DIMENSIONS:—Seated Height 1⅞" max.
Diameter ¾" max.

BRIMAR

WRITE NOW TO DEPT. 4530
for data sheet on the above valves.

TECHNICAL ADVICE SERVICE

STANDARD TELEPHONES AND CABLES LIMITED, FOOTSCRAY, SIDCUP, KENT.

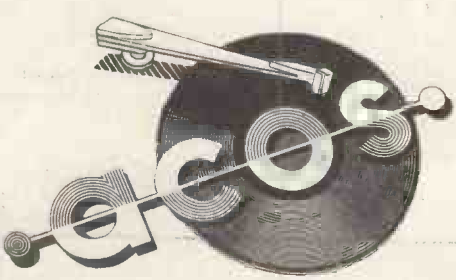


AN APOLOGY

The inconvenience and annoyance caused to the public and to our friends in the trade occasioned by the delay in delivery of *acos* microcell pick-ups is a matter that causes us the gravest concern. It is in the main due to the unprecedented demand for these pick-ups which has outrun the supply of certain raw materials and also made our factory space inadequate. Commitments to manufacturers made prior to the general announcement of the pick-ups have still further aggravated the position.

Happily, the raw material problem should shortly be solved and plans for greater production facilities are being urged forward. In the meantime, we are doing all we can to meet existing orders, but regret that delivery on new orders will be subject to about three months' delay.

We can only express our regrets for the circumstances that have made this announcement necessary, and trust that our trade friends and the general public will bear with us in view of our assurance that all possible steps are being taken to meet the situation and to reduce delay to a minimum.



COSMOCORD LIMITED · ENFIELD · MIDDLESEX

THE "BELLING-LEE" PAGE

Providing technical information, service and advice in relation to our products and the suppression of electrical interference

Apologies to the B.B.C.

In the September issue of the "Wireless World" on this page we stated that the B.B.C. altered the frequencies of Sutton Coldfield a fortnight before the station opened. This was a mis-statement for which we do not hesitate to apologise. Something happened, but at this distant date we cannot recall the details, but B.B.C. Engineering Division tell us that they first published the Sutton Coldfield frequencies on 20th September 1948 and that they were never altered. We agree that nothing should be said or written which might cause uneasiness in the minds of the trade or the public.

While we do our best to be accurate in this page, when we do "drop a brick," the quality of those who come back at us is ample evidence that our page is read by the right people.

Rationalisation of Television Aerial Numbering

Most "Wireless World" readers know that eventually there will be eleven television transmitters operating on five frequency channels, and therefore the sooner we stop talking about the London and Midland transmitters the better. The transmitters should be referred to by their official channel number—London—Channel 1, Midland—Channel 4, etc.

All aerial manufacturing members of the Radio and Electronic Component Manufacturers' Federation have agreed to indicate the television frequency by the official channel number following a stroke, incorporated immediately after the list number of the particular aerial.

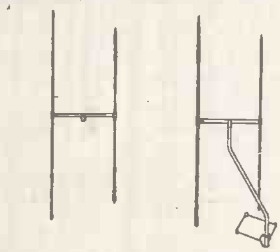
It has also been agreed to standardise a colour code for each frequency channel, but this may not be used by everyone immediately.

So far as all this concerns "Belling-Lee" a complete new list of television aerial numbers has been built up, and became operative on Sept 1st.

At first all aerials *are being* despatched from the factory labelled on the outside with the old and the new numbers, and *using the following colour code:*

Channel No.	Cat. suffix	Colour Code
1. London	1	Yellow
2. North England	2	Light Blue
3.	3	Red
4. Midlands	4	Green
5.	5	Dark Blue

In each "Belling-Lee" case the first figure group before the stroke will indicate the list number, the first suffix the channel on which the aerial will operate (-/1 London, -/4 Midland, etc.) and the second suffix shows either the type of mounting (-/L chimney lashing, -/W wall mounting, -/9 9 foot mast and lashing) or the type of feeder supplied (-/B balanced, -/U unbalanced).



L802/1 or 4/C. L802/1 or 4/L.

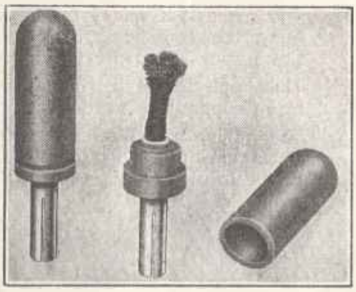
Comparison of Aerial Prices

"Belling-Lee" aerials may appear dearer than some but we do ask those interested to make certain that when they are thinking or talking aerial prices that they are clear in their minds what they are getting for their money. "Belling-Lee" have made a practice of stating the price of a complete aerial, whereas some other manufacturers feature a price which is in fact the price of the cross-arm and elements only, pole, if any, and lashings are extra. Because of this, one is apt to consider that "Belling-Lee" aerials are more expensive than they really are.

Suppression of Motor Car Ignition Interference.

It is very gratifying that some interest is at last being taken in this subject and it is possible that a lot will be done voluntarily before legislation takes place. The A.A. give it its blessing, then the B.B.C. are helping by their film on Television and by demonstration on Sound Broadcast, neither are they always preaching to the already converted. There must be many television viewers whose cars are still a source of annoyance to others. The selfish owner never sees the trouble his own car makes, unless his wife drives too, and then it is only for a minute while the car is put in its garage. It is the duty of every viewer to suppress his own car and to persuade all those who see his television to do likewise Many garages have been slightly hostile towards the fitting of suppressors, so we are grateful to the "Motor" for the excellent article they published recently. This, together with the fact that one of the greatest names in car electrics now recommend and market suppressors, must do a great deal to break down uninformed opposition.

An Amateur testifies on behalf of the "Coronette" silent aerial discharger.



This is an extract from a letter dated July:

"The past week or so has given ample opportunities for studying the effects of the device on 'coronary discharge' interference with the reception of short and medium wave broadcast reception.

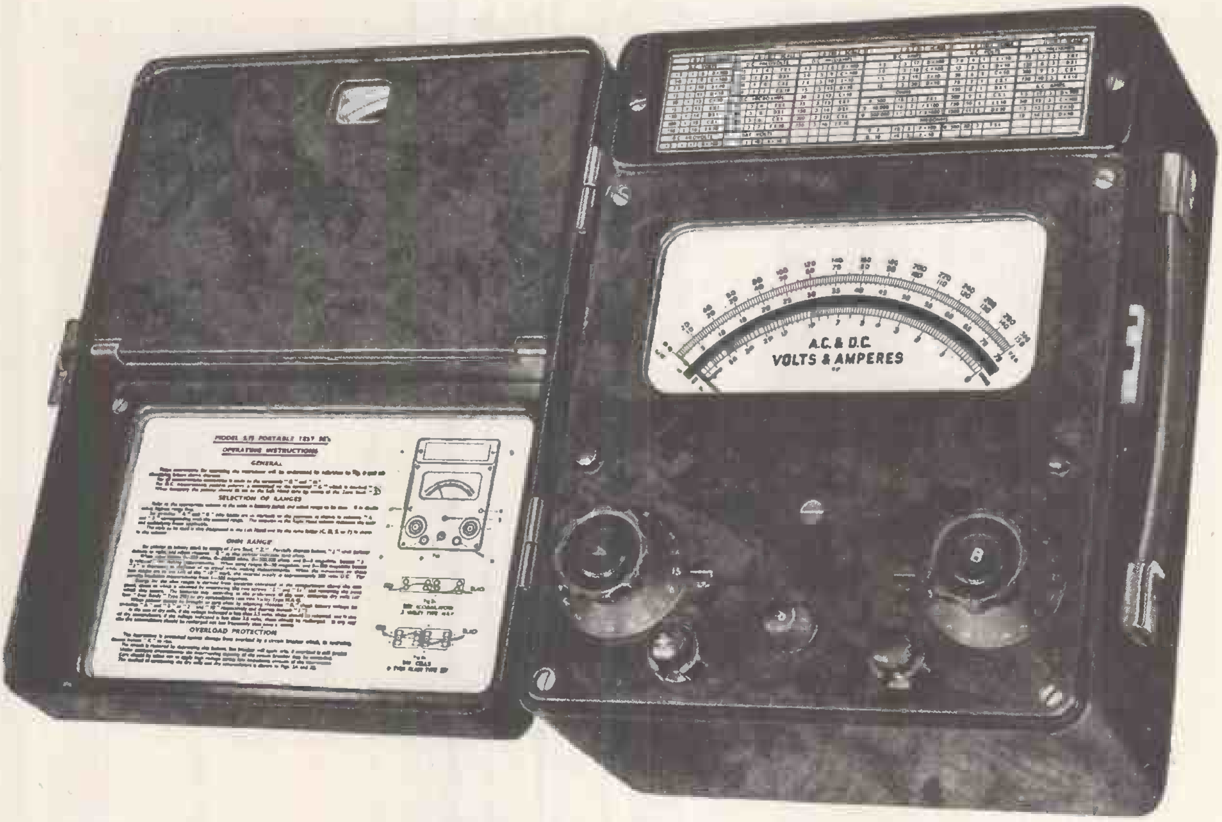
I am using an R.C.A. 'AR.77E' Communication Receiver and can now listen in comfort to the most distant continental medium wave transmitters during heavy and protracted rain storms. It is only after half an hour's torrential rain that a slight background 'hiss' manifests itself, and this is a remarkable improvement after my experience before fitting the Discharger, when, as you know, immediately rain started *any* programme, other than North Regional or Light, was blotted out by terrific 'static' of the shrieking variety.

I am happy to say that the expense incurred in taking down and re-erecting the aerial consequent upon fitting the 'Silent Discharger' has been more than repaid in increased listening pleasure over the last two week-ends.

I might add that I seem to get all-round quieter performances since fitting your Company's device, and am very grateful to you for all the trouble and interest you have taken in the matter."

NOTE: The "Coronette" discharger is designed to fit "Skyrod" aerials only and is unsuitable for other makes of Vertical aerials.

BELLING & LEE LTD
CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX., ENGLAND



The WESTON S.75 Multi-Range Test Set

53 Ranges with Rotary Switch Selection

This uniquely comprehensive Test Set has 53 ranges for measuring A.C. and D.C. current and voltage, resistance and insulation. It is completely self-contained, with internal batteries to provide power for the ohms ranges and self-contained power pack for insulation measurement at 500v. Selection is carried out by two 20-position switches. A fully-protective safety device is fitted and is operative for forward or reverse overload. The 150-division 6in. scale is uniformly divided and is fitted with an anti-parallax mirror. The set is enclosed in a handsome bakelite case and fully complies with B.S.S. No. 89 covering first-grade instruments. Full details of the ranges covered, and of the complete specification, will gladly be supplied on request.

SANGAMO WESTON LIMITED

ENFIELD, MIDDLESEX

TELEPHONE: ENFIELD 3434 (6 LINES) AND 1242 (4 LINES)
TELEGRAMS: SANWEST, ENFIELD

BRANCHES
Glasgow, Newcastle-on-Tyne, Leeds, Manchester, Wolverhampton, Bristol, Southampton & Brighton.

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

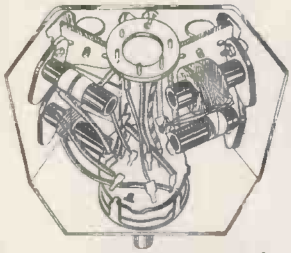
Phone : SHEpherds Bush 1173/4
Telegrams : Sinusoidal, Ealux, London
Foreign Cables : Sinusoidal, London

MAIL ORDER SUPPLY CO.

33 TOTTENHAM COURT ROAD, LONDON, W.1. *MUSeum 6667*

SUPERHET COIL PACKS

This new M.O.S. coil pack of the smallest possible physical dimensions sets a new high standard in performance. It is of exceptionally high gain, and particular care has been taken in the design of the Short Wave range, which gives a performance equal to that normally obtained only on a communications receiver.
Winding of coils gives extremely high magnification in aerial circuit. Iron dust cores also ensure increased efficiency. While the coil packs are supplied pre-aligned and in this condition give excellent results, since stray capacities of the various circuits in which it is used will vary, the trimmers and cores have been arranged to be readily accessible for small final adjustments to ensure maximum performance. Overall size: 2⅜in. deep × 2⅜in. wide × 1⅝in. high.
All connections are via a small terminating strip on rear of coil unit. This can be placed over frequency changer, giving shortest possible circuit leads.



Coil Pack in carton with instructions. Pre-aligned. Post Free. **19/6**

Ranges covered: 16 to 50 metres and 200 to 500 metres.

TRADE & WHOLESALE TERMS AVAILABLE ON APPLICATION

HALF PRICE OFFER

We are able to offer the famous BURGOYNE co-axial Aerial Connector at half the usual list price. Supplied complete with assembly instructions tube of Bostik cement, and all fitting screws. For efficient water-tight co-axial cable connections and to improve signal strength. See that you give your aerial a chance. Used on many famous maritime installations. We have exported these to all parts of the world.

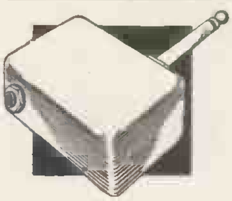
Formerly 24/6. NOW **12/3** Post 9d.

CQ2400 MEGACYCLES TUNING UNIT 207A

10 cm. KLYSTRON equipment comprising CV67 Klystron with tuning plugs, 5Z4G rectifier, 3 neon stabilisers, and power supply. BRAND NEW equipment which may be adapted for use with a Super-regen receiver for the 13 cm. ham-band. The cavity, with extra capacity loading, will be suitable for 13 cm. R.S.G.B. Bulletin July 1948 gives details on use of the Klystron as foundation for the oscillator. ONLY **20/-** (Carr. and pkg. 5/-.)

D.C. "STEP-UP" GENERATOR

A universal purpose Motor Generator fully guaranteed, brand new and in original makers' cartons. This unit can be driven from D.C. voltages from 2 v. to 14 v. and will give varying outputs according to the input voltage. For example: at 6 v. D.C. input an output of about 230 v. 30 mA will be obtained; at 4 v. D.C. input, 180 v.—25 mA; at 12 v. D.C. input 480 v.—40 mA. The motor will also provide sufficient power for use as a grinder, polisher, etc., and a spindle protrudes 1 in. from the casting for mounting these. Approx. R.P.M. at 12 v. D.C. input is 2,000 (varying according to the applied voltage). OUR PRICE **8/11**
Post, pkg., 1/1.

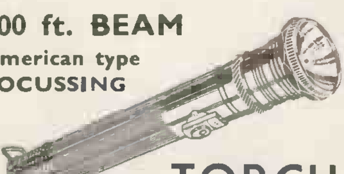


IMPEDANCE MATCHING UNIT

These units measure 2 × 1 × ⅞in. and provide the solution to obtaining a match between low impedance phones and high impedance output.
Each unit contains a miniature transformer, and if desired the connections can be reversed so that high impedance phones can be matched to low impedance line or output. The high impedance match of these units is 2,000/4,000 ohms.
A standard jack plug and socket is fitted to the body of the unit.

AS NEW, **2/-** each ONLY Post and Packing 6d.

600 ft. BEAM American type FOCUSSING TORCH



Solid brass, nickel-plated. Adjustable ring focusing. Takes 3 British U2 batteries. Cleverly designed highly polished reflector. Spare bulb in container in base. Pull-out loop.

Type G Complete **13/11** Post free.

R3515 FOR TV CONVERSION

21-valve radar units with 6 stage 14 MC's. IF strip. Sufficient space on chassis to construct complete TV receiver, excluding EHT valves: one EA50, ten SP61, five EF36, three EBC33 one EF39, and EB34. (See article, May issue "Short Wave Listener").

BRAND NEW IN TRANSIT CASES Carriage Paid. **£3 - 10 - 0**

ELECTRIC MOTORS

A complete A.C. motor ready for use without adaptation. 1/16 h.p., 2,500 r.p.m. For use on 220-250 v. A.C. mains. Spindle fitted with 2in. diameter pulley ready for use with small belt drive. Fitted with 3ft. 3-way mains lead, 27/6, carriage paid. As above but fitted with grindstone and polishing mop instead of pulley, **37/6** Carr. paid.

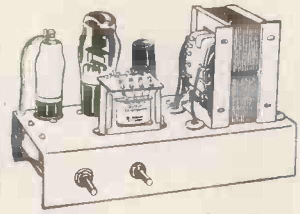
2 VOLT VIBRATOR PACKS for only 35/-

The famous U.S.A.-made vibrator power supply as used on the Canadian type 58 Walkie-Talkie. Complete with vibrator. Post., pkg., 2/6.
SPECIFICATION: 2 v. input: 90v. or 180v. 35 mA. H.T., 1.5 v. L.T. outputs. Size of vibrator unit 8in. × 3½in. × 4½in. Also available complete with two 2 v. accumulators in case for 50/- (Carr. pkg. 5/-)

VCR 97 CR TUBES

Brand new, in original transit cases. ONLY **35/-** (Carr. paid)

MAKE YOUR OWN RECORD PLAYER *incorporating the M·O·S* EASY-TO-BUILD A1 AMPLIFIER



with these features :—

- *High quality output
- *Output four watts
- *Low mains consumption
- *Simple stage by stage easy to follow instructions
- *No previous radio knowledge needed to get first class results
- *All parts generously rated for long life

The amplifier YOU can build and be sure of success from the time you first switch on. It employs three valves in a well designed circuit. It has been specifically designed for use with high quality crystal pick-ups and the reproduction is of the highest standard. It can be used with magnetic pick-up, if desired.
For those who have any doubts about their ability to construct this amplifier, we offer the instruction manual separately. This contains fully detailed instructions besides the circuit, diagrams, photographs, parts list, and sections on operation, fault finding etc.
The kit itself deserves special mention. It is complete in every detail down to nuts and bolts and solder tags. A chassis is supplied with all the holes drilled in the correct places, and all the resistances and condensers wired to a colour coded group board. Whole kit well packed in stout cardboard box. Great care taken in packing valves.

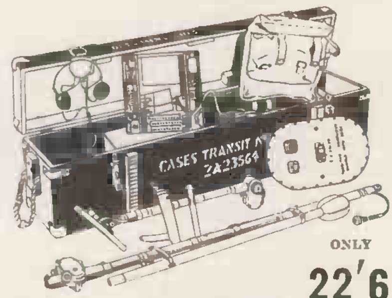
Instruction Manual Post paid. **3/6**

Complete kit, including Instruction Manual, Valves, etc., Post paid. **£4 - 2 - 6**

10in. High Quality Speaker by famous manufacturer at the special price of **15/11**

(Note: this offer only applies to those purchasing the complete amplifier kit).

METAL DETECTORS SPECIAL OFFER



Another purchase of ex-army mine detectors enables us to make a bargain offer to hold good for this month only.
It is anticipated that, as we secured only 300 of these equipments, they will be sold out in a very short while.
The equipment comprises a 3-valve oscillator and amplifier in steel case with headphones, the whole being assembled in a shoulder haversack. Two sets of search coils and poles are also supplied for different methods of detection. A full set of circuits and instructions are included. Sensitivity measuring stick, 2 spare valves and other accessories are included and the whole is mounted in a heavy wooden transit case.

ONLY **22/6** Carr., Pkg 12/6

These units are offered at this very low price as they are store soiled.

M·O·S "FULVISION" DIAL ASSEMBLY

A brand new 3 waveband full vision dial assembly, size 5in. wide and 6¼in. high. Vertical tuning scales.
Dial is arranged for black illumination, printed three colours on unbreakable "Perspex". Clever arrangement of nylon cord drive makes action truly non-slip. Dial, backing plate and pulley, drive spindle, pointer with nylon cord attached, condenser drive drum, dial locating bracket, and full assembly instructions in sealed carton.

NOTE: LATEST COPENHAGEN PLAN ENGRAVINGS.

COMPLETE **17/6** Trade and wholesale terms available. Enquiries invited.

2-Valve Battery-Operated MORSE OSCILLATOR

FOR MORSE TRAINING

Incorporates note selector contol, volume control, key and interference jacks. Size 9in. × 8in. × 8¼in. Power supply required: H.T. 60 v.; G.B., 4½ v.; L.T., 2 v. Provision for these inside cabinet. Complete with two valves, type PM1LF and LP2.

As new and Complete **15/-** Carr. pkg. 1/6.

Pair of phones (if supplied with unit) **3/6**

Heavy duty morse key 1/3. Valves carry 12 months guarantee.

Terms: Cash with order

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD

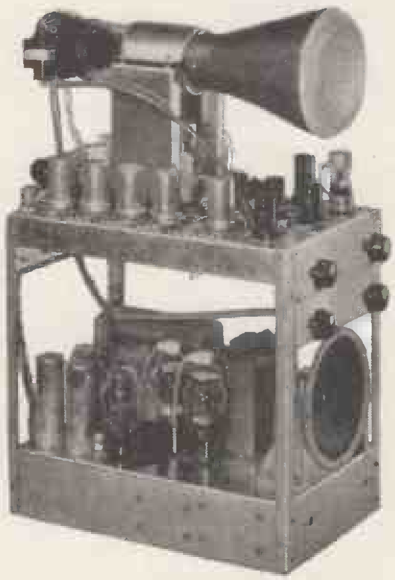
NEW LONG RANGE TELEVISOR KITS

FOR THE LONDON OR BIRMINGHAM FREQUENCIES

—£17 - 17 - 0—

As is usual in 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.

FIVE EASY-TO-ASSEMBLE KITS ARE SUPPLIED :—



A well-made walnut finish **PEDESTAL CABINET** is available from stock at £5/10/0, plus 7/6 carriage and packing.

Working models can be seen during transmitting hours at our Fleet Street and Edgware Road branches.

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 1
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. The Instruction Book costs 2/6, but is credited if a Kit for the complete Televisor is purchased.

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.

20 Valves are used, the coils are all wound and every part is tested. All you need to build a complete Television Receiver is a screw-driver, a pair of pliers, a soldering iron and the ability to read a theoretical diagram.

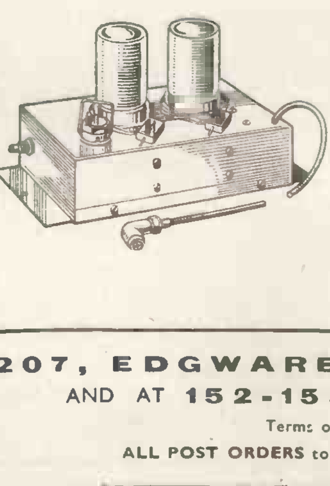
The following sensitivity figures prove that the Premier Televisor Kit is capable of reception at greater distances than any other standard commercial kit or receiver whether T.R.F. or Superhet.

VISION RECEIVER.

Sensitivity	25µv for 15v peak to peak measured at the Anode of the Video Valve.
Sound Rejection	Better than 40 db.
Adjacent Sound Rejection ...	Midland Model Better than 50 db

SOUND RECEIVER.

Sensitivity	20µv. Vision Rejection, better than 50 db.



NEW PRE-AMPLIFIER FOR FRINGE RECEPTION AREAS
With sensitivity better than 35db.

We can supply the complete kit of parts to make this wide band width Pre-Amplifier, using 2 717A Pentodes. With all parts, valves, chassis, diagrams, etc., **27/6**

All parts available separately.

SEPARATE POWER SUPPLY KIT

for use with this Pre-Amplifier can be supplied for **21/-**
(H.T. output 130v., 20mA. L.T. 6.3v., .4A.

When ordering Televisor kits

PLEASE STATE IF THE LONDON OR BIRMINGHAM MODEL IS REQUIRED

BRANCH

207, EDGWARE RD., W.2 Phone : AMBassador 4033 (Open till 6 p.m. Satur

AND AT **152-153, FLEET STREET, E.C.4** Phone : CENtral 2833

Terms of Business : Cash with order or C.O.D. over £1. Send 6d. Stamp for list.

ALL POST ORDERS to our new Head Office : 740 HIGH ROAD, TOTTENHAM, N.17. Phone : TOTtenham 5371.

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

Now being Delivered!

PREMIER TELEVISOR KITS

FOR LONDON AND BIRMINGHAM

USING 9" OR 12" MAGNETIC C.R. TUBES

£19·19·0 *including all parts, valves and loud-speaker, but excluding C.R. TUBE*

(Carriage and Packing 15/-)

CIRCUIT DETAILS

The Vision Receiver consists of 4 R.F. stages (EF54's) which are followed by a Diode Detector and Noise Limiter (6H6) which is directly coupled to the Video valve (EF54).

Complete Kit with valves, **£3/16/0.**

Carriage and packing 2/6.

The Sound Receiver comprises 3 R.F. stages (6SH7's) followed by a Double Diode Triode (6Q7), which acts as Detector and L.F. Amplifier. A Noise Limiter (EA50) is also incorporated. The output valve (6V6) drives a 10in. P.M. Moving Coil Speaker with closed field magnet, which is included in the Time Base Kit.

Complete Kit with valves, **£3/1/0.**

Carriage and packing 2/6.

The Time Bases employ blocking oscillators on both Line (6SH7 and 807), and Frame (VR137 and 6V6). E.H.T. (Non-lethal) is taken from the Line Output Transformer through a voltage doubler employing two valves (VU111). The Sync separators are 6H6 and 6V6.

Permanent Magnet Focusing.

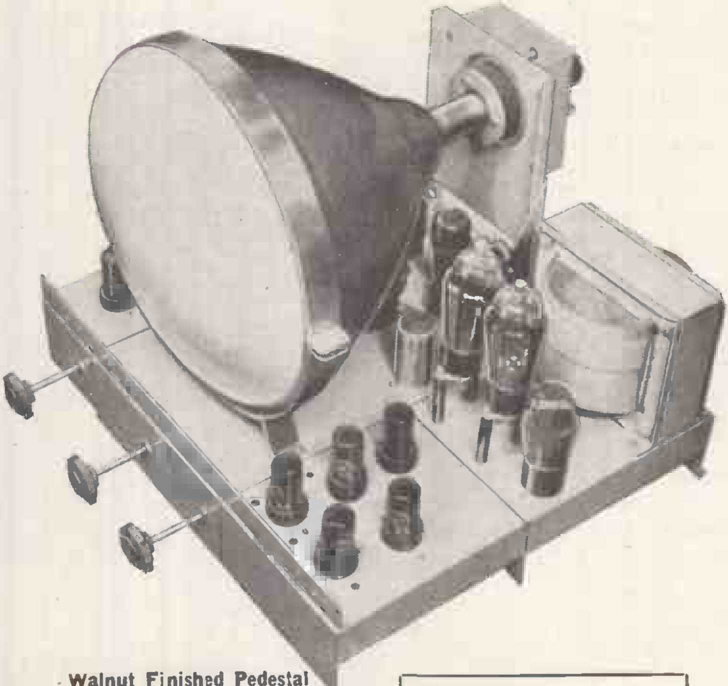
Complete Kit with valves, **£8/5/6.**

Carriage and packing 5/-.

The Power Supply is from a double wound mains transformer completely isolating the receiver from the mains. The H.T. Rectifier is a 5U4G.

Complete Kit with valves **£4/16/6**

Carriage and packing 5/-.



Walnut Finished Pedestal Cabinets from Stock for

9in. Tubes £6 15 0

12in. Tubes £8 8 0

Carriage and Packing 7s. 6d.

EACH KIT OR INDIVIDUAL PART AVAILABLE SEPARATELY

The following sensitivity figures prove that the Premier Televisor Kit is 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 15V peak to peak measured at the Anode of the Video Valve

Sound Rejection : Better than 40 db.

Adjacent Sound Rejection : Midland Model. Better than 50 db.

SOUND RECEIVER

Sensitivity : 20μV. Vision Rejection : Better than 50 db.

"MAGNETIC" CONSTRUCTION BOOK 3/-

207, EDGWARE RD., W.2 Phone : AMBassador 4033 (Open till 6 p.m. Saturdays)

AND AT **152-153, FLEET STREET, E.C.4** Phone: CENtral 2833

Terms of Business : Cash with order or C.O.D. over £1. Send 6d. Stamp for list.

ALL POST ORDERS to our new Head Office : 740 HIGH ROAD, TOTTENHAM, N.17. Phone : TOTtenham 5371.

