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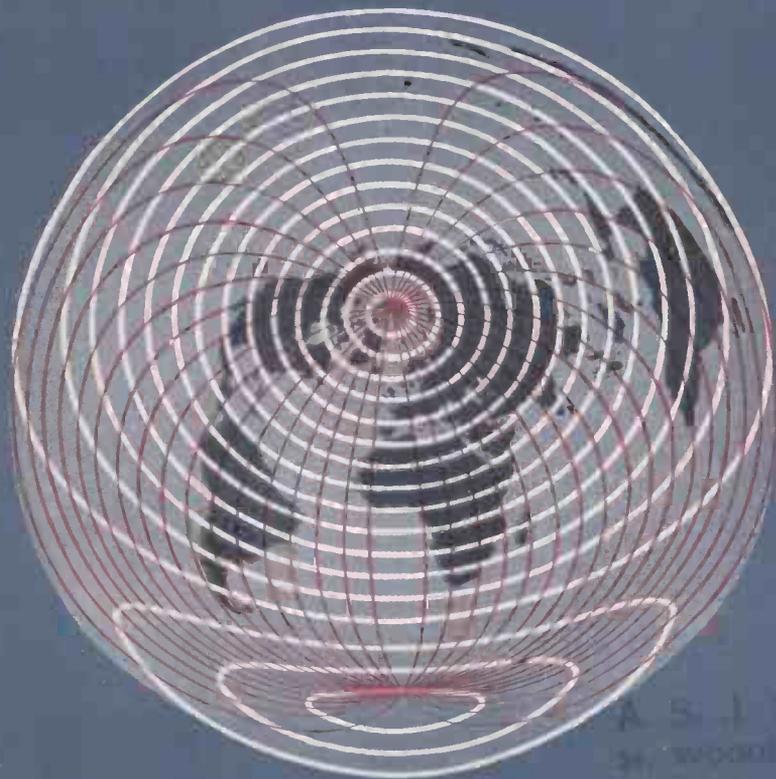
Show Stand-to-Stand Report

Wireless World

ELECTRONICS

Radio · Television

PAGES 366-370 TRANSISTOR RECEIVER, PART 1
PART 2 CONTINUED IN OCTOBER ISSUE →



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Wireless World

ELECTRONICS, RADIO, TELEVISION

SEPTEMBER 1959

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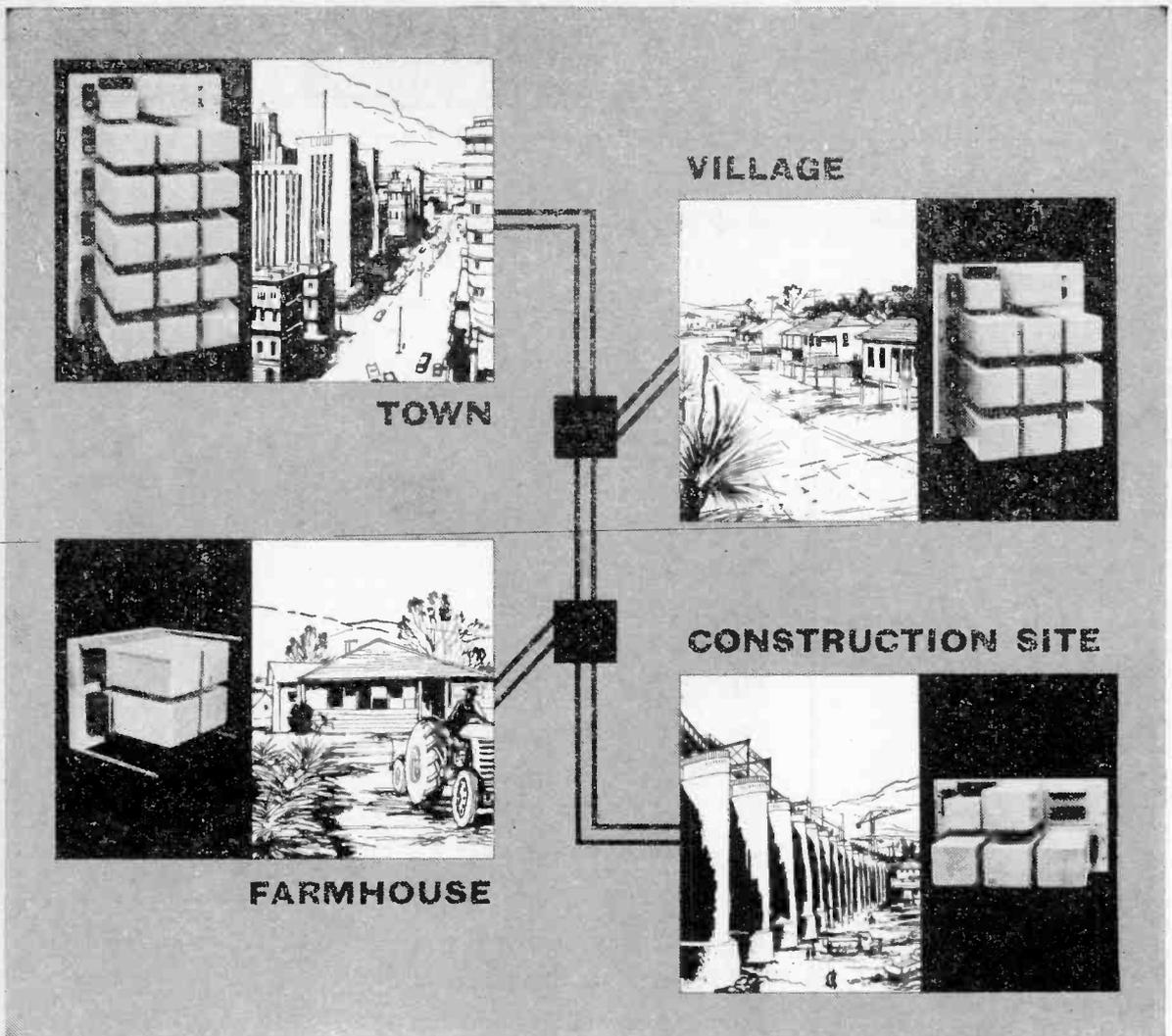
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Shows - Large and Small

THE first function of an exhibition is to show the goods. It may be a one-make show (rather like the one-man shows of paintings or sculpture) at which equipment is demonstrated by the manufacturer's own staff to invited guests; or it may be the permanent display in a dealer's showroom of the comparative merits of the makes for which he is agent. National radio shows fulfil both functions on a larger scale, and they also serve to stimulate interest in broadcasting itself—the end as well as the means.

In this respect the British National Radio Show and German Rundfunk Ausselellung are comparable. Both stress the value of owning a sound receiver and a television set, as sources of instruction and entertainment, and both form a focal point in the year for the buying public. Frankfurt has the advantage of greater space, but Earls Court, by comparison, has a cosier intimacy. Here B.B.C. and I.T.A. are not walled off in separate studios, but mix freely with the throng, even if this at times causes traffic congestion in the gallery.

British manufacturers tend to hold their new models and technical surprises until Earls Court, whereas in Germany most of the new season's sets have already been unveiled at the Hanover Fair in the late spring. Whether this practice will continue when the German Show becomes international in 1961 remains to be seen.

There is already at least one European radio show which is international in character—the Dutch Firato in Amsterdam.

It is often a subject of comment that the capital goods side of the radio and electronics industry has no single major exhibition of its own comparable with the domestic Radio Show. True, it supports the annual Physical Society's Exhibition, the biennial Instruments, Electronics and Automation Exhibition and the recently inaugurated (and highly successful) Computer Exhibition. These serve as a forum for the exchange of ideas within the electronics industry and undoubtedly attract a large number of potential customers. But the managers and craftsmen of the older-established trades must find the high concentration of sophistication and science in some of our highbrow exhibitions more than somewhat baffling, not to say blinding. After one or perhaps two tentative visits they may give up and return with shaking heads and shaken nerves to the comparative security of their traditional methods. Clearly it is difficult to display effectively all the possible electronic applications in other trades at an exhibition which is primarily one of existing methods.

Would it not be better for Mohammed to go to the mountain, for electronics and radio communications firms to go into their customers' own territory? To a limited extent this is already being done by those enterprising firms who have fitted out trailer vans—even boats—to visit their customers at home and abroad, and by sectional specialist exhibitions like the British components show held in Stockholm. But these cannot so well fulfil the functions of general exhibitions in bringing about a wide and diverse cross-fertilization of ideas and interests. Would it not be better for electronics firms to invade in force the specialist exhibitions of other industries—e.g., engineering, building, brewing and chemical engineering—to show what they can already do and to listen to criticisms and suggestions from customers who are much more likely to talk freely and confidently on their own ground? We think it would; but there are the serious obstacles of time, space and cost. For example, it has been estimated that it costs the German radio manufacturers and broadcasting authorities 15DM (about 25s) per visitor to put on a show at Frankfurt—and this is based on an attendance of over half-a-million. Only the more affluent firms could afford to indulge in a continuous circuit of the exhibitions, for that is what it would amount to, and since the electronics industry is now bigger than many of the trades it serves there would often be a risk of incongruity.

In the Hanover Fair in Germany we see one example of the shape of things to come, the simultaneous running of a number of specialist exhibitions in the same place. The compression of time and the reduction of cost is of advantage both to the visitor and the exhibitor, who must otherwise both spread their efforts over the best part of the year. We think that concentration in one necessarily vast exhibition ground is essential if exhibitors and visitors are to be tempted into wandering into *terra incognita* and so receiving the stimulus to new ideas and expansion.

There remain two questions. First, whether manufacturers would support a comprehensive Fair, and, if so, where and how in this country accommodation is to be found? An excellent survey of the present position ("Exhibition Facilities in the United Kingdom") has recently been issued by a committee of enquiry set up by the Federation of British Industries. Second, can such comprehensive Fairs be properly assimilated in the time available, assuming one has the physical stamina necessary even to walk round the stands? This is but part of the problem of keeping pace with a rapidly expanding technology.

Designing a Transistor Receiver

I.—For Use With Mains or Batteries

By T. SNOWBALL

THE receiver which forms the subject of this article would at one time have been described as a 1-V-4 set because it consists of one r.f. amplifier, a detector and four audio stages. In this case, however, transistors are used. The first a.f. stage is orthodox but the following three are connected in a d.c. feedback circuit. Some characteristics of the set, along with reasons for building it, are given in the following pages.

The overall quality of reproduction is comparable to the average mains valve receiver, being limited mainly by the loudspeaker and the cabinet in which it is housed. With an internal ferrite-rod aerial reception is limited to the local stations, but the stronger Continental stations can be received quite well with a small external aerial.

The output transistor has a 3-ohm loudspeaker connected directly in its collector circuit and gives up to $\frac{1}{2}$ -a-watt of audio with a good frequency response from 25c/s to 25kc/s.

A mains supply is virtually essential for continuous use of this receiver; this is because a class A output stage is used in order to give ease of design with freedom from distortion. The class A stage consumes $\frac{1}{2}$ -an-ampere of current which is passed directly through the speech coil of the 3-ohm loudspeaker, resulting in a complete absence of audio transformers and making it simple to get good reproduction, with at the same time ease of construction.

The set is not particularly economical in its use of transistors but only two high-quality ones are essential, namely the r.f. amplifier and the output transistor.

The output transistor can be seen mounted below the loudspeaker in one of the illustrations; it uses the chassis as a heat sink and is insulated from the chassis by mica washers. These washers are supplied with the transistor and the holes through the chassis should be smooth and free from burrs to assist in getting a good thermal contact with the chassis; a smear of silicone grease will help, if any is available. The chassis material should be as thick as possible consistent with ease of bending, $\frac{1}{16}$ -in tinfoil or aluminium is suitable. Tinfoil is ideal for the lazy man because the mains transformer, aerial supports and various earth wires can be soldered directly to the chassis, but aluminium is easier to fabricate.

The ferrite rod used for the aerial coil measures 8in long and $\frac{3}{16}$ in. in diameter. If, in weak signal-strength areas, an external aerial is not practical, a larger diameter rod, or two or more rods, can be used.

The ferrite aerial is mounted on Perspex strips in preference to metal brackets as it is advisable to keep the aerial coils as far as possible from any mass of metal.

In most cases the components are anchored to p.t.f.e. push-through tags, manufactured by the Oxley Development Co., Ulverston, Lancs, and are the Type 156. They need only a No. 19 drill hole in the chassis, the tag then being pushed firmly home. These tags are very convenient to use because they are strong mechanically, good insulators and cannot be damaged by excessive heat while soldering.

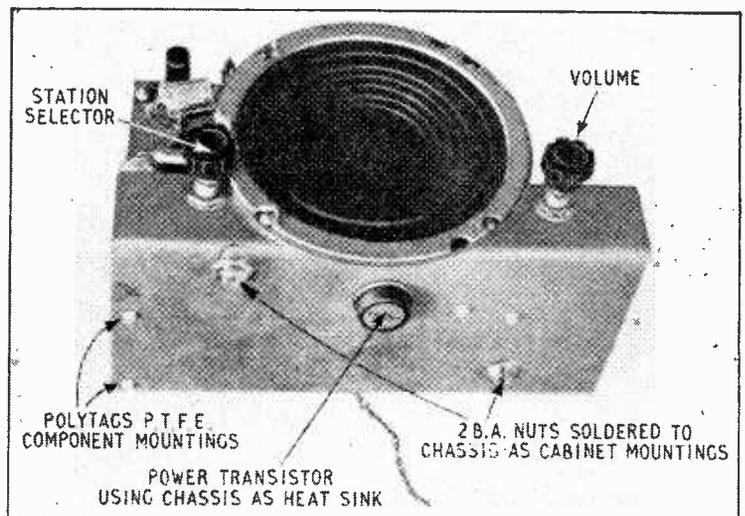
The receiver consumes less power than the average mains radio, costs less to run than a transistor portable and could be used on picnics, with the car battery as a source of power. In an emergency it will run for a few hours from three U2 cells.

There are no awkward transformers to wind, only the r.f. coils are special; the simple chassis requires no large holes or complicated bends. The mains transformer is any 8-V bell type and could well be much smaller than the one which the author used, as only 0.6A rating is necessary. Similarly the smoothing capacitors used were 25-V types but 6-9V ones would be permissible.

The on-off switch is included with the station selector switch, but it could be incorporated with the volume control, thus allowing another station position on the station selector switch, or simplifying the switch from a 6-pole 3-way to a 4-pole 2-way.

The Power Supply.—The receiver requires a voltage supply of +3V and -5V with reference to the earth line. These are obtained from the small 8-V bell transformer previously mentioned and a bridge rectifier with the smoothing choke in the

Front view of the chassis showing the location of the output transistor.



positive output of the rectifier and two 1,000- μ F electrolytic capacitors connected as shown in Fig. 1.

The author used a discarded car-radio energized loudspeaker for the set which had a 5- Ω field coil and this served for smoothing, but a 5- Ω resistor and a P.M. speaker could be used instead. As the current taken by the receiver is about 0.6A the 5- Ω choke, or resistor, drops about 3V. The positive line is "earthed" on the set side of the smoothing choke and the voltage drop across the choke provides the +3V previously mentioned. The -5V supply is the voltage between the earth line and the negative output of the rectifier. The actual voltages of the supply lines are not critical to within a volt or so, as long as the standing current in the output transistor is corrected by adjustment of the positive line feed resistor and this must be borne in mind if an alternative type of power supply is used.

The rectifier elements are silicon or germanium junction types, each element having to pass 0.3A d.c. and the peak inverse voltage of all available types is well above the demands of this circuit. The author used S.T.C. Type RS20A, but Ferranti ZS10B or B.T.-H. GJ3 are quite suitable. Of course selenium cells could be used but the output voltage would be a little lower due to the higher forward resistance. Selenium discs are 12-15V d.c. output and the current depends on area, a 45-mm diameter disc is suitable for 0.3A and four could be used in this power supply.

The Output Stage.—Here the idea is to get a stage which is simple to design and to construct and which gives reasonable results. One aim was to remove the speaker transformer because it always seems to be difficult to design and construct for a good frequency response. D.C. coupling between each transistor seemed a good way of economizing in components, just so long as it was possible to maintain temperature stability.

As was pointed out by Dr. G. B. B. Chaplin* transistors operate successfully at collector potentials which are also correct for the base of the following stage, so leading to the circuit in Fig. 2. Consider-

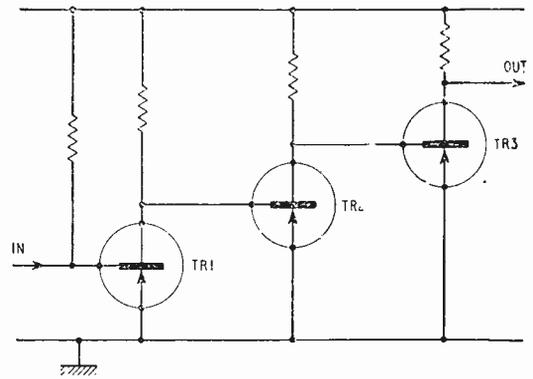


Fig. 2. Basic circuit arrangement of the audio amplifier.

ing TR3, using a transistor such as a Pye V15/20P this will dissipate 2 watts when used with a mica insulating washer on a metal plate of at least 9sq in. In this receiver the "heat sink" is the chassis. Because a transistor can be operated with a minimum of 0.5V on its collector an efficiency of 50% can be expected when it is used as a class A amplifier; this will provide an audio output of one watt. With a 3- Ω speaker this represents an r.m.s. current of $1/\sqrt{3A}$. From this the peak-to-peak current swing will be $(2 \times 1.4 \times 1)/\sqrt{3} = 1.6A$. So in order to accommodate this swing in class A, we need to "sit" the transistor at 0.8A standing current. So allowing 0.5V for collector bottoming, the "sit" point becomes $0.5 + (0.8 \times 3) = 3V$. A swing of $\pm 2.5V$ calls for a supply of 5.5V to give 1 watt output. In order to get the maximum power output this is the condition in which the transistor should be used. A lower current, of say 0.5A, would, however, be advisable in order to permit a greater latitude of "sit" voltage and freedom from bottoming should a rise in temperature cause a rise in current.

While the V15/20P has been used as an example of the design procedure for the output stage, a V30/

* Proc.I.E.E., Part 13, May 1958

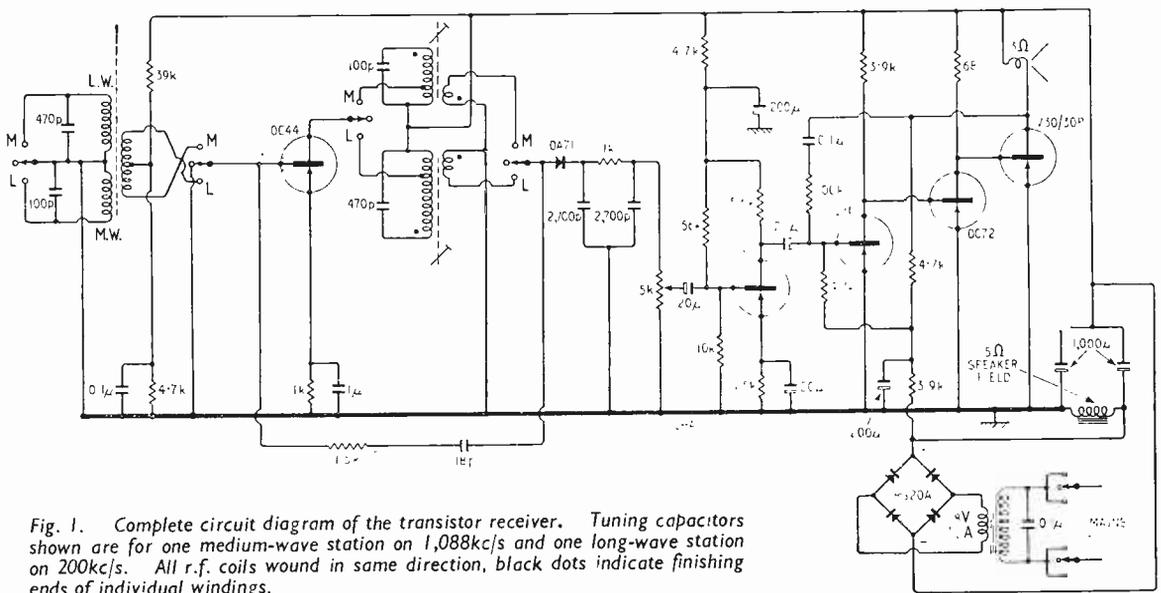


Fig. 1. Complete circuit diagram of the transistor receiver. Tuning capacitors shown are for one medium-wave station on 1,088kc/s and one long-wave station on 200kc/s. All r.f. coils wound in same direction, black dots indicate finishing ends of individual windings.

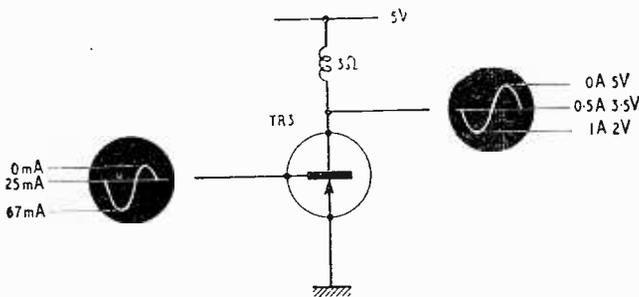


Fig. 3. Base and collector operating conditions in the output stage.

30P was available and is the transistor actually used in the receiver. The OC16 is also quite suitable. The only difference the various types will make to the receiver is confined to the calculations of the operating currents. The voltage rating is immaterial with all the available types, so long as the supply does not exceed 8 to 10V. If cost has to be considered a V15/10P could be used, while if cost is not important a transistor of any voltage, but with a minimum current gain of 30, might well be the choice; such as, for example, a V15/30P.

A supply of 5V and a 3-Ω speaker gives a "sit" point of 3.5V and a dissipation of 1.75W. A Pye transistor marked V15/30P signifies a maximum collector potential of 15V, with a minimum current gain of 30 at 200mA. This unfortunately drops to approximately 20 at $I_c = 0.5A$ and to 15 at $I_c = 1.0A$. Fig. 3 shows that the transistor needs base currents between 67mA and 0mA for a collector swing of 0-1A. The full drive of 67mA to TR3 will be obtained when TR2 is cut off, and so the collector load of TR2 will have to supply 67mA from 5V, making it approximately 67Ω, allowing 0.5V for the base-to-emitter voltage. In the standing condition TR2 will have a collector current of 67 - 25 = 42mA rising to 67mA. If TR2 is an OC72, β will be 60 at 40mA and drop to 50 at 70mA. Thus I_b of TR2 will be 1.3mA peak and 680μA standing, as will be I_c of TR1.

So as before, the collector load of TR1 = $5/1.3 = 3.9k\Omega$. Again, if TR1 is an OC71, β is 50 so I_b of TR1 will be 25μA peak and 13.5μA standing, discounting I'_{co} .

It must be borne in mind that the calculations which have just been made are with transistors having the current gains mentioned and individual transistors may depart by quite large amounts from these figures. This may mean readjustment of the collector loads in extreme cases; the author has found that normally the only one to change has been the 68Ω resistor which in one case needed an increase to 120Ω.

So now we have an audio amplifier with a current gain of $50 \times 60 \times 20 = 60,000$, consisting of three d.c.-coupled transistors. This procedure cannot be extended to four transistors, because it will demand an I_c of 13μA in the preceding stage, this is of course below the leakage current of a germanium transistor in an earthed-emitter amplifier. Indeed this amplifier will also be in trouble from leakage currents unless something is done to prevent it occurring.

If the temperature of TR1 increases by only 7°C the leakage current is doubled. A typical I_{co} at 25°C is 4μA increasing to 8μA at 32°C; this means the collector current of TR1 will rise by $4 \times 50\mu A$. TR2 and TR3 will amplify this and cause a change of

$4 \times 50 \times 60 \times 20/10^3 = 240mA$ in the collector current of TR3. This will bring the collector "sit" point down and could cause bottoming; it certainly upsets all the careful settings of current which have just been worked out. So d.c. feedback will have to be employed to stabilize the circuit. In order to simplify the arithmetic consider the three transistors as being one large transistor of current gain 60,000, or 96dB. One of the best feedback circuits to use is the transistor equivalent of the anode follower shown in Fig. 4.

Here, as with the valve, the transistor output voltage is determined, not by its gain, but only by the resistors and supply voltages. Temperature variations can be reduced to a permissible figure by applying a large amount of feedback. But in the simplified circuit of Fig. 4 a.c. and d.c. feedback occur (too much a.c.) so in order to stop this the feedback resistor is decoupled and a resistor, across which the signal voltages are developed, is inserted in the base lead. Fig. 5 is another simplified circuit showing the decoupling of the feedback circuit, and various currents used in the calculations to arrive at the operating conditions when using feedback.

From Fig. 5:—

$$I_b = I_i - I_f \quad \dots \quad \dots \quad \dots \quad (1)$$

$$I_o = \beta I_b \quad \dots \quad \dots \quad \dots \quad (2)$$

$$I_f = \frac{V_o}{R_f} = \frac{\beta I_b R_L}{R_f} \quad \dots \quad \dots \quad (3)$$

The gain with feedback is $\frac{I_o}{I_i}$

$$\text{From (1) and (2)} \quad \frac{I_o}{I_i} = \frac{\beta I_b}{I_b + I_f}$$

$$\text{From (3)} \quad I_f = \frac{\beta I_b}{I_b + \left(\frac{\beta I_b R_L}{R_f}\right)} = \frac{\beta}{1 + \left(\frac{\beta R_L}{R_f}\right)} \quad (4)$$

which is the usual feedback amplifier formula.

As the gain without feedback is β (from (4)) the reduction in gain with feedback is the factor $1 + (\beta R_L/R_f)$. With the circuit values chosen; $R_L = 3\Omega$, $\beta = 60,000$, and $R_f = 10,000$; the reduction in drift is:— $1 + (60 \times 10^3 \times 3/10^4) = 19$. So in the case mentioned the change in output for a temperature rise of 7°C is 0.04V and 12mA with feedback and 0.75V and 240mA without feedback. This can be expressed also as so many dB of feedback, and below

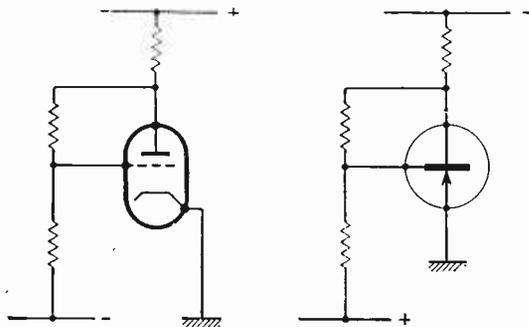
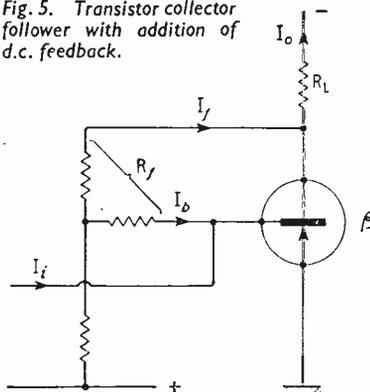


Fig. 4. Valve anode follower and equivalent collector follower transistor stage.

Fig. 5. Transistor collector follower with addition of d.c. feedback.



are the figures for: (a) the d.c. case, and (b) the a.c. case when we shunt the d.c. feedback with a CR network.

(a) In the d.c. case:—

$$R_L = 3\ \Omega$$

$$\beta = 60,000 \quad \text{Feedback} = 25\text{dB}$$

$$R_f = 10\text{k}\Omega$$

(b) In the a.c. case:—

$$R_L = 3\ \Omega$$

$$\beta = 60,000 \quad \text{Feedback} = 9\text{dB}$$

$$R_f = 100\text{k}\Omega \text{ in series with } 0.1\ \mu\text{F.}$$

More a.c. feedback could be easily applied, but the frequency response of 25c/s to 25kc/s, as shown in Fig. 6, indicates a response good enough for most purposes.

D.C. Conditions.—From Figs. 3 and 5 the V_{ce} of TR3 is 3.5V, the base voltage is almost zero, and the resistance to the decoupled point is 5k Ω . So $I_f = 3.5/4.7 = 0.75\text{mA}$ and the value of the feed resistor from the positive line is (positive volts)/ I_f ; with a 5- Ω smoothing resistor the positive line should be 3V. Then the feed resistor is 4k Ω . Preferably when the set is tested the feed resistor should be adjusted to give the correct steady current of 0.5A in the final transistor, this is necessary because the positive and negative lines may not be quite the calculated values. It is hoped that this description is sufficiently detailed to enable the reader easily to modify the design, such as for the use of other transistors, a 15- Ω speaker, or different voltage supplies.

Detector and First Audio Stages.—Practical low-level transistor detectors are quite satisfactory, but as the emitter-base diode has to do the detection it needs to do so without high frequency losses. This will mean using a transistor with a relatively high cut-off frequency if good detection efficiency is required. So in order to avoid the expense of an r.f. transistor for detection, the author uses a diode.

In a diode detector circuit the input impedance of the next stage needs to be high compared to the d.c. load of the diode. This is because the r.f. carrier sees the diode feeding only the d.c. load, but when modulation comes along it sees the d.c. load in parallel with the input impedance of the following stage. This can cause distortion of the modulated envelope when the modulation is deep. In valve circuits, the input impedance can be made several times the d.c. load, because the grid-cathode impedance of the valve itself is normally very high and the input impedance is mainly the grid-cathode resistor; this being easily made 1 to 2M Ω when the d.c. load can be made approximately 0.25M Ω and still

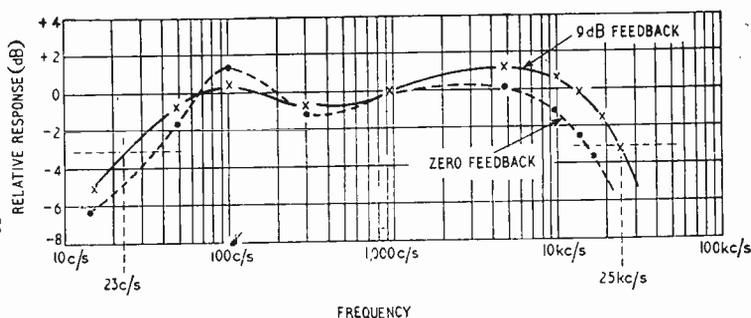


Fig. 6. Response curve of the audio section of the receiver from 15c/s to 30kc/s.

only lightly damp the associated tuned circuit

But in transistor sets the audio amplifier will probably have base-emitter resistors of about 10k Ω and an input impedance of 1 to 10k Ω . Thus the d.c. diode load ought to be in the range 250 Ω to 2.5k Ω , but this gives very poor rectification efficiency as the diode forward impedance is also in this region. So compromising, the diode load can be 5k Ω and it is best to keep the audio stage input impedance as high as possible.

One of the many ways of achieving this, and also one of the simplest, is used in this set and is shown in Fig. 7. Here the volume control is used to pad up the value of input impedance at all volume settings except maximum, which it is hoped will only be needed for distant stations of mediocre quality. The transistor is also operated at a low collector current in order to raise the input impedance. The Mullard data sheets show that the input impedance is mainly dependent on collector current, being $\approx 800\ \Omega$ at 3mA rising to 3.2k Ω at 0.3mA. Lower currents than 0.3mA will give a higher input impedance but β will start to fall and I'_{co} becomes a large part of I_c . So our first audio amplifier has an $I_c = 300\ \mu\text{A}$, which incidentally also gives the best noise figure.

There are other variations of diode-to-audio amplifier couplings, one of the best, but unfortunately wasteful in transistors, is shown in Fig. 8. Here the diode feeds into the high-input impedance of the emitter follower, which is equivalent to a cathode follower, thus getting a good ratio of a.c. to d.c. loads, and providing a low output impedance to feed the next stage. Unfortunately this circuit only gives current gain so losing over the normal earthed-emitter amplifier; but if good quality, especially on

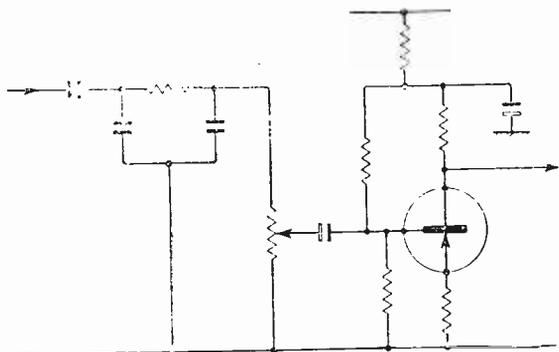


Fig. 7. Coupling arrangement between diode detector and audio amplifier.

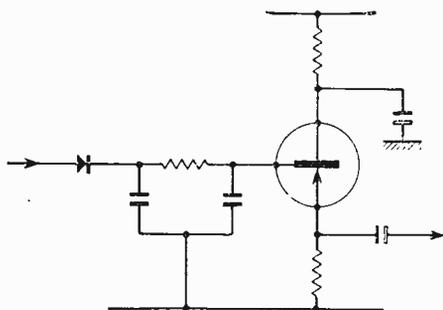


Fig. 8. Diode detector with emitter-follower audio stage.

deep modulation levels, is required, this circuit would be worth considering.

The input impedance of the diode circuit was measured by feeding a tuned circuit from a signal generator, then seeing what value of resistor damped the tuned circuit to the same extent as the diode circuit. An oscilloscope was used to measure the voltages across the tuned circuit. From this measurement the diode was found to be approximately $10k\Omega$ input impedance, and this figure is used for calculating the optimum turns ratio of the

transformer between the r.f. and detector stages.

The value of the diode filter capacitor, with a $5-k\Omega$ diode load and response up to $10kc/s$, comes out as $2,700pF$, when its reactance equals the diode load.

The collector circuit of the audio amplifier is decoupled to prevent audio fluctuations causing instability, and also to augment the smoothing of the power supply. The values of the collector load and the decoupling resistor are reasonably non-critical but the author's choice is outlined below. The first thing is to ensure that the standing current of the stage is sufficient to fully drive the next stage. The output stage only needs about $25\mu A$ drive so the $300\mu A$ in the audio amplifier is more than sufficient.

With a supply of 5V choosing an emitter voltage of 0.5V leaves 4.5V to share across the decoupling resistor, collector load and transistor. The transistor should have not less than 1V collector to emitter to avoid premature bottoming should the temperature rise too much. This gives a collector potential of 1.5V. The current through the decoupling resistor is 0.35mA, as the biasing current is $50\mu A$, so $4.7k\Omega$ will drop 1.65V, leaving 1.85V for the collector load at 0.3mA giving a load of $6.2k\Omega$ or a preferred value of $5.6k\Omega$. The base-bias resistors carry $50\mu A$.

Teaching and Development Aid

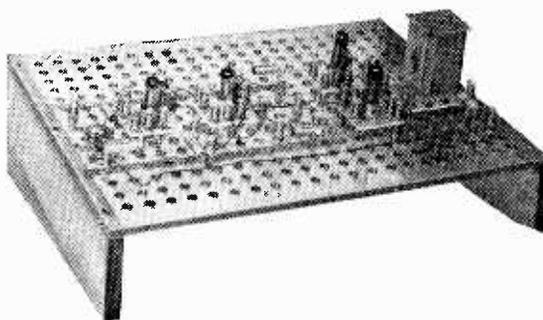
FAST ASSEMBLY FOR "BREAD-BOARD" CIRCUITS

THE technical-college lecturer knows only too well the difficulties associated with the making-up and use of circuits for demonstration to a class or for organized experimental work by students. The development engineer, too, has to waste time either making-up or having made-up for him equipment on which he wants to work. Damage to components usually occurs due to their repeated heating by the soldering iron, so causing further waste, apart from the time taken for switching off the equipment and waiting for it to reach operating temperature again.

There have been many devices offered in the past; which, to some extent, overcome these difficulties; but a new and very flexible system is made by J. H. Lester* under the name "Cirkit." The basis of this system is a Perspex panel which is sand-blasted to prevent specular reflections (and reduce the accumulation of static charges) and drilled in a regular pattern. Into these holes fit terminals carrying spring-loaded plungers which trap the wires in a slot; these terminals can also act as mounting pillars for small panels carrying valve-holders and large components such as transformers and electrolytic capacitors. Bus-bar strips, held down by the terminals, and a variety of clamps and adaptors, which are designed to avoid the use of a soldering iron, complete the kit.

In use, the components are strung very quickly between the terminals (which are inserted only where they are required) together with such wiring as is necessary. For demonstration valves, components and wiring can be arranged in such a way that they approximate to their positions on the circuit diagram, and the board can be stood upright without toppling even if heavy components such as transformers are mounted

at the very top or bottom. For development work the quick and easy changing of components without the use of a soldering iron does much to ease the work of the technician, as does the quick and easy assembly and dismantling, and for both purposes the high accessibility (for all connections are on top of the board) can be nothing but an advantage. All in all, the "Cirkit" is a most satisfactory idea, and the only regret is that, by virtue of its form of construction, the system is not satisfactory for use at high radio frequencies.



Part of a Mullard 5-10 amplifier circuit assembled on the "Cirkit" system. Left to Right: input stage (high-gain pentode), long-tailed-pair waveform inverter (double triode) and push-pull output stage (pentodes). Power supply is not included, but note high-tension and "earth" bus-bar strips.

* 15, Maswell Park Road, Hounslow, Middlesex.

NATIONAL RADIO SHOW

Stand-to-Stand Report

LATEST
SOUND AND TV
RECEIVERS, AUDIO
EQUIPMENT, AERIALS
AND OTHER EXHIBITS
SEEN AT
EARLS COURT



ACOS

Low tracking-weight crystal pickup heads on show included a stereo unit tracking at about 2gm and, tracking at about 0.3gm, an improved version of the single-channel unit described by J. Walton in our April, 1959, issue. These heads were fitted to the low-friction vibration-stabilized arm described in our June issue. An inexpensive low side-thrust arm designed expressly for stereo use was also on show. Another new single-channel cartridge, the GP67-1, has a nominally flat response up to 15kc/s, tracks at about 6gm.

Another new product was a stereo microphone incorporating two crystal pressure-differential figure-of-eight response inserts mounted at right angles to each other.

Cosmocord, Ltd., Eleanor Cross Road, Waltham Cross, Herts.

ADMIRALTY

Examples of some of the latest types of equipment used by the Navy both afloat and ashore, and also in the air, were to be seen on the Admiralty stand. Those who went to the stand expecting to see something worth while of the new 3-D radar installed in H.M.S. *Victorious* were probably disappointed to find that the only part displayed was the control and monitoring panel. Communications equipment and navigational aids were also featured.

Admiralty, London, S.W.1.

AERIALITE

This company's new range of easy-to-erect small-size-package aerials was on show: on these aerials a printed-circuit version of the "Cross-

link" connection between Band-I and Band-III sections of combined arrays is claimed to give improved performance. A new loft-aerial has a telescopic Band-I section and four Band-III elements. The Model 845 combined aerial is designed for locations with a good Band-III but a poor Band-I signal. Other equipment shown included v.h.f./f.m. aerials, cables, installation accessories, and apparatus for wired distribution systems.

Aerialite, Ltd., Castle Works, Stalybridge, Cheshire.

AIRMEC

Although primarily concerned with the production of test and measuring equipment Airmec showed this

link" connection between Band-I and Band-III sections of combined arrays is claimed to give improved performance. A new loft-aerial has a telescopic Band-I section and four Band-III elements. The Model 845 combined aerial is designed for locations with a good Band-III but a poor Band-I signal. Other equipment shown included v.h.f./f.m. aerials, cables, installation accessories, and apparatus for wired distribution systems.

Airmec Ltd., High Wycombe, Bucks.

ALAN-MARKOVITS

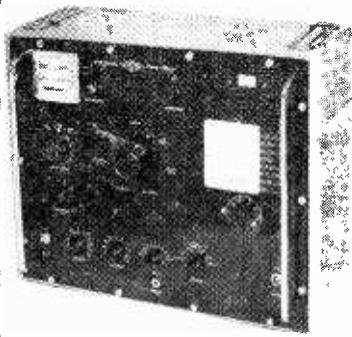
Decorative metal fittings for radio cabinets, escutcheons, cut-out and die-stamped name plates in a wide variety of designs were shown by this firm.

Alan-Markovits Ltd., Emblem House, Sussex Road, Hove, Sussex.

ALBA

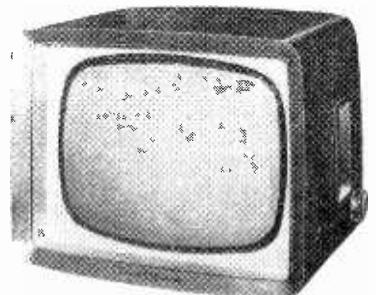
The first tape recorder to be produced by this firm, Model R59, is notable for its low price. It plays at 3 1/2 in/sec, provides for high- and low-level mixing and permits

Alba T656 17-inch television receiver.



Communications receiver Model C864 made by Airmec.

year a new communications set which comfortably meets the G.P.O. recommendations for use in ships. The set covers 15 to 45kc/s and



monitoring while recording. There is also a twin neon recording level indicator.

Last year a system of "packaged servicing" for television receivers was introduced, in which 90% of the components were mounted on two plug-in replaceable printed-circuit panels. This has been continued in three new receivers, the T656 17-inch table model, the T717 17-inch portable and the T721 21-inch model.

A new stereo radio-gram, incorporating a.m./f.m. reception, has two built-in speakers but provides also for one or two external speakers to give an extra-wide stereo effect.

Alba (Radio & Television) Ltd., Tabernacle Street, London, E.C.2.

AMPLION

New tape recorders were introduced using the new B.S.R. or Collaro "Studio" tape decks. Unusual features of these recorders were, in one, the provision of optional volume expansion of about 6dB, obtained by using lamps in a balanced bridge circuit, and, in another, a 50-c/s oscillator to allow operation from d.c. as well as a.c. mains supplies.

Also shown were a number of single-channel stereo record reproducers featuring piano-key type tone controls.

Amplion, Ltd., 175-179 Cricklewood Lane, London, N.W.2.

ANTIFERRENCE

Introduced for Band-III, Hi-lo and Antex-plus aerials, the "Rota-Click" assembly feature is designed to ease the work of the aerial erector. New aerials shown included an 11-element Yagi for Band III, with high forward gain and reduced subsidiary-lobe amplitude, a "V" dipole for channels with a suitable harmonic

relation (such as 4 and 8) and a "Hi-lo" combined array for Bands I and III (three elements each, Band I and Band III). Other exhibits included indoor and outdoor diplexer and triplexer units, plugs and sockets, masts, brackets, car-radio aerials and the Exstat all-wave, anti-interference aerial system.

Antiferrence, Limited, Bicester Road, Aylesbury, Buckinghamshire.

ASTRONIC

A notable model in the wide range of stereo and single-channel amplifiers and pre-amplifiers on show was the very comprehensive "Cecilian" single-channel control unit, which has as many as 7 tone controls—bass, treble, presence, "loudness," rumble filter and low-pass filter cut-off frequency and slope. Also shown was the A1434 stereo pre-amplifier, which has a sensitivity high enough (1mV) to allow it to be fed directly from most tape heads.

Newly introduced was a range of cabinets for housing such units together with a record turntable and, in one case, also a tape deck.

Associated Electronic Engineers, Ltd., Dalston Gardens, Stanmore, Middlesex.

AVANTIC

Two recently introduced products are stereophonic pre-amplifiers for raising the output from tape heads or low-output magnetic pickups sufficiently to feed normal-sensitivity pre-amplifiers. A wide range of stereophonic and single-channel pre-amplifiers and amplifiers and an a.m./f.m. tuner were also shown. Two styles of cabinet for housing these units together with a record player and (in one case) also a tape recorder are available. The range of speaker systems on show included two inexpensive two-speaker reflex

units. A range of stereo tape heads was also introduced.

Beam-Echo, Ltd., 13 South Molton Street, London, W.1.

AVATONE

The new PL21 stereo amplifier and speaker system which was demonstrated consists of a 2x4-watt amplifier and 8in x 5in speaker combined in a single cabinet and a matched extension speaker in a separate cabinet. A range of mains or battery, valve or transistor, 4-speed record reproducers was also shown.

Ava Sound Enterprises, Ltd., Ava Works, Sutton Road, Southend-on-Sea, Essex.

B.B.C.

Although there was considerable accent on programmes and personalities on the B.B.C.'s three stands, there was also much of technical interest to be seen and, too, there was a technical information bureau.

Closed-circuit television is now used between the B.B.C. news room and the news studio to facilitate the accuracy and speed of the broadcast bulletins. It enables additional items to be shown on a screen in front of the reader during the reading of the news. This was demonstrated at the show where a monitor screen was linked to the Broadcasting House news room.

A television translator transmitter, such as is used at Folkestone, was shown in operation. This equipment, which is housed in a cabinet about 6ft tall, receives a signal from another station and after "cleaning up" the picture re-transmits it on another frequency. Monitor screens showed both the received and re-transmitted pictures.

British Broadcasting Corporation, Broadcasting House, London, W.1.

B.R.C.

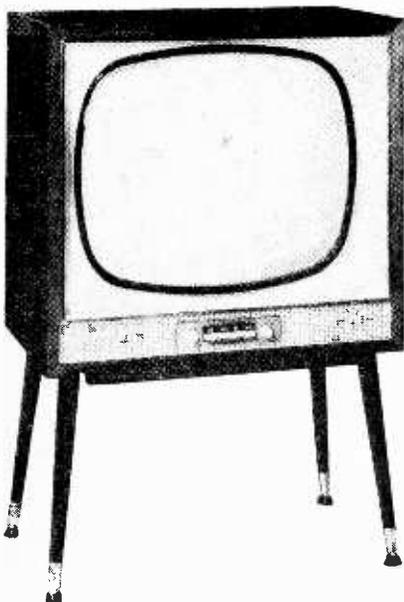
This stand was devoted to the export sound and television receivers of the British Radio Corporation, including models by Ferguson, H.M.V. and Marconiphone. A variety of battery and a.c. mains sound receivers was on view, all with two or three short-wave bands as well as medium waves. Economy switches are fitted on the battery sets. A stereo radiogram, Type 602, covers short, medium and v.h.f./f.m. bands and has four loudspeakers (two 8-inch and two 4-inch).

Television receivers suitable for Band-I 625-line transmissions were also on show, in 17-inch and 21-inch versions with 110° tubes.

British Radio Corporation, Ltd. (Export Division), 21, Cavendish Place, London, W.1.

B.T.H.

A stereo 2x11-watt power amplifier and control unit were demonstrated for the first time. As many as five



Belling and Lee "Metropolitan" set-top Band I/II and III aerial. Knob controls matching network.

Left: Bush TV99 21-inch push-button television set.

stereo inputs can be fed to the control unit. Another innovation was a range of cabinets (including some in "lowboy" coffee-table styles) for housing such equipment. The B.T.H. range of loudspeakers includes 12-in and 18-in coaxial units in which the centrally mounted tweeters are horn-loaded. High-fidelity equipment (such as "line source" loudspeaker systems) especially suitable for factories was also on show.

B.T.H. Sound Equipment, Ltd., Crown House, Aldwych, London, W.C.2.

BELLING-LEE

Television and v.h.f./f.m. distribution systems, components and interference filters were shown on this stand in conjunction with the latest additions to the "Unit Plan" aerial range and the "Metropolitan," a new set-top tunable aerial. A new range of Band-III loft aerials use a tubular boom and plastics-moulded element clamps. New components exhibited included a range designed for use with transistor circuits and even parts for transistors themselves. A full range of aerial installation accessories such as plugs and sockets, diplexers, triplexers and aerial-lead filters was also shown.

Belling and Lee, Ltd., Great Cambridge Road, Enfield, Middlesex.

BRENELL

The Mark 5 record/replay amplifier and tape deck can be obtained separately or as a complete recorder. Features of the tape deck include space for up to four heads and 8½-in diameter reels, four operating speeds and the use of three motors. A stereo record/replay head is available for this deck. The new stereo version of the "Three Star" tape recorder can both record and replay stereophonically.

Brenell Engineering Co. Ltd., 1a Doughty Street, London, W.C.1.

BRITISH RAILWAYS

In addition to providing an information bureau on the services provided by the British Transport Commission the stand included displays showing the use of closed-circuit television at a terminal station and the radio room on a cross-Channel ship.

British Transport Commission, 222, Marylebone Road, London, N.W.1.

BROOMHALL JOINERY

This exhibit consisted of a range of acoustic booths and hoods designed primarily for use in gramophone dealers' showrooms. Included also was a representative selection of record storage and showroom display equipment.

Broomhall Joinery Co. Ltd., 222, High Street, Uxbridge, Middlesex.

BULGIN

The extensive range of components and accessories made by this firm included many new items, such as twin

neon indicator signal lamp fittings, crocodile clips with curved jaws, screened jack plugs, moulded tools for extracting lamps, sub-miniature group-boards for very small components and combined signal-lamp-switches for one-hole fixing.

A range of sub-miniature fuses measuring only 9mm x 2mm, with a wide range of current ratings, has just been introduced for small-size and printed-circuit equipments.

A. F. Bulgin & Co. Ltd., By-Pass Road, Barking, Essex.

BUSH

The push-button station-selection system for television receivers introduced last year has been extended to three new 17-inch models, in standard and fringe versions, and to two 21-inch sets with 110° tubes. There are four buttons, two for Band I and two for Band III, and no fine tuning is required.

Two of the latest radio-grams are stereophonic types with built-in spaced speakers. The SGR81 has two 8-inch speakers and gives an output of 5 watts, while the SRG86 has two 10-inch units with two corresponding tweeters. Both models have a.m./f.m. radio and internal aerials.

A two-waveband transistor portable, the TR82, has 7 transistors running from a 9-volt battery, which is estimated to last for 200 hours.

Bush Radio, Ltd., Power Road, London, W.4.

"C" AERIALS

Shown on this Company's stand was a range of Band-III and Band-II aerials using a novel shape of folded dipole, to which Band-I elements can be attached. It is claimed to be necessary only to change the first director on the Band-III aerials to change the channel to which the aerial is tuned.

"C" Aerials, Ltd., 14-15, Quarry Street, Guildford, Surrey.

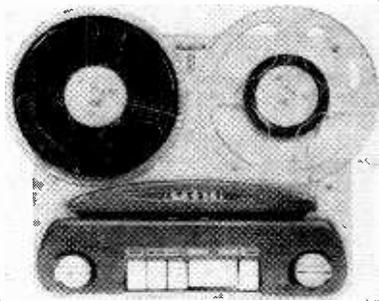
CAREERS

Although small by comparison with previous Radio Show displays devoted to the theme of careers, the stand was used to full advantage to show the public a dealer's service department in operation. One section of the display, arranged jointly by the British Radio Equipment Manufacturers' Association and the Radio and Television Retailers' Association, was used as an enquiry bureau for those interested in taking up servicing as a career.

B.R.E.M.A., 49, Russell Square, London, W.1.

COLLARO

The recently introduced single-direction "Studio" tape deck incorporates a single set of magnetic heads. This deck uses three motors and can operate at three speeds—1⅞, 3⅜ or 7½ in/sec. The well-known Mark IV two-directional tape "Transcriptor" was also on show.



New Collaro uni-directional "Studio" tape deck.

A feature of the latest stereo version of the "Conquest" record changer is that the use of a weight-rather than spring-counterbalanced pickup arm ensures that the difference in stylus pressure between the top and bottom records of a stack is not more than 1gm. A four-speed turntable on a unit plate only 7in x 5in, the Junior, was shown in versions suitable for a.c. mains or battery operation.

Collaro, Ltd., Ripple Works, By-Pass Road, Barking, Essex.

COSSOR

A representative selection of receiving valves and models of television tubes emphasizing the outstanding differences between the older 70° tubes and the modern 110° types were shown, together with the latest range of servicing and test gear.

Recently introduced test instruments included an LCR bridge, Model 1446, a transistor tester, Model 1325, and a signal generator, Model 1450. The bridge covers inductance measurements of from 10μH to 10H, capacitance from 10pF to 10μF and resistance from 1Ω to 10MΩ. A miniature c.r. tube is used as balance indicator. Kits of parts for home assembly of test gear were also included.

A. C. Cossor Ltd., Cossor House, Highbury Grove, London, N.5.

COSSOR RADIO AND TELEVISION

Two new television receivers, the Models 950 and 951, with 110° deflection tubes made their appearance at the show. The former has a 17-in tube and the latter a 21-in, the sets otherwise being similar electrically. Both receivers embody turret tuners and continuously-variable interference limiters.

The new radio models include an a.m./f.m. stereo radiogram, the Model CR1500A, with push-pull output and two 8in x 5in loudspeakers in separate acoustic chambers. Separate a.m. and f.m. internal aerials are provided.

Another new radio set is a portable with 6 transistors and one germanium diode, push-button on/off and

wavechange switches, and a weight of only 3½lb complete with 9-volt battery. It is the Model CR1300T.

Cossor Radio and Television, Ltd.,
71, Endell Street, London, W.C.2.

DANSETTE

Stereophonic and single-channel record players were shown, together with a medium- and long-wave portable radio-gram and a transistor portable radio. Also shown was a 6-transistor receiver, in a polished wood cabinet, covering medium and long waves. This set has a ferrite rod aerial and the a.f. power output is 650mW.

J. & A. Margolin Ltd., 112-116, Old Street, London, E.C.1.

DECCA

Greater accessibility for servicing is a feature of the three new television sets introduced by this firm, the 17-inch DM35/C, the 17-inch DM45/C and the 21-inch DM55/C, the last two of which have v.h.f. sound reception and sliding doors. The three sets have a hinged chassis which swings out at the back and upwards if necessary. Another distinctive feature is the bow-fronted wedge-shaped cabinet (with dimensions reducing towards the back).

Two new stereo radio-grams are the SRG500 and SRG600, both having built-in spaced speakers and a.m./f.m. radio reception. For medium and long waves only there are two new transistor receivers, the TP22 portable, finished in washable leather-cloth, and the TT33 table model, finished in dark walnut and white ash.

Decca Radio and Television, Ingate Place, Queenstown Road, London, S.W.8.

DEFIANT

F.M. receivers marketed by this company have improved a.m. suppression for better performance in areas of multipath propagation, while the television receivers feature correct phase response in the i.f. amplifier. Also on show were portable receivers, record players, stereo and single-channel radio-grams and a television receiver-cum-bookcase in which a tinted-glass door can be used as a "black-screen" filter.

Co-operative Wholesale Society, Ltd.,
1, Balloon Street, Manchester, 4.

DESIGN FURNITURE

Television tables and caster-fitted trolleys are made by this firm and their exhibit consisted of a representative selection of their products. Tables for the latest "slim" style TV sets and others designed to harmonize with unusual cabinet styles were included, together with a range of double-door cabinets for housing large audio reproducing equipments and records.

Design Furniture Ltd., Carnwath Road, Fulham, London, S.W.6.

DOMAIN PRODUCTS

Showroom display shelves and floor stands of various kinds comprised the main exhibits of this firm. Made also are various kinds of wheeled and caster-fitted trolleys for test and industrial electronic equipments.

Domain Products Ltd., Domain Works,
Barnby Street, London, N.W.1.

DUBILIER

Interference-suppression capacitors and chokes were featured in the display on this stand. Also noted were the PW-5, 7 and 10 series of wire-wound power resistors and the Type 560 series of encapsulated-paper capacitors. The standard ranges of components have been extended by the addition of sub-miniature electrolytics and dual-track potentiometers.

Dubilier Condenser Co. (1925) Ltd.,
Victoria Road, London, W.3.

DYNATRON

An unusual feature of the new Vanguard TV50 21-in combined TV and v.h.f. receiver is that push-buttons are used to select the stations, using a synchronous motor to operate the turret tuner. Remote control of the station selection and volume is an optional extra. This and other television and TV/v.h.f. receivers incorporate the new 110° tubes.

Stereophonic sound was demonstrated, using the "Berkeley" 21-valve a.m./f.m. radio-gram in conjunction with the "Panorama" two-speaker bass reflex system.

Transistorized models include the "Romany" 4-speed record reproducer and the "Nomad" receiver. Features of the "Nomad" are a loudspeaker as large as 7 by 4½ in and provision of a tone control.

The range of "hi-fi" chassis includes a number of f.m. tuners, an a.m./f.m. tuner, stereo and single-channel amplifiers and control units and the TC20CS mixer control unit.

Dynatron Radio, Ltd., Castle Hill,
Furze Platt, Maidenhead, Berks.

E.A.R.

In the new one-piece stereo record reproducer, Model 500, which was demonstrated, the speaker compartments can be hinged outwards up to 5 feet apart, or, if greater separation is desired, detached altogether from

E.A.R. Model 500 stereo record reproducer with extendable or detachable speaker compartments.

the main cabinet. Space is available for an f.m. tuner. A separate 2×3-watt stereo amplifier was also shown. Also useful for stereo, or where floor-space is limited, is a column-shaped two-speaker system.

The three tape recorders on show used three different tape decks: the Collaro "Studio," the B.S.R. "Monardeck" and the Garrard magazine-loaded "Bichette."

Electric Audio Reproducers, Ltd., The Square, Isleworth, Middlesex.

E.M.I. RECORDS

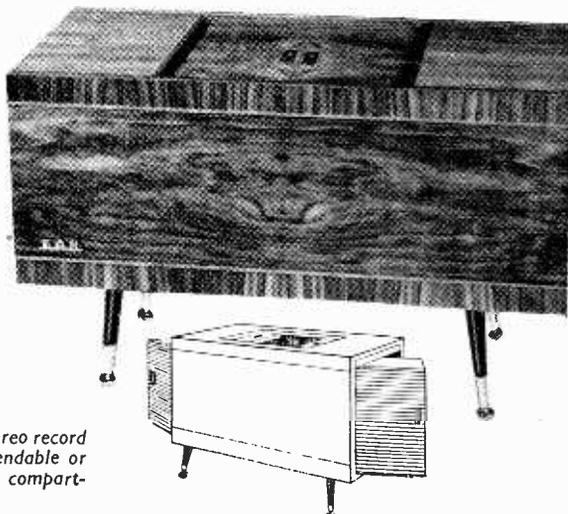
This stand was primarily a record enquiry bureau where information could be obtained on H.M.V., Capitol, Columbia, Parlophone, Emarcy, Mercury and M.G.M. records. Stereo discs were included in the display.

E.M.I. Records Ltd., 8-11, Great Castle Street, London, W.1.

E.M.I. SALES AND SERVICE

Marketed by E.M.I. under the name "Emisonic-Orthotone", sound reproduction equipment produced by Scientific and Technical Developments in conjunction with E.M.I. was displayed and demonstrated in the Audio Hall. Among the Emisonic-Orthotone equipment, a new 2×10W stereo amplifier with a c.r.t. balance indicator and contemporary-styled loudspeakers were noted. Capitol a.f. equipment was also displayed and demonstrated with E.M.I. records in the Audio Hall. Components and equipment for the professional and the amateur were displayed, including a four-speed record playing deck for mains or battery use and a variety of loudspeakers. Professional recorders were demonstrated on another stand in the Audio Hall with recordings registered on Emitape, and a display of Emitape featured the low-priced acetate-base Type 44 and 2-in tape for data-recording.

E.M.I. Sales and Service, Ltd., Hayes, Middlesex.





Emerson transistor personal receiver.



Elizabethan "Bandbox" tape recorder on telephone directory to show small size.

EKCO

The use of a special short-necked 110° television tube in the new 17-in TP347 receiver has permitted a reduction in the cabinet depth of about 2 inches compared with cabinets using normal 110° tubes. The "Tele-gram" combines a 17-in TV receiver and f.m. radio-gram in a single cabinet.

An unusual feature of the new export sound receiver, A733, is the variable selectivity. This receiver also incorporates five wave-bands, bass and treble controls and two speakers. With the new transistor portable BPT351 the station names can be easily read with the receiver at any angle because a pair of oppositely-printed tuning scales are provided.

E. K. Cole, Ltd., Southend-on-Sea, Essex.

ELECTRONIC REPRODUCERS

The "Stereo 60" turnover ceramic pickup cartridge which was demonstrated tracks at 6gm and provides a separation of about 15dB. This cartridge forms part of the "Stereo AD" conversion kit, which also includes an amplifier and speaker housed in a single cabinet. Newly introduced was a low-friction pickup arm incorporating a raising and lowering device. Equipment for demonstrating stereo through headphones was also shown.

The German "Elac" range of single-channel and stereo cartridges is now being manufactured under licence in England by this company.

Electronic Reproducers, Ltd., Windsor Works, Denbigh Road, Bletchley, Bucks.

ELECTROVAC

The main activity of this firm is the rebuilding of cathode-ray tubes. Examples of rebuilt tubes were demonstrated in working television receivers on the stand.

Electrovac Manufacturing Co. Ltd., Chapel Works, Sunnyside Road, Chesham, Bucks.

ELIZABETHAN

The new inexpensive "Avon" tape recorder features a response up to 10kc/s at the single speed of 3¼in/sec. The response extends to 14kc/s at this speed in the new three-speed "Major" recorder, which also incorporates a meter to indicate recording level. The "Bandbox" tape recorder is characterized by its small size (10½in × 9in × 6in) and weight (12lb). Two speeds (1¼ and 3¼in/sec) are provided and up to 3¼-inch diameter reels can be used.

E.A.P. (Tape Recorders), Ltd., Bridge Close, Oldchurch Road, Romford, Essex.

ELPICO

A notable item in the range of single-channel equipment is the new AC55 portable 15-watt amplifier and 10in × 6in speaker in a single cabinet. For stereo, a 2 × 5-watt amplifier and also a column-shaped loudspeaker are available. Two single-channel tape recorders utilizing the new B.S.R. "Monardeck" were introduced. A wide range of tape recording and radio accessories (including car aerials) is also available.

Also shown was the Dulci range of amplifiers and tuners which includes an a.m./f.m. stereo radio-gram chassis.

Lee Products (Great Britain), Ltd., Elpico House, Longford Street, London, N.W.1.

EMERSON

Remote control of television receivers by ultrasonic signals was demonstrated, using a battery-powered transistor oscillator and crystal transducer in a small control box and a receiving crystal transducer on the television set. Working at about 40kc/s, control of station selection (with a motor-driven turret tuner in the set) and sound muting were provided by the system.

A switch on the latest 17-inch and 21-inch television sets allows the receiver to be switched on and off when

required without the need for re-adjusting the controls.

Car aerial sockets are a feature of the three personal transistor receivers made by this firm—the 888, the Vanguard and the 555. They have printed circuits, push-pull outputs and operate from pen-light batteries.

Emerson Electronics, Ltd., Brent Crescent, North Circular Road, London, N.W.10.

EVER READY

Weighing just under 1½lb and measuring 5¼in × 3½in × 1½in, the new Ever Ready "Sky Personal" portable provides full medium-wave coverage and one station on the long waves. It has 6 transistors and a printed circuit. A printed circuit is used also in the new "Sky Queen," a 4-valve portable which has a 5-in speaker, a weight of 12lb complete and a socket for connection of an external aerial. A full range of current models was shown, as well as a new Berac "Bambino" portable very similar, except in appearance, to the "Sky Personal."

Dry batteries, including the "Power Pack" transistor series, were also on view.

The Ever Ready Co. (Great Britain) Ltd., Hercules Place, London, N.7.

EXPERT

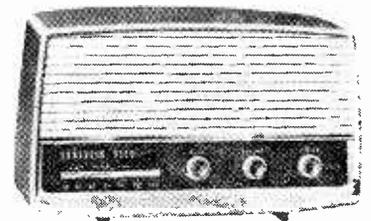
A third model, the "Stereofon III," was added to the Stereofon series of gramophones. This has the same general specification as the Stereofon II—2 × 8-watt ultralinear stereo amplifier, switched bass boost and treble cut control and an f.m. tuner—but it uses an Expert pickup arm and a transcription rather than auto-changer turntable.

The Expert column-shaped loud-speaker system is now available using three alternative bass and treble speaker systems.

Expert Gramophones, Ltd., 39-41, New Oxford Street, London, W.C.1.

FERGUSON

The full "500" series of television receivers was introduced at the Show. Using 110° tubes these receivers range from the "Flight"—a 17-in portable—to a 21-in "consolette" with two loudspeakers and v.h.f. radio. A swivel top to the stand of some models allows the direction in which the screen faces to be adjusted easily. Four radio-grams (three for stereo), a record player, a tape re-



Ferguson G-116-U v.h.f.-only receiver.

corder and nine radio receivers—one was an inexpensive 6-valve f.m.-only set—completed the display. The new tape recorder (Type 447) is Ferguson's first entry to this field.

Ferguson Radio Corporation, Ltd., 105-109, Judd Street, London, W.C.1.

FERRANTI

Demonstrated in the Audio Hall were the "Fidelio" stereo/single channel gramophone and the RP1022 record player. On the stand in the Main Hall the full range of Ferranti radio, television and gramophone equipment was shown. Especially notable for their clean-lined styling were a new single-channel record player using edge-operated controls, a 17-in television receiver using a 110° c.r.t. (available with or without v.h.f. radio) and the new SRG1036 stereo-radio-gram. This latter has two integral bass-reflex enclosures driven by 8-in diameter loudspeakers with aluminium voice-coil assemblies: independent treble and bass controls are fitted and an output of 7 watts per channel is available.

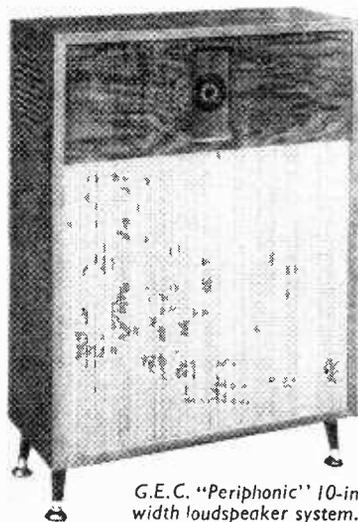
Ferranti Radio and Television Ltd., 41-47, Old Street, London, E.C.1.

FIDELITY RADIO

Two new tape recorders, the "Argyll" and the "Berwick," were included in this year's exhibit. The former is supplied with a crystal microphone and there is provision to take an input from radio or other sources. A 7in x 4in loudspeaker is included and the overall size is 17in x 13½in x 7½in. The weight is 21lb and the price 29 guineas. The "Berwick" has a B.S.R. tape deck and, with microphone, costs only 23½ guineas.

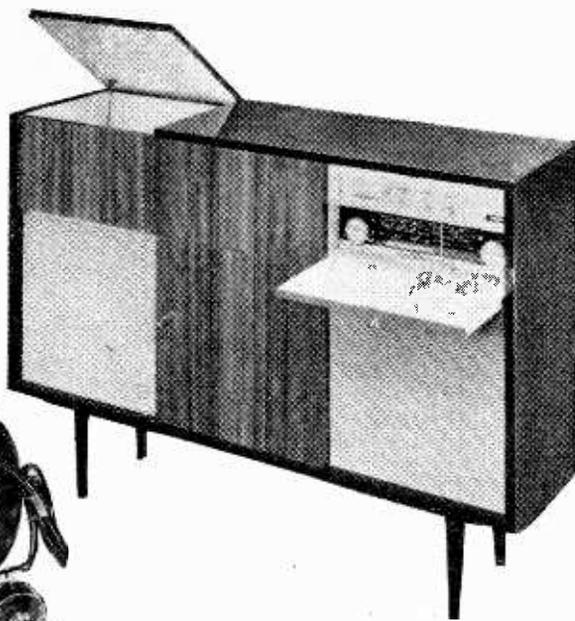
Among the other exhibits were some new 4-speed record reproducers and two radio-grams, one an a.m./f.m. model and the other a.m. only. Stereo equipment was also included.

Fidelity Radio Ltd., 11-13, Blechynden Street, London, W.11.



G.E.C. "Periphonic" 10-in width loudspeaker system.

Ferranti SRG1036 stereo radio-gram. Radio section covers v.h.f.f.m., long and medium waves.



Below: New Goodmans "Triaxiette" loudspeaker.



FUND FOR THE BLIND

On this stand, donated by the organizers, a blind operator demonstrated how the sightless can become skilled workers in engineering production lines.

Greater London Fund for the Blind, 2, Wyndham Place, London, W.1.

G.E.C.

In their high-fidelity section this firm demonstrated a new bookcase loudspeaker, giving bass reproduction from a metal-cone unit down to 40c/s in a cabinet measuring only 24in x 12in x 10in. This and a new slender "Periphonic" speaker system only 10-inches deep were used to demonstrate stereo in conjunction with a console containing two 12-watt amplifiers and a new stereo combining unit.

The "long-low" cabinet design is a feature of one new table a.m./f.m. receiver, the BC402. Edge-operated controls and a thermometer-type dial are used in the a.m. transportable BC401, and there is an f.m. version.

This year's television sets include 17-inch table and console-type models, with or without v.h.f. sound radio, a 21-inch set and a 17-inch portable. The 110° tube is used, and bow-fronted cabinets take advantage of its shape to avoid the conventional "boxy" appearance.

General Electric Company Ltd., Magnet House, Kingsway, London, W.C.2.

G.P.O.

This year being the 50th anniversary of the introduction of the Coast Radio Service it was featured on the G.P.O. stand where a station console with simulated traffic was shown. Methods of fault location in submarine cables and repeaters, and equipment which

automatically corrects distorted signals over long-distance telegraph circuits were also to be seen.

General Post Office, St. Martin's-le-Grand, London, E.C.1.

GALA RECORDS

Demonstrated and displayed on this stand were low-priced 12-in long-playing and 7-in, 45 r.p.m. extended-play records of jazz, popular and serious music. Although the programme material is American, Gala records are made in this country.

Selcol Products Ltd., 114, Charing Cross Road, London, W.C.2.

GARRARD

The new tape deck incorporates a magazine to make the tape easier to handle. Each magazine contains two 4-in diameter reels of double-play tape so arranged that, when the magazine is slotted into its correct position on the tape deck, the tape is already in its correct position for recording or playing. The single record-replay head on the deck gives a response (with suitable equalization) up to 10kc/s at the tape speed provided (3¼in/sec).

The Garrard range of record changers and single-channel and stereo crystal pickups (which includes a new stereo ceramic turn-over cartridge) was also on show, together with the adjustable TPA12 pickup arm, GMC5 moving-coil pickup head, and well-known 301 transcription turntable.

Garrard Engineering and Manufacturing Co., Ltd., Newcastle Street, Swindon, Wilts.

GOODMANS

Notable among the new loudspeakers was an 8-in triaxial unit consisting

of an 8-in coaxial unit with, in addition, a centrally mounted horn-loaded tweeter. The horn cross-section is made elliptical so that the horizontal polar response angle can be varied by rotating the ellipse. A similar but separate horn-loaded tweeter and two full-range 10-in units were also introduced. The compact "Bowl" loudspeaker for reproducing frequencies above 300c/s was on show. This is for stereo systems in which frequencies below 300c/s in both channels are reproduced by a single loudspeaker.

A new compact three-speaker system, using an extension of the Goodmans method of resistive loading to reproduce frequencies down to 35c/s in an enclosure only 24in x 11½in x 14½in, was also introduced.

Goodmans Industries Ltd., Axiom Works, Wembley, Middlesex.

GRUNTHER

A range of specialized measuring instruments on this stand included the Beamec cathode-ray tube tester and reconditioner, Series II. As well as testing for heater current, emission, beam current, gas content and shorts and leakages between electrodes, the instrument has a pulse generator for removing cathode-poisoning by application of pulse currents between electrodes. Inter-electrode shorts and leakages can also be removed.

Grunther Instruments, Ltd., 14, Oriental Street, London, E.14.

H.M.V.

An inexpensive sound receiver for f.m. only is the 6-valve Model 1375, which has a permanently connected flexible indoor aerial for normal signal-strength areas and sockets for an external aerial. A 7in x 4in speaker is used.

Easy servicing is a feature of the 17-inch transportable television set Model 1893. The chassis can be easily withdrawn and the printed wiring is on two hinged panels. This set, like the 17-inch table receiver

Model 1890, uses a 110° tube and has the modern slim cabinet design.

The range of new models is completed by a transistor portable sound receiver, using six transistors and giving 400mW output into a 7-inch elliptical speaker; and a stereo radiogram, the "Meistersinger", which has two separate speaker cabinets, each containing a 10in x 6in unit and a tweeter.

"His Master's Voice" Radio and Television Sales, Ltd., 21, Cavendish Place, Cavendish Square, London, W.1.

HEATHKIT

With the most recent additions the Heathkit range of home constructor's equipments now covers a very wide field indeed. One of the latest is a complete "hi-fi" stereo outfit comprising record player and matched amplifiers, and, with twin loudspeakers, costs under £50. Another is an f.m. tuner kit requiring no alignment after assembly, as it embodies pre-tuned sub-units and a printed circuit. The power pack is included.

Among the portable transistor radio kits were a six-transistor model and also a single-transistor kit for beginners. "Heathkits" for constructing amateur radio transmitters and a comprehensive range of test equipment were included also.

Daystrom, Ltd., Glevum Hall, Gloucester.

HOBDAY

As wholesale distributors of many leading makes of radio, sound recording and reproducing apparatus and accessories, this firm had an exhibit which consisted primarily of a representative range of these products.

Hobday Bros., Ltd., 21-27, Great Eastern Street, London, E.C.2.

HUNTS CAPACITORS

Showing a wide range of miniature and standard-size capacitors for all

purposes, this company's display featured new ceramic capacitors (mainly for printed-circuit use) and a new range of metallized paper types (W197) in values up to 2µF. Also shown was the new W97 Series of metallized paper capacitors whose voltage ratings have been increased to 250, 500, 750 (instead of 150, 400, 600) with a temperature range of -40°C to +100°C.

A. H. Hunt (Capacitors) Ltd., Bendon Valley, Garratt Lane, London, S.W.18.

I.T.A.

As on the B.B.C. stand, the emphasis was on personalities, but for those interested in the means rather than the matter there was some interesting equipment to be seen. Tyne Tees Television, the programme contractors for the I.T.A. north-eastern station, had on show an outside broadcasting unit and a mobile video-tape recording van. The Ampex video-tape recorder, which was used during the show for recording interviews for later playback, is a mobile version of the standard equipment.

Independent Television Authority, 14, Princes Gate, London, S.W.7.

INVICTA

Television receivers shown were 21- and 17-in types—four "standard" models and one for fringe areas. Two new radios were the Models 31 and 320: both are transistor receivers, but the Model 320 breaks away from the usual "portable-set" appearance. Only 3½-in deep by 7in x 9in, this medium- and long-wave receiver is slim enough to stand on the mantel-shelf.

Invicta Radio Ltd., 100, Great Portland Street, London, W.1.

J-BEAM

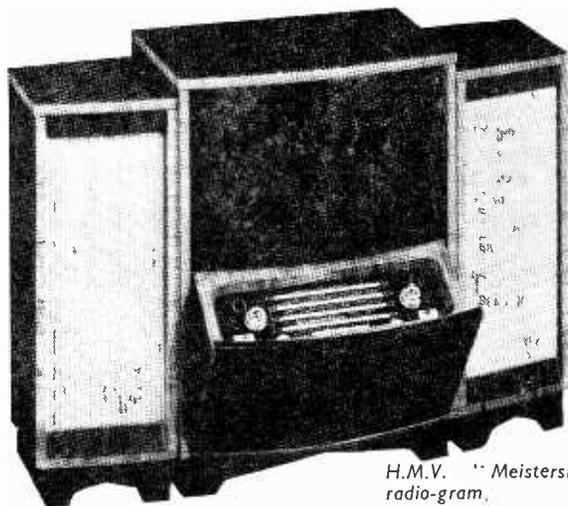
This company, who have always been slot-aerial protagonists, were showing a new wide-band slot aerial, called the Omnislots, for all Band-III channels. The New Omnibeam is a single-channel Band-I aerial combined with a broad-band slot covering the whole of Band III. This is available in two versions—with and without a second Band-I element. Other equipment shown included aerials for Bands I, II and III, for indoor and outdoor use; accessories such as triplexes, and aerial arrays for the amateur.