DON'T MISS THESE BARGAINS

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 amp. 5 v. at 3 amp. Half shrouded drop through, **14/6.**

260-0-260 at 60 mA. 6.3 v. at 3 amp. 5 v. 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 60 mA. 6.3 v. at 3 amp., 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 amp., 202 v. at 2 amp., **27/6.**

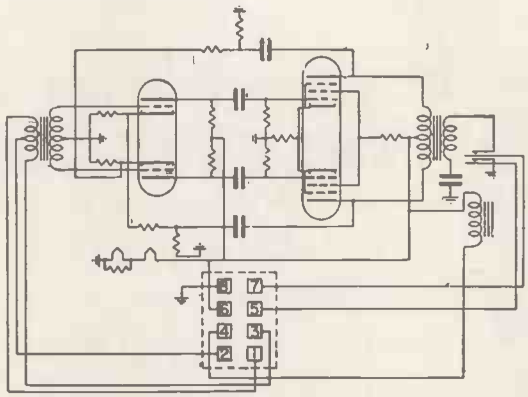
4 KV. at 5 mA., 2 v. at 2 amp., potted with insulators, **67/6.**

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 amp., 6.3 v. at 2 amp., 4 v. at 1 amp., 4 v. at 2 amps., 5 v. at 3 amp., **70/-.**

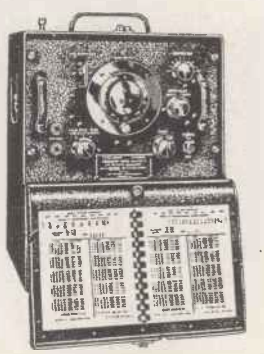
SPECIAL

6.3 v. at 2 amps.,
60 v. at 200 mA.,
tapped 200/220, 230/250,
7/6

PRE-AMPLIFIER MODEL K



The above is the circuit diagram of pre-amplifier model K. You will notice that the circuit includes two double valves, push-pull input, and push-pull output transformers, a relay, a choke, and numerous small resistors and condensers. The whole thing is complete with valves wired up and enclosed in a metal case size approximately 5¼in. × 4in. × 4in. You will readily appreciate that this little unit will fit in almost any cabinet, including table models. These units are very well-made by a famous American company, originally intended for Forces use, to increase the output of low gain microphones and pick-ups. We have a fair quantity available, all new and unused, the price is **17/6** each and as this is the equivalent of a 4-valve push-pull amplifier, it is of course enormous value. We anticipate a big demand, so please order by return.



FREQUENCY METERS BC221

American Manufacture. Accuracy .005%. Frequency range k/cs 20 mc/s. Crystal controlled and temperature compensated. Makes an excellent V.F.O. without impairing its use as a frequency meter. Complete with instruction book. Used, in good condition. Carriage paid, **£25.**

PARTS FOR TELEVISORS

FRAME AND LINE COIL ASSEMBLY

Perfectly made by a very famous maker, for standard type magnetic tubes, 9in., 10in., 12in., or 15in., we have a limited number only, the price is **16/6**, and cannot be repeated once these are cleared, so please act quickly.

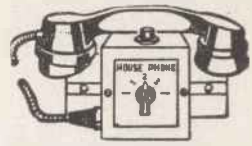
PERMANENT MAGNETIC FOCUSING UNITS. No current drain—for all makes of tubes—patented method of adjusting the gap, giving really clean pictures and even focus of whole of the tube free. Price **16/6** each.

P.M. FOCUSING for clear pictures

R. F. E. H. T. Non-Lethal

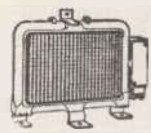
R.F. E.H.T. We were so pleased with the quality of this unit that we have taken up the entire output of the manufacturer, the voltage can be adjusted to make it suitable for working 9in., 12in. or 15in. tubes, the unique design and vacuum impregnation combine to give a trouble-free unit which will give years of satisfactory service, and, of course, the big point about the R.F. E.H.T. is that it is not lethal, the size is only 4¼ × 3¾ × 4in., price complete, ready to operate, **65/-.**

HOUSE TELEPHONES



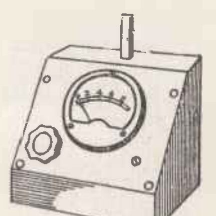
Desk or Wall Mounting

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. 900 watt (heavy) model, **23/6,** plus **5/6d.** carriage. Other models available are: 750 watt, 500 watt, 250 watt, all these are **23/6** each, plus 4/6 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/-.**

MISCELLANEOUS ITEMS

8 kv. sleeving, **3/-** doz. yds. B7G ceramic valve holder, **10d.** Ditto, EF50, **9d.** Pax EF50, **6d.** Int. Oct. Valve holder Amphenol, **6d.** Pax, **4d.** Miniature 100 K pots, **1/6.**

DEPENDABLE SPARES. Unless otherwise stated none of our spares is Government Surplus. Prices do not include postage, for details of this see bottom of this page.

ELECTROLYTIC CONDENSERS

4 mfd. 450 v.	1	6	8 mfd. × 8 mfd. at 450 v.	3	4
8 mfd. 150 v.	1	3	8 mfd. × 16 mfd. at 350 v.	2	6
8 mfd. 350 v.	1	6	8 mfd. × 16 mfd. at 450 v.	3	6
8 mfd. 450 v.	1	11	16 mfd. × 16 mfd. at 350 v.	3	0
8 mfd. 500 v.	2	6	16 mfd. × 16 mfd. at 450 v.	3	9
16 mfd. 450 v.	1	11	16 mfd. × 8 mfd. × 24 mfd. at 450 v.	4	2
16 mfd. 450 v.	2	8			
16 mfd. 500 v.	3	6	25 mfd. × 25 mfd. at 200 v.	3	11
32 mfd. 350 v.	2	8	16 mfd. × 8 mfd. at 350 v.	2	6
32 mfd. 450 v.	3	6	16 mfd. × 8 mfd. at 500 v.	4	6
10 mfd. 25 v.		10	250 mfd. at 12 v	2	3
25 mfd. 25 v.	1	0	16 mfd. × 32 mfd. at 350 v.	3	4
50 mfd. 12 v.		10	12 mfd. at 50 v.	1	3

P.M. SPEAKERS

All speakers are by very famous makers such as Rola, Celestion, Goodmans, etc.

Size.	With Trans.		Less Trans.	
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

ENERGISED SPEAKERS

6½in. with 700 ohm field and hum buckler, price 9/-. 8in. with 2,000 ohm field, hum buckler and output transformer, 15/6.

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.

200 mA. 10 henry	10	0	120 mA. 9 henry	6	6
200 mA. 3 henry	5	0	80 mA. 10 henry	4	6
Midget-type inductance unknown	3	6	80 mA. 5 henry	4	0
			40 mA. 5 henry	3	6

OUTPUT TRANSFORMERS

Midget pentode matching to 3-5 ohm	3	6
Standard pentode matching to 3-5 ohm	3	9
Medium pentode matching to 3-5 ohm	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.

TUNING CONDENSERS

2-gang .0005 mfd. with long spindle	5	6
Ditto, but fitted with trimmers	6	6
4-gang with built-in trimmers fitted into a screening compartment but easily removable	4	9
Single-gang .0005 standard size with medium-length spindle	2	9

LIQUIDATOR'S STOCK

Polished walnut radio cabinet size 20 × 12 × 7½in. complete with L., M. and S. dial, size 7 × 6½in. 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.

FOR 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 resistances and 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.

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 incidently we are not allowed to mention but you will recognise it immediately. This again has normal 2/3 ohm 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 × 2 in.;
- 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, outputsockets, etc., etc. ALL THIS COLLECTION OF PARTS FOR 6/6 only, plus 1/9 postage and packing.

THIS MONTH'S SNIP

RADIOGRAM UNIT BY A VERY FAMOUS MAKER. Comprising centre drive induction motor with speed regulator, auto stop and magnetic pick up, all mounted on a full size unit plate. Brand new in manufacturer's cartons. The motors are 78 R.P.M. type, but we understand that as they are governor controlled, their speed can be reduced to 33 R.P.M. or they can be made into dual speed motor by quite a simple modification. We have no precise details of this modification at the moment, but if these come to hand we will gladly supply free of extra charge to purchasers.

Only a limited supply of these radiogram units are available at this month's Snip price of £5 5s. ea. (this is almost half proper price) so order by return. If not calling enclose 3/6 extra for packing and insurance.

Orders under £2 add 1/6, under £1 add 1/-. Postable items can be sent C.O.D., additional charge approx. 1/-. Good stock of all items at time of going to press. List 6d.

Telephone: Ruislip 5780

ELECTRONIC PRECISION EQUIPMENT (2) ELECTRON HOUSE, Windmill Hill, RUISLIP MANOR, MIDDX.

D. COHEN

RADIO & TELEVISION COMPONENTS

MAINS TRANSFORMERS

Primary 200-250 v. P. & P. on each 1/6 extra.

250-0-250 100 mA., 6 v. 3 amp., 5 v. 2 amp., Upright mounting. 17/6.

250-0-250, 60 mA., 6 v. 4 amp. (to be used on common heater chain with 6×5 rectifier), 13/6.

280-0-280, 80 mA., 6v. 3 amp. 4 v. 2 amp., drop-through, 14/-. Same as above, but 350-0-350 14/-.

Drop thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., 13/6.

Semi-shrouded, drop-thro' 280-0-280, 6 v. 3 amp., 5 v. 2 amp., 15/-. Semi-shrouded, drop-thro' or upright mounting 280-0-280 80 mA., 4 v. 6 amp., 4 v. 2 amp., 12/6.

Auto-wound H.T. 280 volts at 360 mA., 4 v. 3 amp., 2 v. 3 amp., or 6 v. 3 amp. Separate 4 v. 3 amp. rectifier winding (upright or drop-thro'), 10/6.

Heater Transformers Pri. 200-250 v., 6 v. 1½ amp., 6/-; 2, 4 or 6 v. 2 amp., 7/6. P. & P., each 9d.

ELECTROLYTIC CONDENSERS

50 mfd. 50 work. 1/9.
16-24 mfd. 350 work. 3/3.
100 mfd. 12 v. work. 1/3.
16-16 mfd. 450 work. 4/-.
50 mfd. 12 v. work. 1/-.
25 mfd. 25 v. work. 1/2.
16×8 mfd. 450 work. 3/9.
8 mfd. 450 v. work. 1/11.
250 mfd. 12 v. work. 1/3.
8 mfd. 500 v. 2/9.
16 mfd. 500 v. 3/6.
8×8 mfd., 450 work. 3/6.
32 mfd. 350 work. 2/-.
32+32 M.F.D. small tube tag ends 200 v. work. at 2/-.

P.M. SPEAKERS

Size	with trans.	less trans
3½in.	—	9/-
5in.	13/6	—
6½in.	13/6	10/-
8in.	15/6	13/6
10in.	19/6	17/6

P. & P. on each of above 1/- extra

ENERGISED SPEAKERS

8in. 2,000 ohm field with O.P. trans. 5,000 ohm imp., 15/6. 5in. 1,000 ohm field with O.P. trans., 13/6.
Post and packing 1/-.

MIDGET BAKELITE CABINET, 7in.×5½in.×5in. c/w. 5-valve S/H. chassis med./long wave scale and back (Takes std. twin gang condenser and 3½in speaker), 15/-.
EXTENSION SPEAKER, 4in. wide × 4½in. high × 3in. deep at base tapering to 2½in. c/w. 3½in. speaker. 15/-.
Colours of both the above: Cream, walnut, black and maroon. State second choice when ordering.

LINE AND FRAME COIL ASSEMBLY. Frame coils wound but not fitted (full instructions supplied). High impedance frame; low impedance line matching 5-1. 7/6.
6½in. **SPEAKER** (P.M.) specially made for Television with closed field, complete with O.P. transformer. 11/6.
CONSTRUCTOR'S PARCEL
Comprising 5-valve superhet chassis with transformer cut-out, size 13¾in.×6in.×2in., with L.M. and S. scale, size 7in. × 5in. Back plate two supporting brackets, drive drum, pointer, two-speed spindle, twin gang condenser. Mains transformer 250-0-250 v. 60 mA., 6 v. 4 amp. Pri. 200-250, 6½in. speaker and 6×5 rect. **28/-** Plus 2/- post and packing.
6-STATION SWITCHED SUPERHET COIL UNIT, by famous manufacturer. Ideal for Car Radio or radio set. Range coverage Pos. 1, 200-300 m.; 2, 250-360 m.; 3, 250-360 m.; 4, 320-460 m.; 5, 400-550 m.; 6, 1,100-1,850 m.; no oscillator required for lining up, complete with Circuit and medium and long wave frame aerial. 21/-, post and packing, 1/-.
PRE-ALIGNED MIDGET 465 Kc. Q.120 made for the above Coil Unit. 8/6 per pair, post 6d
CHASSIS TO FIT COIL UNITS AND I.F.s, size 11½in.×5½in.×1⅞in. 2/6
MAINS TRANS. TO FIT ABOVE CHASSIS. Pri. 200/250 volt. Sec 250-0-250 v. 60 mA., 6 v. 4 amp., 13/6, post and packing, 1/-.
CONSTRUCTOR'S PARCEL, comprising :—
Chassis 10½in.×5½in.×2in. with speaker and valve holder cut-outs, R. and A. 6½in. P.M. with transformer, twin gang with feet, pair medium and long wave iron cored T.R.F. coils. Four International Octal valve holders, wave-change switch and Erie 20k pot with switch, 25/-, plus 1/6 post and packing
CONSTRUCTOR'S PARCEL, comprising chassis 10½in.×5½in.×2in. with speaker and valve holder cut-outs; Rola 5in. P.M. with O.P. trans.; twin-gang with trimmers; pair of T.R.F. coils; Four international Octal valve holders; wave change switch and Erie 20k pot. with switch, 19/6, plus 1/6 post and packing.
CONSTRUCTOR'S PARCEL, comprising Midget twin-gang with slow-motion drive; pair midget 465 Kc. I.F.s; frame aerial; medium wave osc. coil and layer type H.T. and L.T. batteries 90 v. + 1½ v., 21/-, plus 2/- post and packing.
STANDARD 465 KC. I.F.s. Iron cored Q.120, 7/- per pair.
MINIATURE 465 KC. I.F.s. Type M400B. 12/6, plus 6d. post and packing.
MINIATURE 465 KC. I.F.s (slightly larger than the above item), Q.120. Per pair 10/-.
IRON CORED 465 KC. I.F.s. Q.130, 2¼in.×1⅛in., per pair 6/-.
IRON CORED 465 KC. WHISTLE FILTER, screened, each 2/-.
VALVE HOLDERS. Paxolin International octal. 4d. each. Moulded International octal, 6d. each. EF50 ceramic 7d. each. Moulded B7G slightly soiled 6d. each.
LINE CORD. 3-way 0.3 amp., 180 ohm per yard. 11d. per yard. 3-way 0.2 amp., 300 ohms per yard, 1/-.
CERAMIC P.F.S. 3 each of the following: 330, 220 180 and 82, 2/6.
VOLUME CONTROLS, by famous manufacturer. Long spindle and switch, ¼, ½, 1 and 2 meg, 3/6 each. 20, 25 and 50 k., 3/- each. Post and packing 3d. each.
VOLUME CONTROLS, by famous manufacturer. Long spindle less switch, 5 k., 50 k., 500 k., 1 meg., 1/9 each. Post and packing 3d. each.
5-VALVE A.C. MAINS, 200-250 v., 3 wave-band superhet chassis. 1,000-2,000, 200-550 and 16-50 metres. By very good manufacturer, complete with valves. 6K8 6K7 6Q7 6V6 and 5Z4. Size of chassis 11½in.×7½in.×2in. Size of glass scale 8½in.×7½in. with pick-up sockets (takes 8in. P.M. with trans.). TAX PAID. £8/18/6. Post and packing 2/6.
CONSTRUCTOR'S PARCEL, comprising: 5-valve superhet chassis with I.F. trans. and V/H. cut-outs, 13¾in.×6in.×2in. with L.M.S. scale 7in. × 5in., back plate and two supporting brackets. Drive drum, spindle and pointer, mains trans. G.E.C. 350-0-350 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., and Plessey 8in. M. energised 2,000 ohm field with 5,000 ohm impedance, O.P. trans., 29/6. Post and packing 2/-.
CONSTRUCTOR'S PARCEL, comprising: 5-valve superhet chassis with I.F. trans., and V/H. cut-outs, 13¾in.×6in.×2in. with L.M.S. scale 7in.×5in., back plate and two supporting brackets. Drive drum, spindle and pointer, 6/6. Post and packing 1/6.
CONSTRUCTOR'S PARCEL, comprising: twin gang with feet, pair long and medium iron cored T.R.F. coils, 4 octal V/H., 3 pole 2-way switch Erie 20k. pot. w/s., heater trans. 220-240 v. 1 amp., 2 yds. flat silk flex, 3 black knobs, chassis 10½in.×5½in.×2in. with speaker and V/H. cut-outs, metal rectifier 60 mA., 230 v. and 32+32 mfd. 200 v., 19/6, post paid.
GOVERNMENT SURPLUS. Removed from equipment but guaranteed:
Metal Rectifier, 230 v. 60 mA., 4/-.
Metal Rectifier, 230 v. 80 mA., 5/-.
Post and packing on each, 6d.
8 mfd. metal cased, 450 v. work, with clip, 1/- each.

Stamp for List.

MAINS DROPPERS

2 amp. 1,000 ohms, tapped 900 ohms. 1/9.

.2 amp. 717 ohms, tapped 100 ohms. 1/6.

.3 amp. 520 ohms, tapped 2/6 each.

WAVE CHANGE SWITCHES

3-pole 2-way, 1/2.
4-pole 4-way, and 4-pole 3-way 1/9.
1-pole 12-way, 2/6.
3-pole 12-way, 4/6.
Post and packing 3d. each.

TELEVISION MASKS

White Rubber. 9in. with glass, 10/6.

DUE TO A LARGE PURCHASE OF MANUFACTURERS' SURPLUS WE ARE ABLE TO OFFER THE FOLLOWING :—

Heater transformer fully inter-leaved and impregnated and guaranteed. 6.3 v. 1 amp., max. input 220/240 volts, 3/6, post paid.

THIS MONTH'S OUTSTANDING OFFER

CONSTRUCTOR'S PARCEL, comprising chassis with V.H. and transformer cut-out, size 13¾in.×6in.×2in. with scale size 7in.×5in. Back plate, wo supporting brackets, drive drum, pointer and spindle. Mains transformer input 200-250 v. H.T. 280 v. 4 v. 3 amp. 4 v. 3 amp. and 3 valves, 2 Octal H.F. pentodes, and 1 output valve, all ex-Govt. **£1 1s. 0d.** *Post paid.*

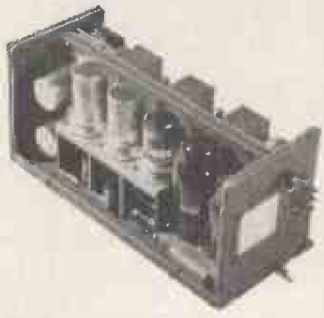
POST ORDERS ONLY

67 RALEIGH AVENUE, HAYES, MIDDLESEX

CLYDESDALE

Bargains in Ex-Service Radio and Electronic Equipment

YOU TOO ! CAN GET GOING ON "144."



The P40 VHF superhet receiver provides yet another basis for that 2 metre rig.
Transmitters prove comparatively simple to build but the receiver is another story, but let us explain—We can supply you with this STRATTON built receiver which can be modified for use on "2."
The set in its present state can be tuned to any spot frequency between 85 and 95 Mc/s by means of a crystal controlled oscillator stage which should not prove unduly difficult to alter, and pruning the coils is quite simple. REMEMBER ! The P40 would make a FB mobile receiver for "144."
Employing an I.F. of 2.9 Mc/s, the valve line includes : I/EF54 RF, I/EF54 MIXER, I/EC52—2/EF54 OSCILLATOR & MULTIPLIER STAGE, 2/EF39 IF, I/EB34 DET & AVC, I/6J5 1st audio, and a 6V6 output. The complete unit is enclosed in a die cast frame with a louvred cover. Dimensions 11½ x 5½ x 4¾in.

CLYDESDALE'S PRICE ONLY £3.19.6 each POST PAID

POWER FOR THE P40 RX.

THE POWER UNIT S-451-B designed for use with the P40 receiver proves to be an extremely handy little unit in any "HAMS" shack, in that it has an LT output of 12 volts, a supply which is often needed for powering Ex-W.D. surplus equipment.

The S-451-B built by STRATTON is complete and ready for use on an A.C. mains supply of 200/250 volts 40/60 cy.

The outputs are 12.5 v. at 2.5 amps and 175 v. at 60 M/a. with double choke smoothing and condenser input.

The power unit is completely enclosed in a die-cast metal frame with a louvred cover. Dimensions 11½ x 5½ x 4¾in.

CLYDESDALE'S PRICE ONLY 39/6 each

POST PAID.

FOR MARINE USE.

The CRV 46151 is a 6-valve superhet suitable for shipping, with a frequency coverage of 195-9050 kc/s 1 RF., and 3 I.F. stages, plus an audio output stage. The 3rd I.F. stage provides C.W. Osc.
VALVE LINE-UP : 4/12SF7, 1/12SA7, 1/12A6 and 1/991 stabiliser.
H.T. power is derived from a 28 v. dynamotor mounted sub-chassis, which has an output of 260 v/70 Ma. The valves are wired in series/parallel providing a 24 v heater circuit.
Complete in metal case 15½ x 8½ x 7½in. Weight 25.8 lb.

CLYDESDALE'S PRICE ONLY £5.19.6 each

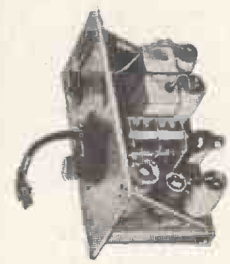
CARRIAGE PAID.

THE 40 METRE RX YOU CAN TAKE WITH YOU.

The receiver unit of the No. 18 WALKIE TALKIE provides an extremely compact set for operation on "40" During tests on 7 Mc/s the 18 Rx proved extremely sensitive and requires only a 2v. accumulator and a 90/120v. H.T. supply with about 1½v. of bias.
The 18 Rx is a 4 valve superhet with regeneration for use when C.W. reception is required, by increasing the L.F. gain control to almost MAX the receiver is in a state of oscillation. The I.F. is 465 Kc/s.
The valve line-up includes 1/ARP12 R.F., 1/ARP12 Mixer, 1/ARP12 I.F., and 1/AR8 2cd DET & AVC and AUDIO OUTPUT. The output jacks are provided for headphone use.
Circuits and details are available as required.

CLYDESDALE'S PRICE ONLY 17/6 each.

POST PAID.



HOT NEWS TIP FOR THE COMMERCIAL RADIO CONSTRUCTOR

WALNUT WOODEN CABINETS.

A professionally built finely finished walnut wooden cabinet with inside dimensions 15¾ x 8½ x 7¾in. complete with a finished dial aperture in the front 5½ x 3½in. and a speaker aperture 5¾x4½in. Three holes are drilled symmetrically below the dial aperture. This is the type of cabinet which will make want to build that new house set. Refer H394.

CLYDESDALE'S PRICE ONLY £1.5.0 each

POST PAID

DIAL GLASS (Graduated) H 410.

A three WAVEBAND DIAL GLASS to suit the cabinet detailed above, completely graduated with station names and wavelength. Dimensions 6 x 4in.

CLYDESDALE'S PRICE ONLY 1/3 each POST PAID

CONTROL KNOBS.

IVORY CONTROL KNOBS 1¼in. diam., ¾in. deep with serrated edges suitable to fit ¼in. spindle with flat side. Knob complete with spring clip. Refer H403.

CLYDESDALE'S PRICE ONLY 9d. each POST PAID.

H404, as above but finished in BROWN

CLYDESDALE'S PRICE ONLY 8d. each POST PAID.

LOUDSPEAKERS.

H396 BRAND NEW 8 inch PM MOVING COIL LOUDSPEAKERS complete with matching transformer. These speakers are standard replacement types and ready for installation, in original makers cartons.

CLYDESDALE'S PRICE ONLY 17/6 each POST PAID.

CONDENSERS.

H399 TWO GANG variable tuning condenser less trimmers .00035 Mfd. nom. with ¼in. spindle ¼in. long. Dimensions 2¾ x 2½in.

CLYDESDALE'S PRICE ONLY 7/6 each POST PAID.

MEDIUM and LONG WAVE PADDERS. 150 and 400 Pf. respectively. These two trimmers are mounted in a single ceramic block fitted with a small bracket for mounting purposes.

CLYDESDALE'S PRICE ONLY 1/- each POST PAID.

H400 8 Mfd. 450 v. Wkg. Ali-can Electrolytic condenser 2¼ x 1in. diam.

CLYDESDALE'S PRICE ONLY 2/9 each POST PAID.

H400A Mounting clips for the above condenser

CLYDESDALE'S PRICE ONLY 4d. each

H401 16 x 24 Mfd. 450 v. Wkg. Ali-can Electrolytic condenser 2½ x 1¾in. diam.

CLYDESDALE'S PRICE ONLY 4/6 each POST PAID.

H401A Mounting clips for the above condenser.

CLYDESDALE'S PRICE ONLY 3d. each or 2/6 doz.

POST PAID.

A "MUST" FOR YOUR WORKBENCH.

An inexpensive ⅛ H.P. motor—modified from the TYPE 29 MOTOR GENERATOR for use on 200/250 Volts A.C. mains. This motor makes an ideal buff, or light tool grinder—or a static drilling machine, a drill chuck can be easily fitted to the end of the 1in. spindle after the existing fan has been removed. Motor size 11in. x 5½in.

CLYDESDALE'S PRICE ONLY 25/- each. POST PAID.

CAN WE HELP YOU.

Circuits and details of numerous ex-surplus units available at low prices. Maybe we can help you to overcome that snag. Write direct.

Order direct from :—

CLYDESDALE SUPPLY CO. LTD. 2 BRIDGE STREET GLASGOW - C.5

Phone: South 2706/9. Visit our Branches in Scotland, England and Northern Ireland

For Quality Bargains – Best Buy at Britain's

COMMUNICATIONS RECEIVER TYPE R1155.

This famous receiver needs no description, but for those not familiar with the set we can supply full circuit details, etc., for 9d. post free. All sets are air-tested before despatch and are supplied complete with 10 valves. We will gladly demonstrate any set to callers. **Brand new.** £9/10/0, or despatched in maker's transit case for £9/19/6, carriage paid. A.C. mains power pack and output stage **for R1155 receiver** enables this receiver to be operated direct from A.C. mains. **Just plug in!** Price £3/10/0, carriage paid.

MEDIUM WAVE COMMAND RECEIVER.

Frequency range 200-600 metres. Valve line up: 12SK7 R.F., 12K8 F.C., 12SK7 I.F., 12SK7 I.F., 12SR7 Det. B.F.O. and 12A6 output (all metal valves). Needs only 50 k. pot. for volume control purposes to be fitted and ten minutes work and receiver is all ready for operation as either a car radio or domestic radio. Note: this receiver is the original medium-wave set with the correct I.F. for the job and not a bodged-up conversion. **Unused and in excellent condition,** only £3/19/6. Circuit details supplied free with set.

RECEIVER TYPE 18.

A four valve battery superhet receiver. Uses standard iron-cored 465 k/cs. I.F. transformers. Complete with all valves. Frequency range 6-9 mc/s. Circuit diagram provided. **Brand new.** Only **17/6.**

RECEIVER TYPE 1147B.

A 7-valve UHF receiver, range approx. 200 megs. Particularly suitable for conversion to 144 mc/s. Valve line-up: two EF50, two EF36 and one each of EBC33, RL7, RL16. This receiver is beautifully constructed and fitted with micro-condenser drive. Contained in black metal case size 8 x 7 x 6in. BRAND NEW IN USEFUL TRANSIT CASE which might have been designed as a tool box! **ONLY 30/-,** carriage paid.

RECEIVER UNIT 25/73 (TR1196).

Valve line-up: two EF36, two EF39, one EK32 and an EBC33. Easily and rapidly converted to a very fine superhet receiver. (See "Practical Wireless" August 1949.) Supplied complete with circuit and conversion data. In very good condition indeed and offered at 22/6, post paid.

RECEIVER UNIT TYPE 6.

Housed in case size 10 x 8 x 7 in. Frequency range 3–7 mc/s. Valve line-up:—five of EF50, and one each of EBC33, and EF36. The dial is exceptionally well geared and calibrated. Slightly soiled condition externally but perfect inside **29/6.** Callers only.

R1355 RECEIVER.

New, but slightly store soiled. **49/6,** plus 5/- carriage.

45 MC/S PYE STRIP.

A ready made vision receiver! (London frequency). Uses six EF50 and one EA50. Complete circuit data provided. All brand new. Less valves, **39/6,** with valves **62/6.**

MODULATOR TYPE 67.

This unit is essentially a heavy duty mains power pack for 230 volts A.C., 50 cps. operation. It contains a heavy duty mains transformer with two 6.3 volt outputs, 5 volts and the H.T. is 345-0-345 volts. Heavy duty choke appropriate smoothing condensers, rectifier, etc. In addition there are sundry SP61's, etc., which we haven't listed. **Don't miss this bargain** at only **52/6,** plus 5/- carriage.

WIRELESS SET NO. 48. Transmitter/Receiver.

Brand new ex-U.S.A. equipment. Frequency coverage 6–9 mc/s. A complete station. All brand new in six cartons. Comprises 1 transmitter/receiver type 48, complete in case, with ten valves and one 1-mc/s. crystal. Two sacchels, one ground aerial, spare valve case, complete with ten spare valves, one key assembly, one hand microphone, two headsets, one hand generator together with mounting tripod, two battery boxes and all necessary interconnecting cables and comprehensive instruction manual. **Special offer for one month only** at less than scrap price. **Only £9/19/6,** plus 10/- carriage. Inland only. Extra for Eire and Overseas.

BRAND NEW AMERICAN MADE 19 SETS.

This is a transmitter/receiver covering 2–8 mc/s. on phone, C/W. and MC/W. It also comprises UHF transmitter/receiver and an intercomm. amplifier. Supplied complete with 15 valves. **Only £15,** plus 10/- carriage.

INDICATOR UNIT 116H.

Brand new and contained in manufacturers original wooden crates. A more up-to-date version of the famous 6A. The contents include VCR97 tube, four EF50, three EB34 and innumerable other useful components. **Price only 79/6,** plus 7/6 carriage and packing.

RECEIVER TYPE 21.

A battery operated superhet receiver covering 4.2-7.5 Mcs. and 19-31 Mcs. Operates as a double superhet on the 10 metre band. Complete with nine 2 v. valves. Circuit diagram supplied. In new condition. 45/- carriage paid.

6 V. VIBRATOR PACK.

Suitable for use with the above set. With circuit diagram. Output 150 v. at 40 mA fully smoothed and rectified. Only **17/6** post free.

ADMIRALTY RECEIVER B36 OR B21.

A superb communications receiver made by Marconi's Wireless Telegraph Company. Valve line-up: two R.F. stages, freq. changer, three I.F. stages, double diode triode, BFO and output pentode. Freq. coverage 1-20 Mc/s. (15-300 metres) in 4 unbroken bands via turret coil change. "S" meter and valve check meter incorporated. Sensitivity for 10 dbs signal to noise ratio—better than 1 microvolt! Filament transformer for 230 v. AC operation is included but the H.T. supply is required. Necessary valves are: International Octal types two of KTW61, two of X65, three of KTW63, one of DH63 and a KT63. In new and unused condition. Complete with circuit diagram. Supplied less valves. **£12/10/-.** carriage paid. Only 20 of these high grade receivers in stock. First come first served!

INDICATOR UNIT 62A.

Contains twelve EF50, four of SP61 (CV118), two of EB34, three of EA50, 13 pots and a VCR97 tube. The finest Indicator Unit of them all. Unused condition but chassis slightly soiled. Offered to callers only. Price **£4/19/6.**

LOUDSPEAKERS.

Plessey 10in. p.m. type. ALNI magnet. Suitable for T.V. Brand new and boxed. Only **17/6** post paid.

MICROPHONES.

M.C. microphone by Vitavox. With on/off switch. 30 ohm impedance. Brand new and boxed. **30/-** post paid.

> LOOK! Marconi/Ekco Signal Generators type TF114G. Marconi/Ekco valve voltmeters. Call for details.

HEAVY DUTY 6 V. ACCUMULATORS.

Size 12 x 9 x 7 in. Brand new. Capacity 85 ampere hours. In teak case. Only **59/6.** Exceptional value.

METAL RECTIFIERS.

Selenium full wave bridge 12 v. 5 amp., **15/- each.**

MAINS TRANSFORMERS.

350–0–350 volts 80 m/a., 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 volts, 130 m/a., 6.3 v. at 6 amps., 5 v. at 3 amps. Fully shrouded top chassis mounting. A quality job. Guaranteed. **27/6.**

E.H.T. Transformer for VCR97 or VCR517 tubes. 2,000 volts, 4 v. for tube heater and 4 v. tapped at 2 v. for E.H.T. rectifier. **30/-.**
All the above transformers have standard primaries, 200/250 volts 50 cycles.

SPECIAL OFFER.

Mansbridge condensers. 4 mfd. 750 v. wkg. All brand new. Six for **10/6.** post paid.

> **SPECIAL BARGAIN FOR CALLERS.**
> **UHF RECEIVER TYPE 1481.**
> Frequency range 65-86 mc/s, 6 in. slow motion drive, 11 of 6.3 v. valves as follows: four of EF39, one of EK32, four of SP61, one of P61, one of EB34. I.F. is 12 mc/s, B.F.O.. etc. **Brand new with circuit. £3/10/0.**

Full range of valves, C R. tubes, components, etc., at very attractive prices. Many, many bargains for the caller. Large quantities of resistors, condensers, valves, etc., for EXPORT AND TRADE DISPOSAL.

> **THE "EASYBUILT" TELEVISOR**
> **COMPLETE DETAILS OF A FULL SIZE MAGNETIC TELEVISOR IN BOOK FORM. DETAILED INSTRUCTIONS, WIRING DIAGRAMS, ETC., A MINE OF INFORMATION FOR ONLY 2/6, POST FREE.**
> **Inexpensive Television data booklet No. 4.** Fully revised and brought up to date. Describes the 45 m/cs. "Pye" strip as well as the R1355 and other well-known government surplus units. Only 2/6, post free.

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

The MAGNAVISTA Television Lens

FROM EVERY POINT OF VIEW —A VAST IMPROVEMENT

The Magnavista Lens is not just a "magnifier"; it is an optical instrument, designed by optical scientists. For perfect clarity, and to avoid distortion, different receivers need different lenses. There is a Magnavista Model specially designed for your set. Here is real television progress which you *can see for yourself.*

PRICES:

There are over 18 different Magnavista models at prices ranging from £4 - 14 - 6 to £7 - 17 - 6.

a product of

METROPEX LTD

38 GT. PORTLAND ST., LONDON, W.I

and

KING'S HEATH STATION, BIRMINGHAM

NEW

R.C.A. TELEGRAPH AND TELEPHONE COMMUNICATIONS TRANSMITTERS TYPE ET. 4336.

Designed and produced by the Radio Corporation of America, the Type ET.4336 is outstanding in the exceptional quality of construction, versatile operation with rapid band selection and adjustment, and the embodiment of modern advantageous features not generally found together in one equipment.
The transmitter is designed for communications service in the high frequency range of 2,200 to 20,000 kilocycles, and any desired operating frequency within this range may be quickly selected, using ordinary crystals. All controls employed in tuning the transmitter to any frequency within the overall range are mounted upon the front panel. Shift from telegraph to telephone operation is switch controlled, and high speed keying is permissible. Two transmission power levels of 250 or 350 watts are available, however the actual outputs obtained are somewhat in excess of these values at 20 mc/s, and increase with decreasing frequency to values in excess of 300 and 450 watts respectively at 3 mc/s.

GENERAL FEATURES.

The complete transmitter is housed in a tall console cabinet, superbly finished, and has a very attractive appearance. Side and rear panels are removeable, and electrical interlocks are fitted as a safety feature. Stylish panel controls are conveniently grouped, and clearly identified. Five Meters are employed to read Aerial, Plate and Grid currents, and Filament voltages. A modulation and keying indicator of the vapour column type is mounted on the front panel. The Type MI-19468 Crystal Multiplier, which we supply with the transmitter, slides into an aperture which is normally concealed by a removeable panel. When employing this unit, the oscillator stage in the transmitter functions as an intermediate P.A. stage, or frequency multiplier, and whilst employment is optional, transmission over the entire transmitter frequency range, using low frequency crystals, is a distinct operational advantage.

CIRCUITRY.

Valves Type 807 are employed in the Crystal Multiplier Unit and the Transmitter Crystal Controlled Oscillator. The Power Amplifier stage utilizes two Valves Type 813 operating in parallel, and the Modulator stage uses two Valves Type 805 operated in a Class B arrangement. Plate and screen voltages for all stages are obtained from a mercury-vapour rectifier comprising four Valves Type 866A, connected in a full-wave parallel circuit. An Antenna Coupling and Matching system is provided, and is so designed to allow the use of various feeder arrangements.

ELECTRICAL CHARACTERISTICS.

Type of Modulation ...	Class B, high level,
Audio-Input Impedance	500 ohms.
Audio-Input Level for 100 per cent. Modulation	20 vu.
A-F Resoonse	±5 db from 400 to 7,500 cycles.
A-F Harmonic Distortion	5 per cent r.m.s.
Power Input :	
Telegraph, Low Power	1.25 kW.
Telegraph, High Power	1.46 kW.
Telephone, 100 per cent Modulation	1.82 kW.
Power Supply Requirements	115—230 v., 1 phase, 50-60 cycles.
Regulation (Maximum) ...	5 per cent.

DIMENSIONS. Height, 58in. Width, 17in. Depth, 24in.

WEIGHT. 500 lb.

CONDITION. New and perfect, as ex-factory. Our Guarantee and Individual Test Certificate is supplied with each transmitter.

We offer immediate delivery of the above equipment to home and overseas buyers; complete and with all valves, at an exceptionally low price.
Full specification and further particulars are promptly available on request.

LAWRENCES

61, BYROM STREET, LIVERPOOL, 3.

Telephone: CENtral 4430.

Experienced Export Shippers.

A GUARANTEE OF SATISFACTION WITH EVERYTHING WE SELL.

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. Rola 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. 2/6 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 1½in. × ⅝ dia., Iron Core, Aerial, H.F. or Osc., 3/6 each.

Electrolytic Condensers. B.E.C. Midget Can Tubular, 8 mfd. 450 v. (1⅝in. × ⅝in. dia.), 2/6; 8-8 mfd. 450 v. (1⅝in. × 1in. dia.), 4/-; 16-8 mfd. 450 v. (1⅝in. × 1in. dia.), 4/6; 32 mfd. 450 v., 5/-; 16-16 mfd. 450 v. (1⅝in. × 1⅛in. 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 k/c, 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 3⅜in. × 2⅛in. × 1⅛in. 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 3⅜in. × 2⅛in. × 1⅛in. 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 4⅛in. × 3⅝in. × 1⅞in., 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.

You're SURE to get it at

STERN'S

ESTABLISHED 25 YEARS

Output Transformer—Stern's. Midget 1⅛in. × ⅞in. × 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; 16in × 8in. × 3½in., 8/6.

I.F. Transformer, 465 k/c. New well-known manufacturer's surplus ⅞in. × ⅞in. × 1⅛in. Iron Core, 9/- each. Denco Iron Core, 465 k/c. or 1.6 m/c. 1⅛in. × 1⅛in. × 3⅛in., 16/6 pair. Wearite Stand Cap, Tuned, 465 k/c., 20/- pr. New Surplus 465 k/c, Iron Core, 4in × 1⅜in. 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/-; 12 or 24 v. 3 amps, 23/-.

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 above 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 2v., 4 v., 5 v., and 6.3 volts 3 amp., 9/6; (b) 4 v. 3 amp. to 5 v. 2 amp. Reversible 6/-; (c) 4 v. 3 amp. to 6.3 v. 2 amp. Reversible, 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. 1⅛in. dia. × 2⅝in.: (a) .15 amp., 1500 ohms, 5/-; (b) .2 amp., 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

"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 4⅜in. × 1⅛in. × 3⅛in.) 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, 9/7.

An attractive Walnut Finished Cabinet, size 9in. × 5¾in. × 5¼in., 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 suppplied se arately 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: IT4 (R.F. Ampl.), IT4 (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. × 4⅛in. × 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 6⅛in. × 4⅛in. × 3in., 12/9. Ever Ready B114 Battery, 9/7. 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 4⅝in. × 1⅜in. × 3⅜in. 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 £3/5/0. 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. issue, at a total cost of £4/10/0 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 Diagrams 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 January 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 "EAS BUILT" TELEVISOR. Full contructional 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 Components 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 of complete Manual 2/6.

★ Send 3d. stamp for our Comprehensive Stock List. When ordering please cover packing and postage.

STERN RADIO LTD., 109 and 115 FLEET STREET, E.C.4

Telephone: CENtral 5814 and 2280

UNSURPASSED PERFORMANCE

The new "RD Baby De-Luxe" amplifier is ideal where an output not exceeding 7.5 watts is required.

Performance Figures

Amplifier: Output, 5 watts with less than .5 per cent total harmonic distortion ● Frequency response ± 1 DB 30-20,000 cps. ● Multiple loops which employ a total of 24 DB feedback, and include all stages and output transformer ● Sensitivity .75 v. for 5 Watts output ● Hum 85 DB below 5 watts output ● Complete stability with inductive, resistive or capacitive load. ● "Woden" iron cored components employed throughout. Pre-amplifier: Sensitivity, pick-up 90 m/V, radio 425 m/V. ● Noiseless switched bass and treble controls, providing compensation for Decca, H.M.V., and L.P. record characteristics, ● Detachable, to operate at a distance from main amplifier.

Prices: Amplifier **£10/10/-**. Pre-amplifier **£4.**

The following firms in London now stock and demonstrate the "RD Baby De-Luxe" amplifier: **Webb's Radio Ltd., The Gramophone Exchange Ltd., Tele-Radio (1943) Ltd.**

QUALITY SUPERHET

By courtesy of the General Electric Co. Ltd., Kingsway, London, we have pleasure in introducing a new pre-tuned superhet, as described in their technical publication TP4. This receiver is ideal for use with amplifiers such as the "Williamson"; where reception conditions are unfavourable to a "straight" type of receiver.

Outstanding Features

- Four pre-selected wavelengths. 3 medium. 1 long.
- Two positions of selectivity. Bandwidth 6 kc/s. and 16 kc/s.
- Very efficient 9 kc. whistle rejector, with approximately 40 DB rejection.
- Variable switched bass and treble controls.

Model RD/TP4: to G.E.C. specification, including extra bass and treble positions for L.P. record characteristics. Ample gain for lightweight pick-ups. Very low overall distortion.
Price: **£18.** Purchase Tax: **£4/4/-.**

Model RD/TP4A: as RD/TP4 but not including tone controls and pick-up input.
Price: **£14.** Purchase Tax: **£3/5/4.**
All individual components for the above units available.

Full details of the above units will gladly be forwarded on request **Trade enquiries invited**

ROGERS DEVELOPMENTS CO.,
"RODEVCO HOUSE," 116 BLACKHEATH ROAD, GREENWICH, S.E.10
Telegrams: RODEVCO, GREEN, LONDON.

---

1 KW TELEGRAPH TRANSMITTERS. Two HF 300's output. Operation 3.5 mc to 16 mc.

HALLICRAFTERS BC 610's. Complete with speech amplifier, antenna tuning unit; exciter units and coils for all bands.

RCA TRANSMITTERS. Type ET-4336. Complete with matched speech amplifier, crystal multiplier and VFO units. Brand new.

LM-300 TRANSMITTERS. (U.S.A.). 140 kc to 400 kc and 650 kc to 1,600 kc. 300 Watt output.

AUTOMATIC HIGH SPEED TELEGRAPH EQUIPMENT "BOEHME" (U.S.A.). Up to 400 signs per minute on line and wireless.

AR-88's, AR-77's, S-27's, HALLICRAFTERS S-37 (VHF 130 mc to 210 mc) HRO'S with coils and power pack.

SKYRIDER DIVERSITY HALLICRAFTERS RECEIVERS. Complete with console, power units and loudspeaker.

All above items in excellent working condition.
Working demonstration upon request.

TX VALVES 803, 805, 807, 813, 814, 832, 861, 866A, DET-16; 6L6 Met. and many others.

Large stock of Tx condensers, crystals and other components. Alignment and repair of communication receivers and all other short-wave equipment undertaken.

P.C.A. RADIO

Transmitter Division:—
The Arches, Cambridge Grove, London, W.6. *Tel. RIV 3279*

Receiver Division:—
170 Goldhawk Road, London, W.12
Tel. SHE 4946

HOME & OVERSEAS
RADIO DEALERS & SERVICE ENGINEERS

are invited to write for our new 1950-51 Season's list. T. C. C. Capacitors, Erie resistors, suppressors, volume controls. Tungsram valves, Brass BA Screws etc., and hundreds of other lines. Postage 3d. Inland, 2/- Overseas Air Mail.

A. W. F. RADIO PRODUCTS LTD.
11 PARK VIEW ROAD, BRADFORD, YORKS.

WALTON'S OF WOLVERHAMPTON
SPECIAL CLEARANCE OFFER!!!

Once again we are making up Parcels of Surplus Equipment which include useful Chassis and Components. Each weigh approximately 100 lbs. and are contained in a non-returnable wooden case.

Parcel No. 1: Radio *Parcel No. 2: Electrical*

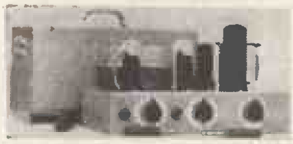
Price per parcel **21/-** *Carriage 4/6*

Our latest LIST gives full details Send S.A.E. to-day

WALTON'S WIRELESS STORES
203, STAVELEY ROAD :: WOLVERHAMPTON

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 inputs for mike and gram with twin faders. Tone control. Complete in case with chrome handle, £9/9/-.

Model AC18E, 6 valve unit with output of 18½ watts. Push-pull output with eedback over 3 stages. Separate mike stage. Inputs as AC10E. Complete in case with chrome handle, £13/19/6.
Model U10E. 6 valve unit for DC/AC mains. Spec. as AC18E. 10 watts output withi eedback over 3 stages. Separate mike stage. Complete in case with chrome handle, £11/15/-. All above have outputs to match 3, 8 or 5 ohm speakers and are ready for immediate use. Finish, Blue stove enamel. Input volts average .003 v mike, .3 v gram. No pre-amplifier required.

MODEL AC4C 105/-

Model AC4C. AC or **U4C** AC/DC 3 valve amplifier chassis for records or radio. 4 watts output to 3 ohms, £5/5/-. All prices include carriage—Stamp for list. The above are as supplied to clubs, schools, hospitals, factories, etc.
SPEAKERS. Stentorian, 2½in., 15/6; 5in., 17/6; Plessey, 8in., 11/9; 10in., 17/6. Truvox, 5in., 10/6; 12in., 42/6. Goodmans, 5in., 12/6; 8in., 16/6; 12in., 130/-. Rola, 3in., 16/6; 8in., 24/-; 10in., 30/-; 12in. (G.12), 130/-. Mains En., 700 ohm field, 10/- (all less o/transfr.).
TRANSFORMERS. E.H.T. 2.5 Kv. 4 v., 4 v. C.T. (for VCR97). Tested 15 Kv., 28/6. 2 x 350 v. 90 mA. 6 v. 4 a., 5 v. 2 a., 18/9. Filament (input 230 v.), 6 v. 1½ a., 5/9; 6 v. 3 a., 8/6; 12 v. 1½ a., 9/6; 4 v. 4 a, 9/6 Output 6V6 to 3 ohms, 3/11; 6V6 P/P to 3, 8 or 15 ohms, 18/-. Midget 154/354, 4/2.
VARIABLE CONDENSERS. 2 gang Midget .0005, 4/3; 3 gang standard size, .0005, 6/9. Solid dielectric, .0003, 3/4; .0005, 3/6. Presets 50 pf., 4d.; 140 pf., 300 pf. or 500 + 100 pf., 1/- ea.
CONDENSERS. 500/550 v. C'b'd., 4 mfd., 2/9; 8 mfd., 3/3; 8 + 8, 4/9; 8 + 16, 6/-; 8 mfd., 2/4; 16 + 16 mfd., 4/6 (all 450 v.). .0001/2/3/5, .01, .05, .1, 350/350 v., 6d.
All goods new and unused. Nearest Tube, Kensal Green.
C.W.O. or C.O.D. Post free over £1.

ASSOCIATED ILIFFE TECHNICAL BOOKS

The books listed below are obtainable at all leading booksellers, or direct from the Publishing Dept., Dorset House, Stamford Street, London, S.E.1. Write for complete Radio Book List.

WIRELESS DIRECTION FINDING

4th Ed. R. Keen, M.B.E., B.ENG (HONS.), A.M.I.E.E. This manual treats the subject comprehensively and supplies a wide range of bibliographical references. New material in this edition deals with systems of navigation using the hyperbolic grid and the application of the Principle of Least Squares to the plotting of a wireless fix, and systems of direction finding which employ special methods of presentation, including automatic systems.
1,059 *pages*. 630 *illus.* 45*s. net.* *By post* 45*s.* 9*d.*

RADIO DATA CHARTS: 43 Abacs for Receiver Design Calculations

5th Edition. By R. T. Beatty, M.A., B.E., D.SC., revised by J. McG. Sowerby, B.A., GRAD.I.E.E. Covers the most frequently recurring problems, the answers to which provide most of the data needed for the design of radio receivers.
91 *pp.* 7*s.* 6*d. net.* *By post* 7*s.* 11*d.*

SHORT WAVE RADIO AND THE IONOSPHERE

By T. W. Bennington. A new edition of "Radio Waves and the Ionosphere." This practical book shows how existing ionospheric data can be applied to problems of short-wave transmission and reception.
138 *pp.* 10*s.* 6*d. net.* *By post* 10*s.* 10*d.*

"ADCOLA" SOLDERING INSTRUMENTS

Reg. Trade Mark

Reg. Design 860302

Designed for Wireless Assembly and Maintenance.
SUPPLIED FOR ALL VOLT RANGES FROM 6/7v. TO 230/50v.
The three Adcola Models cover the requirements of the **Television, Telecommunication and Radar Engineers** and assure thorough jointing.
3/16in. dia. Bit. Standard Model — 22/6
¼in. dia. Bit. Standard Model — 25/-
3/16in. dia. Detachable Bit — — 30/-
Patented in England and Abroad.
Sole Manufacturers:

ADCOLA PRODUCTS LIMITED
ALLIANCE HOUSE, CAXTON STREET WESTMINSTER LONDON, S.W.1. Tele MACaulay 4272

---

15 c/s to 100 mc/s

- - - IN 9 RANGES - - -

AUDIO
RADIO
TELEVISION

AF. RF. SIGNAL GENERATOR TYPE K3
meets the need of those requiring a good instrument for routine tests, measurements or experiments on amplifiers, Radio, Television or other electronic apparatus. ● A clear 6in. scale, for each range, with only the one in use visible, eliminates the confusion so often encountered in multi-range instruments. ● Individual Calibration. 1% accuracy. ● C.W. or M.C.W. (400 c/s) on H.F. ranges ● Output unattenuated—2 volts, variable and Step attenuation to 2 uV, also 20 volts variable on A.F. Ranges. Send for Leaflet.
LIST PRICE **14 Gns.**

ALTAIR INSTRUMENTS 10 LONDON ST. W.2. Telephone: PADdington 5668

RELAYS AND KEY SWITCHES

LARGEST EX-GOVT. STOCK IN GT. BRITAIN

Types 600-3000 Relays — Siemens High Speed
Also A. C. 250 volts 50 cycles
Uniselector Switches, Telephone Switch-boards Telephone Components. Plugs, Jacks, Handsets, Co-Axial Cables — **Government Contractors**

JACK DAVIS (RELAYS) LTD. (Dept. W.)
30 PERCY STREET, LONDON, W.1
Phones: MUSeum 7960, LANgham 4821

RADIOMENDERS LIMITED

FOR SPECIAL TRANSFORMERS AND REWINDS

We specialise in
AMATEURS' WINDINGS, TRANSFORMERS ALL TYPES, CHOKES, PICK-UP COILS, INSTRUMENT COILS, Etc.

Highest workmanship **Good Delivery**

★

RADIOMENDERS, LTD.
Television & Radio Apparatus, Transformer & Coilwinders.
123-5-7 Parchmore Road, THORNTON HEATH, SURREY
LIV 2261. Trade enquiries invited. Established 16 years.

There is only one Portable Pattern Generator

that will give you the B.B.C. wave-form on all channels between 40-70 Mc/s out of viewing hours . . .

There is only one Portable Pattern Generator

which enables a T.V. receiver to be installed or serviced with complete confidence that no further adjustment will be needed . . .

There is only one Portable Pattern Generator

which will enable every minute of a service engineer's time to be used *profitably* . . .

Find out more about the

MURPHY T.P.G.11

before you buy any other make—remember that it is not first cost that matters, but time saved on servicing and installation work over a period of years.

For further details and appointments for demonstrations, telephone TUDor 5277

F. LIVINGSTON HOGG

Specialists in high-grade instruments for the communications industry

65, BARNSBURY STREET, LONDON, N.1

ALEC Davis SUPPLIES Ltd.

DEPT. W.W.

18 TOTTENHAM COURT ROAD, LONDON, W.1

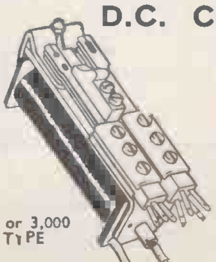
Tel.: MUSeum 2453 Tel.: MUSeum 4539

Shop hours: Monday - Friday 9—5.30. Saturday 9—1

FULL MAIL ORDER FACILITIES. Please add postage

RELAYS (EX-MINISTRY)

D.C. COIL RESISTANCE



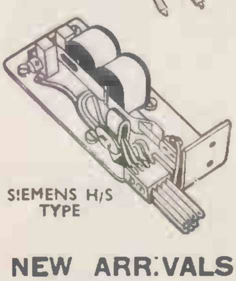
600 or 3,000 TYPE

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.

CONTACTS



SIEMENS H/S TYPE

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/C
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
Elstone 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. 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

L.F. CHOKES.

20 Hy	10 mA.	D.C.	Resistance	1000	ohms.	5/6
10 Hy	75 mA	,,	,,	150	,,	5/6
10 Hy	100 mA	,,	,,	300	,,	10/6
20 Hy	60 mA	,,	,,	500	,,	9/6
50 Hy	20 mA	,,	,,	1000	,,	5/6
50 Hy	30 mA	,,	,,	1000	,,	6/-
15 Hy	150 mA	,,	,,	200	,,	17/
5 Hy	250 mA	,,	,,	80	,,	18/6

AUTO TRANSFORMERS

220/230 v.—110/115 V	40 Watts	12/6
220/230 v.—110/115 V.	75 Watts	17/6
220/230 v.—110/115 V.	100 Watts	19/6

OUTPUT TRANSFORMERS

Wharfedale OP3 30, 60, 90 : 1 Ratio	6/6
,, Type P 30, 45, 60, and 90 . 1 Ratio	7/2
,, GPS 12, 18, 24, 30, 36, 48, 60, and 72 : 1	11/6
,, Universal 20, 30, 40, 60 and 80 : 1	13/6
,, W.12 15, 22, 45 1 Ratio	21/
Quality 6V6 to 3 or 15 ohms	15/-
20 W. 6K ohms P to Plate to 3½, 7 or 15 ohms	30/-
20 W. 8K ohms P to Plate to 3½, 7 or 15 ohms	30/-
20 W. 10K ohms P to Plate to 3½ 7 or 15 ohms	30/-

G2AK *This Month's Bargains* G2AK

POWER TRANSFORMERS. 620/550/375/0/375/550/620 v. at 200 mA. plus 250 mA. at the 375 v. taps. Two separate windings for rectifiers of 5 v. at 3 a. each. Primary 230 v. 50 c. Rated at 278 watts. Our price, 39/6, carriage paid.
HEAVY DUTY L.F. CHOKES. Fully potted. 30 Hy. 100 ma. 150 ohms (Weight 14lb.). Price 13/6. 20 Hy. 126 ma. 100 ohms (Weight 14lb.). Price 15/6. 30 Hy. 150 ma. 150 ohms (Weight 18lb.). Price 17/6. All transformers are carriage paid except to Eire, for which we must ask for 5/- extra.
SPECIAL OFFER. Four 807 valves for £1.
RECEIVERS TYPE 18. Covers 6-9 mcs. and are for battery operation. New condition. Complete with four valves. Only 17/6 each.
TWIN FEEDER. 80 ohms, 5d. per yd. Twin Ribbon Feeder, 300 ohms (heavy duty), 5d. per yd. Co-ax. Cable, ¼in. dia., 70 ohms, 8d. per yd.
Postage on above feeder and cable, 1/6, any length.
TRANSFORMERS. Input 200/250v in 10v. steps. Secondaries, 500,500v,120ma, 4v 3·5A c.t., 4v 4a c.t., 4v 4A c.t. and 10v 1A. 4v can be connected to give 6v if required. Beautiful job, not pitched-in junk. Our price 30/-, packing and carriage 1/6.
SMALL FILAMENT TRANSFORMERS. Input 230 v. Output 6.3 v. Tapped at 4 v. 1.5 amps. Price 7/6. Postage 9d.
MICROPHONE TESTER. In smart teak case 7"×5"×5", contains three jacks, mike transformer, terminals, sockets, etc., with 0-10v rectifier-type meter, 1,000 ohms per volt. 17/6 plus 1/6 post and packing.
500 MICRO-AMP METERS, scaled 0-600, 5/- each.
POWER TRANSFORMERS. 320/320 130 mA, 6.3 v. 5 a. C.T., 5 v. 3 a. Primary 200/250 v. 50 c. Drop through type, 22/6, post 1/6.
VIBRATOR PACKS. 6 v. input. Output 180 v. 40 ma., fully smoothed. Price 19/6, plus postage 1/6. 12 v. input. Output 300 v. 100 ma., fully smoothed. 19/6, plus postage 1/6. All packs are tested and sent out in working order.