J-Beam Aerials, Ltd., "Westonia," Weston Favell, Northampton.

JOHNSON

Decorative trims in metal and metal-covered plastic for cabinets and radio furniture being the speciality of this firm, their stand was devoted to a comprehensive display of fittings of this kind.

G. Johnson Bros. Ltd., 103-149, Cornwall Road, Tottenham, London, N.15.



H.M.V. "Meistersinger" stereo radiogram.



TV trolley fitted with Shepherd casters (Le Grest).

K.B.

Introduced last year, the 17-inch portable television set "Royal Star" is being retained in a mechanically redesigned version, QVP20, with a 110° tube and slim cabinet. There is a hinged printed circuit, controls are at the rear and the speaker is on the side. The 110° tube is used in many of the other 17-inch and 21-inch sets in the range. A new version of one of the biggest sets at the Show, the 24-inch Regina, was also on view.

A suitcase type of sound receiver, the Gaiety QP21, has a detachable lid which allows the set to be used as a conventional indoor receiver or as an outdoor portable. Also on show were stereophonic and single-channel radio-grams and record players, and two extension loudspeakers, one of which, the "Stereo-vox," is housed in an unusual oval cabinet.

Kolster-Brandes, Ltd., Footscray, Sidcup, Kent.

KERRY'S

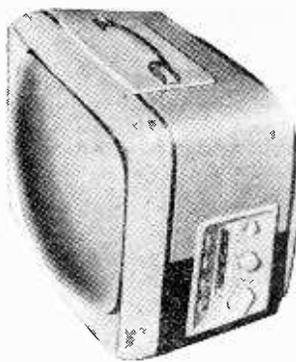
This firm had a representative display of receivers, recorders, sound reproducing apparatus, test gear and accessories handled by them in their role of wholesale distributors to the radio trade.

Kerry's (Great Britain) Ltd., Warton Road, Stratford, London, E.15.

LABGEAR

New aerials shown this year included a combined type for two Band-III and one Band-I channels, a set-top aerial with sputnik-like styling (the "Satellite"), a range of "X" units and a co-linear, in-the-room Band-I/III design. Among the accessories was noted a Channels 9 and 11 diplexer. Several instruments were on show, including stabilised power supplies, a transistor tester, a signal-strength meter for Bands I, II and III and a sine/square wave generator.

Labgear (Cambridge), Ltd., Willow Place, Cambridge.



McMichael MP18 17-inch portable receiver.

LE GREST

"Finger-Touch" television trolleys on Shepherd casters and with non-slip rubber tops were a special feature of this firm's exhibit. One new model has a lower shelf and is so sturdily made it could be used for moving heavy apparatus in dealers' showrooms. Various other models were shown, including some for the new "slim" cabinet sets with short 110° tubes.

Le Grest and Co., 58, Fairfield Street, London, S.W.18.

LINGUAPHONE

Recorded language courses in 34 languages are issued by Linguaphone. The Institute's 4-speed record reproducer has provision for a "solo-phone" attachment enabling students to listen to recordings without being disturbed, or disturbing others.

Linguaphone Institute, 207-209, Regent Street, London, W.1.

LUGTON

Wholesale distributors to the radio trade, this firm were showing a representative range of proprietary makes of radio, sound reproducing and recording and test equipments, with some emphasis on stereo and "hi-fi." Also included were accessories and an exclusive range of diamond and sapphire gramophone styli.

Lugton and Co. Ltd., 209-212, Tottenham Court Road, London, W.1.

LUSTRAPHONE

The stereo microphone VR65 is a double-ribbon unit in which the relative angle of the two ribbons is adjustable. A switch allows them to be connected in or out of phase and in series. The wide range of ribbon velocity and moving-coil pressure microphones on show also included miniature lapel and noise-cancelling microphones.

Transistorized instruments on show included a 4-channel microphone mixer and 10- and 15-watt power amplifiers. A complete transistorized noise-cancelling intercommunication system suitable for factories is also available.

Lustraphone, Ltd., St. George's Works, Regents Park Road, London, N.W.1.

McMICHAEL

Four new television sets, all with 110° tubes and v.h.f. sound reception, were shown on this stand—the 17-inch portable MP18, the 17-inch table model M74T, the 17-inch console M74HFC with "picture-frame" presentation of the tube, and the 21-inch console M247HFC, also a "picture-frame" set. All these sets have the same technical specification and feature a clip-on chassis which can be withdrawn completely for servicing.

On the sound reception side there is a stereo radio-gram, MS202, incorporating both tape and record playing facilities. It has two 10in x 6in speakers, v.h.f. reception and push-button selection of wavebands. The range is completed by two portable receivers, the mains M105R and the mains/battery MBP405.

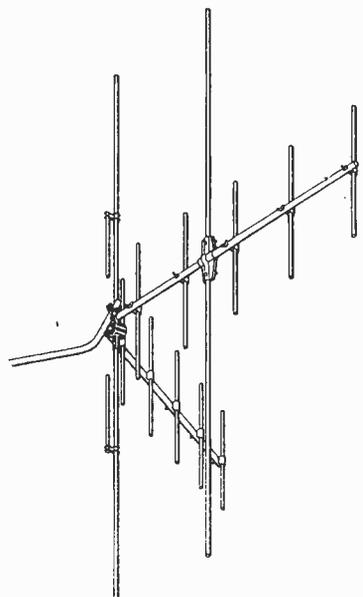
McMichael Radio, Ltd., Langley Park, Slough, Bucks.

MARCONIPHONE

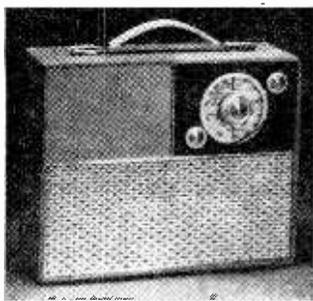
Three new television sets, one new radio-gram and one new sound broadcast receiver were included in the Marconiphone exhibit this year. Two of the TV sets have the new 110° tubes; the Model VT163 has a 17-in c.r.t. and v.h.f. radio reception facilities while the VT164 has a 21-in tube but no v.h.f. channels.

Radio-gram Model RG81 provides stereo reproduction in conjunction with a 4-speed auto-changer and two 8in x 6in speakers housed in integral acoustic chambers. It covers long, medium and v.h.f. wavebands and has provision for use with a tape recorder.

The new sound broadcast set (Model T82B) is a small portable (Continued on page 379)



Labgear three-channel, two-direction aerial for channels 1, 8 and 9.



New Perdio "Continental" transistor receiver.

embodying 6 transistors and 2 diodes and it covers medium and long waves. A 5-in speaker is used and the set is powered by two 6-volt batteries.

Marconiphone Radio and Television Sales Ltd., 21, Cavendish Place, London, W.1.

METRO-SOUND

The new range of tape-recording accessories includes a head-cleaning fluid which is applied via a special tape, and coloured strips, "Metro-tabs," which are folded over the edge of the tape to allow the user to see at a glance the position of a particular passage.

A range of sapphire and diamond replacement styli and other record-replaying accessories was also on show.

Metro-Sound Manufacturing Co., Ltd., 19A, Buckingham Road, London, N.1.

MULLARD

Latest developments in valves for television, v.h.f. radio, stereophony and other applications were displayed, with special reference to frame-grid types. The exhibit on cathode-ray tubes concentrated on technical improvements incorporated in the new 110° tubes. Transistors and their uses in car receivers, portable sets and hearing aids were also an important feature of the stand.

Once again, a Home Constructor Centre was provided to enable amateur constructors to consult the firm's engineers and obtain information on the performance and uses of the company's products.

Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1.

MULTICORE

Accompanying the Model 500 Reflectograph tape recorder this year was the new Model 570 Stereacorder, a self-contained stereo equipment incorporating four amplifiers, two loudspeakers and great flexibility in recording and playback facilities. For example, recording can be made stereophonically on twin-track tape, or the two tracks used independently as single channels. Each channel has a peak-level meter with separate recording and playback controls. It has many other interesting features, not the least being the Reflectograph

tape deck with its variable-speed facilities, clock-type tape-position indicator and three heads.

Savbit and Ersin flux-cored solders, the Bib wire stripper and the Bib tape splicer completed an interesting exhibit.

Multicore Solders Ltd., Maylands Avenue, Hemel Hempstead, Herts.

MURPHY

The basic display on this stand was the V410 and 420 series of 17-in and 21-in television receivers in both console and table-model forms. A notable feature of the models of this type incorporating v.h.f. radio (V430 and 440) is the elimination of the fine tuner: a.f.c. is applied to the local oscillator, so making possible the switch selection, without further tuning, of the three or four f.m. services.

Sound is well-catered for also, with a range of table-model receivers for a.m. and f.m. and radio-grams. The A492R 7-valve radiogram has an ultra-linear push-pull output stage and independent bass and treble controls. New radio receivers include two low-priced v.h.f.-only sets of high sensitivity and an a.m./f.m. model in a plastics cabinet. A last-minute addition to the display—a new transistor receiver—has two quick-change cases, one of polished wood for use in the home and a zip-top carrier for use as a portable.

Murphy Radio, Ltd., Welwyn Garden City, Herts.

N.I.D.

On this stand, the space for which was given by the organizers, the National Institute for the Deaf showed a variety of pieces of equipment designed to aid the deaf and hard of hearing. They included a G.P.O. telephone receiver incorporating a transistor amplifier.

National Institute for the Deaf, 105, Gower Street, London, W.C.1.

PAM

The entire range of television sets, including a 17-inch portable, a 17-inch table model, a 17-inch console

and a 21-inch consolette, have the new 110° c.r. tubes this year. Another feature is the use of Polaroid filters to eliminate reflected light and make possible viewing in a room with all the lights on. A demonstration showed the efficacy of this scheme.

Also on show were transistor portable sound receivers, table model v.h.f. sets, car radios with transistor output stages, a stereo radio-gram with v.h.f. radio, and two stereo record players.

Pam (Radio and Television) Ltd., 295, Regent Street, London, W.1.

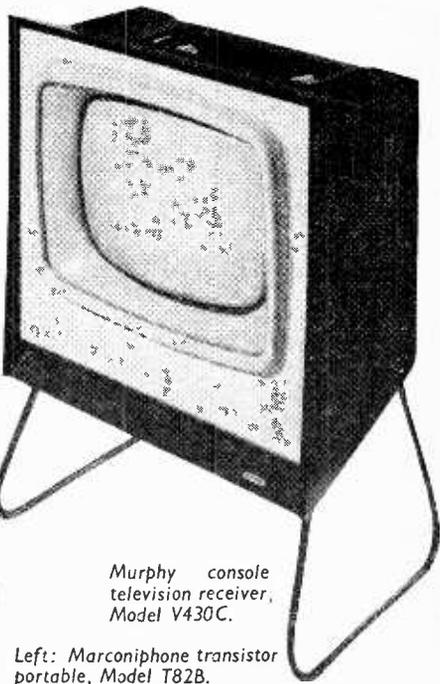
PERDIO

Special features of the new "Continental" transistor receiver are a loudspeaker as large as 8-in by 5-in, one-watt peak output, fixed bass boost to partially compensate for acoustic losses due to the small cabinet, automatically varying selectivity to give optimum signal-to-noise ratio at various signal input levels, and an 87 to 197 metre band. A car aerial socket, and also a socket for connection either to the input of a tape recorder or to earphones, are either already provided on or can easily be fitted to any model in the wide range of Perdio transistor receivers.

Perdio, Ltd., Dunstan House, St. Cross Street, Hatton Garden, London, E.C.1

PERTH

Two styles of radio-gram cabinet (one for stereo) house alternative chassis of "de luxe" and "standard" specification. Record players, both stereo and single-channel, were also shown, together with the new "Clarissa" tape-recorder. This uses the new



Murphy console television receiver, Model V430C.

Left: Marconiphone transistor portable, Model T82B.

Collaro deck and has mixing and superimposing facilities.

Perth Radios, Ltd., 39-47, East Road, London, N.1.

PETO SCOTT

Two new 17-inch table television sets are the Sapphire 1729, using 15 valves, 3 diodes and an 8-in front-facing elliptical speaker, and the Vogue 1730, which has the same specification and includes f.m. sound reception with three pre-set stations. Also provided with v.h.f. reception is the 21-inch consolette, Rondo 2128, which has a 110° c.r. tube.

A 9-valve a.m./f.m. sound receiver is used in the Contessa ARG68 stereo radio-gram, which has a four-speed record changer, a record storage compartment, and provision for an extension loudspeaker.

Peto Scott Electrical Instruments, Ltd. Weybridge, Surrey.

PHILCO

"Pictures on the wall" have long been the aim of c.r.t. designers in their efforts to reduce tube length. The new Philco Model 1021—called the "Telorama"—is probably the nearest approach yet to this ideal. It is a 21-in receiver using a 110° c.r.t. and the cabinet (16½-in deep) is shaped so that it fits into the corner of the room, hanging on specially designed brackets. Also shown on this stand were 17-in television receivers, radio receivers for mains and battery operation and record players, both stereophonic and single-channel.

Philco (Great Britain) Ltd., 30-32, Gray's Inn Road, London, W.C.1.

PHILIPS

Two new stereo radio-grams have been introduced, the G94A and G96A, each with push-button controls, 4-speed record changers, a.m./f.m. reception and built-in aerials. The G94A is a 10-valve equipment using two 6½-in speakers while the

G96A has 9 valves and two 6in x 4in elliptical speakers. In addition there is the "Disc Jockey Stereo," a portable record player in which the lid consists of two removable cabinets, each containing a 6½-in speaker, and the "Automatic Disc Jockey," a single-channel portable record changer.

A printed-coil turret tuner is used in the latest 17-inch table television receiver, 17TG100U, which has a 110° tube and a hinged chassis to give easier access for servicing.

Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

PILOT

Weighing only 5½lb, the latest "Little Maestro" radio receiver covers medium and long wavebands. Television receivers shown were a 21-in model in a "wrap-round" cabinet and two 17-in models. A stereophonic and two single-channel gramophones completed the display.

Pilot Radio and Television, Ltd., Stonefield Way, South Ruislip, Middlesex.

PITRIE

This firm specializes in the rebuilding of television cathode-ray tubes. Examples of typical rebuilt tubes were displayed but the stand was used mainly as a meeting place for trade visitors.

Pitrie, Ltd., 21 Noel Street, London, W.1.

PLESSEY

This stand was used principally as an office where home and overseas representatives of the radio and electronics industries could obtain information on the wide range of components, accessories and equipment made by this firm.

Plessey Co. Ltd., Vicarage Lane, Ilford, Essex.

PORTOGRAM

New transistorized models include a 4-speed radio-gram and a receiver

with a response which is claimed to be from 80c/s to 9kc/s. An addition to the range of portable record reproducers is the "Varsity" Model "B" which features a 6-watt push-pull amplifier and "Lenco" transcription motor.

An f.m.-only radio-gram and portable and console tape recorders were also shown.

Portogram Radio Electrical Industries Ltd., Preil Works, St. Rule Street, London, S.W.8.

PYE

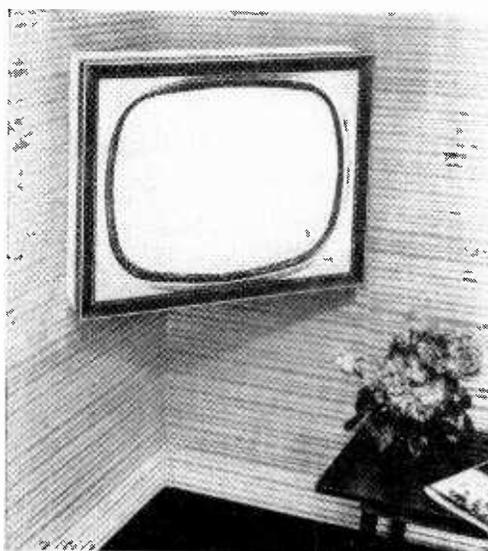
A table sound receiver with facilities for stereo reproduction from a record player was the outstanding exhibit on this stand. In addition to two pairs of spaced loudspeakers and a twin-channel amplifier, it has a 9-valve v.h.f. receiver with magic-eye tuning, stereo balance control, separate bass and treble controls and sockets for tape recording. Called the VHF3D, the set measures 30in wide and is finished in contrasting walnut veneers. A stereo version of the well-known "Black Box" was also on view.

New transistor receivers included a six-transistor set suitable for use in yachts and other small craft. It covers the trawler waveband and has a practical anodised aluminium finish. The output is 450mW into a 5-inch speaker.

Pye, Ltd., Cambridge.

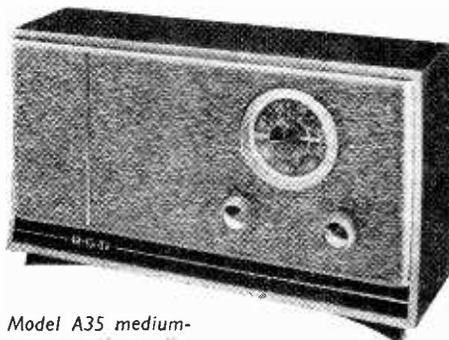
R.A.F.

One of the features of the R.A.F. stand was a d.c. analogue computer designed and built at the R.A.F. Technical College, Henlow. It is intended for training purposes for the simulation of problems associated with guided missiles and incorporates 100 d.c. amplifiers. A range of equipment including airfield surveillance radar; Tacan (the tactical air navigation system); communications gear,



R.G.D. Model A35 medium- and long-wave mains radio.

Philco "picture-on-the-wall" television receiver.

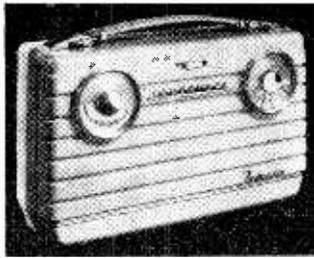


etc., much of which could be operated by visitors, was also shown.

Air Ministry, London, S.W.1.

R.G.D.

This firm's 30th anniversary was celebrated at the Radio Show by a display of television and radio receivers, radio-grams, record players,



Regentone transistor receiver.

tape recorders and a tuner/amplifier unit. The Model T.1. tuner amplifier is mounted in a table-radio-type cabinet and its push-pull output stage provides a power output of 8 watts. A series of television receivers (the 600 series) using 17-in or 21-in 110° tubes features silicon h.t. rectifiers and a circuit which reduces interdependence of contrast and brightness controls. Other additions to the range of products include a mains portable radio.

Radio Gramophone Development Co. Ltd., Eastern Avenue West, Romford, Essex.

R.S.G.B.

The emphasis on the R.S.G.B. stand, which was devoted to the interests of amateur transmitters and short-wave listeners, was on mobile operation. A typical car installation of home-constructed equipment was shown mounted beneath a mock-up fascia-board.

Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1.

R.T.R.A.

An information bureau, both for dealers and prospective buyers of sound or television receivers, was provided by the Association.

Radio and Television Retailers' Association, 15-17 Goodge Street, London, W.1.

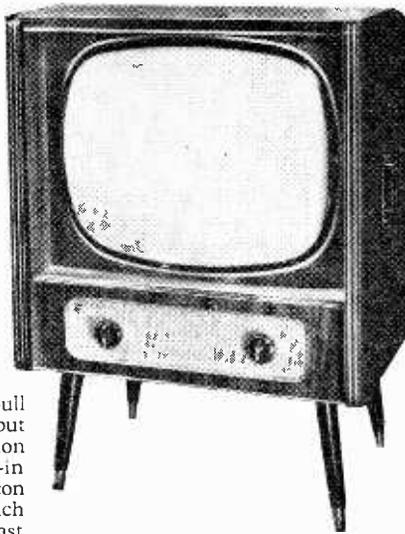
RECORD HOUSING

This stand held examples of both contemporary- and traditional-style cabinets for records, equipment and loudspeakers, together with two three-speed tape recorders—the Courier Mk. II and the Envoy, which uses the new Collaro deck. Also on show were record-carrying cases and “browser racks.”

Record Housing, Brook Road, London, N.22.

REGENTONE

Silicon junction rectifiers for the h.t. supply are a technical feature of the new 17-inch 110° tube television set, the Ten-17. It has a constant-brightness circuit for use when switching channels and an improved low-noise turret tuner. There is an alternative model with v.h.f. sound reception and a 21-inch version also with f.m. sound. In addition the range includes a 17-inch 110° portable, the



Peto-Scott TU2128 21-inch receiver.

Ten-6, with a two-tone leatherette finish.

An inexpensive tape recorder, the RT20, features a tone control and a twin-neon recording level indicator. The tape runs at 3½ in/sec and there is a 7 in × 4 in elliptical loudspeaker.

The new SRG87 stereo radiogram has two banks of loudspeakers inside the cabinet and a.m./f.m. sound reception. The separate volume controls are ganged for two-channel balancing.

Regentone Radio and Television, Ltd., Eastern Avenue West, Romford, Essex.

REPS

Features of the Reps range of tape recorders are the use of push-pull bias and erase oscillators to reduce the d.c. component in the bias waveform and thus noise on the tape, rubber-suspension of the tape deck to reduce mechanical noise, and the use of “humbucking” coils. Recording level is indicated by a meter or wide-angle magic eye.

Recently introduced for converting decks to stereo is a record/replay amplifier with a push-pull output.

Reps (Tape Recorders), Ltd., 118 Park Road North, London, W.3.

ROBERTS' RADIO

Compact portables of pleasing design and embodying well-tried circuitry were the principal exhibits on this stand. Prominent among them was the Model RT1, a six-transistor set covering medium and long waves. It utilizes a ferrite rod aerial, has printed circuitry and provision for attaching an external (car) aerial. The case is Rexine covered with a choice of six different colours or patterns. Valve portables shown included the very compact Model 77 and the slightly larger Model 88.

Roberts' Radio Co. Ltd., Creek Road, East Molesey, Surrey.

ROLA CELESTION

The display on the stand in the Main Hall was devoted to loudspeakers for set manufacturers (2½-in to 15-in in diameter and elliptical units from 6 in × 4 in to 10 in × 8 in including an 8 in × 2½ in type for use in modern-style cabinets) and professional purposes (re-entrant horn, horn and column designs). On the stand in the Audio Hall was shown and demonstrated the “Colaudio” 15-in diameter loudspeaker with its 3-in voice coil and centrally mounted high-frequency pressure unit. Also included in the demonstration was a new 12-in Colaudio l.s.—the model 1220—and the display featured other loudspeakers both for radio receivers and high-quality reproduction.

Rola Celestion, Ltd., Ferry Works, Thames Ditton, Surrey.

ROSE PROJECTS

Television tables and trolleys made from selected cabinet woods and with attractively grained French veneer finish are a speciality of this firm. Table top sizes range from 14 in × 22 in to 20 in × 22 in and tables of various heights are available with or without a lower shelf for periodicals and books.

Rose Projects Inc., Bourne End, Bucks.

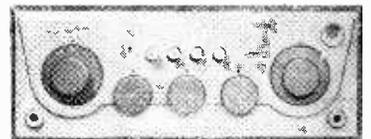
SAGA RECORDS

Long-playing records and pre-recorded tapes (for both 3½ in/sec and 7½ in/sec speeds) were shown, together with New Saga stereophonic discs. These stereophonic recordings are claimed to be compatible in the sense that they may be played with extant single-channel pickups without damage to the groove. Demonstrations of both stereophonic and single-channel programme material were given in an adjoining room.

Saga Films Ltd., Empire Yard, 538/540 Holloway Road, London, N.7.

SCIENTIFIC AND TECHNICAL DEVELOPMENTS

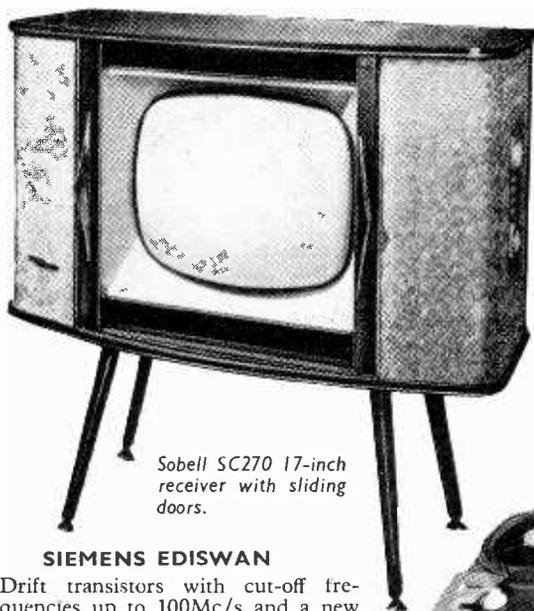
A new range of period reproduction furniture fitted with “Emisonic/Orthotone” high-fidelity units was shown. Most of these cabinets have



Emisonic-Orthotone a.f. pre-amplifier by S.T.D.

space for both a record player and tape recorder. Two alternative “Queen Anne” style loudspeaker cabinets are also available.

Scientific & Technical Developments Ltd., Melbourne Works, Wallington, Surrey.



Sobell SC270 17-inch receiver with sliding doors.

SIEMENS EDISWAN

Drift transistors with cut-off frequencies up to 100Mc/s and a new silicon rectifier for television receiver power supplies were shown amongst the display of semiconductor devices on this stand. A transistorized transistor tester, using an audible note for indication, provided rapid measurements of current gain and collector leakage current of p-n-p transistors under common-emitter conditions.

A new 110° cathode-ray tube, the 17-inch CME1705, has a special design of electron gun which makes the tube about 1¼ in shorter than the equivalent 17-inch 110° tube of conventional design. It uses a new system of electrostatic focusing, operating over a shorter distance than normal. Valves for scanning 110° tubes were also on show.

Miniature multipoint connectors and a new printed-circuit valve-holder were highlights of the Clix display of chassis fittings.

Siemens Edison Swan, Ltd., 155 Charing Cross Road, London, W.C.2.

SIMON

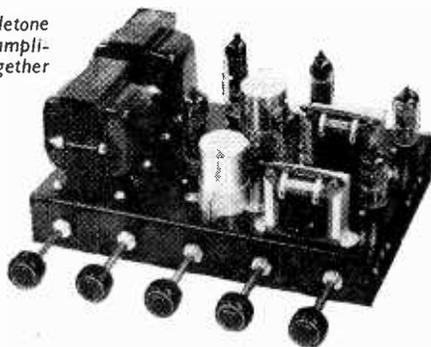
A stereo replay adaptor for the standard SP/4 tape recorder was demonstrated. This clips on to the side of the SP/4 and consists of a twin pre-amplifier and stereo head: the tape is driven past the stereo head using the mechanism of the SP/4. Also available for adapting the SP/4 to stereo are a similar amplifier and two-speaker system to those in the SP/4, housed together in a cabinet to match the SP/4. A useful accessory for the SP/4 recorder is a remote control start/stop and track change switch.

Simon Sound Services Ltd., Recorder House, 46-50 George Street, Portman Square, London, W.1.

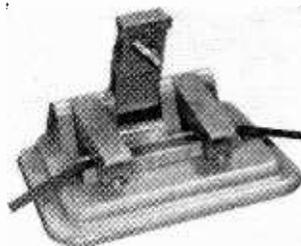
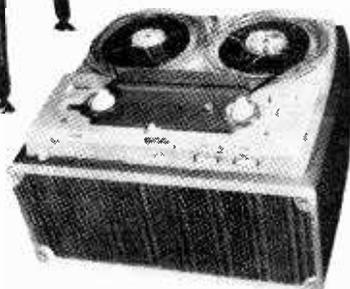
SLINGSBY

Trucks designed primarily for transporting television sets and radio-

Right: Two Tripletone "Convertible" amplifiers coupled together for stereo.



Below: New Truvox R7 two-directional tape recorder.



Sound Sonocolor Tape splicer.

back to form a stroboscope for cine-synchronization.

A range of extension loudspeakers is also available.

Tape Recorders (Electronics) Ltd., 784-788, High Road, Tottenham, London, N.17.

SOUTHGATE TUBULAR PRODUCTS

Manufacturers of showroom and window-display stands in tubular metal, this firm demonstrated a representative selection of stands applicable to the radio trade. A special feature was made of their "Unipole" models.

Southgate Tubular Products, 148 Chase Side, Southgate, London, N.14.

SPENCER-WEST

All components of the four new 17-inch table television receivers introduced this year are mounted on a single printed deck in one plane. Free access to all the components on this chassis can be obtained without removing it from the cabinet. Cabinets have been restyled since last year.

Spencer-West, Ltd., Quay Works, Great Yarmouth, Norfolk.

S.T.C.

A new, inexpensive silicon junction rectifier, making possible simplification of the h.t. supplies of television receivers, is rated at 400V p.i.v. and 500mA at up to 50°C. Zener reference diodes, selenium rectifiers, junction photocells and a wide range of transistors were also on view.

Amongst the quartz crystal units on

gramophones in warehouses and dealers' showrooms, and also some van-loading and unloading equipment, formed the principal items of interest on this stand.

H. C. Slingsby Ltd., 89-97 Kingsway, London, W.C.2.

SOBELL

Nine television receiver models, five of which use 110° tubes, made up the main part of the display on this stand. Two new models—the SC270 and SC24—featured the new trend in cabinet design with front-mounted loudspeakers (one on each side of the c.r.t.) and glide-away doors. Both these sets incorporate v.h.f. radio with a separate tuning dial and on/off switch. The stereo record player (Model SP406) is a portable machine carrying the second loud-speaker in the detachable lid.

Radio and Allied Industries, Ltd., Langley Park, Slough, Bucks.

SOUND

One notable model in the range of tape recorders on show was the "Belle". This is characterized by its small size (10in x 8in x 5in) and light weight (11lb). No capstan is used on this recorder, the tape being driven by the take-up spool. Up to 35 minutes playing time per track is possible using long-playing tape.

The firm also distributes the Sonocolor range of tape accessories. This includes splicing equipment, marking ink, and tape which has vertical black lines printed on its

show was a new three-crystal assembly on a single B7G valve base which has particular application to oscillator control in f.m. receivers.

In Brimar valves, the types PL84 and PL36, for television frame and line output stages respectively, have been designed for adequate margins of performance under the more stringent conditions imposed by 110° scanning circuits.

Standard Telephones and Cables, Ltd., Connaught House, Aldwych, London, W.C.2.

STELLA

A new transistor portable radio, a stereophonic radio-gram and a 21-inch television receiver made their debut on this stand. The radio-gram is a one-cabinet design using the Philips autochanger. The 21-inch television receiver has twin loudspeakers, and push-button vision-definition and sound-tone controls. The definition control gives "crisp," "soft" or normal pictures.

Other equipment shown included a single-channel radio-gram (convertible for stereo), table model long- and medium-wave and a.m./f.m. receivers, a 21-in fringe model TV and a 17-in tube version of the television receiver mentioned above.

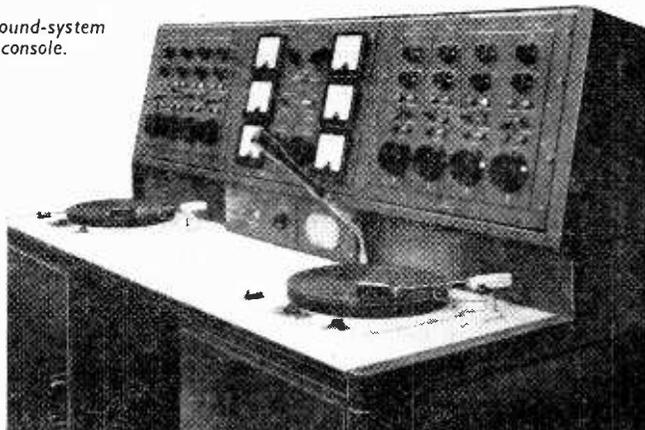
Stella Radio and Television Co., Ltd., 9-15 Oxford Street, London, W.1.

T.C.C.

A full range of capacitors covering practically every need was shown, including a new printed-circuit mounting arrangement for tubular types. From the newly formed Ceramics Division came a display of formers, resistor tubes, plates and rods, stand-off and lead-through terminals, capacitor bodies, bushes and hermetic seals, together with an extensive range of fuses. The Printed-circuits Division were showing items demonstrating the use of flush-bonded and plated-through circuits in applications such as missile telemetry and industrial control. Also on show were piezo-electric transducer elements.

The Telegraph Condenser Co., Ltd., North Acton, London, W.3.

Trix sound-system control console.



TELERECTION

New aerials shown included the Dual Hi-max 5R combined type and an eleven-element Yagi for Band III. The Hi-max 5R completes the Dual Hi-Max range, all of which can have elements added for the reception of v.h.f./f.m. Other equipment shown comprised a full range of aerials for Bands I, II and III reception, the larger items from which (three elements and over for Band I, and Band II, broadside arrays for Band III) feature delta-matching of the feeder.

Telection Ltd., Antenna Works, Lynch Lane, Weymouth, Dorset.

TELESURANCE

In addition to providing information on their television maintenance-insurance scheme, Telesurance gave details of the advisory service on television relay schemes they now provide for dealers. Under this scheme local dealers in areas of bad or indifferent reception form themselves into a company to provide a relay service with which subscribers use their own receivers for both television and v.h.f. sound.

Telesurance Ltd., 14 Windmill Street, London, W.1.

TRIPLETONE

The range of single-channel and stereo amplifiers demonstrated featured middle frequency as well as bass and treble controls. This enables dissimilar response loudspeakers in stereo systems to be more easily balanced against each other. Conversion to stereo has been made easy with the "Convertible" single-channel amplifier by extending the control spindle on both sides of the potentiometers so that when two "Convertibles" are bolted together front-to-back, corresponding spindles can easily be coupled together in pairs. Also shown was a stereo balance indicator unit.

Tripletone Manufacturing Co., Ltd., 241a The Broadway, Wimbledon, London, S.W.19.

TRIX

A wide selection of both domestic and professional equipment was shown, ranging from a portable record player through various stereophonic gramophones (the "Leofric" uses column-type loudspeakers) to control desks such as that shown in the photograph. Many new items were noted, including a 12-V, 15-W transistor mobile p.a. amplifier, a stereo-gramophone for dance halls and theatres, and two tape recorders. One of these, the "Comet," uses the Garrard tape-cartridge deck, whilst the "Everest" employs the new three-speed Collaro transport. Out of the larger equipment perhaps the "brick" construction, enabling a variety of equipment such as f.m. tuners, preamplifiers and alarm signal units to be fitted into a "standard" 19-in rack, was the most interesting; but also seen were two new mixer/preamplifier units for microphone and tape/radio/gramophone. Individual amplifiers and an f.m. tuner cater for most high-fidelity requirements and a display of microphones included ribbon and moving-coil types.

Trix Electrical Co. Ltd., 1/5 Maple Place, Tottenham Court Road, London, W.1.

TRUVOX

The new R7 tape recorder is a two-speed two-directional model. It has two sets of heads so that both tracks on the tape can be played without turning the reels over. Other unusual features of this recorder are a slide type volume control, and provision of two different fast forward and rewind speeds to allow easier winding to a particular point on the tape.

Truvox, Ltd., Neasden Lane, London, N.W.10.

ULTRA

Prominent amongst the new range of 110° television sets was a 17-inch portable, the VP1772. Weighing 33lb, it has an adjustable twin indoor aerial as an optional extra and is finished in Vynair fabric in two alternative two-tone colour schemes. Recent console models are the 21-inch VC2173 and the 17-inch VC1773, both of which have two loudspeakers and f.m. sound reception.

Amongst sound receivers was a new stereo radio-gram, the RG81. It has push-pull output on both channels, a 4-speed record player and v.h.f. radio. A large-scale dial and slow-motion drive for the permeability tuning are features of the "Troubadour" set for f.m.-only reception.

Ultra Electric, Ltd., Stonefield Way, South Ruislip, Middlesex.

VALRADIO

The Mirrascope projection television receiver was shown. This produces pictures up to four feet across and the loudspeaker points at the screen,

the sound being reflected so that it appears to originate at the screen. For those afflicted with d.c. mains supplies the 100-watt electronic d.c./a.c. converter shown should be of interest as it incorporates a tuned-reed frequency meter to facilitate accurate adjustment to 50c/s. Other exhibits included transistor converters and vibrators in a variety of ratings.

Valradio, Ltd., Browells Lane, Feltham, Middlesex.

VERITONE

The new "Venus" stereo portable tape recorder is one of the few stereo models which can record as well as replay stereophonically. This model also continues the feature of other Veritone recorders of having separate record and replay heads and amplifiers, so that the recorded output from the tape can be monitored as distinct from only the recorded input, which is more usual. This head arrangement also makes superimposition of recordings easier.

Veritone, Ltd., 16 Station Close, Potters Bar, Middlesex.

WALTER

The Walter range of tape recorders includes single- and two-speed models featuring the well-known "joystick" method of controlling the tape motion. A stroboscope is supplied for attachment to the capstan on the 505 or 303 recorders to facilitate ciné-synchronization. Stethoscope-type earphones for dictation purposes are also available for these two recorders.

Walter Instruments, Ltd., Garth Road, Morden, Surrey.

WAVEFORMS

To the range of specialized test gear made by this firm has been added a new portable oscilloscope, the Model 303, having a particularly comprehensive specification. For example, high-impedance input; a wideband d.c. "Y" amplifier usable up to 10Mc/s with a rise time better than 0.06μsec; a paraphase-output Miller-multi-vibrator timebase with a range of 0.5c/s to 100kc/s and suppressed fly-back, are a few of its special features. Repetitive or triggered synchronizing can be employed. It is mains operated, weighs 20lb and measures 12in x 9in x 6½in.

Waveforms Ltd., Radar Works, Wallisdown, Bournemouth, Hants.

WESTINGHOUSE

Amongst a new range of silicon junction low-power rectifiers, the type SH5A2 has a maximum p.i.v. of 500V and a current rating of 500mA and is therefore suitable for h.t. supplies of television receivers. Dimensions of the case are ¾in (diameter) by 5/16in.

Selenium rectifiers were shown in various types of assembly to illustrate methods of cooling and chassis mounting. The latest is the edge-



Waveforms Type 303 oscilloscope.

cooled type in which the heat is removed by conduction from three edges of the square element, the fourth edge being used for connections.

Westinghouse Brake & Signal Co. Ltd., 82 York Way, Kings Cross, London, N.1.

WHITELEY ELECTRICAL

The wide range of "Stentorian" loudspeakers on show included units with diameters ranging from 1½ to 18in. These are available with a variety of cone constructions, magnetic field strengths and speech coil impedances to suit different requirements. Folded horns are included in the well-known range of "Break-down" cabinets. "Line source" loudspeaker systems can be obtained for sound reinforcement and public address purposes.

A stereophonic pre-amplifier and

2 x 8-watt amplifier were also on show. Various types of transformers are included in the wide range of components available.

Tables for the new "slim-line" television receivers are an innovation. Record storage cabinets are also available.

Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield, Notts.

"WIRELESS FOR THE BEDRIDDEN" SOCIETY

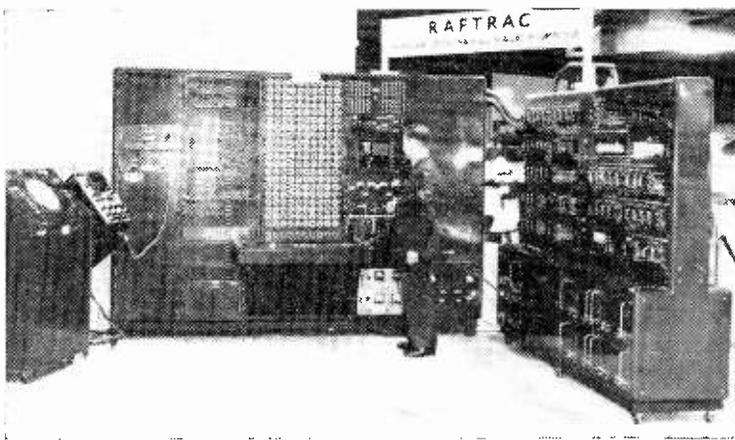
As its name implies the society provides radio facilities for the bedridden or housebound. It installs either a receiver, which is maintained free, or arranges for a relay service. Nearly 7,000 installations have so far been arranged. The Society, which relies entirely on voluntary contributions, was granted free space at the show by the organizers.

"Wireless for the Bedridden" Society, 55a Welbeck Street, London, W.1.

WOLSEY

Most notable on this stand was a display of equipment for wired television and v.h.f./f.m. relay, together with the offer of a free planning and advisory service for use by dealers contemplating the installation of a relay system. The important features of the Wolsey system are that standard television and v.h.f. radio receivers may be used and Band-III programmes may be "translated" to a vacant Band-I channel for distribution. Also shown was a range of aerials for Bands I, II and III and installation accessories.

Wolsey Electronics, Ltd., Cray Avenue, St. Mary Cray, Orpington, Kent.



Professional appearance is presented by the "RAFTRAC" analogue computer shown at Earls Court by the R.A.F. Technical College, Henlow, who designed and constructed the machine. Intended for training weapons systems engineers, it will be used for reproducing missile and target interception courses and for investigating development problems in missile design. The unit on the right incorporates 100 d.c. amplifiers, while the control cabinet (centre) provides facilities for making connections, setting zero, setting gains and inserting initial conditions.

Advances in Medical Electronics

HIGHLIGHTS FROM THE SECOND INTERNATIONAL CONFERENCE IN PARIS

ONE afternoon recently, on a lecture platform in Paris, Dr. H. G. Nöller of Heidelberg did the unusual thing of opening his mouth and swallowing, not a refreshing draught of water, but a small, working radio transmitter. He then proceeded to track its course through his body with the aid of a radio receiver. This was, in fact a demonstration of the "radio pill", or endoradiosonde, technique for measuring pressure and other parameters from inside the gastrointestinal tract for the purposes of medical examination. The occasion was a session of lectures on electro-manometry at the recent Second International Conference on Medical Electronics, held in the new UNESCO building in Paris.

Like many of the other contributions to this conference, Dr. Nöller's demonstration drew attention to the advanced nature of the modern techniques which now form the subject of medical electronics. A few years ago medical electronics hardly existed as an integrated field of study. There were a few isolated centres of activity, such as electro-cardiography, electro-encephalography, and radiography, with very little common ground between them. Nowadays electronic techniques have proliferated to such an extent in the medical field that doctors, physicists and technicians from many different branches of medicine and many different countries have found a great deal in common, and for two years running have met at international conferences in Paris. As reported in our July/August issue (p.315) this feeling of unity has led to the formation of an International Federation for Medical Electronics, and a third international conference is to be held in London next year.

To a non-medical technician one of the most interesting aspects of the techniques described at UNESCO was the possibility of carrying out measurements, or performing therapeutic operations, by small electronic units actually implanted inside the body. The endoradiosonde, though not exactly implanted, was, of course, a notable example. Another was the self-contained "pace-maker" for the heart described by the Swedish workers R. Elmqvist and A. Senning. Electronic pacemakers are essentially pulse generators used as muscle stimulators to ensure the correct beating of the heart. They often have to be used for long periods after cardiac surgery has caused some damage to the heart muscles. The con-

ventional technique of applying stimulation through a cable brought out through the skin brings with it a risk of infection; hence the need for a self-contained device which can be sterilized and sealed inside the body.

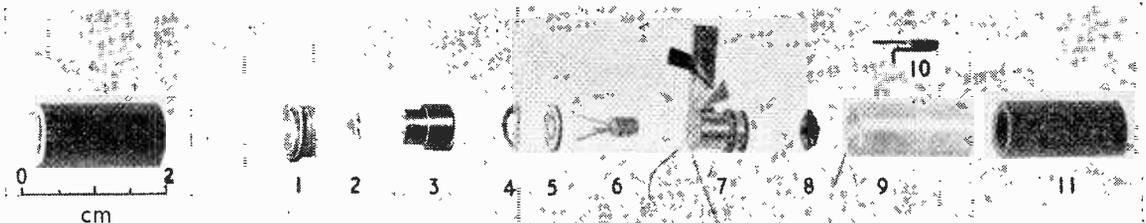
The Elmqvist and Senning pacemaker is a transistor blocking oscillator followed by a transistor amplifier which feeds the stimulating electrode through an RC network. It delivers 2-volt pulses of 1.5msec duration at about 80 pulses per second. The source of power is a small nickel-cadmium accumulator consisting of two 60mAh-capacity cells. This is kept charged from *outside* the patient's body by a magnetic induction system, using a 150kc/s a.c. generator feeding a large-diameter coil and a small pick-up coil and rectification circuit in the pacemaker. The pacemaker is actually implanted subcutaneously in the part of the stomach just below the breast-bone.

Auditory Stimulation

Another example of inductive connection to an implanted device was in the technique of direct electrical stimulation of the auditory nerves of deaf people, described by A. Djournio of Paris. The essentials of this method, in which a small pick-up coil is implanted inside the head, were outlined by Dr. Djournio at last year's conference.* The main limitation of the early experiments was that the same group of nerves in the brain was stimulated whatever the form of the induced signal, so that auditory sensations in the human subject were restricted to the strength and rhythmic pattern of the stimulus: different frequencies, or components of frequency, in the stimuli could not be distinguished. The discrimination of frequencies depends on the fact that each frequency causes a different group of auditory nerve fibres in the brain to be activated, so at least two spaced sources of stimulation are required to obtain such discrimination.

At this year's conference Dr. Djournio expressed the opinion that with two implanted pick-up coils it would certainly be possible for a subject to identify a large number of frequencies—not just two. Each

* "Medical Electronics Conference," *Wireless World*, August, 1958.



A pressure endoradiosonde; on the left, complete, against a centimetre scale; on the right, exploded into its component parts: 1, cap; 2, spring washer; 3, storage cell; 4, spring washer; 5, combined printed circuit and seal; 6, transistor; 7, capacitors and coil; 8, iron core and its suspension spring; 9, combined aerial-shield; 10, emitter resistor; 11, rubber case.

coil could be energized with a strength which was some function of the frequency, so that any given frequency would produce a particular combination of amplitudes in the two coils. Subjectively this combination of stimuli would come to *mean* the said frequency to the patient. Experiments on stimulating the left and right legs of a frog with pick-up coils and tuned energizing coils had shown that a wide variety of different effects (in this case physical postures) could be obtained with different signal frequencies.

A paper by T. Posteli, G. C. Garbini and G. Azzolini (Italy) described a small photoelectric pick-up device which had been implanted experimentally in animals for measuring the volume of blood in blood pulsations (by their varying density to light) in the visceral arterial system. Measurement of the rate of flow of blood from the heart by an implanted flow-meter was described by F. Olmsted (U.S.A.) This technique made use of the type of electromagnetic flowmeter in which the blood flows through a magnetic field and, acting like a moving conductor, generates a voltage across a section of the blood vessel proportional to the rate of flow. Both of these implanted devices, however, required connections passed through the skin of the subject.

Miniature Transmitter

Returning to the endoradiosonde, the particular example described by Dr. Nöller measured only 10mm by 4.5mm (diameter) and was claimed to be the smallest ever made. It is manufactured on an industrial scale and so can be treated as an expendable item. Another, slightly larger, endoradiosonde was the subject of a paper by B. Jacobson of Stockholm. Measuring 18mm x 8mm (diameter), it contains a transistor oscillator working at 350kc/s, powered by a 1.2-V nickel-cadmium storage cell. Pressure changes in the alimentary canal cause movements of an iron core in the oscillator tank coil, thereby modulating the frequency of the oscillator. The sensitivity of the device is expressed as 15kc/s frequency change per centimetre of water pressure. The dipole aerial is in the form of a surrounding electro-

static screen, which prevents varying stray capacitances to the body organs from affecting the oscillator frequency (See picture on previous page). Detection of the frequency of the radiated signal from the sonde is done by a pulse-counting type of discriminator, and the receiver is kept automatically tuned by a frequency control system.

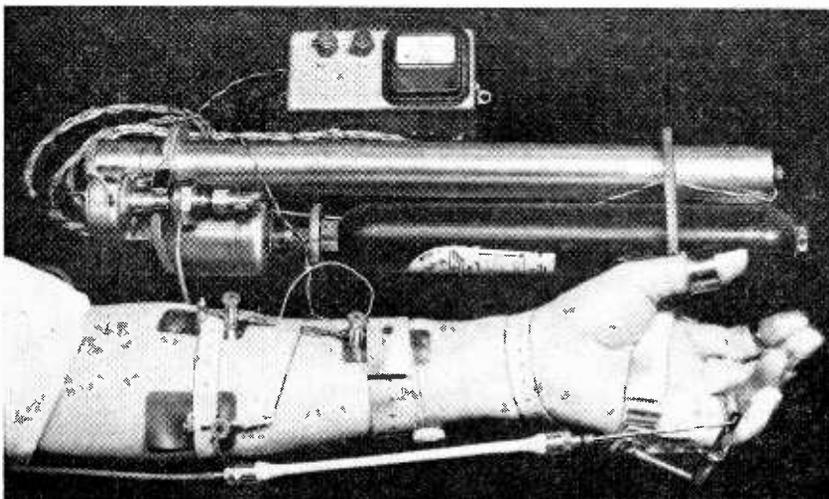
The principle of applying artificial aids to inoperative organs (known as prostheses), as exemplified by Dr. Djourno's work on hearing, came up again in a paper on artificial muscles by L. H. Montgomery and S. E. Stephenson (U.S.A.). Here the idea is that the non-functioning muscles are replaced by mechanical devices which are controlled naturally from the nervous system by amplified muscle potentials.

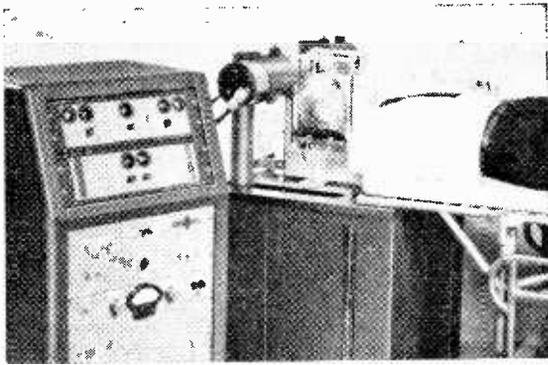
Originally the technique was developed for assisting the respiration of polio patients. It is now being tried out experimentally as a possible aid for extremities of the body such as the hands and arms. In the example shown in the photograph, muscle potentials picked up by electrodes on the arm are amplified and used to operate an electro-mechanical valve controlling the flow of compressed gas from a cylinder. Muscle potential pulses are thereby converted into gas pressure pulses. These pressure pulses pass into the mechanical muscle itself, which consists of a rubber tube covered with a woven sleeve of fine steel wires. When the gas pressure causes the tube to expand radially the angle of the weave is altered and the sleeve is contracted longitudinally, thereby operating the mechanical brace system.

Several interesting developments in the field of radiography were described. One paper, by S. Aronow (U.S.A.), dealt with scanning devices based on the emission of positrons (positive electrons) from radioactive isotopes. The isotopes are combined with certain chemicals which are selectively absorbed by foreign growths such as tumours. By geometrically scanning the radioactive area of the body with radiation detectors and automatically plotting the intensity distribution, the size and position of the tumour can be determined. Here, the particular advantage of positron emission is that it enables greater precision of plotting to be obtained

than is possible with other penetrating rays. When a positron is emitted it combines almost immediately with a (negative) electron and produces *two* quanta of gamma radiation, which travel in opposite directions (180° apart). If two detectors are placed on opposite sides of the radioactive area, and only those signals which arrive at both in precise time coincidence are recorded, a high degree of spatial collimation can be obtained. The equipment shown in the photograph, for brain tumour scanning, is based on this principle, and has two scintillation

Apparatus for muscle control, showing electrodes and artificial muscle on the arm, with (above) electronic unit, gas cylinder and control valve.





Equipment for positron scanning, showing the two radiation detectors on either side of the patient's head.

detectors which mechanically scan the radioactivity distribution in the patient's head.

Solid-state light amplifiers for X-ray fluoroscopy, based on photoconductive and electroluminescent layers, were the subject of a paper by B. Kazan (U.S.A.). Experimental panels measuring 12in x 12in have given images 100 times brighter than those obtained from conventional fluoroscope screens. In another paper, F. Shimazu, S. Miura and K. Fujimoto (Tokyo) described an electronic control system by which X-ray photographic exposures of the heart could be made at predetermined instants of the cardiac cycle. The device is triggered by a characteristic spike-wave potential picked up from the heart, and a variable-delay timer and c.r.t. monitoring system allow the instant of exposure to be set precisely with respect to this spike, which occurs at a known point in the cardiac cycle.

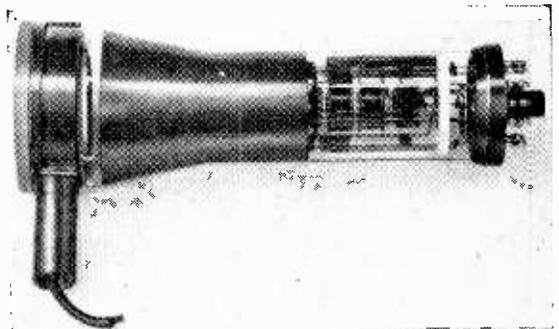
Ultrasonic Devices

A whole session on the applications of ultrasonics revealed that ultrasonic energy is being used not only for echo-sounding exploration of the heart and brain but for producing scanned images of the density distribution of internal organs and for therapeutic destruction of spurious bodies like gall-stones. The principle of the ultrasonic telescope, as an alternative to radiography for obtaining images of internal structures, was outlined by C. N. Smyth at last year's conference. This year the development of a similar ultrasonic image converter was described by W. Freitag, J. Martin and G. Schellbach (Germany). The device (see photograph) is basically an iconoscope television-camera pick-up tube, with a quartz plate sensitive to ultrasonic energy instead of a photo-electric plate sensitive to light energy. Ultrasonic waves falling on the quartz plate in a particular intensity distribution produce a corresponding pattern of piezo-electric potentials on the plate. These potentials modulate a flow of secondary electrons from the plate to a collector electrode, the flow being produced by bombardment by primary electrons from an electron gun scanning the plate in conventional television fashion. The collector (which is screened from the direct influence of the piezo-electric potentials) then gives a signal which is used to modulate the brightness of a synchronized c.r.t. monitor, thus giving a

television-type picture of the ultrasonic energy distribution.

Ultrasonic "lithotresis" is the name given by one group of workers to the use of ultrasonic energy for disrupting stones in the biliary and urinary tract. Early attempts at beaming the energy from a source outside the body were unsuccessful because of the power required and the susceptibility of the intervening body tissues to damage. H. Lampert and co-authors described a method by which the ultrasonic energy is conducted directly to the stone by a solid transmission line and drill tip through a catheter (a thin flexible tubular device used for passing along narrow tracts in the body). This transmission line consists of flat ribbons of Monel metal which are flexible in one direction so that they can follow the bends of the catheter. The length of the line has to be precisely related to the wavelength in order to obtain maximum transfer of energy from the magnetostriction generator, which operates at 20kc/s.

Amongst several papers on particle counting and sizing techniques, probably the most significant one medically was that given by R. C. Bostrom, H. S. Sawyer and W. E. Tolles (U.S.A.) on an automatic instrument, called a cytoanalyzer, for rapid "screening" of samples of human tissue to detect the presence of cancer. The device works on the principle



Ultrasonic image converter tube. The structure at the face end (left) contains the electrostatic screen surrounding the collector electrode.

of measuring the areas of cell nuclei, using a mechanical-optical scanning system and electronic circuits similar to those of a digital computer. Samples of cells are automatically classified as normal or abnormal, to indicate whether the human subject requires further examination. The rapidity of "screening" by the electronic method may eventually make possible the examination of whole sections of the normal "healthy" population, rather like mass radiography, so that symptoms of cancer can be discovered before the disease reaches the incurable stage.

Many other papers of interest to medical people, electronics engineers and workers in related fields of biology and physics were delivered at this conference. As there were about 150 contributions altogether it has only been possible to make a brief selection here. The Proceedings of the Second Conference, however, are to be published by Iliffe & Sons and will become available, at a date to be announced later, in the first half of next year.

WORLD OF WIRELESS

Autumn Audio Fair

HARROGATE is again the venue for the Autumn Audio Fair. It is being held in the Grand Hotel for three consecutive days from October 17th. On the first two days it will be open from 11.0 to 9.0 but on the third day from 10.0 to 6.0, when the first four hours will be restricted to holders of trade tickets. Nearly all the 40 exhibitors will have individual demonstration rooms as well as space in the main exhibition. Admission is by ticket obtainable free from any of the exhibitors listed below, audio dealers or from this office by sending a stamped addressed envelope.

Acoustical Manufacturing Co.
Ampex Corp.
Armstrong
Associated Electronic Engrs.
Audio Fidelity (England)
B.A.S.F.
B.S.R.A.
Beam Echo
Cosmocord
Decca Radio & Television
Decca Record Co.
Dynatron Radio
E.M.I. Sales & Service
E.M.I. Records
Fane Acoustics
Fi-Cord (Distributors)
Garrard Engineering
Golding Manufacturing Co.
Goodsell
Grundig (Gt. Britain)

Hi-Fi News
Leak & Co.
Lustraphone
Minnesota Mining & M'g. Co.
M.S.S. Recording Co.
Mullard
Orthotone
Pamphonic Reproducers
Phlips Electrical
Pye Records
Recording Devices
R.G.D.
Simon Sound Service
Steelman Phonograph & Radio
Sugden & Co.
Trix Electrical
Walters (Sales)
Welmecc Corp.
Wharfedale Wireless
Whiteley Electrical

International TV News

BROADCASTING organizations that are members of the European Broadcasting Union send each other regularly news and actuality films, but the news-value of such films is often lost as a result of the delays in transit by air or rail. The possibility of the distribution of these films over the Eurovision network, simultaneously to all the members, has been investigated by a working party. The merit of such a scheme is that it would provide almost instantaneous delivery to all destinations.

To determine the feasibility of the scheme the broadcasting organizations in nine countries recently took part in a month's experimental transmissions. This experiment was directed from the E.B.U.'s International Television Control Centre in Brussels, and the results are being examined.

Technical Writing

THE Radio Industry Council's scheme for awarding premiums to writers of published technical articles is being continued jointly with the Electronic Engineering Association. A joint committee, calling itself the Radio & Electronics Industry Awards Committee, has been formed and the following panel of judges appointed: Prof. H. E. M. Barlow (University College, London), B. C. Brookes (University College), P. D. Canning (Plessey), A. H. Cooper (E.M.I. Electronics), Hon. John Geddes (Elliott Bros.), F. Jeffery (Murphy), E. H. Ullrich (S.T.C.) and Dr. R. C. G. Williams (Philips). The secretary of the committee is A. S. Marshall (E.E.A.).

The scheme, which provides for up to six 25-guinea awards a year, is aimed at encouraging members of the industry and others to write more freely about their work.

Receiver Despatches.—Figures issued by the British Radio Equipment Manufacturers' Association for deliveries of receivers by manufacturers to the home trade, including those to specialist rental and relay companies, were a record for the first seven months of the year. The January-July figure for television receivers was 1.214M. This was 79% above the same period last year. Sound receivers were up by 19% to 782,000, but radio-gramophones were down by 4% to 78,000.

A Decca Navigator climb-out airway for jet turbo-prop aircraft flying from London to the North and Atlantic routes was introduced by the Ministry of Transport and Civil Aviation on September 1st for a trial period of six months. The statement adds that it is the intention of the Ministry to introduce procedure which will take advantage of the high accuracy of the Decca navigational system to expedite westbound jet and turbo-prop aircraft employing reduced separation standards.

Radio Show Attendance.—Of the 310,161 visitors to the ten-day Radio Show at Earls Court, over 4,000 were from overseas. Of more than 100 countries represented, most visitors were from the Union of South Africa—nearly 400. From India there were over 350; Australia, about 275; Pakistan, over 200; New Zealand, about 175; and Ceylon, over 150.

Portsmouth.—Readers in Hampshire may be interested to know that a stereo record concert is being arranged for October 13th in the recently rebuilt Portsmouth Guildhall. It is being organized by Ernest Wyatt, of 10-16 Queens Road, Portsmouth, from whom free tickets are obtainable.



REMOTELY CONTROLLED television camera developed by the B.B.C. Engineering Division is being used experimentally at one of the interviewing studios near Broadcasting House. All its functions—pan, tilt, focus, zoom and iris—are operated by servo-motors controlled from the news studio at Alexandra Palace, about six miles away. The camera is also controllable by the interviewer, who, as seen in this photograph, holds a small push-button control box.

S.E.E.—The Society of Environmental Engineers has been formed to provide a forum, for the exchange of information and views among engineers concerned with the development of equipment to withstand shock, vibration and other forms of environmental conditions. The chairman is V. G. P. Weake, of Pamphonic. A meeting has been arranged for September 23rd at 6 at the Royal Society of Arts, John Adam Street, London, W.C.2, when two papers will be given; "Electrical characteristics of moving-coil vibrations" and "Some electronic measurements of environmental parameters."

I.E.E. membership increased during the past year by 1,328, bringing the total to 44,556. The annual report also records that the Electronics and Communications Section, the largest of the specialized sections, now has a membership of 5,974.

Receiving Licences.—During July the number of combined television and sound licences in the U.K. increased by 54,601, bringing the total to 9,549,789. Sound only licences totalled 5,324,683, including 398,838 for sets fitted in cars.

Vocational Training Scheme.—Radio and television servicing and marine radio operating are among the 43 different courses at the 14 Government Training Centres providing vocational training for disabled people, ex-service personnel and others. During 1958 over 5,000 people were trained under the scheme operated by the Ministry of Labour and National Service.

Ninth College of Advanced Technology.—The Bristol College of Technology will be designated as a College of Advanced Technology from September next year. This will be the ninth College of Advanced Technology set up under the plan announced in the Government's 1956 White Paper for expanding technical education.

C.R.E.I. (London), the European branch of the Capitol Radio Engineering Institute, Inc., of Washington, D.C., has moved from its temporary offices near Victoria to Granville House, 132/135, Sloane Street, S.W.1 (Tel.: Sloane 8277). The European director of the Institute, which provides postal tuition courses, is A. F. R. Cotton.

Special Short Courses (6-12 weeks) covering colour television, electronics in industry, transistors, etc., are being provided at the Norwood Technical College, London, S.E.27. These are in addition to established full-time courses covering the C. & G. certificates in telecommunications. There are also many evening courses.

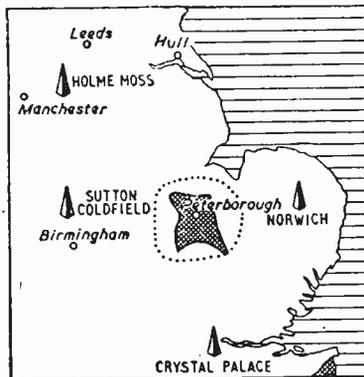
South-East Essex Technical College, Dagenham, is conducting three evening courses in the Department of Physics and Mathematics which are of particular interest. They are, "Theory and Applications of Transistors" (20 lectures on Tuesdays from October 13th); "Microwave Principles and Practice" (20 lectures on Thursdays from October 1st); and "Methods of Non-destructive Testing" (11 lectures on Mondays from October 5th).

Southall Technical College.—A full-time course in electrical engineering and applied electronics is being held in the Department of Electrical Engineering of the Technical College, Beaconsfield Road, Southall, Middlesex. The college is also providing evening courses on digital and analogue computers, transistors, pulse techniques, radio telemetry and servo-mechanisms.

Birmingham.—Part-time day courses (one day a week) in radio and television servicing have been introduced at the Matthew Boulton Technical College, Suffolk Street, Birmingham, 1.

A course covering sound radio and television theory and practice is again being conducted by the Middlesex County Council at the Wesley Evening Institute, Wesley Road, London, N.W.10. Courses will be held on two nights a week from September 21st.

PETERBOROUGH and the surrounding country, which, as shown shaded in this map, is not served by other B.B.C. television stations, will have its own transmitter from October 5th. The new station, six miles south of the city, will operate in channel 5 with a 1-kW e.r.p. using horizontal polarization. The station will also radiate the three sound services on v.h.f.—90.1, 92.3 and 94.5 Mc/s—with an e.r.p. varying from 1 to 22 kW, depending on direction. It uses horizontal polarization.



Solid State Physics.—A series of 10 lectures on solid-state physics is being given by members of the Mullard Research Laboratories at the Enfield Technical College, Queensway, Enfield, Middlesex, on Monday evenings, beginning October 5th (fee £1).

Pulse Techniques.—A course of twenty-two lectures on the fundamental principles of pulse techniques will be given each Monday evening from October 5th at the Borough Polytechnic, London, S.E.1. (Fee £2 10s.) For those students who wish to do practical work laboratory courses have been arranged for Monday afternoons and Thursday evenings (fee £1).

Two-year sandwich course in telecommunications (alternate 6 months in college and industry) is being provided by the South East London Technical College, Lewisham Way, S.E.4. The London fee for the course, which starts on October 5th, is £17 a year.

Transistors.—A course of twenty-one lectures on transistors and allied devices will be given at the Borough Polytechnic, London, S.E.1, on Tuesday afternoons and repeated in the evenings beginning October 13th. The lectures will be devoted to basic principles of design and operation of transistors. There is also a series of 8-week laboratory courses.

Electronic Servicing.—Among the courses listed in the prospectus of the Croydon Technical College is one covering the maintenance of industrial electronic equipment. Each year of the two-year course may be covered by attending on one half-day and one evening a week. There are also day and evening courses in electronics and telecommunications, leading to the City and Guilds Full Technological Certificate.

Advanced Studies.—One-year courses requiring attendance one evening per week for students wishing to sit the graduation examination of the Brit.I.R.E. and supplement their studies in telecommunications and electronics for the C. & G. Full Technological Certificate are among the many courses provided at the Northern Polytechnic, London, N.7.

R. A. E. Evening Courses.—We have been notified of a number of courses being conducted during the present session in preparation for the Radio Amateurs' Examination, including the following:

Ilford Literary Institute, High School for Girls, Cranbrook Road, Ilford, Essex (Mondays and Wednesdays).
Bradford Technical College, Central Hall, Bradford, 5 (Thursdays).

Northwood Evening Institute, Potter Street School, Northwood Hills, Middx (Mondays and Tuesdays).

Brentford Evening Institute, Clifden Road, Brentford, Middx (Tuesdays and Wednesdays).

Wembley Evening Institute, Copland School, High Road, Wembley, Middx (Mondays).

Montem School, Hornsey Road, Holloway, London, N.7 (Mondays, Tuesdays and Wednesdays).

Bognor Regis Technical Institute, Southway, Bognor Regis, Sussex (Mondays and Fridays).

Personalities

Dr. W. R. G. Baker, until recently vice-president of the General Electric Company of America, is to receive the David Sarnoff gold medal of the Society of Motion Picture and Television Engineers for "meritorious achievement in television engineering." Dr. Baker, who since his retirement has been president of the Syracuse University Research Corporation, was chairman of the National Television System Committee which drew up the technical standards of what has become known as the N.T.S.C. colour television system. He is now chairman of the National Television Stereophonic Committee's administrative committee.

Professor H. F. Trewman, M.A.(Cantab.), M.I.E.E., M.Brit.I.R.E., who has been managing director of E.M.I. Institutes, Ltd., and principal of the E.M.I. College of Electronics since their formation in 1945, has retired. As already announced the college has closed and the home study section (E.M.I. Institutes) has been taken over by the Cleaver-Hume Press, Ltd. Professor Trewman was professor of electrical engineering at the Military College of Science for 15 years until 1939 when he joined the Ministry of Supply where from 1943 to 1945 he was assistant director of development and production of electronic equipment.

J. S. Hey, D.Sc., who in 1940 joined the Ministry of Supply as a member of an operational research group dealing with Army radar, and is now at the Royal Radar Establishment, has been promoted to deputy chief scientific officer in the Scientific Civil Service. Since the war he has been carrying out research in radio astronomy for which he received his D.Sc. from Manchester University in 1950.

Appointments in the recently formed Electronic Apparatus Division of Associated Electrical Industries at New Parks, Leicester (one of five new divisions), are announced. **E. Alexander**, A.M.I.E.E., is general manager; **V. M. Roberts**, O.B.E., B.Sc., A.M.I.E.E., commercial manager; **E. T. W. Barnes**, A.M.I.E.E., manufacturing manager; **A. L. Whiteley**, D.Sc., M.I.E.E., chief engineer, and **A. G. Barton**, A.M.I.E.E., divisional executive. Mr. Alexander joined B.T.H. in 1924 and has been manager of the Willesden factory since 1955. Mr. Roberts joined the company in 1924 after graduating in electrical engineering at the University College of North Wales. From 1929 to the outbreak of war he was mainly concerned with the sale of cinema and sound reproducer equipment and during the war with electronic and radar gear. In 1946 he was appointed manager, B.T.H. Electronics Sales Department. He is a director of B.T.H. Sound Equipment, Ltd. Mr. Barnes joined Metrovick as a college apprentice in 1930. In 1953 he became superintendent of the Radio Department, which was subsequently known as the Electronics Department. Dr. Whiteley gained his degree in electrical engineering with first-class honours at the University of Leeds in 1927. In 1932 he was awarded a B.T.H. Fellowship which enabled him to spend a year in the U.S.A. with the G.E. Company, Schenectady. Since 1945 he has been manager of the Electronics Engineering Department. Mr. Barton joined Metrovick as a school apprentice in 1939. From 1943-57 he was in R.E.M.E. with the rank of Captain. On his return to the company he was appointed sales engineer on industrial equipments and since 1958 has been sales manager of the Electronics Department.

R. H. Hacker, M.B.E., and his brother **A. G. Hacker** have resigned the joint managing directorship of Dynatron Radio, Ltd., which they founded as H. Hacker & Sons in 1927. The name was changed in 1936 and in 1955 it became a wholly owned subsidiary of E. K. Cole, Ltd.

Darcy Dane has succeeded **Donald Craig** as London manager of Amalgamated Wireless (Australasia), Ltd. Mr. Dane joined A.W.A. in 1937 and was engaged in the Research Laboratories on the development of piezo-electric quartz crystals. During the war he was engaged on defence development work and in 1948 transferred to the company's aviation department. Since 1950 he has been Melbourne representative of that department. Mr. Craig, who was appointed to London in 1954, has returned to Australia.



Darcy Dane



J. F. Noyes

J. F. Noyes, A.M.I.E.E., has joined the Plessey Company as Group Leader (Radio) in the Domestic Equipment Division. He was previously Chief Radio Engineer of Cossor Radio and Television and, before that, was in charge of radio development at Ultra Electric.

James T. Kendall, M.A.(Cantab.), Ph.D., F.Inst.P., A.M.I.E.E., has been appointed general manager (marketing) of Texas Instruments Ltd., in succession to **K. R. Simmonds** who has resigned. Dr. Kendall joined Texas Instruments on its inception in February, 1957, as general manager (technical) having previously been for three and a half years head of the semiconductor research group of the Plessey Company. Prior to joining Plessey's he was with the A.E.I. group. He is succeeded as general manager (technical) by **John Powell**, M.A., D.Phil., who will be responsible for all research, development, and circuit application work at Bedford. On leaving the R.A.F. in 1945, Dr. Powell spent three years at Queen's College, Oxford, followed by three years post-graduate research in the Clarendon Laboratory. He was then awarded a research fellowship at the National Research Council in Ottawa, Canada, where he investigated the properties of semiconductors, returning to England in 1954 he joined Marconi's Research Laboratories where he stayed until going to Texas Instruments in 1957.

Captain Robert A. Villiers, C.B.E., A.M.I.E.E., R.N.(Ret'd), is the new director of the Scientific Instrument Manufacturers' Association. At one time he commanded the Admiralty's Underwater Countermeasures and Weapons Establishment, the research and development centre at Havant.

M. Carpenter, B.Sc.(Tech.), has been appointed overseas technical representative of Siemens Edison Swan's radio division. He will be concerned mainly with the sales of the company's cathode-ray tubes, valves, semiconductors and other components for industrial and domestic equipment in Western Europe.

T. Snowball, author of the article on the design of a transistor amplifier, has been at the Royal Radar Establishment, Malvern, since coming out of the R.A.F. in 1956. Before joining the Air Force in 1954 he took the Higher National Certificate course in electronics at the Ministry of Supply College of Electronics, Malvern.

H. W. Davis, who joined Waymouth Gauges and Instruments, of Godalming, Surrey, as chief inspector ten years ago and was appointed chief project officer at the beginning of last year, has now become chief technical executive. He was for some time at the Naval Signal School, Portsmouth, before being transferred to the Aeronautical Inspection Department, Ministry of Supply, where he remained until 1945. Waymouth Gauges also announce the appointment of **I. B. Johnson**, B.Sc.(Eng.), as chief designer. After graduating at University College, Southampton, in 1949, he was employed first in the magnetic recording department of E.M.I. Engineering Development and later with the Plessey Group as an electronic development engineer. He joined Waymouth Gauges in 1951.

C. A. Rennie, M.A., head of the high-temperature reactor division of the Atomic Energy Research Establishment, Harwell, has been appointed chief executive of the International High Temperature Reactor Project ("Dragon"). The reactor is to be built at the Atomic Energy Establishment, Winfrith, Dorset. Mr. Rennie, who is 43, graduated at Cambridge and joined the Ministry of Supply in 1940 as a radar officer. A year later he went to the Telecommunications Research Establishment at Swanage, as a scientific officer. He has been at A.E.R.E. since 1946.

Dr. Harry F. Olson, director of the acoustical and electro-mechanical laboratory of the RCA Laboratories, Princeton, N.J., has been elected a member of the American National Academy of Sciences. Dr. Olson, who has received many tributes for his contributions to the field of audio engineering, has been with RCA since 1928 and was also a lecturer at Columbia University from 1939 to 1943.

F. Livingston Hogg, founder and director of Livingston Laboratories, has been awarded the fellowship of the Television Society. He was a personal assistant to J. L. Baird in 1928. In 1935 he joined the radio division of Standard Telephones & Cables and formed the instrument group. Soon after the war he founded his own company.

J. H. Leck, M.Eng., Ph.D., A.M.I.E.E., A.Inst.P., who qualified at the University of Liverpool as a Bachelor of Engineering with first-class honours in electrical engineering (heavy current) in 1945 and returned to the college in 1950 as an assistant lecturer in the Department of Electrical Engineering, becomes senior lecturer in the University's Department of Electronic Engineering on October 1st. From 1946 to 1949 he was in the research department of Metropolitan-Vickers, Manchester. Dr. Leck is 33.

L. A. Woodhead, managing director of Cossor Instruments Ltd., has been elected president of the Scientific Instrument Manufacturers' Association.

OBITUARY

Noël Meyer Rust, who retired from Marconi's in 1955 after 42 years' service with the company, died on August 21st in his 68th year. On joining Marconi's he was appointed to the Clifden transatlantic station and during World War I was seconded to the R.N.V.R. for interception work. In the late 1920s he became largely responsible for the development of the Stille steel-tape magnetic recording system used by the B.B.C. for many years. During World War II he did much valuable work on the design of microwave aerials and made what was probably the first of the so-called "egg-box" type of radio lens. Later he was leader of a section which carried out much vital research into the problems associated with f.m. continuous-wave and Doppler radar. It will be recalled that he contributed two articles to *Wireless World* last year on the Doppler effect in radio and radar. Amongst many other important items of research carried out during his long and distinguished career was his early work on electro-mechanical filters and a study of the problems inherent in long-range radio navigational aids.

L. Bentley Jones, sales director of Radio & Allied Industries, Ltd., the manufacturers of Sobell receivers, died on August 22nd at the age of 53. Before joining the Sobell organization in 1955 he had been with Ekco and Ferguson.

News from the Industry

Marconi's have installed thirty transmitters, ranging in output power from 3.5 to 40kW, together with forty-nine drive units, a coaxial line exchange, an open wire automatic aerial exchange and a considerable amount of ancillary equipment, at the new Admiralty W/T station at Inskip, near Preston, Lancs.

International Aeradio Ltd. have designed and produced equipment for the control and monitoring of a number of Commonwealth Air Force telecommunications circuits at the signals centre at Gan Island, in the Maldives. The equipment has been produced under the technical direction of Headquarters Signals Command, Royal Air Force.

Armstrong Whitworth Equipment is the title of the new division of Sir W. G. Armstrong Whitworth Aircraft Ltd., formed when they took over the Technical Developments Division of Gloster Aircraft Company (see p. 319 July/August issue). A.W.E. will manufacture and market advanced electronic equipment, and a variety of hydraulic and fuel system equipment.

Emidec Type 1100, all-transistor computers have recently been ordered by a number of organizations in this country, including the Air Ministry, the Ministry of Labour and National Service, British European Airways, Barclays Bank, Sainsburys and Kodak. E.M.I.'s larger data processing system Emidec 2400 has been ordered for the Royal Army Ordnance Corps.

Associated Television, Ltd., programme contractors for the I.T.A. London station at week-ends and the Midland station on weekdays, reports a group profit of £2,601,417 for the year ended last April. During the year under review ATV acquired the commercial sound radio and television interests of the *Daily Mirror* group in Australia; 50% of the issued share capital of Pye Records Ltd.; and the whole of the issued share capital of Incorporated Television Programme Company, which has since dropped the word "programme" from its title.

Metal Industries Ltd., who recently acquired Avo and its subsidiary Taylor Electrical Instruments, and also owns Brookhirst-Igranic Ltd., announces a profit of £1.5M before taxation for the year ended last March. This was £250,000 below the previous year's record figure for the group.

Simms Motor and Electronics Corporation, of which group N.S.F. is a member, had a net profit before taxation of £632,072 last year compared with £927,861 the year before.

E.M.I. Electronics have developed a new machine tool control system designed to meet the needs of the small batch producer, giving improved production efficiency for a small capital outlay. It employs the basic principles of the other EMICON electronic positioning control systems.

Xeronic Printer.—Ferranti have ordered the first Rank Xeronic printer, the 3,000-line-a-minute output printer for use with electronic computers, which was described in our January 1959 issue.

Pye, Ltd., report a total consolidated profit for the year ended last March of £945,128, after deducting £984,466 for taxation.

Thorn Electrical Industries, Ltd., announce a group profit of £1,906,000—an increase of £448,000 on the previous year. Taxation absorbed £927,000 of this total.

Solartron France, S.A., with offices in Versailles, is the fifth continental company to be formed by the Solartron Electronic Group. Others are in Munich, Milan, The Hague and Stockholm.

Ekco Electronics, Ltd., announce the formation of a new company in Italy (to be known as Ekco Nucleare Italiana, s.r.l.) in association with Ing. Silvio Garrone, s.r.l. The head office is at Via Dei Malvezzi, Rome.

Zenith radio receivers made by the Zenith Corporation, of Chicago, are now being distributed in this country by United Mercantile Co. Ltd., of Park Lodge, Park Close, London, S.W.1. The sales manager is D. C. Spink, who was for many years with G.E.C., and subsequently Philco and Pilot.

Electronic Limited, of 46/47 Frith Street, London, W.1, are to market in this country the products of Herold Radio and Electronic Corporation, of New York. The products include "Steelman" and "Roland" domestic radio, gramophone and tape-recording equipment.

Marconi vision (4-kW) and sound (1-kW) transmitters in duplicate are to be installed in the proposed two new I.T.A. stations in the Aberdeen and Inverness areas of Scotland. Marconi's are also supplying for each station the control room input and monitoring equipment, flying spot caption scanners and internal feeder and aerial switching gear.

E.M.I. Recording Materials Division is now producing Emitape for video recording.

Thorn House, Upper St. Martin's Lane, London, W.C.2, the new headquarters of Thorn Electrical Industries, was officially opened on September 7th. In addition to office accommodation, the 180-ft building includes extensive showrooms, one section of which is devoted to the products of the subsidiary, Ferguson Radio Corp.

Wirepots, Ltd., of Rainham, Essex, has been acquired by General Controls Co., of Glendale, California. The title has been changed to General Controls, Ltd., and a new factory taken over at 13/15, Bowlers Croft, Honeywood Road, Basildon, Essex (Tel.: Basildon 20415), to which all communications should now be addressed.

Amplivox, Ltd., have moved from 2 Bentinck Street, London, W.1, to their new offices and factory at Beresford Avenue, Wembley, Middx. (Tel.: Wembley 8991.)

Light Soldering Developments, Ltd., manufacturers of the Litesold soldering iron, have moved to 28 Sydenham Road, Croydon, Surrey. The telephone number is unchanged—Croydon 8589.

Haddon Transformers, Ltd., of Masons Avenue, Wealdstone, have transferred their head office, design departments and main production line to a new factory at Victoria Park Industrial Estate, Field End Road, Ruislip, Middx. (Tel.: Byron 9444). The Wealdstone works are being retained.

A.N.T.E.X. (Anglo-Netherland Technical Exchange, Ltd.), who market the Precision miniature soldering iron, have moved from Tower Hill to 7/8 Idol Lane, London, E.C.3 (Tel.: Mansion House 2716).

Decca Radar, Ltd., have purchased the lease of Cowes Airport, Isle of Wight, and will be establishing a manufacturing unit there in the near future.

EXPORTS

Television transmitting and studio equipment for two stations has been ordered from Marconi's by the Western Nigerian Government. The stations will be at Ibadan, the regional headquarters, and at Abafon to cover the towns of Lagos, Abeokuta and Ijebu Ode. They will have an e.r.p. of 1.5 and 15 kW, respectively. The programme link between the two stations will be provided by the existing v.h.f. radio-communications system, also installed by Marconi's. The operation and maintenance of the stations will be carried out by Marconi's for a year while Nigerians are being trained.

"**Lambda,**" the latest version of the Decca "Two-Range" radio surveying system developed from the Navigator, is to be used by the Royal Australian Navy. The master station of the system, which is designed for fixing the position of a vessel during oceanographic surveys, is on the ship itself and two portable slave transmitters are set up on shore.

Airfield Radar.—The Indian Civil Aviation Authorities are installing the Decca 424 airfield control radar at Madras airport. This 3-cm approach and landing aid, which has been in use at Dum Dum Airport, Calcutta, for the past two years, incorporates variable polarization to suppress rain echos.

Television Station.—A £250,000 order for the complete transmitting and studio equipment for a new television station being built at Recife, Pernambuco, has been placed with Marconi's through their Brazilian agents, Murray Simonsen S.A. The transmitter, which will operate in Band I, will feed into a six-stack quadrant aerial giving a vision e.r.p. of 110kW.

Microwave telephone link between Galway and Athlone, Eire, with a repeater station at Cappataggle, is to be supplied by Standard Telephones and Cables. The equipment, operating around 7,400 Mc/s, can handle 240 telephone circuits on each of two both-way radio-frequency channels.

Television cameras and ancillary equipment made by Marconi's and camera tubes made by English Electric, are now being handled in the United States by the Ampex Corporation, of Redwood City, California, who have been appointed sole distributors.

A mobile demonstration unit, including a 25-ft trailer fitted out as a workshop equipped with an E.M.I. electronic machine tool control system, is touring the Continent. The unit also carries industrial closed-circuit television equipment. Its first stop was in Paris for the Machine Tool Exhibition.

I.L.S. equipment, air-to-ground communication gear and mobile radiotelephones for airfield vehicles has been ordered from Pye Telecommunications for three airports in Yugoslavia.

Radar Simulator.—Equipment providing a six-target radar simulator for the training of radar operators and controllers, has been ordered by the Royal Norwegian Navy from Solartron Radar Simulators, Ltd., a member of the Solartron Group.

Doppler Navigator.—Marconi's have received a substantial order for Doppler equipment and navigation computers for the new French supersonic bomber—the Mirage IV.

Marine Radio.—Transmitters, receivers, direction finders and echometers, worth over £100,000, are to be supplied by Marconi Marine for 24 ships for Indonesia which are being built in Polish shipyards.

Nucleonic equipment worth some £17,000 has been ordered from Ekco Electronics, Ltd., for installation in China.

triode is cut off. When the potential at the cathode approaches that of the grid, the triode starts to conduct. The resulting current flowing through the triode anode resistor produces a negative pulse which is passed on to the pentode control grid by the capacitor C_2 . This causes the pentode to cut off, and its screen-grid potential to rise. This positive-going voltage is coupled to the triode grid, which therefore becomes positive to its cathode. This makes the triode conduct heavily so that it discharges the capacitor C_1 . As the capacitor discharges, the anode-to-cathode voltage of the triode falls. The consequent reduction of anode current eventually becomes sufficient to cause the voltage across the anode resistor to be too small to hold the pentode cut off. Once conduction restarts in the pentode, the screen-grid current causes a reduction of screen-grid voltage. The grid of the triode is therefore taken negative to its cathode and the cycle is repeated.

The presence of a cathode resistor in the pentode

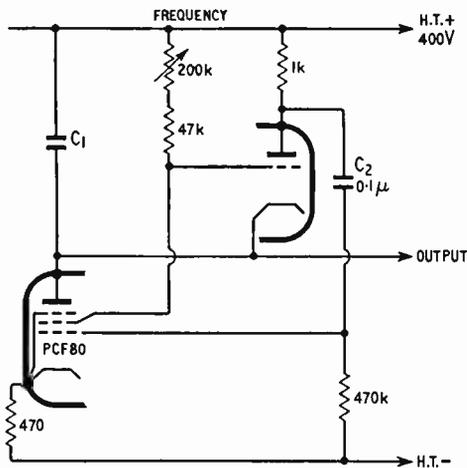


Fig. 2. Simplified version of Keen's timebase.

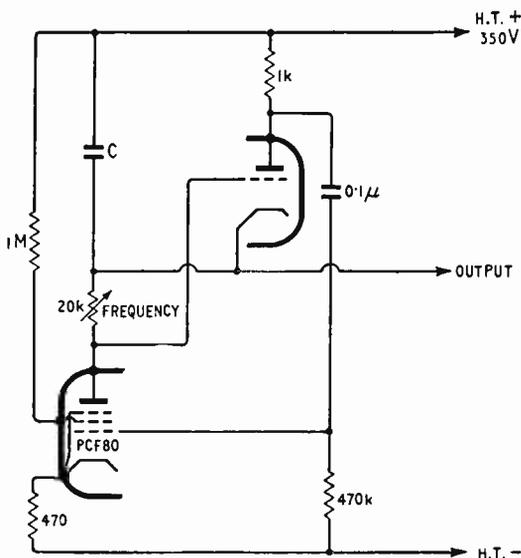


Fig. 3. Alternative method of coupling to triode.

circuit not only provides bias, but it also produces negative (current) feedback to further linearize the waveform at the anode. This method of linearization is inferior to that using Miller effect because the output impedance is higher. This is not of great importance where the output is to be applied directly to a deflection plate of a cathode-ray tube. The initial step obtained with Miller-type timebases is avoided.

Positive synchronizing pulses can be fed on to the screen grid of the pentode, or negative pulses on to the control grid. If flyback suppression of the beam of the cathode-ray tube is desired, a suitable negative pulse is available at the anode of the triode. Where a range of repetition frequencies must be covered, different values of the capacitor C_1 can be switched into circuit and the pentode-screen-grid variable resistor used for fine frequency control. However, the output amplitude varies as the screen resistor is changed, over a range of 150 to 230V with a 400-V supply. Operation is possible at frequencies up to about 100kc/s, the scan-flyback ratio being about four at such frequencies.

The negative voltage required to cut off the triode during the run down of the pentode need not be derived from the screen grid. It can be derived from the anode current of the pentode³ as shown in Fig. 3. The added anode resistor has no effect on the charging of the capacitor, as it is in series with the relatively high anode impedance of the pentode. When the pentode bottoms and the current falls, the voltage across the pentode anode resistor disappears and the triode conducts and discharges the capacitor. The pulse at the anode of the triode is coupled back to the grid of the pentode as before. This circuit is a version of Fruhauf's multivibrator³, but it uses a constant current pentode to replace one of the triodes. While the capacitor C is charging, the grid-to-cathode voltage of the triode is determined by the value of the pentode anode resistor. This grid voltage determines the triode anode voltage, and hence the capacitor voltage reached before flyback is initiated. The value of this resistor therefore controls the amplitude and, as the charging rate of the condenser

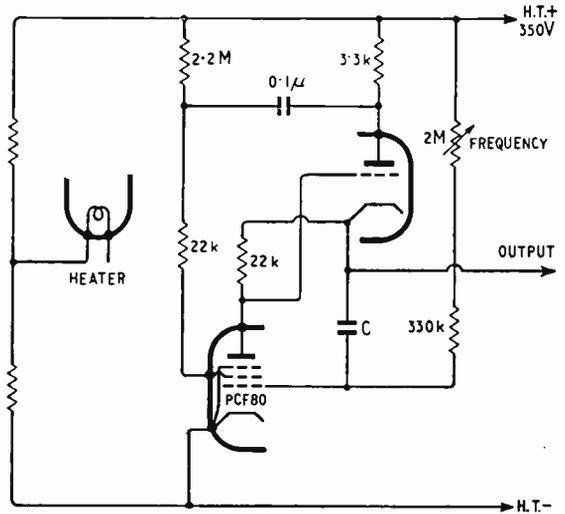


Fig. 4. Preferred triode-pentode timebase.

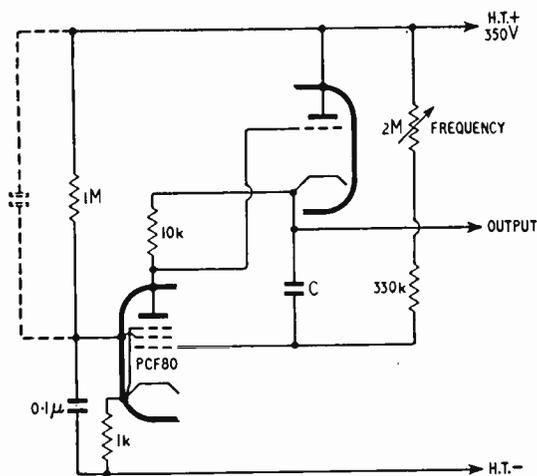


Fig. 5. Cathode coupling to pentode screen grid.

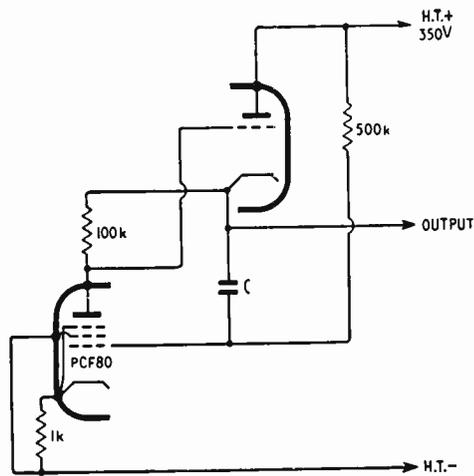


Fig. 6. Simplified cathode-coupled circuit using PCF80.

is constant, the frequency of the waveform. Alternatively, the screen or the cathode resistor can be varied to adjust the charging rate. Synchronizing pulses can be fed on to the pentode screen grid and pulses for flyback suppression can be obtained from the triode anode, as in the previous circuit.

The pulses at the triode anode in Fig. 3 are large and the screen grid of the pentode is free, so the possibility occurs of feeding back to the screen grid, instead of to the control grid of the pentode. If this is done, the control grid is no longer used in the multivibrator action, so it is possible to operate the pentode as a Miller integrator rather than as a simple constant-current device. The resulting arrangement is shown in Fig. 4. Assuming the capacitor C to be charged initially, it discharges through the pentode and its grid and anode resistors. The voltage produced across the pentode-anode resistor holds the triode cut-off and the pentode-anode current is supplied from the capacitor: the pentode then performs a normal Miller rundown. When the pentode bottoms, the anode current falls and the triode conducts, so recharging the capacitor with pentode control-grid current. The negative pulse from the triode anode is coupled back to the pentode screen grid, which holds the pentode cut off during the flyback. When the capacitor is fully charged and the triode anode current falls, the screen voltage rises and current flows again to the pentode anode. The triode is then cut off and the Miller rundown starts again. The cycle is then repeated.

Because the capacitor is charged by the control grid current and through the cathode circuit of the pentode, a positive pulse would be produced during the flyback across any resistor added in series with the cathode. It is therefore possible to cathode-couple to the screen as shown in Fig. 5. The screen can be decoupled either to the negative or to the positive supply line, as shown dotted. However, with this arrangement the cathode resistor causes a large initial step in the output waveform. If the utmost simplicity is required, the circuit of Fig. 6 can be used. Here the screen is earthed and coupling is via the pentode cathode. This circuit works with the PCF80 valve, though the output amplitude is rather low. The exact mode of operation of this circuit seems to be rather obscure; therefore it is

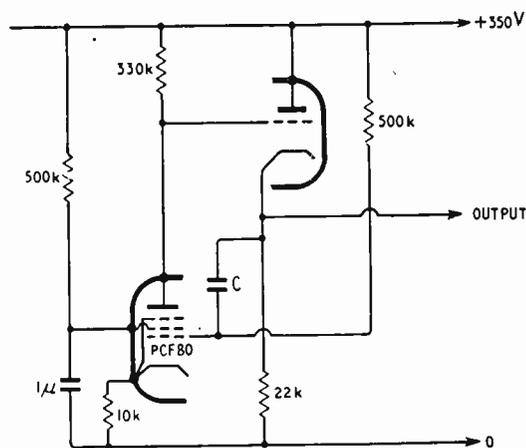


Fig. 7. Circuit using cathode follower and cathode-coupled screen-grid switching.

offered as a basis for experiment, rather than as a complete timebase. A further circuit using cathode coupling is given in Fig. 7. This uses a cathode-follower triode as described by Attree¹ together with the cathode-to-screen grid coupling which is mentioned above.

The most satisfactory of these timebases is that of Fig. 4. As a large-amplitude sweep is obtained with this circuit and no cathode resistor need be used with the pentode, the initial step at the start of the rundown is negligible. The screen-grid stopper resistor is necessary in order to avoid the onset of low-amplitude high-frequency oscillation when large values of pentode control-grid resistor are inserted. In the absence of the screen-grid stopper, the high-frequency oscillation can cause a small flat portion to appear at the bottom of the output waveform.

Unlike most Miller timebases, the one shown in Fig. 4 has no other anode load than the capacitor and the resistors in series with it, so that the effective gain during the rundown is very high. Consequently the linearity of the waveform is excellent. A peak-to-peak amplitude of 250V is obtainable with a h.t. supply voltage of 350. This is quite sufficient

for full-screen deflection of a normal double-beam cathode-ray tube working with a final anode potential of 2000V, which ensures adequate brightness of the trace. Satisfactory operation has been obtained with a timebase h.t. supply at 500V. This gives a larger output amplitude; but its use is not recommended as the anode voltage rating of the valve is exceeded. In order to avoid exceeding the heater-to-cathode voltage rating of the valve, the heater preferably should be "tied" some 50 to 100V positive with reference to the negative supply line, as shown.

Operation of the timebase is possible at frequencies up to about 100kc/s with reasonable scan-to-flyback ratios. As with most timebases, operation at higher frequencies can be obtained by reducing the circuit impedances and stray capacitances; but only at the expense of output amplitude. The amplitude of the pulse available at the triode anode for flyback suppression is greater than 50V and it has an initial peak value of 150V. The screen grid of the pentode is the most suitable place for the application of negative synchronizing pulses, and these should preferably be injected through a diode in order to avoid interference with the circuit operation.

The frequency control shown in Fig. 4 covers a frequency range of greater than five-to-one, so that if several ranges are required the successive values of the switched scan-determining capacitors should be in this ratio: there will then be an overlap between the ranges. If the frequency-control resistor is made too large, the starting of the timebase becomes unreliable. If it is made too small, the output amplitude increases and the rundown becomes non-linear. As an alternative to the method of fre-

quency control shown, the fixed 330-k Ω resistor can be taken to a potentiometer across the supply.

None of the resistors in the circuit is suitable for use as an amplitude control. The simplest method of amplitude control is by variation of the supply voltage; because the timebase will operate with h.t. voltages down to less than 100. A convenient method is the addition of a 100-k Ω variable resistor in series with the supply. If this is done, it is necessary to add a decoupling capacitor at the junction of the resistor and the timebase circuit if the flyback time is to be maintained short; because the timebase capacitor is charged by the triode from the power supply. The series resistor provides an amplitude variation of about two-to-one. The supply current is 2.6mA with a 350-V h.t. supply, and this changes to 0.6mA with 100V and to 3.8mA with 500V. With a 100-k Ω series amplitude control at the minimum amplitude position, the current drawn from a 350-V h.t. supply is 1.4mA.

Although the PCF80 valve was used in the course of these experiments, it may be more convenient to use the ECF80, which is identical except for the heater rating. The PCF80 has a 0.3-A heater designed for series-heater operation, developing a nominal 9V. The ECF80 has a 6.3-V heater, for parallel connection, rated at 0.43A.

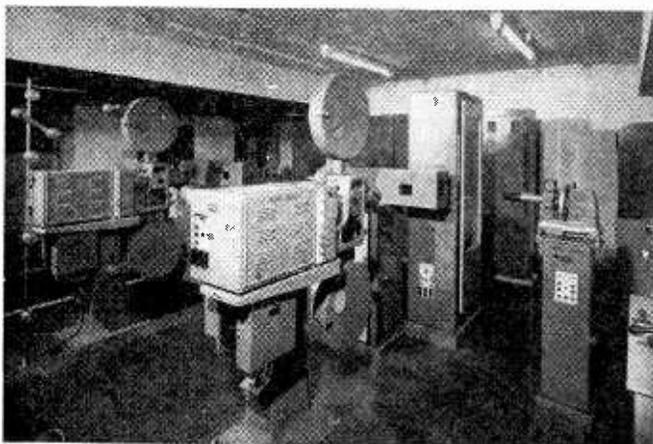
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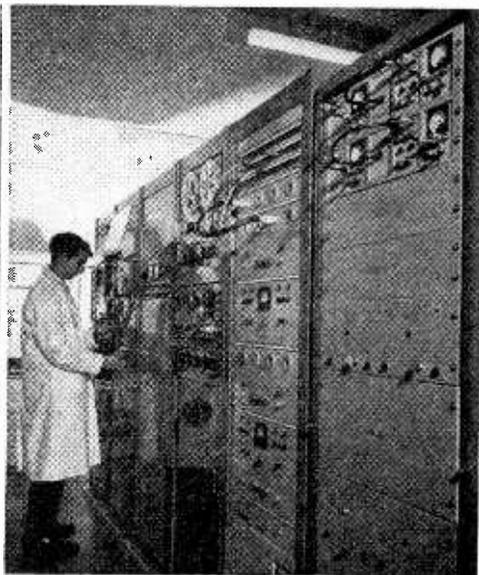
Closed-Circuit Television System

TO enable their clients to see commercial television advertisement material under conditions equivalent to those in the home, the J. Walter Thompson Company have installed at their London premises a comprehensive closed-circuit television and teleciné system. Dis-

tribution is at r.f. in coaxial cable so that normal receivers can be used at the many outlets, selection of programme being made by the channel switch. There is, in addition to film and slide facilities, a complete "live" studio for auditions and experimental work.



Photographs show part of closed-circuit television system, for which contractors were Pye Ltd.: (above) Staticon photo-conductive camera and 16- and 35mm-film and still-slide projectors; (right) distribution amplifiers.



THE GREAT STEREOPHONY FAKE

By "CATHODE RAY"

IN the days when only the outbreak of a World War could stretch newspaper headlines across more than one column—and then only in mild terms—Horatio Bottomley kept his weekly paper going by an unbroken succession of (by the standards of his day) sensational headlines such as the sample above. If it wasn't a fake it was a hoax or a fraud or a swindle. Whether what one learnt on buying the paper justified the titles I never found out, because (having inherited a canny Aberdonian outlook) I suspected it didn't. Come to think of it, my headline is really unnecessary, it being well known that of all *Wireless World* readers the audio section are the most fanatical, and to them the word "stereo" is the most emotive, so that if merely printed by itself in very small type it would compel all of them at least to begin to read, before disagreeing. Come to think of it again, my headline is probably unwise, too. Horatio Bottomley ended up in jail.

But I was driven to it by attending the I.E.E. Convention on Stereophony, my outstanding conclusion from which was that any connection between the admitted benefits of stereophony and the techniques currently employed therein was largely coincidental. In so far as these techniques—the two channels, spaced loudspeakers, etc.—seem to the superficial observer to imply a fairly exact science, the word "fake" is perhaps not too far-fetched. However (though I wouldn't accept a brief for the salesman-demonstrator) I don't want to suggest that the designers of such equipment are men of guile. It is from them, chiefly, that one learns how empirical the whole thing is.

To begin with, in spite of the vast amount of research that has been carried out on hearing, that sense is still very far from being completely understood. Accustomed though we now are to the fabulous exploits of electronic computers, the continuous almost instantaneous analysis of data in the form of minute fluctuations in air pressure at each side of the head, and their presentation in terms that can control the actions of the most clueless clot as well as ravish the soul of the most cultured musician, makes the said computers look pretty clumsy.

Brain Judges Directions

One aspect of this complicated business of hearing is the ability to locate sources of sound. After a lot of argument, it seems now to be generally agreed that the time difference of arrival of sound at the two ears is the main basis for aural direction-finding. But it is also agreed that three or four other things come into it, and that the brain (without any course of scientific training) makes the best use of all the available data, and in favourable circumstances can judge directions correctly to within about one degree. If the source is exactly straight in front or behind, the sound reaches both ears simultaneously. Now if you calculate the time difference when the source is shifted one degree, assuming your ears are 8 in apart and that sound travels at 1,100 ft/sec, you will find it

is about 0.00001 sec, or 10 microseconds. In some way or other, it seems, we can detect such minute time differences and interpret them as angular differences.

But, of course, only the very naive think of stereophonic reproduction chiefly as a means of locating and following sources of sound—trains going through stations, or even Wagnerian villains moving in on helpless heroines. Much more important is the restoring of what is lost in "hole-in-the-wall" monodic* reproduction—the quality rather vaguely described as spatial effect.

Before considering it, one might think that in direct listening this effect was due mainly to being able to locate the source or sources of sound. So much so that many months ago a correspondent† asserted that such items as piano music and songs had nothing to gain from stereophonic reproduction, nor even orchestral music, the ideal for which was a perfect blending of the separate sounds into a single unified sound. If a singer was standing or a speaker sitting in a perfectly anechoic (acoustically "dead") studio, and was being reproduced monodically in a listening room of suitable acoustical characteristics, then certainly it would be difficult to see how stereophony could help. But anyone with normal hearing and appreciation who has had the opportunity to compare the two kinds of reproduction of an orchestra could hardly fail to be struck by the improvement with stereophony.

Sensational Evidence

The nature of this improvement is difficult to describe, and the attempts of salesmen to describe it in terms favourable to their commission accounts may only have tended to prejudice it adversely in the minds of you discriminating and unguillible readers. But that such a (if he will forgive me) hard-headed north-countryman as James Moir waxed as enthusiastic as he did in the issue of November 1956 may well have shaken even the most sceptical. In particular, he gave one factual piece of information beside which all the eulogies of all the world's advertising copywriters pale into insignificance—that three ladies sat for more than an hour listening to opera in Italian and music by Prokofiev and Sibelius without saying a single word to each other except in the intervals. I—and I can hardly imagine any dissident—can reinforce his testimony that in a very long experience this has never been known to happen before. The information that these ladies did speak to one another in the intervals, is of course, of vital significance; without it one would naturally assume that Mr. Moir was charitably entertaining a group of dumb patients.

The nature of this improvement, as I said, is difficult to describe, and without some investigation

* Being numbered among those who dislike "monaural" and "monophonic." I'm provisionally following the Editor's recommendation (June issue).

† B. Wallace, December 1958. p. 599.

might perhaps not be expressible more definitely than by saying that stereophonic reproduction is easier to listen to. One can have the music at somewhere near full natural sound intensity without feeling—as I invariably do during monodic demonstrations—that it is uncomfortably loud. There is a sense of “space” which one does not get merely by having several paralleled speakers about the room, and the instruments “stand out” more clearly. This last, by the way, is not bound up so directly as one might think with aural direction-finding. Listening to such reproduction, I for one am not particularly conscious of this instrument being situated on the left, and that one in the middle; in fact even when I try I often find it difficult to locate them and tend to fall back on knowledge of the customary placing of such instruments in an orchestra.

Nobody, I imagine, would expect two-channel stereophonic reproduction by loudspeaker to be theoretically perfect, even though theory does lead one to expect (and listening confirms) that the apparent direction of a sound can be reproduced with fair accuracy anywhere within the angle subtended by the two speakers—and perhaps even a little beyond. But anyone who hasn't studied the thing and has only a vague idea that the two channels are supposed to correspond with our two ears, and may even have heard that the microphones are sometimes placed at each side of a dummy head, may feel no great surprise that stereophonic reproduction seems—and probably is—a much closer approximation to the real thing than monodic. If any readers are in that state, my purpose is to try to awaken or increase their surprise.

Before discussing the usual loudspeaker method, for the sake of comparison let us look at the headphone method. Fig. 1 shows the minimum requirements; the microphones and earphones could, of course, be linked by broadcasting channels. Given

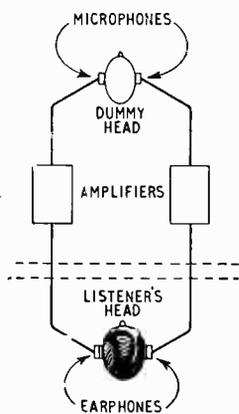


Fig. 1. A true binaural sound transmission system (provided the dummy moves his head in synchronism with the listener)

perfect apparatus, this system should give perfect binaural hearing—with one important exception, often forgotten. A listener coming from different directions, especially if their sources are moving, is not content to keep his head rigidly fixed in one position. He moves it; perhaps only slightly, but we have already calculated that one degree (corresponding to one-seventh of an inch path difference) is significant. Head movement is necessary for direction-finding, and especially for

resolving the ambiguity when the source is exactly ahead or astern. If this listener moves his head, his purpose is frustrated unless the dummy moves its head in exactly the same way. Such a refinement, presumably by means of selsyns attached to the two heads and interconnected, would add considerably to the cost and inconvenience. Without it, whenever the listener moves his head the whole of the room in which the dummy is located appears to move with it—a rather disconcerting effect. However, one feature that should particularly be noted is that this kind of stereophony is effective over the full azimuth of 360°.

Suppose next that this system remains the same

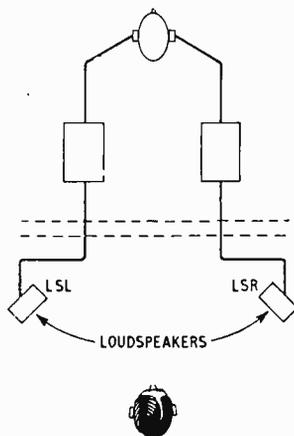


Fig. 2. The same as Fig. 1 at the pick-up end, but earphones replaced by loudspeakers at the receiving end. This entirely alters the listening conditions.

at the microphone end, the dummy being placed in the most desirable seat for the particular kind of performance, and for convenience the earphones are replaced by loudspeakers. Where should they be placed?

This moment might, with more justification than in some television programmes, be deemed to be a natural break; not for being switched abruptly from deep tragedy to frivolous sales promotion for alternatively a “cuppa,” but for deep thought. Remember that the main object of using loudspeakers is to enable more than one person to listen. So it's not much use suggesting putting them equidistantly on each side of the listener's head. Even if they were so placed, the fundamental difficulty about loudspeakers would remain—each would be heard by both ears. So the scientific each-ear-its-own-channel basis of Fig. 1 goes by the board. Such a fundamental failing would, of course, lead the theorist to abandon the project forthwith, leaving the field clear for those who do what all well-informed persons know is impossible.

Let us then see how loudspeakers one on each side could be expected to work, still with the microphones on the dummy head, and assuming at first that all listeners are compelled to sit (or stand, if they prefer) at equal distances from the speakers (Fig. 2). A sound coming from straight ahead of the dummy would affect both microphones simultaneously and equally, and (assuming exactly similar channels throughout and loudspeakers connected in phase) the speakers would reproduce in unison, as if they were connected in parallel. The sound from LSL reaches the listener's left ear just as the same sound from LSR reaches his right ear. If both speakers are inclined at 45° with reference to the

listener, the same sounds reach his opposite ears 430 microseconds or 0.43 millisecond later.

These conditions can be represented as in Fig. 3, where sound from LSL is represented by a dotted line and sound from LSR by a full line; not that the "programme" consists necessarily of a single sharp pulse, but the line marks any one phase of a sound. The higher its frequency, the more the sound reaching the farther ear is screened by the listener's head, but at fairly low frequencies this effect can be neglected, as I have done here so as not to confuse the issue by introducing one of the subsidiary influences in aural sound location.

If the source of sound had been straight ahead of the listener, reproducing the circumstances of the dummy, Fig. 3 would have had only one simultaneous pair of verticals.

What impression would we expect this arrival of the same sound from widely differing directions to make? Since the sounds represented in Fig. 3 by dotted and full lines are identical, the first impact should be the same as if it were being received from one speaker at the same distance as the two, but straight ahead. The second impact could be due to a second speaker also straight ahead but $8/\sqrt{2}=5\frac{1}{2}$ in beyond it. So one would expect the apparent source to be straight ahead. And if you try it you will find it to be so. Thus far, then, the system is doing its job.

But you may be a trifle worried by the thought that as little as one seventh of an inch inequality in the listener's distances from the two speakers results in a time difference sufficient to be interpreted as an angular deviation from the centre of about 1°. I don't know what the experts say, but I certainly can't judge the apparent source to within 1°; however, a shift of the order of 10° is perceptible on moving the head a very short distance sideways, possibly as little as is sufficient to cause 1.4 (ten sevenths) in difference. In these circumstances Fig. 3 gives place to Fig. 4. Here, the first impacts on the ears correspond to what one would get from a single source 10° to the left. But the second impacts mimic a source 10° to the right! Apparently, however, only the first impacts are significant.

Further sideways movement shifts the apparent source, as one would expect, to the nearer speaker. But, contrary to what one might expect, it remains there no matter how much nearer one is to it than to the other. In the October, 1957, issue (p. 479) Mr. Moir explained this as an example of the Haas effect, which is the name given to the fact that when the same sounds reach a listener from more than one direction with a time difference of more

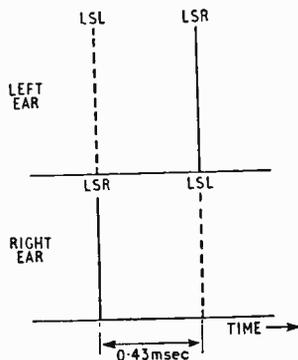
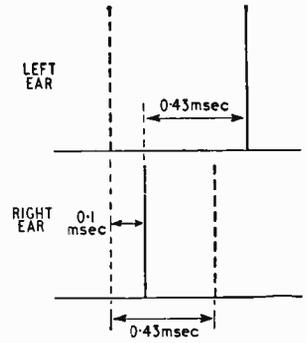


Fig. 3. In this and the following diagrams the amplitude of sound reaching the two ears from the left-hand loudspeaker is represented by the height of the dotted lines; that from the right-hand speaker by full lines. The relative times of arrival are indicated by horizontal spacing. This diagram refers to Fig. 2, with a sound coming from straight in front of the dummy.

Fig. 4. Here, the sound is coming from a source 10° to the left of straight ahead of the dummy.



than about 1 millisecond they appear to come from the source that delivers the sound first.

Next, suppose the listener is put back on dead centre, and the source of original sound is moved say 10° over to the left of the dummy. This causes the left-hand microphone to "hear" 0.1 millisecond before the other, and consequently LSL to speak that much ahead of LSR, and (owing to the exact equality of distances) the listener is affected as shown in Fig. 4. The result should be the same; namely, as if the source was inclined 10° to the left.

Up to a point, then, this system seems to be stereophonic; but it suffers from the serious snag that there must not be more than a fraction of an inch difference between the distances from the listener to the two loudspeakers, or the sound will appear to come from one or other of them. (In this respect, I regret to say, it resembles too many of the allegedly stereophonic demonstrations I have

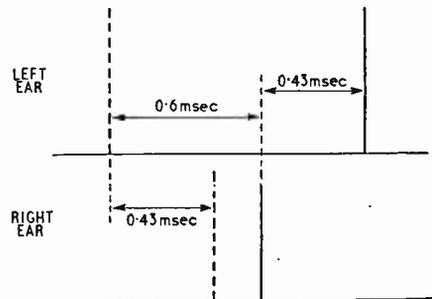


Fig. 5. The angle of sound direction to the left is here increased to 90°; straight into the dummy's left "ear."

attended.) Note, incidentally, that if the sound came from a point full left of the dummy (90° leftward displacement from straight ahead) the diagram would be as in Fig. 5, since the sound from LSR would be delayed 8 in, equivalent to 0.6 millisecond. This indicates a maximum displacement (with this loudspeaker placing) of 45°.

So the dummy head scheme is, in either one sense or the other, phoney. The scheme usually adopted at the present time replaces time differences by amplitude differences. Both microphones are as nearly as possible in the same spot, but they are directional, so that the more the sound source is to the left the greater the amplitude ratio between left and right channels. The loudspeakers are (or should be) directional too, in order to compensate for time differences when the listener is nearer one than the other. To anyone who knows

Fig. 6. Here again the sound is coming from left of straight ahead, but the microphones are placed together and are directional so that one receives more strongly from sounds to the left and the other from sounds to the right.

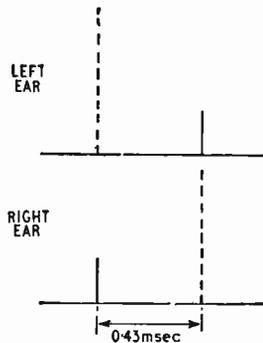
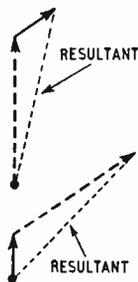


Fig. 7. This vector diagram shows more clearly than Fig. 6 that differences in amplitude of sounds coming from different directions with phase displacements affect their resultant phase. In this example the sound would apparently reach the left ear in advance of the right.



more than very little about microphones and loudspeakers the thought will immediately occur that it is one thing to prescribe that their directional characteristics must be such and such, and a very different matter to make them so—at all audio frequencies. This technical difficulty no doubt accounts for much of the shortcoming of actual stereo results.

But before going on to that you may find it necessary to convince yourself (as I did) that amplitude differences are going to do what is wanted. This can only be done properly by quite a bit of trigonometry, which is given in proper treatments of the subject; but let us see what our simple diagrams show.

When the sound comes from the direction which can be described as straight ahead of the microphone site, both microphones pick it up equally, so Fig. 3 again serves to represent the result. The listener (assumed for the moment to be on the centre line) hears it from his straight-ahead position, midway between the speakers.

A sound coming from the left gives a stronger output from LSL than LSR, so the diagram is as Fig. 6. One might guess that this would make the sound appear to come from the left, but it is by no means obvious that the angle of leftwardness could be made equal to that of the original source by suitable microphone directional characteristics, as usually expressed in polar diagrams. It can be shown better by a vector diagram, Fig. 7, on the assumption of course that the sound has a sine waveform. Here the amplitudes from LSL and LSR are represented as before by the lengths of dotted and full lines respectively, but the time delay shown in the previous diagrams by a horizontal displacement to the right are here shown as an angular displacement clockwise. The amount of angle for a given time depends of course on the frequency of

the sound, and in this case is assumed to be 45° . If the sounds from both speakers were equal in amplitude, the two vectors for each ear would add up to give resultants in phase with one another, but this example of unequal amplitudes shows a resultant phase difference. This means a certain time difference between the sound at the two ears, interpreted by the listener as a leftward source of sound. The greater the difference in amplitude, the greater the phase difference and the greater the apparent leftward angle of the source. Of course if the amplitude from LSR is the greater, the angle will be rightward.

If the original source is straight ahead, this system obviously is the same as the other one in so far as movement of the listener to one side shifts the apparent source of sound in the same direction. It can be shown (I'm not pretending to be giving an exhaustive treatise) that when the source is off-centre its apparent direction also depends on the position of the listener. One has only to draw the vector equivalent of Fig. 4 with unequal amplitudes to see that. Now that we know that time (or phase) and amplitude differences are (for stereophonic purposes) equivalent, we can deduce that the time advance as regards LSL when the listener moves to the left can be compensated by a reduction in loudness from LSL as compared with LSR. As I said, it is one thing to call for loudspeakers having the directional characteristics needed to achieve this compensation at all frequencies, and in the present state of the art quite an impossible thing to get them. Which is why what one hears from different positions even within a defined stereophonic listening area is usually strikingly different. And remember we have considered only one of several kinds of data used in aural direction-finding, and have ignored indirect sound and reverberation. But, again as I said, one can get a very marked improvement on monodic reproduction even when the two-channel system yields far from theoretically perfect stereophony. Why worry how it is faked so long as it sounds good?



TECHNICAL CENTRE.—The new offices of the Technical Centre of the European Broadcasting Union at 32 avenue Albert Lancaster, Brussels 18. The E.B.U. Receiving and Measuring Station at Jurbise-Masnuay and the International Television Control Centre in the Palais de Justice in Brussels are not affected by the move.

LETTERS TO THE EDITOR

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

"Solo Stereocasting"

MAY a "Yank" enter, somewhat belatedly, the solo stereocasting fray initiated by "Free Grid" in your June issue?

We have stereophonic or solid sound, implying sound from a number of sources arrayed in three dimensions. Analogously we may have planophonic sound from sources lying in a plane, linophonic sound from sources lying on a line, and finally pointephonic (pointe is old French for a sharp point) for sound from a single source.

Now this sound may be picked up in the studio with one or several microphones, but if their outputs are all mixed monodically into a single *functional* channel then the stereophonic sound has been reduced to an equivalent pointephonic sound. This equivalent pointephonic sound may be transmitted by any number of wire or radio channels. However, it is somewhere along the way recombined into a single *functional* channel where it may be fed to a number of loudspeakers or to a single one and may be listened to binaurally, monaurally, or even with only half an ear (semi-aurally?), so to speak.

Likewise two clusters of microphones or two single microphones may be used in the studio. The outputs of the microphones are grouped diodically into two *functional* channels and sent to two or more loudspeakers, again by any number of actual physical channels. This diodic reproduction generally provides a satisfactory sensation of stereophonic sound, however, for two omnidirectional microphones the stereophonic sound is actually being reduced to its equivalent linophonic sound.

More than "left-rightedness" is often desired as in a Cinerama or Cinemascope production. Then we must turn to triodic or multidiodic reproduction involving three or more *functional* channels each fed with one or more microphones and feeding one or more loudspeakers. From this arrangement of speakers and channels a planophonic or even true, surrounding stereophonic reproduction can be achieved.

Thus it would seem that the *functional* channelness of the reproduction, as proposed by "Free Grid," is a fair basis for classification and no apologies need be made for the technical vicissitudes of life which may dictate the type or number of *radio* channels which are involved.

To summarize: We start off with stereophonic sound which may be perceived monodically, diodically, triodically, tetradically, or multidiodically. The perception by these classes of systems then reproduces the pointephonic, linophonic, planophonic, and finally stereophonic equivalent of the original sound. And last but not least, the reproduction may be listened to binaurally, monaurally, or semi-aurally.

With this I hope that the original problem, which undoubtedly has been lost sight of, has been sufficiently generalized out of existence.

Wellesley, Mass., U.S.A. JOE M. KNIGHT, JR.

Long-distance V.H.F. Reception

WITH reference to Mr. H. V. Griffith's comments, in your delayed June issue, regarding my recent letter on long-distance v.h.f. reception, I would like to say that since I was not in a position to observe the Band-II signals continuously, too much importance should not be attached to actual figures of occasions on which these signals were heard, and which appear to show 1957 as the peak year. I would also like to clarify a few points which may be of interest, in regard to the mode of propagation of the **Band II** signals.

1. No point received in Tangier, in Band I or II, is less than 1,500 km distant, and most of them exceed 1,750 km.

2. When Band II signals are received, it is invariably following indications of a rising sporadic-E maximum usable frequency, and these signals fade out on a falling Es/MUF. When heard they are accompanied by fairly fast fading, which is not normally associated with tropospheric propagation.

3. When conditions are such as to bring in Band II signals, these frequently come from a number of British and European stations simultaneously, and from such widely separated points as the U.K. and Italy.

I am not a propagation expert, but in view of the above, I find it difficult to believe that the Band II signals heard here in Tangier are propagated *via* the troposphere, and I would be very interested to hear other opinions on this subject.

I am continuing my observations, and since June 15th I have again been in a position to observe some of the Band II channels. I have already heard these signals on seven occasions, and on June 25th signals were heard on a number of channels between 89 and 94 Mc/s from Britain, Holland, France and Italy, over the periods of approximately 1045 to 1300, and 1545 to 1745 G.m.t.

Tangier, Morocco. J. E. LE B. TERRY,
RCA Communications Inc.

Mc/s and Mc/ms

IT seems to me that Mr. Aldo Suglia's kMc/s or kHz is a doubtful improvement on "Free Grid's" Mc/ms for thousands of megacycles. Surely Gc/s is far simpler, "giga" is the recognized abbreviation for 10^9 and frequently encountered in papers and treatises on microwave subjects. *Wireless World* diary also lists it.

Ovingdean, Sussex.

H. B. HAYBALL.

Amateur Electronic Organ Society

MANY amateurs in the British Isles are now constructing electronic organs, and many organs have been completed and are working well. In order to make a successful job of constructing an organ, it is necessary to have some knowledge of a wide range of subjects, including electronics, mechanics, cabinet making, theory of music, etc., and very few amateurs are proficient in all of these subjects. Consequently many organs are on the way, but are stopped for lack of information. I know of three such cases in the North London area.

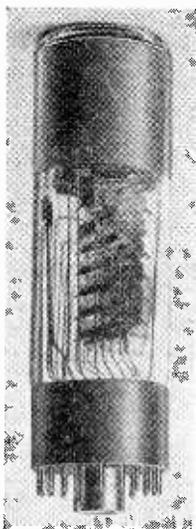
Unfortunately, I, like so many others, have been floundering along for years on a hit-and-miss basis, whereas a little technical assistance from a fellow constructor might provide the answers to some of the problems which are worrying me. On the other hand, I have made quite a lot of interesting discoveries during this period and might know the answer to some of *his* problems.

With this thought in mind I should like to see an Amateur Electronic Organ Society formed, where members could meet occasionally and discuss their problems, and where experts might be persuaded to lecture and perhaps demonstrate. I would be glad if any person interested in joining such a society would get in touch with me.

A. LE BOUTILLIER,
26, St. Catherine's Road, Chingford, London, E.4
(SILverthorne 4884.)

Technical Notebook

High Definition Photomultiplier tube, introduced by Mullard, is designed for use when exceptionally high definition is required in scintillation counting and nuclear radiation spectrography. The most important requirement of a photomultiplier intended for very high definition work is that differences in the transit times of the electrons through the tube must be negligible; otherwise the tube will not accurately resolve extremely short signals received in quick succession. In the



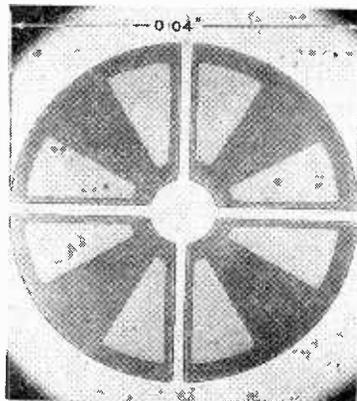
Mullard tube, named 56AVP, transit time differences under typical operating conditions have been kept down to 0.3 millimicrosecond—an improvement of about 100 times over normal types of tube. As a result, the width of the output pulse delivered by the tube can be as little as 2 millimicroseconds at half height, and the rise time of the same duration. This substantial reduction of transit-time differences is due largely to a specially designed input electron-optical system consisting of the photocathode, a focusing electrode, an accelerator, and a deflector plate. The photocathode is curved so that the path lengths to the first multiplier stage are approximately equal for electrons leaving any part of its useful area. The focusing electrode and the accelerator act to concentrate the electrons into a single, narrow

path, and to compensate for inequalities in their initial velocities. The deflector plate directs the electrons on to the first of the secondary cathodes. The uniformity of transit times to the first multiplier stage is maintained throughout the tube by careful shaping of the secondary cathodes, and by additional focusing electrodes, situated between each multiplier stage, which progressively narrow the electron beam from stage to stage, despite the rapid growth in the number of electrons. With the very narrow pulses obtainable from the tube it is desirable, in the interests of economy and practicability, to dispense with an external amplifier. The tube has therefore been designed to provide a peak anode current of 1 amp—sufficient for direct use without further amplification. At values up to 300mA the anode current has a linear relationship with incident light flux, so that the tube can be used for measuring the energies of incident radiation.

TV Bandwidth Reduction by a method of frequency interleaving was demonstrated by E. A. Howson and D. A. Bell at the recent Brit.I.R.E. Television Convention. The method is analogous to that used in the N.T.S.C. colour television system and obtains a bandwidth reduction of a black-and-white video signal by a factor of approximately 2:1. The normal signal is split into two frequency bands, 0-1.5Mc/s and 1.5-3.0Mc/s. The higher band is used to amplitude-modulate a sub-carrier, whose frequency is an odd multiple of half the line scanning rate. The lower sideband of the modulator output is selected and combined with the original 0-1.5Mc/s band, so that the frequency spectra of the two signals interleave. The combined signal can then be sent over a channel of 1.5Mc/s nominal bandwidth. At the receiving end of the channel the composite signal is applied to a synchronous demodulator, fed also with sub-carrier of the same frequency as at the transmitter. The lower sideband of this demodulator is taken and combined with the received signal, to yield a "normal" video signal extending from zero to approximately 3Mc/s, together with an "interleaved" signal. The interleaved signal is such as to give an

interference pattern on the display which, in a stationary picture, should optically cancel after four successive frame scans. However, the pattern is built up in such a way as to give rise to a "crawling" motion which is very noticeable at close viewing distances. Incidentally one couldn't help noticing that when the 0-1.5Mc/s band only was transmitted the picture still looked reasonably acceptable. According to L. C. Jesty this is all that is necessary for bandwidth reduction.

Stepping Transistor is the name given to a new Bell Telephone Laboratories' experimental device intended as a semiconductor version of the glow-discharge type of digital counter tube (such as the Dekatron). The example shown here has four stages fabricated on a single piece of silicon. Each stage is bi-stable element formed by a p-n-p-n transistor which acts as a pulse-controlled on-off switch (see our July/August, 1959, issue, p. 348). The design of the complete structure is such that the bi-stable characteristic exists between a single common electrode and a set of multiple electrodes. A unidirectional transfer of voltage around the device is obtained by an unsymmetrical arrangement of the electrodes, as in the glow-discharge tube. But, unlike the glow-discharge tube, the stages do not have to be in close proximity for the device to work properly. Conse-



quently, the individual bi-stable elements can be made as separate components and then wired in circuit—and, in fact, such individual elements, consisting of four-terminal p-n-p-n components, have been constructed at the Laboratories. The stepping transistor can be designed to operate with currents in the range 1 to 100mA and voltages in the range 10 to 100 volts. Speeds of operation up to 10^6 pulses per second have been achieved, and it is expected that even greater speeds will be possible with improved designs. Computing circuits are one application.

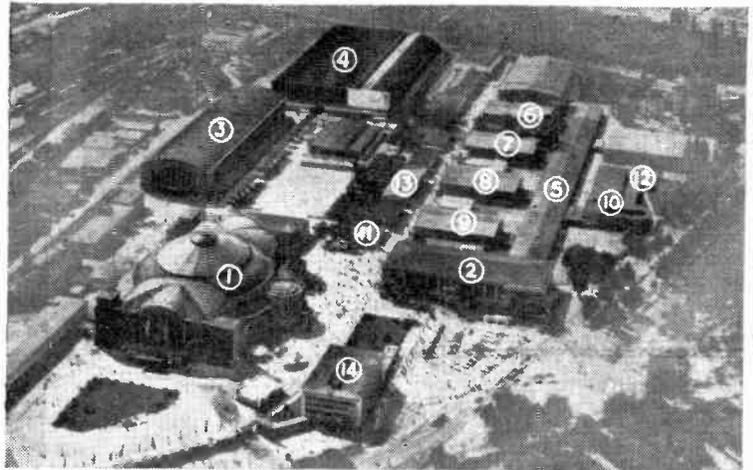
THE GERMAN RADIO SHOW

Highlights and Trends
Seen at Frankfurt

TO the visitor entering the Frankfurt exhibition grounds the 1959 *Grosse Deutsche Rundfunk-Fernseh- und Phono-Ausstellung* (14th-23rd August) must have seemed superficially to have changed very little since 1957. (There are several smaller radio exhibitions in Germany, but the main event is held in alternate years). The layout of the 14 halls, covering more than 12 acres (one hall alone has a floor area of 4 acres), followed the 1957 plan. The principal exhibitors were to be found in or near their accustomed positions, often with the same stand layout and décor; the itinerant vendors of cigarettes, iced drinks and fruit (many of them young students making pin money in their vacation) were out in force; in the lobbies and in the open air (necessarily!) the Frankfurters were being cooked and eaten with relish.

But outward appearances can be deceptive and on closer acquaintance we found no lack of interest in the changing pattern of public demand, and in the many technical developments since we last reported this event (September 1957 issue).

Although television is gaining ground it is still far from reaching the dominant position which it holds in Great Britain. Fewer than 3 million television licences have been



Aerial view of the Frankfurt exhibition grounds. 1, 2 Television studios. 3-9 Manufacturers' exhibits. 10 Special show "Everyone should have television." 11 Gramophone record pavilion. 12 Record Bar. 13 Tape recording ("Hobby for Everyone"). 14 Administration and information.

taken out so far in Germany, compared with more than 15 million sound broadcast licences. (The U.K. figures are roughly $9\frac{1}{2}$ million television and a little less than 15 million sound.) To stimulate interest a special show, *Fernsehen müsste man haben* ("Everyone should have television"), was arranged with a sequence of non-stop films in a sort of television avenue, giving examples of the many aspects of programme building—news, sport, plays, documentaries, etc. The quality of the German television programmes both in content and studio lighting and camera work seemed to us to reach a very high standard, and there could be no doubt of the growing interest of the public which daily watched the live programmes in the exhibition No. 1 television studio (a building outwardly resembling the Albert

Hall and with a seating capacity of 12,000 or more depending on the area used as a stage). Once again the thorough preparations of the German Post Office, who had erected special microwave links with the local broadcast authority (Hessischer Rundfunk) and through them with the rest of Germany, are worthy of special commendation.

At the moment only a few stations are working in Band IV but it is expected that by the end of 1960 there will be full coverage of the centres of population in West Germany with a second television programme.

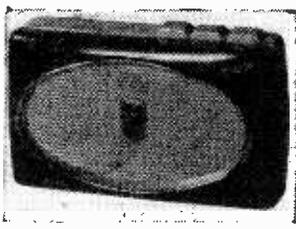
Television Receivers. Walking round the exhibition one gained the impression that the stability of the German television receiver has greatly improved since 1957. In some hundreds of sets only one temporary maladjustment (an unsuppressed line flyback) was seen. To show the reliability of his product, one manufacturer placed 12 receivers close together in a row; the closest inspection did not reveal any lack of uniformity of brightness, definition or screen colour. Picture quality in general seemed about the same as that of the sets one sees at Earls Court, but it was not at first appreciated that the sets were nearly all 21-in, not 17-in. In fact, 75.4% of the models on the German markets are 53 cm (21-in) and 15% 23.3 cm (17-in). Only 1.3% have 61-cm (24-in) tubes. The 625-line standard clearly has an advantage over 405 lines in satisfying the public demand for larger pictures. Most of the leading makers offer sets with 110° tubes.

In Germany one looks for a *leitmotiv* and in television receivers this year it is *Vollautomatik*—fully automatic operation. This cult is pursued with Teutonic thoroughness, and sales literature enumerates as

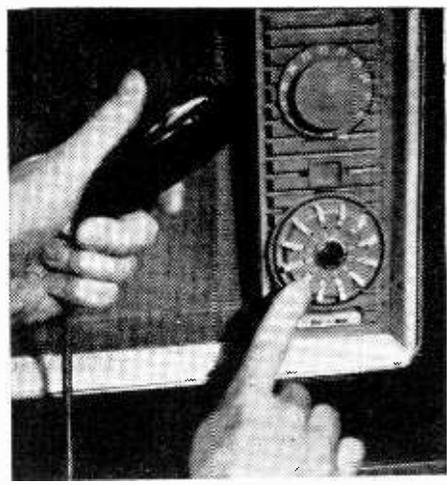


Youth is served—the Siemens "Stereo Bar."

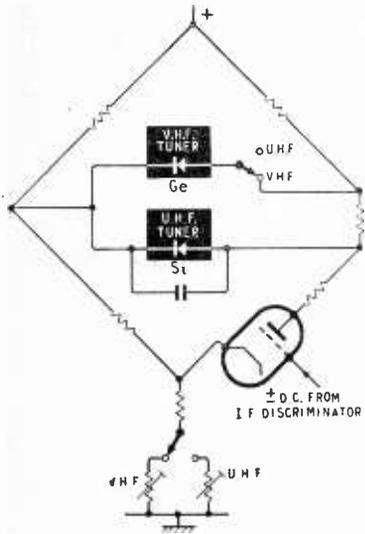
many as 15 or 20 circuit features which are self-regulating. Most of these, such as thermistor control of picture size, e.h.t. regulation, etc., are common to British sets. Not so common is *automatische scharfabstimmung* (automatic sharp tuning) which is universal in German TV sets working in Band III. A control voltage is derived from a separate discriminator working from the i.f. and with zero transit on the picture carrier. After a single stage of amplification the control voltage is usually applied to a diode (acting as a variable capacitance in the reverse bias region) which is connected in parallel with the r.f. oscillator. Graetz seem to be the only people so far to have applied a.f.c. to Band IV as well as Band III. A silicon diode is used for Band IV and germanium, with a wider capacitance range, for Band III. A different working point is required on each



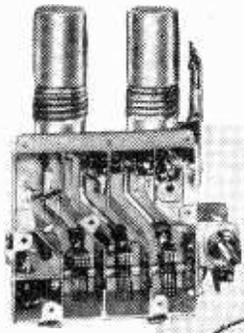
Above: Grundig ultrasonic remote control unit for television receivers.



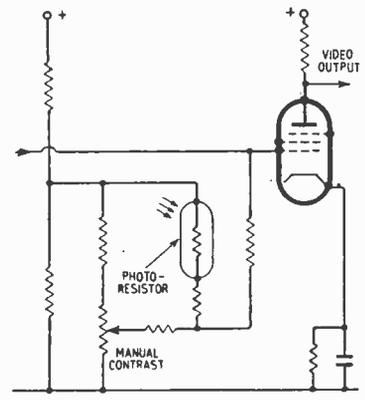
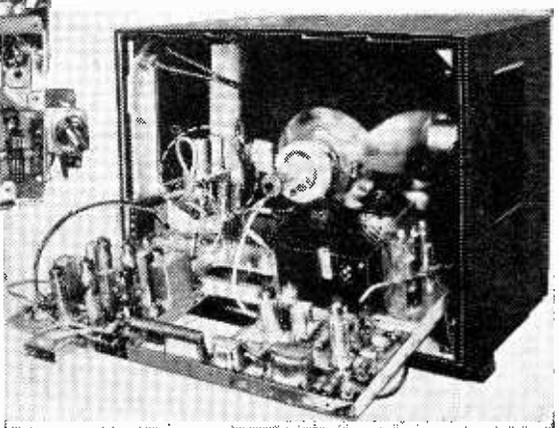
Right: Remote control of pre-set channel selection in the Telefunken FE20 television sets.



The high-impedance silicon diode is left in circuit when the set is switched to v.h.f. in the automatic tuning circuit developed by Graetz.



Telefunken FE18/43T chassis with built-in u.h.f. tuner.



Simplified circuit (for negative modulation) of automatic contrast control (Loewe-Opta).

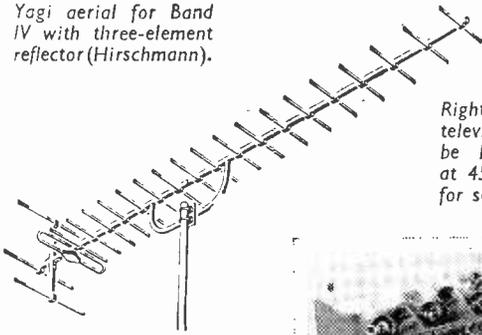
band, and to simplify switching the diodes are connected in a bridge circuit (see accompanying diagram). Since the impedance of the silicon diode is much higher than that of the germanium it can be safely left in circuit when the set is switched to Band III. While most manufacturers use diode capacitance as the variable reactive element Grundig have chosen variable inductance for which an even wider range of control is claimed. The d.c. from the control amplifier is passed through the winding of an electromagnet, the field of which is used to change the permeability of the ferrite core in the oscillator.

Automatic contrast control according to the level of the ambient light in the room is now accepted as a normal feature in all but the cheapest German television receivers. It is simple and effective in automatically maintaining picture quality when the curtains are drawn or a light is switched on. The normal manual contrast-control potentiometer, which controls the standing bias on the video output stage, is supplemented by a potential divider, one element of which is a photo-resistor of the

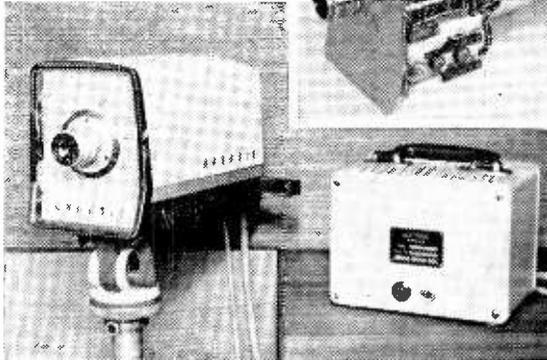
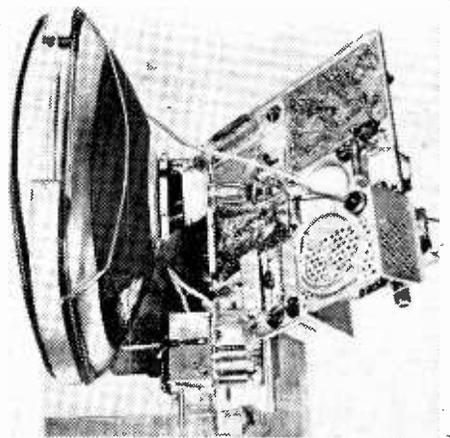
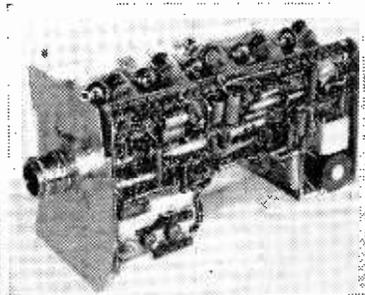
cadmium sulphide or similar type. These resistors, which have a working range of 5 to 200kΩ, are quite small and are mounted unobtrusively somewhere on the front of the chassis.

Such external controls as are necessary—for example channel selection—are mechanized and remotely controlled from the viewers' position. Grundig were showing a system which does not require a connecting cable and operates by supersonic sound pulses from a small transistorized hand unit. Frequencies used are 12kc/s for sound volume, 23.5kc/s for brightness and 28kc/s for channel selection and, when we saw it, it was working reliably through an exhibition audio background level well up into the nineties (phons). Another effective remote control demonstration on the Grundig stand was by microwave link to a television camera mounted a couple of miles away in the centre of Frankfurt. Visitors were able to operate a joystick and view the Hauptwache from all angles on a monitor tube. Grundig have also in production a photo-conductive television camera costing only 2,000 DM (about £170). It is designed for use

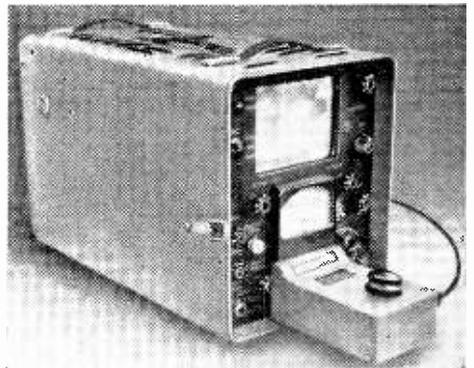
Yagi aerial for Band IV with three-element reflector (Hirschmann).



Right: The Loewe-Opta television chassis can be locked vertically, at 45° or horizontally for servicing.



Grundig FA40 general purpose television camera, costing the equivalent of £170.

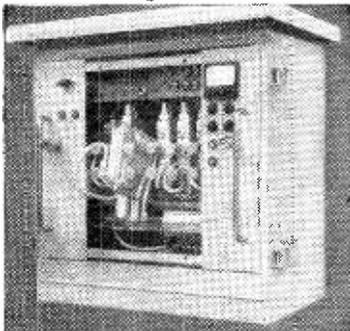


Siemens-Electrogeräte aerial performance meter (SAM317/bW) with u.h.f. attachment.

with domestic television receivers and is directed at the amateur as well as the professional market.

There are few equivalents in Germany of the light portable TV set with large 110° tube now in England. Most Germans prefer their sets in expensive cabinets to match their polished wood furniture. The Kaiser "Prinz" portable with 18 x 14.5 cm screen is therefore something of a novelty, though one still sees the Ekco 9-in set (for mains or 12-V battery operation), now made for export only, prominently displayed in many radio shops in Germany. The price was just short of 1,000 DM—

Antennenwerke Hans Kolbe ("fuba") u.h.f. converter for television distribution systems.



about the same as that of a German 21-in domestic set.

The position as regards Band IV is much the same as it was in the U.K. just prior to the establishment of the I.T.A. A few manufacturers already supply built-in u.h.f. units, but most leave space for the addition later of an internal adapter, or can supply external converters for the older existing sets.

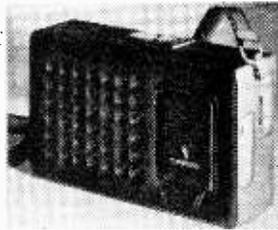
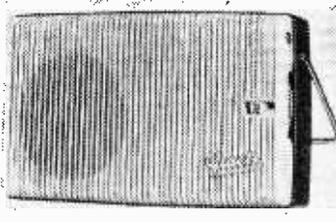
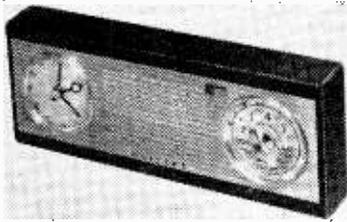
Aerials. As in 1957, the aerial manufacturers' section of the industry arranged a collective outdoor exhibit of their latest designs—this in addition to individual displays on their stands. The main interest was in Band IV aerials for the forthcoming second-programme network from stations now in course of erection throughout Germany. Long Yagi arrays with anything up to 30 elements covering 5 or 6 channels are most favoured, but one broadband (470-581 Mc/s) butterfly aerial in a corner reflector was noted ("fuba," Hans Kolbe). An interesting item on this stand was an *antennensprechgerät*—two miniature transistorized loudspeaker/microphone units for interpolation, with suitable r.f. filters, in the coaxial feeder so that the erector on the roof can communicate with his assistant viewing the screen while the best aerial position is being found. Also shown by "fuba" was a well-engineered multi-channel converter unit for

Band IV designed to operate with existing community television distribution systems.

An interesting aerial measuring equipment (SAM317/bW) was shown working by Siemens and Halske. It combines a valve voltmeter with a range of 10 μ V to 2.5V and a picture tube (95 x 125 mm), so that in adjusting the aerial the best compromise between signal strength and the elimination of ghosts and noise can be quickly found. Two models are available, one for normal 625 lines and the other with a built-in 4-standard time base system.

Sound Receivers. The enthusiasm of German youth, which dictates to a large extent the sales policy of the manufacturers, seems to have shifted from the station-hunting on multi-keyed all-wave table-model receivers which was a feature of the 1957 Show, to the miniature transistor portable which can be concealed about the person and which has a phenomenal acoustic output for its size. By an aural illusion your reporter was genuinely deceived by a passer-by into looking down the road for the P.A. van!

There are some clever variations of the main theme. In their TPI, Max Braun provide a separate miniature



Representative pocket transistor receivers. Deutsche Philips "Jeanette", Graetz "Susi" and Siemens T2.

45 r.p.m. record player to go with (or without) the radio receiver, which, incidentally, covers short as well as medium and long waves. The pickup is concealed below a trap-door inside the case, which slides open when the motor is switched on and allows the spring-loaded pickup head to engage the *underside* of the record.

For use in the home Grundig have a larger loudspeaker housing into which the pocket portable is inserted; this automatically cuts out the small internal speaker in the set. Deutsche Philips in their "Jeanette" model have even included a battery-driven clock and time switch.

Of somewhat larger size are the three-waveband transistor portables, with telescopic aerials, for v.h.f. as well as medium- and long-wave reception. In 1957 Graetz demonstrated their first experimental v.h.f. set, using American transistors for the signal-frequency stages. Now at least five manufacturers are in full production. The Philips "Colette," Nordmende "Transita," Grundig "Teddy Boy" series, Graetz "Joker" and Schaub-Lorenz T400 employ the European OC 171 or OC 615 v.h.f. transistors in the early stages and have performances that belie their somewhat frivolous names. The two latter can be supplied with special under-dash mounting brackets for temporary use as car radios.

Blaupunkt proudly displayed their millionth car radio which had been gold-plated to celebrate the event. They were also running a car-radio "bar" at which visitors would operate all the many types made by this firm. Max Egon Becker were

Braun TPI pocket radio-gramophone. The two sections can be used independently.

showing car radios with large transistor output stages—up to 12 watts for coaches.

Small and simple mains transportables for use as a second set in any room in the house are on the increase and have to some extent displaced the full-specification table model, but the interest in the larger radio-gramophones and combined television and high-quality sound receivers is as strong as ever. The large number of cabinet makers exhibiting were all doing firm business with show visitors who choose their basic receivers and then have them installed in cabinet work of their own choice.

Most sets over the 350DM (£30) mark are fitted with stereo amplifiers and loudspeakers, and the larger stereo radio-gramophones undoubtedly give something better than the *raumklang* or 3D to which the German buying public has been accustomed now for many years. In their "New York" radio-gramophone "with Concert Hall" Blaupunkt offered the best of both worlds by providing a 50-millisecond electro-acoustic delay line to add artificial reverberation at controlled level, either to mono or to one channel of stereo recordings.

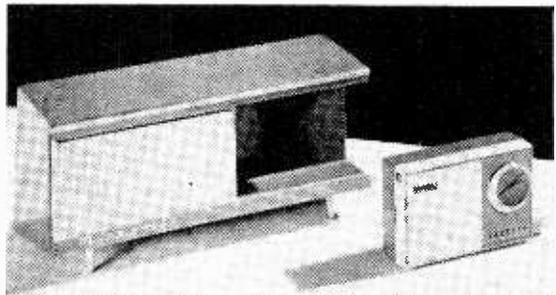
There was, judging from some of the remarks overheard, some sales resistance to the smaller stereo sets with closely spaced loudspeaker units. Better results were heard from some of the portable stereo record players (e.g., Perpetuum-Ebner) in which divided lids with a loudspeaker in each half can be spaced at any required distance.

The same principle of a variable base line is applied in some of the more expensive equipments, notably the Siemens STR 30 stereo radio-

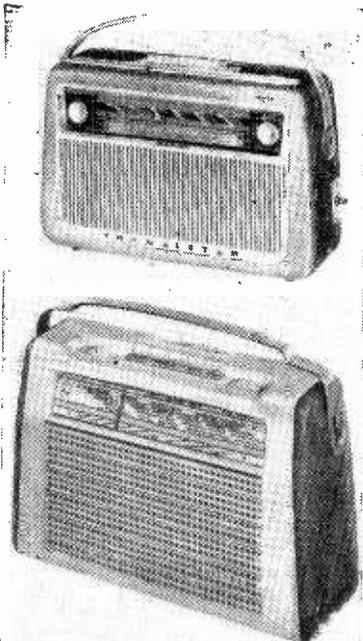
gramophone in which the loudspeakers, installed in thick front doors are not only adjustable for angle but can also be pulled out to increase the base line if the size of the listening room permits. Incidentally, many of the Siemens sets have automatic noise suppression by which the high-frequency response is automatically reduced for weak signals. The principle is, of course, not new, but what is interesting is the economy of application. The Miller effect in the variable- μ amplifier section of the cathode-ray tuning indicator, controlled by the carrier amplitude, is used as a variable capacitance in the a.f. filter.

Gramophone Record Reproduction. Inevitably this was dominated by "stereo" which has permeated the industry at all levels. On the one hand there were the 45 r.p.m. "pop" record "stereo bars" with teenagers listening *binaurally* on headphones to the latest hit tunes, and on the other the "Schallplatten Pavillon" in which leading firms had combined to give lectures and continuous demonstrations of their vintage classical records. This was an oasis in the pandemonium of noise in the rest of the exhibition and your reporter has no hesitation in including this performance in his own private collection (now numbering three) of completely satisfying demonstrations of stereophonic sound. Reproducing equipment chosen for this demonstration included Isophon loudspeakers, Elac stereo pickup and Thorns turntable.

Another impressive performance was given by the Braun Studio 2 high-quality equipment costing 2,000DM (£170) which comprises stereo amplifier, record player and radio receiver units, in the now



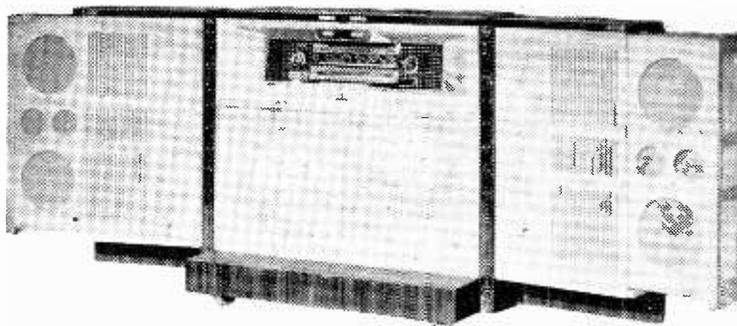
Grundig "Micro-Transistor-Boy" with larger loudspeaker cabinet for home use.



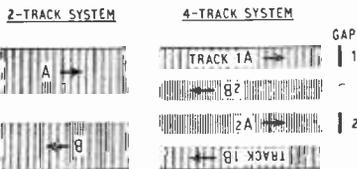
Two representative all-transistor all-wave (including v.h.f.) battery portables. (Above) Graetz "Joker" and (below) Deutsche Philips "Colette."

world-famous Braun styling, together with type LE1 electrostatic wide-range loudspeakers, the latter made under exclusive licence from the Acoustical Manufacturing Company ("Quad").

Tape Recorders. The principal development in German magnetic tape recorders this year is the introduction of 4-track recording, which has been adopted by all the leading makers in their latest machines. By doubling the playing time this system goes far to reduce the cost of running a tape recorder and the manufacturers hope thereby to induce more people to take up home recording as a hobby. A collective demonstration "Tonband—Hobby für Jedermann" (Tape—Hobby for Everyone) ran continuously throughout the exhibition to show the possibilities not only of straight recording and the use of tape sound in conjunction with home cinema projectors, but also the numerous "tricks" of sound synthesis that can be accomplished by superposition—particularly with 4-track recording. In this system two heads, stacked vertically and spaced a track width apart, can by suitable switching give two runs of stereo or four runs of single-channel recording on a given length of tape. The reduced width of track does not affect the signal/tape-noise ratio but gives a reduced level of signal output. Hum and amplifier noise is then the limiting factor in determining the signal/noise ratio, and some firms, e.g. Telefunken in their 76 and 77



Siemens STR 30 stereo radio-gramophone with loudspeakers adjustable for spacing and angle.