PLEASE PRINT YOUR NAME AND ADDRESS.

CHAS. H. YOUNG, G2AK
All Callers to 110 DALE END, BIRMINGHAM
Phone: CENTRAL 1635.
Mail Orders to 102 HOLLOWAY HEAD, BIRMINGHAM
Phone: MIDLAND 3254.

MIDLAND INSTRUMENT CO.

FOR GOVT. SURPLUS STOCK ETC.

MAINS TRANSFORMERS. Input 200-220-240 v. 50 cycles 1-phase, tapped output giving 3-4-5-6-8-9-10-12-15-18-20-24-30 v. at 2 amps., superior job, with termination data, new boxed, 20/-, post 1/3. **L.T. RECTIFIERS,** selenium, D.C. output 12 v. 1¼ amp., suitable for use with above transformers, will charge 2 to 12 v. battery, new unused, 7/6, post 7d. **WAVEFORM GENERATORS TYPE 30,** includes 5 valves, VR65 (2), 6V6G, VR116, VR54. Also various transformers, coils, resistors and conds., etc., chassis mounted with side protection, new unused, 12/6, post 1/-. **IMMERSION HEATERS,** water or other liquids, 230 v. 500 watts, fitted high-grade thermostat which cuts out at 80° C., and in at approx. 3 degrees less, 1⅞in. dia. hole flange mounting, superior make, new unused, 12/6, post 1/-. **MOTOR GENERATORS TYPE 72,** these can be converted in a few minutes to an efficient sewing machine, etc., motor, fitted 3/16in. shaft, standard base mounting, approx. 7in. long by 3in. dia., 200/250 v. A.C., new unused, with data for converting, 15/-, post 1/6, precision turned brass v-pulleys to fit above motors, ⅞in. dia., 2/6 extra, motors converted and fitted pulley, 20/-, post 1/6. **TELESCOPIC DINGHY MASTS,** extend to 7½ft., base ⅝in. tapers to 5/16in. dia., suitable for aerials, microphone stands, fishing rods, etc., weight 6 oz., new unused, 5/-, post 6d. **AUTO TRANSFORMERS,** 1.6 kVA., 230 v. 50 cycles 1 phase, tapped for 40-80-110-150-190 v. at 7 amps., new unused, bargain, 45/-, carriage 5/-. **UNITS.** Contains a 4-section mains suppressor, 10 H., 80 m/A. smoothing choke, 10 mfd. 450 v.d.c. surge-proof electrolytic conds., 400 plus 400 ohm 2-pole make relay, slug at armature end, twin selenium relay rectifier, plate mounted, new unused, bargain, 5/-, post 1/-. **MICROAMMETERS** 0-100 2½in. scale, flush panel mounting, new boxed, 30/-, post 6d. **MICRO SWITCHES,** 4 different patterns, new unused, 5/-, post 7d. **MOTORS** fitted enclosed centrifugal fan blowers, 24 v. A.C./D.C., or 12 v. with less effect, new unused, 7/6, post 10d. **TELEPHONE SETS,** consists of 2 combined microphones and telephones, 25ft. twin connecting flex, provides perfect 2-way communication, self-energised (sound power) no battery required, new boxed, 7/6, post 7d. **A.C. BELLS,** single dome with enclosed mechanism, suitable for 230 v. A.C. mains, new unused, 2/6, post 7d. **SATCHWELL THERMOSTATS,** oven type, 250 v. 15 amp. A.C. or .1 amp. D.C., variable setting knob, 10 to 90° C., stems 12in. long, flange fitting, new unused, 25/-, post 10d. **WINCHES** for hand operation or can be motorised, geared 187.5 to 1, triple stranded steel cables extend to 6ft., ¾in. dia. bar support, cables fitted shackle, lifts 12 cwt., supplied less handles, new unused, 30/-, post 1/6.

Send S.A.E. for a copy of our new 29-page lists; contains many fresh items.

MOORPOOL CIRCLE, BIRMINGHAM 17.

Tel.: HARborne 1308 or 2664

THE IDEAL MICROPHONE FOR TELE-COMMUNICATION

MODEL C 51
MOVING-COIL MICROPHONE BY

Designed and developed essentially for G.P.O. hand-sets, with mobile tele-communication and P.A. work in view, LUSTRAPHONE Model C.51 is fast establishing itself wherever a good microphone is called for. It provides maximum intelligibility at extreme range and under adverse conditions, and is used extensively by Broadcast Engineers and others needing quality and dependability. Available as insert unit, or complete hand instrument. Data sheet on request.

LUSTRAPHONE LUSTRAPHONE LTD. 84, BELSIZE LANE, N.W.3

WANTED

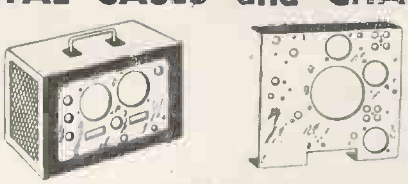
SURPLUS

All types of receiving and transmitting valves.
Regulator, control and special purpose valves.
Radar Units and Accessories.
Receiving and transmitting equipment.
Cathode Ray Tubes.
V.H.F. and S.H.F. valves.
Wave guide sections and pieces.
Centimetric instruments and equipment.
Klystrons and magnetrons.
Test Instruments and Laboratory Equipment.

Large or small quantities.

Details to Box Office No. 7010

ELECTRONIC INSTRUMENT METAL CASES and CHASSIS



and General
SHEET METAL WORK

CHASE PRODUCTS (Engineering) LTD.
27, Packington Road, South Acton, London, W.3.
Tel.: ACOrn 1153/4.

WANTED?

CONDENSERS	Silver Mica · Tubular · Mansbridge
CRYSTALS	American · British
HEADPHONES	High and low impedance
METERS	Thermo · Moving Coil · Moving Iron
PLUG & SOCKETS	All types
RESISTORS	Carbon and wire wound
VOLUME CONTROLS	Carbon and wire wound

We hold large and comprehensive stocks of new components and units, both Government and Manufacturers' Surplus.

Your specific requirements are invited

Wholesale and Export only.

ANDERS RADIO LTD.
167, HAMPSTEAD ROAD, LONDON, N.W.1
EUS.: 1639 EST. 1928

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.

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

BROUGHTON quality amplifiers, 10-12watts, for 3, 9, 15ohm speakers, p.p. output, couples to pre-amp by extension cable for a full range of bass and treble control, complete with top cover; £26/10; packing crate £1/5 returnable, carriage paid.—C. Steward, The Glen, Broughton Rd., Hadleigh, Essex. [5799

NEW amplifier by Midland Radio Coil Products: The Symphonic Seven High Fidelity portable, seven watts of high fidelity reproduction in highly portable form full bass and treble tone controls, 2-stage N.F.B., high gain; price £10/15/6.—For full details of this and other amplifiers and radio feeders address a post card to 19, Newcomen Rd., Wellingborough. [5618

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

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

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.

NEW RECEIVERS AND AMPLIFIERS

WILLIAMSON amplifier from £15/10 to exact specification, also a revolutionary new 20w amplifier with two d.c. stages, of exceptional high quality, tuning units, etc.—For details and demonstration write or 'phone A. S. Colman, 1, St. Stephen's Gardens, W.2. Bay. 3661. [6117

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

EDDYSTONE 680 as new, maker's guarantee expires Feb. 1951; offers.—Box 6781.

EDDYSTONE 358X, 150kc/s, 31mc/s, ex-W.D.; £12/10, or nearest offer.—Box 7152.

11-VALVE radiogram chassis 5 W.B. 10w P.P. output, E. speaker; 10gns.—13, West Vale, Filey. [6026

R1155, as new, in orig. case, with power pack and speaker; carr. paid; £10, or nearest.—Box 7150. [6158

PHILIPS P.C.R. communication receiver, with ac power pack, £12.—31, Alexander Terrace, Douglas, I.O.M. [6139

COMPLETE 30-watt amplifier, 4 K.T.66s in parallel push-pull switching for mic. gram. or radio, £18/10.—Mit. 3668. [6096

SOUND sales 456 amplifier, P/P PX4bs, 5 watts 3 db, 20c-20kc; offers.—Waters, 152, Stifford Long Lane, Grays, Essex. [6020

V.R.L. double conversion receiver with 19 spare valves and 350 watt auto-transformer, little used; offers.—Box 7153. [6167

HAMMALUND, super pro, as new, complete with power unit and speaker, £40.—Philbey, 219, Ilford Lane, Ilford 0295, Essex.

TRIX amp. with speaker and extra speaker, mic and chrome stand, type U, 200-250v; £25-£30 new.—Apply Horse & Groom, Cambridge. [6150

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

EDDYSTONE model S750, new, £45.—Ring Chancery 8720, 10.30 a.m.-4.30 p.m. F. W. Thompson, 37, Chandos Court, The Green, Southgate, N.14. [6104

H.R.O. Rx's from £12/10; some coils now available; also in stock, AR88, AR77E, BC348, CR100, S27, SX16, etc.—Requirements please to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0053

8V AC high quality amplifier and feeder unit, 3 w.b. 6V6 P.P. output, 2 chassis, black and chromium; £15/15, guaranteed; 7v AC/DC radiogram chassis, 3 w.b. P.P. output, illuminated glass dial, guaranteed; £12.—Box 6779.

HAYNES radiogram, complete in cabinet; two R.F. tuner unit; 14-watt amplifier with PX.25 valves; Garrard auto-changer; crystal pick-up; Goodman's 12in speaker on separate baffle; spare valves; also Williamson amplifier and pre-amplifier and tone control unit.—Box 7154. [6169

SCOTT Philharmonic 30v receiver in magnificent cabinet with lightweight auto-changer, many refinements, complete with service books, etc.; this receiver is considered the world's finest domestic radio and was purchased regardless of cost; Voight domestic and H.C. speakers, twin units, Lowther amplifiers; a first-class high fidelity system; AR88D with speaker, trimmers untouched, in mint condition; offers wanted; s.a.e. for full details.—Hampshire, 1a, Thornton Hill, S.W.19. Tel. Wimbledon 6718.

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

B.C. 967a U.S. Army receiver, 5 wavebands, 2/20 mc/s, 9 valves, RF., 3I.F., 2 D.D., etc; vernier tuning can be used for D.F.—L.V.P., Stanstead Hotel, Sutton, Surrey. [6162

BEST offers (1) Philips 1947 5-valve AC/DC 3W.B. model, unavailable England, (2) Decca FFRR head (low impedance), (3) Decca case for Garrard autochange unit.—Box 6953.

ENGLISH electric model 1550 televisor, 15in tube, superb results, less than 50 hours use, gladly demonstrated in Bury district, 90 miles from Sutton Coldfield; offers over 85gns.—Box 6774. [5988

NATIONAL HRO seven sets coils AC, power pack, complete with 12-inch Vitavox high fidelity speaker and fitted oak stand (optional); best offers over £45 (forty-five pounds) to—Pritchard, 55, Aldhelm Crescent, Hawthorn, Wilts. [6068

BATTERIES

WALTON'S OF WOLVERHAMPTON offer Ni-Fe accumulators.
ONCE again we have been fortunate to secure a limited number of these famous accumulators; all are new and have never been filled with electrolyte, but are slightly externally soiled due to storage; voltage, 2.5 (2 cells), Cap. 15 A.P.H. Act. size 2½in×2½in×8in deep.
LIST price over 50/-; our special price, including packing and carriage, 12/6 each, 3 for 30/-, 12 for £5.
WALTON'S WIRELESS STORES, 203, Staveley Rd., Wolverhampton. [0011

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 electric 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

VALRADIO D.C./A.C. converter, type 230-200; 200 watts, 75 cycles, unused, £11.—Box 6794. [6048

LIGHTING plants; please note items 1, 2 and 3 are not surplus but current products of well-known British manufacturers.
ONE alternator, 230/1/50, 3kva, belt driven by Petters very latest type diesel engine, governor control, self energised, voltage control, starter handle or press button, also by remote control, 1 press button start and stop unit supplied, extra units supplied; complete with H.D. starter battery and charger; cheap to run; engine covered by Petters inspection service; strong, lasting job; tested on full load; supplied ready for use, £195 delivered; second plant with Petters latest diesel engine, 5hp, 1,500 rpm, direct coupled to alternator, 2.5kva, 230/1/50, self energised, voltage controlled, handle or press button start, main switch and fuses, voltmeter, tested on full load; £135 delivered; starting battery extra; only a few at this price; covered by Petters inspection service.
230/1/50 ALTERNATOR, 400va with volt reg., self energised, clock or anti-clock, 3,000 rpm, 44 cycles at 2,500 rpm, suitable television, etc.; £18/10 delivered; 12 and 24v charging and lighting sets, new or used, example, Chore Horse, 32v 11a, 4-stroke, air-cooled, dynamo, self-start, ammeter, auto cut-out, Field reg. terminals, cheap to run, new, unused; £20 delivered; used, £14.
ONAN 24 or 30v 1.25kw, self start, tested, used but good condition; £18.
NEW unused, unfilled, uncharged, 6v batteries, 72, 85, 110-125, 23 plate and 200 amp/hr; £2-£6 delivered; descriptive price list; send P.C.; engines, 1.2 and 3½hp; cheap.
HEAVY flexible rubber covered cable, 100amp, 2/- yd, heavy duty sliding res. charging and rectifying equipment; no catalogues or lists (except 6v batts.); please state exactly your requirements; see displayed ad., page 100, for S.T.C. rectifiers, including just available new high-voltage disc, E.H.T. rect.
TERMS, c.w.o., pro forma invoice, or c.o.d. (post goods only).
PEARCE, 66, Great Percy St., W.C.1. Near Angel. [0014

DYNAMOS, MOTORS, ETC.—SURPLUS AND SECONDHAND

E.D.C. rotary converter, 200-230v D.C. to 230 V. A.C., 180 watts, latest type, as new, with voltage regulator, smoothing and silence cabinet, suitable television or radio.—Dr. Cameron, Pro. 5440. [6002

NEW LOUDSPEAKERS

BASS reflex chambers from £4/7/6; cross over units; write for lists.—E.L.R., 342, City Rd., E.C.1. Terminus 2303. [6013

BASS Reflex cabinets, beautiful walnut finish, for all good speakers; stamp leaflets.—Cabinetware, 1a, Heyes St., Blackburn. [0090

LOUDSPEAKERS—SURPLUS AND SECONDHAND

VOIGT P.M. unit in domestic carrier, horn speaker; £50.—Box 6960. [6095

VOIGT m.c. speaker, AC/DC with home constructor's horn, £15/15; Voigt m.c. pick-up for auto changer or with own tone arm, £5; pre-war quality AC/DC motor, 78rpm, with non-magnetic turntable, £4; R.C.A. amplifier, 15 watts, unused, £10.—62, Lichfield Rd., Sutton Coldfield, Warwickshire. [6124

TRANSMITTING EQUIPMENT

TR9 transmitter-receivers; these were formerly sold at £6 each, the remaining few to be cleared at 25/-, carriage paid.
THE STAMFORD RADIO Co., 199, Stamford St., Ashton-under-Lyme, Lancs. [0200

INTERNATIONAL marine radio transmitter and receiver, for telephony or telegraphy, with motor generator, in perfect condition and complete with instructions and diagrams; £40.—For further details apply Overhill Engineering Co., Ltd., Holton Heath, Poole, Dorset. [6128

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

LABORATORY equipment, enquiries are invited for various precision electronic measuring instruments and a quantity of electrical test equipment.—Details and prices on application to Truvox Engineering Co., Ltd., 130, Mount Street, W.1. [6093

OSCILLOSCOPE and Wobbulator complete, £20; T.B. c/s 10 to 350,000 c/s X and Y plate amplifiers, easy to handle, has outstanding performance fully guaranteed, immediate delivery with set of leads and booklet, "Oscilloscope Technique"; further details from the manufacturers.—Erskine Laboratories, Ltd., Scalby, Scarborough [0180

TEST EQUIPMENT—SURPLUS AND SECONDHAND

AVO model 7, new and unused, in makers' carton; £14/10.—Box 6780. [6003

UNIVERSAL Avo Minor, £5.—Cherrywood, Styecroft Rd., Chalfont St. Giles, Bucks.

UNUSED Oscillograph, model No. 339 by Cossor; £50.—Wills, Station Approach, Gravesend. [6143

VALVE tester, in good working order, E.S. & T.P., Ltd., Manor Way, Boreham Wood, Herts. [5981

COSSOR D.B. oscilloscope model 339A, blue tube, as new; £30.—Lugg, Fairyfield, Newton Rd., Great Barr, Birmingham, 22A. [6084

TAYLOR meter, generator and valve tester, cost £60, unused; best offer over £30.—Cycle Shop, Queen's Rd., East Grinstead, Sussex. [6116

R.C.A. U.H.F. signal generator, type 710-A covering 370 to 560 mc/s.—Box No. 570, Dorland Advertising, Ltd., 18-20, Regent St., S.W.1. [6129

A.F. oscillator, C.R.O., microphones, power unit, flash test, meters, loudspeakers, etc., for sale; amateur giving up; list available.—Tovey, 63, Hythe Rd., Swindon. [6161

AVO valve tester, Hunts resistance and capacitance analyser, B.P.L. R.F. signal generator, all in excellent condition; also 230, up-to-date service sheets; the lot £27, instruments separate if required.—L. Wilson, 4, Delph Lane, Leeds, 6. [6130

SALFORD sig. gen. 517F, £40; Cossor 339 D.B. Scope, £30; Marconi TF340 output meter, £20; Dumont Scope, £20; Avo valve tester, £12; Marconi valve voltmeter, £37/10; Advance El. Sig. Gen., £16, all as new, carr. extra; many other items in stock.—Please state requirements to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0056

BARGAIN! As brand new! Original export packing! One Mullard Cathode Ray Oscillator, Type E-800/1; one Mullard Cathode Ray Oscillator Type E-805; one Mullard Cathode Ray Tube Unit, Type B-100; two LTP voltage stabilizing, oil cooling transformers, output 230v, 1kVA suitable for use with an input voltage varying between 190-260v; two LTP single-phase rectifier units 230v 50 c/s and output of 145v, 7a, dc; please write.—ATA Scientific Progress, Ltd., 63, Kensal Rd., London, W.10. [6144

NEW GRAMOPHONE AND SOUND EQUIPMENT

TAPE recordings platforms, using 2 motors and 2 heads, complete with tape and spools; £10/10; limited number only.
A. S. WARBURTON, 70, Alcester Rd., Moseley, Birmingham, 21. [6171

MAGNETIC tape, Emitape type 65 on 1,200ft spool, 25/-; paper tape, 25/-; blank recording discs, 12in d/sided, 4/6; all from stock; full trade terms available.
SOUND DISCS (SUPPLIES), Ltd., 178, Bispham Rd., Southport, Lancs. Tel. 8153. [5335

INFINITE baffle corner deflectors, scientifically designed acoustic chambers for 8 to 15in speakers; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0064

GALPINS

ELECTRICAL STORES

408 HIGH ST., LEWISHAM, LONDON, S.E.13

Tel. : Lee Green 0309 *Near Lewisham Hospital*

TERMS : CASH WITH ORDER. NO C.O.D.

All goods sent on 7 days' approval against cash.

EARLY CLOSING DAY THURSDAY

DYNAMOS BY WELL-KNOWN MAKERS. 110 volts, 1 kilowatt D.C. output, 2,300 R.P.M., £5/10/0 each, carriage 10/-. A.C. Alternators, output 85 volts at 2½ amps. 75 cycles, 2,300 R.P.M., £3/10/0 each.

CONDENSERS by well known makers. (New boxed). 2,500 M.F.D., 50 v./wkg., 7/6 each. Smoothing Chokes, 3/5 henries at 250 m/a., as new by well known makers, weight 7 lb., 12/6 each.

BRIDGE MEGGERS by well known makers. 250 v. type complete in leather carrying case, as new, £12/10/0 each, carriage and packing 7/6. Also a few Wee Meggers for sale, price on application, 250 volt type.

LARGE RECTIFIER UNITS. Input 100/250 v. A.C., 50 cycles 1 phase, output 36 v., 20 amps. D.C. Smoothed, as new, weight 2½ cwt. A few only to clear, £15/10/0, carriage forward.

SPENCER TURBO COMPRESSOR UNITS fitted with a Universal A.C./D.C. 250 v. 2 h.p. motor, 10,000 R.P.M., 3 inch inlet and outlet, condition as new, £12/10/0, carriage 10/-.

ROTARY CONVERTORS. 24 volts D.C., input 50 v. 50 cycles 1 phase at 450 watts output, complete with step-up transformer from 50 to 230 v., £6/10/0 each, carriage 10/-. Condition as new.

MAINS TRANSFORMERS (new). All with 200/250v. primaries in steps of 10 v. Output 350/0/350 v. 180 m/a., 6.3 v. 8 a., 5 v. 3 a., 37/6 each ; 350/0/350 v. 180 m/a., 6.3 v. 4 a., 5 v. 3 a. 4v. 4a., 37/6 each ; 500/0/500 v. 150 m/a., 6.3 v. 4 a., 4 v. 4 a., 5v. 3 a., 42/6 each.; 425/0/425 v. 160 m/a., 6.3 v. 3 a., 6.3 v. 3 a., 5.3 a., 39/6 each. Carriage extra 1/6.

ISENTHAL SLIDER W/W. control Dimmer Resistances, mains voltage, 750 watts, from full to b/out, 27/6 each, carriage 2/-. **CELL TESTING V/METERS,** reading 3-0-3 v. moving coil movements, by well known makers, 7/6 each.

MAINS TRANSFORMERS (new). All 200/250 v. primaries in steps of 10 v. Output 350/0/350 v. 300 m/a., 6.3 v. 8 a., 6.3 v. 8 a., 4 v. 4 a., 5 v. 4 a., 62/6 each ; 450/0/450 v. 300 m/a., 6.3 v. 8 a., 6.3 v. 8 a., 4 v. 4 a., 5 v. 4 a., 62/6 each ; 500/0/500 v. 300 m/a., 6.3 v. 8 a., 6.3 v. 8 a., 6.3 v. 4 a., 5 v. 4 a., 4 v. 4 a., 67/6 ; 350/0/350 v. 250 m/a., 6.3 v. 8 a., 4 v. 8 a., 4 v. 4 a., 6.3 v. tapped 2 v. 2 a. (electronic), 57/6 each. Carriage 3/6.

EXTENSION P.M. SPEAKERS. Makers Johnson & Phillips, 3½ inch, 2/3 ohm speech coil. Will handle 1½ watts (new boxed), 8/6 each. Rotary Transformers, ex-R.A.F., D.C. to D.C., 28 v. to 1,200 v. at 70 m/a., 7/6 each, carriage 1/6.

MAINS TRANSFORMERS (new). All 200/250 v. input in steps of 10 v. Outputs 0, 6, 12 and 24 v. at 10/12 a., 47/- each ; 0, 18, 30, 36 v. at 5/6 a., 42/6 each ; 0, 6, 12 and 24 v. at 25/30 a., 68/6 each ; 0, 6, 12 and 24 v., 5/6 a., 35/- each.

PRE-PAYMENT 1/- SLOT ELECTRIC LIGHT CHECK METERS, all electrically guaranteed, 200/550 volts 50 cycs., 1 ph., A.C. input, 2½ amp. load, 27/6 each ; 5 amp. load 35/- each ; 10 amp. load, 42/6 each ; 20 amp. load, 50/- each, carriage 2/- extra ; in quantities of one dozen or more a special discount of 10%.

EX R.A.F. MICROPHONE TESTERS. These contain a 2½in. scale 0 to 450 Microamp meter shunted to 1 m/amp. calibrated 0 to 10 volts, moving coil, complete with 1 m/a. rectifier, "mike transformer," etc., all contained in polished wood box, as new. 17/6 each.

POWER TRANSFORMER AUTO WOUND voltage changer, tapped 0, 110, 150, 190 and 230 volts at 1,500 watts, £5/5/0 each, carriage 3/6 ; ditto, 2,000 watts, £6/5/0 each, carriage 3/6; another tapped 0, 110, 200, 230 volts at 350 watts, at 47/5 each, carriage 2/-.

ELECTRIC LIGHT CHECK METERS, quarterly type, for sub-letting garages, apartments, etc., all fully guaranteed electrically for 200/250 volts A.C. mains, 50 cycs., 1 phase, 5 amp. load, 17/6 each 10 amp. load, 20/- ; 20 amp. load, 25/- each ; 50 amp. load, 37/6 each ; 100 amp. load, 45/- each ; carriage 2/- extra on each ; special discount of 10% on quantities of one dozen or more.

MAINS VARIABLE SLIDER RESISTANCES, protected type, by well-known makers, 450 ohms, .9 amps., 22/6 each ; ditto, 1,500 ohms to carry .45 amps., 22/6 each, not protected, 0.4 ohms, to carry 25 amps., 10/- each ; 14 ohms to carry 1/4 amps., 12/6 each.

NEW GRAMOPHONE AND SOUND EQUIPMENT

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

SCOPHONY-BAIRD tape recorder (portable), 6-valve, push-pull 6V6s, frequency range 50-8,000 cycles, complete with 1,200ft tape and M/C. microphone, brand new with 3 months' guarantee, £45; slightly used model, less microphone, £38/10; tape and wire recorders bought for cash.

HAYNES & SONS, 14, St. Mary's, Bedford.

LINE-A-TONE tape recording panels; a precision panel comprising 2 motors, high fidelity sound and erase heads, high-speed capstan suspended on ball races, giving tape speeds of 7½in, 15in and 30in per sec.; freedom from wow, no unlacing necessary for rewind; finished in black crackel, size 14in by 12in, £20.

LINE-A-TONE tape recording units. This unit comprises the Line-A-Tone tape panel, 4-stage, 4½ watt amplifier, with built-in oscillator, hand microphone and speaker; in handsome walnut cabinet 18in by 14in by 11½in high; the complete unit with one reel of tape, £60.

SOUND and erase heads, high fidelity type, £3 each, standard type £1/10; oscillator coils, input transformers, etc.; send for price list; trade enquiries invited.

MORECAMBE SOUND SERVICE, Sealand Works, Cross Cop, Morecambe. [0078

GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

BRIERLEY armature pick-up and transformer, £3/3; non-magnetic turn-table, 15/-.—Box 6950. [6053

WILLIAMSON Partridge output transformer 1.7Ω secs, unused, 90/-; exchange for .95Ω secs.—Ormerod, 17, St. Annes Rd., Blackpool.

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

MAGNETIC sound recording wire, stainless steel, temporary wooden spools, approx. 1¼ hours' running time at 2ft per sec.; 14/- per spool.—A. Smart, 40, Grange Rd., Halesowen.

PRACTICALLY new double track U.S.A. tape recorder, complete with amplifier, high quality microphone and ex. speaker, any technical examination; £47/10.—A. S. Warburton, 70 Alcester Rd., Moseley, Birmingham, 21. [6172

GRAMOPHONE motors by Garrard and Collaro, ac and dc models 100/250v; spool emitape, spool mag. recording wire; transformers, capacitors, volume controls, etc., for sale; surplus to requirements, all new or slightly used; not ex-Govt.; list.—Box 7033. [6133

M.S.S., late type disc recorder with M.S.S. amplifier, pre-amplifier, radio feeder unit, ball and biscuit microphone, mixer, special extra German turntable graded for dubbing, etc., all in oak consul cabinet, cost over £250; exchange for car, etc., sell £130.—11, Somerset Gardens, Teddington. Molesey 1817. [5990

TAPE record heads high or low impedance, single screw fitting, 26/-; motors for magnetic recording, 21/-; complete tape recorder platform; including tape and empty spool, head and two motors, £14/10; for magnetic recording machine complete or components write to E. & M. Developments, 9, Troy Grove, Kings Heath, Birmingham, 14. [6035

FOR sale, complete mobile public address equipment including two 20W amplifiers loudspeakers, etc.; installed in 10cwt van type trailer, A.C. equipment with convertors, for D.C. or battery use; also service equipment.—Further particulars and offers to Barnes, Freeman & Co., Incorporated Accountants, 22, London Road North, Lowestoft. [6044

AMERICAN Presto portable recorder, model K-8; complete in case with speaker, amplifier, re-recording turntable, playback, Turner high impedance mike, cable, pair of headphones, instructional manual; records at 78 rpm, 33⅓ rpm in to out, out to in, 110/230 transformer; condition as new.—Krahmer, 76, Bedford Court Mansions, Bedford Ave., W.C.1. Museum 1810.