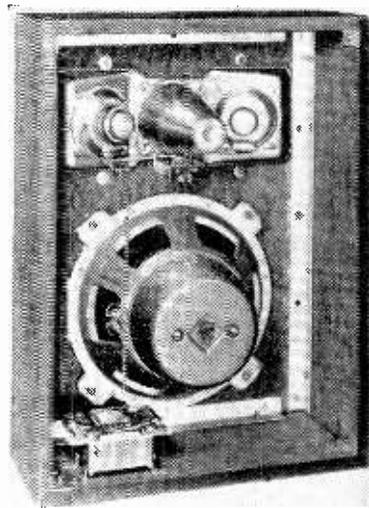


Four-track magnetic tape recording convention for single channel, compare with the two-track system. The two heads can be switched for simultaneous operation for stereo if required.

models, and Körting in their MK108, are using transistors in the early amplifier stages. Telefunken also use d.c. for the subsequent valve heaters.

Special demonstrations included live-versus-recorded jazz sessions by Telefunken, and a reliability test by Uher in which one of their recorders was mechanically cycled through all its switching functions continuous throughout the duration of the exhibition.

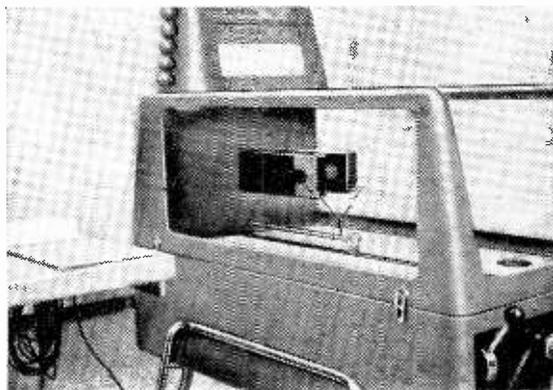
Polyester tapes of greatly improved mechanical and thermal stability were shown by B.A.S.F. and Agfa, the latter firm playing a long continuous length of recorded tape which was passed successively through a freezing bath at -62° , a water bath at 90° and an air-drying chamber at 90°C before going over the playback head.



Isophon wide-range loudspeaker (G3037).

The exhibition was organized by the radio and television section of the Zentralverband der Electrotechnischen Industrie (Z.V.E.I.) and was opened in a nation-wide television broadcast by its patron, Prof. Dr. Ludwig Erhardt. The total number of visitors was 532,000 compared with 493,000 in 1957. The next exhibition, which is to be held in 1961, will be open to foreign as well as German radio manufacturers.

Model of a stereo pickup (Telefunken) demonstrating, by means of enlarged and interchangeable sections of record groove, the principles of "45/45" recording and reproduction.



Vibration in Gramophone Turntables

Correct Distribution of Mass to Minimize Pickup Disturbance

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

THE stereo disc has brought with it many problems, some new, some old, showing up once more. In the latter category is groove jumping due to external vibrations reaching the pickup, particularly from the floor.

High-quality equipment incorporating the various well-known motors that were perfectly satisfactory with single-channel pickups tracking at 5-10 grams are now giving trouble when fitted with stereo pickups tracking at somewhat smaller pressures. The writer is amongst those afflicted with a well-sprung floor to the listening room. Normal walking has been impossible anywhere near the playing desk.

Most motor boards are suspended at 4 points, a few at 3 points. The springs are generally spaced at roughly equal intervals, and more often than not are

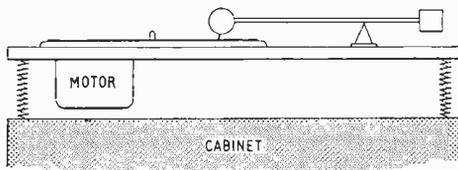


Fig. 1. Typical playing desk arrangement shown in front elevation.

identical. Fig. 1 shows the front elevation of a typical playing desk arrangement. The heavy transcription turntable is well to the left side of the motor board and the driving motor is usually further still to the left. The centre of gravity is then much nearer to the left-hand springs than the right-hand springs. The left-hand springs will in consequence be compressed more than the right-hand, but the usual screw adjustment will have been set to put the turntable level. Though differently loaded, the springs are still of equal compliance. The system can be simplified to two dissimilar masses connected by a rigid bar and suspended on two identical springs (Fig. 2).

Now consider the effect of a vertical disturbance on this system, say a single vertical displacement of short duration. It is quite obvious that the lighter side will oscillate with a larger amplitude than the

heavier side (Fig. 2a). The system is subjected to two disturbing motions in the vertical plane, a linear one (Fig. 2b) and a rotational one (Fig. 2c). Both will affect the pickup.

As J. Walton has already shown (*Wireless World*, June 1959), the gravity-balanced type of arm is but little affected by vertical linear accelerations (Fig. 2b). In fact, the only change of stylus force for a vertical linear acceleration is equal to the force produced by similarly accelerating a mass equivalent to the stylus force.

Fig. 3(a) shows a perfectly balanced pickup arm. The stylus will not be pressing on the disc though it may be touching it. A vertical acceleration applied to the whole system—in this case solely via the pivot—will not alter the attitude of the pickup arm since head and counterweight moments balance. There is thus no change in stylus pressure, it remains at zero all the time, even if it is touching. Fig. 3(b) shows the same arm loaded for simplicity with m grams on its head. Again the pivot “looks after” the arm and the stylus only has to accelerate the m grams.

As a further check on the validity of this argument, consider the stylus detached from the head and carrying the m grams. Apply the vertical acceleration to the system and note the result. The stylus has accelerated the m grams: the distance between arm and the head is unaltered as the perfectly balanced arm is unaffected: therefore the loaded stylus may as well have been left attached to the head! Moving the counterbalance weight slightly to produce the m grams tracking weight would give the same result.

To get some idea of the forces involved, assume a disturbance producing ± 2 mm of sinusoidal vertical (linear) motion at 5c/s. For tracking weights of 1, 3, and 5 gm the forces will be 0.2gm, 0.6gm, and 1.0gm respectively. They are, of course, proportional to the tracking weight for gravity-balanced arms.

These forces are not negligible, but they are not likely to promote groove jumping unless they happen to coincide with some very heavy modulation and then only if relative phases are just so.

Of interest rather than usefulness is the following point. If a pickup arm is gravity balanced to give

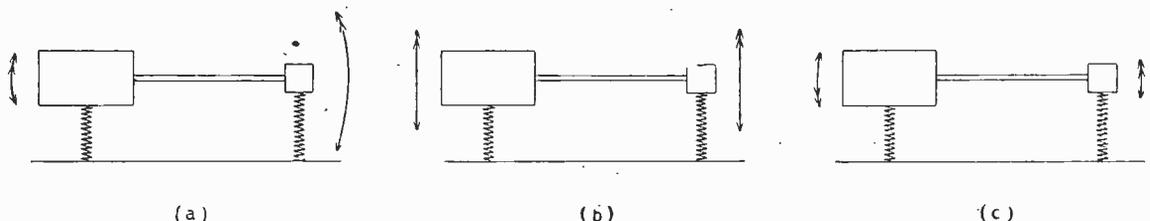


Fig. 2. Simplification of Fig. 1. The actual motions in Fig. 2(a) are equivalent to the combination of the linear motion in Fig. 2(b) with the rotational motion in Fig. 2(c).

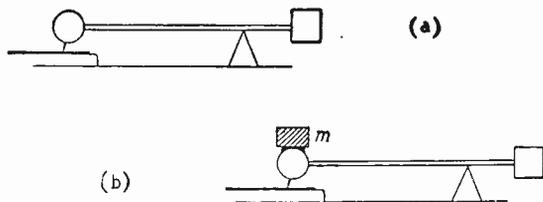


Fig. 3(a). Perfectly balanced pickup arm. (b) To obtain the required stylus force, the arm of Fig. 3(a) is loaded with m gm on its head.

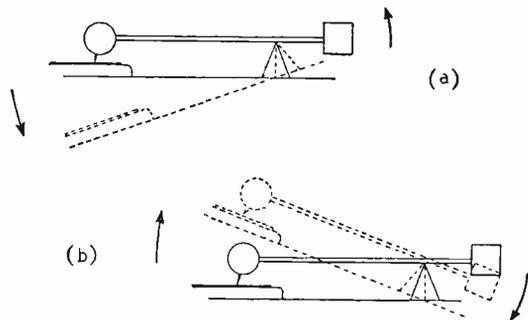


Fig. 4. Perfectly balanced arm acted on by anti-clockwise (Fig. 4(a)) or clockwise (Fig. 4(b)) rotations of the playing desk.

zero stylus pressure, and the stylus pressure is then applied by a massless spring, the arm is completely immune to all straight-line vertical motion!

Now consider the rotational component in the vertical plane (Fig 2c). Here the *direction in space* of the *whole* arm is being altered. Therefore it resists with its *whole* inertia. The stylus tip takes almost the whole brunt of this type of disturbance. To clarify this argument, consider a perfectly balanced arm (Fig. 4) with the stylus touching the disc, but, of course, with zero pressure. Now rotate the pivot pedestal-cum-disc system about the pivot point. This is the centre of gravity and is chosen as we are considering the rotational component only. An acceleration as shown in Fig. 4(a) will clearly leave the pickup behind, i.e., it will jump clear of the disc—relatively.

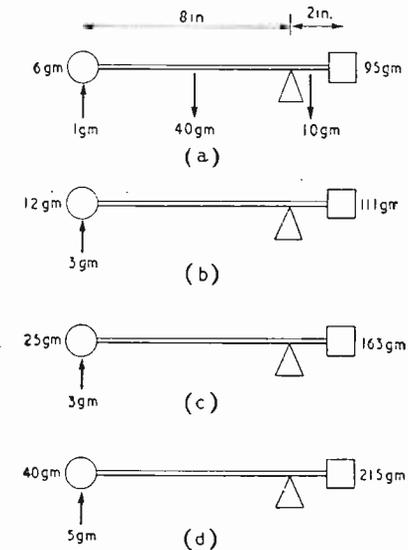
In the opposite direction, Fig. 4(b), the disc-stylus contact will obviously cause the arm to rotate with the system (unless it lifts it off the pedestal!) To produce this rotation, the stylus has been opposed by the inertia of the whole arm—measured about an axis through its pivot and perpendicular to its length. This same force would be required to keep the stylus in contact with the disc in Fig. 4(a). Adding in the stylus pressure does not alter the situation very much. If weight is added to the head, the total inertia rises a little. If the counterbalance weight is slid toward the pivot the inertia is reduced by an almost imperceptible amount. If by spring, then the inertia is unchanged.

Incidentally a *spring counterbalanced* arm scores in this case as there is no counterbalance weight and arm overhang to add to the inertia. It is, however, a very doubtful gain, as the extra complexity and its accompanying friction may well be even more serious.

For comparison purposes consider the motor

board stationary on one side and still moving ± 2 mm vertically on the other side, still at the same frequency. For a 15-in wide motor board this is an angular rotation of ± 0.0052 radians (about $\frac{1}{3}$ degree), and an angular acceleration of 5.2 radian/sec².

Fig. 5 shows dimensions and weights of typical pickups based on J. Walton's figures on page 269 of the June issue of *Wireless World*. Below are given moments of inertia about the pivot, calculated on the basis of concentrated head and counterbalance weights and distributed arm mass. In all cases the disturbing force is well in excess of the tracking weight and must cause jumping.



	Moment of inertia gm-cm ²	Disturbance to stylus force gm
(a)	10500	2.7
(b)	13400	3.5
(c)	20100	5.2
(d)	27600	7.1

Fig. 5. Dimensions and weights of typical pickups with corresponding moments of inertia about the pivot and disturbances to stylus force for an angular acceleration of 5.2 radians/sec².

Lest anyone feels these figures are unduly large, consider the motor board motion to be $\pm 1\frac{1}{2}$ mm on the left, and $\pm 2\frac{1}{2}$ mm on the right, in phase. This will produce a just visible rocking motion and involves accelerations and disturbing forces exactly half of those quoted above. Even bringing in the fact that the pickup is most of its time at say 45° to the plane of maximum rotation, the figures are only reduced by a further factor of 0.707.

Observation of motor board movements when the floor or the cabinet is disturbed often reveal quite alarming gyrations, some of them much faster than 5 c/s. Anyway, the initial acceleration is usually larger than any of the following observable movements. It can thus be seen how important it is to minimize all rotational components.

The simplest way of dealing with existing equipment is to add a mass W to the other side of the motor board (Fig. 6), so that the centre of gravity

of the whole suspended system coincides with the geometric centre of the suspension. The extra mass added to the system must also help somewhat. The mass and position can be found by experiment, but to give some idea of the quantities involved, the writer quotes 6½lb of lead (in a cocoa tin!) under the centre of the pickup arm in its rest position, for a fairly heavy transcription motor.

The benefits are quite striking; whereas previously theatrical tiptoe movements were necessary, now the youngsters can romp in and out of the room with impunity.

Looking still farther into this problem, it can also be seen that, strictly speaking, not only should the centre of gravity coincide with the suspension centre in plan, but also in elevation. If this is not so, sideways blows to the cabinet, in the direction of the length of the pickup arm, can also promote rotational (rocking) movements. Fortunately the centre

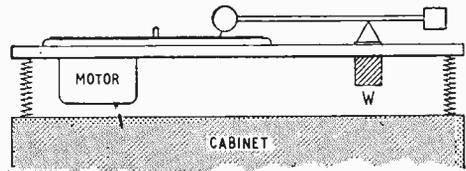


Fig. 6. Adding the weight *W* to Fig. 1 makes the centre of gravity of the suspended system coincide with the geometric centre of its suspension, and thus minimizes the disturbance to the pickup.

of gravity is never likely to be displaced as far above or below the centre point as it can be laterally. This is then a small order effect in most designs.

An alternative scheme is the use of graded springs, i.e., stiffer ones under the heavier side. This is not often seen in use and might be worth further investigation.

Books Received

The Radio Amateur's Handbook, 1959 edition, by the headquarters staff of the American Radio Relay League. A standard manual of amateur radio communications, explaining basic theory and the latest techniques and practices. Considerably revised and including descriptions of new equipment, particularly applications of transistors in amateur radio. Pp. 612 including 32 pp. of valve and semiconductor data and 1,300 illustrations. Obtainable from the Modern Book Co., 19-23, Praed Street, London, W.2, or from the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1; price 32s 6d (34s 3d by post).

Brans Radio Valve Vade Mecum. 14th Edition (1948) of comprehensive guide to British, Continental and American receiving valves. Pp. 464. Price 32s. P. H. Brans, Ltd., Antwerp. Agents: Bailey Bros. & Swinfen, Ltd., Hyde House, West Central Street, London, W.C.1.

British Instruments Directory and buyers' guide to electronic, nuclear, navigational and survey, optical, engineering and general measuring instruments prepared by the Scientific Instrument Manufacturers' Association.

Includes a glossary in English, French, German and Spanish. Pp. 322. Price £2 2s. United Science Press, Ltd., 9 Gough Square, London, E.C.4.

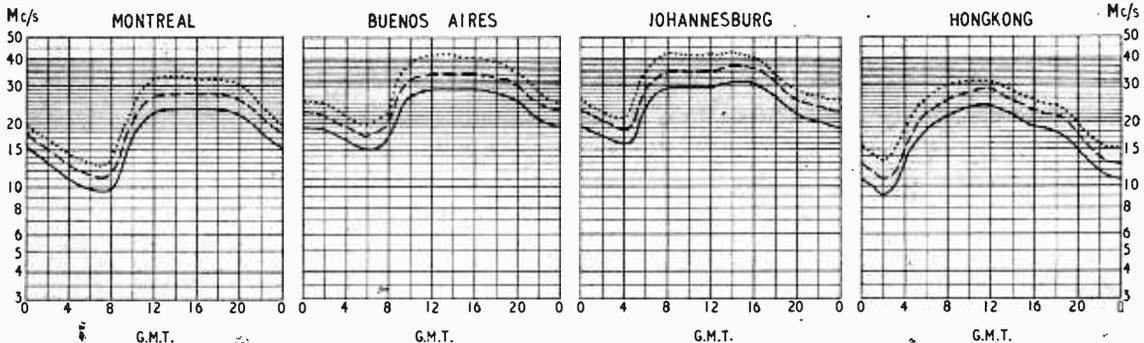
Transistors Theory and Practice by Rufus P. Turner. Second edition revised and enlarged to include thyristors, four-layer diodes, spaciators, double-based diodes and phototransistors. Pp. 160; Figs. 105. Price \$2.95. Gernsback Publications, Inc., 154 West 14th Street, New York, 11.

G.R.R. Year Book, 1958. Classified guide to more than 3,000 records of the year, with an introduction to the "A.B.C. or Hi Fi," a "Stereo Symposium" and a directory of audio equipment. Pp. 45, illustrated. Price 5s. *Gramophone Record Review* (Francis Antony, Ltd.) East Hill, St. Austell, Cornwall.

World Radio Handbook for Listeners, edited by O. Lund-Johansen. 1959 edition of this well-known guide to broadcasting stations. Gives signature tunes, times of transmission, addresses of broadcasting organizations, etc. Pp. 186, illustrated. Price 14s 6d. Wm. Dawson & Sons, Ltd., Cannon House, Macklin Street, London, W.C.2.

SHORT-WAVE CONDITIONS

Prediction for September



THE full-line curves indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during September.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

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

Elements of Electronic Circuits

5.—AMPLITUDE SELECTION AND AMPLITUDE COMPARISON

By J. M. PETERS, B.Sc. (Eng.), A.M.I.E.E., A.M.Brit.I.R.E.

THE term "amplitude selection" means the process of selecting a portion of a waveform lying above or below a boundary, or within two bounds. In the section on Amplitude Limiting (June, 1959, issue) a diode in series with the applied wave has been shown as a device capable of amplitude selection. Fig. 1 shows the circuit arrangement, and Fig. 2 the portion of the triangular wave lying above the potential V_k which has been selected. The potential at which selection operates is often termed the "reference potential".

Another example of selection is in the process of waveform shaping. Fig. 3 shows the series diode

again, to which is applied a differentiated square wave. The "reference potential" is chosen so that the negative excursions as well as the slower parts of the positive excursions are eliminated. The top portions of the positive excursions are therefore selected, Fig. 4, and can be utilized as marker pips.

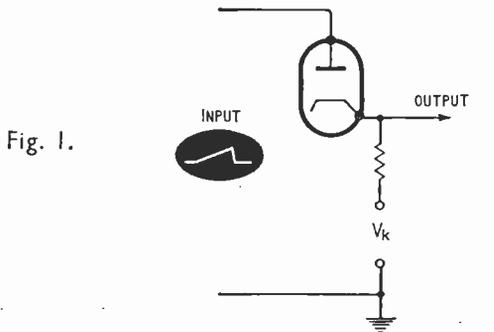


Fig. 1.

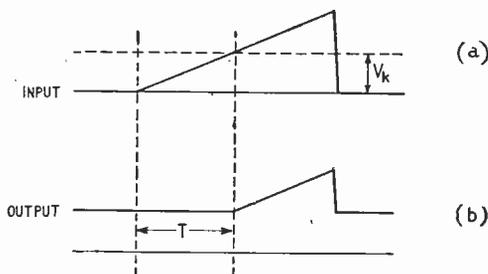


Fig. 2.

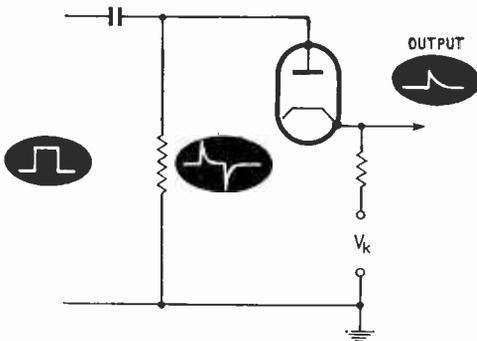


Fig. 3.

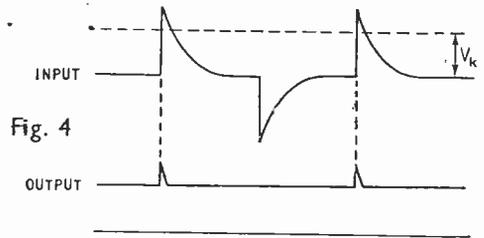


Fig. 4

The diode selector is widely used for the accurate selection and reproduction of a portion of a waveform, but if the wave is to be amplified, and if accurate reproduction and boundary limitations are of secondary importance, triodes and pentodes are used instead.

Fig. 5 illustrates a cathode-follower type of selector which uses the triode cut-off as the boundary condition, at the same time making use of the low output impedance property of the cathode-follower.

The stability of the point of cut-off under varying operating conditions is important, as is also the linearity of the characteristic in the vicinity of cut-off. In the case of the diode selector, inaccuracies arising from this factor are minimised by the use of large inputs. The cut-off point of the triode characteristic is not as stable as that of the diode. However, Fig. 5 may provide a boundary definition only slightly inferior to that of the diode.

In an attempt to maintain a more stable cut-off point an improved circuit as shown in Fig. 6 can be used. The second valve, V_2 , is identical with V_1 . V_2 acts as a low-impedance load upon V_1 , during the first part of the selected wave. A distorted out-

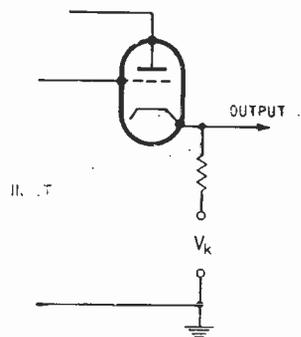


Fig. 5.

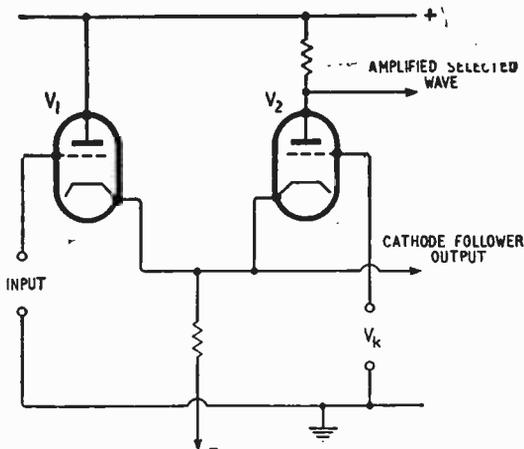


Fig. 6.

put waveform is produced until V_2 is cut off. It will be noted that an *amplified* selected wave output at the anode of V_2 can be obtained as an alternative to the "cathode-follower" output.

Amplitude selection between limits is a condition commonly encountered, and the boundary limits imposed by the cut-off and saturation points of the dynamic characteristic of either a triode or a pentode are often made use of. An alternative method of improving the two boundary conditions (and, incidentally, of deriving a square waveform) is by the use of two diodes connected as shown in Fig. 7. Amplitude selection occurs between the limits controlled by the potentials E_1 and E_2 (Fig. 8).

The foregoing examples show that ideally the selector delivers a portion of the input wave. The output wave comprises sections of the input wave all the time "selection" is occurring, but periods of constant voltage during the "rejection" phase. In the *ideal* case the transition from "selection" to "rejection" is abrupt, but in practice this is limited by the non-linearity of the valve characteristic near the cut-off point.

When we come to consider amplitude comparators, the instant of transition is more important

than the shape of the selected wave; the main purpose of the comparator being to determine the *moment of equality* between two waves being compared. The abrupt rise of the selected portion marks an instant of time which can be used as a marker, the subsequent shape of the selected wave being of little importance. A high "voltage rise rate" at the instant when the wave reaches the reference voltage is an important requirement, and this

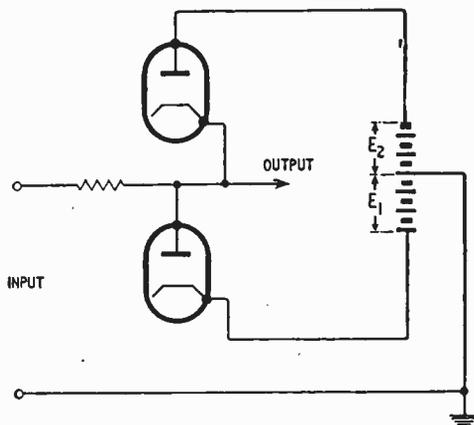


Fig. 7.

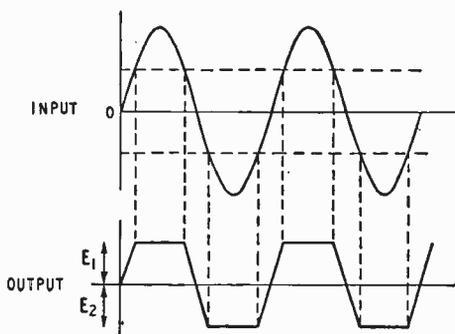


Fig. 8.

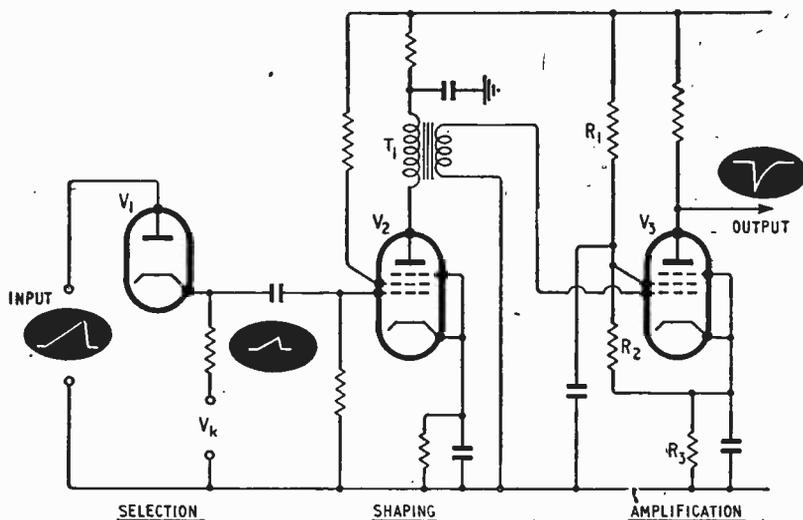


Fig. 9.

can be achieved by "selection" followed by amplification. High-gain amplifiers with positive feedback are sometimes employed to obtain the high voltage rise rate.

A simple diode comparator is shown in Fig. 9. Let us assume that a slowly rising triangular input wave is applied to the selector diode V_1 . The upper portion of the wave is selected (see Fig. 1), differentiation occurs at the grid of V_2 and also by T_1 in the anode circuit of V_2 . V_3 is arranged to be cut off (by the screen potentiometer chain R_3, R_4, R_5) and will only amplify the positive-going trigger pulse at the grid of V_3 which appears as a sharp negative drop at the anode of V_3 . Amplification only occurs, therefore, while the diode V_1 is conducting. The pulse transformer T_1 is connected so as to invert the V_2 anode trigger pulse so that it appears as a positive-going voltage at the grid of V_3 . The resultant trigger pulse corresponds to the instant of selection (neglecting amplifier delay).

A blocking oscillator used as a regenerative output stage is an alternative method of producing the output pulse. This is illustrated in Fig. 10. The input in this case is assumed to be a negative-going step wave which cuts off V_1 . On returning to zero V_1 conducts and a negative signal appears at the anode of V_1 . Differentiation and inversion by the pulse transformer then takes place. The trigger pulse is further amplified by V_2 and applied to the

anode of V_3 which acts as the blocking oscillator. The detailed action of the blocking oscillator will be described in a later instalment, so that here its action as a pulse generator will have to be accepted. A voltage rise rate of 100 volts/microsecond is possible by using this arrangement, either positive-going or negative-going according to whether the output is taken from X or from Y.

Finally, before leaving this section, mention must be made of the process of "time modulation". Suppose that in Fig. 1 the "reference potential" is replaced by a potential which varies relative to V_K in accordance with an input signal. The time T elapsing between the start of the linear rise in (a) and the instant of "selection" (and hence of the derived pulse) will be modulated in accordance with the input signal. This type of modulation often finds an application in the field of radar.

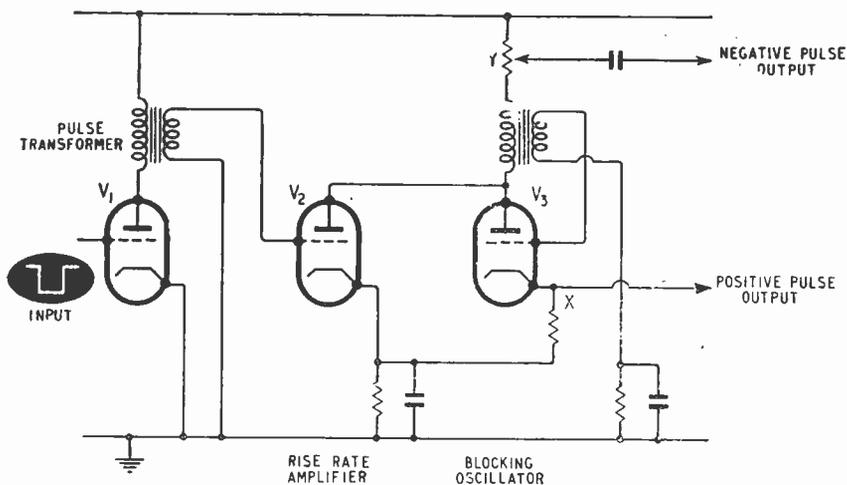


Fig. 10.



MOBILE VIDEO-TAPE RECORDER

Many visitors to the Earls Court Radio Show had their first glimpse of a video-tape recorder in use. On the I.T.A. stand Tyne Tees Television, programme contractors for the North East, were using a mobile version of the standard Ampex machine for recording interviews for subsequent "play back" through the television distribution system in Earls Court. Altogether there are now 25 video-tape recorders, each costing £35,000, being used by the different programme contractors for the I.T.A. Four of them are installed in vehicles. In this photograph R. Jones, supervisory engineer (video tape) of Tyne Tees Television, is adjusting the equipment. It employs 2½-in. tape, which is scanned transversely by four rotating heads spaced at 90° intervals round a drum revolving at 1,500 r.p.m. The tape moves past the head assembly at 15 in/sec.

FINNAGLE'S LAW

SOME APPLICATIONS TO ELECTRONICS DESIGN AND MAINTENANCE

By JACK DARR*

THIS paper is dedicated to those selfless souls who have devoted their lives to explaining the inexplicable, fathoming the unfathomable and unscrewing the inscrutable: the electronics researchers and maintenance men. Their years of experience in correlating the observed results of their experiments with the theoretical predictions have been of incalculable value in preparing this dissertation. For many years, early researchers laboured in ignorance of the fact that there was a valid scientific principle which would account for the wide variations between these two sets of values. Once the basic principle was uncovered, however, and brought into daily use in our electronics laboratories, things progressed much more smoothly.

The basic premise is known simply as "Finnagle's Law." Its basic statement is quite simple: it is this. "If anything can possibly go wrong in a given experiment, it will certainly do so." From this discovery, an extremely large set of axioms, postulates and corollaries have been founded, and verified by exhaustive experimentation. They will be discussed in detail farther along, with especial reference to their application to electronics work, both in the abstruse field of design and in the more mundane application to everyday electronics maintenance (especially in TV repair).

A brief discussion of the origin of this historic discovery might help to clarify matters at this point. The initial "effect" was discovered by Brian Boru a Finnagle, an Irishman residing in Sligo in the 18th century. His efforts to work out a unified field theorem were somewhat vague, since they were mainly applied to such subjects as the behaviour

of dice, the relative speed of horses, and the random distribution of tarot cards, etc. Later in his career, a slightly more scientific and better-controlled experiment enabled the refinement of the First Law, as the result of observation of the behaviour of an experimental formula to a batch of potheen. It was first committed to writing by his eldest son Cleathas, after aiding his immortal father in cleaning up bits of broken glass, potsherds, and ragged sections of copper tubing at the conclusion of the experiment. From these slightly cleaned-up and vague scribbles has come the concept which has been refined and brought forth into the cold light of day as Finnagle's Law.

An historical note here: many other nations have endeavoured to claim a share in the glory of this discovery: France¹, Algeria², Germany³, China⁴ and, of course, the inevitable Russians⁵. These claims are all so patently ridiculous that we have granted them only the dignity of footnotes to the main discussion. It should be quite obvious to all readers of perception that only an Irishman could have worked out such an obscure mathematical principle from such scanty beginnings, and in such circumstances.

The Law, the axioms, and the corollaries thereto have been observed in numerous other fields: physics, biology, mathematics and, most especially, in chemistry. Its specific application to the field of electronics was somewhat surprisingly delayed until early in the 20th century. The fact that there was no science of electronics *per se* before that time should not really have interfered: Finnagle's Law

(Continued on page 415)

* Ouachita Radio-TV Service, Mena, Arkansas.

¹ The French have claimed the discovery for their Pierre Phedelle, a mathematician of Valois. However, while M. Phedelle *did* work out some applications of what has since been anglicized into the "fiddle factor," he had nothing to do with the Law. A fiddle factor is a mathematical innovation much beloved of sophomores in 2nd year calculus, village carpenters, and not a few TV design engineers. Briefly, it is the factor which must be added to the theoretical predictions to make an experiment agree with the observed results. M. Phedelle's original equation for this was:

$$E + T + M + F_f + P = R_o$$

where E = environment, T = time, M = materials, P = process used, F_f = fiddle factor, R_o = observed results.

² There has been a certain amount of natural confusion between this factor and the "diddle coefficient," which is utilized in much the same way. However, the basic difference between the two is that while the fiddle factor is more or less static in application, the diddle coefficient could be called dynamic. Its principal application lies in adjustment of a process by main strength and awkwardness to make results agree with predictions. To the best of our knowledge, it was discovered by a Welshman, Owen Dyddyll, of Llanfuddy-duddy Glamorgan. The French also entered a claim here, for a Breton, the Sieur d'Ydelle, of a small coastal village in Brittany, but it has never been seriously considered among the more erudite students of the Law and its applications.

³ The Algerians have claimed the discovery of the fiddle factor for their candidate, Mohammed Sidi Fhe Dhal, also known as the Mad Moorish Mathematician of al Qahal, but its validity is open to doubt by all serious historians. However, the Mad Moor's name is not without its glory, for his invention of the "portable decimal point," or the "roving point," as it is jocularly called, is greatly favoured among undergraduate mathematics majors, printed-circuit designers, and, most especially, those technical writers who prepare service data and instruction books for i.c.t. equipment. The basic principle has at times been combined with the use of a fiddle factor, to clarify experimental results, especially in all-band TV antenna design work.

⁴ A patently false claim to the discovery of Finnagle's Law has been advanced by the Teutons, with their candidate being a Freiherr von Nagel. This has been summarily rejected by the authorities, together with a still further French claim for a Jean-Pierre v'A-Naigle, as being patently absurd.

⁵ The Chinese have claimed the discovery for a pre-Confucian named 弗兒老哥 roughly translated to Fi Nao Go. However, the basic characteristics of the Law are so foreign to the Chinese and their oriental temperament that no further thought was given to this.

⁶ This, of course, was inevitable. Both Finnagle's Law and the fiddle factor was claimed by the Slavs, in an article in, I think it must have been, *Pravda* last year, basing their claims on a pair of South Kalmucks named Phonaglovich, and Fidelovski. However, the etymological strain necessary for this was so great that even the Russ gave up! This may have been the basis for the development of that characteristic expression, "Nichevo!"

A claim has also been entered by the Americans, with an entirely different candidate. They contend that what the rest of the world knows as the fiddle factor should rightly be known as the "Fudge-Factor," crediting Hieronymus Q. Pfudge, an associate professor of mathematics at Boston University with it. This, it is asserted, was the reason for the popularity of "fudging," both at marbles and among the students taking Chemistry III, who were often accused of "fudging" the results of experiments. However, the similarity between this "constant" and the original Law of Finnagle is so marked that it has been decided to accept it as merely another manifestation of the original principle.

and electronics are so obviously made for each other.

The Law and the basic Constants have been carefully studied over many years by some of our most painstaking researchers, both in physical and psychological phenomena. It was even thought for quite a while that the Law had a metaphysical basis, akin to telekinesis: a sort of modified "death-wish" on the part of the scientist. The phenomena themselves have been under observation for many years. Actually, they were thought at first to be merely manifestations of an earlier theory, dealing with the I.P. of I.O. (The Innate Perversity of Inanimate Objects). There is a sound basis for this conjecture, based on thousands of carefully recorded experiments. Early research men, however, completely failed to recognize that there was a definite correlation between the perverse behaviour of their experiments and a simple natural Law. (Thus neglecting William of Occam's Razor entirely.) It was only with the discovery and clarification of Finnagle's Law, the derivation of the Axioms, with their Corollaries, and the associated Constants and Factors (see footnotes) that an explanation of the mysterious behaviour was obtained.

While the I.P. of I.O. can account for a large number of cases, a more modern development finds its greatest application in the field of electronics. This is the I.C. of E.A. (the Inherent Contrariness of Electronic Apparatus). In the field of electronic maintenance, this is often made more complex by a similar factor, the N.S. of E.T. (The Native Stupidity of Electronics Technicians). Actually, a personal study of case histories over a period of some thirty years has brought forth the following findings: they seem to be about equally divided between the two. (This is especially valid if the sampling process is carried out over a period of time long enough to allow for natural fluctuations in the curves: the effects of Monday mornings, work done after hours on Saturday nights, indigestion, printed circuits, and the like.)

Herewith follows the basic Laws, Constants, Axioms and their Corollaries, reduced to tabular form, in order to conserve space and paper. This is, of course, not a complete list by any means: this covers only the personal experiences of the writer and his associates. Any others sent in will be happily added to the list, for the benefit of future generations of electronics technicians.

FINNAGLE'S LAW:

(Specific Applications thereof to Electronics)

I. Service Data

In a schematic diagram, the voltage readings that are blurred and illegible will be those for the stage on which you are working.

Corollary 1.—If a decimal point is missing in a voltage reading, it will be in the most critical stage in the set.

Corollary 2.—In the one TV set out of 1,000 which really is in need of re-alignment, the alignment adjustments given in the service data will be mislabelled; traps shown as alignment adjustments, and vice versa.

Corollary 3.—If a twin-triode tube is used in the stage you are working on, the pin-numbering of the two halves will be reversed on the schematic; leading

you up some wonderfully scenic garden paths as to voltages, resistance, etc., before you discover the truth.

II. Design features.

1. The inaccessible, very hot tube which requires 15 minutes to remove and replace will always be perfectly good.

2. The paper capacitor which is copiously sweating wax, discoloured, and with obviously loose leads, is perfectly good: the brand-new unit, nearby, is the defective one.

3. The resistor which is burned until its colour bands are entirely illegible retains its exact value as given in the schematic: the one next to it, shining and new, measures about three times normal.

III. Diagnosis.

1. If the TV screen is white and black, a defect will be immediately diagnosed in the signal channel; r.f., video i.f., video amplifier, etc. If the tubes are replaced, in order, beginning at one end of the chain, the defective tube will be the last one at the other end.

Corollary 1.—This holds true no matter which end of the chain you begin with.

Corollary 2.—If you attempt to begin in the centre, to circumvent the Law, or to test the end tubes first, the dead tube will always be the last one tested.

(Sub-Section I, which follows, is for special application to series heater strings)

Axiom.

1. If there is a dead tube in a series heater string, rendering the set completely inoperative, it will always be the last one tested.

Corollary 1.—If the technician removes a tube near the centre of the string, in order to facilitate location of the open one, by taking resistance measurements to either end of the string, the tube removed to make the test will be the open one.

Corollary 2.—This is true, unless, in a vain attempt to circumvent the Law, he tests this tube first; in this case, it will be perfectly good; the trouble will be found in an open mains cord.

Corollary 3.—If the TV set uses two sets of series heater strings, the last tube tested in the second string will be the defective one.

Further Axioms applicable to series-heater sets.

I. Defects, the location of which could be immensely speeded up by removing one tube at a time, leaving the rest in operation, will always predominate in series-heater sets.

II. If a tube has an intermittently open heater, and a voltmeter is applied across each heater in turn in order to find it, it will always be the last tested.

Axioms applicable especially to intermittent sets.

I. If a TV set has an intermittent defect, it will not show up at all on your test bench.

Corollary 1.—It will recur, however, as soon as you have returned the set to its owner. Statistics indicate that this occurs within 5 to 20 minutes after you have returned to the shop.

Corollary 2.—Variation: Saturday nights. Defect

shows up approximately 5 minutes after you have reached home; after a very exhausting day.

Corollary 3.—If, upon a careful examination of the chassis, several defective parts are discovered, carefully tested, and replaced, none of them will be in any way connected with the intermittent trouble.

Corollary 4.—In diagnosing intermittent troubles, the actual part causing the trouble will always be as far removed as is physically possible from the stage or stages definitely indicated by the visible symptoms.

Corollary 5.—(Sub-class.) It is entirely impossible to make any kind of a valid diagnosis of the trouble from the symptoms.

Axiom.

Whenever a new TV antenna has been installed to replace an older outmoded model, a solar prominence, dust storm, or other meteorological freak will immediately cause the viewer's average signal level to drop an average of 60%, for at least two weeks.

Axiom.

The new customer who comes to your shop because you have repaired her neighbour's TV sets for a very nominal charge will always have a bill of at least £15.

Axioms, general; Shop work.

I. The sets which are the most difficult to replace in their cabinets will always be the ones upon which the knobs have been left.

Corollary 1.—These are also the sets which, after all screws and knobs have been replaced, have a large black thumbprint near the centre of the c.r.t. screen: they also will have a solidly fixed front glass.

Corollary 2.—These sets also, during the removal from their cabinets, always have speaker leads, antenna leads, still connected. This is never discovered until the chassis is in its most precarious state of balance, with the picture tube teetering on the edge of the bench.

Corollary 3.—The sets which utilize the most unusual, complicated and outré circuitry will always be the ones without even a blurry rubber-stamped model number on the chassis for identification purposes.

Further Axioms and Corollaries (Spare, if needed) Axiom.

If seven TV sets have been repaired, one of which has been completely overhauled, all weak valves replaced, suspicious parts changed, etc., while the remaining six have needed only one valve each, which TV set will fail, within a period of two hours after delivery to the owner? (Set No. 1: the completely overhauled one.)

Corollary 1.—If five service calls have been made, four within a few streets of the shop, the last 8 miles out in the country, which set will break down during that evening's viewing? (The last: the one 8 miles out in the country.)

Axiom.

The likelihood of failure of a newly overhauled

TV set will increase logarithmically with the distance to the shop, and the amount of the service charges.

Axiom.

The set which has been "cooked" on the bench all day, to find a suspected intermittent condition, will upon return to its owner, show up the intermittent condition as a broken lead-in cable.

CLUB NEWS

A.R.M.S.—A national organization has been formed for mobile radio operators which is to be known as the Amateur Radio Mobile Society. At the inaugural meeting some 70 operators of mobile stations were present. The chairman is R. G. Shears (G8KW) and G. E. Storey (G3HTC), of 10, Avon Road, Sunbury-on-Thames, Middx, is secretary.

Bexleyheath.—October meetings of the North Kent Radio Society, which meets on alternate Thursdays at 8.0 at the Congregational Hall, Chapel Road, Bexleyheath, will be devoted to operating practice (8th) and the I.G.Y. and the radio amateur by G. M. C. Stone, G3FZL (22nd).

Birmingham.—"Non-destructive Testing Techniques" is the title of the lecture to be given by L. T. Perriam, of I.C.I., at the September 25th meeting of the Slade Radio Society which will be held at 7.45 at the Church House, High Street, Erdington.

Bradford.—At the September 22nd meeting of the Bradford Amateur Radio Society H. D. Kitchin will deal with the interpretation of valve data. Meetings are held at 7.30 at Cambridge House, Little Horton Lane, Bradford 5. On October 6th there will be a Mullard film meeting in St. George's Hall, Bradford.

Cambridge.—R. Kerley (G3MIK) of St. Johns College is chairman and D. B. Smart (G3MGB) of Clare College, secretary of the Cambridge University Wireless Society for the academic year 1959/60. The society will have an exhibit at the Societies' Fair held at the beginning of the Michaelmas Term. A programme of lectures is being arranged for the term's meetings to be held in the Cavendish Laboratories at 8.15 on Tuesdays.

Derby.—Demonstrations of stereophonic equipment have been arranged for the October 21st meeting of the Derby and District Amateur Radio Society, at 7.30 in Room 4, 119 Green Lane, Derby.

Dorking.—Meetings of the Dorking and District Radio Society are held on the 2nd and 4th Tuesday of each month at 8.0 at the Star and Garter Hotel. On October 27th C. Crook (G5BT) will speak on amateur radio in America.

Locking.—The R.A.F. Amateur Radio Society (G8FC) which now has its headquarters at No. 1 Radio School, Locking, Somerset, comes of age this year. Corporate membership is open to all serving members of the R.A.F. and associate membership to retired Air Force personnel. Civilian employees in the Air Ministry are also eligible for membership. The patron of the Society is Air Marshal Sir Raymond Hart (retd.), the new director of the Radio Industry Council. The Society's bi-annual magazine is entitled "QRV."

Nottingham.—The inaugural meeting of a tape-recording club for the Nottingham area was held on September 3rd. Details may be obtained from Norman D. Littlewood, 129, Standhill Road, Nottingham.

Radio Amateurs' Examination.—The report on the 1958 Radio Amateurs' Examination recorded an improvement in the general standard of the candidates' work compared with the previous year. Of the 716 who sat the examination 518 (72%) passed compared with 67% of the previous year's 562 entrants.

World Tape Pals, of Dallas, Texas, U.S.A., recently appointed L. W. Watkins, of 40, Ravenslea Road, London, S.W.12, as U.K. representative following the resignation of Dr. R. Smallwood.

FORTHCOMING MEETINGS

Tickets are required for some meetings; readers are advised therefore to communicate with the secretary of the society concerned.

LONDON

Sept. 24th. Armed Forces Communications & Electronics Assoc.—“Communications and electronics in an allied command” by Major General V. A. Conrad, chief signal officer, SHAPE, at 7.0 at the Columbia Club, Lancaster Gate, W.1.

Sept. 30th. Brit.I.R.E.—“Microwave valves: a survey of evolution, principles of operation and basic characteristics” by W. E. Willshaw and C. H. Dix at 6.30 at London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

Oct. 1st. Television Society.—“Single-gun v. three-gun tubes: their influence on colour receiver design” by R. N. Jackson (Mullard Research Laboratories) at 7 at 164, Shaftesbury Avenue, W.C.2.

Oct. 7th. Brit.I.R.E.—“Some reflections on computer design” by W. Renwick at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

Oct. 9th. I.E.E.—Presidential address by Sir Willis Jackson at 5.30 at Savoy Place, W.C.2.

Oct. 14th. I.E.E.—Education Circle discussion on “Graduate training in industry” opened by W. H. Taylor at 6 at Savoy Place, W.C.2.

Oct. 14th. Brit.I.R.E. Students' meeting.—“The use of transistors in communication and control” by E. Wolfendale at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

Oct. 14th. Society of Instrument Technology.—“An automatic analogue computer for missile homing investigations” by J. G. Thomason at 7.0 at Manson House, 26 Portland Place, W.1.

Oct. 16th. R.S.G.B.—“Practical applications of transistors for the radio amateur” by a representative of Newmarket Transistors at 6.30 at the I.E.E., Savoy Place, W.C.2.

Oct. 16th. Junior Institution of Engineers.—“Programming a computer” by A. C. Quarterman at 7.0 at Pepys House, Rochester Row, S.W.1.

Oct. 16th. B.S.R.A.—“Looking at stereo—on a C.R.O.” by Bernard Shelley at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2.

Oct. 22nd. I.E.E.—“The transmission of news film over the transatlantic cable” by C. B. B. Wood and I. J. Shelley at 5.30 at Savoy Place, W.C.2.

Oct. 22nd. Television Society.—“Discussion on ‘New television standards: their effect on British TV’” at 7 at 164, Shaftesbury Avenue, W.C.2.

Oct. 22nd. Institution of Production Engineers.—“Computers as applied to production control” by B. L. J. Hart at 7.0 at the Royal Commonwealth Society, Northumberland Avenue, W.C.2.

Oct. 27th. I.E.E.—Measurement and Control Section discussion on “Future trends in memory stores for high-speed digital computers” opened by W. Renwick at 5.30 at Savoy Place, W.C.2.

BRISTOL

Oct. 7th. Brit.I.R.E.—“The drift of electronics” by Capt. L. Hix, R.N., chairman of South Western Section, at 6.30 at School of Management Studies, Unity Street.

CAMBRIDGE

Sept. 29th. I.E.E.—“The uses of network theory” by Dr. K. F. Sanders at 8 at the Engineering Laboratory, Trumpington Street.

Oct. 13th. I.E.E.—“New amplifying techniques” by C. W. Oatley at 8 at Cavendish Laboratory, Free School Lane.

CHELTENHAM

Oct. 2nd. Brit.I.R.E.—“Loudspeakers” by F. H. Brittain at 7.0 at North Gloucestershire Technical College.

Oct. 5th. Society of Instrument Technology.—“Record reproduction equipment” by E. W. Mortimer at 7.30 at the Belle Vue Hotel.

CHESTER

Sept. 24th. Society of Instrument Technology.—“Feedback—the principle of control” by R. S. Medlock (president) at 7.0 at the premises of the English-Speaking Union of the Commonwealth, Stanley Place, Watergate Street.

FAWLEY

Oct. 2nd. Society of Instrument Technology.—“Feedback” by R. S. Medlock (president) at 5.30 at the Administration Building, Esso Refinery.

MIDDLESBROUGH

Oct. 15th. Society of Instrument Technology.—“An ultrasonic flowmeter” by R. E. Fischbacher at 7.30 at the Cleveland Scientific and Technical Institute, Corporation Road.

NEWCASTLE

Oct. 14th. Brit.I.R.E.—“True motion radar” by A. Harrison at 6.0 at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road.

Oct. 19th. I.E.E.—North-eastern Measurement and Electronic Group chairman's address by C. C. Baxendale at 6.15 at Rutherford College of Technology.

NOTTINGHAM

Oct. 15th. Society of Instrument Technology.—“The atomic clock” by Dr. L. Essen (N.P.L.) at 7.15 at the University, University Park.

OXFORD

Oct. 7th. I.E.E.—“New methods of exploiting electronic computers in the industry” by H. McG. Ross at 7 at the Southern Electricity Board Service Centre, 37, George Street.

STONE

Oct. 9th. I.E.E.—“The use of information in control systems” by A. Asbury (chairman, North-Staffordshire sub-centre), at 7 at Duncan Hall, Stone.

TREFOREST

Sept. 30th. Brit.I.R.E.—“The use of demonstration equipment in basic radio theory” by H. Henderson at 6.30 at Glamorgan College of Technology.

WESTON-SUPER-MARE

Oct. 7th. Brit.I.R.E.—Symposium on “The training of radio apprentices” at 10.30 and 2.15 arranged in conjunction with the R.A.F. Radio Apprentices School, at Locking, near Weston-super-Mare.

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RANDOM RADIATIONS

By "DIALLIST"

Radar Returns from Venus

THE establishment of radar contact with the planet Venus last year by the Massachusetts Institute of Technology was a remarkable feat but even more remarkable was the evaluation of the results by electronic computer. Venus is about 100 times farther away from us than the moon and it is estimated that the power in the pulses reaching it was of the order of 0.25 watt; that in the returning echoes it was no more than 10^{-20} watt. As the out and home time was expected to be about five minutes, trains of pulses at the rate of 30 per second were transmitted for $4\frac{1}{2}$ minutes. Even with maser amplification the returning echoes were so drowned by noise that no single pulse of the 8,000 transmitted in $4\frac{1}{2}$ minutes could possibly produce a strong enough signal to be measured; but a whole pulse train should cause the mixture of noise and pulses to show a minute increase in strength. The signals were therefore recorded and fed into a computer. Months of work were needed for comparing the recorded patterns, but eventually no fewer than 600 pulse trains were identified with a less than one in ten million chance of error. The experiments are to be repeated this month and if these confirm the results already obtained, the astronomical unit—the mean distance of the earth from the sun in its orbit—will need a slight correction, for it will have to be reduced by some 1,200 miles. Since distances of bodies in the solar system are now usually given in parsecs and are related to the radius of the earth's orbit, they will be more accurately expressed than ever before, thanks to radar contact with Venus.

Refrigeration by Thermo-electricity

A GREAT deal of work on the development of thermo-electric appliances is going forward both in this country and in America. The two applications now mainly being studied are refrigeration and the generation of current. In 1954 the Armour Research Foundation began to study the possibility of producing thermo-electric refrigerators for industrial and domestic use. The basis of the process is the use of the Peltier

effect: if a junction of two dissimilar metals is placed in a circuit and an electric current is made to flow, one metal becomes warmer than the general temperature of the conductors and the other cooler. The snag is that heat flows from the warmer metal round the circuit and tends to increase the temperature of the cooler member of the junction. So long as metals were used little progress could be made, for those which are good conductors of electricity are also good conductors of heat. Then semiconductors came along and the outlook at once became brighter. By careful doping of the semiconductors (lead telluride and bismuth telluride have so far given the most promising results) a satisfactory compromise between good electrical conductivity and low heat conductivity can be achieved. Ten years ago the best that could be done was to cool a container to about 10°F below room temperature; today temperatures down to -40°F have been reached.

Power Too

At the same time the thermo-electric generator of power seems to be coming along quite nicely. The U.S. Navy Bureau of Ships has placed a contract for the supply of a 5kW generator with the Westinghouse Electric Corporation. This is the largest generator of this type so

far. The hot part of the thermo-junction will have its temperature maintained by oil burners; the other part will be water cooled. It is hoped to be able to use sea water for the purpose, but if this isn't satisfactory, fresh water will be used and cooled by sea water in a heat exchanger. The design is to aim at the quietest possible running and to combine maximum resistance to shock and vibration.

'Ware Live Chassis

NOT long ago a serviceman was electrocuted while repairing a television set. Sometimes I wonder that there aren't more of such tragedies, for servicemen, and amateurs too, for that matter, are apt to take quite unnecessary risks with live chassis sets—the TV set that isn't of that type is a rarity nowadays. Many a time I've seen men get to work on a set without taking the trouble to see whether the chassis is connected to the neutral or not; and in the home with an a.c. supply and 2-pin sockets it's a fifty-fifty chance whether this is so or whether it's connected to the "live" side of the mains. Everyone, amateur or professional, who makes adjustment inside a set when it's switched on should make a particular point of verifying with a neon tester that the mains connections are as they should be before he does anything else. Even



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if a set is switched off, it isn't safe to take it for granted that the switch is in the right "leg". When I moved into another house some years ago I went round the wall sockets and lampholders and found that several of the switches were wrongly wired.

Interesting Reading

AS usual, the annual report of the E.R.A. (the British Electrical and Allied Industries Research Association, to give it its full style and title) makes interesting reading. It records, for instance, some important work carried out on magnetic materials. It has been established that nitrogen is a far more deleterious impurity than carbon in silicon iron transformer sheet and two ways of minimizing this are under examination. The first is to coat transformer laminations, before annealing, with a thin layer of aluminium. In experimental transformers this process has shown a substantial reduction in hysteresis loss. The second way is to make use of the modifying influence of titanium. If it is found possible to introduce commercially a minute amount of titanium without increasing the nitrogen content and without increasing the danger of oxidation, then this will provide a method of reducing the effect of nitrogen. It has not hitherto been possible to produce high purity alloys containing manganese and sulphur with any but a weak and rather unstable texture; but it has now been found that alloys of satisfactory texture and with good magnetic properties can be made. Much good work has been done, too, on investigating interference with wireless reception caused by car ignition systems and by radiation from industrial r.f. equipment.

More Test-card C, Please

MY sympathies are entirely with those who call for more test-card transmissions and fewer still pictures during non-programme hours. It is then that the majority of new sets are installed and that adjustments are made by most of us to our existing receivers. Without the test-card on the screen you can't successfully carry out many of those delicate adjustments which make so much difference to reception. You need pictures as well, but not too many of them. If the e.h.t. regulation of a set is poor, the test-cards with their white and light grey areas may give rise to an abnormally large image. Then when a picture comes on it may not quite fill the screen.

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Why Not Archode?

IN THE olden days before the B.B.C. and before many of my readers were born we relics of a past age used to speak unashamedly of the capacity of a condenser, and we spoke also of a 40 plate and a 20 plate variable condenser when we meant a capacitor of 0.001 mfd and 0.0005 mfd respectively. In those days, of course, 0.001 mfd was quite a normal value for a tuning capacitor.

Similarly, a tuning coil of 200 microhenries which was ideal for receiving 2LO was known to us as a 50 turn coil, and was wound on a cardboard former of 3 inches diameter. In those days we were equally unscientific when speaking of the innards of a valve which we called grid, plate and filament. Those of us who were in London bought many of our bits and pieces in Lisle Street near Leicester Square. One of the best known of the radio dealers there was, I recollect, an outsized lady for whom we all had a great affection even though in moments of irritation she would make "sinister" remarks about our ancestry.

Eventually the more learned of us—or those of us who thought we were more learned—began to speak of microfarads and microhenries. After a time, the "turn" and the "plate" disappeared as units of inductance and capacitance, and nowadays a complete swing-over has been made to scientific nomenclature.

But there still remains an ancient relic of forty years ago which has refused to bow the knee to the Baal of technical terminology; it stands

out like a lone monument of those great days of long ago when every reader of *Wireless World* built his own set, and would have been ashamed to send out for the local dealer to repair a fault.

I refer, of course, to the grid of the valve which still holds its head up proudly among such genteel etymological upstarts as the cathode and anode. Why was it I wonder that the grid of the triode was allowed to keep its ancient name instead of being renamed the archode (hard "ch," please) or control-ode.

Can anybody tell me why this anachronism is not only allowed to persist but has been allowed to multiply in step with the increasing number of grids in our valves? The other grids could not, of course, have been called by the name archode but without exception they could all have been given appropriate names ending in "ode."

Monodic Murmurings

MY suggestion that the radiation of sound by ordinary single, audio channel methods be termed monodic transmission to distinguish it from its stereophonic counterpart and the support given to it by the Editor, have met with strenuous but totally unjustified opposition.

There are in the first place the advocates of the dreadful word monophonic who were so ably represented by Mr. E. L. E. Pawley in the correspondence pages of the July/August issue. I replied to his mistaken advocacy there and so will say no more here.

The other school of thought, of which Mr. W. Thurlow Smith was the chief protagonist in the correspondence columns of the last issue,

tries to rule out monodic on the ground that this adjective is already in use with another meaning.

So indeed it is, but it is a very little-used word, being the adjectival form of "monody" which is itself not exactly a household word. The final part of this word comes, of course, from the Greek "ode" ($\omega\delta\eta$) meaning a song or ode, whereas the word I suggested comes from the Greek "hodos" ($\eta\delta\omicron\varsigma$) meaning a path.

Now if we look in a dictionary we shall find several instances of words of the same spelling but of different meaning and derivation. A typical example is the adjective "lowering." If we speak of "the news having a lowering effect on prices" are we likely to confuse this use of lowering with the other one where we speak of a lowering sky on the approach of a storm?

These two similar words have a totally different meaning and also a different derivation, the "lowering [frowning] tempest" is to be found in Shakespeare (Richard II) with the spelling "lowring," although certain editions of Shakespeare give the less correct modern spelling.

There are many other words such as riddle (conundrum) and riddle (sieve) which can only be differentiated by the context in which they are used. Must we give up asking each other riddles at a Christmas party in case some befuddled member of it might think we were talking about sieves?

I feel that the word monodic is fully justified from all points of view.

Audion

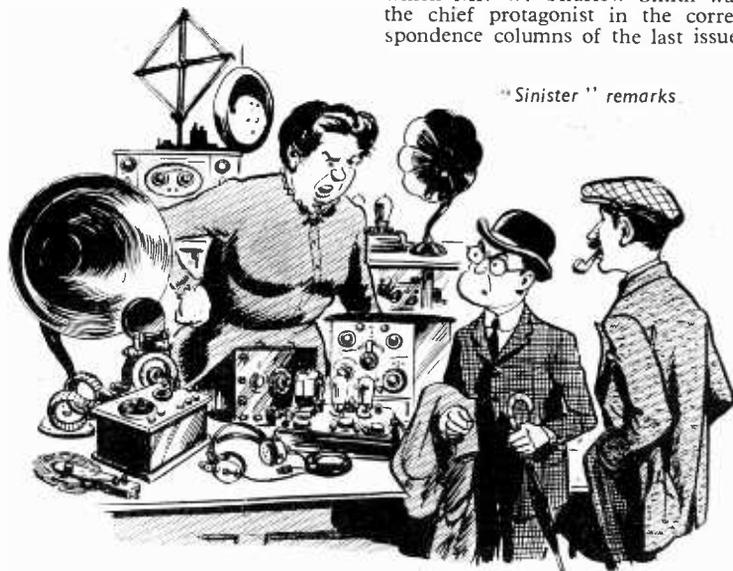
I WONDER if any of you can tell me the true derivation of the word Audion which de Forest gave to his triode valve. It does not fall into the category of a mere trade name given by a manufacturer to his version of a certain product.

On first thoughts we might be tempted to say it has something to do with the Latin verb Audio. But it was not the first device for making radio waves audible, if I may so put it; nor did de Forest intend to mean that the device was mainly intended for use in audio-frequency circuits.

For the same reason I cannot see that it is a combination of "Aude" ($\alpha\upsilon\delta\eta$) one of the many Greek words meaning vocal, with the word "ion" meaning basically something to do with going and which Faraday used in his words "cation" and "anion" to mean the particles which went to the cathode and anode respectively in electrolysis.

We can permissibly stretch the meaning of "ion" a bit so that the word Audion means "voice-producing" but that had already been done by the magnetic detector and the crystal. But I think that de Forest did not choose the word idly, but what had he in mind?

"Sinister" remarks.





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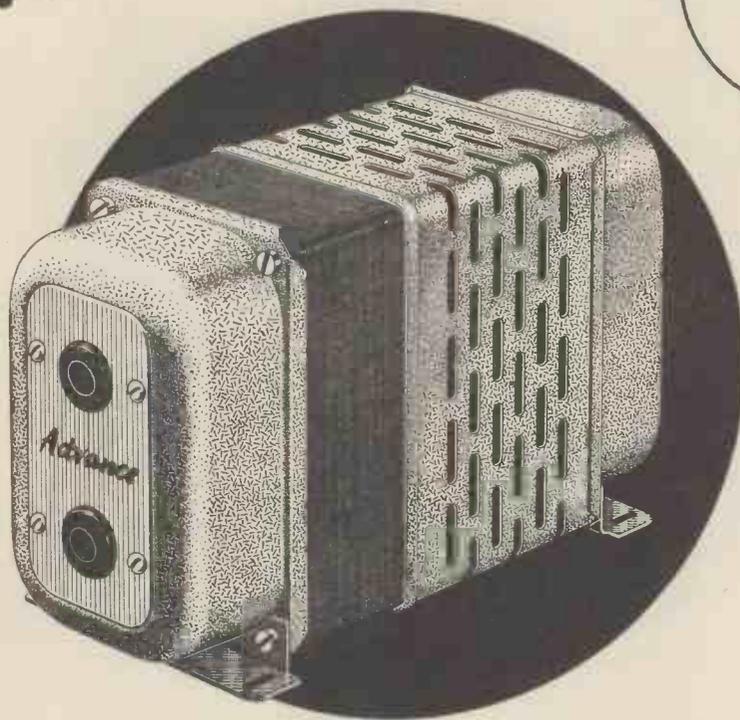
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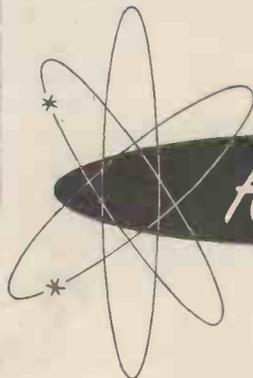
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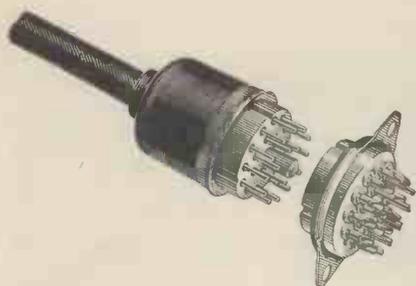


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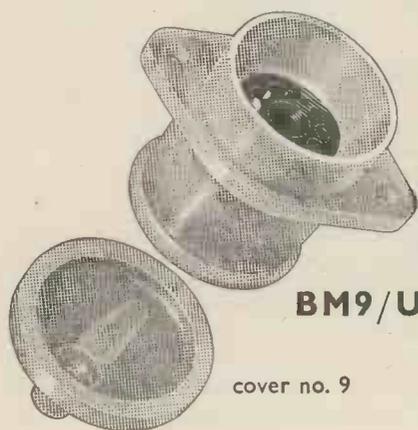
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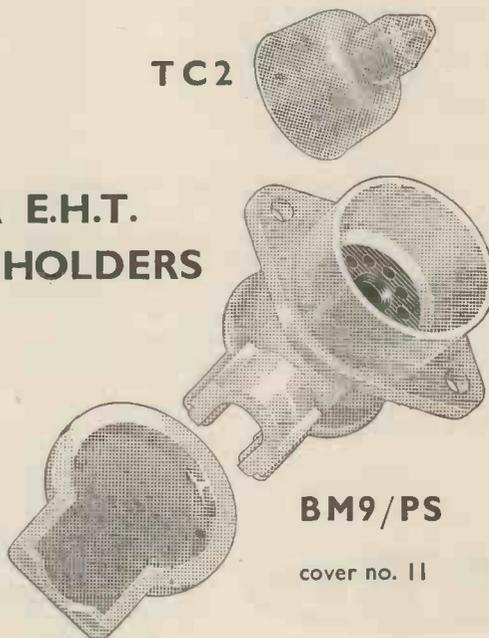
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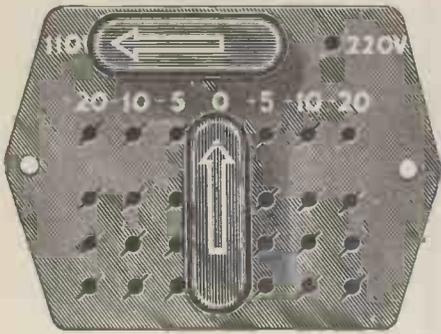
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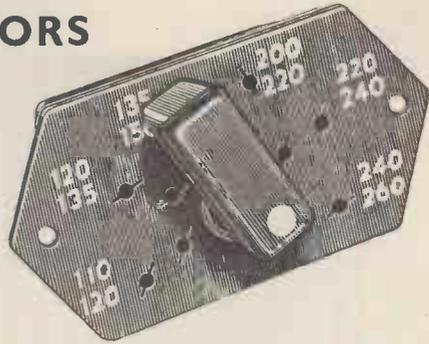
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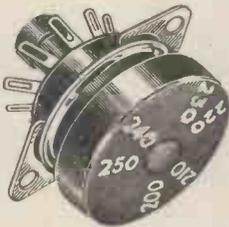
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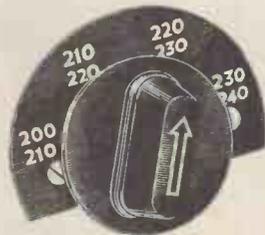
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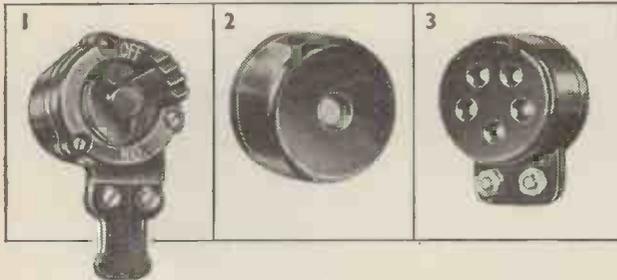
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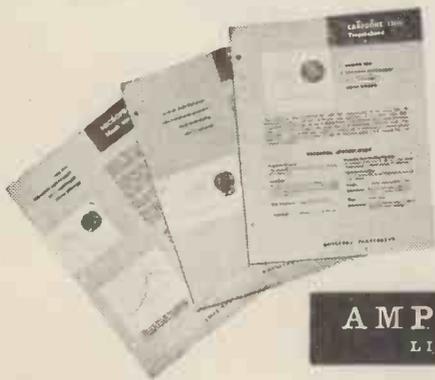
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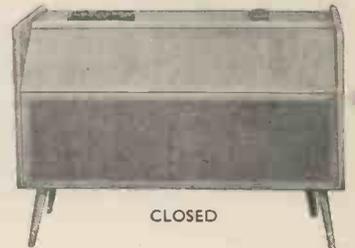
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S-88	Hi-Fi Stereo Amplifier Kit	UJR-1	Dual-Wave Transistor Radio
S-33	6-Watts Stereo Amplifier Kit	S-3U	Electronic Switch Kit
UXR-1	Transistor Portable Kit	309-CU	R.F. Probe Kit
DX-40U	"Ham" Transmitter Kit	DX-100U	Amateur Transmitter Kit
O-12U	Sin. Oscilloscope Kit	—	Matched Hi-Fi Stereo Kit
V-7A	Valve Voltmeter Kit	RP-UI	Transcription Record Player
SSU-1	Hi-Fi Speaker System Kit	—	Gloucester Stereo Cabinet Kit
AG-9U	Audio Signal Generator Kit	—	Cotswold Speaker System Kit
C-3U	Resistance-Capacitance Bridge Kit	—	Hi-Fi F.M. Tuner
VF-IU	Variable Frequency Oscillator Kit	CM-IU	Capacitance Meter Kit.
USP-1	Stereo-Head Booster Kit		

NAME ADDRESS

(In CAPITAL letters please)

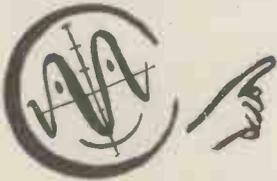
W.W.9

DAYSTROM LTD.

DEPT. W.W.9. GLOUCESTER, ENGLAND

THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

Transistorized Power Units

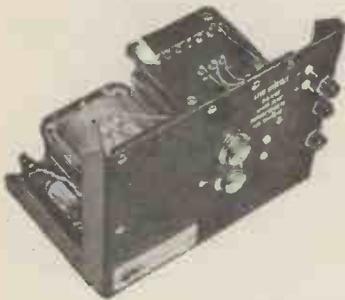


**HIGHLY STABILIZED OUTPUT
VERY LOW OUTPUT IMPEDANCE
VERY SMALL RIPPLE CONTENT**

MODEL 1328 LABORATORY POWER UNIT

Model 1328 provides a continuously variable output monitored by two front-panel, mirror-scale, voltage and current meters. It is eminently suitable for use in the design stage of transistor circuits where a power supply of high purity is essential.

Output: 0-30V at 1A.



(chassis mounting)

MODELS 1326 & 1329 LOW VOLTAGE POWER UNITS

The 6V Transistorized Power Unit Model 1326 is an ideal supply for transistor d.c. amplifiers, transistor pulse-technique circuits and filaments of thermionic valve amplifiers, particularly in low-level microphone stages.

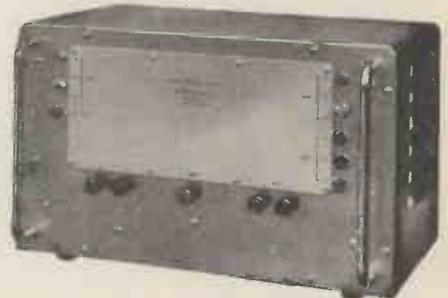
MODEL 1326
Output: 6V at 0.2A.

MODEL 1329
Output Voltage: Continuously variable 5V-10V.
Output Current: 0-1A in range 5V-9V
0-0.5A at 10V.

MODEL 1327 BATTERY ELIMINATOR

The Battery Eliminator Model 1327 has been designed primarily to power the Cossor Pre-amplifiers, Models 1430, 1434 and 1440, but it can be used in many other applications requiring a power unit to provide high and low tension supplies.

L.T. Supply: Output 6V-6.5V at 1.7A.
H.T. Supply: Output 120V at 15mA.



Please send for the latest Cossor Catalogue or ask for a representative to call and discuss your special requirements.

COSSOR INSTRUMENTS LTD

The Instrument Company of the Cossor Group

COSSOR HOUSE, P.O. BOX 64, Highbury Grove, London, N.5.

Telephone: CA Nonbury 1234 (33 lines).

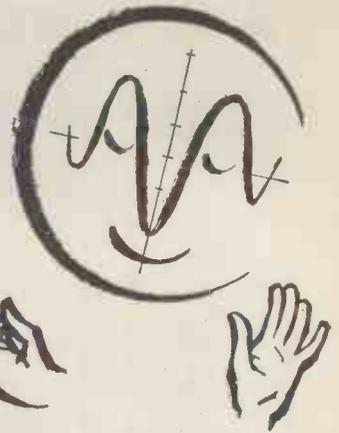
Telegrams: Cossor, Norphone, London.

Cables: Cossor, London.

Codes: Bentley's Second.
TAS/CI.18

Four first-class performers

These four Cossor Oscillographs, each designed for an important range of applications, offer first-class performance backed by rigid adherence to published specifications.

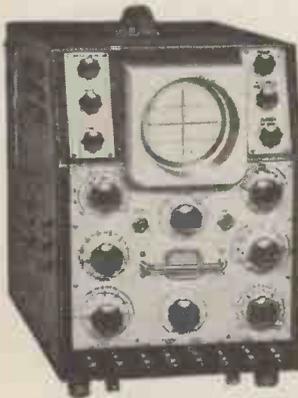
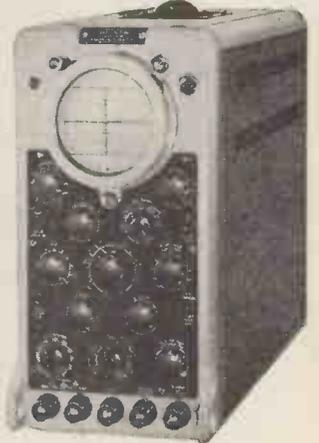


MODEL 1065 PULSE OSCILLOGRAPH

Tube: single-beam, P.D.A.
Bandwidth: d.c. to 15 Mc/s (—50%).
Sensitivity: 250 mV/cm.
Overshoot: less than 3%.
Time-base: triggered or repetitive over range 40 cm/sec to 5 cm/μsec.
X Amplifier: gain 5, continuously variable.
Time-base delay: 2 ranges, continuously variable.
Calibration: voltage and time, by calibrated shifts
 Probe: 1.5 MΩ, 12 pF

MODEL 1058 FOR THE TV & RADIO ENGINEER

Tube: single-beam
Bandwidth: d.c. to 6 Mc/s (—50%).
Sensitivity: 250 mV/cm.
Time-Base: triggered or repetitive, over range 30 cm/sec to 1.5 cm/μsec.
 Special facilities for triggering from TV line or Frame pulses on IV.D.A.P. composite video waveform.
X Amplifier: gain 5, continuously variable.
Calibration: time and voltage calibration facilities.



MODEL 1049 INDUSTRIAL DOUBLE-BEAM OSCILLOGRAPH

Y Amplifier: A1: d.c. to 200 kc/s (—30%) at gain 900; A2: d.c. to 400 kc/s (—30%) at gain 30.
Time-Base: repetitive or triggered in 18 ranges, down to 7.5 sec/sweep.
Intensity modulation: three modes including beam bright-up.
Calibration: time and voltage, by calibrated shift (X and Y1) and multiplier (Y2).