P.A. EQPT in ex. cond., comprising Vortexion super 50w amp. (£38 list), 2 accoustical labrynth speakers (£19/10 list), 2 Goodman's horn reproducers, 2 Reslo M/C mics. with chrome stands, 1 chrome table stand, twin turntable unit with fader circuit and Rothermel Senior P.U.s, good record stock mod. and O.T. dance music; for quick sale, £120, or offers for items.—Hill, 52, Copy Nook, Blackburn. Tel. Blackburn 6528. [6163

NEW COMPONENTS

CRYSTAL microphone inserts (Cosmocord Mic-6), guaranteed brand new; 15/6 post free.

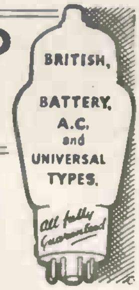
RADIO-AID, Ltd., 29, Market St., Watford. Tel. Watford 5988. [0036

ALLEN & GOULD, 5, Obelisk Parade, Lewisham, S.E.13. Please see our displayed advertisement under name Garland Brothers on page 84. [0191

YOU are bound to try an Osmor "Q" Coilpack eventually and be delighted with the results; why not save time and money now? Send a stamp for free circuits and latest lists of coils, coilpacks, dials, etc., etc.

OSMOR RADIO PRODUCTS, Ltd. (Dept. W.C.A.) Borough Hill, Croydon, Surrey. (Tel. Croydon 1220.) [0046

"DEMOBBED VALVES" MANUAL



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.

EBLI is very rare now—we have a few left. BVA price increase will not affect the greater part of our large stock at present.

EX-W.D. CHASSIS with brand new valves 1R5, 1S4, 1S5, 1T4 and circuit Diagram, showing how this can be converted to a very excellent Personal Portable. Post 1/-. **32/6**

SERVICE SHEETS. The one you require on FREE loan if you buy one dozen assorted at **10/6**

EASY TERMS up to 10 months—and very near Cash Price on all TAYLOR meters. Catalogue FREE.

AMPLION TESTMETER

1,800 ohms per volt on all D.C. and A.C. ranges. 10 v., 100 v. and 500 volts D.C. and A.C. 50 mA. and 500 mA. D.C. Resistance up to 200,000 ohms (3,000 ohms centre scale) with self-contained battery. 5,000 volts range with a separate H.T. test prod (9/6 extra). Supplied with test prods. Multicolour scale easily readable. **£3.17.6**

PHOTO CELLS. All sizes, mounted and unmounted. Special Leaflet on application.

ELECTROLYTIC CONDENSERS

4 mfd. x 450 v. small can	2/4
8 mfd. x 150 v. tubular metal midget	1/10
8 mfd. x 350 v. can	2/5
8 mfd. x 450 v. midget can	2/6
8 mfd. x 500 v. card. Tubular	3/-
8 mfd. x 500 v. cardboard case	3/-
16 mfd. x 350 v. midget can	2/6
16 mfd. x 500 v. can	3/4
16 mfd. x 500 v. cardboard tubular	3/9
32 mfd. x 500 v. High Surge, type K5	5/6
32 mfd. x 350 v. standard can	2/9
8 x 8 mfd. x 450 v. can	3/6
8 mfd. x 16 mfd. x 450 v. standard can	2/6
8 mfd. x 16 mfd. x 450 v. standard can	3/3
16 mfd. x 16 mfd. x 350 v. standard can	4/-
16 mdf. x 16 mfd. x 450 v. midget can	4/-
32 mfd. x 16 mfd. x 350 v. small can	4/-
16 mfd. x 32 mfd. x 350 v. type K47	5/6
16 mfd. x 24 mfd. x 350 v. standard can	3/6
20 mfd. x 20 mfd. x 200 v. for Pilot, Maestro, etc.	4/6
25 mfd. x 25 mfd. x 200 v. block	4/6
50 mfd. x 12 v. American can	1/8
50 mfd. x 50 v. micropac	2/6
12 mfd. x 50 v. ali can	1/10
25 mfd. x 25 v. cardboard tubular	2/1
8 mfd. x 8 mfd. x 450 v. ali can	4/3
14 mfd. x 450 v. wet standard can	3/3
16 mfd. x 450 v. wet standard can, single screw fixing	4/6
250 mfd. x 12 v. small tubular	3/
500 mfd. x 12 v. small tubular	3/-

Plus 6d. postage. Kindly mark envelope (W.W.).

RADIO BULLS VALVES
246, HIGH ST. HARLESDEN NW10

NEW COMPONENTS

HANNEY OF BATH offers:—

WIRELESS World T.V. superhet, complete set of 20 coils wound exactly to designers specification: 45/-.

POLYSTYRENE formers, 1½in×⅜in tapped 0 B.A. for slug, with fixing hole, 1/-; 2¼in×⅜in, 8d.

PAXOLIN formers, 1½in×⅜in, tapped 0 B.A. for slug, with fixing hole, 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, 7/6; B.T.H. CG1-C crystals, 11/3; H.4/200 rectifiers, 28/-; co-axial cable, 1/3 yd; Dubilier type 680 condensers, 5,000v test, 0.001 6/6 each, 0.002 7/-; Reliance pots, 1K, 2K, 10K, type TW., 4/6; 100K, 150K, 2 meg, type SG., 5/-; Erie resistors, ¼ and ½ watt, all values, 4d; also T.C.C. condensers, Dubilier drilitics, valves, tube masks, Belling-Lee and J-Beam aerials, etc.; Mullard tubes, 9in, MW22-14C, £11/6/9; 12in, MW31-14C, £15/2/5.

WILLIAMSON amplifier, Gardner output transformer, 104/6; Woden (potted) ditto, 97/6; Savage 2B36B, 90/-; Woden mains trans (potted), 70/-; Varley ditto, 55/-; Woden potted chokes, CH1 24/-, CH2 31/6, CH3 (pre-amp) 33/-; Reliance 100 ohm pots, W/W, 4/6; Dubilier high stability resistors, all specified values, ½ watt 1/3 ±5%, ±1% 2/3, ¼ watt ±5% 1/-, ±1% 2/-; silver mica condensers, 25 to 500 pfd, ±5% 9d, ±1% 1/3, 1,000 pfd, 1/-, 4,000 pfd, 2/-; 5-bank 6-position switch, 7/6; matched resistors and matched valves supplied ex-stock.

ACOS GP20 pick-up, £3/11/5; Goodmans audiom 60, £6/15, axiom 12 £8/8; Wearite P coils, all ranges, 3/- each; Denco type C TRF coils, 6/6 pr.; Amplion test meter, 77/6; enamelled copper wire, ¼lb to 7lb reels, all gauges; nuts, bolts, washers, 2, 4 and 6 BA, brass studding, etc., etc. We supply everything for WW, PW, EE and Bernards designs . . . . get our quotation by return, retail only; TV list 2½ stamp; general list, inc. Williamson components, 3d stamp please.

L. F. HANNEY, 77, Lower Bristol Rd., Bath.

GARLAND RADIO, Chesham House, Deptford Broadway, S.E.8. Please see our displayed advertisement under name Garland Brothers on page 84. [0192

EHT Transformers, mains transformers, output transformers and chokes; open or bolted types; transformers designed to individual specification; singles or in quantity.

WILLESDEN TRANSFORMER COMPANY, Ltd., 781, Harrow Rd., N.W.10. Ladbroke 2846. [0075

10-metre converter as last issue, four coils to spec. by Bel, 12/6 post free; Wobbulator L1, L2, and L3, 7/6 post free.—Marlborough Yard, London Archway, N.19. [0183

TELEVISION: "Wireless World" Superhet Televisor, fully illustrated set of reprints, 5/-. Construction simple with the following parts, all made closely to specification:

COMPLETE coil set, L, B. or Holme Moss, 52/6; copper RF chassis set, fully drilled and with V/H and 11 screening cans mounted, 52/6; VF box, 10/-; de luxe chassis set, all fully drilled chassis with V/H and tagpanels, cond. clips, etc., 120/-; fully drilled only, inc. power chassis, 98/-, fully punched but not drilled, 50/-; set of scanning coils, 35/-; focus coil, 47/6; mains trans., 77/6; main choke, 50/-; blocking trans., 15/-; line trans., 42/-; 4kv EHT subassemblies, 70/-; Westhet 4kv recs., 16/6 ea.; H4200 recs., 45/- pr.; condensor sets, latest Hunts types. Trade enquiries invited.

BEL SOUND PRODUCTS Co., Marlborough Yard, London Archway 5078. [0184

COILS.—Williamson tuner coils, 7/6 per pr.; iron cored s'het, 2/6 ea.; L.M.S. electronic, Wireless World, Prac. W'less and other tele. coils. Coils wound to order, precise measurements made, mfrs.' and factors' enquiries invited.

BEL SOUND PRODUCTS Co., Marlborough Yard, London Archway, N.19. Arc. 5078.

ELECTRONICS.—Write to the firm which specialises in electronic equipment for your requirements in relays, valves, thyratrons, photo-cells, electron multipliers, special C.R.T. image converters, selsyns, velodynes, etc., as well as all components.—J. McMillan, 5, Oakfield Rd., Bristol, 8. [5972

T.R.F. coilpack kits, 2-stage 3-station (1LW, 2MW) preset, amazing performance, only wiring to complete, size 3½in×2in, full instructions, circuit diagrams, etc., 12/6, post 6d; midget relays, size 1¼in×1in×¾in, weight 1oz, coil 5K ohms, contacts SPDT, operates on 3ma, 12/6; all c.w.o.—A. P. Cretton (W), 349, Copnor Rd., Portsmouth. [5908

A.W.F. RADIO PRODUCTS for rapid deliveries of Tungsram valves, T.C.C. capacitors, Erie resistors, suppressors and volume controls, components for the View Master & E.E. televisors, A.W.F. transformers for all radio needs and hundreds of other service lines; send 1d stamp for our new monthly bulletin to, 11, Park View Rd., Bradford. Tel. 41854. [5900

69/9 only for the famous Model 30 tuning unit, consisting of 3-waveband Model 30 superhet coil pack, pair I.F. transformers, 2-gang condenser and attractive dial (8in×6in); each component individually selected pre-aligned, sealed and the whole matched together as a unit; the superhet you build with this unit needs no further adjustment! Or supplied instead with the superb J.B. horizontal 5pin wheel tuner and dial assembly at 90/6. Full details of these and our other high quality products (coils, IFTs, mains transformers, etc.), together with many circuits and constructional tips, contained in the latest edition of the "Home Constructor's Handbook," price 1/6. Mail order office.

SUPACOILS, 98, Greenway Ave., London, E.17.

NEW S.T.C. SELENIUM RECTIFIERS

Largest L.T. range in Great Britain. Current products. NOT surplus. E.H.T. H4/200, W.W. Televisor, H4/100 VR97, Now replaced by N2/100, 15/10 and N2/500, 11/2. Post 6d.

HALF WAVE RECTIFIERS.

16v., ¾a., 7/- ; 1a., 8/6 ; 2a., 9/10 ; 3a., 17/- ; all post 6d. 4a., 18/- ; 6., 22/6 ; post 10d. 30v. 1a., 12/6 ; 2.a, 14/8 ; 4a., 26/- ; 6a., 38/6 ; 48v. 1a., 16/6 ; 2a., 21/- ; 4a., 37/6 ; 6a., 54/- ; 100v. 2a., 36/6 ; 4a., 69/- ; 6a., 100/-, all p. 1/-.

HALF-WAVE HEAVY DUTY, 7¾in. SQUARE COOLING FINS.

16v. 5a., 22/6 ; 10a., 24/6 ; 30a. 5v., 37/- ; 8a., 40/6 ; 48v. 2.5a., 27/6 ; 5a., 50/6 ; 8a., 57/-, all post 1/-.

BRIDGE CONNECTED FULL WAVE.

Special price 230v. 1a., D.C., 90/-. 2.5-3a., D.C. 105/-. 17v. 1.25a., 12/9 ; 2a., 16/4 ; 2.5a., 21/3 ; 3a., 23/- ; 4a., 26/- ; 5a., 27/6 ; all post free. 33v. ¾a., 19/6 ; 1a., 22/6 ; 1.5a., 29/6 ; 2a., 32/6 ; 3a., 37/6 ; 4a., 45/6 ; 5a., 46/6 ; all post 10d. 54v. 1.5a., 41/- ; 2a., 50/- ; 3a., 57/- ; 5a., 70/- ; 72v. 1.5a., 53/- ; 2a., 64/- ; 100v. 1.5a., 76/- ; all p. 1/-

BRIDGE CONNECTED HEAVY DUTY 7¾in. SQUARE COOLING FINS.

17v. 6a., 36/2 ; 10a., 44/- ; 12a., 76/- ; 20a., 84/- ; 33v. 6a., 68/- ; 10a., 75/- ; 12a., 132/- ; 20a., 148/- ; 54v. 6a., 95/- ; 10a., 106/- ; 72v. 6a., 122/- ; 10a. 138/- ; 100v. 10a. 200/-, all p. 1/4.

BRIDGE INDUSTRIAL FUNNEL COOL. 17v. 12a., 80/- ; 20a., 92/- ; 30 a., 130/- ; 50a., 198/- ; 33v. 6a., 73/- ; 10a., 84/- ; 12a., 132/- ; 20a., 152/- ; 54v. 6a., 97/- ; 10a., 114/- ; 72v. 6a., 120/- ; 10a., 144/- ; 100v. 6a., 168/- ; 10a., 202/6, all post 1/6.

VALVE CHARGER REPLACEMENTS.

No wiring alterations. Philips & Tungar. 2-12v. 4-5a. Charger Kit, 230 A.C. Vent. Case, Ammeter, wt. 22lb. £5/10/-, del.

Wholesale & Retail

T. W. PEARCE (Est. 18 yrs.)

66 GREAT PERCY STREET, LONDON, W.C.

Off Pentonville Rd. Between King's Cross and Angel

LABORATORY TEST EQUIPMENT

High Grade test equipment supplied by Hatfield Instruments is GUARANTEED equal in every way to the maker's specification. All instruments are either New or Rebuilt in our own laboratories.

FERRIS NOISEMETER type 32A. This instrument measures either noise or field strength in the range 160 Kc. to 20 Mc/s. It is supplied complete with 6 v. vibrator power pack, standard aerial, and external multipliers, to enable field strength measurements up to 10 v. per meter. NEW.

BEAT FREQUENCY OSCILLATOR, Type 195L by Marconi Instruments. Condition absolutely as new.

OHMMETERS by Airmec. 6 ranges selected by press buttons. First range 0-100 ohms, full scale. Large 8 inch meter, accuracy 1%, mains operated. NEW. Price £25-0-0.

CONSTANT VOLTAGE TRANSFORMERS by Advance. Type MT161 input 190-260 v. Output 230 v. 1 per cent. at 60 w. These transformers are in new condition.

PRECISION CONTACT DRIVEN FORKS, and Phonic Motors, by Muirhead. For use at low frequency.

COSSOR OSCILLOSCOPE, Type 339. A few only, ex stock.

Send for comprehensive lists of Signal Generators, Valve Voltmeters, Wavemeters, etc.

HATFIELD INSTRUMENTS

175, UXBRIDGE RD., HANWELL, LONDON, W.7.

Telephone : EAL. 0779

COMPONENTS—SURPLUS AND SECONDHAND

RADIO CLEARANCE, Ltd.

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.

PERSONAL receivers, 3 valve T.R.F. using IT4'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, £3/19/6.

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 paid; 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., 465kc/s, iron cored, size 13/16in dia., 1 13/16in height, 10/- fair.

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 in 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.

5K wire wound pots, standard spindle, 3 watt; 1/- each, 9/- doz.—Hoyle, 320, Dewsbury Rd., Wakefield. [6017

SALE.—General radio precision variable condenser, type FS5.722; offers.—Box 7151. [6164

SUPREME RADIO, 746b, Romford Rd., Manor Park, London, E.12. Tel. Ilf. 1260. Est. 16 years. New bargains!

P.M. focus units from 15/- each; E.F.50 valve holders, 6d each; retaining rings for same, 8d. each; B7G valve holders, Amphinol type, 9d each; Alladin coil formers with cores, 8mm, 8d. each, 6mm 6d each; 3 meg carbon vol. controls, 7½ each; 100 KΩ vol. controls, with long spindle and s/p switch, 2/6 each; 0.25 MΩ vol. control, long spindle less switch, 2/- each; noise suppressor units, consisting of 2, 0.1mfd cond and iron cored choke, 6d. each; co-ax cable, 80Ω 8d. yd, 60Ω type 6d yd; twin balanced feeder, 5d. yd or 4/6 doz yds; C.V.102 crystal diodes, 2/6 each; Westinghouse type metal rectifiers, 250v, r.m.s., 65 m/A, 4/- each; 630Ω, 0.2amp flat type mains dropper, tapped for 200-250v, 1/6 each; 2-pole 2-way small switches, 8d. each; fly-back type line-trans, with provision for EY51 valve, 22/6 each; 16mfd 350v Drylitic cond., 1/9 each; 50mfd 50v or 25mfd 25v tub. cardboard bias cond, 1/- each, 11/- doz or ass. 4mfd 450v metal or cardboard cond. 6d. each; i.f.t./s. 465 Kc/s. small type, 12/6 pr; 6-pole 4-way 2-bank switches, 1/6 each. Special lines—just arrived! Mains trans, drop through type, primary tapped 0 to 250v. sec. 275-0-275v 100 m/a, 6.3v 4amp, 5v 3amp, with screen, bargain price, 14/11 each; also 465 kc/s, standard size i.f.t./s, 8/6 pr; p.f. condensers, 40pf, 50, 60, 65, 70, 100, 307, 500, 700, 1,800, 1,980 p.f., all at 2/- doz, or ass. doz.

COMPONENT parts for constructor television and radio circuits our speciality.

TERMS c.w.o., no c.o.d.; send 6d. extra for postage orders under £5; 2½d. s.a.e. all enquiries and list. [0021

SOUTHERN RADIO SUPPLY, Ltd., 11, Little Newport Street, London, W.C.2. See our displayed advertisement page 111. [0016

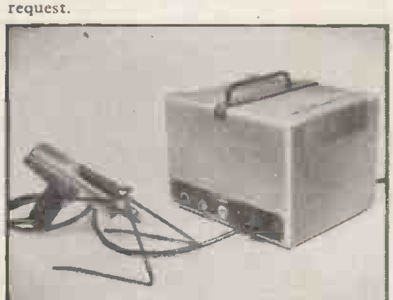
MAGSLIP transmitters, 3in Mk. 2 and Mk. 4, 21/6; Magslip Hunters, 2in Mk. 1, 9/6; s.a.e., details.—K. Logan, Westalley, Hitchin, Herts. [5889

An ultrasonic soldering iron

- Can be used for soldering aluminium, magnesium, duralumin and other metals which form refractory oxides.

The soldering iron has a nickel silver bit driven by a magnetostriction transducer. The transducer is arranged to run at its natural resonant frequency by a feed-back system. A conventional low voltage winding heats the soldering bit.

THE problem of soldering metals which form refractory oxides has now been overcome. A new soldering iron, developed by Mullard, destroys oxide film by ultrasonic stimulation and provides a "clean" metallic surface.
This means perfect soldering of aluminium, magnesium, duralumin, etc., can now be achieved without scraping or brushing molten metals. Standard soft solders can be used. And no flux is needed.
A small electronic amplifier supplies the ultrasonic power. There are no controls, apart from the mains switch, to operate. Unskilled workers can use the apparatus without discomfort, since the ultrasonic frequency used is inaudible to the human ear. Full information about the Mullard Ultrasonic Soldering Iron — the only commercial model in the world — is available on request.



The Mullard Ultrasonic Soldering Iron and Amplifier. The unit operates from A.C. mains and is robustly made to suit workshop conditions.

Mullard Mullard

MULLARD ELECTRONIC PRODUCTS LTD., EQUIPMENT DIVISION, CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2.
TELEPHONE: GERRARD 7777

(MI340B)

COMPONENTS—SURPLUS AND SECONDHAND

C. J. EMMS, Ltd.
BRIDGE full wave metal rectifiers, 6 or 12-volt 1 amp, 5/6; 6 or 12-volt 3amp, 10/-; 6 or 12-volt 7amp, 17/6; 6 or 12-volt 10amp, 25/-; 24-volt 1amp, 11/-; 24-volt 3amp, 20/-.
SLIDING resistances, 1 to 4amp 14ohm, 5/6; 12amp 1ohm, 6/-; 12amp 1ohm, non-slider, 3/6.
26a, Colherne Mews, London, S.W.10. Fremantle 8941. [0201

W./W.S./HET. televisor, complete parts, every item as specified, as new, great reduction.—"Newlands," Moss Lane, Churchtown, Southport.

HUMDINGERS 50 ohm w.w. pre-set pots, one hole fixing, ins. from sp. and E., ideal hum control, brand new; 1/- each, 6 for 5/-.—Palmer, 16, The Crest, Widley, Portsmouth. [6010

TELEVISION 2v preamp self con. for London, 50/-; Antiference H aerial, London, 40/-; 2v converter self con., London to B'ham, 50/-; all perfect.—1350, Stratford Rd., Birmingham, 28. [6102

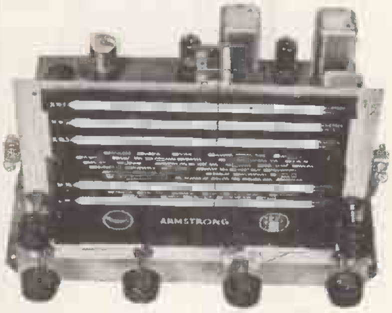
600 watt auto transformers, new but soiled, 45/- plus 3/- carr., wt. 16 lb, 230/110v; Lustraphone m/c mikes, new 52/6, post 1/-; Rola 8in p.m. speakers, less trans., new 13/6, post 1/3; crystal diodes, capsuled, new 3/6.
CHAMPION PRODUCTS, 43, Uplands Way, London, N.21. Lab. 4457. [0100

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/-.
SIEMENS high-speed relays, 75 ohm, double coil, 4/6 each, 45/- per doz.
TUFFNEL jockey pulleys, 2in diam, fitted ball race for ¼in diam. spindle, 2/- each, 20/- per doz.; ditto, 3½in diam., 3/- each, 30/- per doz.
SOLENOIDS, fitted cantilever action, operating voltage 10/12 volts D.C.; dimensions, 3in long, 1in diam; price 5/6 each; post paid; solenoids, heavy duty, 12/24 volts D.C., 10/- each, post paid; solenoids, operating voltage 12/24 volts. —2¼in long—1 inch diam., ideal for model train track controls, etc., 4/- each, post paid; 15 amp. Mercury switches, fitted with saddle and clip, 4/- each, postage paid.
VOLTAGE regulators, 300 ohms, 0.29/1.0 amps, size 7in×7in×7in, 32/6 each; 12-volt gong bells as used by police, nickel-plated, size 7½in diam., 7in long; price 35/- each, post paid.
WESTOOL electric furnaces, 200/220 volts, high and medium heat control for heating two soldering irons, up to inch diam. bits, 50/- each.
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 5½in× 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 230 V.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.
EXTRACTOR motors, complete with fan, 12v. 3½amps D.C./16 volts A.C., new in original packing, price 17/6, postage 1/6.
NEW Klaxon, 200/250 volt, 50 cycle A.C. motors, capacitator inductance start, 2,700 r.p.m., 1/40 hp, fitted in cradle, condenser supplied, price £2/7/6 each.
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 5in 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.
NEW Rolls-Royce "Coolant" pumps with tower, inlet 2¼in diam, twin outlets, 1¼in diam approx, aluminium casing, brass impeller, pumps approx. 500 g.p.h., price 30/- each, carriage paid.
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

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

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 rangeof 0-7 volt; price 27/6 and postage 1/-.
TELEKIT SUPPLY COMPANY, 51, Addington Rd., West Wickham, Kent. [6138

UP to the ARMSTRONG standard DOWN to 10.9 Metres!



ARMSTRONG Model EXP 125/2
All-Wave 14 Valve (inc. Cathode Ray)
RADIOGRAM CHASSIS.

THIS model, although produced for the home listener, has been designed primarily for the export market. With the increasing use of the 11-metre band, the provision of a Continuous Wave-Band Coverage from 10.9 to 550 metres (plus 1000 to 2000 metres on the home model) is an outstanding feature of this British chassis. Ideal as a radio receiver or record reproducer, Model EXP 125/2 combines an exceptionally high standard of performance with a splendid quality of reproduction.

★ **Continuous Wave-Band Coverage from 10.9 to 550 metres.**
★ **Radio Frequency Pre-Amplifier.**
★ **2 Intermediate Frequency Stages.**
★ **Variable Selectivity.**
★ **Bass and Treble Lift Controls.**
★ **15 watt Push-Pull Output.**
★ **Home Model: From 200-250 v A.C. Price £33.12.0 plus tax.**
★ **Export price on request.**

Kindly write for illustrated catalogue.

ARMSTRONG CO. LTD.
(Wireless & Television)
Warlters Road, Holloway,
London, N.7
Telephone: NOR 3212

COMPONENTS—SURPLUS AND SECONDHAND

LITTLEWOODS, North London's best selection of radio and television components; pay us a visit or post or phone your enquiries; no lists. LITTLEWOOD & GRUNER, Ltd., 27, Ballards Lane, Finchley, N.3. Fin. 3060. [0055

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

SURPLUS, unused, .1 350v 2/6 doz, .01 1,000v 3/- doz, .05 500v 3/- doz, .1 500v 3/- doz, .01 mica 3/- doz, 4pf, 20pf 2/- doz, 2mfd 500v 9d each; TRF coils 4/9 pair, etc.—Bargain list from: T. G. Howell & Co., 29, McWilliam Rd., Brighton, 7. [5619

NEW silver mica condensers, 30, 33, 47, 50, 58, 60, 75, 120, 150, 200, 470, 1,900, 3,000, 4,000, 4,700, 5,0000 pf, 2/6 doz, 22/6 gross; including postage, any values; mail orders only. I. A. DUCK, 97, Belgrave Rd., Ilford, Essex.

5-PIN sockets, twin push buttons (no knobs, etc.), twin feed troughs, all 3d each, 2/6 doz, 24/- gross; 0.1mfd 500v Aladdin formers, SW coils, 3d each, 2/6 doz; many other bargains; post extra; money back guarantee; no c.o.d.; s.a.e. lists.
ANNAKIN, 25, Ashfield Place, Otley, Yorks.

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 tranformer, 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., D.S.G., No. 15 U.X. base American valves available; prices do not include postage.
SERVICE RADIO SPARES, 4, Lisle St., W.C.2. Gerrard 1734. [0188

FRESH stock electrolytics, 8mf 450v 2/6, 8×8 450v 3/-, 8×16 450 3/9; v/controls 1/spindle 10K to 2 meg, L/sw, 2/6; W/sw, 3/9; P.M. speakers 5in 11/6, 6in 11/9; 8in 13/6, 10in 16/6; Pen/out trans., 3/3; M/ratio, 4/9; chokes, 7H, 80m/a, 5/6; P/type coils, 2/6; half-price offer, mains trans., 350/350, 4v, 80m/a, 21/-; 350/350, 6v, 5v, tapped at 4v, 80m/a, 16/6; V/holders, Int/oct, 6d, B7G 9d, B9G 6d, B.A. 5; headphones with T/mics, 5/6; Tannoy hand mics., 4/6; asst. tub. conds. 001, 01, 05 005, etc., 6d ea.; B.V.A. valves, current prices; order c.o.d.; new stock list available; stamp please.—Radio Unlimited, Elm Rd., London, E.17. Tel. Key. 4813. [0062

T.V. COMPONENTS.—An exceptional opportunity to secure high quality television components, guaranteed in perfect working order, at very moderate prices; heavy duty T.V. mains transformer, 60/-; specification, primary 210, 230, 250v, 50 cycles; secondaries, 350.0.350 at 175mA, 2 volt 1 amp., 4 volt, 3 amp, 6.3 volt 8 amp. R.F./E.H.T. unit, 5.5kv, complete 55/-; smoothing choke 3.3hy, 175mA, 12/-; focussing and deflecting equipment, comprising line and frame oscillator transformers, line and frame O/p transformers, scanning coils and P.M. focussing unit, 72/6 for the 6 items; smoothing capacitors 60mfd 450v working plus 100mfd, 350v working, 6/-; transparent tube guard, cream surround, for 12in C.R.T., 18/-; resistance panels with six pre-set resistors, 12/-; co-axial plugs or sockets, 1/- each; all goods sent carriage paid on seven days' approval, cash with order (refund in full if goods not acceptable); post orders only.—Scotsman Sales, 13, Queensway, Bayswater, London, W 2. [6052

NOTICES

BRITISH Sound Recording Association.

THE lecture season has now commenced and an outstanding programme has been arranged; to all actively engaged or interested in high quality sound recording and reproduction, membership of the Association is essential; 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 are available to non-members, price 2/9 p.f.; the Manual of Equipment and Accessories is also available, price 1/2 p.f.; write for brochure and membership application form to—The Membership Secretary, Harrie J. King, 48, Mount View Rd., North Chingford, London, E.4.

A WINDOW WORTH LOOKING INTO

Television. Receivers Type 3585, complete with 45 mc/s. strip using 5 EF50's Diode (EA50) and Cathode follower, together with a further 2 EA50's, 1 EF50, 4 SP61's, 5 VR56, 3 VR55, 1 VR53, 1 VR54, also stacks of resistors and condensers, 2 5,000 and 2 1,000 relays, all brand new, in sealed boxes, at £5/10/- each.
Television. I.F. strips only, ex the above units, complete with 6 EF50's, 1 EA50, also brand new and unused, 62/6 each. Ditto, less valves, 37/6. Limited number only.
Television. Units type 208a, 2-stage 45 mc/s. vision or sound, 2 EF50's, complete with full instructions, 14/6 each while they last.
Television. Brand new R1355 Receivers complete with valves, as used in the "Inexpensive Televisor." Suitable for London or Sutton Coldfield, 51/6 each.
Television. Power Packs. Complete television power supply, giving you 2,500 volts at 5 m/a., 350-0-350 volt H.T. at 200 m/as. and 6.3 volt at 15 amps., input voltage 230 volts 50 cycle, fully smoothed and with all valves, ex-Admiralty units. 92/6 each. Limited number only.
Television. Coil formers, 1in. x ½in. polystrene with slugs. 6 BA single hole fixing, 6d. each. Wound, 7d. each.
Television. Condensers for the "Electronic Engineering" 1,000 P.F. midget moulded mica ditto, 500 P.F., 4d. each.
Television. High voltage condensers, oil-filled Mansbridge type, "TROUBLE FREE." .1 mfd. 3 kv., 2/6 each; ditto, 4 kv., 3/- each; ditto, 5 kv., 3/3 each.
Television. High voltage valve caps, fully insulated, 6d. each. Diode holders, 3d. each. E.H.T. sleeving, 3d. per length. E.H.T. cable, 12 yards 1/9.
Television. Iron dust cores for "Alladdin" formers, also 24, 25 and 26 U.H.F. units, also 1355 and 1155 receivers, 2d. each.
Chokes. 5 Henry 200 m/a., resistance 100 ohms, 3/6 each; 25 Henry up to 40 m/a., 4/6 each; 7 Henry 60 m/a., 3/6 each; 20 Henry 100 m/a., 6/6 each; 1 amp. L.T. smoothing chokes, 1/6 each, all ex-W.D.
Television. Transformers ideal for 'scope, input 230 volt 50 cycle, output 700 volt 20 m/a. 4-volt 1½ amp. twice, each tested at 5 kv., suitable for voltage doubling, 16/6 each. Brand new and boxed.
Type 25/73 Units, complete with valves. Brand new, 22/6 each.
Accumulators. Unspillable 2-volt 7 amp., 4¾in. x 3½ x 1½. Lead acid. Brand new, 6/6 each.
Accumulators. 6 volt 85 amp. Lead acid. Brand new. Very limited number. Only, 59/6 each.
Special Offer. 6 mfd. 1,000 volt Mansbridge condensers, 2/6 each; 16 mfd. 350 volt, 1/6 each; 24 volt blower motors, A.C./D.C., 6/- each. Rectifiers, 12 volt 5 amp., 17/6 each.

Open all day Saturday

G. W. SMITH & CO.
(RADIO) LTD.
3, LISLE STREET, LONDON, W.C.2
Phone: GERrard 8204.

WANTED, EXCHANGE, ETC.

WANTED, war surplus test set Type 87.—Box 7157. [6175

WANTED, "Wireless World," Vol. LV, No. 6, June, 1949.—Box 7158. [6176

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, 2 AR88D and 2 AR88LF receivers; state condition and price; will buy separately.—Box 7159. [6177

WANTED, receiver giving clear high fidelity voice and music English stations; reasonable price.—Box 7030. [6123

WANTED, Type 805C G.R. signal generator; only oscillator portion need be in good condition; write details.—Box 7155. [6170

WANTED, junction boxes JB-70-A and T-50 microphones.—P.C.A. Radio, Cambridge Grove, London, W.6. Tel. Riv. 3279. [0080

WANTED, H.R.O. coils, Rx's, etc., AR88s BC348s, etc.—Details to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

APS-15 radar indicators, scanners, waveguide, 1B24s, Cannon plugs, leads and all APS parts; CRTs 517G and VCR530.—Cramp'ns Grimsby. [6030

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

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

WIRELESS Engineer, 1940, Nos. 5, 6, 7 and 12; all issues for 1941, 1942, 1943, 1944 and 1945; also indexes for Wireless World, 1945-1948 inclusive.—Box 6772. [5978

CASH offered for Trix amplifiers T114, T101, B65, B65M, B619; all Trix or Vortexion amplifiers also wanted.—Harmony House, 116, Cambridge Rd., Southport. [6055

WANTED, BC-610 Hallicrafters transmitter, SX-28; AR-88 receiver and spare parts for above; best price.—Write Box 851, c/o Spiers Service, 69, Fleet St., London, E.C.4. [0081

WANTED, receiving equipment AN/APR.4, complete with tuning units and handbook; reasonable offers to—Salford Electrical Instruments, Ltd., Times Mill, Heywood, Lancs. [6051

WANTED, copies of the Wireless World, vol. 44, No. 2, February, No. 6, June, No. 9, September, and index; please write or telephone.—The Librarian, Research Laboratories, The General Electric Co., Ltd., Wembley, Middx. Arnold 4321. [6135

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

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. [0113

MAINS transformers rewound promptly, usual guarantee.—Radio Rewind Service, Brithdir, nr. Dolgelly, N. Wales. [5243

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

ELECTRICAL measuring instruments of every make repaired and standardised.—The Electrical Instrument Repair Service, 329, Kilburn Lane, London, W.9. Tel. Lad. 4168. [3715

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

A REWIND service which duplicates or modifies as required; transformers, loudspeakers, etc.; prompt returns.—Raidel Services, 49, Lr. Addiscombe Rd., Croydon. Cro. 6537.

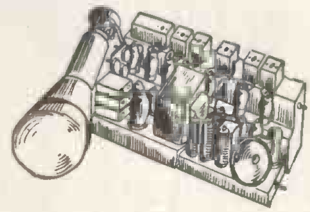
REPAIRS.—E.H.T., mains and O.P. transformers, field coils and chokes; also armatures and motors; new transformers designed to any specification; all work fully guaranteed.
WILLESDEN TRANSFORMER Co., Ltd., 781, Harrow Rd., N.W.10. Tel. No. Ladbroke 2846.

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

The NEW 1355 CONVERSION!

Radio Exchange Co., who gave you the £6 televisor, now presents, for the first time,

A COMPLETE TV SET — VISION, SOUND, TIME BASES, POWER SUPPLY, and SPEAKER, ON ONE 1355 CHASSIS.



RF units are NOT required.

Data for London is now available, price 3/- per copy; data for Birmingham will be ready shortly.

We can supply new 1355's, in original maker's cases, price 55/-.

RECEIVER 3547. Containing 15 EF50's and 8 other valves, midget motor, hundreds of components, and a "Pye" 45 mc/s strip. In original maker's sealed cases, £6/7/6.

AMPLIFIER 1135A—twin inputs, three valves (EBC33, EK32 and EL32) complete with our "10 min. conversion data," 17/6.

CONTROL UNIT 214. In sealed maker's cartons, with 3 EF50's, 2 EB34's, 1 D1, 39 resistors, 17 condensers, 8 pots, yaxley switch heavy toggle switches etc., 19/6.

PHOTO-CELL MULTIPLIERS. Complete with 931A multiplier (equivalent to Mazda 27M1), 2 6AC7's and 1 6AG7, this unit contains the cell bleeder network and will find a wide variety of applications where really high gain is required. ONLY 30/-.

RECEIVER 21. Supplied complete with vibrator pack, these may have slightly damaged switch *spindles* (not damaged wafers) but are otherwise perfect. Complete with 9 valves and circuit, 35/-.

POWER UNIT S441B. With separate and individually controlled HT and filament transformers, these provide 300V at 200mA DC, 12v. 3A AC and 5v. DC. In attractive cases measuring 14 x 7 x 7½in., they are fully fused, and complete with HT and LT indicator lights. OUR PRICE 65/-.

STILL AVAILABLE. Midget Motors, 9/6; Receiver 18, 17/6; Mod. Transformers, 6/6; HT Batteries, 94v., 6/6; 157v., 8/6; Indicator, 198, 40/-; American Telephones, 37/6; Control Box C-56/APX2, 4/3; Control Box C-57/APX2, 4/3; Receiver 25, 19/6; Vibrator Pack 21, 15/6.

RADIO EXCHANGE CO
9, Cauldwell Street,
BEDFORD. Phone 5568.

a RECORD instrument

The "MAJOR" Insulation Test Sets

Outstanding in the famous "Record" family, this Test Set has a constant pressure generator of patent design. Ranges are available up to 500 volts 50 megohms, with or without continuity range of 0/30 ohms.

Our engineers will be pleased to discuss your problems. Write for folder D/b.

THE RECORD ELECTRICAL CO. LTD.
BROADHEATH, ALTRINCHAM, CHESHIRE
Telephones: Altrincham 3221-2-3
Telegrams: 'Circscale', Altrincham
Cables: 'Circscale', Altrincham
28, VICTORIA STREET, LONDON, S.W.1
Telephones: ABBey 5148
Telegrams: 'Circscale', Sowest, London
Cables: 'Circscale', London

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 3¼in., 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

REPAIRS AND SERVICE

"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

"STURDY" rewinds, mains transformers, chokes and fields, first-class work, prompt deliveries and satisfaction guaranteed.—Sturdy Electric Co., Ltd., Sturdy Works, Burnopfield, Newcastle-on-Tyne. [0125

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

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. [6108

REWINDS and conversions to mains and output trans. pick-ups, fields, clock coils, car vibrator units, etc., from 4/6, p.p.; equipment a speciality; all work guaranteed.—N. L. Rewinds, 4, Brecknock Rd., N.7. Tel. Wordsworth 7791. [5795

24-HOUR service, 6 months' guarantee, any transformer rewind, mains outputs and i.f.s., etc.; all types of new transf., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth.

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

CONSULTING electronic specialist can accept commissions for design, development or assembly of most types of apparatus, technical advice, flat rate, 10/- per query.—Box 6786.

QUALIFIED free-lance radio, T.V., communications engineer (25 years' experience), undertakes service manufacturers, dealers; Surrey, Middlesex; own car; gear; laboratory; confidential.—Write BM/FFBJ, W.C.1. [5998

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

"CLEARPIC" black screen.
TELEVISION black screen of Perspex gives better contrast in daylight or at night; cuts out highlights on tube; attachable any set, any size screen, 10/- each; c.w.o.—D. A. L., Ltd., Harley Road, Blackpool. [6009

POLISHED walnut console cabinet, 12×10 panel; £8.—32, Chatham Rd., Kingston. [6159

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. [6151

WALNUT radiogram and television cabinets, sample designs, few only, stamp details.—Shaw, 69, Fairlop Road, Leytonstone, E.11. [5922

SELENIUM photo-electric cells, 45mm dia, 10/-; 40mm×22mm, 7/6; all standard-size photo-cells in stock; s.a.e. for details.—G. R. Products, 22, Runnymead Ave., Bristol, 4. [6008

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

EX-GOVERNMENT steel instrument cases, copper-plated and finished battleship grey, size 23in long, 10in high, and 8in deep, excellent condition 12/6 with carrying handles, 10/- less carrying handles, plus 2/6 packing and carriage England and Wales.—Weatherhead's, Bletchley, Bucks. [5793

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; BA 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

SITUATIONS VACANT

EXPERIENCED and qualified radio and television engineer required, Kensington area, highest wages to experts only.—Tel. Frobisher 7464 appointment. [6173

RADIO SUPPLY CO.

34, Hanover Street, Park Lane, Leeds, 3

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 ma., 6.3 v. 3 a., 5 v. 2 a. Standard ...	12/11
250-0-250 v. 70 ma., 6.3 v. 2 a., 5 v. 2 a. Midget, 2½-3-2½in. ...	14/11
350-0-350 v. 70 ma., 6.3 v. 2 a., 5 v. 2 a....	15/9
350-0-350 v. 80 ma., 6.3 v. 3 a., 5 v. 2 a. Standard ...	17/9
350-0-350 v. 100 ma., 6.3 v. 3 a., 5 v. 2 a. Standard ...	19/6
350-0-350 v. 120 ma., 6.3 v. 4 a., 5 v. 3 a. Standard ...	23/9
350-0-350 v. 150 ma., 6.3 v. 4 a., 5 v. 3 a. Standard ...	25/9

Fully Shrouded Upright Mounting Types

250-0-250 v. 60 ma., 6.3 v. 3 a., 5 v. 2 a. Midget, 2½-3-3in. ...	15/6
250-0-250 v. 100 ma., 6.3 v. 6 a., 5 v. 3 a.	23/9
350-0-350 v. 100 ma., 6.3 v.-4 v. 4 a. C.T., 0-4-5 v. 3 a. ...	21/6
350-0-350 v. 150 ma., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. ...	27/9
425-0-425 v. 200 ma., 6.3 v.-4 v. 4 a. C.T., 6.3 v.-4 v. 4 a. C.T., 0-4-5 v. 3 a....	42/6

ELECTROLYTICS. 8 mfd. 450 v. Small Met. Tubs, 1/11 ea.; 16 mfd. 350 v. Small Cans, 2/3 ea., 18/6 doz; 8-16 mfd. 450 v. Cans, 3/6 ea., 35/- doz.; 8-16-32 mfd. 450 v. Cans, 4/9 ea.; 50 mfd. 12 v., 8d.

SMOOTHING CHOKES. 40 ma. 10 h. 360 ohms, 3/3; 60 ma. 15 h. 400 ohms, 4/3 ea., 42/- doz.; 80 ma. 12 h. 350 ohms, 5/3 ea., 45/- doz.; 100 ma. 10 h. 100 ohms, 200 ma. 5 h. 100 ohms, 7/6 ea., 66/- doz.; 250 ma. 10 h. 100 ohms Potted, 11/9 ea.

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/-.

TERMS. C.W.O. or C.O.D. over £1. Post extra under £2. Full list 3d. Special List for Trade, 3d.

AN UNUSUAL "BUY"

for

ELECTRICAL

and

RADIO ENGINEERS!

FLIK-O-DISK Answers! Quick!

The Unique OHM'S LAW CALCULATOR

Whether you are constructing or servicing a radio set, problems involving voltage, current and resistance can delay progress. A "FLIK-O'-DISK" will give the answer in a jiffy—with the mere touch of your forefinger. Send for yours—TODAY!

LIMITED NUMBER ONLY—
offered at

HALF PRICE!

Send P.O. NOW to:—

3/3d.

IONIC LABORATORIES LTD.
Swinley Buildings, Bath Road,
CIPPENHAM, SLOUGH,
BUCKS

MAINS TRANSFORMERS

(Postage Extra under £2)

As supplied by us to the Ministry of Supply, B.B.C Education Authorities, Admiralty, etc.
Interleaved and impregnated. Screened primaries tapped 200/250 v.
(Also built to your specification—prompt deliveries—quotation per "Return of Post.")

DROP THROUGH TYPE. TOP SHROUD

(a) 250-0-250 v. 60 mA., 6.3 v. 3 a., 5 v. 2 a... 15/6
(b) 250-0-250 v. 60 mA., 4 v. 4 a., 4 v. 2 a. 15/6
Following types have Universal L.T. windings. 6.3-4-0 v. 4 a. C.T., 5-4-0 v. 2 a.
(c) 250-0-250 v. 80 mA. 17/6
(d) 300-0-300 v. 80 mA. 17/6
(e) 350-0-350 v. 80 mA. 17/6
(f) 250-0-250 v. 100 mA. 19/6
(g) 300-0-300 v. 100 mA. 19/6
(h) 350-0-350 v. 100 mA. 19/6

FULLY SHROUDED UPRIGHT TYPES

(i) 350-0-350 v. 150 mA., 6.3 4.0 v. 6 a. C.T., 5-4-0 v. 3 a. 39/-
(j) 425-0-425 v. 180 mA., 6.3 v. 4 a. C.T., 6.3 v. 4 a. C.T., 5 v. 3 a. 42/6
(k) 425-0-425 v. 180 mA., 4 v. 8 a. C.T., 4 v. 4 a. C.T., 4 v. 4 a. 44/6
(l) 425-0-425 v. 180 mA., 6.3 v. 4 a. C.T., 4 v. 2 a. C.T., 4 v. 2 a. C.T., 5 v. 3 a. 47/-
Note.—Model (j) above is suitable for Williamson Amplifier.

Williamson Pre-Amp Mains Transformer
325-0-325 v. 20 mA., 6.3 v. 6 a., 6.3 v. 1.5 a. .. 19/6

WILLIAMSON AMPLIFIER REPRINT

36-page booklet published by "Wireless World" 3/6

WILLIAMSON OUTPUT TRANSFORMER

Built to Author's specification 1.7Ω secondaries. Approved type £3 12 6

WILLIAMSON SMOOTHING CHOKES

Choke No. 2 £1 2 6. Choke No. 1, 12/6
PRE-AMP. CHOKE, 50H. 20 mA., 1,500Ω .. 15/6

FEEDER UNITS

High class radiofeeder units with R.H. stage. Switched pick-up sockets. Glass scales. Completely aligned.
MODEL A. Covers 16/50, 190/50 and 900/2,000 metres. Price, including Purchase Tax........ £10 6 6
MODEL B DE LUXE. Covers 45/145, 190/550, 900/2,000 metres and six ranges of band spread. Price, including Purchase Tax £18 7 6
MODEL E. As Model A, but with Variable Selectivity and infinite impedance detector. Price, including Purchase Tax £12 15 0

"VIEW MASTER" TELEVISION RECEIVER

All as individual parts stocked as well as complete kits. CONSTRUCTOR'S ENVELOPE, containing full instructions, layouts, diagrams, etc., 5/-, post free.

POLISHED ALUMINIUM CHASSIS, 16 S.W.G., 4 SIDES, 3 in. DEEP

10in. × 6in., 10in. × 8in., 8/6; 12in. × 9in., 10/6; 14in. × 9in., 16in. × 8in., 11/6; 20in. × 8in., 12/6

EDDYSTONE SHORT-WAVE COMPONENTS

Full range stocked. Eddystone illustrated catalogue 6d

SPECIAL OFFERS

.0005 2-gang T. Condensers 6 6
Coil Packs 3 W.B. Miniature £1 9 6
465 Kc/s I.F. Transformers, pair 12 6
T.M.C. ·1 mfd. 7 Kv. Condensers, with clip 12 6

INSTRUMENT WIRES

Comprehensive range in enamelled cotton and silk covered copper wires from 16 S.W.G. to 40 S.W.G.

500 V.A. Auto Transformers, 115/230.... £2 2 0
PACKARD BELL PUSH-PULL PRE-AMPS. In sealed cartons with accessories and two valves, 6SL7 and 28D7 16 6

TRANSMITTING VALVES

807, 6/-; 805, 23/6; 813, 27/6; 6L6, 9/6; 6J6, 9/6.
VCR97 C.R.T.s in maker's transit cases £1 12 6
Quantity discounts on Ex.-Govt. Valves.

SEND NOW 6d. P.O. for 64-PAGE CATALOGUE

Terms C.W.O. or C.O.D.

COULPHONE RADIO

"The Return of Post Mail Order Service"

53 BURSCOUGH STREET
ORMSKIRK, LANCS.
Phone 987

SITUATIONS VACANT

E.M.I. INSTITUTES.

PRINCIPAL: Professor H. F. Trewman, M.A. (Cantab.), M.I.E.E., M.I.Mech.E., M.Brit.I.R.E. APPLICATIONS are invited for two full-time posts as lecturers in Electrical, Electronic and Telecommunications Engineering to students on two, three and four year courses. For one post applicants should have a good degree in Electrical Engineering, with Telecommunications. For the other post, a graduate Telecommunications Engineer is required, preferably with Post Office experience. Applicants for both posts should be under 30 years of age, and are required to possess industrial and good instructional experience.
THE commencing salary depends on experience and will be in the range of £450-£600 per annum.
APPLICATIONS, stating age, qualifications, and experience, with the names and addresses of three persons to whom reference may be made, should be sent, within fourteen days after the appearance of this advertisment, to The Principal, E.M.I. Institutes, Ltd., 10, Pembridge Square, London, W.2. [6057

CROWN Agents for the Colonies.

RADIO Engineer (development) required by the Government of Fiji for one tour of three years in the first instance, for duties in connection with the installation and maintenance of small H.F. radio stations and the general planning of an enlarged radio-telephone network; commencing salary according to qualifications and experience, in the scale £F840 rising to £F960 a year (£F111=£100 sterling); free passages; gratuity on satisfactory completion of service at the rate of £F25 for each period of 3 months' service; candidates must have had wide practical experience of installing and maintaining radio stations, administrative experience of the organisation required for operating a group of stations, and experience of International procedure and frequency allocation; a knowledge of the special requirements of meteorological and aeronautical radio services an advantage; 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 M/N/25777(3B) on both letter and envelope; the Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [6000

CROWN Agents for the Colonies.

RADIO Officer required by Nigeria Government Posts and Telegraphs Department (for aeronautial wireless stations) for one tour of 18-24 months in the first instance, with prospect of permanency; salary according to age and experience in scale £660-£850 a year (including expatriation pay), plus temporary allowance between £51 and £65 a year according to salary; outfit allowance £60; free passages; liberal leave. Candidates should preferably hold a Postmaster-General's Certificate in radio-telegraphy or an air operator's certificate, should have had a thorough grounding in I.C.A.O. codes and procedures, and recent experience in operating wireless and direction finding stations used for aeradio services. Experience in radio-telephone procedure and knowledge of manual V.H.F.D/F would be an advantage.—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 M/N/25824(3B) on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [6046

YORKSHIRE ELECTRICITY BOARD.

RADIO and Television Assistants (Vacancy No. 69/50).—A Specialist Assistant is required for the Radio and Television Section in each of the Sub-Areas of the Board at Bradford, Huddersfield, Sheffield, Leeds, Wakefield, Hull and Grimsby. Salaries in accordance with the National Joint Council Agreement, Grade 5 £570/20/£630 per annum. Applicants must have had a sound training and experience in the maintenance and repair of various makes of radio and television sets and the duties will include supervision of the Sub-Area Radio Service Depots carrying out installation, repair and maintenance of apparatus, and will also include responsibility for the training of radio mechanics. The possession of a qualification will be an advantage. Applications, stating the above vacancy number, age, qualifications, experience, and indicating the Area to which they wish to be appointed, should be forwarded to the Secretary, Yorkshire Electricity Board, Wetherby Road, Scarcroft, Leeds, within fourteen days of the appearance of this advertisement. [6074

RADIO television engineer, first-class only; accommodation available.—Box 7036. [6140

RADIO service assistant engineer; knowledge T/V an advantage; write.—Robert Bennett, Ltd., 73, Stroud Green Rd., N.4. [6076

RADIO service engineer required to take charge of workshop, television experience essential, able to drive; good prospects for right man.—Bruce Moore, 109, York Rd., West Hartlepool. [6040

RADIO engineers, experienced, required for work on communication receivers, D.F. equipment; work in N. London or S.W. area of London; write giving particulars of experience.—Box 6961. [6097

BETTER THAN TWINS

The words "twin-units," "cross-over," "feed-back" exercise so magical a fascination these days that we feel it is not amiss to point out that the Barker patent drive is in fact the equivalent of a very efficient twin unit with its own built-in cross-over, plus an extremely high degree of self-adjusting feed-back found in no ordinary speakers, twin or otherwise.

Further, the Barker patent cone corrugations provide a smoothly varying effective cone area which radiates adequately over the full audio range. Nor does it exhibit any break in quality or space since its material and treatment are homogeneous and continuous.

These facts are well known to many hundreds of our friends who find constantly recurring pleasure in the way their Barker speakers bring out the essence of good performances, new experiences in music, speech, and even in noise!

Send now for details of the 148a and 150, twelve inch units, and the new 501 cabinets.

BARKER NATURAL REPRODUCERS

BCM/AADU
LONDON, W.C.1.

SITUATIONS VACANT

WOOLWICH POLYTECHNIC, London, S.E.18.
THE Governing Body invite applications for the post of lecturer in the department of Physics and Telecommunications, to teach chiefly electrical subjects to the standard of the Intermediate B.Sc. examination and the Higher National Certificate in Telecommunications. Candidates will be preferred who have a degree in physics and a knowledge of some branch of telecommunications, but a candidate with a suitable degree in electrical engineering will be considered.
BURNHAM technical scale salary £300-£15-£555 plus London allowance and graduate additions, starting salary according to industrial and teaching experience. Maximum possible is £708.
FULL particulars of the post and application forms may be obtained from the Clerk to the Governors, to whom they should be returned within two weeks of the date of this advertisement. [6028

HIS MAJESTY'S COLONIAL SERVICE—MALAYA.
A VACANCY exists for an Engineer in the Department of Broadcasting, Malaya, to install and manage broadcasting studios, recording channels, and transmitters on a salary scale of $460 to $1,065 per month (equivalent to £644—£1,491 per annum). In addition a cost of living allowance is payable, and varies from £210 per annum for a single officer to a maximum of £525 for a married officer with children. Income tax is at a low rate.
The appointment is permanent and pensionable but subject to a probationary period of 3 years. Free passages are provided for the officer, his wife and up to 3 children on appointment; and for the officer and his wife in respect of each tour, while assistance is given towards children's passages. Furnished quarters are provided if available, at rates varying from $20.5 to $71 per month (equivalent to just under £29—£100 per annum). Vacation leave will be granted at the rate of 4 days per month of resident service in a tour of 3-4 years. Free medical attention.
CANDIDATES, between the ages of 23 and 35, should have an Engineering Degree, Graduateship of the Institute of Electrical Engineers or equivalent, and at least 2 years' general experience with an organization handling studio and transmitter equipment. The successful candidate will later be required to pass an examination in Malay.
CANDIDATES should write for an application form, stating age, experience and qualifications, to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting reference No. 27326/39. [6073

SENIOR television engineer required for research dept. of McMichael Radio, Ltd.; applicants should write stating age, experience and salary required, to—Personnel Officer, Wexham Rd., Slough. [6015

CAPABLE man of high intelligence and integrity as personal assistant to owner-manager of soundly established London retail radio business; state age and full details of career.—Box 6788. [6023

TELEVISION testers and radio testers required for firm of radio manufacturers; top rates, plus bonus; good conditions and prospects.—Apply, Hale Electric Co., Ltd., Talbot Rd., West Ealing, W.13. [5999

INTERNATIONAL company has vacancy for radio technician, South America; should have experience ground installation, maintenance navigational aids and good command Spanish.—Box 6782 [6007

E. K. COLE LTD. (Malmesbury Division), invite applications from electronic engineers for permanent posts in development laboratories engaged on long-term projects involving the following techniques:—
1. PULSE generation and transmission.
2. SERVO mechanisms.
3. CENTIMETRIC and v.h.f. systems.
4. VIDEO and feedback amplifiers.
5. V.H.F. transmission and reception.

THERE are vacancies in the senior engineer, engineer and junior grades; candidates should have had at least 3 years' industrial experience in the above types of work, together with educational qualifications equivalent to A.M.I.E.E. examination standard; commencing salary and status will be commensurate with qualifications and experience; excellent opportunities for advancement are offered with entry into pension scheme after a period of service.—Forms of application may be obtained from Personnel Manager, Ekco Works, Malmesbury, Wilts. [5974

PILOT RADIO, Ltd., requires immediately fault finders, testers and mechanical inspectors for radio and television alignment experienced in factory production, five-day week with good rates of pay.
APPLY or write to:— Park Royal Rd., London N.W.10. [6179

RADIO and electrical engineer, preferably single, aged 26/32, required by British Company trading Middle East; salary according experience, pension scheme, cost living allowance, etc.—Apply Box 6777 [5992

ELECTRICAL inspector for mains and audio transformer test department, previous similar experience essential; N.W. London.—Write with full details of age and salaries earned to Personnel Manager Box 6792 [6038

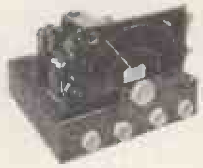
TESTERS for pre-production assembly; must be experienced in electronic and radar equipments and be able to work on own initiative with minimum supervision.—Apply giving full details, to the Personnel Manager E. K. Cole, Ltd. (Development Department), Malmesbury, Wilts. [6085

-towards perfection-

TUNER TYPE DT/4

by

LOWTHER



The finest tuner unit in existence for quality reception (T.R.F. & Superhet) No complications in connecting to any well known amplifier.