MODEL 1035 GENERAL PURPOSE DOUBLE-BEAM OSCILLOGRAPH

Y Amplifiers: A1: 5 c/s to 5 Mc/s (—30%), Maximum gain 3,000. A2: 5 c/s to 250 kc/s (—30%) at gain 30, with trace inversion facility.
Time-base: repetitive or triggered in 9 sweep ranges from 100 msec to 10 μsec. Time-base delay and pulse bright-up facilities.
X Amplifier: gain 5, continuously variable.
Calibration: voltage and time, by calibrated shifts.

Let us send full details of Cossor Instruments or arrange for a representative to discuss your special needs.

COSSOR INSTRUMENTS LTD

The Instrument Company of the Cossor Group

COSSOR HOUSE, P.O. BOX 64, Highbury Grove, London, N.5.

Telephone: CANonbury 1234 (33 lines)

Telegrams: Cossor, Norphone, London.

Cables: Cossor, London.

Codes: Bentley's Second. TAS/C1.19

'A new standard of quality, by which other machines will be judged'

Angus McKenzie in TAPE RECORDING AND HI-FI MAGAZINE



* Automatic, in the Simon sense, is meant to be taken literally: it means continuous replay—the machine stops, reverses and changes to the other track with only a two-second pause, and with no necessity to touch any control. Similarly, up to three hours' continuous recording can be made without attention, the machine automatically stopping at the end of the second track.

This is the enthusiastic opinion of an expert, an independent reviewer, after thoroughly testing the Simon S.P.4. Throughout the Hi-Fi world, this superb new tape recorder, with its combination of high performance and range of exclusive features, is sparking off similar praise from those who have seen and heard it. Look at this list of star features—then come and see it for yourself at your nearest dealer—try it, test it and you too will join the crowds of Simon enthusiasts.

SIMON AUTOMATIC DECK fully 'push-button controlled'

AUTOMATIC TAPE REVERSAL without touching controls

3-WAY MIXING FACILITIES on both record and playback
BASS AND TREBLE LIFT AND CUT with independent controls

REMOTE CONTROL FACILITIES on both record and playback

HIGH QUALITY MONITORING Paired bass and treble loudspeaker units

10 WATTS OUTPUT from ultra-linear push-pull amplifier

PUSH-PULL OSCILLATOR for noise and hum suppression

ACCIDENTAL ERASURE PREVENTION by special record 'safety button'

ACCURATE TAPE POSITION INDICATOR based on linear tape scale

'PIN-POINT' MODULATION with cathode ray magic eye

simon S.P. 4

incorporating the new Simon fully automatic deck

and you can replay stereo, too
with the
SIMON STEREO ADAPTOR

You can convert the SP4 for stereo at any time—and enjoy the brilliant realism in reproduction which only SP4 performance plus stereo can give. The Simon Stereo Adaptor replays pre-recorded tapes to CCIR specification and has full tone control as in SP4. Complete with amplifier and bass and treble speakers matching those in the SP4, **PRICE 49 gns.**

Your Simon Dealer would be pleased to arrange H.P. terms.

95 gns.

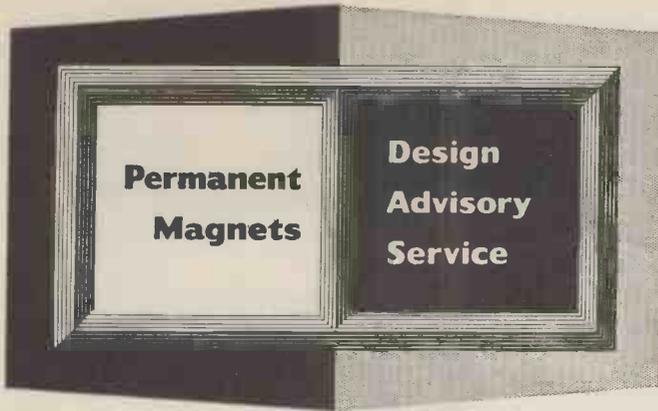
Choose Simon for Sound

Write for leaflet (F9) to:

SIMON SOUND SERVICE LTD.

46-50 George Street, Portman Square, London W.1.

No. 16

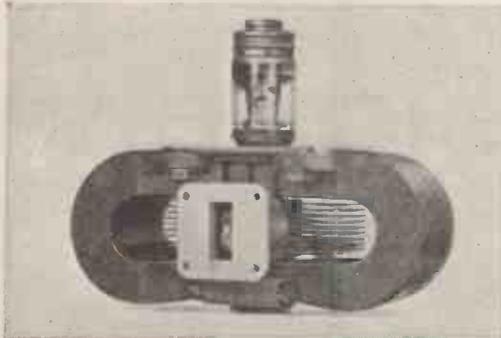


Microwave Applications-1

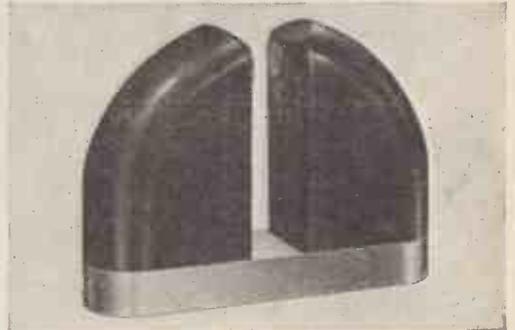
Advertisements in this series deal with general design considerations. If you require more specific information on the use of permanent magnets, please send your enquiry to the address below, mentioning the Design Advisory Service.

It is well known that the efficiency and performance of many modern U.H.F. tubes depend on the reliability and stability of the permanent magnets associated with them.

To meet the magnetic requirements of some of these tubes, powerful electro-magnets consuming several kilowatts would be required. It is therefore not surprising that permanent magnets are in everyday use supplying these fields without the consumption of power, or the generation of heat.



As a typical example, the above illustration shows a 'packaged' magnetron fitted with 'Ticonal' permanent magnets weighing approximately 3½ lb. each. They are protected to some degree, from disturbance due to the close proximity of ferro-magnetic objects, by an aluminium covering. These magnets supply the required magnetic field with extreme accuracy and stability, and take the place of an electromagnet which would weigh approximately 30 lb. and consume about ½ kW. The provision and stabilisation of a suitable power supply for such an electro-magnet would present additional problems of size, weight and cost.



Another example, illustrated above, shows a fully protected 'horn' shaped magnet which gives a magnetic field in the gap of 5500 oersts and weighs only 14 lb. A particular feature of this magnet is that it is specially designed to give an accurate and stable performance under the worst possible condition of usage. It can be brought into contact with iron and steel and other magnets and still remain within the manufacturer's specification and retain its magnetic calibration.

Many types similar to the one illustrated are in current use, each magnet being specially designed to meet the individual requirements of a particular tube.

Among the many problems in connection with the generation of power at microwave frequencies, the requirements of stable magnetic fields can best be solved by the use of 'Ticonal' permanent magnets. Mullard engineers will be pleased to give details of available types and advice on the design of the magnetic circuits for new tube developments.

If you wish to receive reprints of this advertisement and others in this series write to the address below.

Mullard



'TICONAL' PERMANENT MAGNETS
'MAGNADUR' CERAMIC MAGNETS
FERROXCUBE MAGNETIC CORES

RCA



SSB-L1 Fixed Station. 60 watt (500 watt double sideband equivalent) eight channels 3-15 mc/s.

SINGLE SIDEBAND

Communications system

Over 4000 RCA single sideband equipments are in use the world over as fixed and mobile stations.

- Eight Channels.
- Instant Selection of Upper or Lower sideband.
- Compatibility with double sideband systems.
- Remote aerial tuning facility for SSB-L1.
- Mechanical Filter giving outstandingly High Selectivity.
- Exceptionally Stable and Reliable Operation.
- Rugged construction for naval and military use.



SSB-L30M Mobile Station. 30 watt (250 watt double sideband equivalent) eight channels 3-15 mc/s.

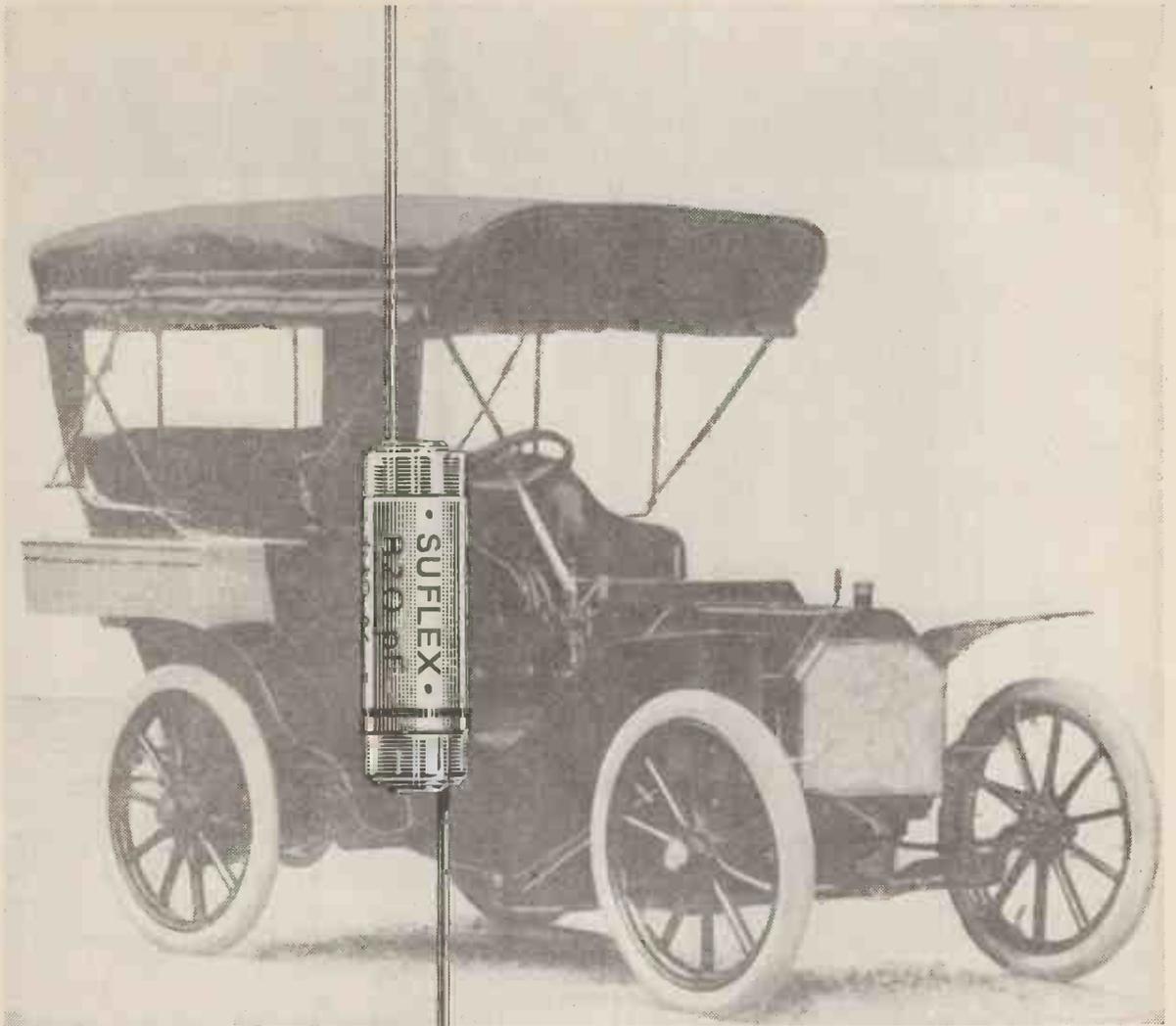


Noise limiter-clipper-filter for heavy interference conditions.

Automatic remote antenna tuner AAT-L100



RCA GREAT BRITAIN LTD. LINCOLN WAY, SUNBURY-ON-THAMES, MIDDX. Tel: Sunbury-on-Thames 3101
An Associate Company of Radio Corporation of America.



AGEING

The parameters of young capacitors tend to be changeable: Polystyrene capacitors are therefore exposed to extremes of climate (Russian winters and New York summers) in rapid succession. This would put years on anybody's life. By the time a Suflex Capacitor reaches you, it has left the frolics of youth and reached mature dependability: exceptionally good stability, high dielectric strength, low loss. And no middle-age spread whatsoever, for the Suflex Polystyrene Capacitor is as small as any for a given rating. Altogether, a capacitor in the prime of life, steady and fighting fit.



Suflex Polystyrene Capacitors

SUFLEX LTD

35 Baker Street, London W.1 Telephone: WELbeck 0791

NEW

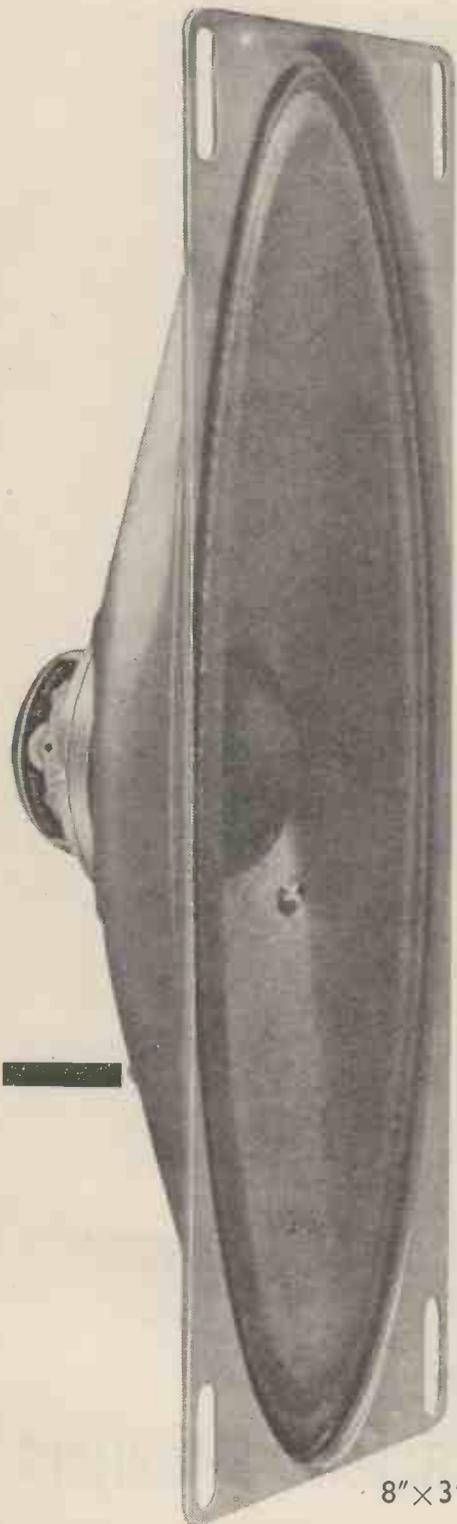
ELAC

speakers

RETAIL PRICE LIST

TYPE	FLUX	POWER RATING PEAK	PRICE	P'TAX
8 x 3G	6500g	2.5 WATTS	19/6	6/3
8 x 3C	8500g	2.5 WATTS	22/6	7/3
7 x 4G	6500g	3 WATTS	18/6	5/11
7 x 4C	8500g	3 WATTS	21/6	6/11
5G	6500g	3 WATTS	18/6	5/11
5C	8500g	3 WATTS	21/-	6/9

TRADE DISCOUNT 33 $\frac{1}{3}$ %



8" x 3"



7" x 4"

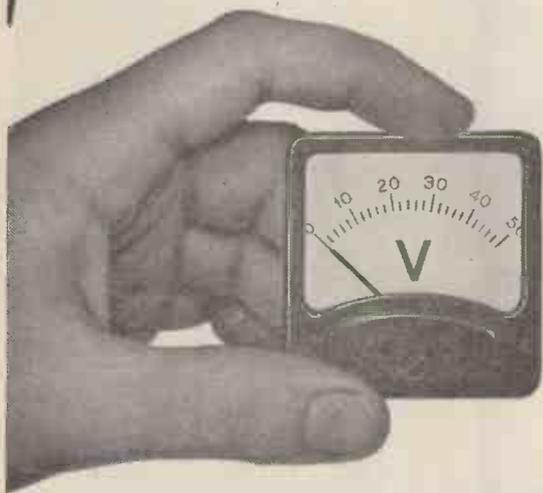


5"

ELECTRO ACOUSTIC INDUSTRIES LTD., Stamford Works, Broad Lane, Tottenham, N.15.

Tel: Tottenham 0505/19 (5 lines)

A COMPREHENSIVE RANGE OF "Miniature" Instruments



Above: 2" square moving coil voltmeter

- ★ DESIGNED TO HARMONISE WITH ALL MODERN ELECTRONIC EQUIPMENT
- ★ FIXINGS CONFORM TO ACCEPTED PRACTICE
- ★ PRICES ARE HIGHLY COMPETITIVE

For utmost reliability all 'ENGLISH ELECTRIC' miniature instruments have been designed with a higher-than-normal torque/weight ratio in combination with lower power consumption. All types have been successfully subjected to the following tests:

- RESISTANCE TO IMPACT SHOCK OF 200g in any plane.
- VIBRATION FATIGUE TEST—two million cycles at peak resonant frequency.
- OSCILLATORY TEST—up to one million operations.

SPECIFICATIONS B.S. 89-1954 and other International Specifications.

TYPES

Moving coil for D.C. applications.
Rectifier moving coil for A.F. applications.
Thermo-couple operated moving coil for R.F. applications.

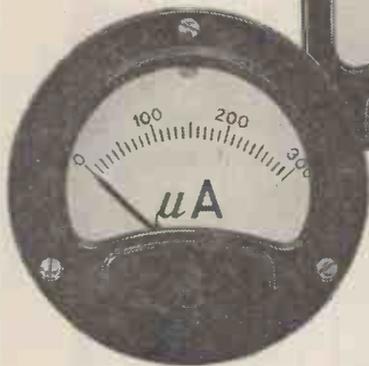
SIZES

Square: 2", 2½" and 3½" nominal scale length.
Round: 2½" and 3½" nominal scale length.
Rectangular: 5" x 6" or 3" x 4" nominal case size.

Design registrations pending.



Above: 3" x 4" rectangular absorption wattmeter



Left: 2½" round moving coil microammeter

Over 50 standard ranges in any of the seven case types.

Delivery ex stock for standard ranges.

Non-standard ranges to customer's specification within 21 days.

Literature available on request to The ENGLISH ELECTRIC Co. Ltd., Instrument Department, Stafford.

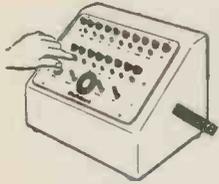
'ENGLISH ELECTRIC'

THE ENGLISH ELECTRIC COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2
Meter, Relay and Instrument Division, Stafford

WORKS STAFFORD · PRESTON · RUGBY BRADFORD · LIVERPOOL · ACCRINGTON

THAT ELUSIVE WORKS MANAGER . . .

found



in 10 seconds

NO LOUDSPEAKERS, BELLS or
FLASHING LIGHTS
only the man who's wanted knows and replies.

Selective Induction is saving time, money and worry in Offices, Factories, Hospitals, Hotels, Departmental Stores etc., all over the Country. All key personnel carry small transistorised receivers bearing a number. When they are wanted their numbered key is pressed on a small transmitter. Immediately they must respond to the URGENT 'PEEP PEEP' in their pockets which summons them and them alone to ACTION! A verbal message can be transmitted if desired.

- Covers areas indoors or out, up to 10,000,000 sq. ft.
- Designed for the man who cannot afford to be tied to his office.
- Equally suitable for large or small concerns.
- Low purchase price—virtually no indoor wiring—low rental terms.

Write or 'phone for further particulars — WE CAN BE FOUND IN TEN SECONDS

personal call

(the 'Peep Peep' in the Pocket)



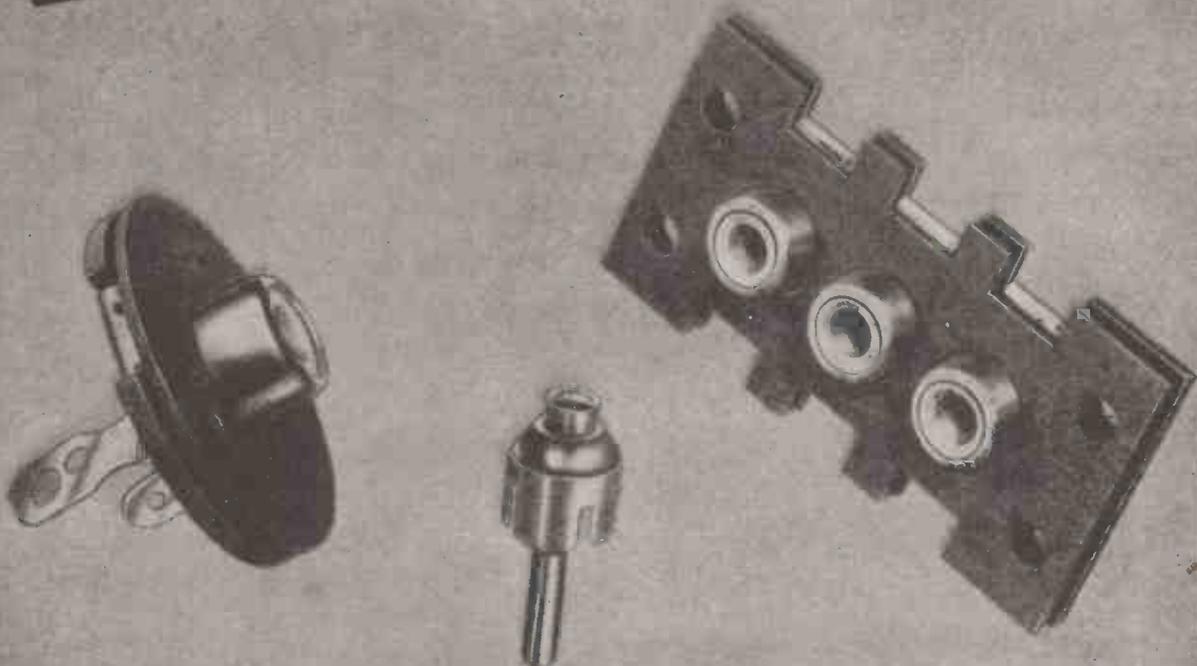
THE ONLY STAFF LOCATION SYSTEM WORTH INSTALLING

MULTITONE ELECTRIC COMPANY LIMITED
12/20 UNDERWOOD STREET LONDON N.1. TELEPHONE: CLERKENWELL 8022



CINCH

phono plugs and sockets



79/756 SOCKET



79/841 SOCKET



79/842 SOCKET



79/843 SOCKET



79/844 SOCKET

The design and dimensions are to the international standard. With the sockets, backing plates can be supplied for complete insulation from the chassis.

Please write for Leaflet No. 4992

CINCH

CARR FASTENER CO LTD

STAPLEFORD · NOTTINGHAM

London: 197 Gt. Portland St., W.1. Phone: Langham 3253/4/5 Manchester: 50 Newton Street, Manchester 1. Central 4057
 Birmingham: Filhill House, 2235 Coventry Road, Birmingham, 26. Sheldon 5208/9. Glasgow: 13 Queens St., Glasgow C.1. City 3202

Stabilized POWER PACKS



PP1 FOR
THERMIONIC
VALVES

£150 NETT IN U.K.

Leaflet W60

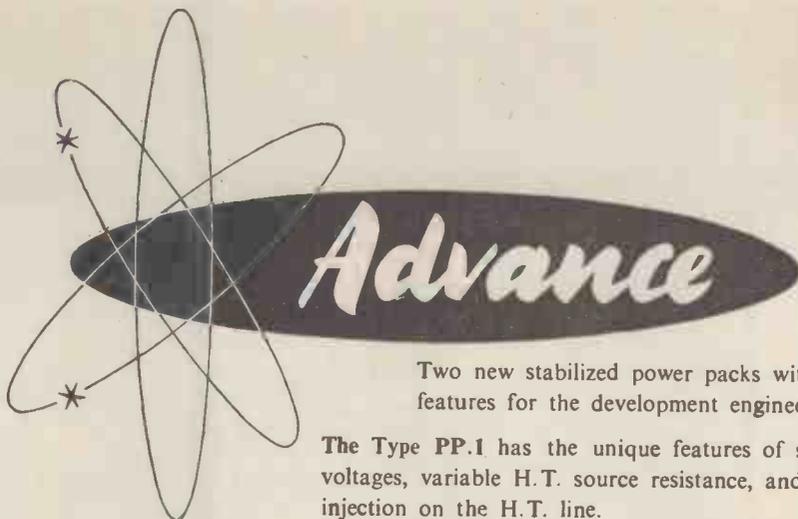
- ▶ High-power 0-600 volts stabilized 300 mA max.
- ▶ L.T. supplies stabilized — two independent outputs at 6.3 volts 4 amps.
- ▶ H.T. source resistance less than 0.1 ohm at d.c. and less than 0.5 ohm up to 30 kc/s.
- ▶ H.T. source resistance may be varied up to a maximum of 40 ohms.
- ▶ Mains ripple of up to 6 volts can be superimposed on H.T. line.
- ▶ Overload protection of H.T. line by resettable cut-out.

Advance COMPONENTS LIMITED

INSTRUMENTS DIVISION

ROEBUCK ROAD • HAINAULT • ILFORD • ESSEX • TELEPHONE : HAINAULT 4444

by



Advance

Two new stabilized power packs with outstanding features for the development engineer.

The Type PP.1 has the unique features of stabilized L.T. voltages, variable H.T. source resistance, and mains ripple injection on the H.T. line.

The Type PP.3 is fully transistorized and provides simultaneous d.c. voltages of either polarity, and is fully protected against accidental short-circuit.



PP3 FOR TRANSISTORS

£110 NETT IN U.K.

Leaflet W62

- ▶ Two independent variable d.c. supplies 0-30 volts 1 amp.
- ▶ Positive and negative supplies provided simultaneously.
- ▶ Up to 60 volts d.c. by series connection.
- ▶ Fully protected against short-circuits.
- ▶ Ripple less than 1 mV peak-to-peak.
- ▶ Both voltage and current monitored simultaneously.

We shall be pleased to arrange for our Area Sales Engineer to demonstrate these models to you.

OPERATIONAL RELIABILITY



EDDYSTONE

**VHF & UHF
(AM & FM)
Communications
Receivers**

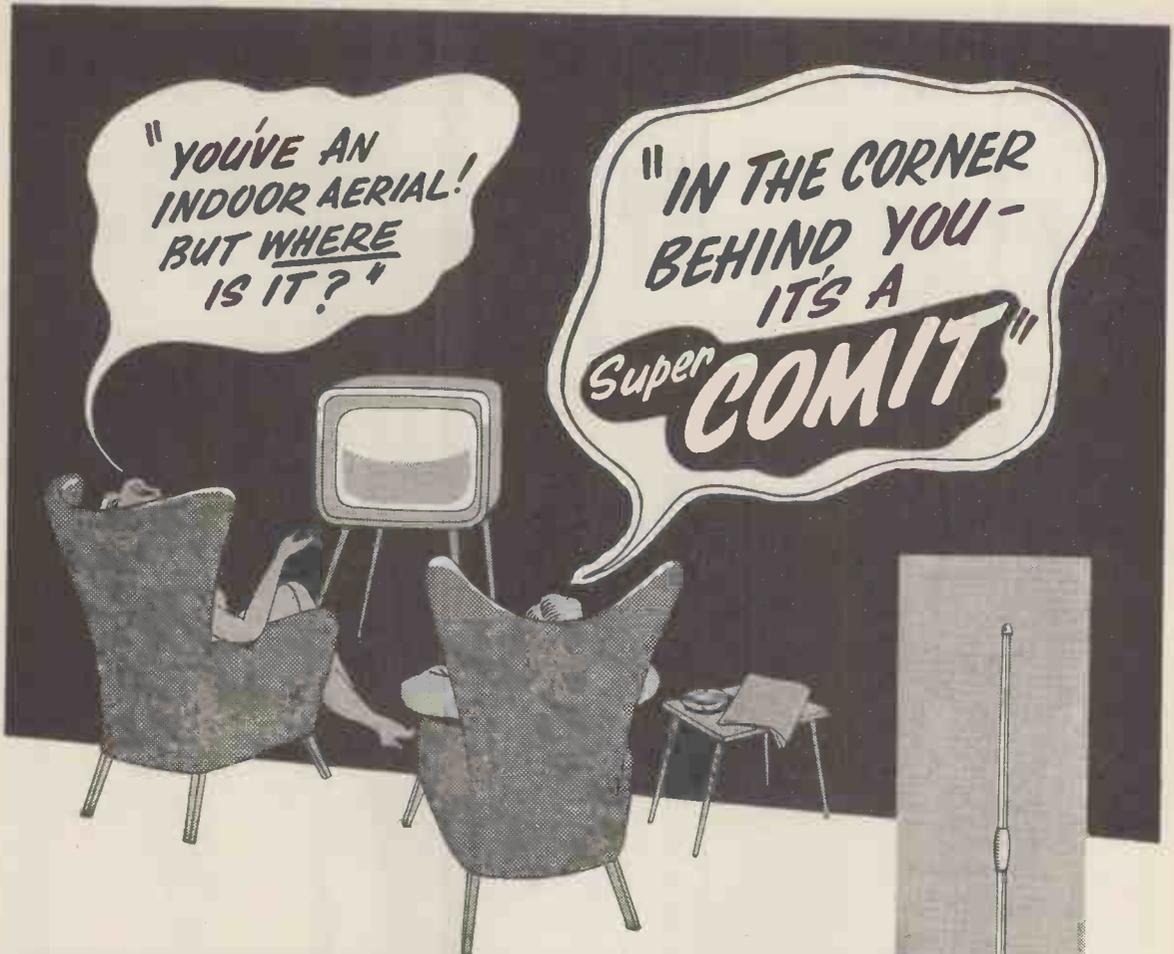
Model 77OR.
19-165 Mc/s.

Model 77OU.
150-500 Mc/s.

Agents in all parts of the world

Please write for full Technical Specifications to the Manufacturers

STRATTON & CO. LTD., BIRMINGHAM, 31



There is **nothing** to distract your customers' attention when the aerial is **A**

super
COMIT

—the stream-lined room model that "can't be seen." T.V. enjoyment is *uninterrupted*. The compact "Super Comit" can be fixed, easily, at NO installation cost. It resonates on both bands, without adjustment. It is attractively finished in untarnishable lustre gold and cream, and well presented. Packed in cartons of one dozen. Retail price 22/6, or with fitted co-axial plug 25/-.

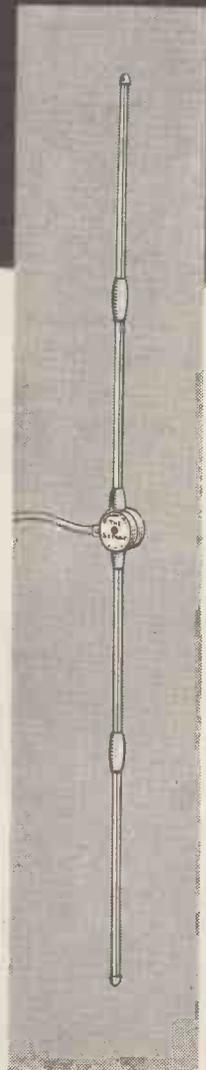
★ Over 100,000 are already in use in the Greater London area alone—Positive proof of efficiency.



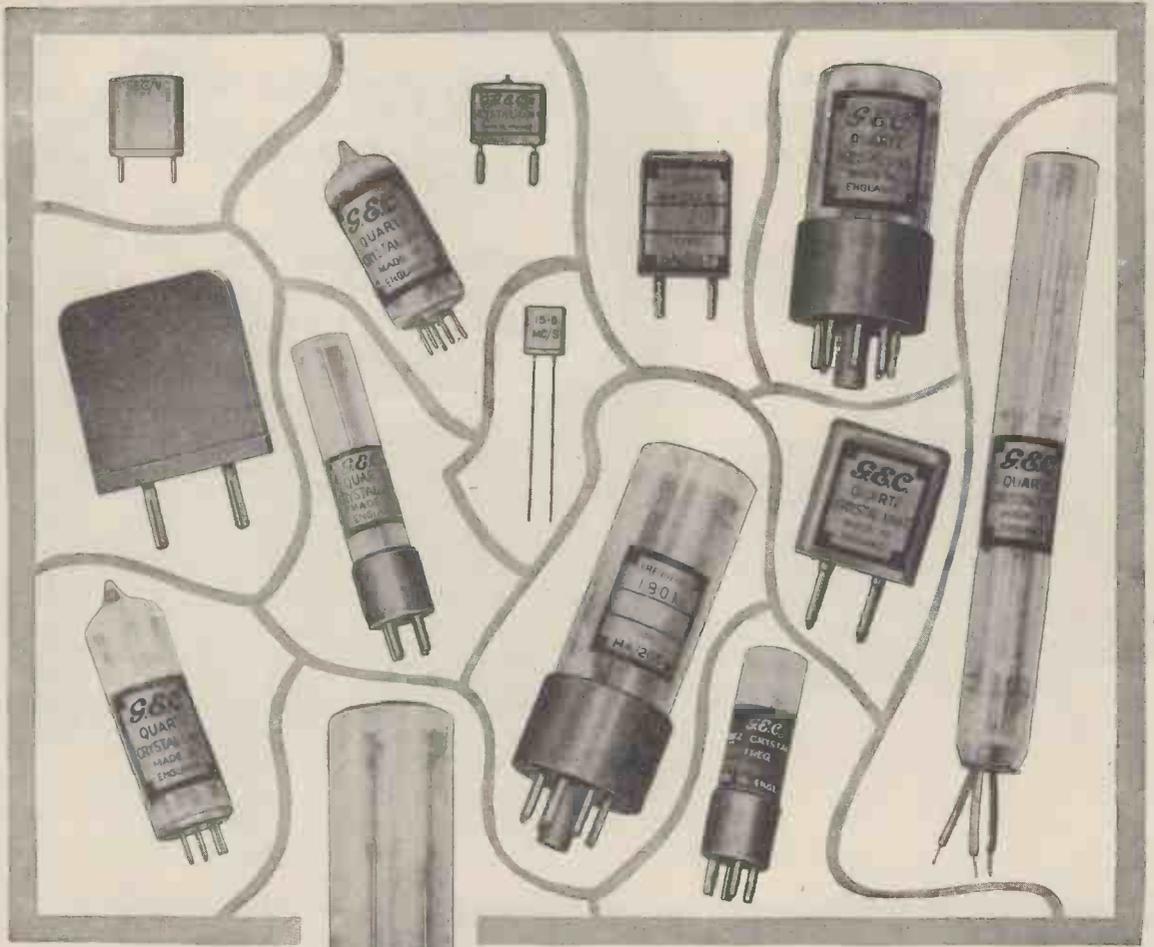
TELECRAFT LIMITED

Quadrant Works, Wortley Road, Croydon, Surrey.

Depots: **BIRMINGHAM · SHEFFIELD · SOUTHAMPTON · WAKEFIELD**



THOrnton Heath
1191/2/3



S&C

From
200 cycles/sec.
to
90 Mc/sec.

No pieces missing

For long term stability and unfailing activity, G.E.C. Quartz Crystal Units provide the basis for reliable communications systems.

A complete range of units to meet

D.E.F. 5271 and

R.C.L. 271 Inter-Service styles can be supplied.

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QUARTZ CRYSTALS

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London Sales Office: Tel.: TEMple Bar 4668. A Subsidiary of the General Electric Co. Ltd. of England



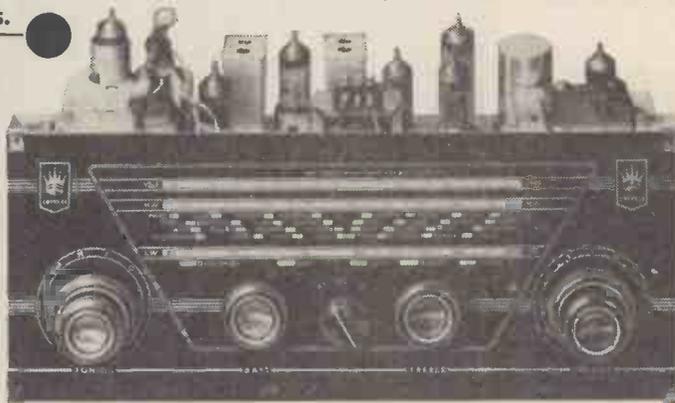
EMPRESS

RADIOGRAM AND TUNER CHASSIS

STEREOPHONIC AND A.M./F.M.

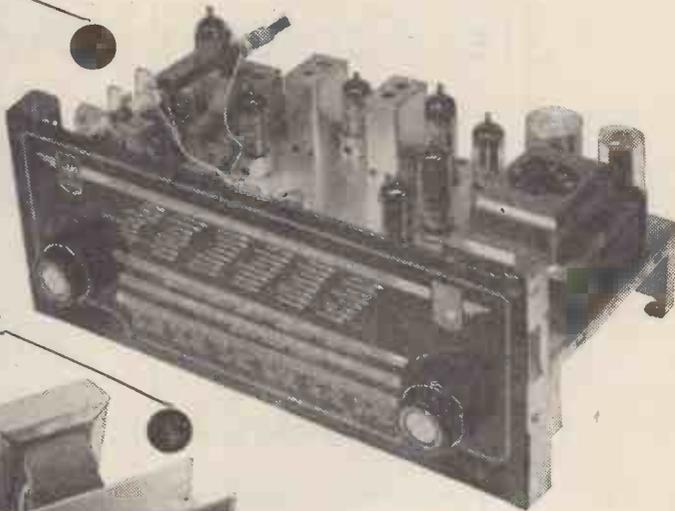
S.S.8 STEREO R.G. CHASSIS 26 Gns.

8 Valves. Ganged Bass and Treble Controls.
 Dual Volume Controls with Concentric Knobs.
 3 Wavebands: L. M. and F.M.
 Built-in Ferrite Aerials.
 Extremely High Sensitivity on F.M.
 3 Position Amplifier Switch.
 1. R.H. Channel only (Monaural)
 3½ watts Gram or Radio.
 2. R. & L.H. Channels (Monaural)
 7 watts Gram or Radio.
 3. R. & L.H. Channels (Stereo)
 7 watts.
 Dipole and all leads supplied.
 Dial size 15in. x 6in. 15 ohm. outputs.



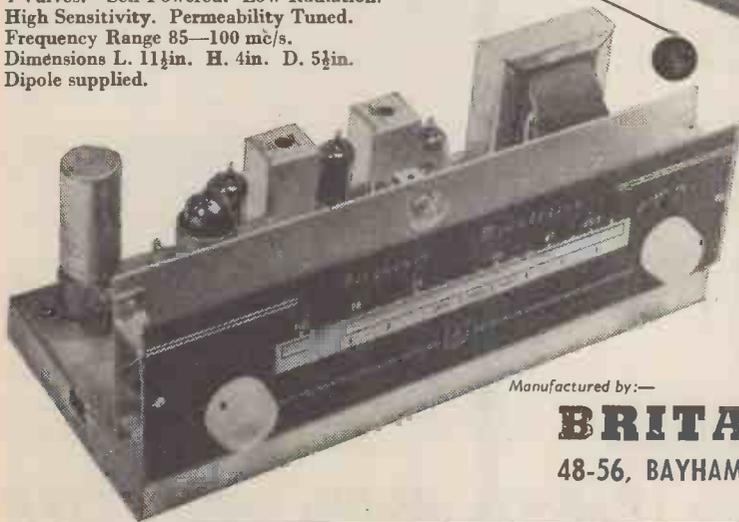
R.G.9 A.M./F.M. CHASSIS 25 Gns.

9 Valves. Push Pull Output. 6 Watts.
 Built-in Ferrite Aerials.
 Magic Eye Tuning.
 Extremely High Sensitivity on F.M.
 4 Wavebands. L. M. S. & F.M.
 Dipole and all leads supplied.
 Dial size 15in. x 6in.
 15 ohm. output.



T4 F.M. TUNER CHASSIS 13 Gns.

4 Valves. Self Powered. Low Radiation.
 High Sensitivity. Permeability Tuned.
 Frequency Range 85—100 mc/s.
 Dimensions L. 11½in. H. 4in. D. 5½in.
 Dipole supplied.



OTHER MODELS

- RG6. 6v. A.M./F.M. Radiogram Chassis—21 Gns.
- FMT5.5v. A.M./F.M. Tuner Chassis—19 Gns.
- SA4. 4 Valve Stereo Amplifier—£8.0.0d.

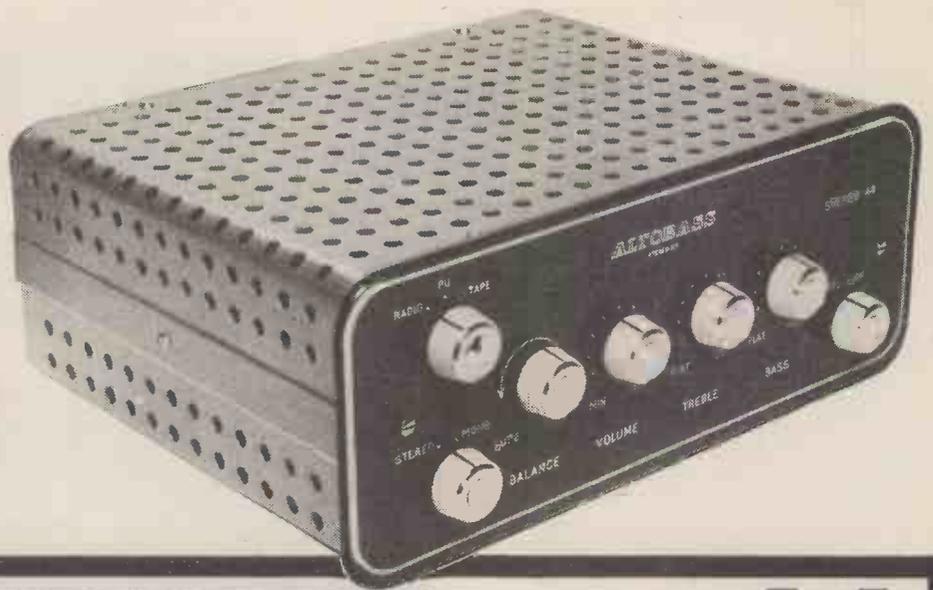
Manufactured by:—

BRITAMER LIMITED

48-56, BAYHAM PLACE, LONDON, N.W.1.

Telephone No. EUSon 7841-3

Build-it- yourself



ALTOBASS

STEREO 44

Stereophonic Amplifier Kit

There's everything you need in this new Altobass Stereo 44 kit—all the parts, easy-to-follow instructions, even a spanner! When completed this amplifier gives extremely high fidelity and realism.

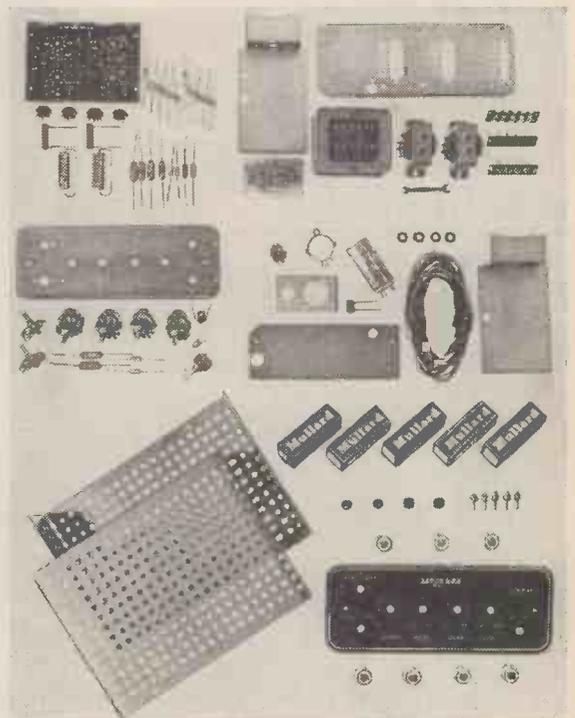
Apart from its use as a stereo amplifier, it can be used as a two channel monaural amplifier giving 4 watts per channel through each speaker. Facilities are also provided for connecting to crystal or ceramic pick-ups, radio tuner or equalised tape.

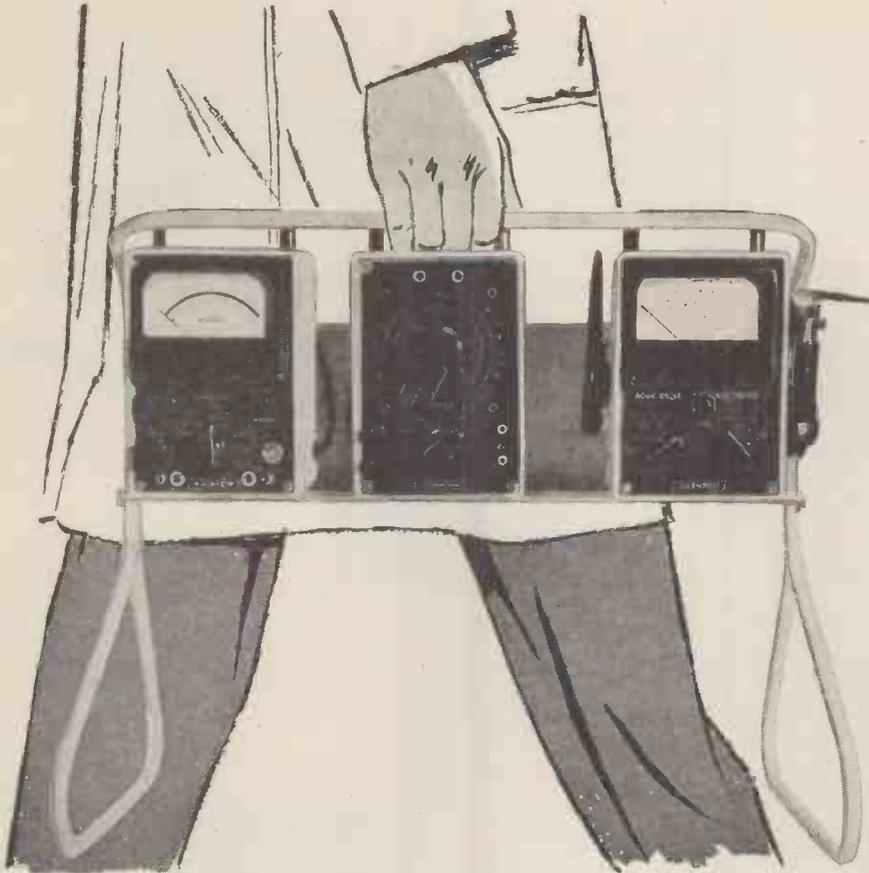
- ★ *Complete kit, even includes wire and spanner*
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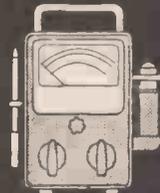
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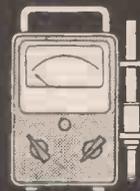
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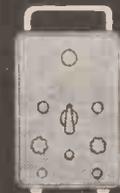
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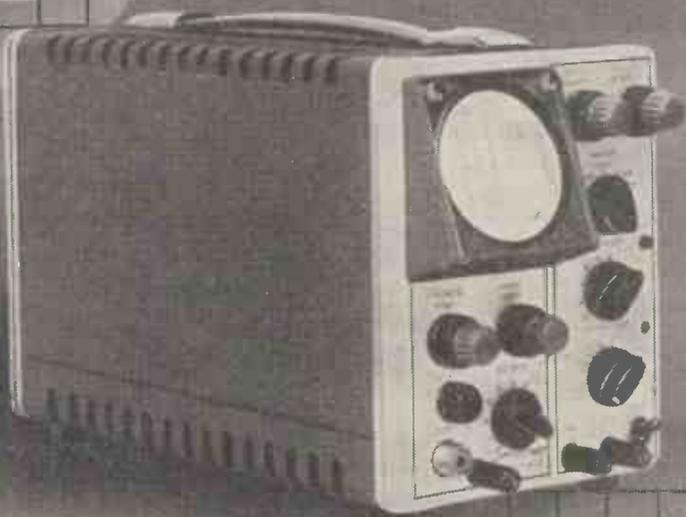
Display	Three digit plus automatic polarity indication and automatic decimal placement.
Automatic Ranges	D.C. Volts in 3 ranges 0.01 — 9.99 V 10.0 — 99.9 V 100V — 999 V
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Average Reading Time	0.7 seconds.
Input impedance at Balance	10 Megohms.
Input	110 — 250V A.C.50—60 c/s 50W.
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Style	Bench cabinet 17" x 13" x 10½" high with optional brackets for standard rack mounting.

In view of continuing development, the right is reserved to alter the specification or design of this instrument.

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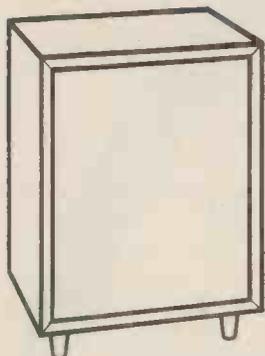
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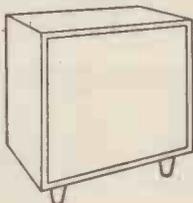


Tall boy—above

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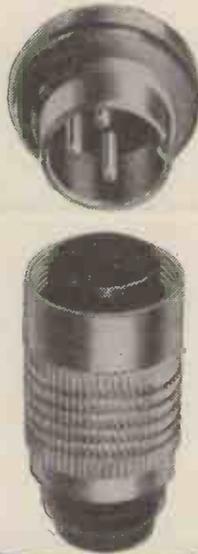
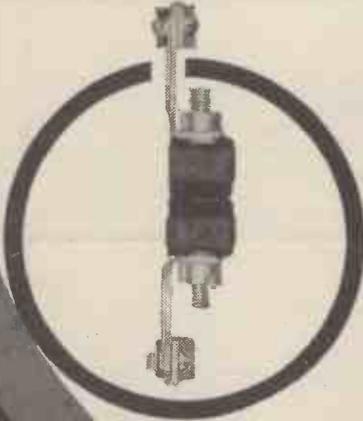
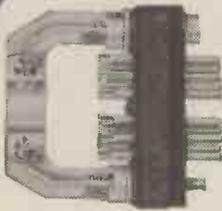
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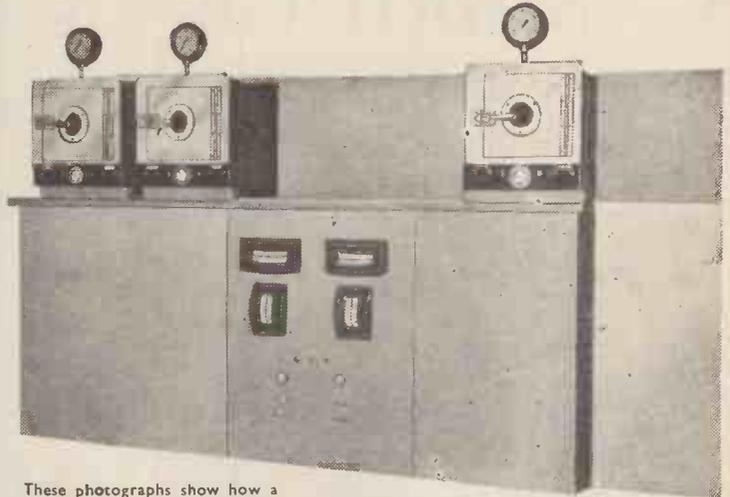
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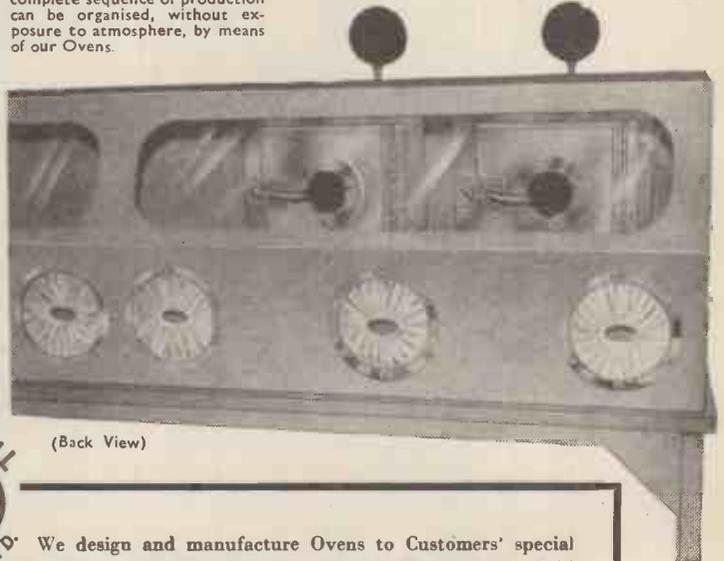
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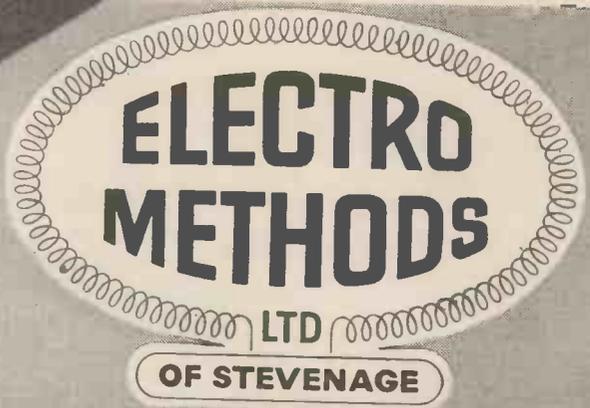
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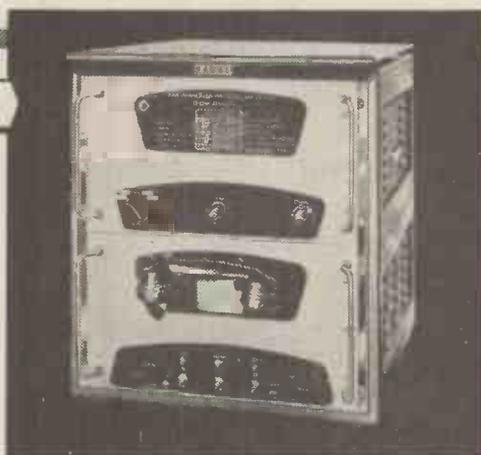


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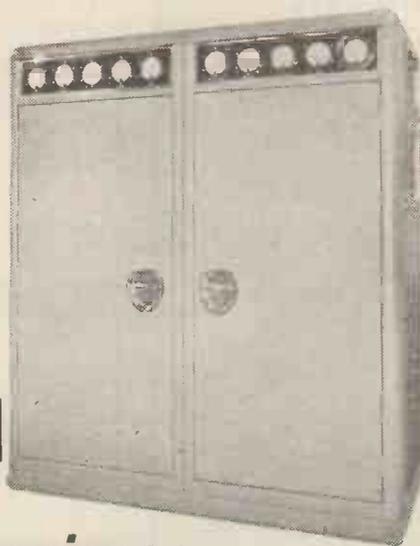
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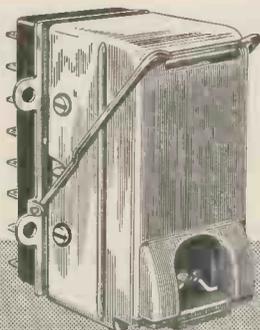
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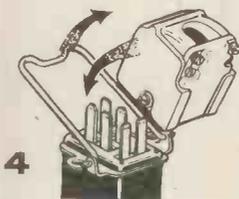
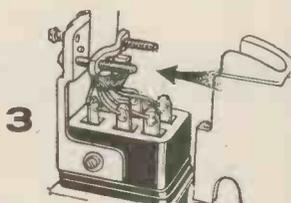
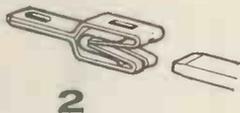
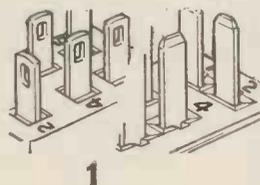
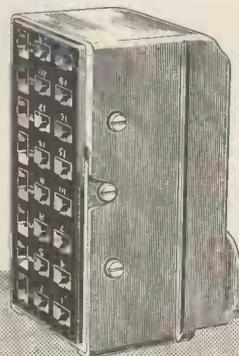
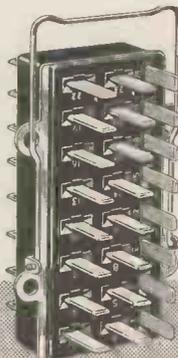
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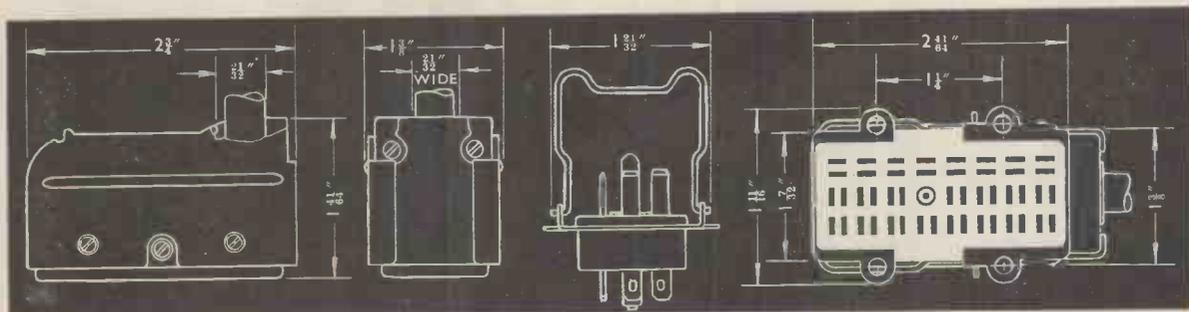
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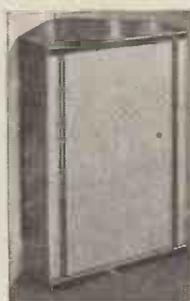


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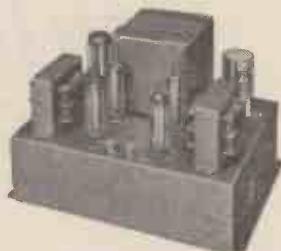
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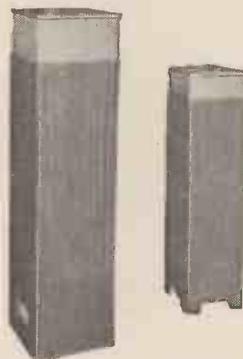
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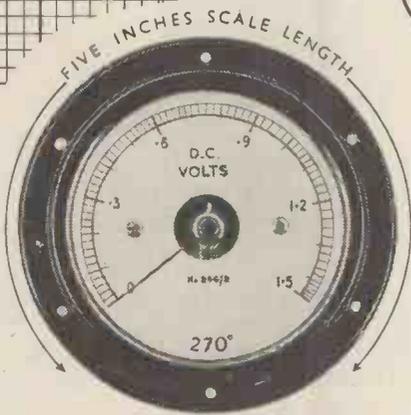
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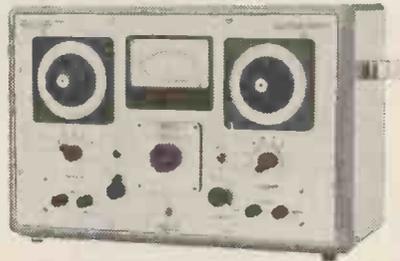
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backed by the 22 years specialisation and World-wide experience in the design and manufacture of aerials and aerial equipment by Antiference—the World's largest aerial manufacturers.

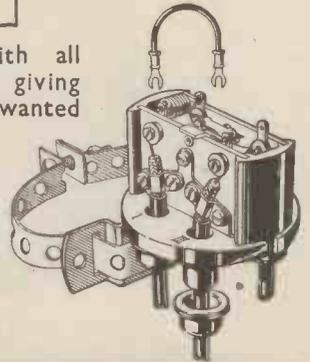


**NEW!
OUTDOOR
Weatherproof
DIPLEXER/TRIPLEXER**

Regd. Design.

For combining or dividing Bands I, II and III aerial downleads.

High "Q" circuit with all "open" components giving maximum selection of unwanted bands with minimum insertion loss. Easy cable connections with detachable waterproof universal grommets. One-piece seamless canister.



Y4 17/6

ANTIFERENCE DIPLEXER/TRIPLEXER UNITS and AERIAL ACCESSORIES

Single COAXIAL OUTLET BOX

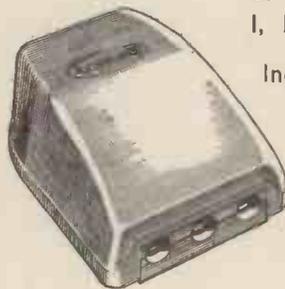


Fully insulated by streamlined, cream, high impact polystyrene case. Easy in-line cable connections. COAXIAL Plug and Socket to R.E.C.M.F. specification.

Regd. Design No. 887221.

COB/1 4/6
Complete with plug.

INDOOR DIPLEXER/TRIPLEXER



For combining or dividing Bands I, II and III aerial downleads.

Incorporating the same High "Q" circuit as the Y4 (outdoor) unit, the Y3 is fully insulated by an attractive cream snap-on cover of high impact polystyrene.

Regd. Design No. 886499.

Complete with standard Co-axial Plug.

Easy cable connections for any size or type of downlead.

Y3 13/6

STANDARD COAXIAL PLUGS & SOCKETS



Robust one piece construction, efficient in use, easy to fit.

PLUG TVP/1 BOTH 8D EACH
SOCKET TVS/1

To R.E.C.M.F. specification

SUPPLIED ONLY THROUGH APPOINTED ANTIFERENCE DISTRIBUTORS

ANTIFERENCE LIMITED

AYLESBURY, BUCKS. Tel. Aylesbury 2511 (6 lines)



PANORAMA

FEATURING PYE TELECOMMUNICATIONS EQUIPMENT



BY APPOINTMENT
TO H.R.H. DUKE OF EDINBURGH
SUPPLIERS OF
RADIO TELEPHONE EQUIPMENT
PYE TELECOMMUNICATIONS LTD.

Ranger '450' Radiotelephone Fixed Station

Brief specification:

Frequency Range: 450—470 Mc/s.
R.F. Output: 5 watts
Channel Spacing: 50 or 60 Kc/s.
Modulation: F.M.
Service: F 3 telephony
Operation: Single or double
 frequency simplex
 or duplex.
Power Supply: 100—150 and
 200—250 volts
 A.C. 40—60 c/s.

The Pye PTC 8710 Fixed Station has been designed to provide reliable communications in the 450—470 Mc/s band. Both the transmitter and receiver are fitted with temperature-controlled crystal units to ensure an exceedingly high frequency stability over a wide temperature range. All the materials used have been chosen to ensure reliable operation under a wide range of climatic conditions. Additional control equipment is available for operating the Station at distances of up to 200 feet or, via telephone lines, over greater distances. A switchboard Termination Unit is also available for working the Station into a manual or automatic telephone switchboard.

PYE TELECOMMUNICATIONS LIMITED

NEWMARKET ROAD · CAMBRIDGE

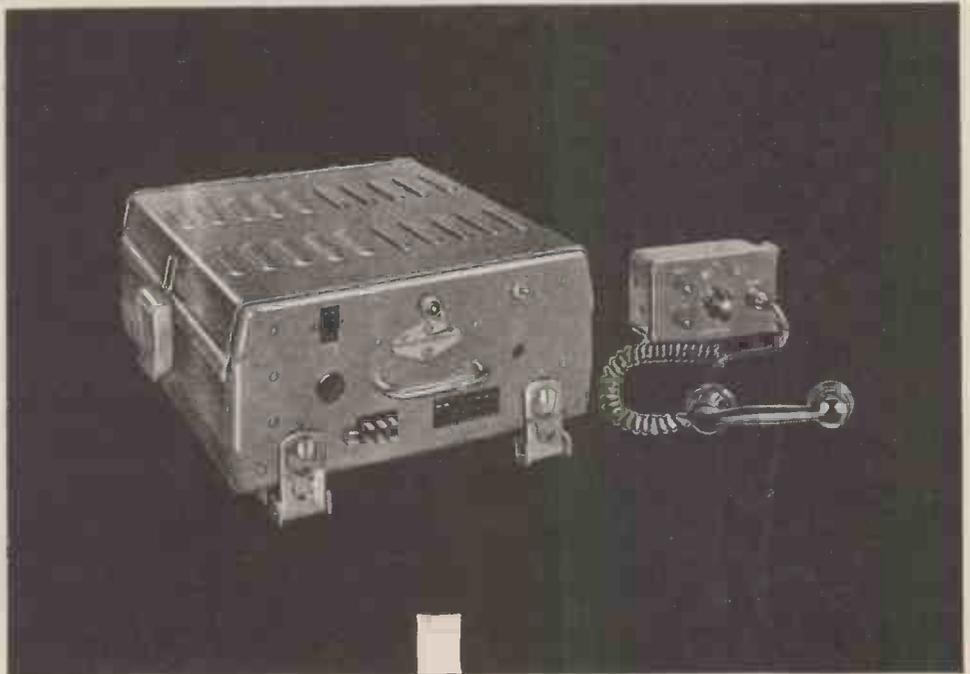
Telephone: Teversham 3131

Telegrams: Pyetelecom Cambridge.



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TO H.R.H. DUKE OF EDINBURGH
SUPPLIERS OF
RADIO TELEPHONE EQUIPMENT
PYE TELECOMMUNICATIONS LTD.

V.H.F./F.M. Marine Radiotelephone

Brief Specification

Frequency Range 156-162 Mc/s.
R. F. Power Output 20 watts. F.M.
Power Supply 6, 12, or 24 volts d.c.,
or 100-150 or 200-240
volts a.c., 40-60 c/s.

The Pye PTC 8302 is one of the "Ranger" series designed for Marine use. It complies with the British G.P.O. and international specifications for ship-to-shore communication.

Up to a maximum of twelve channels can be selected by the Remote Control Unit; thus saving valuable space on the bridge. Mounting may be either bulkhead or horizontal, with a standard or weather proof control unit. An A.M. version of this equipment for operation in the private marine bands is also available.

PYE TELECOMMUNICATIONS LIMITED
NEWMARKET ROAD • CAMBRIDGE

Telephone: Teversham 3131.

Telegrams: Pyetelecom Cambridge.

T.



PANORAMA

FEATURING PYE TELECOMMUNICATIONS EQUIPMENT



BY APPOINTMENT
TO H.R.H. DUKE OF EDINBURGH
SUPPLIERS OF
RADIO TELEPHONE EQUIPMENT
PYE TELECOMMUNICATIONS LTD.

Microwave Television Link Equipment

The Pye PTC M1000 is a transportable long-range Microwave Television Link. It is suitable for use with N.T.S.C., C.C.I.R. or British 405-line systems. A sub-carrier f.m. music link circuit is incorporated. The equipment can be operated back-to-back as a demodulator repeater for long multi-stage transmission links. Transmitter and Receiver, r.f. wavemeter and intercommunication circuits are all contained in four lightweight luggage-type cases. The parabolic reflectors are of spun aluminium up to 10 ft. in diameter. All ancillary equipment including that for matching rack-mounting can also be supplied.

Brief Specification

- Frequency Range 6875—7425 Mc/s.
- R.F. Power Output 1 watt. Under favourable siting conditions a transmission distance of 50 miles or more can be obtained.
- Vision Signal-to-Noise Ratio 59dB (weighted) assuming standard 70dB path loss.

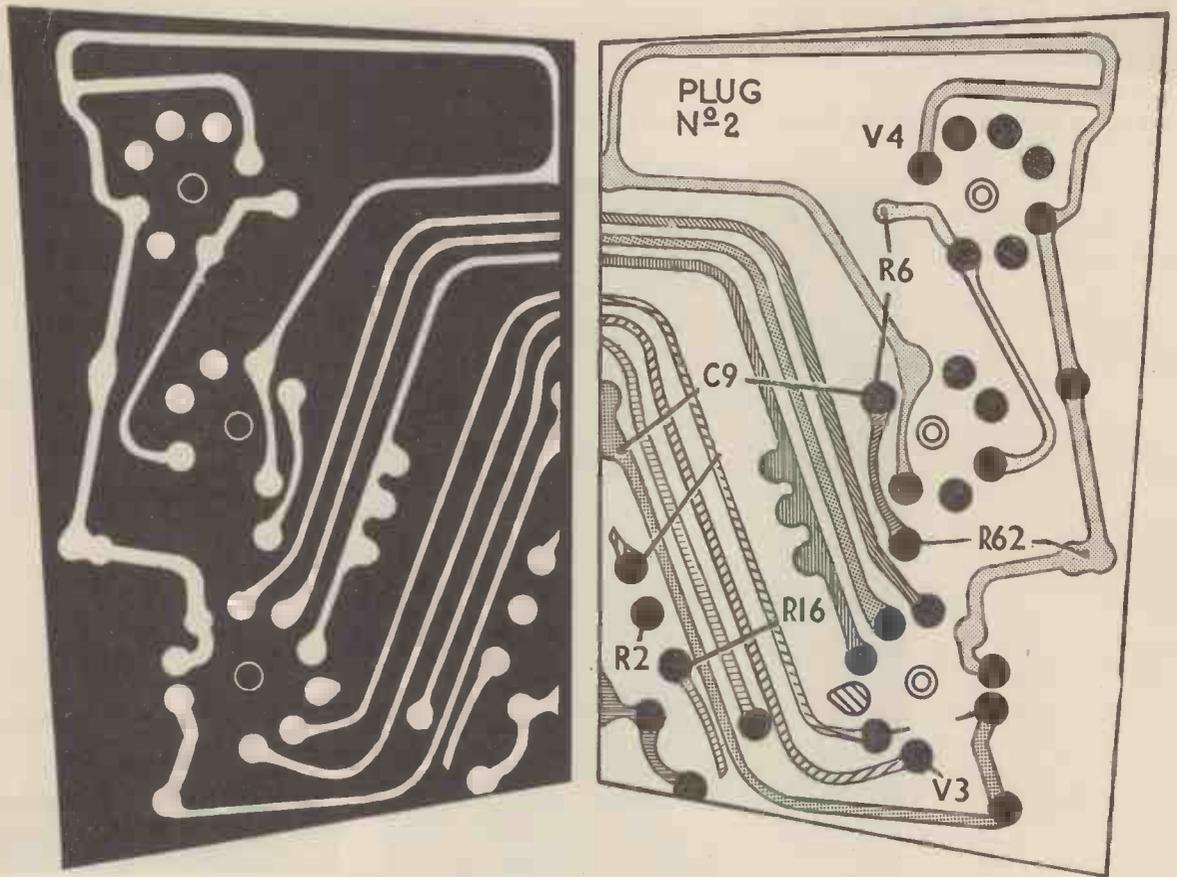
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TA29

A TWO-FACED CIRCUIT!



is a service man's dream

And we've made it come true. Mills & Rockleys' technical skill and eye to progress will continually supply their clients with all the best and newest ideas on printed circuits: and our two-faced circuit (patent applied for) is just one very good example.

Not only the component numbers but the actual circuit is printed, in colour code if necessary, on to the upper surface of the panel, reducing circuit tracing to child's play.

The completion of new plant in Coventry, incorporating the most advanced techniques and up-to-date facilities—including automatic temperature and humidity control—enables any requirement however complex to be met efficiently and economically.

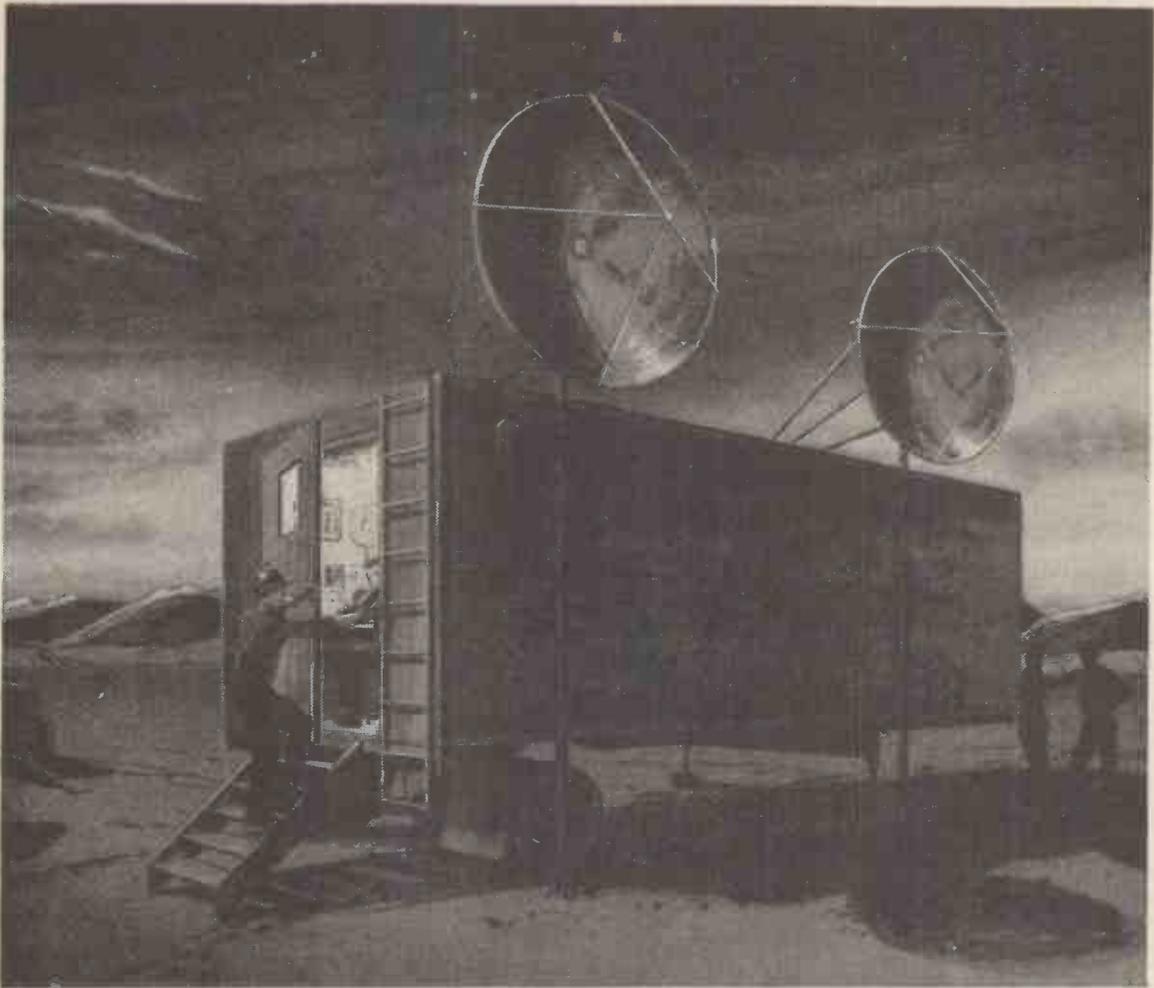
DESIGN · CONSULTATION · PROTOTYPES · MASS PRODUCTION

WRITE TO:



MILLS & ROCKLEYS (PRODUCTION) LIMITED

PRINTED CIRCUITS DIVISION · SWAN LANE · COVENTRY TELEPHONE: 41327



NEW TROPO SCATTER SYSTEMS

can be set up anywhere in 8 hours or less!

A new, transportable communication system has been developed by Canadian Westinghouse for sending two-way voice or teletype messages up to 200 miles *without* relay stations.

Its name is MICROSCATTER—the most *compact* system ever developed for low-cost, long range tropospheric scatter communications.