Write for full descriptive folder to:—

THE LOWTHER MANUFACTURING CO.

(The Laboratory Production Unit)

Lowther House, St. Mark's Road, Bromley, Kent RAV. 5225

M. & J. PEARSON

263, GALLOWGATE, GLASGOW, C.4.

Offer the following Clearance Lines :—

100 K/C Crystals, Bliley and R.C.A., 12/6 each. **Selenium Rectifiers**, full wave, 24 v. 4 amp., 25/- each; 12 v. 4 amp., 15/-. **Ex.-U.S. Tuning Units.** Range C. and D. enclosed in Black Crackled Case 12in. × 9¾in. × 8¼in. with handles, 15/- each.

New Transformers. Input 220-240 volts. Output 350-0-350, 80 mA., 6.3 and 4 volt, 5 amp., 5 volt 2 amp., 16/- each.

Ferranti 0-500 Micro-Ammeters. 2½in. Flush Type. New and Boxed, special offer, 16/6 each. **Modulation Transformer**, D a' In out and Output 360 watts and 12 watts. Multi tapped primary, totally enclosed, 7in. × 7in. × 7in. Weight 30 lb. 25/- each. **Choke.** 10 henry, 650 mA. Totally enclosed 7in. × 7in. × 7in. Weight 30 lb. 25/-. **Swinging Choke.** 3.6 to 4.2 H., 250 mA. Totally enclosed, 4½in. × 3½in. × 4in. Weight 7 lb. 7/6 each. **American Loran Indicator.** Less Valves and Tube. Contains a host of components, including 24 Ceramic Valves, Holders, High Voltage Condensers, Switches, etc. 17/6.

Receiver Type 78. 5 Valve Superhet, with 100 k/c. crystal, E.C.H.35, E.F.39, 6J5, VR91, VR92. Good condition. 35/- each.

Transformer, 230 volt, 50 cys. input. 115 volts, 500 v.A, 35/-.

Eddystone Power Unit. 200-250 volt, 50 cys, input, 300 v 200 mA D.C., 12.5 volts 3 amp. A.C. and 4 volt D.C. smoothed for microphone output. £2/5/0. **Test Set,** Type 74, input 230-250 volts, 50 cys. Tube 139R. Valves VR135, 5Z4, VU120, 6J5, 6Q7, 5VR, 65.. Good condition. Ideal for conversion to Scope. £3/5/0. **Sperry Bomb Sight Computer**, as advertised at £3/15/0. Brand new in transit case. Our price £2/10/0. A gift to the model makers.

All prices include Carriage or Post.

Cash with Order and please write name clearly.

SITUATIONS VACANT

MINISTRY OF SUPPLY invites applications from electronic engineers and physicists for unestablished appointments in the Experimental Officer Class at Research and Development Establishments in the South Midlands.
CANDIDATES should possess at least Higher School Certificate or equivalent qualification, but special consideration would be given to applicants who have such additional qualifications as a full apprenticeship in light electrical engineering or electronics, or a degree in physics or electrical engineering; experience of radar or radio gained in the Services or in industry, of electronic techniques, particularly in the U.H.F. range or of valve development, would also be an advantage.
SALARY according to age, qualifications and experience within ranges: Experiental Officer (min. age 28), £495-£645; Assistant Experimental Officer, £220-£460; rates for women somewhat lower.
APPLICATION forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting D.253/50-A. Closing date 14 days after date of appearance of this advertisement. [6090

JUNIOR engineering and laboratory assistants with knowledge of radar or radio wanted for interesting work in Luton.—Graduates or ex-radar or radio mechanics should write giving full details mentioning ref. HAE to Box 6952. [6062

ELECTRONIC engineers and physicists are invited by the Ministry of Supply to apply for unestablished appointments in the experimental officer class at Research and Development Establishments in and near London.
MINIMUM qualification Higher School Certificate; applications also invited from candidates holding Higher National Certificate in light engineering including electronics, or higher qualifications; experience in the following fields is desirable; electronic measurements in connection with field trials; radio and electronic circuitry; high speed electrical transients; electronic development; general experimental research requiring some mathematical facility.
SALARY according to age, qualifications and experience within ranges: experimental officer (minimum age 28), £525-£675 (London); £495-£645 (provincial); assistant experimental officer £230-£490 (London), £220-£460 (provincial); rates for women somewhat lower.
APPLICATION forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register (K) York House, Kingsway, W.C.2, quoting A.294/50A. Closing date 14 days after the appearance of this advertisement. [6101

ADMIRALTY invites applications for unestablished appointments as technical author in various naval establishments; the duties are to prepare technical publications and handbooks on electronic equipment used in H.M. ships.
THE posts will be graded in one or other of the ranges: £625×£25-£750 or £500×£20-£625 according to qualifications and experience; rates outside London will be a little lower.
CANDIDATES should have had experience in the production, maintenance and/or operation of radio and radar equipment or electronic control systems; in addition, they should either have completed an engineering apprenticeship or equivalent training and possess technical knowledge to the standard of Higher or Ordinary National Certificate, or alternatively, have had extensive experience in one or other of the appropriate technical and specialist branches of the Royal Navy; preference will be given to those who have had previous experience in technical writing.
WRITE quoting D.49/50-A to Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, W.C.2, for application form which must be returned completed 14 days after appearance of this advertisement. [6114

RADIO and television, experienced men required for servicing, the rate for electrical fitter (radio and television) is at present 35d per hour; N.J.I.C. conditions.—Apply Midlands Electricity Board, 31, Kingsway, Stoke-on-Trent. [5986

ELECTRICAL engineers or physicists required with experience in the theory and practice of servo mechanisms and analogue computors for interesting new development work near London.—Apply, mentioning ref. DEF, to Box 6252. [5866

TELEVISION/RADIO service engineer, fully experienced, able to drive; permanent position with excellent opportunities; full particulars, references and salary required to W. J. Elliott, Ltd., Howardsgate, Welwyn Garden City Herts. [5880

RADIO engineer, able to drive, required by motor agents in west of London suburb; must have sound experience of car radio, car electrical systems and mains wiring; write stating age, experience and wage required to—Box 6778. [5994

SALES engineer required by the Edison Swan Electric Co., Ltd., 155, Charing Cross Rd., London, W.C 2, for department engaged in the sales of heavy duty thermionic valves. Technical qualifications essential. State also age and experience in detail. [6042

YOUNG man, 21/22, required as service/sales engineer for London area by well-known manufacturer of industrial high frequency equipment; starting salary £400 per year and expenses; write, stating if car owner or driver (not essential)—Box 6964. [6112

QUALIFIED engineer or physicist required, with experience in design of electronic instruments; salary £550 or more according to age and experience.—Reply with full particulars to P.D. Research Division, A. C. Cossor, Ltd., 22, Highbury Grove, N.5. [6079

SURPLUS BARGAINS

MANUFACTURERS' & BANKRUPT STOCKS

LIMITED SUPPLIES ONLY

We can offer for immediate delivery

Resistors ¼, ½, ¾, 1, 2 and 3 watt. ALL VALUES

16 foot sectional aerial in Canvas carrying bag.

2 Volt Accumulator suitable for Radio or Model Driving, House Lighting, etc. Heavy Mass Type Plates. Pre-charged. Only need filling. Size: 7in. x 2in. x 2in.

Receivers: R1155, 1355 and 184 Brand New in original cases. Dinghy Radio Transmitter SCR 578.

Celluloid (R.A.F.) Portable 2 v. lead. Acid Accumulators 7 amp. H.R.5. Size: 3¾in. x 3¼in. x 1½in.

Charging Control Boards with Auto. cut out, 3 amp. 220 v.

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.

Storage Secondary Portable Canadian Hart Batteries, 6 v. 100/125 amp.

6 v. 125 amp "Globe" Car Batteries.

Brand New Accumulators 6 v. 85 a. Size: 12 x 9 x 7in. Weight 45 lb. British Made.

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.

SITUATIONS VACANT

GENERAL assistant manager required specialising in radio and electrical departments in old-established music, radio and piano business; accommodation available.—Apply with full particulars and references to Morlings, Ltd., The House of Music, Lowestoft. [6022

SALES engineer required by the Edison Swan Electric Co., Ltd., 155, Charing Cross Rd., London, W.C.2, for department engaged in the sales of electronic and light electrical instruments; technical qualifications essential. State also age and experience in detail. [6043

E. K. COLE, Ltd., have vacancies for testers at their Electronics Division experience in the testing of radar, communications or electronic equipments, to Ministry specifications, essential.—Full details in writing to the Personnel Manager, Malmesbury, Wilts [5805

FOREMAN for assembly of radio and electronic equipment in factory located South Wales; wide experience in Government contract work desirable; apply giving full details of experience to—Personnel Department, Murphy Radio, Ltd., Welwyn Garden City. [5983

ASSISTANT metallurgist required for employment in Essex with a knowledge fo physical testing and heat treatment; age 24-30, and preferably in possession of at least H.N.C. in Metallurgy or L.I.M.—Apply, giving full details, mentioning reference HAD, to Box 6958. [6088

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

A WELL-KNOWN electrical manufacturing company in North London requires test foreman for large department producing wide range of h.f. and l.f. coils and transformers; good standard of technical knowledge required; state experience and salary required to "P.M." Box 6775 [5989

DRAUGHTSMAN required for radio technical handbook work; ability to produce first-class diagrams from rough notes is essential; good prospects, permanency and superannuation scheme.—Apply, stating age, qualifications, experience and salary required, mentioning ref. AEC, to Box 6793. [6039

DESIGNER of mains and audio transformers required, experience of commercial design work necessary, must be able to produce full manufacturing and test specifications, interesting position; N.W. London area.—Write, stating experience, age and salaries earned, to Personnel Manager, Box 6791 [6037

MECHANIC required for the construction and servicing of industrial electronic apparatus, maintenance of electro-mechanical transducers, etc.; West London area.—Forward details of education, experience and salary required to Box A.E.151, Central News, Ltd., 17, Moorgate, London, E.C.2. [6154

REQUIRED for original and interesting design work on magnetic recorders, a design engineer capable of undertaking a complete project; location South Bucks; convenient for West London; reply stating qualifications, experience and salary required to Box No. M.1795, Haddons, Salisbury Sq., London, E.C.4. [6092

RADIO engineers required; the General Electric Co. Ltd., are expanding their radio development laboratory at Coventry, and a number of vacancies for senior and junior engineers exist at present and a further considerable number of vacancies will occur during the next few months in the new laboratory.

APPLICATIONS are invited from development engineers with experience of microwave radio or radar techniques who are capable of developing equipment and components to service specifications.

WRITE, quoting Ref. CHC.(3), to Personnel Officer, General Electric Co., Ltd., Radio & Television Works, Spon St., Coventry [5879

A TELEVISION receiver manufacturing company in the North West requires a chief engineer; only experienced engineers interested in the design and progressive development of a rang of high quality receivers for quantity production need apply; write giving full details mentioning ref. DDG to—Box 6783. [6011

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

YOUNG men, with knowledge and experience of radio required by large manufacturer to fill certain vacancies in radio and television manufacture; applicants should have civilian or Forces radio experience and should possess adequate technical knowledge.—Kindly state full details of experience, with age, to Box 6789. [6024

CHEMIST (aged 28/35) with good honours degree required for Industrial Research Laboratory at Chelmsford; familiarity with analytical techniques is looked for, particularly in metallurgy, together with good experience in the physical chemistry field.—Write, giving full particulars mentioning ref. HAJ, to Box 6951. [6060

BELLING & LEE, Ltd., Cambridge Arterial Road, Enfield, Middlesex, have a vacancy for an assistant for television aerial research; applicants must hold Grad. I.E.E. or equivalent qualifications, and should preferably have had previous experience of V.H.F. aerial problems. —Apply in writing giving age, qualifications, and full details of experience and salary required. [6069

SITUATIONS VACANT

RADIO engineer required by manufacturer's service department in North London area; applicants should give full details of education, which should not be below School Certificate Standard, technical training and experience, age and salary required to—Box No. 430, c/o Era Publicity, Ltd., 7 Fitzroy Square, London. W.1. [5995

THE General Electric Co., Ltd., radio and television works, Coventry, have vacancies for senior-junior mechanical designers, design and detail draughtsman accustomed to the design and layout of electronic apparatus.—Applicants should state fully their experience, age and salary required to the Personnel Manager. [6127

DRAUGHTSMEN.—Several vacancies exist in West London for mechanical and electrical draughtsmen and designers with well-known engineering group; experienced switchgear and electronic men are required, but men with sound mechanical or electrical D.O. experience will be considered.—Apply quoting ref. AAB to Box 6785. [6016

PHYSICIST or electronic engineer required for the development of apparatus fpr physical measurements; preferably honours degree standard, or equivalent, with several years industrial experience; full particulars, age, qualifications, experience, salary required, etc.—Box A.E.94, c/o Central News, Ltd., 17 Moorgate, London, E.C.2. [6001

CHARGE hand required for radio coil-winding section; must have had 2/3 years' experience; good prospects for keen young man capable of handling female labour; the ability to plan winding capacity, fix piece rates, etc., an advantage; pleasant working conditions; close to sea.—Weymouth Radio Manufacturing Co., Ltd., Weymouth. [6100

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

YOUNG man aged about 20 (or less if not subject to National Service) required by progressive and well-known Croydon firm, to learn coilwinding, testing, etc.; intelligence and good practical knowledge of radio essential; write stating age, experience and salary required (5-day week).—Osmor Radio Products, Ltd., Borough Hill, Croydon. [6098

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

APPOINTMENTS of two assistant foremen in the test department, will shortly be made; knowledge of electrical work essential; experience and technical standard of radio electrical work desirable, but not essential; 5-day week, and all welfare conveniences.—Apply Personnel Superintendent, The Edison Swan Electric Co., Ltd., Cosmos Works, Brimsdown, Enfield. [6109

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

ELECTRONIC development engineers.—Senior and junior electronic engineers required for design and development work on interesting new projects, degree or higher national certificate essential; good salary and excellent prospects, pension scheme.—State age, qualifications and experience to Personnel Manager, Fairey Aviation Co., Ltd., Hayes, Middlesex. [6050

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. [6160

SERVO engineers for experimental work are requried by a prominent aircraft concern; applicants, preferably under 35 years of age, must be educated technically to degree standard and have experience in the design of one or more of the following: hydraulic systems, servo amplifiers, small electrical mechanisms.—Apply stating age, experience and salary required to Box 6954. [6066

TECHNICAL assistant required by large firm in N.E. London suburb for experimental work in connection with the industrial application of electronics (di-electric heating, process control, etc.); applicants should have fulfilled liabilities under the National Service Act and have a good degree (or near equivalent) in electrical engineering or physics and some practical engineering or radio experience, a knowledge of radio frequency oscillators, transmission line theory and radio frequency measurement is essential; the post offers good scope, interest and experience; commencing salary will be in the region of £400 to £450 per annum according to qualification and experience; successful applicant would be required to join staff pension scheme.—Write giving full details of training and experience to Box 7156. [6174

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 1"¼", DEPTH 5¼"
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

YOUR METER DAMAGED?

Leading Electrical Instrument Repairers to the Industry.

Repairs by skilled craftsmen to all makes and types of Voltmeters, Ammeters, Microammeters, Multirange Test meters, Electrical Thermometers, Recording Instruments, Synchronous Clocks, etc. Quick deliveries—for speedy estimate send defective instrument by registered post to

L. GLASER
Electrical Instrument Repairers
341 CITY ROAD, E.C.1
Tel. Terminus 2489

WE DON'T THINK

that you will see the following units advertised elsewhere, and we believe that they represent REAL value for money.

(1) Brand new Indicator Unit (ID-11/APS4) and Amplifier Unit (AM-5A/APS4). The two units in sealed cartons, with viewing hood, in plywood transit case. Contain 3 6J6, 2 6V6GT, 1 6SL7GT, 1 3FP7 (3in. C.R.T.), 6 potentiometers, etc., etc. Valves are by R.C.A. Only 45/-, plus 6/- towards carriage by passenger train.

(2) Admiralty Wavemeters G82A. Beautifully made grey steel case, 13in. x 9in. x 9in. Contain 3 EF50, 1 ECS3 ("peanut" triode oscillator), Y63 (magic eye), EA50, 200 : 1 two-speed tuning dial (real precision job) and of course a host of other components. Calibration chart 2850-3150 Mc/s supplied. No rectifier crystal. Price only 31/-, plus 5/- car.

REED and FORD,
Mail Orders: 46B Grosvenor Road, Southport.

SITUATIONS VACANT

A LEADING firm of mobile radio equipment producers requires resident technical representatives for liaison duties with automobile manufacturers in Birmingham and Coventry areas.—Applicants between 25 and 35 and possessing sound radio engineering training should apply, in writing, giving age, qualifications, details of experience and salary required to Box 7148. [6153

ENGINEERS required for electrical design of radar apparatus and also for laboratory work in connection with radio and television; applicants must have sound basic training, preferably a degree in physics and some experience in industrial design laboratories.—Write, stating age, experience and salary required, to Personnel Dept., Murphy Radio, Ltd., Welwyn Garden City, Herts. [6058

UNIVERSITY COLLEGE, London, has a vacancy in the Department of Psychology for a Grade I technician; experience in construction and maintenance of electronic and electrical apparatus and metal work; salary scale £390 ×£13—£481; family allowance scheme.—Application forms from the Secretary, University College, London, Gower St., W.C.1, quoting Psychology/2. [6152

WAYNE KERR have vacancies in their laboratories for a senior development engineer and a development engineer to undertake design and development work covering a wide field of electronic applications and measurements; applicants should apply in writing to—The Chief Development Engineer, Wayne Kerr Laboratories, Ltd., Sycamore Grove, New Malden, Surrey. [6120

DEVELOPMENT engineer (electronics) required by old-established company, to be responsible for the design and development of specialized radar and electronic instruments; applicant should have good circuitry experience in time-base, pulse and C.R.T. techniques; preferably conversant with Service design requirements; state age, experience and salary expected.—Box 6965. [6113

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

AN experienced valve design or production engineer required by the English Electric Valve Co., Ltd., at Chelmsford, aged 25-35, with previous experience on the manufacture of large receiving valves and small transmitting valves.—Apply giving full details and present salary, quoting reference 497A, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6025

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. [6039

MINISTRY OF SUPPLY invites applications from electronic engineers and physicists for unestablished appointments in the Scientific Officer and Experimental Officer Classes at the Royal Aircraft Establishment, Farnborough, particularly in the fields of radio communications, including microwave techniques, circuit design and measurements servo mechanisms and measurement of flight parameters.

(1) SCIENTIFIC Officer Class: candidates must have a good honours degree in appropriate subject or equivalent qualifications: at least 3 years' post-graduate research experience required for senior posts; grade and salary to be assessed according to age, date of graduation and experience within following ranges: Senior Scientific Officer (min. age 26), £670-£860; Scientific Officer, £380-£620; rates for women somewhat lower; posts carry F.S.S.U. benefits.

(2) EXPERIMENTAL Officer Class: minimum qualifications is Higher School Certificate with mathematics or a Science subject as a principal subject, but candidates with other qualifications, such as Higher National Certificate in electronics or light electrical engineering, or a pass degree in physics, are invited to apply; appropriate experience is required for senior posts and would be an advantage for all appointments; grade and salary to be assessed according to age, experience, etc., within following ranges: Senior Experimental Officer (minimum age 35), £705-£895; Experimental Officer (minimum age 28), £495-£645; Assistant Experimental Officer, £220-£460; rates for women somewhat lower.

APPLICATION forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, W.C.2, quoting D.220/50-A. Closing date 14 days after the appearance of this advertisement. [6091

DESIGN draughtsmen are required by Wayne Kerr for work covering a wide range of electronic applications, measurements and radio communications; applicants should have had several years of experience in this class of engineering; write giving full details of qualifications and experience to—The Senior Project Engineer, Wayne Kerr Laboratories, Ltd., Sycamore Grove, New Malden, Surrey. [6121

RETAIL radio component dealers, S.E. London, have following vacancies: (1) Senior sales assistant with knowledge and experience of radio and television component business; good salary and commission, with prospect of managerial appointment. (2) Service engineer, with experience in design and construction work; amateur would suit; good salary and bonuses.—Applications to Box 7032. [6132

A REMARKABLE ACHIEVEMENT IN FILTER DESIGN

Pat. Applied For

E.M.G. STEEP-CUTTING INFINITELY VARIABLE FILTER

- Cuts at any selected frequency between 4,000 and 8,000 c.p.s.
- Average steepness of cut 30 db. per octave.
- Connects between secondary of output transformer and speaker (15 ohms, rated impedance).
- Specially valuable for use with new microgroove records.
- Greatly reduces needle-hiss on ordinary records with minimum high note loss, and suppresses high pitched interferences on radio.
- No distortion, and no appreciable loss of volume.
- Leaflet available from the manufacturers.
- *Novel circuit, patents pending.*

£4 - 10 - 0

Trade Enquiries invited

E.M.G. HANDMADE GRAMOPHONES, LTD.
6, Newman St., Oxford St., W.1.
Telephone: Museum 9971-2-3.

ELECTRONICS
DUPLEY
LTD.
CRANMER AV. EALING. W 13.

Transformer and Coil Manufacturers to the Trade
Telephone: EALing 3683

RADIO G200 OFFERS

ECHOMETERS. Marconi type 445A recording Echometers complete. Maximum depth of sounding 180 ft. Could be modified for deeps if necessary. Price £70.

ARTHUR HOILE 55, UNION STREET, MAIDSTONE, KENT
Phone: 2812.

ENGINEERS!

Whatever your age or experience, you *must* read "ENGINEERING OPPORTUNITIES". Full detail of the easiest way to pass A.M.I.Mech.E., A.M.I.C.E., CITY & GUILDS (Electrical, etc.), MATRIC., etc., on "NO PASS—NO FEE" terms and details of Courses in all branches of Engineering—Mechanical, Electrical, Civil, Auto., Aero., Radio, etc., Building, etc. If you're earning less than £10 a week, tell us what interests you and write for your copy of "ENGINEERING OPPORTUNITIES" today—FREE!

176 PAGES *Free!*

B.I.E.T.
387 Shakespeare Hse., 17-19, Stratford Place, London, W.1.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

SITUATIONS VACANT

INTERNATIONAL AERADIO, Ltd., require immediate applications for appointment of radar specialist, Middle East, to take charge installation and training; experience required centimetric ground and air radar equipment, including Marconi Type 21, Eureka, Babs, Rebecca, I.F.F.; inclusive salary £1,600; free single accommodation; pensions fund; free passage.—Apply Personnel Officer, 40, Park St., W.1. [6078

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 applicants with previous design or production experience of small transmitting valves; write giving full details of previous experience mentioning ref. 497B to—Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6099

BELLING & LEE, Ltd., Cambridge Arterial Rd., Enfield, Middlesex, require a television service engineer aged 20/25, to be trained in the suppression of electrical interference and to handle the relative correspondence; applicants should possess City and Guilds certificates in Radio Comunications 1 and Tech. Elect. 1, and must be prepared to work for finals; written applications to state age, experience and salary required. [5995

ENGLISH ELECTRIC require a technical representative for the Birmingham area; candidates should have good experience of industrial electronic equipment and be resident in the Birmingham area; previous commercial experience in this field is desirable; car provided; write giving full details of previous experience quoting ref. 356D to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [5932

URGENTLY required for employment in Swindon area personnel experienced in the maintenance and repair of radar fire control equipment; salary £380 p.a., rising to £495 p.a.; opportunities for advancement; applicants must give full details of age, practical experience and technical qualifications held.—Replies quoting Swindon Vacancies should be addressed to A.D.M.E., 2 A.A. Group, Barossa Barracks, Aldershot, Hants. [6156

THE General Electric Co., Ltd., radio and television works, Coventry, have vacancies for senior-junior development engineers for broadcast radio receivers, television receivers, H.F. and V. H.F. communication transmitters/receivers.—Applicants who should preferably be graduates of a university and experienced in one or more of the above fields should write stating age, experience and salary required to the Personnel Manager. [6126

ELECTRONIC engineer; fully experienced electronic engineer required (grad. I.E.E. or equivalent qualifications) for work in a large Birmingham light engineering company; the work will be closely connected with laboratory and development departments and will consist of the design, construction and maintenance of all kinds of electronic apparatus; applicants should state age, experience, qualifications and salary required.—Box 6962. [6110

MANAGER required to take charge and develop service department of home company trading in British Central Africa, handling radios, refrigerators, typewriters and sewing machines, etc.; sound electrical and radio knowledge essential; preliminary training will be given in other service requirements before departure; four years' contract with passage, housing, paid leave, etc., etc.; good salary and prospects. —Address, 1,301, Wm. Porteous & Co., Glasgow [6070

REQUIRED, radio and radar superintendent preferably single for British Shipping Company's Hong Kong Office, with first-class technical qualifications and experience, and good administrative capacity; starting pay £800 p.a., plus fluctuating high cost of living allowance (at present £360 p.a. single £720 married); home leave; provident fund and pension scheme; excellent prospects for right man.—Reply, giving full qualifications and references, to Box 6957. [6093

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

AMERICAN services equipment.—London firm of manufacturers, stockists and exporters of radio radar and signal equipment have vacancies for (a) radio-electrical engineer fully conversant U.S.A. Services radio, radar and signal equipment, required practice in installation, operation and maintenance, stores experience an advantage, excellent prospects for right applicant; (b) technical assistant to export director, familiar with American equipment.—Box 7149 [6157

MARCONI'S WIRELESS TELEGRAPH Co., Ltd require staff for their modern development laboratories at Chelmsford, Essex to undertake important development work on interesting radar projects; qualified electrical engineers and physicists with experience of radar are required at various levels, there is also scope for young men without experience, including those who possess the highest academic attainments; where necessary a period of training will be given at the Marconi College.—Please send full details indicating present salary level, quoting Ref 474, to Central Personnel Services English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [5783

QUARTZ CRYSTAL UNITS

Q.C.C.

For—

AIRCRAFT, MARINE AND COMMERCIAL USE are available in the complete range from 35 kilocycles to 15 megacycles.

Alternative mountings in standard two-pin A.M. pattern 10X, International octal, and miniature type FT243, can be supplied for most frequencies.

Prices are fully competitive, and we specialise in prompt deliveries for urgent requirements.

WE WELCOME YOUR ENQUIRIES.

THE QUARTZ CRYSTAL Co., Ltd.
63-71 Kingston Road,
NEW MALDEN, SURREY
Telephone: MALden 0334

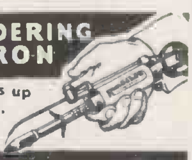
SQUARE - WAVE GENERATORS

Driven by any A.F. Oscillator. Rise time less than one micro-second. Extremely wide frequency range. A high grade instrument for laboratory use.

Full details on request.

DUN ELECTRONICS
Riley Works, Riley Street, Chelsea, S.W.10.
Telephone: FLA 3217.

Autofeed SOLDERING IRON



Simple self-feed speeds up soldering. Better work. Saves solder.
Write for leaflet 30.J.

RUNBAKEN · MANCHESTER 1

CHASSIS

HAYES RG/120 RADIOGRAM CHASSIS. Write now for full details and circuit data of this outstanding 5-valve chassis, costing only **£13/7/6** with matched 8" loudspeaker. Delivery anywhere by rail.
ARMSTRONG CHASSIS. We hold full stocks of this famous chassis ranging from 7-14 valves and including T.V. Demonstrations in our Showroom. Full details will be sent on request.
We shall be closed from December 24th to January 14th for alterations to our premises. Postal business as usual during this period.