Now in production for customer orders, MICROSCATTER radio is a super high frequency system that can go *anywhere*. MICROSCATTER transmitters and receivers for quadruple diversity, including antennas, can be mounted in a standard 30 ft. truck trailer. Units designed for self-contained field shelters can be set down by helicopter in remote locations—and a MICROSCATTER installation can be set up ready for operation within 8 hours!

MICROSCATTER APPLICATIONS

COMMERCIAL	MILITARY
Fixed Station — 120 telephone channels — television and sound	Wide Band — radar — data — 120 telephone channels
Transportable — 48 telephone channels — teletype	Tactical and Transportable — 48 voice channels — teletype — data

FEATURES

- Frequency—4400-5000 mc
- Antennas—10 to 28 ft. diameter
- Power—2 KW
- Range—100 to 200 miles

A Westinghouse communications specialist will gladly furnish complete information on MICROSCATTER radio. Phone your nearest Westinghouse office, or write to Canadian Westinghouse Company Limited, Electronics Division, Hamilton, Canada.

YOU CAN BE SURE ...IF IT'S **Westinghouse**

SFB/3

REPRODUCES OBOE AND PIANO *with near perfection*



Regd. Design
881,557

Size 34" x 31" x 12"

Weight 64 lb.

Price £39.10.0 complete

*J. R., Shenfield.
The recording actually sounded
like the real thing!
L.G.B. London, S.E.12.
I could not tell except by looking
whether or not the soloists were
playing.*

*R. A. W., Tottenham.
A great credit to your SFB/3
units.*

*G. E., Cambridge.
Excellent: Could not detect changes
of either piano or oboe to the re-
corded sound, even when watching
the oboe carefully. Complete
absence of box feeling.*

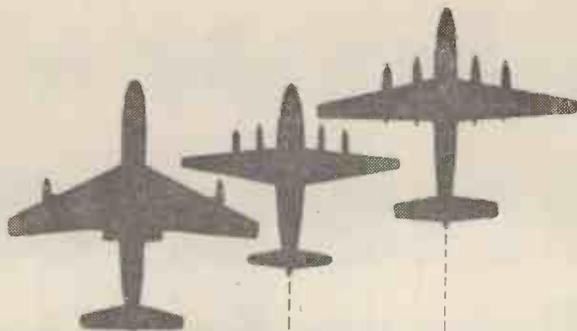
During Mr. G. A. Briggs' fourth demonstration at the ROYAL FESTIVAL HALL on the 9th May 1959, the world famous artists Leon Goossens, oboe, and Denis Matthews, piano, played together, in direct comparison with their E.M.I. recording reproduced on a pair of SFB/3's. Here are some comments from members of the capacity audience—

The success of this comparison was mainly due to the non-resonant qualities of the unique sand-filled baffle which is fitted with three foam surround loudspeakers of advanced design. Full details available on request from:

Wharfedale
WIRELESS WORKS LTD
IDLE BRADFORD YORKS

Telephone: Idle 1235/6

Grams: 'Wharfedel' Idle Bradford



TOROIDAL

SUPPRESSION CHOKES

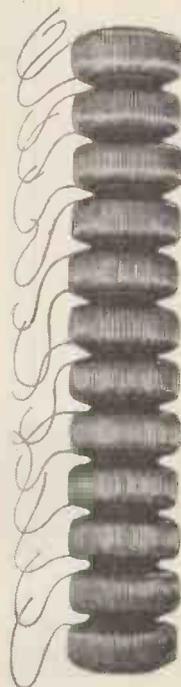
used in all the major airliners including the **COMET, VISCOUNT and BRITANNIA**

With the greater use of radio and navigational aids on ships and aircraft, it is increasingly important to suppress interference likely to arise from other electrical equipment which is also an inseparable part of modern transport. S.T.C. with over 40 years experience in the development of high grade magnetic materials; now introduce a selection of the many types of chokes which are manufactured for industrial, marine and aeronautical applications.

RANGE OF SIZES AND WEIGHTS

The following table lists the size, weight and normal range of inductance and current rating of several S.T.C. Toroidal Chokes:

SIZE CODE	SIZE				INDUCTANCE & CURRENT RATING (μ H and Amp. AC or DC)
	Outer Diam: cm	Inner Diam: cm	Length cm	Weight gm	
C1	1.3	0.7	0.52	3.5	from 10 μ H ($\frac{1}{2}$ amp) to 1000 μ H (0.1 amp)
C2	2.3	1.2	0.80	14.5	.. 100 .. ($1\frac{1}{2}$..) to 1000 .. ($\frac{1}{2}$..)
C3	2.95	1.4	1.3	50.0	.. 100 .. ($2\frac{1}{2}$..) to 1000 .. ($\frac{1}{2}$..)
C4	4.1	2.4	1.3	85	.. 100 .. (4 ..) to 2000 .. ($1\frac{1}{2}$..)
C5	4.8	2.7	1.4	130	.. 100 .. (5 ..) to 2000 .. (2 ..)



**COMPONENTS
GROUP**

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

MAGNETIC MATERIALS DEPT: NORTH WOOLWICH • LONDON • E.16

Now - PTFE Insulated Instrument Wire

Conforming to Sections B & C
of Specification EL1930, M.O.S. (Air)

Siemens Ediswan PTFE insulated instrument wire, developed for certain highly specialised services, has a wide potential field of application in modern electronic engineering. The physical and electrical properties of PTFE make it the best material available wherever the emphasis is on performance and complete stability. In brief, PTFE has these advantages:

- Stable at all temperatures from -75°C to $+250^{\circ}\text{C}$
- High dielectric strength
- Low dielectric constant
- High resistance to corrosives and solvents
- Non-chafing and self-lubricating
- Available in 11 colours
- Non-adhesive

PTFE is extremely difficult to form, but we have considerable pioneering experience in its processing and fabrication. As a result we are able to produce PTFE insulation by extrusion with concentricity guaranteed to close limits. We are anxious to extend the uses of this wire and will gladly supply interested manufacturers with samples for them to test. If we can help you with information on the use of PTFE in any shape or form, please let us know.



Send your enquiry to:

SIEMENS EDISON SWAN LIMITED *An A.E.I. Company*

PTFE SECTION (PD17)

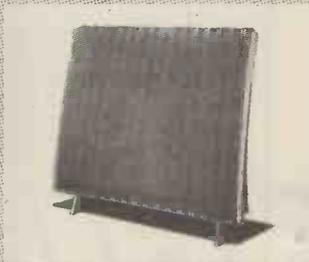
155 Charing Cross Road, London WC2

Telephone: GERrard 8660. Telegrams: Sieswan, Westcent, London

THE
QUAD
22

CONTROL UNIT

*... a new unit
anticipating trends
in future listening
requirements.*



Used with a single QUAD 11 power amplifier the unit provides every facility and refinement necessary for highest quality monaural reproduction.

Used with two QUAD 11 power amplifiers, the unit will in addition accommodate all forms of Stereo programmes with all the necessary facilities for that medium. Whilst providing extreme flexibility—the push buttons, for example, provide nineteen different services—straightforward and logical control has been maintained.

QUAD for the closest approach to the original sound

ACOUSTICAL MANUFACTURING
COMPANY LIMITED
Huntingdon, Hunts.
Telephone: Huntingdon 361

EXTRA HIGH SENSITIVITY

instrument tube 5CLP1

THE FIVE-INCH instrument tube 5CLP1 has a deflection sensitivity of 1.7V/cm with a useful Y scan of 6 cm.

A special system of shielding the post-deflection field from the deflection plates in this tube allows p.d.a. ratios as high as 15 to 1 to be used without pattern distortion.

The extraordinary deflection sensitivity achieved with such high p.d.a. ratios profoundly affects oscillograph design.

Bandwidths can be increased, amplifiers simplified and power supply requirements reduced.

Write to the address below for full details of 'Etel' Instrument Tube type 5CLP1.

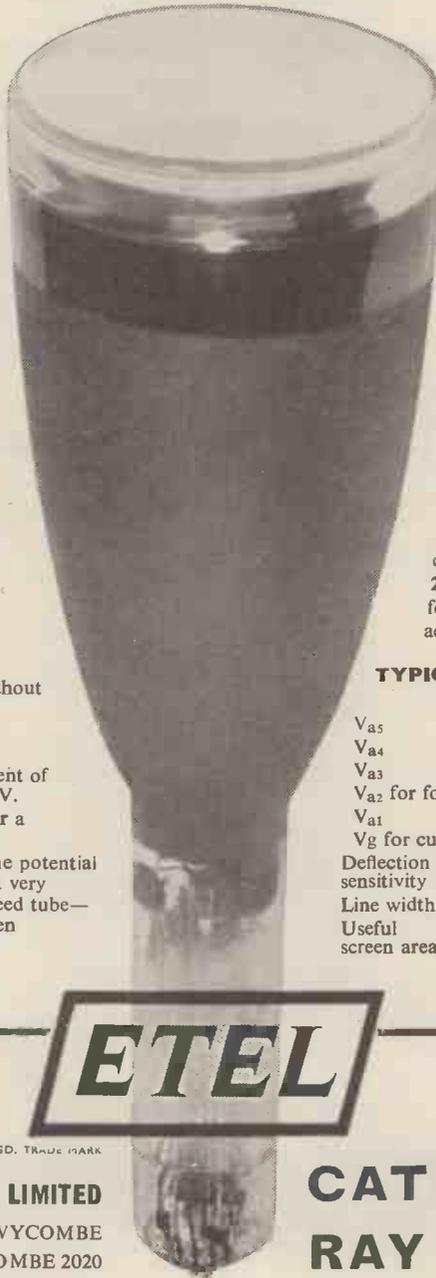
* P.d.a. ratios of 15 : 1 possible without pattern distortion.

* Sensitivity 1.7V/cm with useful Y scan of 6 cm.

* Sensitivity substantially independent of final p.d.a. voltages from 10 to 15 kV.

* High resolution—only 200 mV for a deflection of one spot-width.

* Versatility—by simply altering one potential the 5CLP1 may be converted from a very sensitive tube to a higher writing speed tube—pulses may be first examined and then a single shot photograph taken.



ABRIDGED DATA

This is tentative. Final data is being prepared.
5-inch flat faced precision oscillograph tube 5CLP1.

CAPACITANCES

X₁ to X₂ ... 2.5 pF

Y₁ to Y₂ ... 2.0 pF

One X plate to all other electrodes
less other X plate 4.0 pF
One Y plate to all other electrodes
less other Y plate 2.0 pF

COMPARE CONDITIONS SHOWN IN DATA

1 and 2

to see how deflection sensitivity is maintained over range of V_{a4} and V_{a5}.

1 and 2 with 3

for an illustration of a slightly lower sensitivity condition giving higher brightness.

2 and 4

for the reduction required in V_{a4} potential to achieve higher writing speeds.

TYPICAL OPERATING CONDITIONS

	1.	2.	3.	4.
V _{a5}	10kV	15kV	15kV	15kV
V _{a4}	10kV	15kV	15kV	3kV
V _{a3}	1kV	1kV	1.5kV	1kV
V _{a2} for focus	250V	250V	375V	250V
V _{a1}	1kV	1kV	1.5kV	1kV
V _g for cut-off	-60V	-60V	-90V	-60V
Deflection sensitivity { y 1.7V/cm x 7V/cm	1.7V/cm 7V/cm	1.7V/cm 7V/cm	2.5V/cm 11V/cm	2.5V/cm 11V/cm
Line width	1mm	1mm	<1mm	<1mm
Useful screen area { y 6cm x 10cm	6cm 10cm	6cm 10cm	6cm 10cm	4cm 6.6cm

ETEL

REGD. TRADE MARK

ELECTRONIC TUBES LIMITED

KINGSMEAD WORKS · HIGH WYCOMBE
BUCKS · TEL: HIGH WYCOMBE 2020

CATHODE RAY TUBES

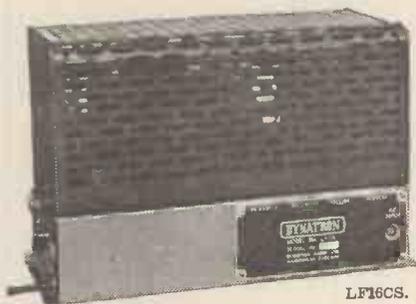
STEREO

—FOR PEOPLE WHO MUST HAVE THE BEST

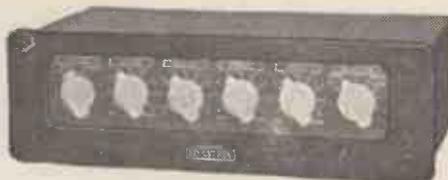
DYNATRON have nearly 30 years experience in building the best possible equipment for reproducing sound. Their leadership is based on three things. Advanced design. Scrupulous attention to detail. *And the narrowest tolerances in the industry.* This last point is especially important to Stereo enthusiasts. For it ensures that matching units really do match. Without this, stereo fidelity is impossible. Dynatron is never cheapest: it is always best!



LF15CS



LF16CS.



TC16CS.

LF15.CS. POWER AMPLIFIER £20.5.0. 4-valve push-pull LF Amplifier, with auxiliary power supply for tuners, etc. 10 watts undistorted output. F.R. 15-30,000 c/s flat within 0.5db. Neg. Feedback 20db. Hum and noise 80db. below 10 watts. 1 volt R.M.S. input for full output.

LF16.CS. POWER AMPLIFIER £17.10.0. Specially designed as second channel amplifier in stereophonic systems. Specification identical to LF15 but auxiliary power outputs omitted. Mains output socket for gramophone or tape deck motors.

TC16.CS. PRE-AMPLIFIER £27. This very high performance unit comprises identical twin pre-amplifiers with a comprehensive control system. Duplicated inputs for magnetic or ceramic pick-ups, Radio and tape deck. Two output sockets for recording purposes. Pick-up equalisation by selective negative feedback. Frequency response 60-15000 c/s within ± 1.0 db.

STEREOPHONIC
OR MONOPHONIC

DYNATRON

BUILD
TO
LABORATORY
STANDARDS

COUPON

Will you please send me a copy of the **DYNATRON**
'High Fidelity Audio Equipment' brochure

NAME _____

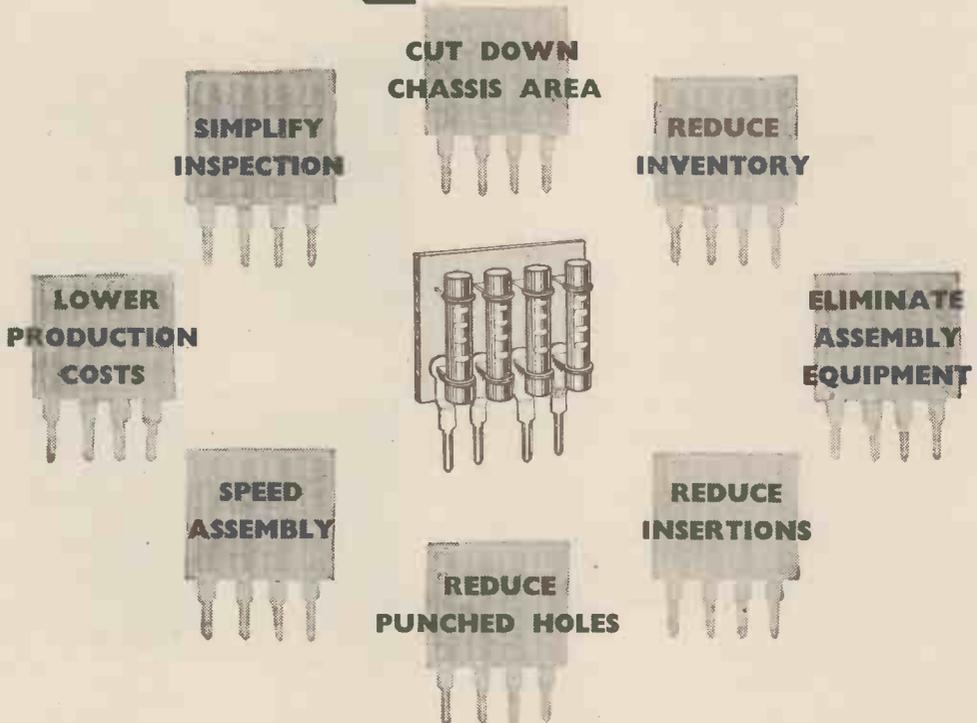
ADDRESS _____

DYNATRON RADIO LIMITED.

Dept. 4, St. Peter's Road, Furze Platt, Maidenhead, Berks.
Telephone: Maidenhead 5151/2

Living Together

Pre-assembled Components



British Patent No. 798,869
Foreign Patents Pending

THE ERIE pre-assembled component system, known as "Pac", is a thin vertical module containing standard resistors and capacitors, of proven quality, mounted to a printed wiring board in a stable mechanical assembly, tailored to the specification of the designer.

Thanks to the pioneering spirit of individual customers, and the help and co-operation which they have given us, the Erie "Pac" unit has

established itself as one of the outstanding developments of the day.

The Mark III version, depicted above, which is due to be released later in the year, will embody the type 8AP pluggable resistor, and the type BP pluggable capacitor, an innovation which not only facilitates testing, but also enables any component to be replaced in servicing.

1, HEDDON STREET, LONDON, W.1
Telephone: REGent 6432

FACTORIES

Great Yarmouth and Tunbridge Wells, England; Trenton, Ont., Canada; Erie, Pa., Holly Springs, Miss., and Hawthorne, Cal., U.S.A.

★ **ERIE**

R E S I S T O R
L I M I T E D

★Registered Trade Mark

5-1000 Q...1kc/s-300Mc/s

NEW
MARCONI
Q METER
 TYPE TF 1245
 With Oscillator
 TF 1247



HERE FOR THE FIRST TIME is a single Q Meter covering the range a.f. to v.h.f. Q is directly indicated from 5 to 500 by a 3-range transducer-stabilized valve voltmeter, and a second meter shows Q multipliers from $\times 0.9$ to $\times 2$. Minimum test-circuit capacitance is $7.5\mu\text{F}$ at all frequencies. Exceptional stability of Q reading, plus the high-discrimination 25-0-25 Δ Q control, brings new simplicity, speed and certainty to low-loss measurements on modern insulants and dielectrics. For flexibility and economy, the test-circuit section is energized by external plug-in oscillators which can be ordered as required. They can also be used as general-purpose signal sources. Comprehensive optional accessories include standard inductors and test jigs for special measurements.

Specification for TF 1245

FREQUENCY RANGE: 1 kc/s to 300 Mc/s.
 MEASURES Q: 5 to 1,000; accuracy 5% at 100 Mc/s.
 Q MULTIPLIER: $\times 0.9$ to $\times 2$.
 DELTA Q: 25-0-25.
 TEST CIRCUITS: Separate l.f. and h.f. test circuits have ranges of 1 kc/s to 50 Mc/s and 20 to 300 Mc/s.
 CAPACITANCE RANGE: 7.5 to $110\mu\text{F}$ with 1-0-1 μF incremental, for either test circuit. 20 to 500 μF with 5-0-5 μF incremental for l.f. test circuit.
 SHUNT LOSS: 12 M Ω at 1 Mc/s, 0.3 M Ω at 100 Mc/s.
 EXTERNAL OSCILLATORS: TF 1247, 20 to 300 Mc/s. TF 1246, 40 kc/s to 50 Mc/s. TF 1101, 20 c/s to 200 kc/s.

Send for Leaflet G150

MARCONI
INSTRUMENTS

AM & FM SIGNAL GENERATORS · AUDIO & VIDEO OSCILLATORS
 FREQUENCY METERS · VOLTMETERS · POWER METERS
 DISTORTION METERS · FIELD STRENGTH METERS
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 OSCILLOSCOPES, SPECTRUM & RESPONSE ANALYSERS
 Q METERS & BRIDGES

Please address enquiries to MARCONI INSTRUMENTS LTD. at your nearest office:

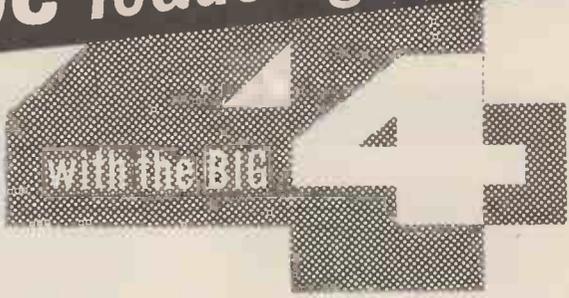
London and the South:
 Marconi House, Strand, London, W.C.2
 Telephone: COVENT Garden 1234

Midlands:
 Marconi House, 24 The Parade, Leamington Spa
 Telephone: 1408

North:
 23/25 Station Square, Harrogate
 Telephone: 67455

Export Department: Marconi Instruments Ltd., St. Albans, Herts. Telephone: St. Albans 56161

Mastertape leads again



Unique to Mastertape is the new development of 4 grades, covering every requirement from Standard high performance tape, to flawless Supergrade for the discriminating connoisseur of sound reproduction at its best. More people are insisting on Mastertape.

SIZES	SUPERGRADE		STANDARD		SIZES	LONG PLAY		DOUBLE PLAY	
	feet	£ s. d.	feet	£ s. d.		feet	£ s. d.	feet	£ s. d.
3"	—	—	150	5 6	3"	225	8 6	300	14 0
4"	—	—	300	10 6	4"	450	14 6	—	—
5"	—	—	600	1 0 0	5"	850	1 8 0	1,200	2 5 0
5½"	—	—	850	1 7 6	5½"	1,200	1 15 0	—	—
7"	1,200	2 10 0	1,200	1 15 0	7"	1,800	2 10 0	2,400	4 0 0
8½"	—	—	1,750	2 10 0	8½"	2,400	3 10 0	—	—



MASTERPIECE...

Full lists of tape, prices, accessories, etc., on application.

Mastertape

MAGNETIC RECORDING TAPE BY
MSS RECORDING CO. LTD. Colnbrook, Bucks.
 Telephone: Colnbrook 2431.

Showroom and Studio
 21, Bloomsbury Street, London, W.C.1.
 Telephone: MUSEum 1600.

Introducing the *Redifon* Type RA.10

Now being supplied to the
British Post Office and
Cable & Wireless Limited

A NEW TRANSISTORISED SSB/ISB RECEIVER ADAPTOR

- DSB/SSB/ISB Reception.
- Full, partially suppressed or totally suppressed carrier.
- Upper/Lower Sideband Selection.
- AFC correction ± 3 Kc/s.
- Self-contained - A.C. Power Unit and Dual A.F. Amplifiers.
- Built-in monitor speaker and tuning indicator.



Facilities:

Reception of:

- (a) DSB full carrier signals using either sideband—reconditioned or local carrier with AFC or local carrier without AFC.
- (b) SSB partially suppressed carrier signals (up to 26 dB) using upper or lower sideband—reconditioned or local carrier with AFC or local carrier without AFC.
- (c) SSB totally suppressed carrier signals using upper or lower sidebands—local carrier without AFC.
- (d) ISB partially suppressed carrier signals (up to 26 dB)—reconditioned or local carrier with AFC or local carrier without AFC.
- (e) ISB totally suppressed carrier signals—local carrier without AFC.

For the reception of DSB/SSB and ISB signals with Communication Receivers such as the Redifon type R.151, R.145 or R.150, or any Receiver which will provide 0.1 Volt R.F. Input between 95-950 Kc/s.

The RA.10 is completely self-contained with A.C. Power Unit and built-in dual A.F. Amplifiers, thus eliminating the need for interfering with existing Receiver power and audio wiring. Separate audio outputs associated with the upper and lower sideband are provided and a monitor speaker may be switched to either channel as required. The use of transistors reduces the size, weight, power consumption and heat dissipation to a minimum.

Input Impedance:
75 ohms.

Input Level:
0.1 Volt, r.m.s.

Unwanted Sideband Rejection:
Better than 50 dB.

Intermodulation products:
Better than 30 dB down.

Automatic Frequency Control:
Up to ± 3 Kc/s.

A.F. Response:
300-3000 c/s. within 6 dB.

A.F. Output:

- (a) 1.5 W. at 3 ohms for external loudspeaker.
- (b) 0.5 W. at 3 ohms for internal speaker.
- (c) 6 mW at 600 ohm balanced (upper sideband).
- (d) 6 mW at 600 ohm balanced (lower sideband).
- (e) Low impedance headphones output, internal speaker muted when in use.

Tuning Indicator:
A meter is provided to assist in tuning the adaptor.

Power Supply:
100/125 and 200/250 V.
50/60 c/s. Single Phase, A.C.

Power Consumption:
30 W. approx.

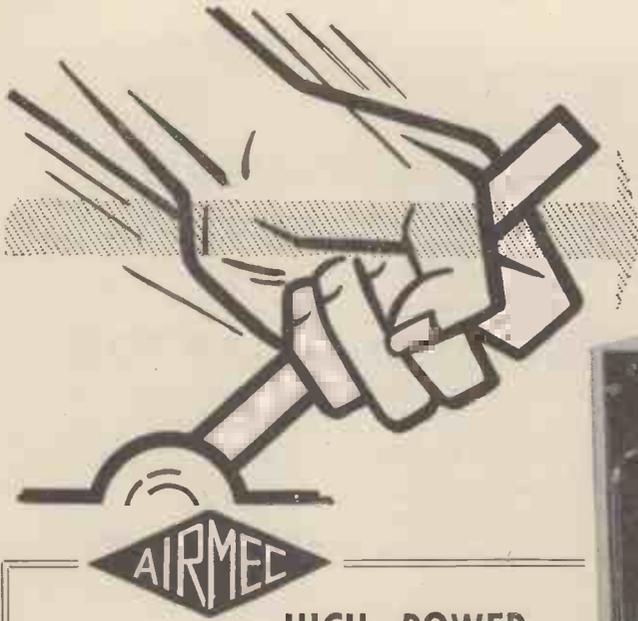
Dimensions:
19in. wide x 3½in. high x 13½in. deep.

Weight:
27 lbs.

REDIFON LIMITED

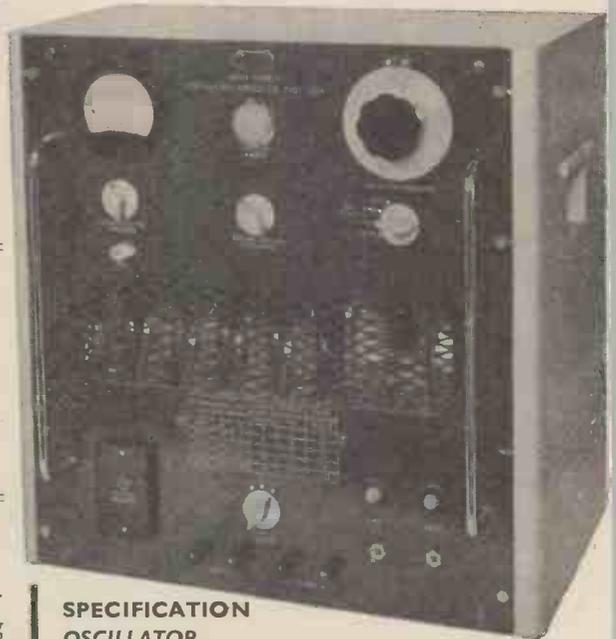
Communications Sales Division, Broomhill Road, London S.W.18 • Tel: VANdyke 7281

A Manufacturing Company in the Rediffusion Group



HIGH POWER OSCILLATOR/AMPLIFIER

TYPE 254



The High Power Oscillator/Amplifier is an instrument which combines an L.F. oscillator operating over the frequency range 30 c/s to 30 kc/s with a power amplifier capable of delivering up to 150 watts into a wide range of output impedances. The amplifier output is monitored by means of a built-in Voltmeter and an input socket is provided for use with external signal sources (microphones, pick-ups, signal generators, etc.).

SPECIFICATION

OSCILLATOR

Frequency range: 30 c/s to 30 kc/s in 3 ranges.
Calibration accuracy: $\pm 2\%$ on all ranges.

AMPLIFIER

Sensitivity: 0.1 volt r.m.s. input for full output.

MAXIMUM CONTINUOUS

POWER OUTPUT (SINE WAVE):

150 watts from 50 c/s to 5 kc/s.
100 watts from 30 c/s to 10 kc/s.
50 watts from 30 c/s to 30 kc/s.

THERE'S NO END TO ITS APPLICATIONS

The instrument has a wide variety of uses of which the following are representative:—

- ★ Power source for 40, 400, 1,600 and 2,400 c/s equipments.
- ★ Power Source for double voltage, double frequency testing on transformers in accordance with RCS.214.
- ★ Drive amplifier for A.C. servomotors.
- ★ Energising source for moving coil vibrators.
- ★ Modulation amplifier for Radio Transmitters.
- ★ High Power Amplifier for Public Address systems.
- ★ A power source for laboratory work on variable frequency filter response tests, variation of magnetic amplifier performance with frequency, etc.
- ★ Drive for synchronous clocks

Airmec

HIGH POWER OSCILLATOR/AMPLIFIERS

AIRMEC LIMITED · HIGH WYCOMBE · BUCKS
Telephone: High Wycombe 2060



The Silicon Diode shown above is actual size.

FERRANTI

Silicon Diodes ZS30 series

for MINIATURIZED Circuitry

SPECIAL FEATURES

- AUTOMATIC WIRING TECHNIQUES
- HIGH TEMPERATURE OPERATION
- HIGH RECTIFICATION EFFICIENCY
- HIGH POWER TO SIZE RATIO
- HIGH FORWARD CONDUCTANCE
- RUGGEDISED CONSTRUCTION

Ferranti Miniaturized Circuit Diodes are designed for automatic wiring techniques. These diodes, in addition to being run at maximum ratings for forty-eight hours, are rigorously tested to satisfy the following conditions:

Vibration	Grade I (Aero Engines)
Shock	> 500 g.
Humidity	Class HI
Temperature Range	-70°C to + 135°C.



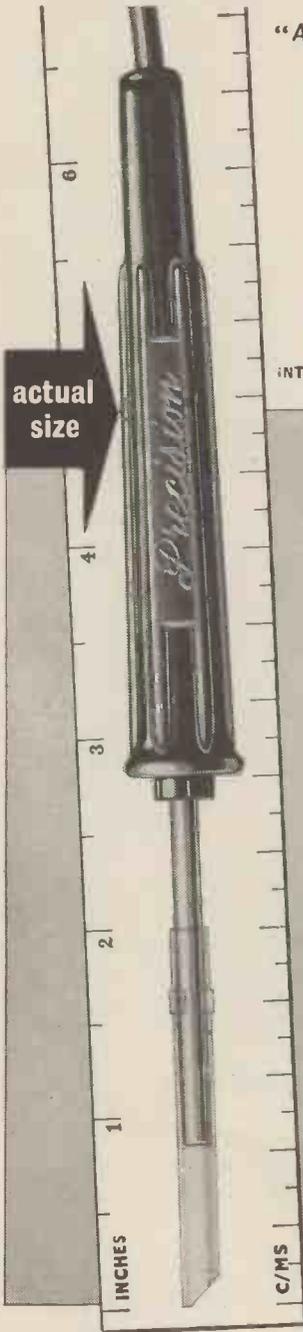
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LONDON OFFICE: KERN HOUSE, 36, KINGSWAY, W.C.2 Telephone: TEMple Bar 6666



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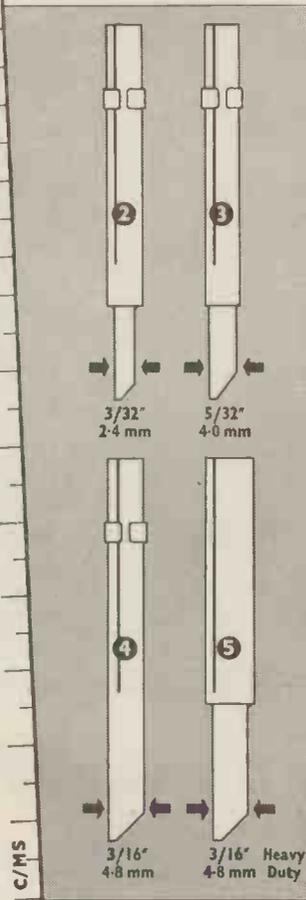
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“AS LIGHT AS A PEN”



MODEL	VOLTAGE
C.240	230/240
C.220	220/230
C.125	120/130
C.115	110/120
C.50	48/52
A or B.6	6
A or B.12	12/13
A or B.24	22/26
A or B.28	26/28

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As part of their service to the electronics industry, Acheson Colloids Limited now offer a range of 'dag'* dispersions of silver for applications where high conductivity is essential.

Air-dried silver coatings can be used as screening media, starters for the electroplating of plastics, as contact material, or as conducting inks. Among other applications for these Acheson products, the silvering of ceramics and mica at relatively low temperatures deserves special mention.

Here are two outstanding examples of their use. First, a 'dag' dispersion of silver was adopted by the G.P.O. after a long series of tests as a screening coating for the repeater valves of the first transatlantic telephone cable. Second, following two years of research and testing by Acheson technicians working in collaboration with a well known component manufacturer, a special silver coating for potentiometer low-end contacts was developed. The Acheson dispersion has now been adopted as a standard material for this purpose.

The Acheson Organisation is backed by fifty years' experience in the development and application of colloidal dispersions. If your interest is in conducting coatings, whether of silver or graphite, get in touch with Acheson's first.

dag
dispersions
of
silver

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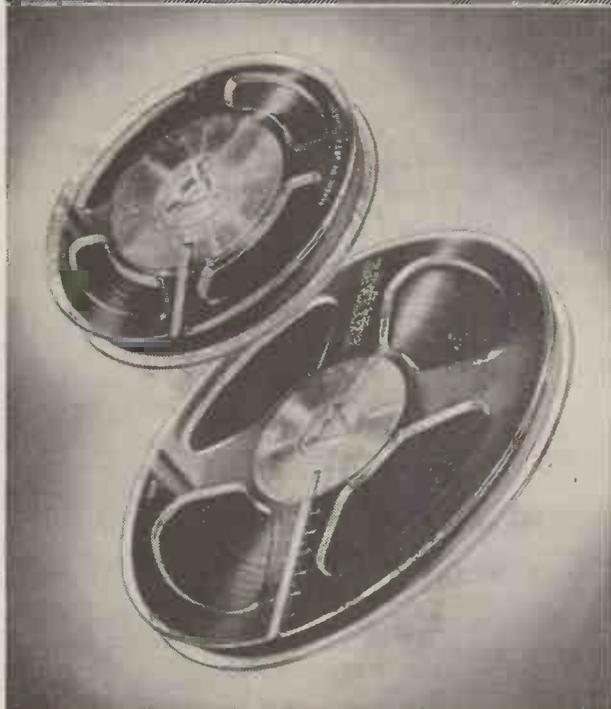
Acheson Colloids LIMITED

Subsidiary of Acheson Industries (Europe) Limited
P.O. BOX No 12 · PRINCE ROCK
PLYMOUTH · DEVON

Also Acheson Colloids N.V., Scheemda (Gr) Netherlands & Acheson Colloids Company, Port Huron, Michigan, U.S.A.



Emitape



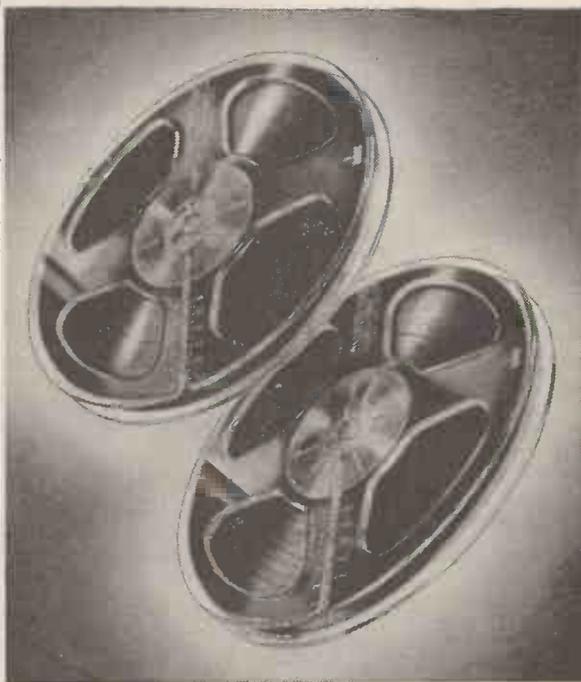
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99" LONG PLAY

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99/3		3" dia.	250'	—	9 6
88/3N		3½" dia.	175'	—	7 6
99/3N		3½" dia.	250'	—	9 6
88/6	"Junior"	5" dia.	600'	£1 3 6	£1 1 0
99/9		5" dia.	850'	£1 10 6	£1 8 0
88/9	"Continental"	5½" dia.	850'	£1 10 6	£1 8 0
99/12		5½" dia.	1200'	£1 17 6	£1 15 0
88/12	"Standard"	7" dia.	1200'	£1 17 6	£1 15 0
99/18		7" dia.	1800'	£2 12 6	£2 10 0
88/18	"Professional"	8½" dia.	1750'	—	£2 17 6
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Whether you want stereo right away or prefer to continue with ordinary single channel listening and turn to stereo later.

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Two independent amplifiers giving 8 watts high fidelity output, VHF and medium wave tuners on a chassis only 12in x 8in x 7in high.

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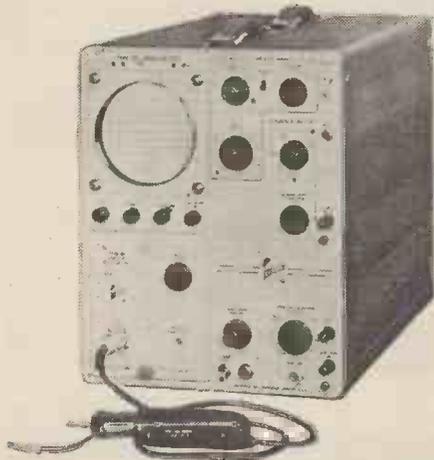
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3.5 - millimicrosecond risetime.

Type 581.

A new laboratory oscilloscope with many of the capabilities needed in the current rapid advancement of the electronic art. Its 3.5- $m\mu$ sec risetime, 0.1-v/cm sensitivity and 0.01- μ sec/cm sweep time are features for modern high-speed pulse applications. A new series of Tektronix plug-in preamplifiers promises outstanding signal-handling versatility for an oscilloscope with a vertical passband of dc to approximately 100 mc.

Type 585.

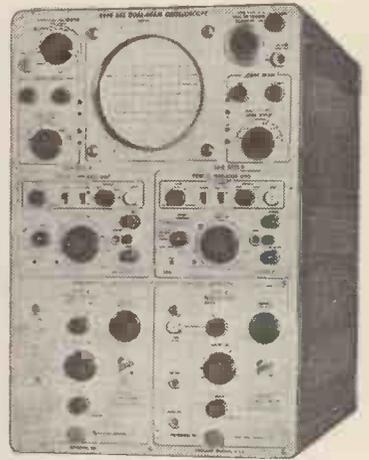
Having the identical general specifications as Type 581, the 585 has second time base generator. This acts as a sweep delay generator, providing a wide range of calibrated sweep delay, continuously variable over the range of 1 μ sec to 10 sec. Colour-correlated controls eliminate confusion, making this new high performance oscilloscope easy to operate.

NEW DC to 30 MC

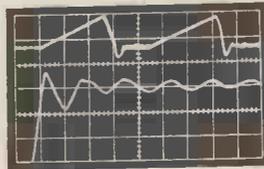
Dual - Beam Oscilloscope

Type 555.

Two electron beams, each with its own X and Y deflection systems, help make possible a highly versatile dual-beam oscilloscope. Either of the two time-base generators in the Type 555 can deflect either beam for dual and single displays, and either can deflect both beams for a dual display on the same time base. Time-base units are the plug-in



type to facilitate instrument maintenance and the sweep speed is variable between 0.02 μ sec/cm and 12 sec/cm. This new oscilloscope will accept the standard range of plug-in pre-amplifiers.



Same signal displayed simultaneously on slow sweep (upper beam) and fast sweep (lower beam) shows both coarse and fine structure of waveform. Delay range—0.5 μ sec. to 50 secs.



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6in. legs for use in upright position as illustrated, right 25/-. 12in. legs (horizontal position) 35/-.

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SOUNDS.

THE CAPRIOL EQUIPMENT CABINET

will accommodate every kind of turntable (auto-change or transcription) plus a radio tuner, plus amplifier and pre-amp.

All the above can be housed under the lid.

PRICE £12.19.0

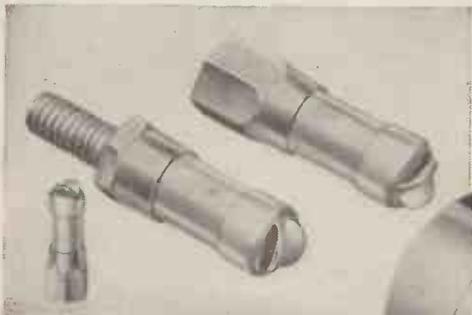
DIMENSIONS: Each cabinet measures 30in. wide, 17in. deep, 16in. high (plus 12in. legs).

Write today for details of full range of Hi-Fi Furniture to Dept WW99. We shall be pleased to advise you of your local stockist if you indicate your nearest main shopping centre.

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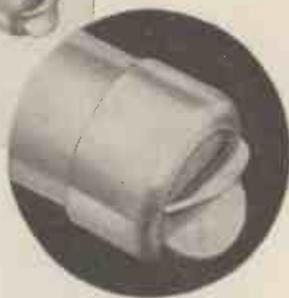
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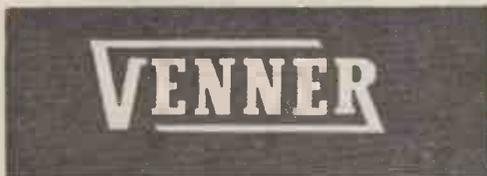
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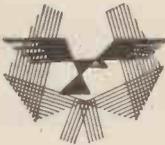
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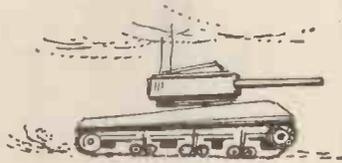
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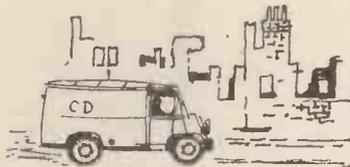
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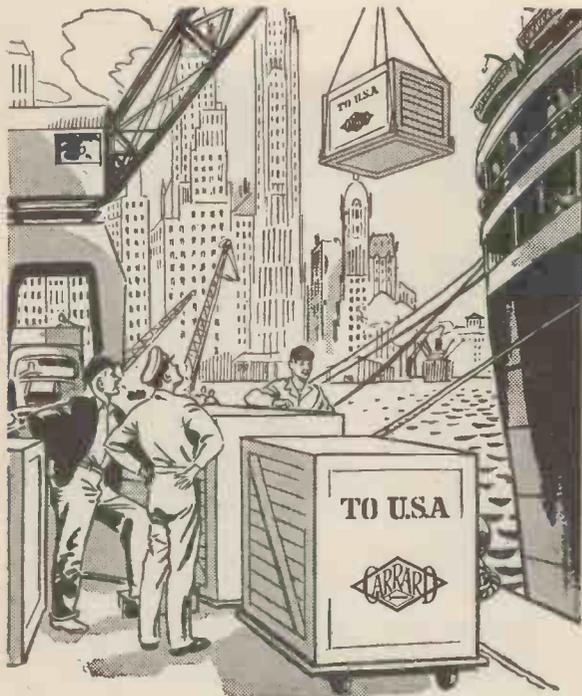
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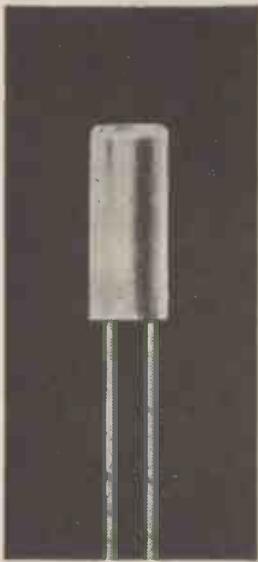
Free The NEW EDITION of Goodmans High Fidelity Loudspeaker Manual contains details and specifications of all Goodmans High Fidelity products, together with detailed information on choosing a loudspeaker, the design and construction of enclosures, stereophonic systems, stage built multiple unit loudspeaker systems, etc., etc., fully illustrated.

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Europe's largest manufacturers and the
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zener diodes

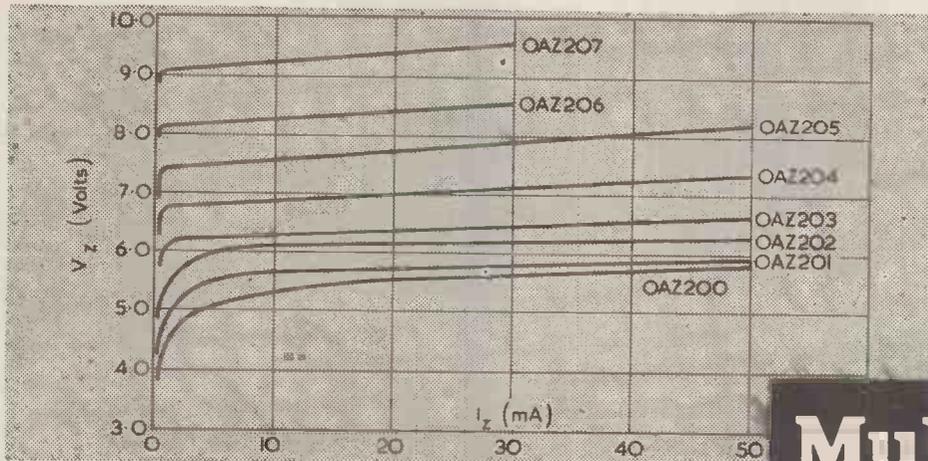
voltage
stabilisation
down to
exceptionally
low currents



Voltage stabilisation down to exceptionally low currents is provided by Mullard Zener Diodes. This feature is particularly marked in the higher voltage types where stabilisation is provided at currents as low as one milliamp. In all types the dynamic impedance is low and the zener characteristic is very sharp.

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OAZ201	5.1	4.8	5.4
OAZ202	5.6	5.3	6.0
OAZ203	6.2	5.8	6.6
OAZ204	6.8	6.4	7.2
OAZ205	7.5	7.1	7.9
OAZ206	8.2	7.7	8.7
OAZ207	9.1	8.6	9.6
15% Tolerance Range			
OAZ208	4.2	3.3	5.0
OAZ209	5.1	4.4	6.0
OAZ210	6.2	5.3	7.2
OAZ211	7.5	6.4	8.7
OAZ212	9.1	7.7	10.6
OAZ213	12.2	9.4	15



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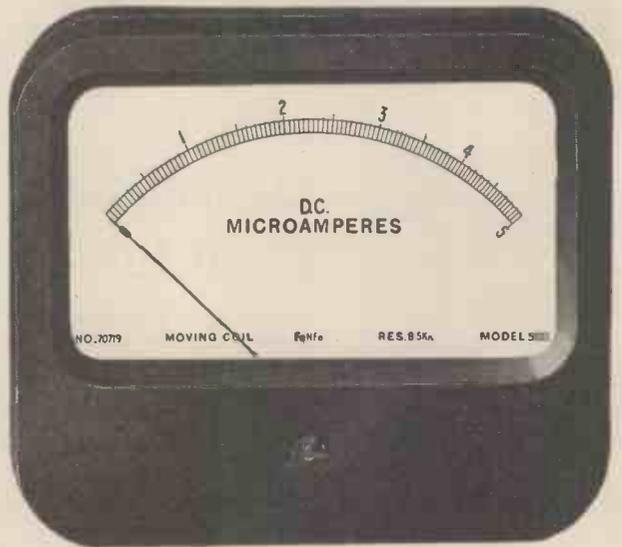
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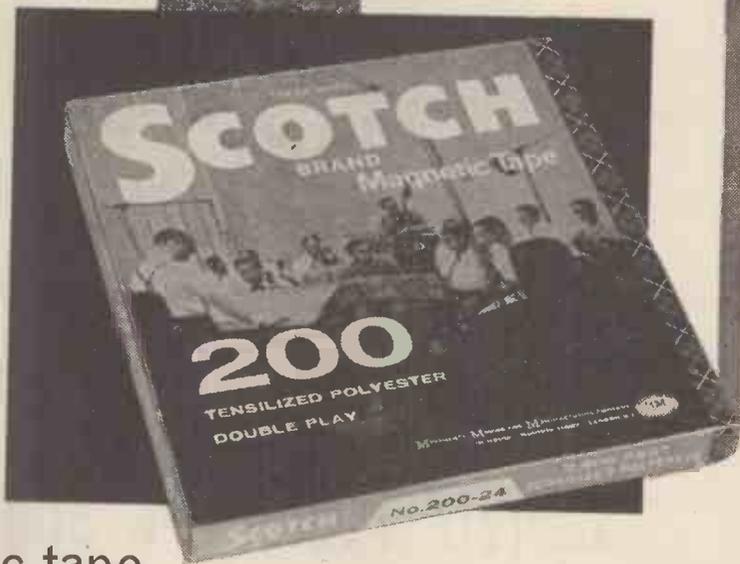


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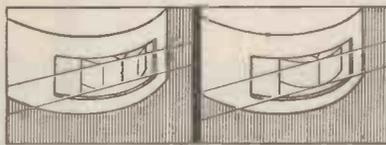


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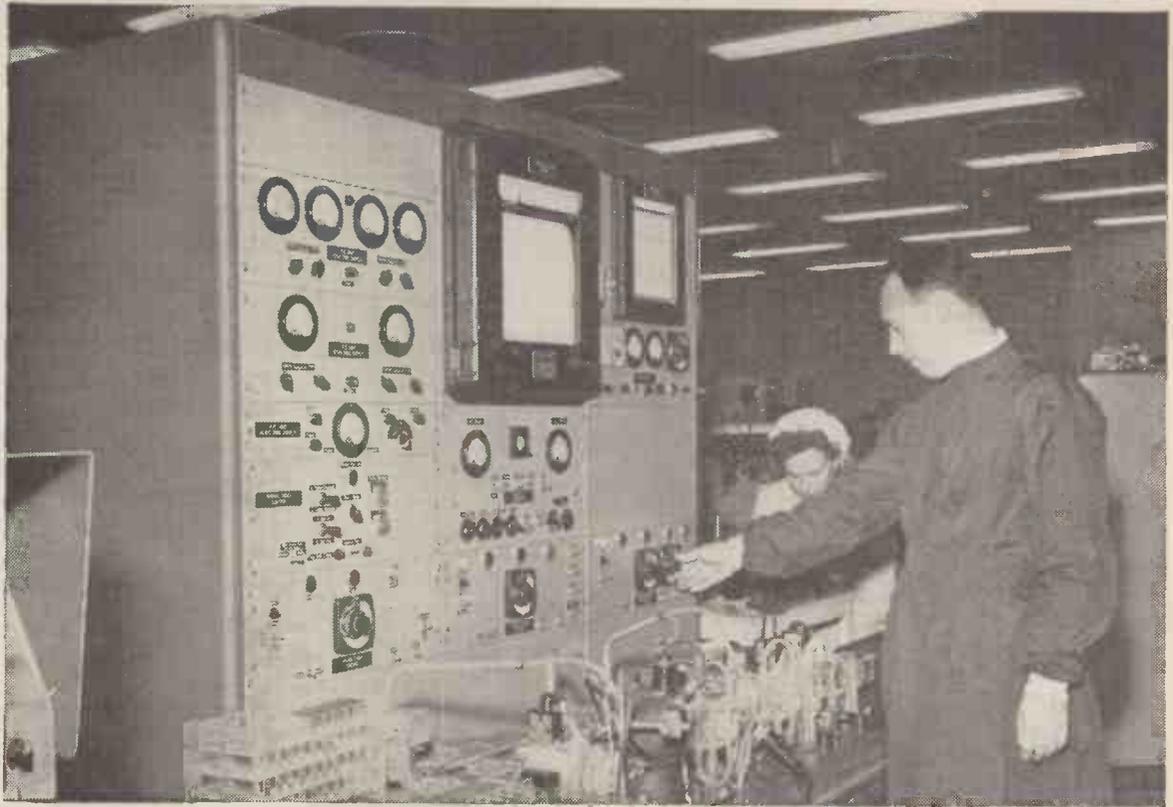
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(5.30 p.m.—9 a.m.)

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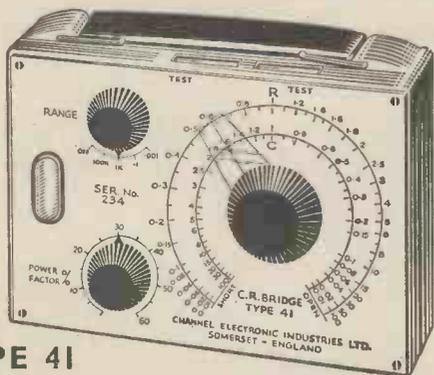
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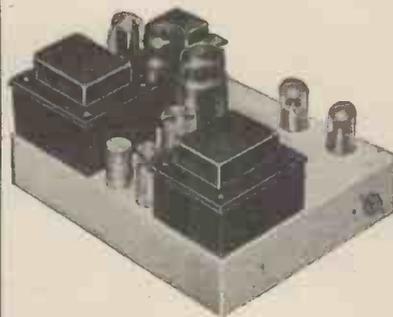
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2N640	-1	60	1500	-1	28	-12	-5
2N641	-1	60	262.5	-1	41	-12	-7
2N642	-1	60	1000	-0.6	40	-12	-7
2N591	-2	70	1	-2	41	-1	-7
2N301	-1000	70	0.4	-1800	33	-0.5	-100

● Conversion Power Gain. ■ Peak value. Zero-Signal DC Collector Ma = -900. ▲ DC Current Gain.



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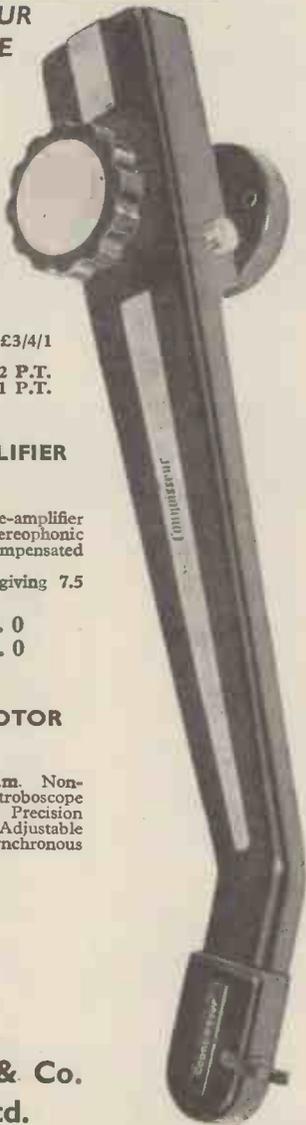
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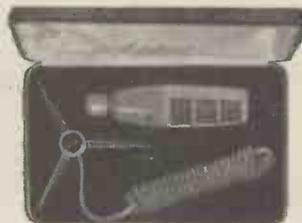
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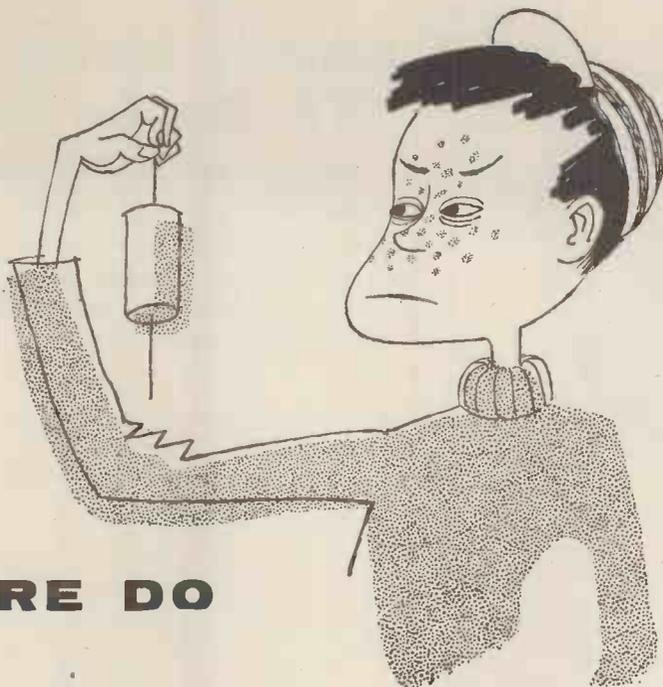
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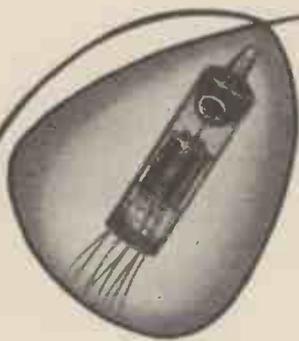


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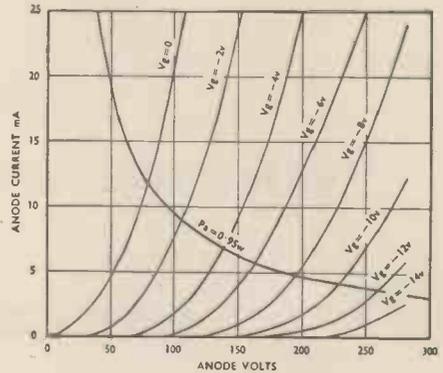
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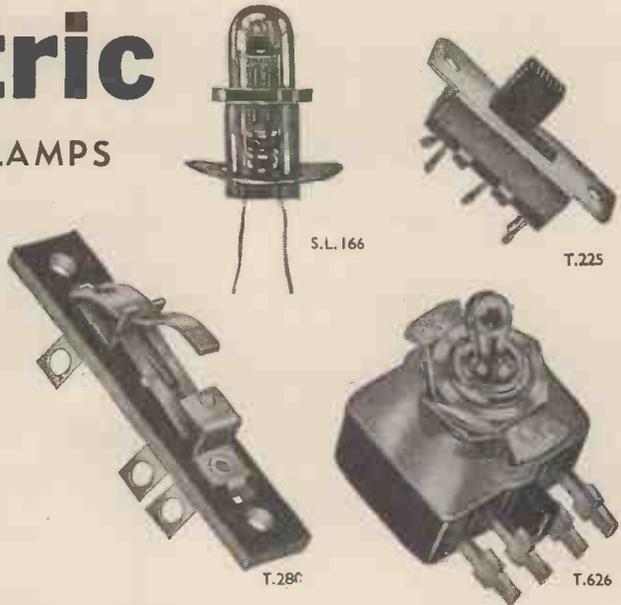
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Slope Resistance at 25°C Min. Limit	15 ohms	14 ohms	12 ohms	12 ohms	6 ohms	5 ohms
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Voltage Range	5.4-6.1	5.9-6.6	6.4-7.6	7.4-8.6	8.4-9.6	9.4-10.6
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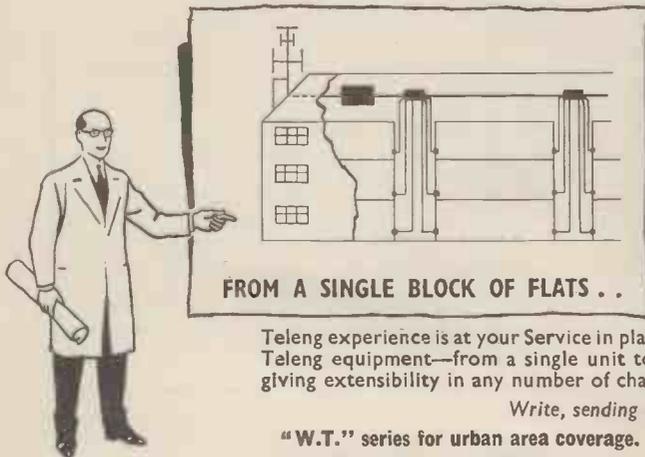
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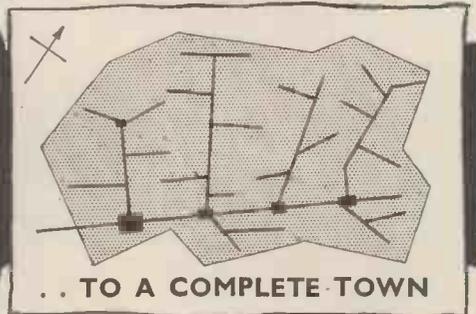
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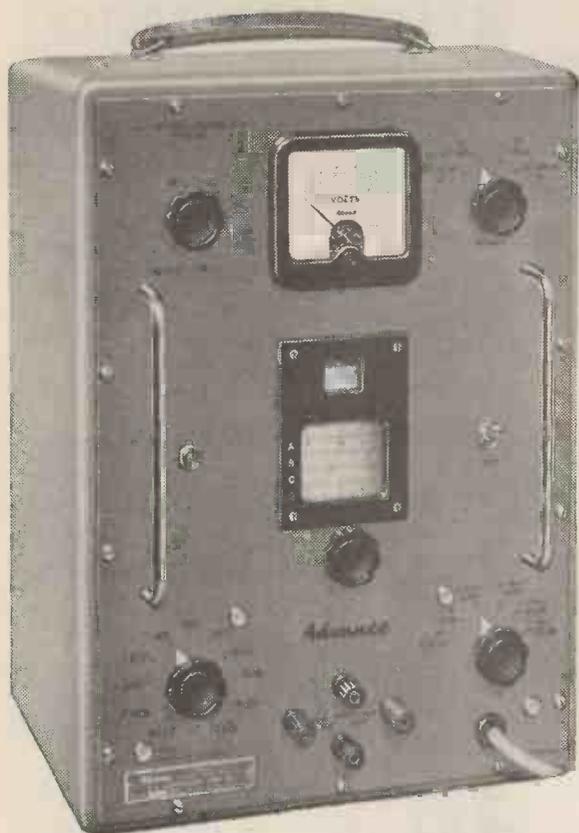
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Type **SG.81.**



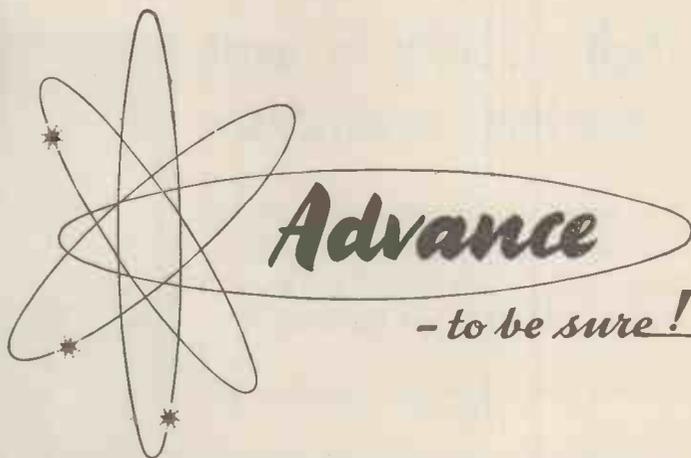
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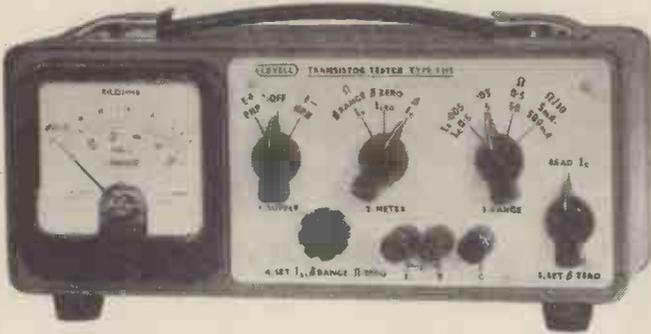
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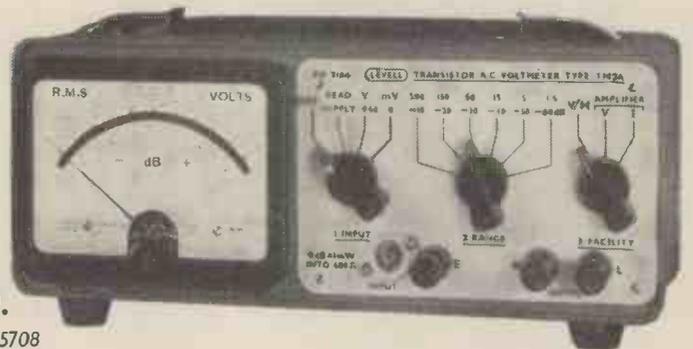
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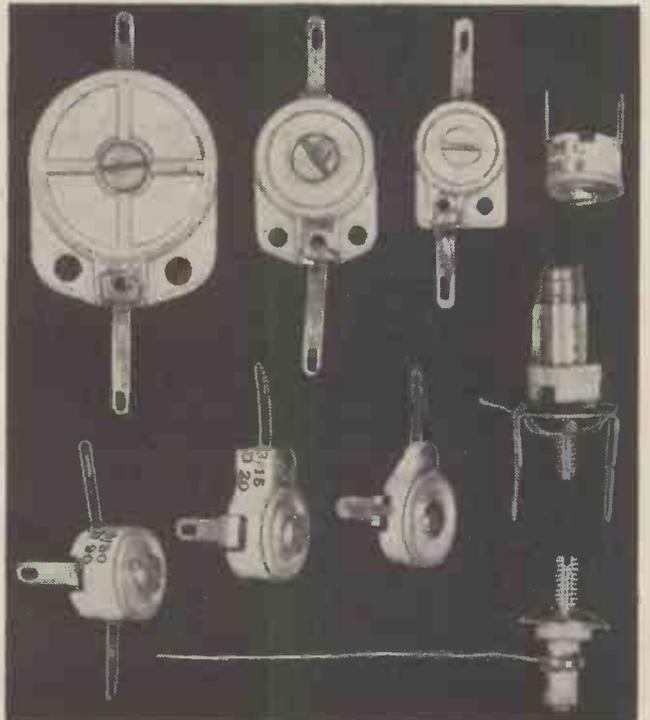
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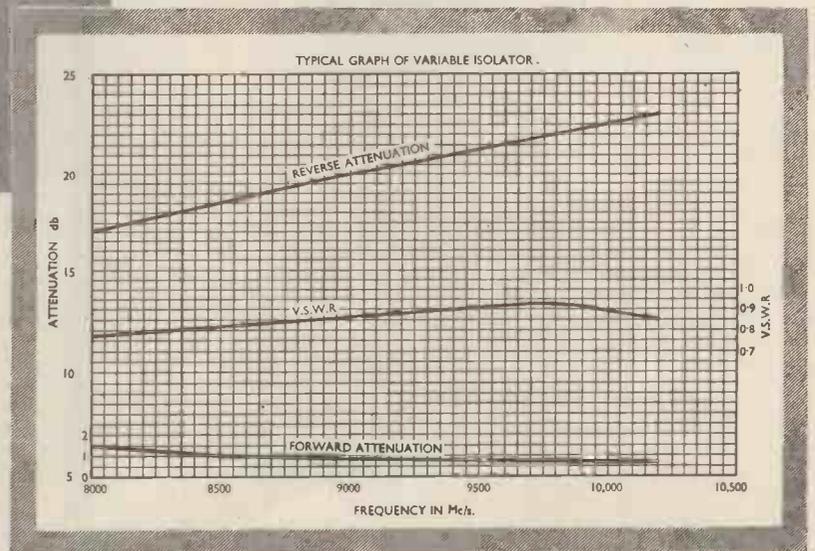




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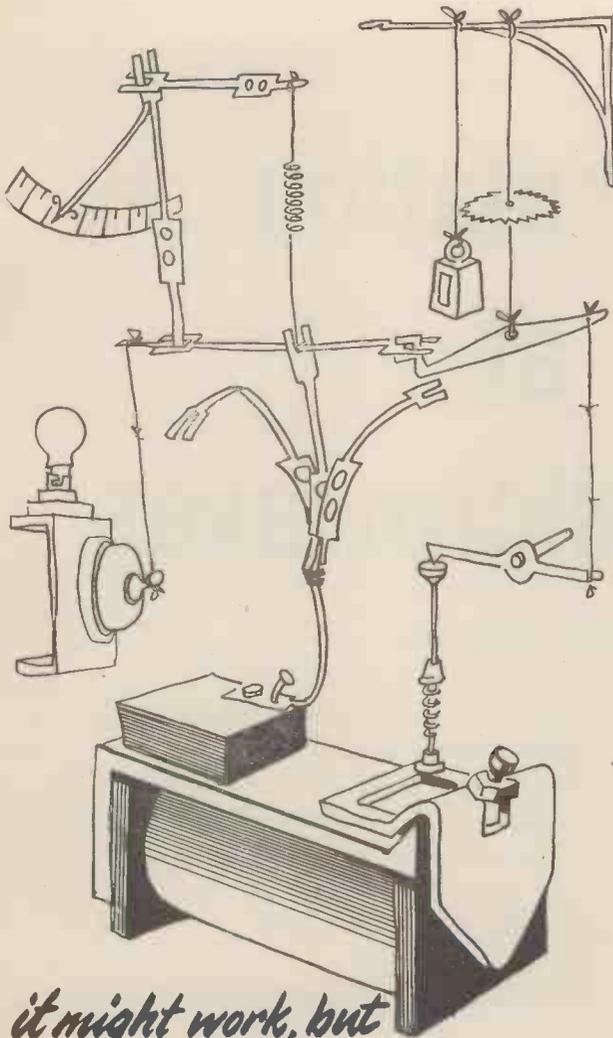


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Note: Transformer holes are not drilled in the above chassis excepting for the 20-watt amplifier.

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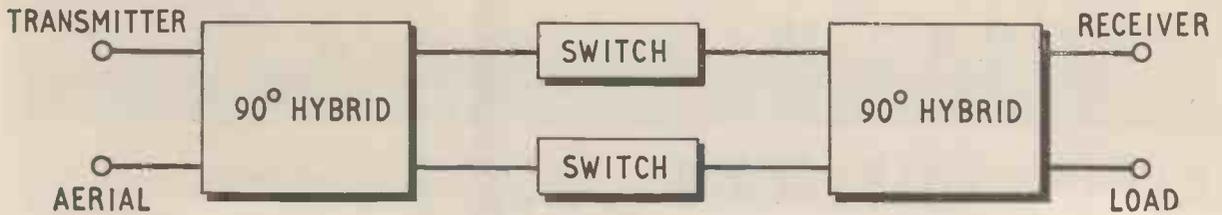
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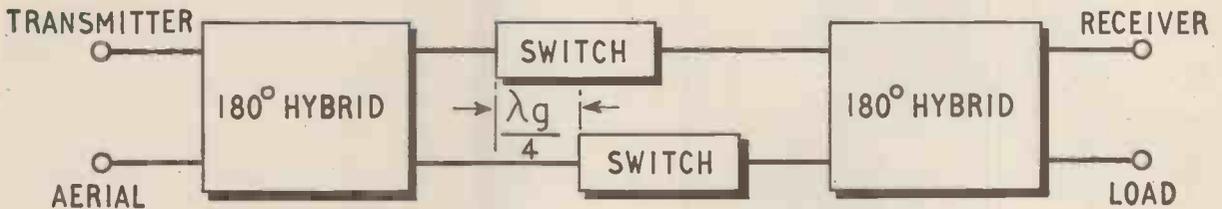
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(a)



(b)

Hybrid Junctions

The August issue of *Electronic & Radio Engineer* contains an article dealing with the frequency characteristics of hybrid junctions when used as phase dividers and duplexers. It is shown that most well-matched hybrid junctions have wide-band characteristics, but that a hybrid ring becomes narrow-band unless a quarter-wave matching section is inserted in a particular arm.

Original articles by leading authorities are a prominent feature of ELECTRONIC & RADIO ENGINEER. Regular readership will keep you in constant touch with progress in the entire field of electronics, radio and television.

ARTICLES

IN THE SEPTEMBER ISSUE INCLUDE

Magnetic Tape Recording

This article discusses in detail the mechanism of magnetic tape recording and provides a novel explanation of the manner in which signals that are fed into a recording head modulate tape.

Linear Amplifier for Decimicrosecond Pulses

This article describes a method of achieving a short rise-time by using a subsidiary amplifier to supply the charging current for stray capacitance. Economy of h.t. current is claimed.

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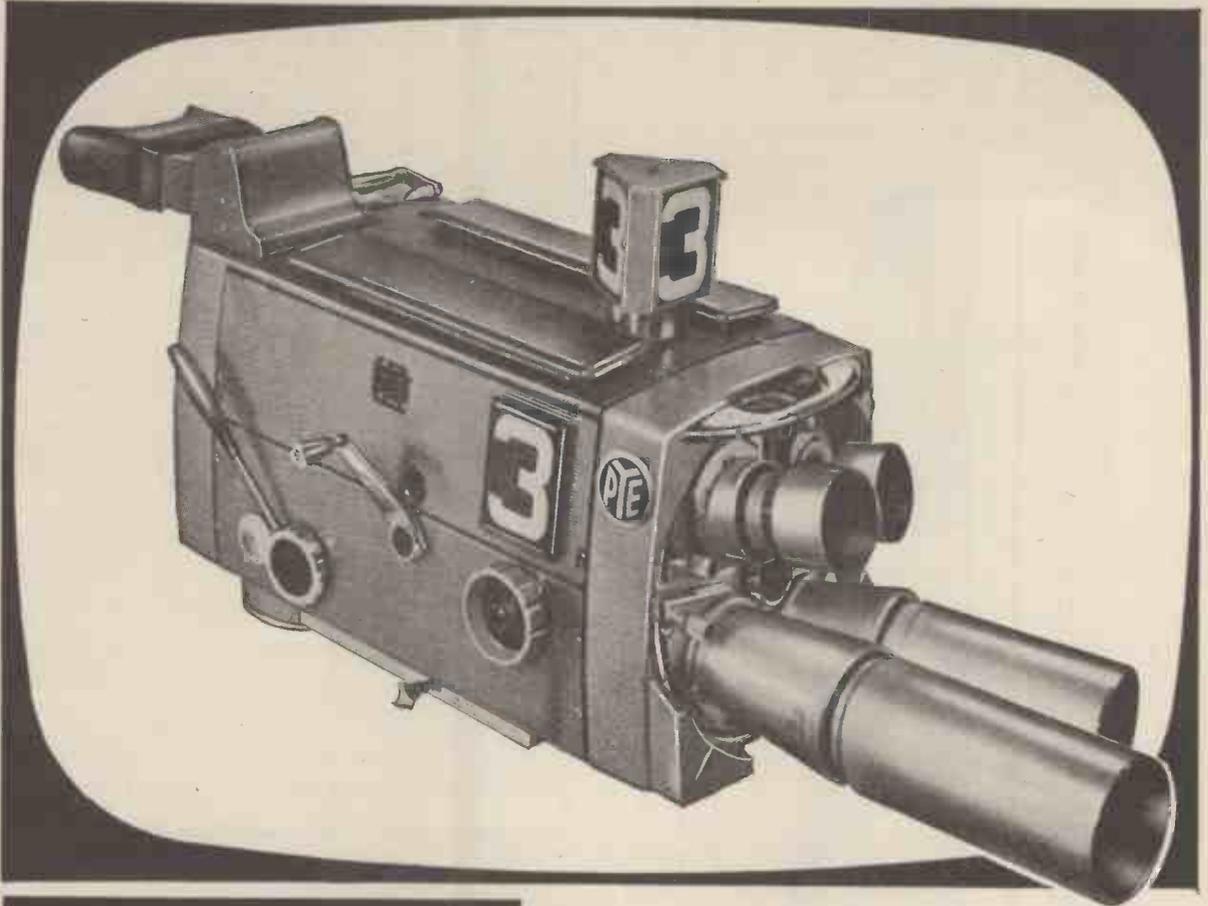
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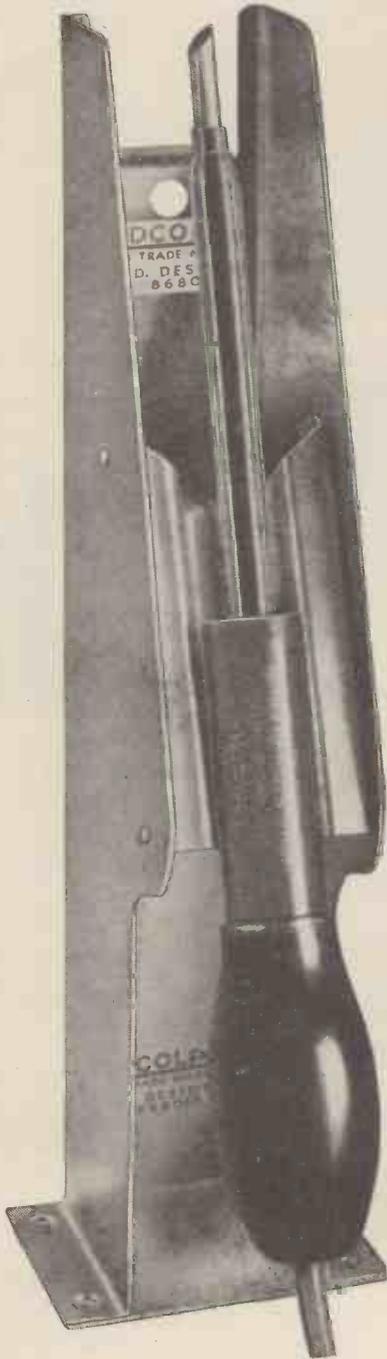
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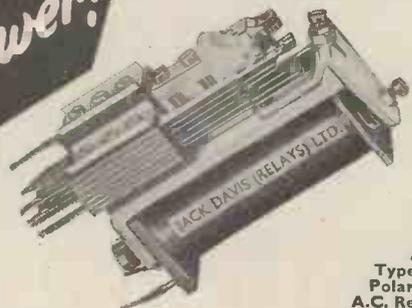
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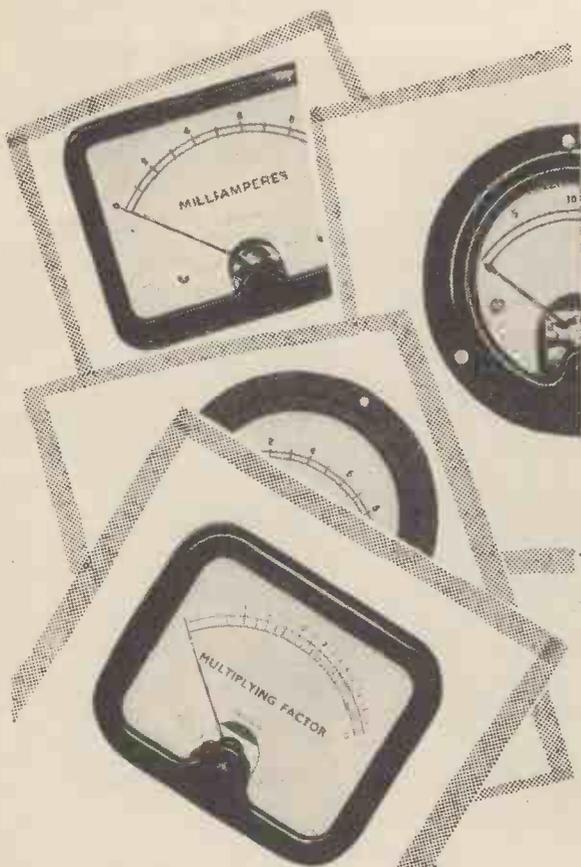
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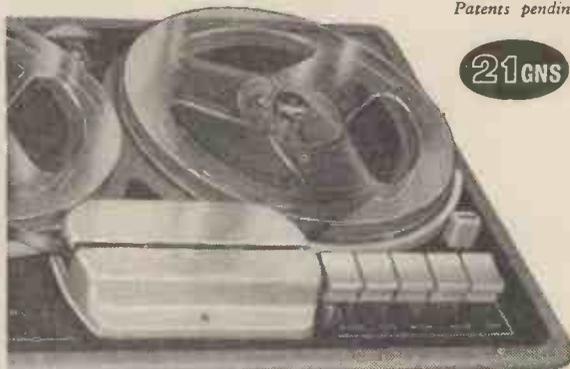
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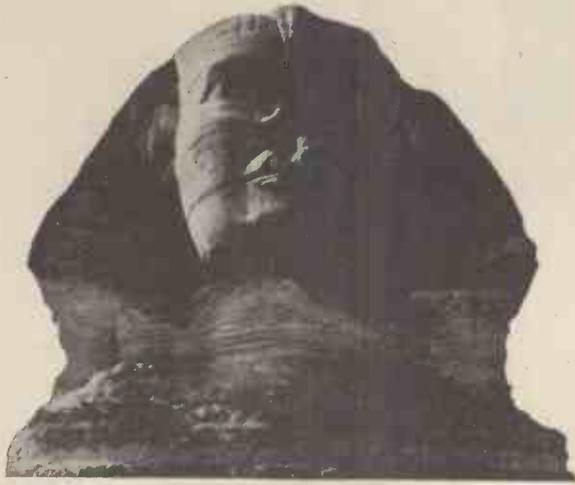
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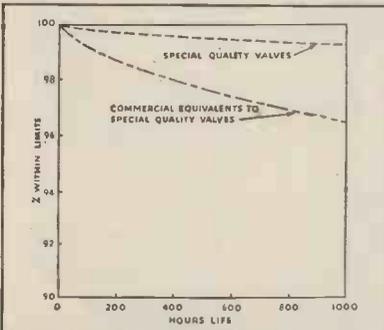
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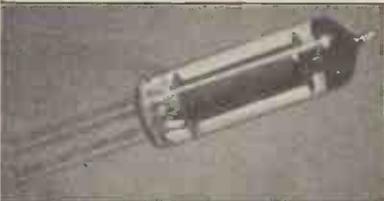


In his article (given at the 4th National Symposium of Reliability and Quality Control in Electronics in New York). Mr. R. Brewer* describes the tests carried out on M-O.V. Special Quality valves. In comparing the reliability of these Special Quality valves with that of their commercial equivalents, he states:—"the Special Quality valves are about *seven times better* than their commercial equivalents."

**Research Laboratories of the General Electric Co. Ltd., Wembley. Reprints of Mr. Brewer's article, which first appeared in the April 1958 issue of "British Communications and Electronics", are available on request from the M-O. Valve Co. Ltd.*

The table shows in detail the results obtained by the comparative life-testing of special quality valves and their commercial equivalents. Of this and the vibration-fatigue test, Mr. Brewer writes:—"... tests carried out on four types of Special Quality valves have shown a high order of reliability in both types of test. The development of these valves has benefited from the study of the causes of failures occurring in the life tests of commercial valves. This study has shown how valve assembly, processing and design faults can affect life, and it has thus provided an important feedback path by which improvements in valve reliability have been made."

"Comparison between Special Quality valves and commercial equivalents on 500-hour electrical life test."



Type references		Reliable			Commercial		
Reliable	Commercial	No. run	No. outside limits	% outside limits	No. run	No. outside limits	% outside limits
CV4005	U78	1,185	2	0.17	474	9	1.9
CV4014	Z77	1,245	4	0.32	991	22	2.2
CV4062	N78	185	2	1.1	960	22	2.3
Totals ...		2,615	8	0.31	2,425	53	2.2

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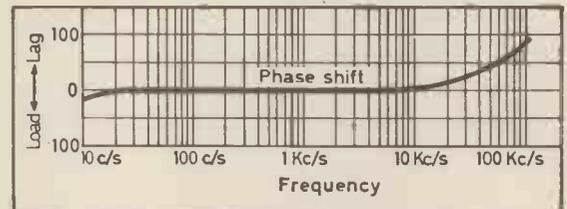
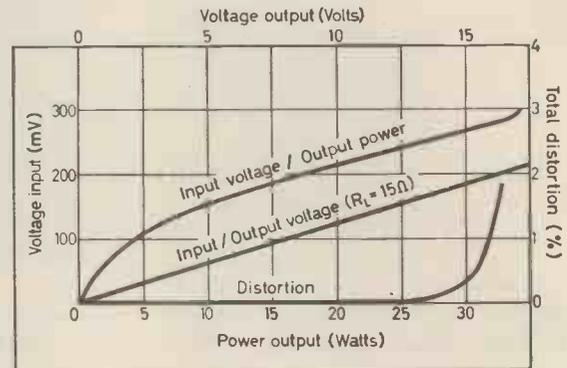
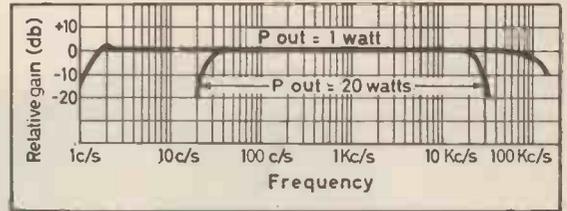
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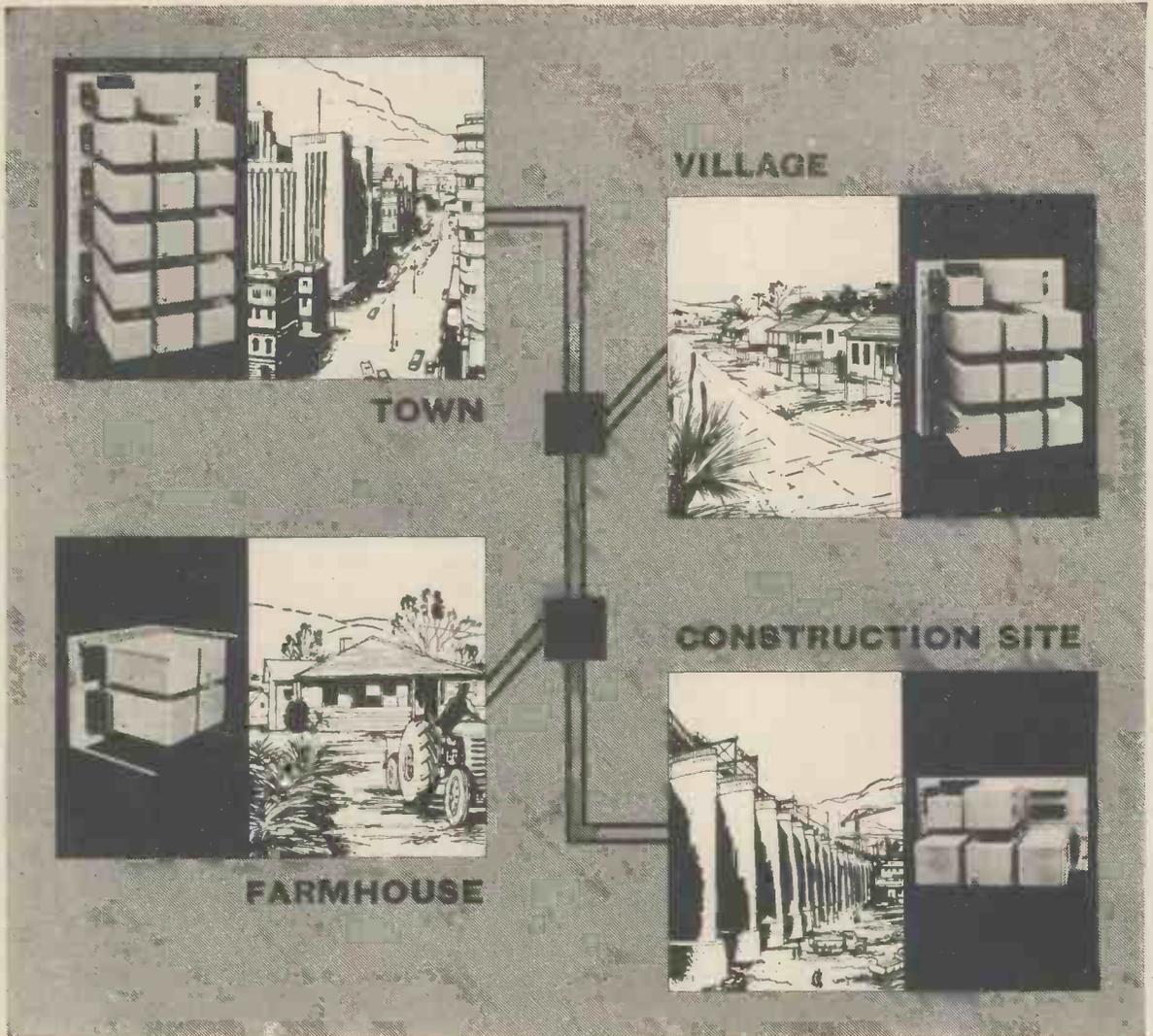
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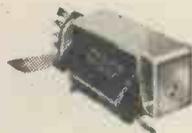
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"BELLING-LEE" NOTES

Certain senior members of the Company without high technical knowledge, but with plenty of technical appreciation asked for a toddlers guide to transistors. We searched the library in vain, the most elementary explanation used words apparently out of context, so that unless the reader understood the jargon he was lost. The "Wireless World" and other journals have written up "Transistors for the Beginner", but to be truthful how many could explain the article to their wives? We have physicists who are quite at home with transistors in their work, but ask them to explain them in simple words and they are stumped.

We have ventured to prepare a very elementary explanation using not more than 350 words all of which are in every day use. We have refrained from using words like "holes" which move from here to there. We even went so far as to ask the Editor of a wireless journal to define a hole, back came the honest and understandable answer "a bung hole without the barrel."

WHAT IS A TRANSISTOR?

A very elementary explanation.

A transistor and a household water tap are both valves in so far that they are concerned with the "flow" of something. An electronic valve is used to control the electron flow from the cathode to the anode, and with the discrete application of applied potential, it can be used to control considerable power. This is also true of a transistor, except that in place of cathode and anode we have emitter and collector. You have diode and triode valves and diode and triode transistors. Some types of valves have metal housings, most have glass; most transistors have metal housings, some have glass; metal is less fragile, and helps to get rid of heat. It is essential that the whole is air-tight, i.e. sealed. Conductors, such as silver and copper have plenty of free electrons. Insulators, such as glass or porcelain have hardly any. Germanium in a state of absolute purity is almost an



FIG. 1.

insulator. The least impurity of certain kinds renders it slightly conductive; it has become a semi-conductor. A volume of one pin-head in a ton is sufficient to change its nature or characteristic, so a very careful control is required.

The transistor shown in Fig. 1 is in the form of a sandwich. The Centre is germanium with selected impurities added to give it free negative charges and is known as "N" type. The outer components of the sandwich have been so treated as to have a positive charge and are known as

"P" type. A complete transistor arranged in this way would be known as a "PNP" type. Free electrons can flow from one of the outers to the other through the semi-conductor base in the centre. This flow is caused by applied potential from a source of power, such as tiny dry cells.

It may be a dangerous analogy, but at the risk of being criticised by the pure physicist, we dare to suggest that the type of transistor we have described may be compared with a triode valve, although there is a

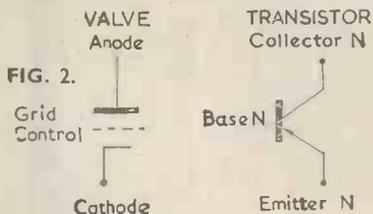


FIG. 2.

difference, in that in the transistor the control is applied between the emitter and the base which makes the base highly conductive enabling current to flow to the collector.

Taking the analogy one stage further, the emitter base and collector are equivalent to the cathode, grid and anode. There is one major difference in that with the PNP type transistor, the polarities are reversed, the collector being negative and the emitter positive with respect to the base. The transistor can be made to work with reversed polarity by having an NPN arrangement, in which case the supply voltage becomes positive. Many semi-conductors other than germanium may be used in a similar manner, particularly silicone, or they may be arranged differently.

The reader will have noted the stress laid on purity and controlled impurities, which are often conveyed by moisture, therefore it is necessary to contain the transistor assembly in a sealed housing, and this is where "Belling-Lee" comes in.

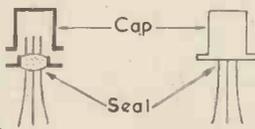


FIG. 3.

We provide the assemblies, metal flanges with the conductor wires passing through glass seals. The transistor manufacturer assembles his transistor in a dry atmosphere, on this ready-made platform, over which a metal cover, filled with a component such as silicone grease is placed, the whole being soldered or welded together. The seal is so perfect that the leakage is of the order of 1 c.c. in 30 years, or 10⁻⁶ Lusecs. The Lusec is the unit of rate of gas flow.

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L.1387, L.1388, L.1389

Our range of miniature Unitors, designed for the inter-connection of units in miniaturised equipment, is proving extremely versatile in application. This versatility is assisted by the flush- or surface-mounting shrouds available.

Current rating (small pins):

5A. each for a 20°C. rise in temperature.

Breakdown voltage:

With shrouds L.1404/5/6. Sea-level At 68,000 ft.
Between pins: 3kV. 500V.
Pins to earth: 2.5kV. 500V.

Voltage proof: 2kV.

Max. working voltage: 500V. (in dry conditions).

Contact resistance:

Less than 2 milliohms.

Withdrawal force: 8 oz./pin.

Weights of mated pairs:

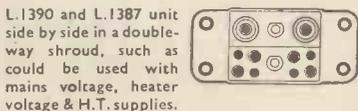
L.1387 10 gms. L.1388 8 gms.
L.1389 9.5 gms.

Other Unitors in this range include L.1390 (Two-pin mains) and L.1391 (Double coaxial).

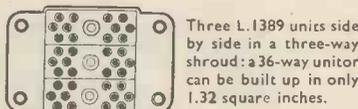
MINIATURE UNITOR SHROUDS

- L.1404/F. Flush, Single-way.
- L.1404/S. Surface, Single-way.
- L.1405/F. Flush, Double-way.
- L.1405/S. Surface, Double-way.
- L.1406/F. Flush, Three-way.
- L.1406/S. Surface, Three-way.

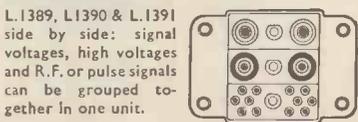
The material is brass, cadmium-plated and passivated, and the positions in the two- and three-way units are identified by letters. Here (shown half-size) are three of the more common arrangements from the several thousand possibilities.



L.1390 and L.1387 unit side by side in a double-way shroud, such as could be used with mains voltage, heater voltage & H.T. supplies.



Three L.1389 units side by side in a three-way shroud: a 36-way unit can be built up in only 1.32 square inches.



L.1389, L.1390 & L.1391 side by side: signal voltages, high voltages and R.F. or pulse signals can be grouped together in one unit.

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Advertisement of BELLING & LEE LTD. Great Cambridge Rd., Enfield, Middx. Written 15th June, 1959



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	LOW NOISE	LOW POWER†					MEDIUM POWER‡		
	Maximum noise factor = 5dB (f = 1 kc/s, R _s = 500 Ω V _{ce} = -2V, I _e = 0.5mA)	Maximum collector dissipation at 45°C = 200mW at 55°C = 150mW					Maximum collector dissipation at 45°C = 800mW at 55°C = 600mW (on 3" x 3" cooling fin)		
ic(pk)(A)	—	I					I		
	GET106	GET114	GET113‡	GET103	GET102‡	GET104	GET115	GET116	GET105
Vce(pk)(V)	15	15	15	30*	30*	30	15	30*	40*

‡ New high gain types * Re/Rb > 0.03 † Can be supplied in matched pairs

G.E.C. Semiconductor Division, School St. Hazel Grove, Stockport, Cheshire. Tel: Stepping Hill 3811. London enquiries Tem. Bar 8000. Ext. 10

Aspects of design 14

NEUTRALISATION OF TELEVISION I.F. AMPLIFIERS

This is the Fourteenth of a series of special features dealing with advanced problems in television and radio circuit design to be published by Siemens Edison Swan. The Edison Mazda Applications Laboratory will be pleased to deal with any questions arising from this or other articles, the fifteenth of which will appear in the October 1959 issue.

In "Aspects of Design" No 2 the stability of a single stage in an I.F. amplifier was discussed, and the variation with frequency of the anode to g_1 admittance of the Edison Mazda 30F5 was shown in a curve. The smaller this admittance, the less feedback occurs from anode to control grid and the more stable the stage becomes. Thus if the admittance were zero, complete stability over the stage would be achieved.

STABILITY AND VALVE DESIGN

Although there can only be zero admittance at one particular frequency (apart from zero frequency), it is possible to minimise the admittance by keeping the coupling within the valve to a low level. Edison Mazda valves for this application have therefore been designed to have a low admittance over the whole range of frequencies with which they are likely to be used. This enables vision I.F. strips to be designed with complete stability.

LIMITATION OF SOUND GAIN

In the case of sound I.F. strips, requirements are rather more stringent. Here input and output impedances of the valves are not limited by damping resistors. (In the vision I.F. these are necessary to attain the 3 Mc/s bandwidth occupied by the video signal.) Instead, the tuned circuit impedances in the sound strip can be made as high as possible consistent with stability, without the bandwidth becoming too narrow. The impedances are limited by the following expression for stability:

$$R_{d(in)} \times R_{d(out)} \times g_m \times Y_{g1a} < 0.8$$

where R_d = dynamic resistance of the tuned circuits
 g_m = mutual conductance of the valve
 Y_{g1a} = effective anode to g_1 admittance

If this condition is fulfilled, oscillation is avoided in a single stage circuit using band-pass tuned circuits with $kQ = 1$. With two stages the limiting figure on the right-hand side of the expression is reduced to 0.4. In practice, these figures must be reduced by a factor of 4 or 5 to avoid asymmetrical responses.

Thus for a given valve, $R_{d(in)} \times R_{d(out)}$ would seem to be restricted to a definite upper limit for a given factor of safety from oscillation, and this in turn limits the gain attainable in the strip. It will be remembered, however, that Y_{g1a} in the above expression is the effective admittance from anode to g_1 , and is therefore determined in practice not only by the internal structure of the valve, but also by the external layout of the circuit. In the past the layout has been adjusted by experiment to give the most stable arrangement.

NEUTRALISATION

Nowadays a more scientific approach is being adopted, and the effective anode to g_1 admittance is being balanced out, or in other words neutralised, by some form of bridge circuit. It enables higher impedance circuits to be used with stability, giving more gain in the sound I.F. strip.

PRACTICAL METHODS

Two of the neutralisation bridge circuits in use are shown in Figs. 1 and 2. In the first, the balancing feedback is via the common impedance of the anode and g_3 decoupling capacitor (C_n). This component must have a fairly close tolerance. (Typical values are 1000 pF to 1500 pF $\pm 10\%$.) Basically this circuit is independent of frequency, but in practice the unavoidable inductances of the capacitor leads and the stray inductances in the other arms of the bridge limit its full effectiveness to one particular frequency with a given value of neutralising capacitor C_n .

In the second method (Fig. 2), the connection from g_3 to chassis takes the form of a small coil (L_n). This completes a bridged-T network between anode and g_1 , which can be tuned to present a high impedance at the intermediate frequency. Instead of g_3 , other elements in the valve can be used for neutralisation (e.g. by taking the internal screen to chassis through a small inductance). A neutralising coil can be wound to close tolerance quite economically, which gives this method an advantage over the method shown in Fig. 1 where for the same consistency an expensive close tolerance capacitor (C_n) would be required.

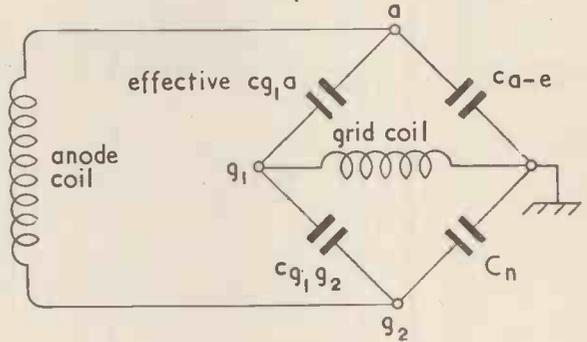


FIG. 1.

$$C_n = \frac{c_{g1g2} \times c_{a-e}}{\text{eff. } c_{g1a}}$$

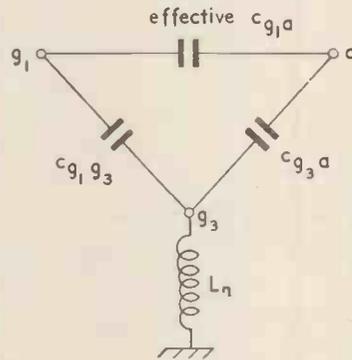


FIG. 2.

$$L_n \doteq \frac{\text{eff. } c_{g1a}}{c_{g1g3} \times c_{g3a}}$$

Simple formulae for the values of the neutralising components are given in Figs. 1 and 2. These are only approximate because of the presence of unknown inductances and the fact that the exact value of effective c_{g1a} in any particular layout is unknown. It is therefore necessary to determine the optimum value of neutralising component by a direct method. One of the best methods is to feed a signal from a wobulator into the grid tuned circuit of the valve to be neutralised, and to take the output to the display unit (via a suitable detector circuit) from the same point, i.e. the grid. The feedback via the effective anode to g_1 admittance produces a disturbance on the display as the sweep frequency passes through the resonant frequency of the anode and this can then be minimised by correct adjustment of the neutralising component.

It will be seen that these bridge circuits involve various inter-electrode capacitances, other than the anode to g_1 capacitance. Before neutralisation came into use, certain of these inter-electrode capacitances had very little effect on performance, but with the advent of neutralisation this is no longer so, and all Edison Mazda I.F. valves are manufactured with suitably close tolerances on all relevant inter-electrode capacitances, making them eminently suitable for high gain I.F. strips using neutralisation.

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 Technical Service Department, 155 Charing Cross Rd., London, W.C.2.
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110° TELEVISION CATHODE RAY TUBES

EDISWAN MAZDA CME.1703 AND CME.2101.

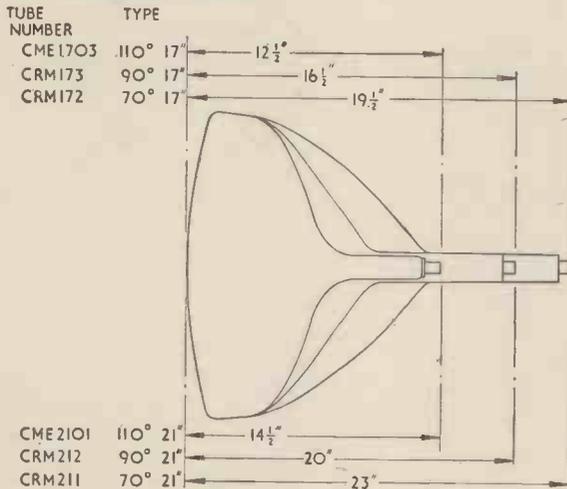
These new Ediswan Mazda Cathode Tubes with 110° diagonal deflection angle offer the TV receiver manufacturer considerable reduction in overall length without deterioration of picture quality. An electrostatically focused electron gun requiring a focus electrode voltage of approximately one hundred volts provides good resolution and uniformity of focus over the whole of the tube face. Picture brightness has been increased by combining a new silver activated phosphor with the well established aluminising technique.

A brief specification of these tubes is tabulated below.

GENERAL DETAILS

Rectangular face	Aluminised screen
Electrostatic focus	Grey glass
Magnetic deflection	External conductive coating
Straight gun—non ion trap	Heater for use in series chain

COMPARISON OF OVERALL LENGTH FOR VARIOUS DEFLECTION ANGLES



Heater Current (amps) I_h 0.3
 Heater Voltage (volts) V_h 12.6

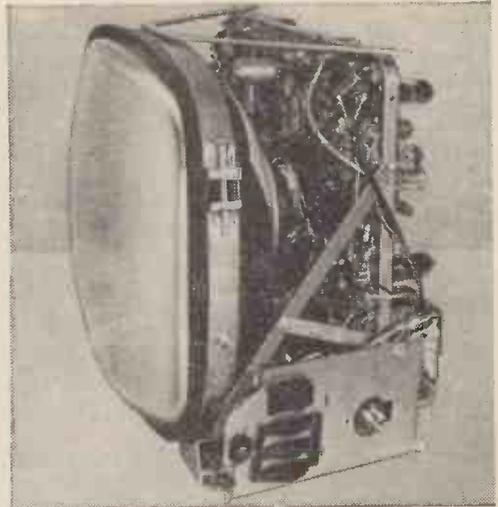
TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings	CME.1703	CME.2101
Second and Fourth Anode Voltage (volts) $V_{a2,a4(max)}$	16,000	16,000
Third Anode Voltage (volts) $V_{a3(max)}$	± 500	± 700
First Anode Voltage (volts) $V_{a1(max)}$	400	400
Heater to Cathode Voltage-Heater Negative (dc) (volts) $V_{h-k(max)}$	180	180
Inter-electrode capacitances (pF)		
Cathode to All* C_{k-all}	5	5
Grid to All* C_{g-all}	6.5	6.5
Final Anode to External Conductive Coating (approx.) $C_{a2,a4-M}$	1700	2000

Typical Operation

Second and Fourth Anode Voltage (volts) $V_{a2,a4}$	CME.1703	CME.2101
First Anode Voltage (volts) V_{a1}	300	300
Third Anode Voltage for Focus-Mean (volts) V_{a3}	+100	+100
Grid Bias for cut-off of Raster (volts) V_g	30-72	30-72
Average Peak to Peak Modulating Voltage for Modulation up to 150 μA (volts)	24	24

*Inter-electrode capacitances including Siemens Ediswan Clix B8H holder (6 pin).



Maximum Dimensions (mm)

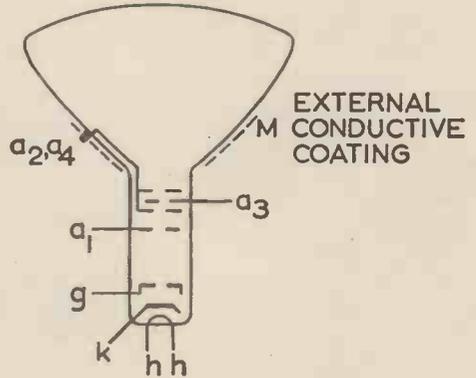
	CME.1703	CME.2101
Overall Length	324	378
Face Diagonal	424*	546†
Face Height	327*	419†
Face Width	400*	518†
Neck Diameter	29.4	29.4

*The maximum dimension at the face seal may be 7 mm. larger than this dimension but at any point round the seal the bulge will not protrude more than 3.5 mm.

†The maximum dimension at the face seal may be 3.5 mm. larger than this dimension but at any point round the seal the bulge will not protrude more than 2 mm.

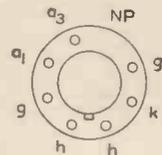
Tube Weight (lb.)

	CME.1703	CME.2101
Nett (approx.)	9 1/2	21
Anode Cap: CT8 (cavity)		
Base: B8H		



Connections

Anode terminal in line with a_3 pin. Tolerance $\pm 30^\circ$

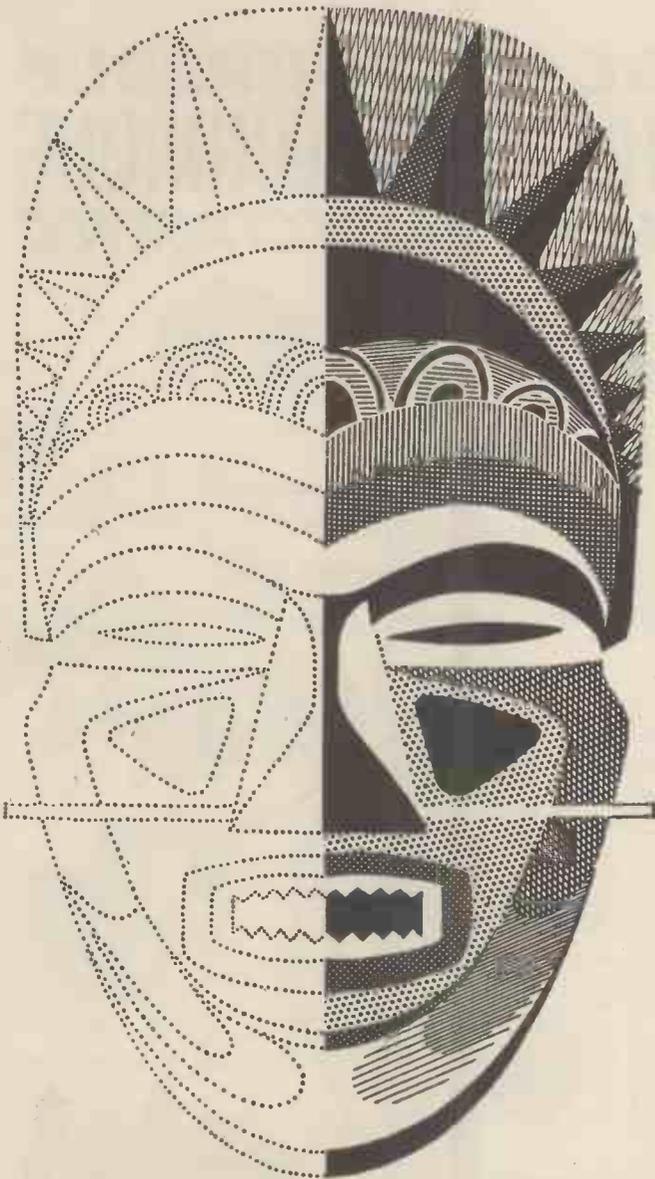


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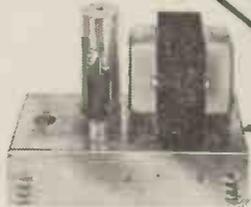
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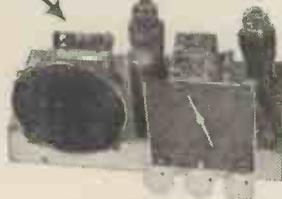
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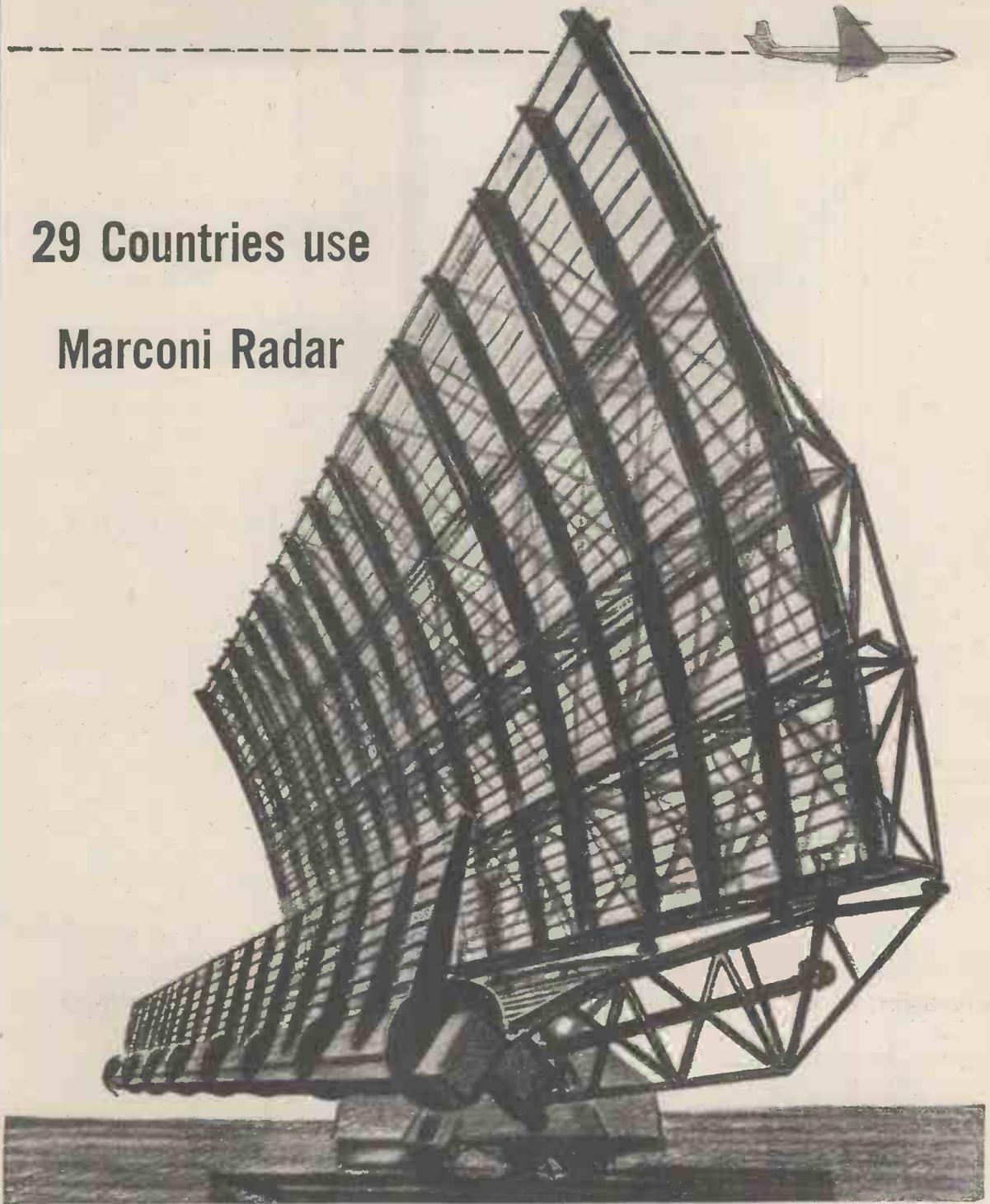
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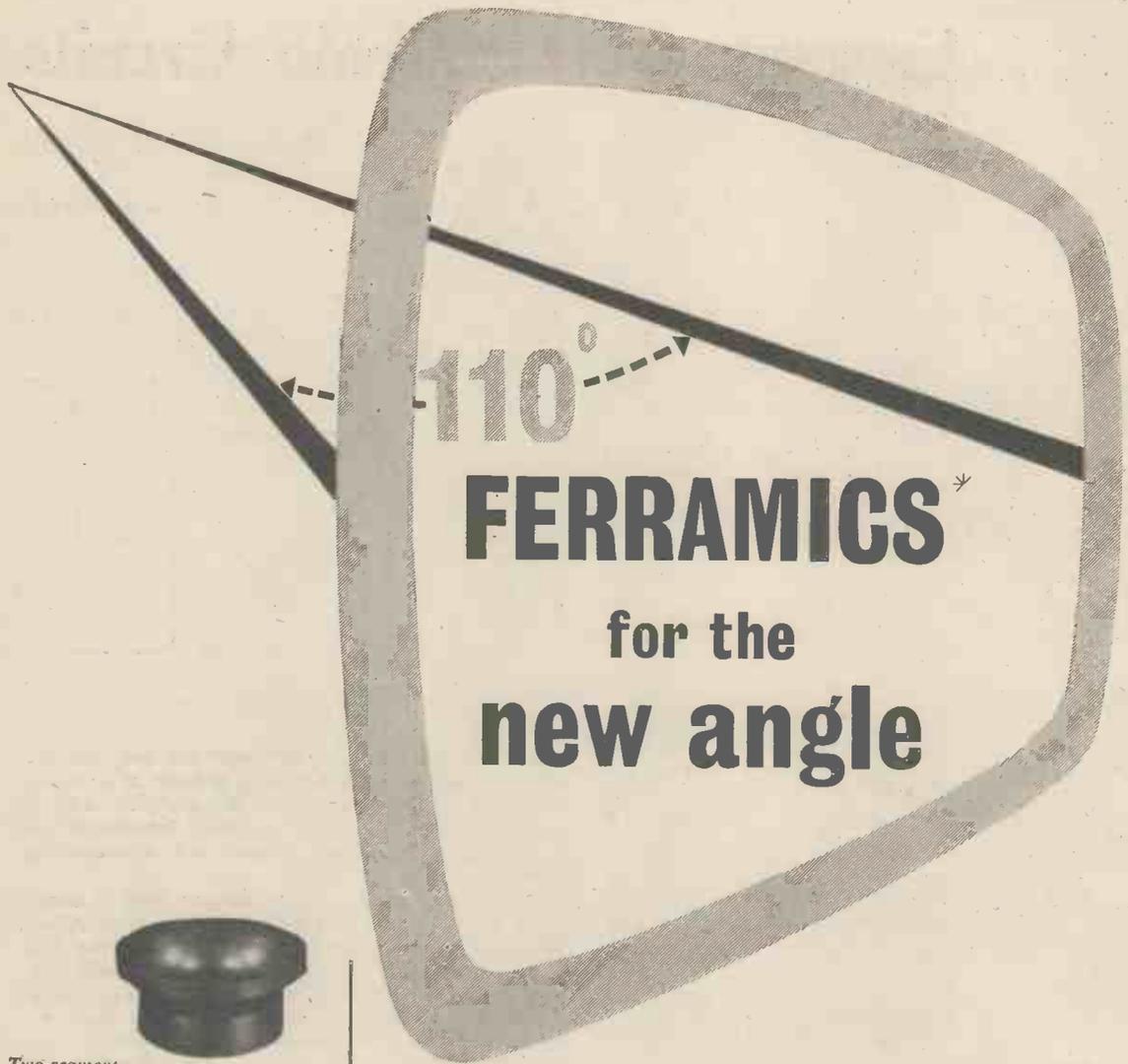


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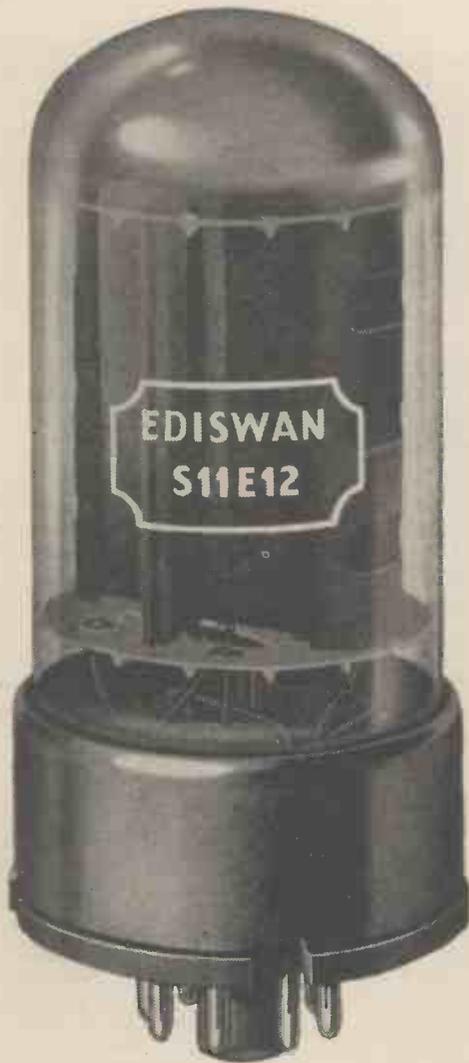
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Mutual Conductance (mA/V)	g_m	13.5
Anode Dissipation (watts)	P_a (max)	28
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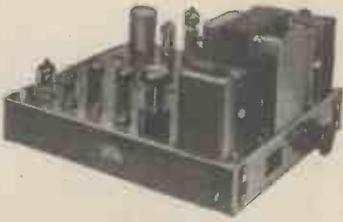
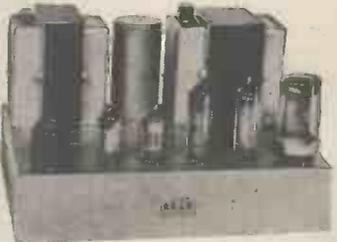
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RI155 for Spares



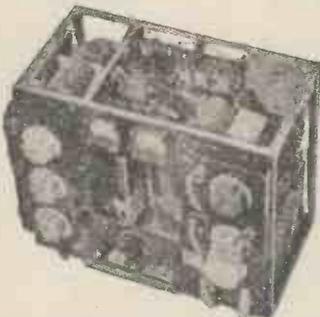
These are less valves but otherwise reasonably complete—ideal for spares—prices £2 to £4 depending on condition. Carriage 7/6.

Don't Stumble in the Dark



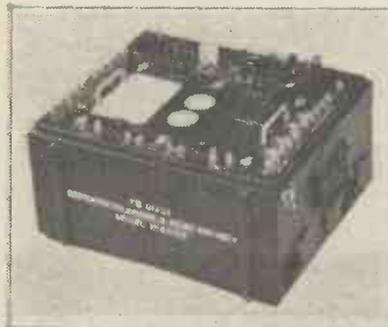
Install 2-way switches. Our outfit comprises: 30 yards multi-core cable, two 2-way switches, two wood blocks. Full instructions, 9/6 each, post and insurance 2/6.

£100 WORTH OF EQUIPMENT 19/6



The famous RI154—unused but slightly soiled and not tested. Covers 200-500 kc/s. 3-5.5 Mc/s. and 5.5-10 Mc/s. Has unique "click stop" mechanism (7 stops) and permits selected frequency to be held, returned to, etc. Hartley oscillator, power amplifier, keying and speech. Wonderful breakdown value—meters, relays, switches. Complete with valves—real bargain at 19/6 plus 10/- carriage.

TELEPHONE REPEATER No. 1, MARK I



This equipment is for amplifying telephone signals in both directions of traffic and also to remedy line distortion of speech. It is intended for use with two wire or four wire circuits, has four amplifiers and is in fact two quite independent repeaters mounted on the same panel and having a common power supply. The power supply may be operated from a 12-volt car battery or from standard A.C. mains. The units are absolutely new in original packing complete with spares and instructional manual. Price £20 each.

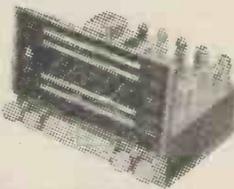
THIS MONTH'S SNIP

Car Starter Battery Charger—Due to a fortunate purchase we are able to offer you a fine ready-made high output battery charger in stove enameled sheet steel louvered case. New, complete and ready to work, this charger is rated at 12 V. 4 amps. and has a variable rate selector for trickle charging, also a meter to show charging rate. Suitable for 230/250 A.C. mains. Made to sell at 85/-, but offered this month at special snip price of 55/-, plus 3/6 post and insurance.

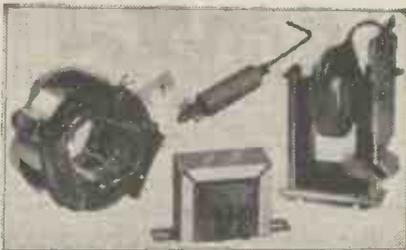


Dulci AM/FM Radiogram Chassis

Dulci AM/FM Radiogram Chassis. Chassis Model H.3. This has three wavebands, F.M. 87-101 Mc/s., Medium Wave 187-540 metres and Long Wave 1,000-2,000 metres, uses 7 of the latest miniature valves and built-in ferrite aerial. "Why not modernise your Radiogram, get the best from modern records with this hi-fi 4 watt output chassis." Price £19/17/6, or £2 down and 20 fortnightly payments of £1/0/6. Hi-I Model H.4 PP, £27/16/6 or £2 18/6 down and 26 fortnightly payments of £1/2/- (Note: Hire-purchase figures include insurance for 12 months.)



FOUR ITEMS FOR PRICE OF ONE



Set of modern TV. parts suitable for modernising old television or for a new one. For wide angle 14in. or 17in. tubes comprises: (1) Line output E.H.T. transformer. (2) 700 scanning coils on ferrite yokes. (3) Width control with ferrite core. (4) Frame output transformer. (5) Circuit diagram of a modern television. Offered at the price of the Line output transformer only, namely, 57/6, plus 2/6 post and insurance.

SUPER SENSITIVE (2,000 O.P.V.) MULTIMETER KIT

17 ranges including D.C. volts to 1,000 V. A.C. volts to 1,000 V. D.C. milliamps to 500 ohms, to 2 meg. All the essential parts, including metal case, selected resistors, wire for shunts, selected switches, calibrated scale and instructions, 32/6, plus 2/6 post and insurance.

FOR ADDRESSES SEE NEXT PAGE

Connecting Wire



P.V.C. covered in 100ft. coils—2.9 a coil or four coils, different colours, 10/- post free.

W.D. Circuit Details

Diagrams and other information extracted from official manuals. All 1/6 per coil 12 for 15/-.

A-1194	R.109
BC.348	HRO Receiver
BC.312	R28/ARC5
R.103A	R1116/A
BC.342	RA-1B
RA-1B	AR88D
R-308	AN/APA-1
R-1155	78
R-1124A	76
R-1132A/R-1481	R.T.18
R-1147	CAY-46-AAM-
R-1294A	FADAR
R-1082	A.S.B.-3
R-1355	Indicator 62A
B.C.1206-A/B	Indicator A.S.B.3
R-455-A (or-B)	Indicator 62
R-454-A (or-B)	Indicator 6K
R-453-N-A (or-B)	R.F. unit 24
Transmitter T1154	R.F. unit 25
Fifty-eight walkie talkie	R.F. unit 26
Frequency meter	R.F. unit 27
B.C. 221	Wireless set No. 19
	Demobbed valves

Cabinet Snip



This fine cabinet as illustrated but less control knobs is available this month at special snip price of 12/6, plus 3/6 post and insurance. Size is 13 1/2 in. x 9 in. x 4 in. and it is nicely covered in two-tone I.C.I. fabric.

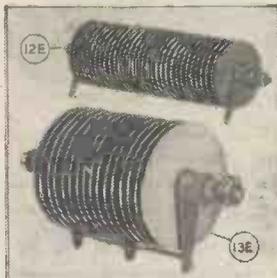
Racking Equipment

STANDARD POST

OFFICE OPEN RACK 6ft. high and 19in. wide, heavy steel construction. Holes drilled and tapped at 7in. spacings. Price £3/15/-, plus carr. Similar rack but without the drilled and tapped holes. £2/15/-.

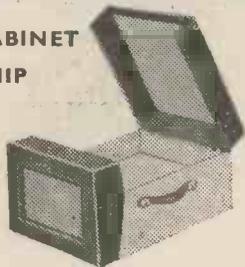


Rectifier Bargains



Selenium rectifier type 12, 500 V. 1/2 A. half-wave, easily rebuilt into full wave or multiple type, contains 30 35 mm. discs. Price 8/6, plus 1/6 post. Type 13, 36 volt 9 amp. easily rebuilt into six full wave charger rectifiers suitable for 6 or 12 volt batteries at 3 amps., contains 24 84 mm. discs. Real bargain at 19/6, plus 1/6 post. Type 14 240 V. 1/2 amp., 7/6.

**CABINET
SNIP**



Extremely well made portable amplifier case finished in two-tone and very modern in appearance. Large enough for stereo outfit with tape deck or autochanger. Snip price 59/6, plus 3/6 carriage and insurance.

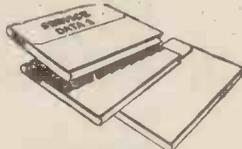
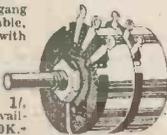
Speaker Bargain



12in. Hi-fidelity loudspeaker. High flux. Permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new by famous maker. Price 32/6, plus 3/6 post and insurance.

Morganite Potentiometers

Single and 2-gang types available. standard size with good length spindle. all new and boxed. Single types 1/ each. values available: 5K, 10K, 25K, 50K, 100K, 250K, 1 meg., 2 meg., 5 meg. 3/ each—values available: 5K + 5K, 100K + 100K, 1/2 meg. + 1/2 meg., 2 meg. + 2 meg.



T.V. Service Sheets

200 sheets covering most popular post-war televisions by leading makers—Cosmor, Ekco, Ferguson, Pye, etc., £2 post free. PRE-VIDUOS PURCHASERS OF THESE SHEETS PLEASE NOTE: WE CAN SUPPLY SHEETS Nos. 100-200, £1, or 150-200, 10/-.

**Hi-Fi Snip
Infinite Wall Baffle**

Nicely veneered and polished. Corner fitting (attaches to picture rail). Takes up no floor space. Gives really fantastic results with only low-priced 8in. speaker. Fitting for tweeter. Only 45/- each. Carriage and insurance 3/6.



Stereo Outfit

Stereo Amplifier outfit comprising 7 watt twin channel amplifier for A.C. mains working and two 8in. P.M. Speakers on veneered and polished corner baffles. Whole outfit giving really terrific reproduction and amazing 3-D effects. £14 complete plus carriage and insurance. Or £1 down and 28 weekly payments of 10/-.

Assure your future

The ownership of a good instrument has been the turning point in many a famous career. You can own the latest Pullin Series 100 Test Set which is undoubtedly a most useful instrument by a firm long famous for fine instruments, entirely redesigned, it has a square movement with diacron plastic cover, this makes for a brighter, more readable scale, extra scale length and wider angle of vision. With the test set is included a pair of combined test prods and crocodile clips also a stand for inclining the meter at the best reading positions. Ranges A.C. Volts: 0-10, 0-25, 0-100, 0-250, 0-500, 0-1,000, ditto D.C. A.C. Current 0-100 mA. D.C. Current 0-2.5, 0-10, 0-100, 0-500 mA. Resistance: 0-1M and 0-10K. All at 10,000 ohms per volt.—Price £12/7/6 or £17/4/- deposit and 26 fortnightly payments of 10/-, non callers add 5/- carr. and insurance.

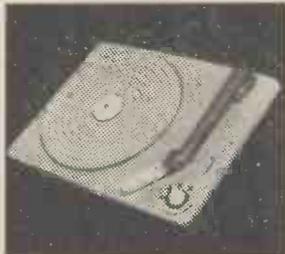
FREE GIFT.—All purchasers of the above items this month will receive Range Extender scale and data which add capacity 2PF—1mPd., in two ranges. Inductance 0-100 henrys, etc., etc.



Virtually a Transcription Unit

Philips AG2009 Record Player

The Philips AG2009 Record Player, a modestly priced 4 speed unit with many outstanding features, is ideal for the enthusiast who is assembling his own equipment or modernising an older installation. The pick-up arm is wired for stereo and the Philips stereo head is available as an optional extra. Eddy Current Brake gives ±2% fine adjustment on all four speeds. Continuously variable pick-up playing weight (2-12gms.). Supplied with Philips H.P. crystal head type AG3019, for microgroove and 78 r.p.m. Frequency response 30-15,000 c/s. Auto-stop and automatic release of idler wheel. Pick-up lifting and lowering device. Individually balanced heavy turntable. Wow and rumble of a low order. Muting switch fitted. Can be used with any amplifier or radio set. Mains voltage range: 110-127 v. and 200-240 v., A.C.-50 cycles. Complete with monaural pick up £10/10/- or £1 deposit and 22 fortnightly payments of 10/- carriage etc. 5/-.



1960 All Mains Amplifier



Undoubtedly finest value obtainable in amplifiers—powerful three valve circuit ideal for dances, parties, etc. Complete with valves, mains transformers, volume and tone controls, but less chassis, speaker and cabinet. Price only 29/6 plus 2/6 post and ins. Data free with parts or available separately 1/6.

Beginner's Superhet

As supplied to many schools and colleges. A simple basic superhet —easy to understand and which can be progressively extended —ideal for students—components include —valves—metal rectifier tuning condenser —I.F. transformers, etc. In fact complete superhet except speaker. Price £3 plus 3/6 post and insurance. Data included free or sep. 1/6.



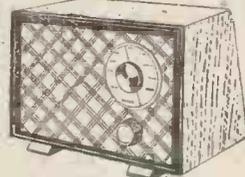
A.C./D.C. Multimeter Kit

Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries. 0-300,000 with external batteries. Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, transformers, calibrated scale and full instructions, price 19/6, plus 2/6 post and insurance.



**Cabinet for Hi-Fi
Speaker System**

Acoustically designed bass reflex cabinet made by W.B. "STENTORIAN." Price £9/9/- or 20/- deposit and 19 weekly payments of 10/-. Choice of several others available. Call or write for list. Add 5/- carr.



Dulci DPA10 Amplifier

Made by the Dulet Company. It is laboratory designed and is of the highest fidelity, has superb reproduction and complete freedom from hum, high output sensitivity, 10-watt output and ample feedback all combined to give a truly linear output. Uses all-glass miniature valves, including two EL84s in push-pull. Price £12/12/- or 25/- down and 26 weekly payments of 10/- Carr. & Ins. 6/6.



Unique Opportunity to build Fine Transistor Set

Constructor's parcel: to build Pocket 6 Transistor Set currently being sold at £17/17/-. Parcel comprises motified two-tone cabinet as illustrated, tuning dial, two gang tuning condenser, combined bakelite chassis/printed circuit and easy-to-follow circuit. Costing value £7/6—offered while supplies last at only 29/6, plus 2/6 post. Suitable for your own circuit or to build original circuit. All parts available at highly competitive prices. Do not miss this tremendous bargain.



The Skysearcher

1960 Vircion uses Mains Transformers This is a three valve receiver kit using modern circuitry. Ideal as a second set for the bedroom, workshop, etc. All parts including mains transformer, valves, resistors, coils, etc., but not cabinet, chassis or speaker, 29/6, plus post and ins. 3/6. Data free with parts or available separately 1/6.

Band III Converters

Suitable Wales, London, Midlands, North, Scotland, etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers and resistors. (Metal case available as an extra). Price only 19/6, plus 2/6 post and insurance. Data free with parts or available separately, 1/6. Please send two more kits, the one you sent last week is performing magnificently. We receive this sort of letter every day of the week, so if you have hesitated because you thought our kits too cheap you need hesitate no longer.



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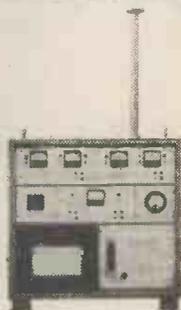
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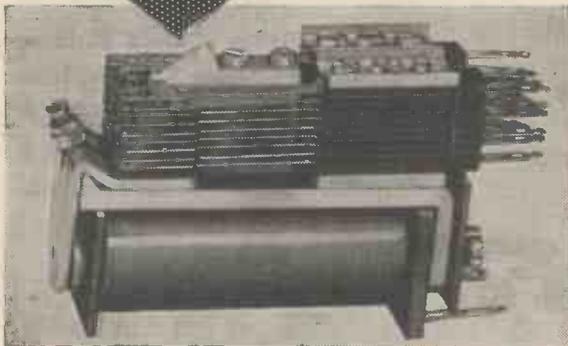
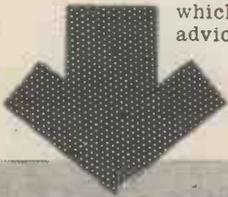
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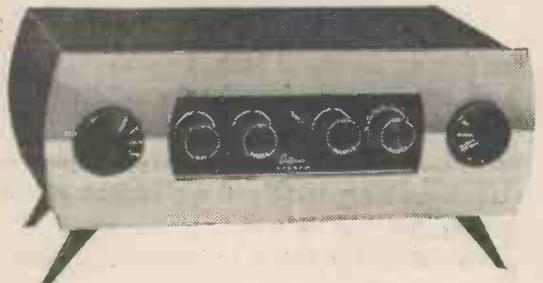
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305 Control Unit 18 gns. Main Amp. 20 gns. Matching FM or AM/FM Tuners available.

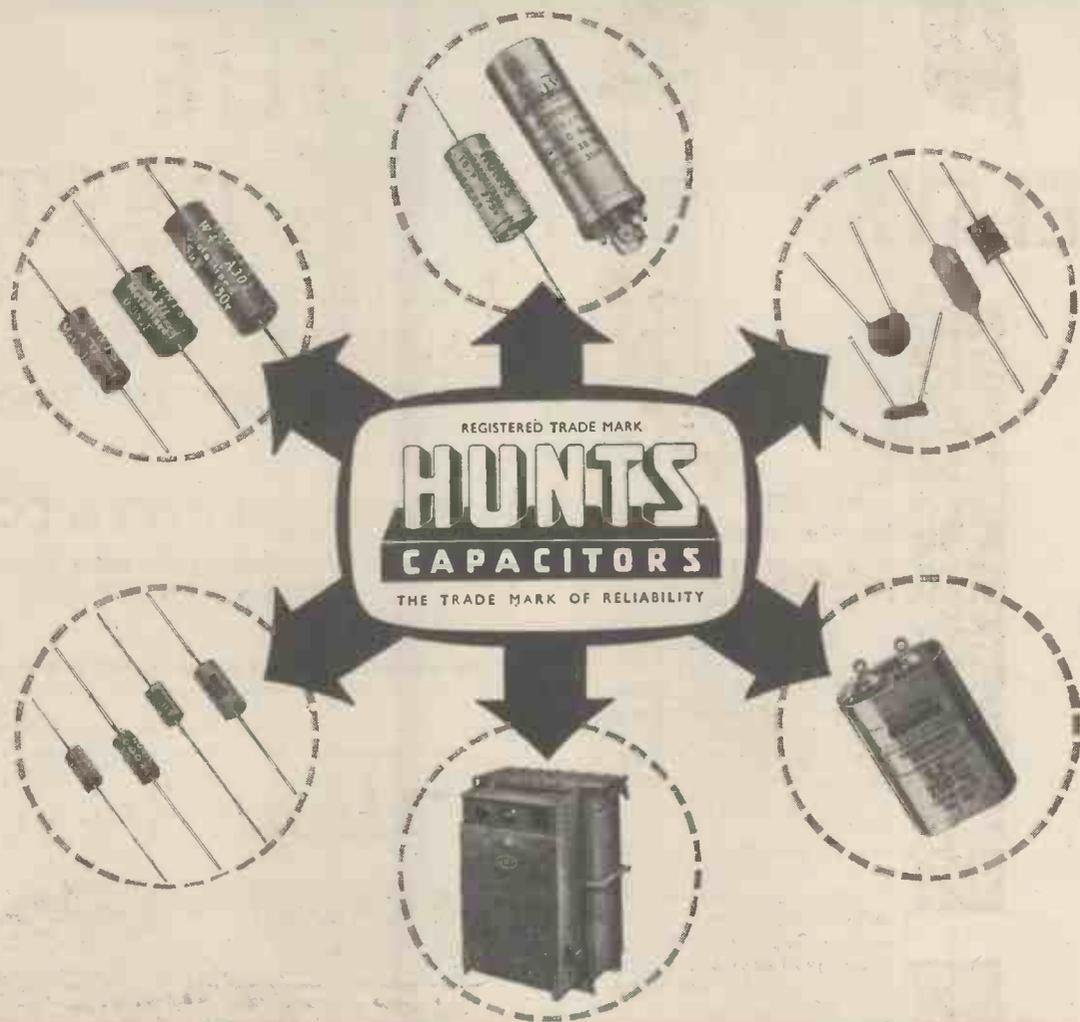
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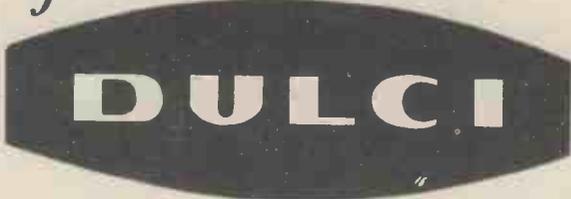
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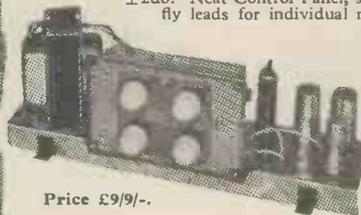
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MODEL DPA 10 AND PRE-AMPLIFIER

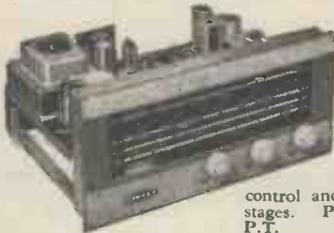
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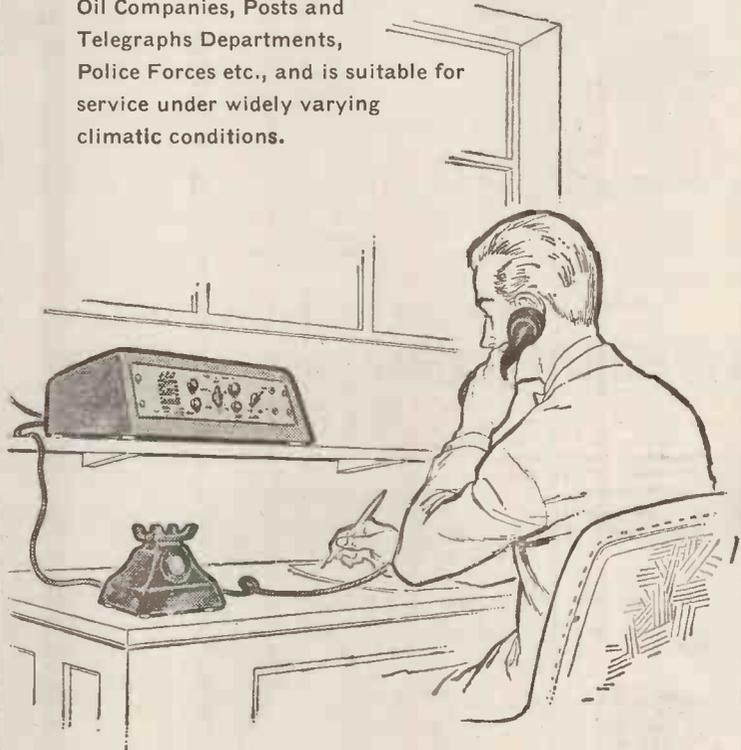
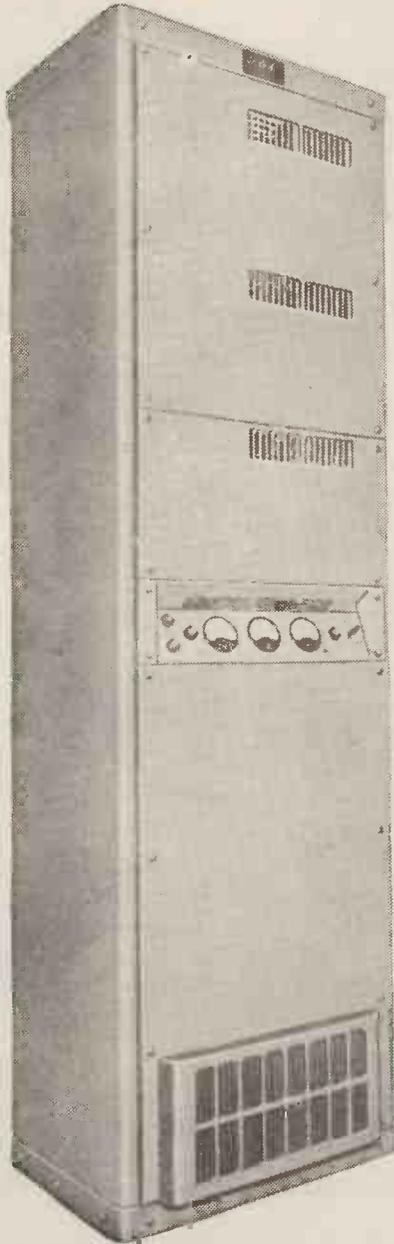
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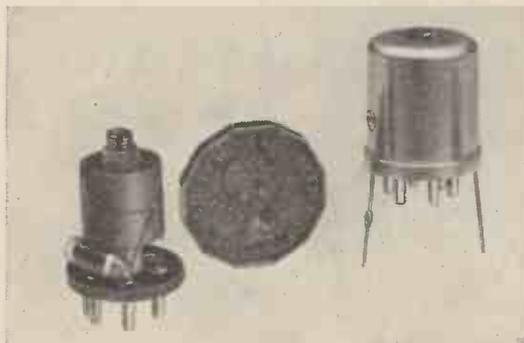
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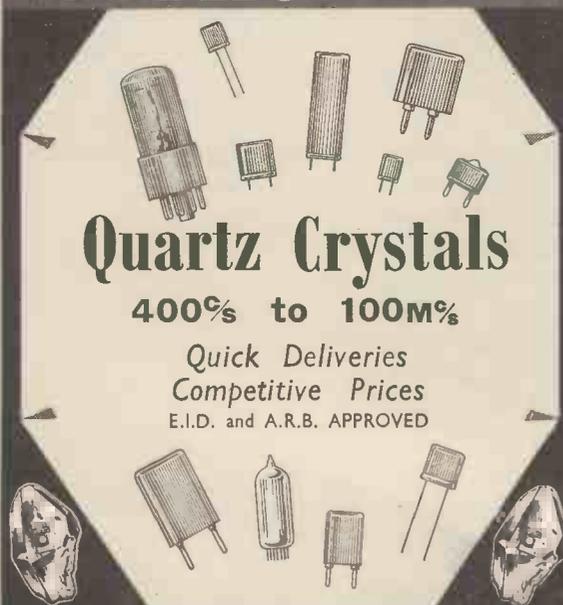
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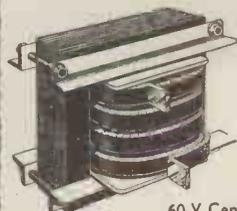
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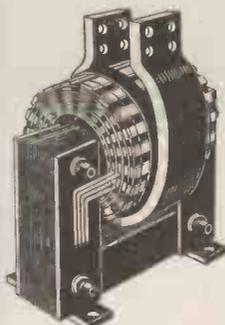
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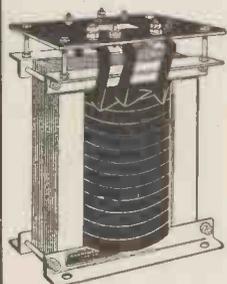
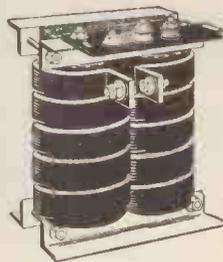
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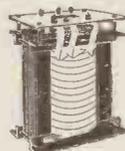
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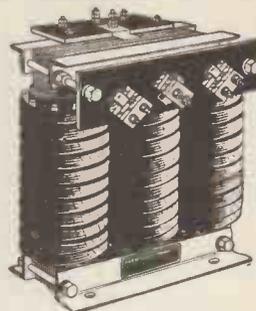


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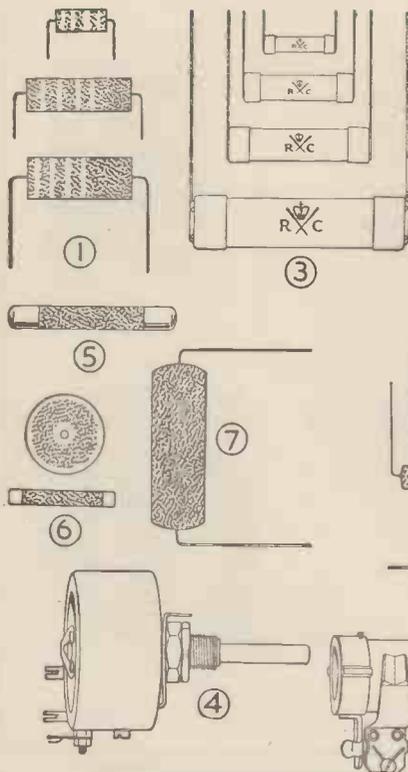
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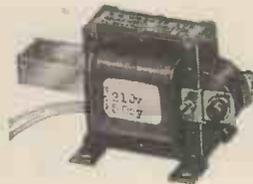
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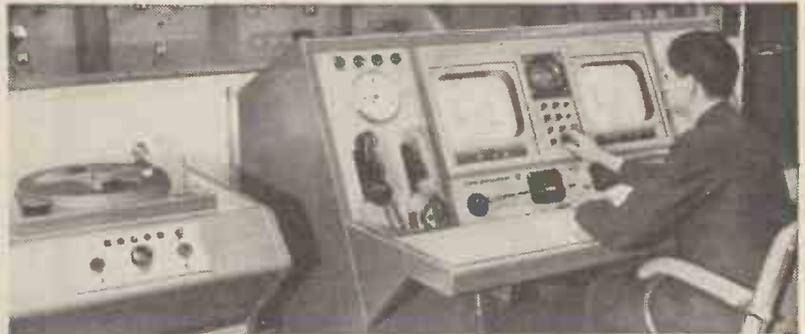
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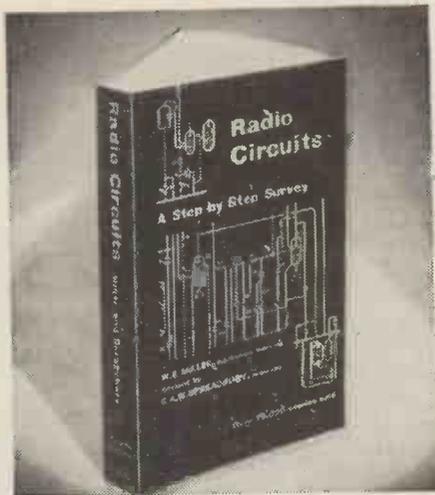
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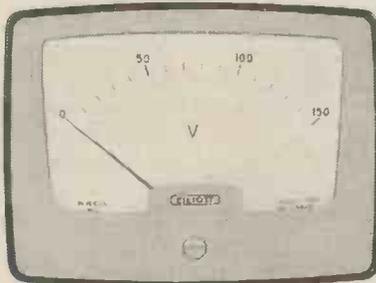
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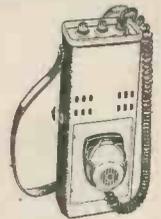
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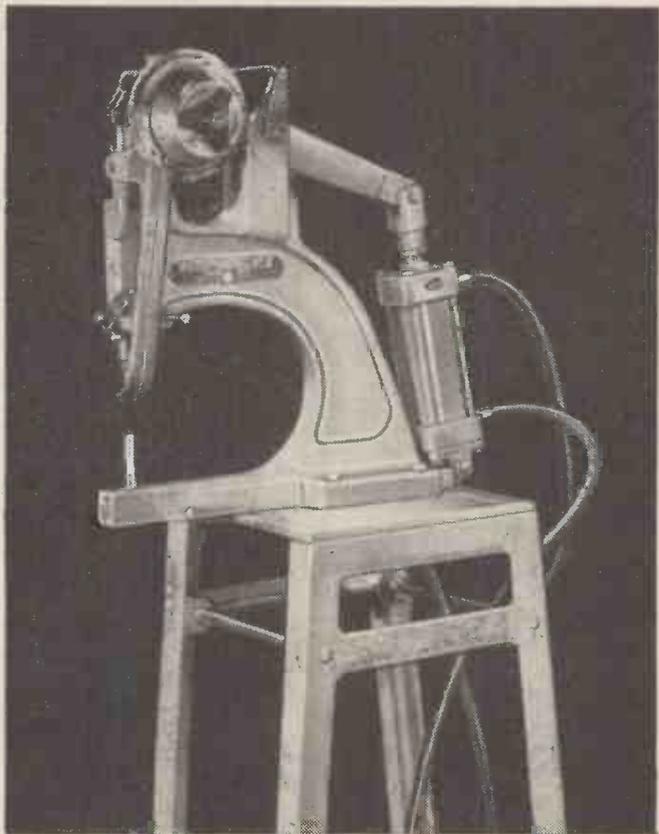
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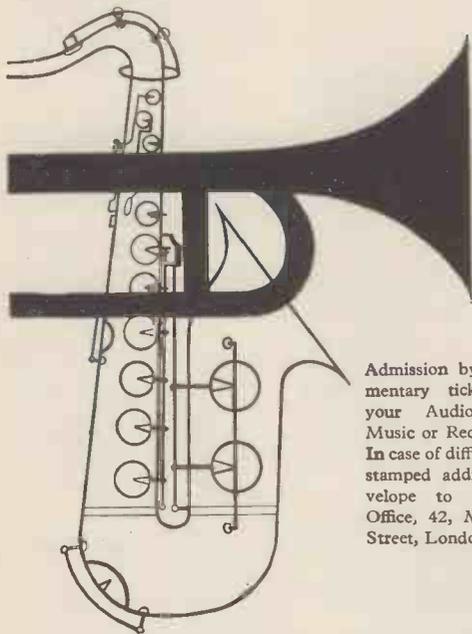
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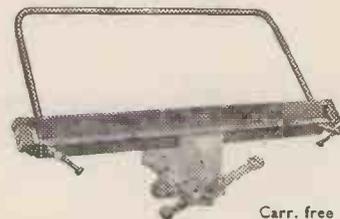
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Supplied complete only (i.e. Main Amplifier and Pre-amp.) **15** Retail Price **GNS.**

Size of main amplifier 9in. x 7in. x 5in., Pre-amp. 11in. x 4½in. x 2½in. Front-Plate 12in. x 3½in. Stoved Gold hammered finished chassis. Front Plate Polychromatic Gold. Weight of main amplifier 10lb. Pre-amp. 3lb. For 50/60 c.p.s. A.C. mains 200-230-250 v. or to order for export.