THE HAYES COMPANY
1 ALCESTER RD., MOSELEY, BIRMINGHAM, 13
Phone: SOUTH 0202

SITUATIONS VACANT

REQUIRED at once, by the Plessey Co., Ilford, young engineers of British birth with several years' experience of radio communication, radar, or electronic development work; applicants should preferably have a degree in physics or engineering, but this qualification is not essential; the posts involve work on interesting long term development projects and are permanent and pensionable; please state full particulars with age and salary required to Personnel Manager. [6106

McMICHAEL RADIO, Ltd., require senior project engineers in their Equipment Division Development Laboratory at Slough; training and experience in the field of Applied Electronics (including communications) and experience of working with Government departments, are the chief qualifications required; salary will be commensurate with ability; write, stating age and full details of training, qualifications and experience, to the Chief Engineer, Equipment Division, McMichael Radio, Ltd., Slough, Bucks. [6080

NELSON RESEARCH LABORATORIES, ENGLISH ELECTRIC Co., Ltd., Stafford, require draughtsman for development work on vacuum devices, including industrial type electronic valves; must have flair for design of jigs and fixtures for assembly and processing of components and be familiar with modern shop techniques in this field; salary according to qualifications and experience.—Apply, mentioning reference 143A, to Central Personnel Services, 24-30, Gillingham St, London, S.W.1. [5881

SEVERAL draughtsmen with electronic experience are required by an old-established firm at their research laboratories, Borehamwood; applicants must have experience of the design and detailing of modern electronic equipment; please state full details of experience, age and salary required; there are also several vacancies for juniors to train as electronic draughtsmen; an experienced drawing office clerk (male) for office records and photo copying is also required, age 40-55 years.—Apply Box 6784. [6012

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.—Write, giving full details, quoting reference 142A, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1 [5769

A NUMBER of senior radio development engineers are required by the Research Division of the Plessey Company to work on interesting long-term radio communication projects; candidates must be British-born, between the ages of 25-35, and should have some years' experience in the design of radio communication equipment; the posts are permanent and pensionable.—Apply to Plessey Co., Ltd., Ilford, giving full particulars of age, education and past experience. All applications will be treated in confidence. [6075

RESEARCH and Development engineer for work on electronic switching, control and computing apparatus required by N.W. London firm of repute manufacturing a variety of electrically controlled light mechanisms and extending their development in the electronics field; position offers good remuneration and permanency; candidates should have good theoretical background of wire and tape recording principles and practical experience in development.—Kindly submit details of experience, age, salary required, etc., to Box 7035. [6137

A VACANCY exists with a well-known radio engineering firm near London for a technical writer; duties will be to originate technical sales literature of all kinds, to deal with printers and typographers, and to liaise with design engineers within the company; experience gained would range over the company's many products and would be invaluable to a young engineer; applicants should have a good general knowledge of telecommunications, be between 21 and 30 years of age, and have an ability for this special kind of writing.—Apply giving full details, mentioning Ref. BGH to Box 7031. [6125

A NUMBER of interesting vacancies have arisen for physicists and engineers for experimental and design work in research teams at the Research Laboratories of the General Electric Co., Ltd., East Lane, North Wembley, Middlesex. A variety of problems are being investigated and applications will be considered from men with both general and specialised training and experience in the fields of physics and light mechanical or electronic engineering. Details of openings will be sent to all selected candidates who send particulars of their qualifications and experience to the Personnel Officer (Ref. GBCL/33/4). Replies will be sent to all letters. [6027

APPLICATIONS are invited by the Marconi's Wireless Telegraph Co., Ltd., for the post of project engineer in the broadcasting division; applicants should have a university degree in electrical engineering or equivalent qualifications and have had experience in the installation, operation and maintenance or design of transmitting or studio equipment; the successful candidate must be able to assist in the planning, organisation, co-ordination and control of the development, sales production, distribution and installation of all television equipment handled by the company.—Write, giving full details mentioning ref. 466, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [6061

E·L·R

BASS REFLEX CABINETS

Kits or completely assembled cabinets with or without speakers. Massive, sturdy and resonance free construction.

10in. Models from £4/12/6 in the white.
12in. Models from £5/7/6 in the white.

Duplex models also available to house twin speakers with or without cross-over units and speakers.

CROSS-OVER UNITS

2,000 cycle cross-over units.........	£1 10 0
1,000 cycle cross-over units.........	£1 15 0

Many other types available, including models with independant volume controls for Bass and Treble.

Write for free lists.

(Callers by appointment only.)

E·L·R 342, City Rd., London, E.C.1
Tele: TERminus 2303.

—AUTOMATIC SWITCHES—

(RECONDITIONED)

ELECTRIC 1 to 100 AMPS. **CLOCKWORK** 7 to 35 DAYS

From **35/-** EACH

All guaranteed for a year.

Write for illustrated lists: **DONOHOE,**
2, UPPER NORFOLK ST., NORTH SHIELDS, NORTHUMBERLAND.

BULLANCO. 66 QUEEN'S Rd. S.E.15 TEL. NEW CROSS 1092

ALUMINIUM

SHEET, EXPANDED, TUBES, ANGLES, BARS, RODS, MOULDINGS, RIVETS

S.A.E. FOR LIST — ANY SIZES CUT OR FOLDED

SAMSONS SURPLUS STORES

WILLARD BATTERIES. 12 v. 85 ah. In solid vulcanised rubber. Sealed case, £6/10/-. Carriage 6/-.

PRITCHETT & GOLD. 12 v. 16 ah. Batteries in oak cases. Brand new. Dim. 6¼ x 8¼ x 8¾in., 29/6. Carriage 2/6.

ALKALINE BATTERIES. By Brittania batteries, Ltd. 1 4 v. 45 ah. Brand new and unfilled. Dim. 8½ x 4¼ x 2in., 15/-. Carriage 1/6. 2 5 v. 21 ah. Dim. 9 x 2½ x 3in., 12/-. Carriage 1/6.

MASTER VOLTMETER. O 20 v. A.C. Moving Iron, 6in. mirrored scale made by Metro Vickers. Brand new, 17/6. Carriage 1/6. 150 voltmeters D.C. 2½in. panel mounting, 12/6. Carriage 9d. 6 v. D.C. Voltmeters scaled at 6 v. and 60 v., 10/6. Carriage 9d.

EX-A.M. AUTO TRANSFORMERS, TAPPED. O. 110 v. 150 v., 190 v., 230 v. 1 6 kva., £4/10/0 Carriage 5/-. Heavy Duty.

TRANSFORMERS. Prim. 0-240 v. 50 cy. Sec. 0-14-20 v. 20 amps., 37/6. Carriage 5/-. Prim. 200-250 v. 50 cy. Sec. 6 3 v. 15 a., 17/6. Carriage 1/6.

30FT. LENGTH COILS CO-AXIAL CABLE. With Pye Sockets on each end, 8/6. Postage 9d.

Edgware Road Branch open all day Saturday.

169/171 Edgware Road, London, W.2. Pad 7851
125 Tottenham Court Rd., W.1. Eus 4982

Hundreds of BARGAINS for CALLERS

GOVT. SURPLUS, UNUSED

CONDENSERS

of all types . . .

We can offer, FOR IMMEDIATE DELIVERY from very generous stocks, a wide range of ultra-high quality fixed paper Condensers, from .001 μF to 8 μF. Also STOCKS of small, genuine MICA Condensers from .00001 (10 pf) to .01 μF (10,000 pf). *Prices are exceedingly moderate.*

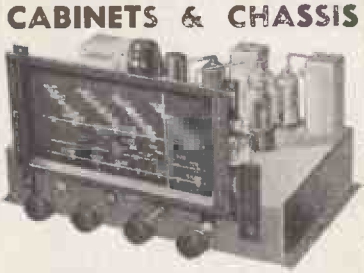
Enquiries are invited for manufacturers' requirements, wholesale and export only for bulk quantities, and for scheduled deliveries over a period as required. Most condensers are now available for immediate delivery.

Please request our 4-page bulletin CONSEVEN 01114

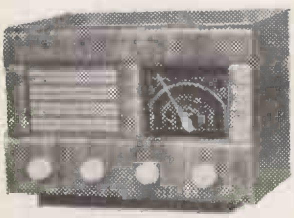
CLAUDE LYONS LTD.

180 Tottenham Court Rd., London, W.1
and 76, Oldhall St., Liverpool 3, Lancs.

CABINETS & 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



CABINETS as illustrated 12"×9"×7" 30/-
All the components to fit this cabinet are available.
Walnut veneered radiogram cabinets. All apertures cut to suit your own units £16/10/0
WE CAN MAKE ANY TYPE OF CABINET TO YOUR SPECIFICATION.
Send a sketch and full details.
AMPLIFIERS: 4 to 15 Watts from £3/15/0
Full details of above from:—

LEWIS RADIO CO.
322, HIGH ROAD, WOOD GREEN, LONDON, N.22. Phone: BOWes Park 5997

SITUATIONS VACANT

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 0991. [6122

E.M.I. ENGINEERING DEVELOPMENT, Ltd., offer outstanding opportunities for experience in interesting development in many branches of electronic engineering, including radar, radio communication, television receivers, audio-frequency engineering and magnetic recording; applications will be welcomed from men with engineering or physics degrees or the equivalent, with design experience; salaries according to age and experience.—Applicants should write, giving full details, to Personnel Department, ED/21, E.M.I. Engineering Development, Ltd., Blyth Pond, Hayes, Middx. [6081

UNIVERSITY of Glasgow requires, for work in the physiology department, a technician (grade A) with experience in building electronic devices; he will be required to construct to specification high-gain L.F. amplifiers, stabilised power supplies, time bases, etc.; a good standard of workmanship is expected; a knowledge of physiology is not essential, but a successful applicant would be expected to learn physiological laboratory technique; salary scale: £350-£435.—Applications, stating experience and qualifications, should be sent to the Senior Administrative Assistant, The University, Glasgow, W.2, from whom further particulars may be obtained. [6054

LABORATORY technician required for electroencephalography department of medical school; applicants should possess technical training in electronics and servicing of amplifiers; workshop practice essential; previous E.E.C. experience not essential. Preference will be given to graduateship of British Institution of Radio Engineers, Institution of Electrical Engineers, or equivalent qualification. Salary scale £370, rising by 4 increments to £435 p.a., plus London weighting allowance according to age.—Application forms, to be returned within 14 days of the appearance of this notice, from the Secretary, Institute of Psychiatry, Maudsley Hospital, S.E.5. [6045

MARCONI'S WIRELESS TELEGRAPH Co., Ltd., have vacancies for two engineers for work on VHF development, applicants for the first post must have good practical knowledge and experience on VHF low power transmitters, for the second post experience on multiplex channelling audio and/or video is required; applicants must be familiar with problems on linearity, distortion, etc., and a knowledge of centimetric techniques would be an asset; salary will be not less than £650 per annum, and may be higher for candidates with outstanding qualifications and experience; the company has a staff pension fund.—Please apply giving full details, quoting Ref. 822, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [6178

ADMIRALTY.—Vacancies exist for electrical and/or mechanical engineering draughtsmen in Admiralty research and development establishments located in the vicinity of Weymouth, Portsmouth, Teddington (Middlesex) and Baldock, Herts. Draughtsmen experienced in light current, electro-mechanical, precision mechanical and electronic equipment are particularly needed. Candidates must be British subjects of 21 years of age and upwards, who have had practical workshop experience (preferably an apprenticeship) together with drawing office experience. Appointments will be in an unestablished capacity, but opportunities may occur for qualified staff to compete for established posts. The salaries offered, depending on age, experience, ability and place of duty, will be within the range £283-£510 p.a. Exceptionally well qualified candidates may be considered for appointment in a higher grade within the salary range £470-£610 p.a. Hostel accommodation is available at some establishments.
APPLICATIONS, stating age and details of technical qualifications and apprenticeship (or equivalents) and workshop and drawing office experience, should be sent to Admiralty (C.E.II, Room 88), Empire Hotel, Bath. Original testimonials should not be forwarded with application. Candidates required for interview (at London or Bath, whichever is nearest) will be advised within two weeks of receipt of application. [6134

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

SUPACOILS

OFFER

THE LATEST EDITION OF THE

HOME CONSTRUCTOR'S HANDBOOK

No keen radio enthusiast should be without this invaluable booklet which is of equal use to beginner, amateur or professional radio engineer. It contains, among other things:

- Circuits of Feeder units, Superhet receivers, Test equipment, Amplifiers and power packs, etc.
- Pages of servicing and constructional information which will assist you in YOUR radio problem.
- Complete resistance colour code.
- A considerable amount of invaluable general Radio information.
- A comprehensive catalogue.
- Above all it is profusely illustrated with half tone blocks and costs 1/6 only or a copy will be given **FREE** with every order for £1 or more.

We also offer the following selection from our stocks of quality components:

- **COILS.** A complete series of High Q variable iron dust cored coils (as recommended for the P.W. 9 valver) in wavelengths 10-30, 16-50, 30-75, 75-200, 190-550 and 800-2000 metres; Aerial, H.F. or Oscillator at the remarkable price of 3/- each.
- **MODEL 30** famous 3 waveband superhet Coil Packs, aligned, 40/11 inc. full connection details and instructions given with every pack.
- **MODEL 40** Coil Packs—similar, with R.F. stage, aligned, 70/3 inc.
- **MODEL 30 TUNING UNIT** consisting of 30 Coil Pack, pair of I.F. Transformers, matched 2-gang and attractive Dial. Components aligned together as a unit and sealed. 69/9 inc.
- **MODEL 40 TUNING UNIT,** similar with R.F. stage .... 99/6 inc.
- **CHASSIS.** Good quality aluminium chassis in stock for 5 v. Rec. 11/-; 6 v. Rec. 12/-. Amplifiers and Feeder Units, etc., from 7/-
- **J.B. SL8 SPIN WHEEL** Tuning Assembly to suit Coil Packs and Chassis above .... 25/- each
- **COIL GROUPS.** The very popular Coil Group A .... 26/9; Coil Group B 43/9
- **GRAM** components of all types in stock.

SUPACOILS MAIL ORDER OFFICE
98, Greenway Ave., London, E.17

Have you had a copy of our

25TH BIRTHDAY

Radio & Television Component Catalogue?

If not, send today, 6d. post paid. All Radio enthusiasts should possess a copy, an excellent reference list for ALL leading makes of components. *You can rely on* Quality, Value and Service from

COVENTRY RADIO
Dept. 'W', 189 Dunstable Road, LUTON

SITUATIONS VACANT

EXPERIENCED electronic engineer with sound recording experience required for research and development department South London district.—Box 6773. [5987

RADIO tester with experience in testing communications and radar equipment to Ministry specifications required for marine radio manufacturers; London area.—Box 7034. [6136

RADIO/TELEVISION service manager required by organisation with branches throughout London area; first-class technical experience essential.—Apply by letter to:—W. H. BARNES, Ltd., Head Office, 36-38, Peckham Rd., London, S.E.5. [6029

DRAUGHTSMEN between 25 and 30 years of age are urgently required for work on the development of miniature airborne radio equipment; experience in design of microwave radio and/or radar equipment and components to Service specifications would be an advantage though not essential; attractive starting salaries will be paid and there will be excellent prospects of advancement in an expanding organisation.—Replies should be sent in writing to the Personnel Officer (Ref. GBLC/127), Research Laboratories of The General Electric Co., Ltd., East Lane, North Wembley, Middlesex, and should give full details of experience, qualifications and age. [6155

APPLICATIONS are invited from electronic development engineers for positions, with an expanding organization near Kingston, engaged on interesting new projects involving radio and radar techniques; candidates should have good technical knowledge and experience of these techniques together with some experience in engineering equipment to the prototype stage; candidates should preferably possess an electrical engineering degree or a diploma or be corporate members of a professional institution; salaries offered will be commensurate with qualifications and experience, and the positions will be progressive for applicants with initiative; working conditions are ideal in pleasant surroundings, and a first-class canteen is on the premises; write stating age, nationality, qualifications, experience and salary required.—Box 6963. [6111

SITUATIONS WANTED

ADVERTISER, 16 years pre-war experience in radio industry, 11 years radar officer Royal Air Force, latterly industrial liaison officer between R A F., Ministry of Supply and leading manufacturers, leaving Service shortly, requires position where experience in both industry and Service and an appreciation of problems common to both would be an advantage.—Box 6955. [6071

AGENCIES

LONDON sales organisation wishes to communicate with manufacturers of electronic equipment and light electrical apparatus who desire London and Home Counties representation.—Box 6790. [6031

BUSINESSES FOR SALE AND WANTED

MOBILE radio workshop for sale, ideal for "on the spot radio repairs," built into 1941 Morris 13.9hp van, all in good condition.—Full details of internal fittings and power supply from Cunliffe, 68, Church Rd., Stretton, Burton-on-Trent. [4107

FOR domestic reasons, working director wishes dispose 51 per cent holding in limited company of flourishing North London radio retailers, fully furnished flat in modern block nearby if needed; £1,385 for quick sale.—Page, Moore & Page, 30, Ely Place, E.C.1. [5746

FINANCIAL PARTNERSHIPS

WANTED, working interest in small progressive radio, electrical business.—Box 6776.

MANUFACTURERS of quality product whose name is household word require director to develop retail section; new shop front recently fitted; premises occupy prominent position in rapidly developing parade and should be capable of considerable business; capital required about £2,000 but applicant must have either first-class technical ability or experience of retail selling and servicing; only first-class men willing to work hard and carve out a future for themselves need apply; good salary and share of profits.—Full details to Box 6956. [6072

TECHNICAL TRAINING

QUALIFIED radio officers urgently required.—Training details from the Radio & Television College, Ibrox Terrace, Glasgow. Boarders accepted. [6118

CITY & Guilds (Electrical, etc.), on "No Pass—No Fee" 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. [0117

TRADE MARKS

THE Trade Marks Nos. 615902-03 consisting respectively of the words "Vacolite" and "Otarian" and both registered in respect of instruments and apparatus for aiding the deaf and parts thereof, were assigned on September 25, 1950, by Allen & Hanburys, Ltd., of Three Colts Lane, Bethnal Green, London, E.2, to Bonochord, Ltd., of 48, Wigmore St., London, W.1, without the goodwill of the business in which they were then in use. [6166

TUITION

WIRELESS, land, sea and air; students, both sexes, age 14 upwards, trained for interesting appointments in all branches of radio; low fees, boarders accepted; 2d stamp for pros.—Wireless College, Colwyn Bay. [0018

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

TELEVISION minded?
E.M.I. gave the world electronic television E.M.I. is now giving the finest home study television courses; free brochures giving full details on application to—Registrar, Dept. W.W.6, E.M.I. Institutes, 10, Pembridge Sq., London, W 2. Bayswater 5131/2. [0001

BOROUGH POLYTECHNIC, Borough Rd., S.E.1.
DEPARTMENT of Electrical Engineering.
A TWO years' full-time Higher National Diploma Course in electrical or radio engineering will begin at the Borough Polytechnic on the 8th January, 1951; the course includes industrial training as well as college work and leads to the above qualification; students must have obtained an Ordinary National Diploma in engineering (electrical or mechanical) or have attained an equivalent standard; prospectuses and forms of application for admission may be obtained from the Secretary. [6094

RADIO training.—P.M.G. exams. and I.E.E. Diploma; prospectus free.—Technical College, Hull. [0111

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 106. [0172

QUALIFIED radio officers urgently required, training details from the —Radio & Television College, Ibrox Terrace, Glasgow; boarders accepted. [6006

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

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.

TELEVISION Servicing Manual, 4/9; practical work with special attention to fault finding and correction.—Blackshaw, BCM/HADOR, London, W C 1. [6103

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

"RADIO Servicing," by Abraham Marcus; a complete handbook which covers theory and practice and shows how to deal with all radio faults; write for free descriptive leaflet to —Allen & Unwin, 40, Museum St., London, W.C.1. [5786A

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

INDEX TO ADVERTISERS

PAGE

A.A. Tools
Acoustical Mfg. Co., Ltd. 55
Acru Electric Tool Mfg. Co., Ltd., The 50
Adcola Products, Ltd. 94
Aerialite, Ltd. 4
Air Ministry 31
Albert Mfg. Co. 34
Alfa Precise Instrument Co. 111
Allan, Richard, Radio, Ltd. 49
Altair Instrument Co. 94
Anders Radio, Ltd. 96
Antiference, Ltd. 10
Armstrong Wireless & Television Co., Ltd. 101
Ashworth, H. 36
Audigraph, Ltd. 106
Automatic Coil Winder & Electrical Equipt. Co., Ltd., The 1
Automatic Telephone & Electric Co., Ltd. 21
B. & H. Radio 114
Bakers "Selhurst" Radio 10
Baldwin Instrument Co., Ltd. 26
Barker, A. C. 105
Beethoven, Ltd. 108
Belling & Lee, Ltd. 69
Berry's (Short Wave), Ltd. 46
Bird, S. S., & Sons, Ltd. 56
Birmingham Sound Reproducers, Ltd. 42, 64
Booth, Jas., & Co., Ltd. 36
Bradmatic, Ltd. 51
Brierley, J. H. (Gramophones & Recordings), Ltd. 48
Britain, Chas. (Radio), Ltd. 89
British Institute of Engineering Technology 110, 115
British Insulated Callender's Cables, Ltd. Cover ii
British National Radio School 106
British N.S.F. Co., Ltd. 19
British Physical Laboratories 44, 59
British Rola 72
Brookes Crystals, Ltd. 108
Brown, S. G., Ltd. 44
Bulgin, A. F., & Co., Ltd. .... Edit. 423, 116
Bull, J., & Sons 99
Bullanco 112
Bullers, Ltd. 53
Cabot Radio Co., Ltd. 108
California Radio & Electronics Co. 44
Candler System Co. 109
Caxton Publishing Co., Ltd. 74
Champion Products 115
Chancery Precision Instrument Service, Ltd. 26
Chapman, C. T. (Reproducers), Ltd. 116
Charles Amplifiers, Ltd. 57
Chase Products (Engineering), Ltd. 96
Cheshire, Maurice, & Co. 26
Cinema-Television, Ltd. 29
Clydesdale Supply Co., Ltd. 87
Cohen, D. 85
Cosmocord, Ltd. 68
Cossor, A. C., Ltd. 15, 37
Coulphone Radio 105
Coventry Radio 113
Davis, Alec, Supplies, Ltd. 95
Davis, Jack 94
Donohoe, J. 112
Drayton Regulator & Instrument Co., Ltd. 28
Dubilier Condenser Co. (1925), Ltd. 45
Duke & Co. 115
Dun Electronics 112
Dupley Electronics, Ltd. 110
Edison Swan Electric Co., Ltd. 13
Electradix Radios 104
Electro Acoustic Developments 109
Electronic Instruments, Ltd. 32
Electronic Precision Equipment 80, 81
E.L.R. 112
E.M.G. Handmade Gramophones, Ltd. 110
E.M.I. Institutes 12, 74
English Electric Co., Ltd., The 39
Enthoven, H. J., & Sons, Ltd. 60
Erskine Laboratories, Ltd. 12

PAGE

Feldman, A. W. 92
Felicity Amplifiers 32
Ferranti, Ltd. 5
Filmer, J. T. 114
Fluxite, Ltd. 102
Franck Nielsen Radio 20
Frith Radiocraft, Ltd. 34
Furzehill Laboratories, Ltd. 53
Galpins 99
Gardners Radio, Ltd. 72
Garland Bros. 84
Gee Bros. Radio, Ltd. 62
General Electric Co., Ltd. 11, 57
General Lamination Products, Ltd. 52
Glaser, Ltd. 110
Goodmans Industries, Ltd. 7
Goodsell, Ltd. 2
Grampian Reproducers, Ltd. 18
Gray, Arthur, Ltd. 54
Hallam, Sleigh & Cheston, Ltd. 40
Hartley, H. A., Co., Ltd. 98
Hatfield Instruments 100
Hayes Co., The 112
Haynes Radio, Ltd. 38
Henley's, W. T., Telegraph Works Co., Ltd. 46, 106
Henry's 88
Hivac, Ltd. 51
Hogg, F. Livingston 95
Hoile, Arthur 110
Holley's Radio Stores 106
H.P. Radio Services, Ltd. 88
Hunt, A. H., Ltd. 50
Industrial Electronics 55
Inter Electron Industries 43
International Correspondence School, Ltd. 22
Ionic Laboratories, Ltd. 104
Jackson Bros. (London), Ltd. 6
Johnsons (Radio) 115
Lasky's Radio 82, 83
Lawrence, G., & Co. 90
Leak, H. J., & Co., Ltd. 75
Lewis Radio Co. 113
L'Exportation Electricite-Radio 20
Lockwood & Co. 108
Londex, Ltd. 58
London Central Radio Stores 47
London Radio Supply Co. 18
Lowther Mfg. Co. 107
Lustraphone, Ltd. 96
Lyons, Claude, Ltd. 113
Lyons Radio 114
Mail Order Supply Co. 76
Major Distributors 52
Marconi Instruments, Ltd. 40
Marconi's Wireless Telegraph Co., Ltd. 58
McMurdo Instrument Co., Ltd. 14, 86
Measuring Instruments (Pullin), Ltd. 48
Metro Pex, Ltd. 90
Metropolitan-Vickers Electrical Co., Ltd. 25
Midland Instrument Co. 96
Miers, N., & Co., Ltd. 38
Modern Book Co. 30, 102
Modern Electrics, Ltd. 108
M.R. Supplies, Ltd. 28
Mullard Electronic Products, Ltd. 33, 66, 101
Multicore Solders, Ltd. Cover iv
Murex, Ltd. 62
Mycalex, Ltd. 16
Newman, J. & S., Ltd. 34
Northern Radio Services 111
Nusound Products 109
Oliver Pell Control, Ltd. 54
Osmor Radio Products, Ltd. 22
Painton & Co., Ltd. 61
Park Radio, Ltd. 49
Parmeko, Ltd. 20
Partridge Transformers, Ltd. 97
P.C.A. Radio 92
Pearce, T. W. 100
Pearson, M. & J. 107

PAGE

Pennine Amplifiers 110
Philips Electrical, Ltd. 22
Pitman, Sir Isaac, & Sons, Ltd. 111
Post Radio Supplies 114
Pratts Radio 94
Premier Radio Co. 77, 78, 79
Quartz Crystal Co., Ltd. 112
Radio Exchange Co. 103
Radiomenders, Ltd. 94
Radio Merchandise Co., Ltd. 107
Radio, Radar & Television 8
Radio Servicing Co. 98
Radiospares, Ltd. 106
Radio Supply Co. 104
Radio Unlimited 109
Record Electrical Co., Ltd., The 104
Redifon, Ltd. 59
Reed & Ford 110
Rego-Fraser 114
Reliance Mfg. Co. (Southwark), Ltd. 115
Reosound Engineering & Electrical Co. 102
Reproducers & Amplifiers, Ltd. 24
Robshaw, Bros., Ltd. 54
Roding Laboratories 24
Rogers Development Co. 92
Rollet, H., & Co., Ltd. 114
Rothermell, R. A., Ltd. 30
Runbaken Electrical Products 108, 112
Salford Electrical Instruments, Ltd. 23
Samsons Surplus Stores 112
Sangamo Weston, Ltd. 73
Savage Transformers, Ltd. 60
Scharf, Erwin 46
Sifam Electrical Instrument Co., Ltd. 24
Simmonds Aerocessories, Ltd. 27
Simon Sound Service 17
Smith, G. W. (Radio), Ltd. 103
Solartron Laboratory Instruments, Ltd. 60
Sound Rentals, Ltd. 9
Sound Sales, Ltd. 70
Southern Radio Supply, Ltd. 111
Stability Radio Components, Ltd. 32
Standard Telephones & Cables, Ltd. 67
Steatite & Porcelain Products, Ltd. 41
Stern Radio, Ltd. 91
Stewart Transformers, Ltd. 62
Stratton & Co., Ltd. 8
Sugden, A. R., & Co. (Engineers), Ltd. 63
Supacoils 113
Szymanski, S. 56
Taylor Electrical Instruments, Ltd. 56, 53
Taylor, Tunnicliff (Refractories), Ltd. 35
Telegraph Condenser Co., Ltd. Cover iii
Telegraph Construction & Maintenance Co., Ltd., The 61
Telemechanics, Ltd. 102
Tele-Radio (1943), Ltd. 40
Thermionic Products, Ltd. 48
Thornber, J. E., & Sons 115
Transradio, Ltd. 42
Trans World Airlines 14
Trix Electrical Co., Ltd. Edit. 421
Ultra Electric, Ltd. 28
United Insulator Co., Ltd. 38
Universal Electrical Instruments Corpn. 93
University Radio, Ltd. 86
Valradio, Ltd. 50
Vitavox, Ltd. 3
Voigt Patents, Ltd. 114
Vortexion, Ltd. 71
Walton's Wireless Stores 92
Wayne Kerr Laboratories, Ltd., The 30
Webb's Radio 6
West Spencer 52
Westinghouse Brake & Signal Co., Ltd. 63
Weymouth Radio Mfg. Co., Ltd., The 56
Wharfedale Wireless Works 18, 30
Whiteley Electrical Radio Co., Ltd. 74
Wilco Electronics 114
Woden Transformer Co., Ltd. 16
Wright & Weaire, Ltd. 65
Young, C. H. 96

Printed in Great Britain for the Publishers, ILIFFE & SONS, LTD., Dorset House, Stamford St., London, S.E.1, by THE 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. R. 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.