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L.P. 25 m.v.
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Input Impedance

All inputs 500k. Plus 10pfd.

Frequency Response

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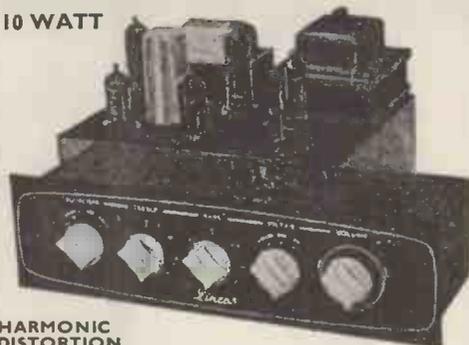
90 watts

Maximum Power Output

In excess of 12 watts.

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Total 32 d.b.



HARMONIC DISTORTION (Inc. Pre-amplifier)

0.09% measured at 10 watts.

Damping Factor 35

Bass Control

+9 d.b. to -9 d.b.

at 50 c.p.s.

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MULLARD VALVES:

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For 3 ohm and 15 ohm L/Speakers

from high grade sectional-wound output transformer

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300 v 30 m.a. smoothed and 6.7 v

1.5 a. at 4-pin socket.

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Size approx. 7.5-5½in. high. Sensitivity is 28 millivolts so that the input socket can be used for either microphone or gram, tape, radio tuner etc. B.V.A. valves used are ECC83, EL84, EZ80 Controls are Vol. Treble and Bass with mains switch. The Tone controls provide full compensation for long playing records. Output matching for 3 ohm loudspeaker. Retail price £5/19/6.

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A complete unit (power pack and oscillator incorporated, ready for connection to A.C. mains. 3 ohm loudspeaker and practically any make of deck. Negative feedback equalization adjustment by multi-position switch for 3½, 7½ and 15in. per sec. Retail price 12 gns.

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RCA 15 KW TELEGRAPH TRANSMITTER

Type ET-4750-X

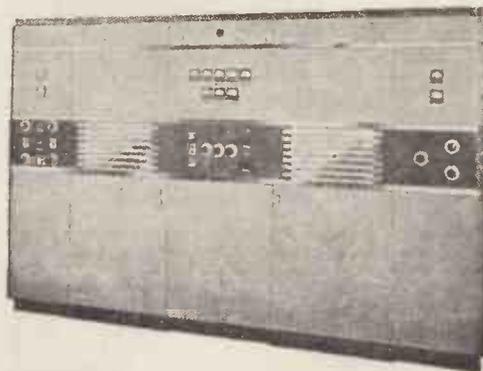
Frequency range—2 to 22 megacycles.
 Keying Speed—up to 250 words per minute.
 Power Supply requirements—230 v. 3 phase 50/60 cycles.

Tube complement: Oscillator—807 (1), Doubler (1st) Amplifier—807 (1), Intermediate Power (2nd) Amplifier—813 (4), Power (3rd) Amplifier—889-R (2), Plate Rectifier—872A (6), Auxiliary Rectifier—872A (3), Bias Rectifier—872A (2), Keyer—807 (2).

	Length	Height	Depth
Enclosure	11ft.	7ft. 6ins.	4ft. 1in.
Rectifier Unit	4ft. 2ins.	5ft. 3ins.	3ft. 2ins.
Plate Transformer	2ft. 6½ins.	3ft. 6½ins.	1ft. 9½ins.

Weight (Nett)

Enclosure (including control, R.F. and Output panels)	3,000 lbs.
Rectifier Unit	1,675 lbs.
Plate Transformer 7,000 volts	1,250 lbs.



We have a full range of spares for this equipment.

If desired, we can modify this transmitter to work also on the telephone with an output of approximately 5 kW.

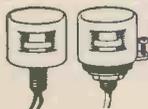
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ELECTRONIC, RADIO & T.V. COMPONENTS, UNITS, CONSTRUCTOR KITS, CABINETS, CASES, ETC.

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TODAY'S VALUE £35

LASKY'S PRICE, including 5in. spool of tape, empty spool, crystal hand mike and radio jack. **21 GNS.**

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5in. 5½in. 7in. 8½in.
3/6 4/3 4/- 5/6

7in. Metal Spools, 1/9 each.

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Also all other types.

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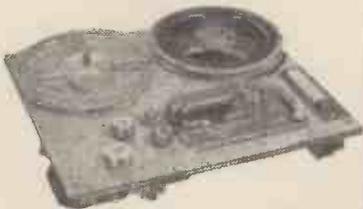
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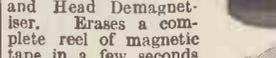
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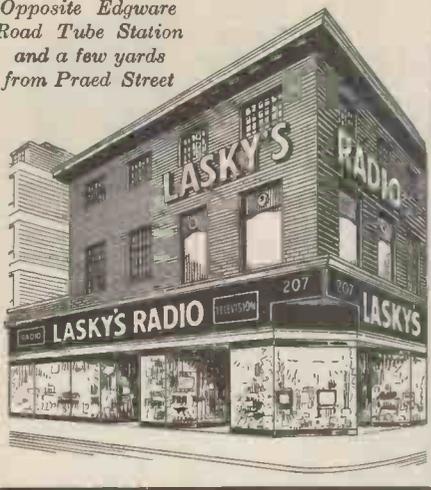
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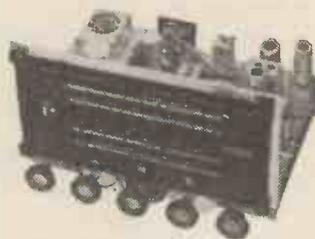
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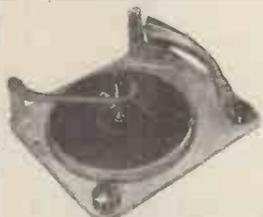
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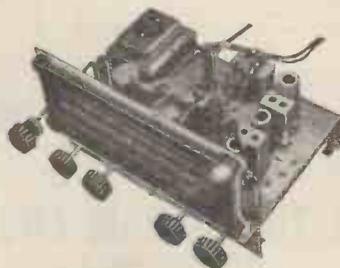
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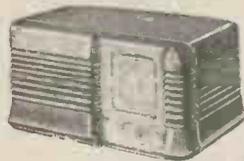
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THE SKYFOUR T.R.F. RECEIVER



A design of a 3 valve 300-350 v. A.C. mains. L and M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. It employs valves 6K7, 8P61, 6P6 and is specially designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point-to-Point wiring diagram. Instructions and parts list. 1/9. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite or veneered walnut.

designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point-to-Point wiring diagram. Instructions and parts list. 1/9. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite or veneered walnut.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supply 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v. This includes latest low consumption types. Complete kit with diagram 39/9 or ready for use 46/9.

Type BM2. Size 8 x 5½ x 2½in. Supplies 120 v., 90 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp., fully smoothed. THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND H.T. 2 v. ACCUMULATORS when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator.

Complete kit with diagrams and instructions. 49/9 or ready for use 59/6.



SIX TRANSISTOR POCKET RADIO RECEIVER

All parts including cream or coloured plastic case, printed superhet circuit, ferrite aerial. Transistors, 2½in. P.M. speaker. Long and medium wavebands. Size of unit 5½ x 3½ x 1½in. Detailed construction booklet supplied.



£9-19-6

Total cost of parts. A working unit can be demonstrated at any of our branches. All items are available separately.

ACOS HI-FI CRYSTAL 'MIKES'

33-1 hand or Desk type
35/9 (Listed) (50/-)
39-1 Stick type
39/6 (5 Gas.)
Limited number.

R.S.C. TRANSFORMERS

FULLY GUARANTEED INTERLEAVED AND IMPREGNATED

MAINS TRANSFORMERS	
Primary 200-230-250 v. 50 c/s.	
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t. 6.3 v. 1 a. suitable for Mullard 510 Amplifier	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	35/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t. 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9
TOP SHROUDED DROP-THROUGH TYPE	
260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	16/9
300-0-300 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	22/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9

ELIMINATOR TRANSFORMERS	
Primary 200-250 v. 50 c/s.	
120 v. 40 mA. 5-0-5 v. 1 a.	14/9
80 v. 15 mA. 6-0-6 v. 250 mA.	9/11

FILAMENT TRANSFORMERS	
Primary 200-250 v. 60 c/s.	
6.3 v. 1.5 a.	5/9
6.3 v. 2 a.	7/9
0-4-6.3 v. 2 a.	7/9
12 v. 1 v.	7/9
1.5 a.	17/6

OUTPUT TRANSFORMERS	
Midget Battery Pentode 66: 1 for 3S4, etc.	3/9
Small Pentode 5,000Ω to 30	3/9
Standard Pentode 5,000Ω to 30	5/6
Standard Pentode 8,000Ω to 30	5/6
Push-pull 8 watts 6V6 to 3 ohms	8/9
Push-pull 9 watts EL84 to 15 ohms	8/9
Push-pull 10-12 watts 6V6 to 3Ω or 15Ω	16/9
Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω	17/9
Push-pull EL84 to 3 or 15 ohms	17/9
Push-pull 15-18 watts, sectionally wound, 6L6, KT66, etc. or 3 or 15 ohms	23/9
Push-pull 20 watt high-quality sectionally wound, 6L6 KT66, etc. to 3 or 15Ω	47/9

SMOOTHING CHOKES	
250 mA., 5 H., 100 ohms	11/9
150 mA., 7-10 H., 260 ohms	11/9
100 mA., 10 H., 200 ohms.	8/9
80 mA., 10 H., 350 ohms.	5/6
60 mA., 10 H., 400 ohms.	4/11
1 amp., 0.5 ohm I.T. type	6/6

PHILCO F.M. RAD. TUNERS

With self-contained power pack. A 6-valve deluxe unit housed in beautiful walnut veneered cabinet. For 110-200-250 v. A.C. mains. Magic eye tuning indicator **12½ GNS.** Carr. 5/-.
Or Deposit 22/6 and 12 monthly payments of 22/6.

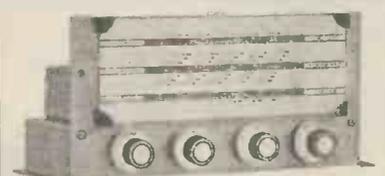
R.S.C. A12 STEREO AMPLIFIER KIT

£3-19-6

A complete kit of parts to construct a good quality 3+3 watt (total 6 watt) stereo amplifier providing really life-like reproduction. Suitable for use with all stereo, pick-up heads at present available. Ganged volume and tone controls. Preset balance control. Outputs for matched 2-3 ohm speakers. For 200-250 v. A.C. mains. Astonishing value.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012, 10 watts 15 ohms (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. 4 Gns. Please state whether 3 ohm or 15 ohm required.



AM/FM RADIOGRAM CHASSIS, HIGH QUALITY. PUSH-PULL. 6-8 WATT OUTPUT. Current manufacture. 12 months guarantee. For 200-250 v. mains. Covers L. and M. wavebands plus F.M. Includes 8 latest type miniature B.V.A. valves. Only 22 gns. plus 7/6 carr. Or deposit £2/12/- and 9 monthly payments of £2/12/-.

GARRARD 4-Speed Single Players with hi-fi turnover crystal pick-up head. £6/19/6. Carr. 4/6.

EXTENSION SPEAKERS

Limited number in hand - some Walnut veneered cabinets. 2-3 ohms speech coils, 6½in. 29/9. 8in. 35/9. 10in. 56/9.

DRY SHAVERS. Brand new in carrying case. Operation from 3 U2 batteries, fitted in case. Just the thing for travel. Only 59/6 (approx. half price).

RECORDING TAPE. GEVASONOR Best quality L.P. 5in. 850ft. reels 22/6, 7in. 1,700ft. reels 35/-, Less than wholesale price.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). A Triode Heptode Feeder is used. Pentode I.F. and double Diode Second Detector, delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W. Ch. Sw. incorporates Gram. position. Controls are Tuning W. Ch. and Vol. Output will load most Amplifiers requiring 500 mv. input depending on Ae location. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost is £4/15/-. Point-to-Point wiring diagrams and instructions 2/6.

LITTLE STAAR BATTERY OPERATED RECORD PLAYING UNITS. Complete with Pick-up to take 45 r.p.m. records. Used by leading manufacturers in Transistorised Record Players. Require 6 v. battery. Only £3/19/6. Carr. 3/6.

COLLARO JUNIOR 4-SPEED RECORD PLAYER with separate pick-up having dual point sapphire stylus. Brand new, cartoned. For 200-250 v. A.C. mains only. Only £3/15/- Post 3/6.

B.S.R. MONARCH AUTO-CHANGERS

Type UA8, 4 speed, T/O Pick-up with sapphire styli £6/19/6. Carr. 4/6.
Collaro AC4/864 4-speed single players with hi-fi turnover crystal pick-up head £6/9/6. Carr. 4/6.

R.S.C. A.10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES, E88, E88B, ECC83, 807, 807, GZ34. Tone Control Pre-amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolts minimum input is required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP.**



Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "micro" and gram, etc., etc., can be simultaneously applied for mixing purposes. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 v. 1.5 A. FOR A RADIO FEEDER UNIT.** Price in kit form with easy-to-follow wiring diagrams.

Only **11 Gns.**

Or Factory built with 12 months' guarantee £13/19/6. **TERMS ON ASSEMBLED UNITS.** DEPOSIT 24/6 and 12 monthly payments of 24/6.

Carr. 10/-

Cover as Illustrated

Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. **CELESTED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ± 3 D.B. 30-20,000 c/c. Tone Controls ± 12 D.B. at 50 c/c. ± 12 D.B. to $- 8$ D.B. at 12,000 c/c. Hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12 x 9 x 9 in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c.p.s. Patents for 3 and 15 ohm speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS. IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc.** We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. **EXPORT ENQUIRIES INVITED.**

LINEAR "DIATONIC" 10 WATT HIGH FIDELITY AMPLIFIER. A compact attractively finished unit. 12 gns. Cash. Send S.A.E. for leaflet. H.P. Terms. Dep. 22/3 and twelve monthly payments of 22/3.

LINEAR L5/5 HIGH QUALITY STEREO AMPLIFIER. Total output 10 watts. Handsome Perspex Facia Plate. All controls gauged. Only 11 Gns.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. Bass and Treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves. Size only 6 x 5 x 5 1/2 in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **£5/19/6.** Or Deposit 22/- and 3 monthly payments of 22/- Send S.A.E. for leaflet.

L63 MINIATURE 3 WATT GRAM AMPLIFIER

For 200-250 v. 60 c.p.s. A.C. mains, overall size only 6 1/2 x 4 1/2 x 2 1/2 in. Fitted vol. and Tone Control with mains switch. Designed for use with any kind of single play or record changing unit. Output for 2-3 ohm speaker. Guaranteed 12 months. Only 55/6.

R.S.C. A7 3-4 WATT QUALITY AMPLIFIER. Spec. exactly as A5 below with exception of output wattage. Complete kit of parts, diagrams and instructions £3/15/-, carr. 3/6.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 20 mA. and 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/c. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-to-point wiring diagrams and instructions. Exceptional value at only **£4/15/-** or assembled ready for use 25/- extra, plus 3/6 carriage. Or Deposit 22/- and five monthly payments of 22/- for assembled unit.



TWEETERS. 4in. Plessey, 3 ohms 16/9. Rola/Celestion 15 ohms 21/9.

P.M. SPEAKERS. 2-3 ohm 2 1/2 in. Percio 21/9. 5in. Goodmans 17/9. 7 x 4 in. R.A. Elliptical 19/9. 6in. Rola 19/9. 8in. Rola 19/9. 8in. Goodmans 21/9. 10in. R.A. 28/9. 10 x 6in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12in. R.A. 3 or 15 ohms, 10 watts, 12,000 lines. 59/6.

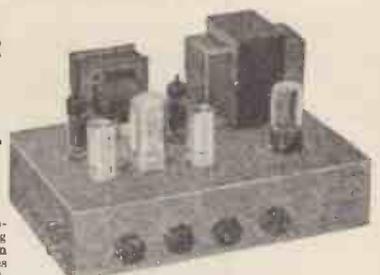
COLLARO CONQUEST 4-SPEED AUTO-CHANGERS. With studio pick-up with turnover head. BRAND NEW. Cartoned latest model. For 200-250 v. A.C. mains. £7/19/6. Carr. 4/6.

GRAM MOTOR with Turntable and pick-up, standard 78 r.p.m. Brand new. Only 25/9.

AC03 Crysta. Microphone Inserts. Brand new. Only 5/11 ea. Ex. Equip. 4/11 ea. **AC05 EGP59 Hi-Fi** Crystal Cartridges. (Turnover type with sapphire stylus.) Standard replacement for Garrard and Collaro. Only 17/9. B.S.R. Ful-B 17/9. Garrard GC2 19/9.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH PULL ULTRA LINEAR OUTPUT "BUILT IN" TONE CONTROL PREAMP STAGES



Two input sockets with associated controls allow mixing of "micro" and gram, as in A10. High sensitivity Includes 6 valves. ECC83, ECC85, EL84, EL84, 5Y9. High Quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. **INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut."** Frequency response ± 3 D.B. 30-30,000 c/c. Six negative feedback loops. Hum level 60 D.B. down Only 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. **FOR STANDARD OR LONG PLAYING RECORDS.** For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. **OUTPUT SOCKET** with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12-9-7in. For A.C. mains 200-250 v. 60 c/c. Output for 3 and 15 ohm speakers. Kit is complete to last unit. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. (Or factory built 45/- extra.) Only **8 Gns.** Carr. 10/- required for metal cover with 2 carrying handles can be supplied for 18/9. **TERMS ON ASSEMBLED UNITS. DEPOSIT 18/9, and 12 monthly payments of 18/9.** Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones etc., with cash and credit terms

R.C.S. PORTABLE GUITAR AMPLIFIERS



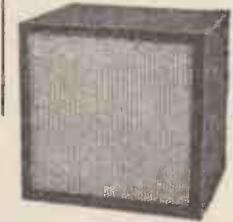
JUNIOR 5 WATT. High Quality Output. Separate Bass and Treble "cut" and "boost" controls. Sensitivity 15 m.v. High Flux 8n. 1/2 speaker Input sockets for Radio/Tape and Mike/Instrument Pick-up. Handsome strongly made cabinet (Size approx. 14 x 14 x 7 in.). Finished in satin walnut and fitted carrying handle. **£8.19.6** Carr. 7/6. Or Deposit £1 and nine monthly payments £1.

SENIOR 10 WATTS. High Fidelity Push Pull output. Separate Bass and Treble "cut" and "boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two Loudspeakers are incorporated, a 12in. P.M. for Bass notes and a 7 x 4in. elliptical for Treble. Cabinet is well made and finished satin walnut. Size approx. 18 x 18 x 5 in. 13 gns. Plus 10/- carr. H.P. TERMS. DEPOSIT 23/6 and 12 monthly payments 23/6. Both models for 200-250 v. A.C. mains

STAR GALAXY 4-SPEED MIXER AUTO-CHANGERS. Brand New, cartoned. Turnover sapphire styli. Many exclusive features. Unique design motor virtually free from rumble. For 200-250 v. A.C. mains. Limited number tested and guaranteed £5/19/6. Carr. 4/6.

PORTABLE CABINETS

For Record Players or Tape Recorders. Resine covered. Wide selection of attractive designs and colour combinations **PRICES FROM 15/9**



12in. 10 WATT HIGH QUALITY LOUSPEAKER IN POLISHED WALNUT FINISHED CABINET

Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms Only 24/19/6. Carr. 5/-
Terms: Deposit 11/- and 9 monthly payments of 11/-.
12in. 20 WATT 15,000 line 1/2 speaker 15 ohms, in Cabinet finished as above. Size 18 x 18 x 8 in. £7/19/6 or Deposit 13/10 and 12 monthly payments 13/10.

PORTABLE CABINETS. Attractive design. Two-tone resine covered. Will take Collaro, B.S.R., Garrard or Star Auto-changer, amplifier and 7in. x 4in. or 5in. speaker. Slightly soiled. Only 49/6.

AC05 HIGH FIDELITY PICK-UPS. GP54 with EGP59/82 Cartridge. Turnover sapphire stylus, cream finish. Limited number at approx. half price. Only 35/9.

SPECIAL OFFER

Above cabinet Star Changer, Gram amplifier, and 5in. or 6in. x 4in. speaker £9/19/6. Carr. 10/-. Or with B.S.R. changer in lieu of Star 11 Gns. Carr. 10/-.



PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms) consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended or use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only £5/17/6. Or Deposit 10/8 and 12 monthly payments of 10/8.

R.S.C. MANCHESTER, LEEDS & BRADFORD (LEEDS) LTD.

Open to callers at following branches:—

- 5-7 County Arcade, Leeds, 1.
- 54-56 Morley Street, Bradford, 1.
- 8-10 Brown Street. (Market St.) Manchester, 2.

TERMS: C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/9 extra on all orders under £2. 2/9 extra under £5 unless carriage stated. Trade supplied. Post orders to

Mail Order Dept.,
29-31 Moorfield Road, Leeds, 12.

R.S.C. MANCHESTER (LEEDS) LTD., BRADFORD and LEEDS

For addresses and terms see page 139

TANNOY RE-ENTRANT
LOUDSPEAKERS. 8 watt
7.5 ohms 19/6

HIGH FIDELITY 10 watt PUSH PULL AMPLIFIERS.
Separate Bass and Treble controls. Inputs for Gram
and Mike. Mullard latest type valves. Brand New
Guaranteed in perfect order but slightly store
soiled. Very limited number. £6/15/-. Carr. 7/6.

ELECTRIC BELLS. 3 m. diameter. 4.5 v. to 12 v. Battery
or Mains operation. Only 4/9.

AUTO TRANSFORMERS. 50 watts 0-110/120-230/
250 v. 7/11.

We can quote special prices for quantities of 12 to 10,000
of most types. Special types made to order.
SELENIUM RECTIFIERS. L.T. Types: 2/6 v. 1 a.h.w. 1/9;
6/12 v. 2 a. 6/11; 6/12 v. 3 a. 9/9; 6/12 v. 4 a. 12/3; 6/12 v.
5 a. 14/6; 6/12 v. 6 a. 15/6; 6/12 v. 10 a. 25/8; 6/12 v.
15 a. 35/9. H.P. Type H.W.: 120 v. 40 mA. 3/8; 250 v.
50 mA. 3/11; 250 v. 80 mA. 7/9; 250 v. 250 mA. 12/8.
Contact cooled 250 v. 75 mA. F.W. (Bridge) 8/11; 250 v.
80 mA. H.W. 6/11.

2 v. 16 A.H. EX. GOVT. ACCUMULATORS. New boxed.
Only 5/6 each. 3 for 15/-. plus 2/6 carr.
D.C. SUPPLY KITS. Suitable for electric trains. Consists
of mains trans. 200-250 v. 50 c.p.s.; 12 v. lamp selenium
rect. (F.W. Bridge); 2 fuseholders, 2 fuses, change direction
switch, variable speed regulator, partially drilled steel case,
and circuit. Very limited number, 29/9.

VIBRATORS. Oak and Wearite, synchronous 7 din. 2 v.
7/8, 6 v. 8/9, 12 v. 4 din non-synchronous 7/8.

JUNCTION TRANSISTORS. R.F. type, 12/6. Audio type
6/9. Power type Goltop V15/10P 2 watts 16/9. OC71,
10/-, OC72, 17/-, XB102, 10/-, XB104, 10/-.

JACK PLUGS. Standard type complete with 4ft. screened
lead. 1/11 each. New Jack Sockets (moulded type),
Igranlo 2/9 each.

EX GOVT. MAINS TRANSFORMERS
All 200-250 v. 50 c/s input.
Pr. 0-110-200-230-250 v., 275-0-275 v. 100 mA., 6.3 v.
7 a., 5 v. 2 a. 22/9
300-0-300 v. 60 mA., 6.3 v. 2 a. 11/9
265-0-265 v. 150 mA., 6.3 v. 11 a., 6 v. 3 a., 5 v. 3 a. 29/11
350-0-350 v. 100 mA., 6.3 v. 2 a., 5 v. 2 a. 18/9
350-0-350 v. 160 mA., 6.3 v. 5 a., 5 v. 3 a. 27/9
400-0-400 v. 250 mA., 5 v. 2 a., 5 v. 2 a. 18/8
450-0-450 v. 250 mA., 6.3 v. 3 a., 6.3 v. 1 a., 5 v. 6 a. 49/9
0-24-26-28 v. 15 amps. A.C. conservative Govt. rating (mark-
ed with D.C. rating after rectification) 69/9. Carr. 15/-.
0-10-20-25 v. 24 a. (Govt. rating) 79/6. Carr. 15/-.
AUTO 500 watts, 0-215-220-225-230-235-240 v. 29/9
Carr. 7/6.

ARDENTE DEAF AID EARPIECES with lead and plug.
Brand New. Only 15/6

**SPECIAL OFFER. Brand
New Ex. Govt. 24 v. 15 amp.
F.W. Bridge Selenium Recti-
fiers. Only 27/9 ea.**

EX. GOVT. SMOOTHING CHOKES
200 mA., 3-5 H., 50 ohms, Parmeko
100 mA., 5 H., 100 ohms 3/11
150 mA., 10 H., 50 ohms 9/9; 80 mA., 20 H., 900 ohms 5/9;
120 mA., 12 H., 100 ohms 9/9; 50 mA., 50 H., 1000 ohms 6/9;
100 mA., 10 H., 100 ohms 6/9; 60 mA., 6-10 H., 250 ohms 2/11

EX. GOVT. CASES. Well ventilated, black crackle
finished, undrilled cover. Size 14 x 10 x 8 1/2 in. high
IDEAL FOR BATTERY CHARGER OR INSTRU-
MENT CASE, COVER COULD BE USED FOR
AMPLIFIER. Only 9/9, plus 2/9 post.

BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250 v. 50 c/s

Guaranteed 12 months

HEAVY DUTY CHARGER KIT.

6/12 v. variable up
to 6 amps. Consist-
ing of Mains Trans.,
F.W. (Bridge) Selenium
Rectifier, 0-7 amp.
meter, multi-position
switch with knob,
fuses, fuseholders,
panels, plugs and
circuit. Only 59/9.
Post 4/6.

ASSEMBLED CHARGERS

6 v. 1 a. 19/9
6 v. 2 a. 29/9
6/12 v. 1 a. 27/9
6/12 v. 2 a. 38/9
6/12 v. 4 a. 56/9
Above ready for use with
mains and output leads.
Cases well ventilated and
finished in stoved blue
hammer. Carr. & pkg. 3/6

TRANSFORMERS

200-230-250 v. 50 c/s.
0-9-15 v. 1 a. 11/9;
0-9-15 v. 2 a. 14/9;
0-9-15 v. 3 a. 16/9;
0-9-15 v. 4 a. 19/9;
0-9-15 v. 6 a. 23/9.

BATTERY CHARGER KITS

Consisting of Mains Trans-
former F. W. Bridge. Metal
Rectifier, well ventilated steel
case. Fuses, fuse-holders,
grommets, panels and circuit.
Carr. 2/9 extra.
6 v. or 12 v. 1 amp. 22/9
As above, with ammeter 32/9
6 v. 2 amps. 25/9
6 v. or 12 v. 2 amps. 31/6
6 v. or 12 v. 2 amps. 42/9
(inclusive of ammeter)
6 v. or 12 v. 4 amps. 53/9
6 v. or 12 v. 4 amp.
with variable charge rate
selector and ammeter 59/9
CHARGER AMMETERS.
0-1.5 amp., 0-3 amp., 0-4 amp.
0-7 amp., 0-25 amp., 0-60 amp 8/9

ASSEMBLED CHARGER

6 v. or 12 v. 2 amp.
Fitted Ammeter and
selector plug
for 6 v. or 12 v.
Louvred metal
case, finished at-
tractive hammer
blue. Ready for
use with mains
and output leads.
Double Fused.
Only 49/9
Carr. 3/9.
As above but for
3 amp. charging.
Only 59/6. Carr.
3/9.

ASSEMBLED 6 v. or 12 v. 4 amps.



Fitted Ammeter and
variable charge selector.
Also selector plus for 6
v. or 12 v. charging.
Double fused. Well
ventilated steel case
with blue hammer finish.
Ready for use
with mains and
output leads. Carr. 5/-.
Or Deposit 13/11
As above but for 6 amp. charging.
4 GNS. Carr. 5/-. Or Deposit 16/-
and 5 monthly payments of 16/-.

BARGAINS IN COMPONENTS FR. E. POST and P.C.ING

TRANSFORMER. 24 v. 3 Amp. C.T.
Fr. 0-110-200-220-240. Other sec's. 95 v. 0.1 amp.
3 times and 200 v. 60 mA. Well rated, double screened
and potted. ex new equipment. Size 4 1/2 x 4 1/2 in.
Only 12/6.

L.F.F. UNITS B.C. 966A.
Contains 18 Volt dynamotor output 480 volt 60 mA.
Fitted with fan and gear box. Also has 4 relays (1
12,000 ohm 2 P.C.O.) 6 R.F. Pentodes 6SH7, 3 of
7193, 3 of 6HG valves and many useful components.
Only 28/6.

RANGE CALIBRATORS B.C. 949A.
Smart louvred black crackle case 9 1/2 x 6 x 5 1/2 in., lea-
ther handle. Valves 1 ea. 6SL7, 6HG. Several useful
components including water switch 1p 3w. and 3
amp henoi coax sockets. 12/6. Brand new. Coax
plugs to match 1/- ea. extra.

CONDENSERS.
Sprague 3MF 4kV Wkg. Brand New 6/6 ea. or 11/6
for two. Size 4 1/2 x 3 1/2 x 7/16 in. Compact RMF 450 v.
wkg. Ex. New eqpt. 3/- ea. or 5/- for two. Size 4 1/2 x
2 1/2 x 2 1/2 in.

POTENTIOMETERS.
50 ohm 5 watt W/W and 100K 1 1/2 watt log carbon.
Both brand new 1/3 ea. 3 for 3/-.

RESISTORS. Miniature 1/2 w. 47K, 18K, 2/6 doz.

METAL RECTIFIERS
250 v., 40 mA. 5 x 1/2 in. dia., 3/6. 100 v., 60 mA. bridge
5 x 1/2 in. diam. 3/-. Germanium diode 1N92, P.I.V.
200. Max. output 100 mA. size 0.3 x 0.25 in. diam. (0.4 in.
skirt), 6/-.

SCPL C.E.T. Brand new neofluoroscope tube with P.D.A.
Fraction of original cost £1. Base, with tube only
2/- extra.
Test equipment as in previous issues. Sets sent on
application.

Terms: C.W.O. Trade enquiries invited.

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Nr. MANCHESTER. STA. 2148

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TEST GEAR. BRITISH and AMERICAN, re-
built, laboratory tested and guaranteed.
"X" BAND. Signal Generator Type TS.13/AP.
Frequency range 6,400/9,600 Mc/s. incorporating
resonant cavity wavemeter, piston attenuator and
thermistor bridge, mains operated.

POWER METER. Type TS36/AP accurately
measures 3 cm. power with thermistor bridge.

TEST KIT type 25, comprising 3 cm. Directional
Couplers, English/American waveguide
adapters, etc.

SIGNAL SOURCE. Type TS.45/AP generator
10 mw. or 3 cw. power, mains operated.

ATTENUATORS. "T" type ladder network
overall attenuation 80 db., arranged to give steps
of 20 db., 20 db., 20 db., 10 db., 5 db., 2 db., 2 db.,
1 db. 600 ohms impedance input and output,
in metal case with lid. £9/10/-.

"Q" METER. Type TF 329A by Marconi
Instruments.

BEAT FREQUENCY OSCILLATOR. Type
TF.195L/4 by Marconi Instruments. Frequency
range 10 cycles to 150 Kc/s. dual output, low level
1 µV to 100 mV. High Level 2-watts into 50 ohms.

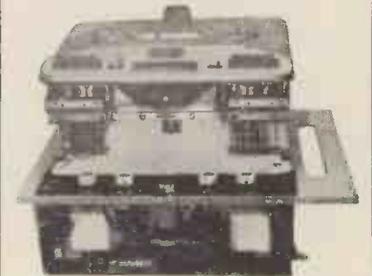
"K" BAND. Transmitter/Receiver complete
with 2K33 Klystron and Magnetron.

"X" BAND. Transmitter/Receiver complete
Type TR.3699.

WAVEMETERS. Type TS-509-UR Absorption
type, 90/400 Mc/s., no battery or mains required.
Fitted sealed micro-ammeter reading 0-50 µA.
crystal and built-in telescopic aerial, £6/10/-,
Carr. 3/6. General Radio type 724 B, 16 Kc/s. to
50 Mc/s. Type TE 149 by R.C.A. 200 Kc/s. to 30
Mc/s. Type 69/AP 300/1,000 Mc/s.

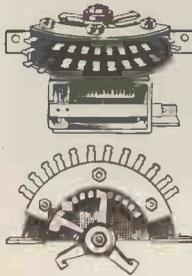
Leslie Dixon & Co.
Dept. A, 214 Queenstown Road, London. S.W.8
Telephone: MACaulay 2159

THE NEW TUTOR DE LUXE TAPE RE- CORORDER RLNS AT 1 1/2" INSTEAD OF 1 1/2" p.s.

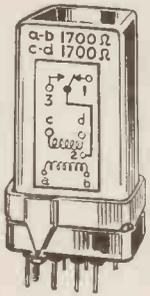


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with superimposing and mixing
facilities and Power Pack completely
assembled and mounted on grey
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with instructions and
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New Russian recordings available.
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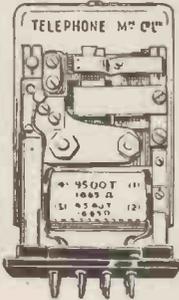
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Telephone: Paddington 8555
Cables: Tutape LONDON



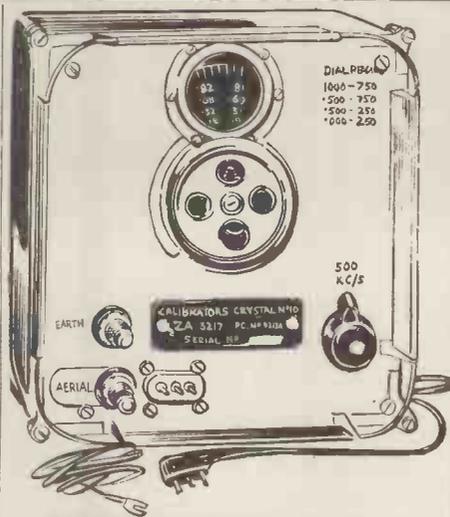
MINIATURE UNISELECTOR SWITCH. Two banks of ten plus home contacts, one bank continuous of normal. 30 ohms coil for 24 volt operation. Brand new, manufacturer's packing. Price 22/6 each. P. & P. 2/6. Illustrations above and below.



SIEMENS H.S. RELAY. Very latest type, sealed. H96E. 1,700 ohms plus 1,700 ohms, single C.O. contacts. Brand new with fixing clip. In maker's cartons. Price 1/6 each, plus 1/- P. & P.



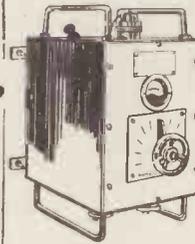
NEW CARPENTER'S TYPE POLARISED RELAYS. 2 x 9 500 turns at 1,685 ohms. Price 22/6 each. P. & P. 1/-.



CRYSTAL CALIBRATOR No. 10. A crystal controlled 4-valve high-grade instrument in the same category as the famous B.C.221. Directly calibrated, does not require cross reference or charts—functions as follows: (1) A crystal controlled oscillator which provides fixed frequency signals of 500 KC and all harmonics of 500 KC to beyond 10 Meg. and up to 30 Meg. (2) A variable oscillator from 250 KC to 500 KC, this enables all intermediate frequencies between 250 KC/s. and 30 Meg. to be produced and modulated. The instrument is supplied complete with 3 spare valves, all leads and maker's instruction book in carrying haversack. The complete outfit is brand new—repeat NEW. Price: £4/19/6. Carr. 3/-.



NEW GALVANOMETERS Solid brass, 3in. dial, in polished wooden case. 70 degree scale, 35 mA either side. 100 ohm coil. Price 12/6 each. P. & P. 1/6.



L.T. TRANSFORMER. Input 230 V. Output 50 V. 50 amp. Adjustable by regulator switch on primary steel case with mains switch. Will take 100% overload. Weight 150lb. Wound at 800 amps per sq. inch. Brand new. Price: £15. Carr. £1.

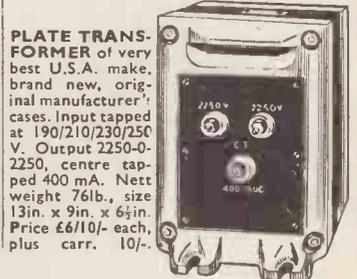


PLATE TRANSFORMER of very best U.S.A. make, brand new, original manufacturer's cases. Input tapped at 190/210/230/250 V. Output 2250-0-2250, centre tapped 400 mA. Nett weight 76lb., size 13in. x 9in. x 6 1/2in. Price £6/10/- each, plus carr. 10/-.

MINIATURE MOVING COIL DIFFERENTIAL RELAY. Two coils 350 ohms each. Operating current minimum 140 microamp, nominal 400 microamp, maximum 8 milliamp. One pole two way, or, centre stable.



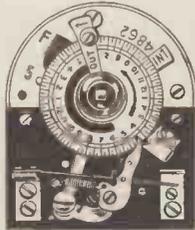
Two way contact current 100 mA at 50 V. A.C. or D.C. Size 1 1/4 x 3/8 x 3/16 in. Price: 22/6 each.



MUIRHEAD PRECISION, 4 bank, 1 pole. 24 position Stud Switch. Heavy duty contacts, brand new, original boxes. Price 17/6 each. P. & P. 1/-.

CERAMIC PRECISION SWITCH. 2 pole, 6 way, 4 banks. New in manufacturer's boxes. Price 10/6 each. P. & P. 1/6.

VENNER 8-day clockwork Time Switch. Contacts 1 amp. 230 volt. 24 hour phase, 1/4 hour divisions, allows setting for one make and one break to be made every 24 hours, complete with key. Used but guaranteed perfect. Price 27/6 each. P. & P. 1/6.



MINIATURE P.M. MOTOR. 12/24 volt, reversible. 1 1/2 in. dia. New, price 9/6 each. P. & P. 1/-.

AIRCRAFT CINE CAMERA G45B Mk. III. Fully modified, fitted with f/3.5 triple anastigmatic lens, takes 25ft. of 16 mm. film, fitted with 24 v. motor. 16 exposures per sec. Brand new, original packing, £4/10/- each. P. & P. paid.



20 WAY STRIP containing standard Post Office telephone Jack Sockets, overall size 1 1/4 x 3 1/2 in. New. Price 15/- each. P. & P. 1/6. **10 WAY STRIP** standard Post Office telephone Jack Sockets spacing allowing 1granic Jack Plugs. New. Price 10/- P. & P. 1/6.

LATEST MOST MODERN TYPE OF EX W.D. MINIATURE HEADPHONES As illustrated. Brand new, low impedance. Price: 10/6 plus P. & P. 1/6.



NEW MOVING COIL HEADSETS. Complete with Tannoy carbon hand microphone, with plug suitable for No. 19 set. Price: 12/6 each, plus P. & P. 2/-.

AUTO TRANSFORMERS. Step up, step down, 110-200-220-240 v. Fully shrouded. New. 1/-.

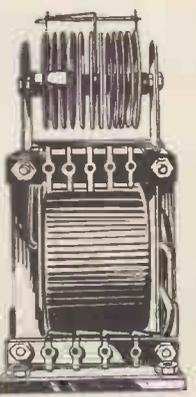
300 watt type £2/2/- each. P. & P. 2/6. 500 watt type £3/3/- each. P. & P. 3/9. 1,000 watt type £4/4/- each. P. & P. 6/6. Also 60 watts, 19/6 each. Plus P. & P. 2/-.

MARCHING COMPASS Mk. I. Brand new, ex W.D. Price 14/6. P. & P. 1/-.



BRAND NEW SELENIUM FULL WAVE BRIDGE TYPE RECTIFIERS, in manufacturer's original packing, D.C. output 36 v. 10 amp., made up of 12 x 110 mm. dia. plates. These fitted in cooling funnel (removable). Size 1 1/2 in. x 8 in. x 4 1/2 in. Price 45/- P. & P. 3/3.

TWELVE PLATE F.W. BRIDGE CONNECTED RECTIFIER mounted on 200/250 volt A.C. input transformer. Output 36/40 volt D.C. at 1.2 amps. New, perfect. Price 16/6. P. & P. 3/6.



METERS 500 microamp., 2in. round, with clip, correctly calibrated. 16/6 each. P. & P. 1/-.

200 microamp. F.S.D. 2 1/2 in. proj., calibrated 0 to 5 (50 divisions). Internal resistance 470 ohm. New. Price 29/6 plus 1/- P. & P.

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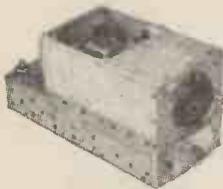
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3-34 LISLE STREET, LONDON, W.C.2



PARMEKO TABLE TOP TRANSFORMERS
Input 230 v. 50 c/s.
Output 620/550/375/0/375/550/620 volts
250 mA. Also 2.5 v.
3 amp. windings
Size 6½ x 6½ x 5½ in.
Brand new only,
45/- each. P/P 5/-.

BENDIX BC-453 COMMAND RECEIVERS "Q" FIVER



Coverage 190 to 550 kc/s.
Complete with 6 valves, 3-12SK7, 12K8, 12SR7, 12A6.
85 kc/s I.F.T.
Supplied brand new and boxed, 89/6 each. P/P 3/6.

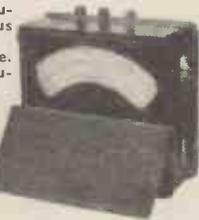
CRYSTAL CALIBRATORS No. 10

An extremely useful instrument providing the following facilities: 1. Xtal controlled osc. giving fixed frequency signals of 500 kc/s and harmonics to 30 Mc/s; 2. An additional switched oscillator (250-500 kc/s) enabling all intermediate frequencies from 500 kc/s to 10 Mc/s to be produced. Compact size, 7 x 7½ x 4 in. Utilises 2-1T4, 1R5 and CV286 valves and 500 kc/s Xtal. Supplied with instructional handbook. 59/6 each. P/P 3/6.



PORTABLE PRECISION VOLTMETERS

Brand new instruments by famous manufacturer. In polished teak case. Moving iron instrument reading A.C. or D.C. volts on 2 ranges 0-160 v. or 0-320 v., 8 in. mirror scale. Accuracy within 2%. £5/19/6 ea. P/P 3/6.



TINSLEY PHOTO VOLTAGE AMPLIFIERS

These special instruments incorporate a 1 microamp mirror galvanometer and a double selenium photo-electric cell. Housed in aluminium case complete with 12 v. lamp and housing. Brand new £15 each. P/P 7/6.

AMERICAN 1,000 O.P.V. MULTI-RANGE TESTMETERS



400 microamp basic mov. Seven A.C./D.C. volt ranges 0 to 5,000v. D.C. current 1 mA, 10 mA, 100 mA, 1 amp. Res. 100 ohms, 100 K ohms and 1 meg. Decibels. Supplied brand new with test prods, batteries and instructions. £3/19/6 each. P/P 2/6.

MINE DETECTORS No. 'A'

Complete equipment comprises search head, amplifier, headset, control box, telescopic rods for search head, test unit, test measure and haversack. Operation from Std. 67½/1.5 v. battery. Will detect ferrous or non-ferrous metals. Very portable and sensitive. Supplied brand new in original transit cases with circuit and instructions. 99/6 each. Carr. 10/6.

BRAND NEW R.C.A. EXTENSION LOUD-SPEAKERS. 8 in 3 ohm Quality speaker mounted in attractive black crackle case to match AR88 Receivers, etc. 45/- each. P/P 3/6.

DON Mk. 5 FIELD TELEPHONES

Ideal for all inter-communication. Buzzer calling. Supplied fully tested, complete with batteries and instructions.



39/6 each. P/P 3/6 ea., 5/- pr.

MAINS ISOLATION TRANSFORMERS. 230 v. input, 230 v. output, 5 amp capacity. Housed in ventilated metal case, £5 each. P/P 10/-.

750 watt AUTO TRANSFORMERS. Tapped from 110 to 230 v. Fine heavy duty type, 69/6 ea. P/P 5/-.

A.C. MAINS VOLTAGE REGULATOR TRANSFORMERS. Input 230 v. Output var. 185 to 250 v. 24 amps or 185 to 250 v. input, 230 v. output 24 amps, £12/10/-, P/P 10/-.

WESTON 772 TESTMETERS. Supplied in perfect working order, with leads and batteries, £7/10/- each. P/P 4/6.



A.C. volts: 2.5 v., 10 v., 50 v., 250 v., 1,000 v. D.C. volts: 2.5 v., 10 v., 50 v., 250 v., 1,000 v. D.C. current: 100 micro/A, 1 mA, 10 mA, 50 mA, 100 mA, 500 mA. Output Meter A.C. Current: 500 mA, 1 amp, 5 amp. Resistance: 100 ohms, 1,000 ohms, 100 k. ohms, 10 megohm.

COSSOR DOUBLE BEAM OSCILLOSCOPES



Type 339. 10-position time base, 6 cps. to 250,000 cps. Amplifier 10 cps. to 2 mill. cps. Reconditioned, perfect working order. Complete with handbook. £27/10/- each. Carriage £1.

ROTARY CONVERTERS



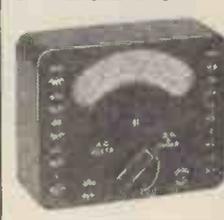
12 v. D.C. input. 230 volt A.C. 150 watts 50 cycles output. Housed in wooden case and fitted with voltage control slider resistance, switch, plugs and A.C. mains voltage output check meter. Supplied in perfect condition, individually tested £9/19/6 each. P/P 10/-.

VORTEXION PORTABLE AMPLIFIERS

Operation from 200/250 volts A.C. or 12 volts D.C. Separate inputs for microphone or gram. Output matched to 7.5, 15, 250 or 500 ohms. incorporates volume control and full switched tone control. Valve line-up: 6C7, 6J5, 6V6, 6V6, 5Z4. Size 8½ x 6½ x 17½ in., not brand new but supplied in perfect working order, fully tested. £10/10/- each. P/P 6/-.



UNIVERSAL AVOMINOR TESTMETER



A.C./D.C. volt ranges to 500 v. Current 0 to 500 mA. Resistance 0 to 20K ohms. Supplied in perfect working order complete with batteries, leads and ether carrying case. £3/19/6 each. P/P 2/6.

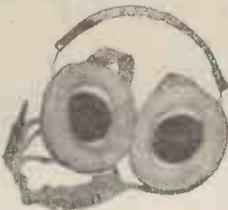
8-RANGE SUB-STANDARD D.C. AMMETERS



Ranges 1.5, 3, 7.5, 15, 30, 60, 300 and 450 amps. 2 in. mirror scale. Meter housed in polished teak case. Supplied complete with all thunts and leather carrying case. £15 each. P/P 7/6.

RCA PADDED MOVING COIL HEADPHONES.

Brand new boxed. Finest tonal quality, low impedance. Fitted with std. jack plug. 19/6 per pr. P/P 1/6.



RCA PLATE TRANSFORMERS.

Input 200/250 volts. Output 2,000/0/2,000 volts 500 mA. Tapped 1,500/0/1,500 volts. Supplied brand new boxed, £6/10/- each. carriage 10/-.



24 VOLT ROTARY CONVERTORS.

Input 24 volts D.C. Output 230 volts A.C. 50 cycles, 100 watts. Housed in metal carrying case with inlet/outlet plugs. Brand new, 92/6 each. P/P 7/6.



AMERICAN GEARED MOTORS

24 volt D.C. motor fitted with precision gearbox giving twin outputs of 20 and 6 r.p.m. Also operates on 12 volts. 1/2 in. shafts. Brand new. 19/6 each. P/P 1/6.

FERRANTI TESTMETERS TYPE Q

D.C. VOLTS	A.C. VOLTS	D.C. Current	Ohms.
8 v.	15 v.	7.5 ma.	25,000
30 v.	30 v.	20 ma.	
150 v.	150 v.	150 ma.	
600 v.	0.60 v.	750 ma.	

500 ohms per volt on all ranges B.S.S. first-grade accuracy on all self contained ranges. Supplied in perfect working order complete with leads, battery, instructions and reline covered carrying case. Price 52/6 each. P/P 2/6.



ADMIRALTY POWER UNITS 234A. 200/250 volt A.C. input. Output 250 volts 15 mA. and 6.3 volts 6 amps. Fully smoothed double choke and paper condensers, fused and fitted with input and output plugs. Sockets are provided on the front panel for meter check. Housed in grey metal case for standard 19in. rack mounting. Supplied brand new. 59/6 each. P/P 7/6.

CR.100 SPARES KITS. 15 valves, resistors, pots, o/p trans. condensers, all new boxed, 59/6 per set. P/P 3/6.

ADVANCE CONSTANT VOLTAGE TRANSFORMERS. 190 to 260 volt input. Constant 230 volts output. 150 watts. Brand new, £8/10/- each. P/P 5/-.

UNIVERSAL AVOMETERS. Reconditioned, perfect order. Model Z £8/10/-. Model 40 £10/10/-. Model 7 £12/19/6.

FIELD TELEPHONES TYPE L.

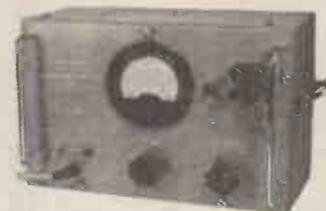


Generator bell ringing. Light and very portable. Ideal for all installations. Supplied complete with batteries, fully tested. As new, 59/6 each. P/P 3/-, 5/- pr.

NINE ALKALINE ACCUMULATORS. 12 volt 45 ampere. £4/19/6 each. P/P 7/6.

MARCONI SIGNAL GENERATORS TF-517. 10-18 mc/s. 33-58 mc/s. 150-300 mc/s. Operation 200/250 volts A.C. Supplied in good working order. £12/10/- each. P/P 10/-.

MURHEAD PRECISION STUD SWITCHES. 2 pole, 2 bank, 24 position, 10/6 each. P/P 1/-. 4 pole, 4 bank, 24 position, 17/6 each. P/P 1/3.



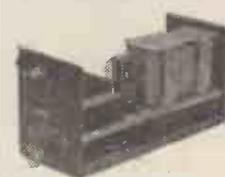
MARCONI TF-428 B/I VALVE VOLTMETERS. 5 ranges A.C. and D.C. 1.5, 5, 15, 50 and 150 volts. Operation 200/250 volts A.C. Supplied in perfect working order complete with internal H.F. probe. Brand new with Handbook. £17/10/- each. P/P 10/-.

R.1155 COMMUNICATIONS RECEIVERS.

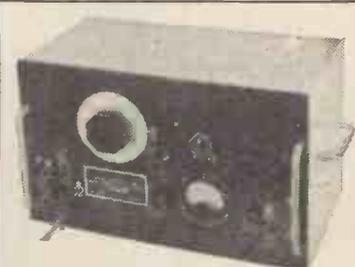
MODELS L & N. Both models incorporating the trawler and top band. Supplied in perfect condition realigned, fully tested. £12/19/6 each. **STANDARD MODEL B.** Fitted with improved N type drive, perfect order re-aligned, etc., £7/19/6 each. **CARRIAGE 7/6** both types. **COMBINED POWER PACK AND OUTPUT STAGE,** to suit either models, 85/- extra. Illustrated instruction book with all receivers.



EDDYSTONE MAINS POWER PACKS



200/250 volts input. Output 175 volts 60 mA. and 12 volts 2.5 amps. Double choke and condenser smoothed, 5Z4 rectifier. Supplied as new and unused, 32/6 each. P/P 3/6.



FURZEHILL BEAT FREQUENCY AUDIO OSCILLATORS. Frequency range 0 to 10,000 cycles. Output 10 or 600 ohms. Separate 50 cycles check. Sex zero control. 200/250 volt A.C. operation. Supplied in perfect working order, fully tested, £9/19/6 each. P/P 10/-.



HALLCRAFTERS S.27 U.H.F. COMMUNICATION RECEIVERS. F.M. or A.M. coverage 27 to 143 mc/s. on 3 bands. Incorporates S meter, variable sel. b.f.o. a.n.l. etc. Output for phone or speaker. Operation 110 or 230 volts A.C. Supplied in good working order, £27/10/- each. P/P 10/-.

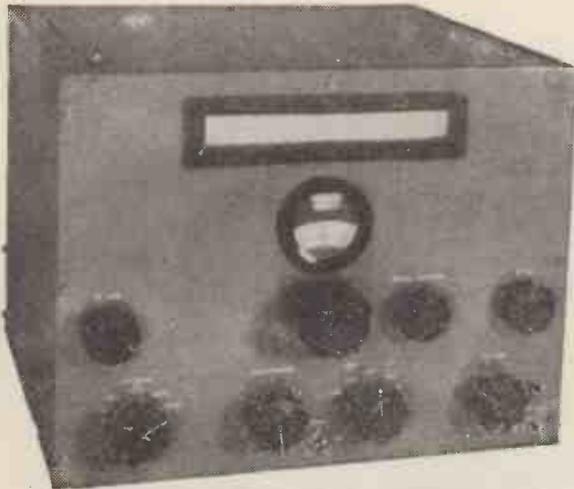
FIELD TELEPHONE TYPE F

Generator bell ringing. Supplied complete with batteries fully tested and complete with wooden carrying case 59/6 each. P/P 3/6, 5/- pr.



HOURS OF BUSINESS: 9 A.M. TO 5 P.M. THURSDAY 1 P.M. OPEN ALL DAY SATURDAY SEND S.A.E FOR LISTS.

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 Phone: GERRARD 8204/9155
 Cables: SMITHEX LESQUARE
 3-34 LISLE STREET, LONDON, W.62



COMMUNICATIONS RECEIVER B28 (MARCONI CR100)

PRICE — ONLY £21

Later Model with Noise Suppressor £25

Carriage England and Wales 30/- Send S.A.E. for further details.

CR100 SPARES KITS

Contents: 15 valves, 2 of U50, DH63, KT63, X66, and seven KTW61. Output transformer, Resistors, Condensers, Potentiometers, PK screws, pilot lamps, drive cord, etc., etc. ALL BRAND NEW 59/6. Post 3/6

COMMUNICATIONS RECEIVERS R-1155B

A first class 10 valve Communication and D/F receiver, covering 75 Kc/s. to 18 Mc/s. (16.2-4,000 m.) in 5 bands. The large scale and superior dual ratio slow-motion drive make tuning easy, and the R.F. stage and 21.F stages ensure world-wide reception ALL the receivers we sell have been thoroughly overhauled and completely re-aligned, and are in first class order. ONLY £7/19/6.

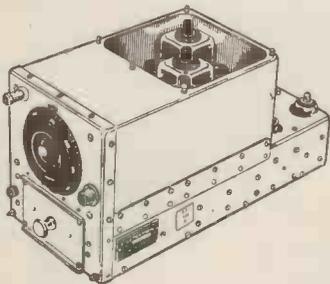
ALSO available, R-1155-N as above, but has 1.5 to 3 Mc/s (100-200 m.) in place of the 75-200 Kc/s. band. ONLY £12/19/6.

A.C. MAINS POWER PACK OUTPUT STAGE

In handsome black-cracked steel cabinet to match the R-1155 Fitted with 8in. speaker. Just PLUG IN and switch on! Only the finest quality components are used, and we guarantee OUR power packs for 6 months. ONLY £6/10/-. Deduct 10/- when purchasing receiver and power unit together. Send S.A.E. for further details, or 1/3 for 14 page illustrated booklet giving technical data and circuits etc. (FREE with each receiver). Add 10/6 carriage for receiver, 5/- for power unit.

HALLICRAFTER SX-24 RECEIVERS

Covers from 540 Kc/s. to 44 Mc/s. in 5 bands. With separate bandspread tuning, variable selectivity crystal filter, B.F.O., "S" meter, noise limiter etc. For 117-230 v. A.C. mains. In perfect working order and first class condition. £25. Carr 10/-.



Q5'er (BC-453)

This Command Receiver covers 190-550 Kc/s. (I.F. 85 Kc/s.) and is ideal for double superhet conversion etc. Supplied BRAND NEW in original cartons, with all 6 valves and CIRCUIT. 89/6. Post 3/6.

MARCONI VALVE VOLTMETERS

Ranges: 0 to 1.5, 5, 15, 50, and 150 volts. Fitted with probe unit for R.F. measurements. A.C. mains operation. In good condition and working order. A laboratory instrument for ONLY £8/19/6. Carr. 7/6.



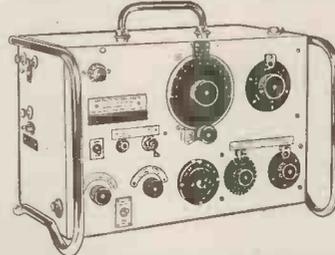
Best Buy at Britain's

CRYSTAL CALIBRATOR

No. 10. Consists of 500 Kc/s. crystal oscillator and a variable 250-500 Kc/s heterodyne oscillator. This enables all intermediate frequencies between 500 Kc/s. and 10 Mc/s. to be produced. These frequencies are indicated on the calibrated scale. The calibrator may actually be used up to 30 Mc/s. The unit uses a CV-286 neon modulator, 1T4 crystal osc., 1T4 het. osc., and 1R5 mixer. Operates from 300 v. 15 m/a., and 12 v. 0.3 A., but can be easily modified for 120 v. and 1.4 v working. Size 7x7½x4in. In first class condition, complete with valves, crystal, instruction manual and circuit. One of our "best buys" at ONLY 59/6. Post 3/6.



FERRANTI TESTMETER TYPE Q. An extremely compact self-contained multimeter. Volts 0 to 30, 150, 600 A.C./D.C., with additional 0.3 v. D.C. and 0-15 v. A.C. ranges; Milliamps 0 to 7.5, 30, 150 and 750 D.C.; ohms 0-25 K. Accuracy BSS first grade. 500 ohms per volt. Knife-edge pointer and clearly calibrated 2½in. scale. Complete with leads, prods, battery, and instructions in fitted velvet-lined 4 x 7 x 3in. case. Brand new condition, perfect working order. Bargain price. ONLY 59/6. Post 2/6.



ADMIRALTY G-73 SIGNAL GENERATOR/WAVEMETERS

Combines the facilities of a well made signal generator with those of a crystal checked heterodyne wavemeter. Generates 100 Kc/s. to 25 Mc/s. in 6 ranges (CVV or 400 c/s. mod.), or operates as wavemeter over same ranges. Carrier or modulation level may be monitored on 500 microamp plug-in

meter (not supplied). Has built-in 1 Mc/s. crystal oscillator for self checking calibration, coarse and fine attenuators, 400 c/s. output available separately. Operates from 100-230 v. A.C. mains. Size 15 x 10 x 8in. Supplied complete with valves, crystal and list of crystal check points and instructions for drawing of individual graphs. Condition used but O.K. 79/6. Carr. 10/6

RCP 20 RANGE TESTMETERS

1,000 ohms per volt, 400 micro-amp basic movement	
D.C. VOLTS	A.C. VOLTS
2.5 v.	2.5 v.
10 v.	10 v.
50 v.	50 v.
250 v.	250 v.
1,000 v.	1,000 v.
5,000 v.	5,000 v.
D.C. CURRENT	RESISTANCE
1 ma.	500 ohms
10 ma.	100k. ohms
100 ma.	1 megohm
1 amp.	DECIBELS
	-10 to +69



In light oak case 6½ x 6 x 4½in., including lid. Complete with test leads and prods, internal battery, and instructions manual. ALL BRAND NEW and tested. Post 2/6.

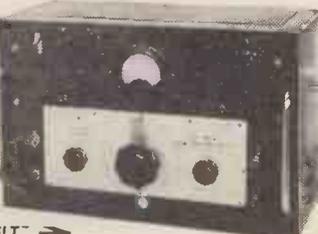
LIMITED NUMBER 79/6.

VOLTAGE REGULATOR TRANSFORMERS. Input 230 v A.C. output variable from 187-250 v., OR input 187-250 v., output 230 v at 24 amps. Rating 5.5 KVA. Wt. 42 lb. Brand new condition. £9/19/6. Carr. 10/6.

MINIATURE RELAYS (ALL BRAND NEW AND BOXED).
 G.E.C. sealed, wire ends, 670 ohms. 2 H/D makes, M1099 15/-
 G.E.C. sealed, wire ends 670 ohms. 4 C/overs, platinum, M1092 19/6
 G.E.C. sealed, wire ends, 5000 ohms 2 C/overs, platinum, M1052... 17/6
 S.T.C. size 1½ x ½ x ½in. 250 ohms. 2 C/overs, double contacts ... 7/6
 Siemens High Speed, 1K + 1K ohms. 1 C/over 10/6

FURZEHILL BEAT FREQUENCY OSCILLATOR No. 5.

Push-pull output 0-10,000 c/s. of 0.5 v. at 10 ohms, or 0.50 v. at 600 ohms monitored by 2½in. M/C meter Incorporates set-zero control and 50 c/s. check Operates from 100-250 v 50 c/s mains. In handsome instrument case. 17½ x 9 x 11in. Despatched in transit case, in perfect condition, tested, complete with 7 valves, circuit and instructions. A laboratory instrument for ONLY £12/10/-. Carr. 10/-.



SEE ADVERTISEMENT OPPOSIT →



SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. RMS. D.C. output 30 v. 10 amps. BRAND NEW. Boxed. 45/-. Post 3/6.

HEAVY DUTY L.T. TRANSFORMERS. (Gresham.) Latest type potted, oil filled. Pri. 230 v. 50 c/s. Sec. 0-70-75-80 v. 4 amps. Size 5½ x 4½ x 6½ in. high. Wt. 19 lb. BRAND NEW. 42/6, carr. 5/-.

DUAL PURPOSE TRANSFORMERS (Gresham). Pri. 230/250 v. Secs 240-0-240 v. 1.5 amps., 5 v. 12.5 amps. 5 v. 1.75 amps. Ideal for ISOLATING TRANSFORMER, to obtain TWO 240 v. 360 watt lines. Potted, oil-filled, 7 x 7½ x 10½ in. high. Wt. 50 lb. BRAND NEW. £3/10/-. Carr. 10/-.

MAINS ISOLATING TRANSFORMERS (Vortexion). Fully-shrouded. For testing A.C./D.C. sets in safety. 230 v. in. Output 230 v. 100 watts, 22/6. Post 2/6.

ADMIRALTY HT TRANSFORMERS Pri. 230 v. 50 c/s. Secs. 620-550-375-0-375-550-620 v. (620 and 550 v. 200 m/amps., 375 v. 250 m/amps.), plus two 5 v. 3 Amp. rectifier windings. Total rating 278 VA. Upright mtg. Wt. 25 lb. Made 1953. BRAND NEW. Original boxes. 45/-. Carr. 5/-.

INSTRUMENT TRANSFORMERS. 230 v. A.C. input. Outputs 0-65-130-195 v. 85 m/amps., 6.3 v. 5 amps., 6.3 v. 0.3 amps. Shrouded. Size 3½ x 3½ x 3½ in. high. 15/- post FREE.

AR88D MAINS TRANSFORMERS. Input 110-240 v. Output 345-0-345 v. 125 m/amps., 6.4 v., 4.5 amps., 5 v. 2 amps. 4½ x 4½ x 5½ in. high. Wt. 12 lb. Potted. Tag ends. RCA BRAND NEW. Boxed. 29/6, post 3/6.

TRANSFORMER BARGAIN. Input 0-200/250 tapped. Outputs 250-0-250 v. 80 m/amps., 5 v. 2 amps.; 6.3 v. 4.5 amps. Upright mtg. BRAND NEW. Boxed. Ex-Admiralty made 1952. A fine 50 c/s. mains tranny for ONLY 16/5, post FREE.

MODULATION TRANSFORMERS. Collins type 20 watts 807 to 807. 8/6 each. Post 1/6.

FERRANTI TYPE, for T x 36 etc., push-pull 807's to plate and screen modulate push-pull 807's, ratio 2:1. Fully shrouded. Wt. 6½ lb. 17/6. Post 2/6

ADVANCE CONSTANT VOLTAGE TRANSFORMERS. Input 190-260 v. 50 c/s. A.C. mains. Output 230 v. 150 watts. £8/10/-. Carr. 5/-.

STANDARD TRANSFORMERS. Vacuum impregnated, interleaved, E.S. screen, universal mounting. Size 4 x 3½ x 2½ in. ALL BRAND NEW. 18/6 each. Post 1/6.

Type 1. 250-0-250 v. 80 m/a., 6.3 v. 3 A., tapped at 4 v. 4 A., 6.3 v. 1 A. tapped at 4 v. and 5 v. 2 A.

Type 2. As above, but 350-0-350 v. 80 m/a.

Type 3. 30 v. 2 A., tapped at 12, 15, 20 and 24 v., to give 3.4-5.6-8.9-10 v., etc. Type 5. 0.5-11-17 v. 4 A. Ideal for chargers.

MORE METER BARGAINS

RANGE	TYPE	SIZE	PRICE
25 Microamp.	D.C. M/C	2½ in.	69/6
25 Microamp.	D.C. M/C	2½ in.	59/6
50 Microamp.	D.C. M/C	3½ in.	79/6
50 Microamp.	D.C. M/C	2½ in.	59/6
100 Microamp.	D.C. M/C	3½ in.	62/6
100 Microamp.	D.C. M/C	2½ in.	42/6
1 Millamp.	D.C. M/C	3½ in.	50/-
1 Millamp.	D.C. M/C	3½ in.	69/6
200 Millamp.	D.C. M/C	2½ in.	10/6
1 Amp. Thermocouple		2½ in.	6/6
300 Volts	A.C. M/I	6 in.	79/6
300 Volts	A.C. M/I	2½ in.	25/-
500 Volts	A.C. M/I	2½ in.	25/-
40 Amperes	D.C. M/C	2 in.	7/6

METAL RECTIFIERS. Full wave bridge. BRAND NEW. Salford 1 mA. 8/6, 5 mA. 8/6. 5TC 2 mA. 5/6.

MINIATURE 378 IF STRIPS. For FM tuner designed in "Practical Wireless." Complete with 3 of EP91, 2 of EP92 and 1 of EB91. A fresh release enables us to offer these once again. BRAND NEW Complete reprint of conversion instructions and circuit supplied free. 35/- OR less valves. 12/6. Post. either 2/6.

RCA HF SWEEP GENERATORS

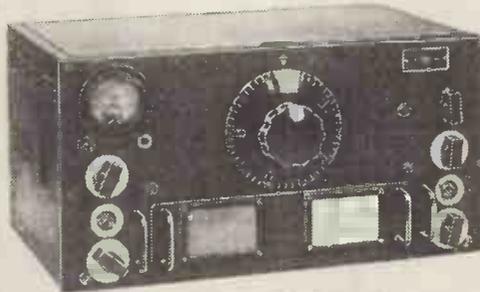


Laboratory type equipment designed for alignment of wide band RF and IF amplifiers. Comprises generator and regulated power supply unit each housed in grey crackled steel case 17 x 10 x 12 in. Centre Frequency 5-65 Mc/s. Sweep width 0.2-20 Mc/s. Marker oscillator frequency 5-70 Mc/s. Operates from 105-125/210-230 v. A.C. Mains. Complete with 13 valves and Technical handbook. BRAND NEW condition. £39/10/-. Carr. 10/-.

MEGGERs

E. & V. Series 2 Meggers. 500 volts, 0-100 Megohms. In leather case: First-class condition. ONLY £12/10/-. E. & V. BONDING TESTERS. ~5 ohms at 12 m/amps. max. Hand generator type for earth testing. In leather case. £7/19/6. INSULATION TESTERS. "Record" hand generator type. 0-60 Megohms at 500 volts pressure. Complete in leather case. £7/19/6. Post 4/-.

HRO SENIOR RECEIVERS



Complete with ALL NINE general coverage plug-in coils for 50 Kc/s to 30 Mc/s. Instruction booklet, and circuit, but less external power supply unit. Table models, as new condition, 21 GNS. Rack mounting, 18 GNS. Packing and carriage 22/- extra. Send S.A.E. for further details. HRO POWER PACKS. 115/230 v. A.C. mains input. Tested, and in good condition, 69/6. Post 4/-.

AR-88. D AND LF. SUPER* CONDITION. NOW IN STOCK.

R.F. UNITS

RF24. 20-30 Mc/s.	5 switched positions	12/6
RF28. 50-65 Mc/s.	Super slow-motion drive	17/6
RF27. 65-80 Mc/s.	Super slow-motion drive	22/6

Unboxed, but as new condition. Postage 3/6 each.

CHARLES BRITAIN (Radio) LTD. 11 UPPER SAINT MARTIN'S LANE LONDON, W.C.2

One Minute from Leicester Sq. Station (Up Cranbourne St.) Shop Hours 9-6 p.m. (9-1 p.m. Thursday.) Open all day Saturday



SANGAMO-WESTON VOLTMETERS. S61. Dual range 0.5 and 0-100 v. D.C. FSD 1 mA. 3 in. scale. Recent manufacture. Ideal for schools. Complete in super quality canvas carrying case, with test prods and leads.

BRAND NEW. Boxed 27/6. Post 2/6.

SANGAMO-WESTON ANALYSER E772. A useful multi-range meter in rexine covered carrying case. Thoroughly overhauled and in perfect working order. For full details see previous adverts. £7/19/6. Carr. 4/6.

AVO LC & R BRIDGES. Capacity 5 pFd to 50 mFd. Resistance 5 ohms to 50 megohms. Inductance can be measured against external standard. Balance is indicated on a meter which can be used as a valve voltmeter from 0.1 to 15 v. Leakage test and Power Factor scale. For use on A.C. mains. Tested and guaranteed. £8/10/-. Post 3/6.

HICKOCK I-177 VALVE TESTERS. Checks dynamic mutual conductance, shorts, emission, gas, and noise. For UX4, UX5, UX6, UX7 Octal, Local, 87G, and Acorn types. Portable, in wooden carrying case 15½ x 8 x 5½ in. Wt. 13½ lb. BRAND NEW. Complete with instruction book and valve testing charts. For 117 v. A.C. 10 gns. Carr. 7/6. Matching auto. transformer for 230 v. A.C. 12/6.

MARCONI TF987/1 NOISE GENERATORS. Range 100 Kc/s to 200 Mc/s. Determines noise factor of AM and FM receivers. Fully stabilised H.T. supply. A.C. mains operation. Brand new and in original boxes. £25.

MARCONI SIGNAL GENERATORS. 85 Kc/s. to 25 Mc/s. A.C. mains operation. In fair condition and working order. TF144F £40. TF144G £50.

MARCONI TF.340 OUTPUT METERS. Perfect working order. £19/10/-. SCR522 TRANSMITTER/RECEIVERS. 100-150 Mc/s. Comprises BC624A rec., and BC625 trans. with valves and in good condition. BC624A, less relay 19/6. BC625, 22/6. With relay 25/-. These two on rack 47/6. Carr. 7/6

MOVING COIL PHONES. Finest quality Canadian, with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable 19/6. Post 1/6.

INVICTA LOUDSPEAKERS. Good quality 10 in. unit (impedance 3 ohms.). In wooden cabinet 17 x 17 x 6 in. Complete with 50 lb. lead and jack plug. BRAND NEW. 39/6. Carr. 5/6.

VITAVOX PRESSURE UNITS TYPE N. 20 watts P.M. Heavy duty. BRAND NEW boxed. 89/6 Carr. 5/6.

RESISTORS

Morgan "T" (½ watt) and "R" (1 watt). Latest types all BRAND NEW 100 assorted, 10/-. Post 1/-.

HEAVY DUTY SLIDER RESISTORS. 1.25 ohm 20 amp., 12/6. post 3/6. 1 ohm 12 amp., 8/6. post 2/-.

PRECISION RESISTORS. 1 megohm 1% 1 watt wire wound Ex-U.S.A.A. BRAND NEW 10/6 per dozen

DC/AC CONVERTERS. Input 12 v. D.C. Output 230 v. 50 c/s. A.C. at 135 watts. Fitted with 0-300 v. A.C. 2½ in. meter and slider resistor for voltage adjustment. In stout wooden carrying case with lid. Perfect working order. £9/19/6. Carr. 10/6.

24 v. Input 230 v. A.C. 50 c/s. 100 watts output. In grey metal case. BRAND NEW 92/6. Carr. 7/6.

RADIATION METERS. Portable dose-rate meter, containing modern type rectangular 50 microAmp meter, CVX494 electrometer valve, etc. BRAND NEW. In canvas carrying case. £3/19/6. Post 2/6. For details of other equipment, see our previous adverts.

FOR YOUR CONVENIENCE!

EASY, NO DEPOSIT, INTEREST FREE DEFERRED TERMS ON ALL GOODS—Send for details.

★ THE WORLD'S FINEST AUTOCHANGER



U.A.8
B.S.R.
MONARCH

4 - SPEED AUTOCHANGER
£6/19/6

Collaro Conquest 4-speed Autochanger, £6/19/6.

U.A.12. Latest B.S.R. Monarch 4-speed Mixer, £8/9/6.

T.U.9. B.S.R. 4-speed Single Player, 89/6.

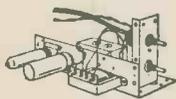
B.S.R. Monarch 4-speed Stereo Autochanger, £9/19/6.

Collaro Conquest Stereo Autochanger, 11 Gns.

P. & P. on the above, 5/6.

★ **AMPLIFIERS** ★

12 MONTHS' GUARANTEE



PORTABLE AMPLIFIER
MK. D.1. **59/6**

Brand new. Latest design with printed circuit. Dimensions 7 x 2½ x 5in. A.C. only. Mains isolated. 2-3 watts output. Incorporating EL84 as high gain output valve. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MK. D.2. 79/6

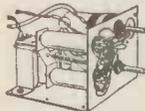
Printed circuit. Latest design. Dimensions: 7 x 2½ x 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MK. D.3. 89/6

De luxe model. Printed circuit. Latest design. Dimensions: 7 x 2½ x 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume, treble and bass control. Knobs 3/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER

MK. D.4. **49/6**



Brand new. By famous manufacturer. Especially built for portable record players. Dimensions 4½ x 3½ x 4in. A.C. only. 2 valves EL84 as high gain output valve, EZ80 as rectifier. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MK. D.5. 39/6

Simple circuit employing ECL80 triode pentode output valve giving 2-3 watts output. A.C. only. Mains isolated. Single control for volume and on/off switch with knob. P. & P. 3/6.

★ **IDEAL FOR STEREOGRAPHIC SOUND** ★

8in. P.M. Speaker 8/9. 6½in. P.M. Speakers 12/6, with O.P. Trans. fitted 10/-. 8 x 5 and 4 x 7in. Elliptical Speakers 19/6. Post 2/9.

EXTENSION SPEAKERS 19/9

Polished oak cabinet of attractive appearance. Fitted with 8in. P.M. Speaker, W.B. or Goodmans of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Ins., carr. 3/6.



HERE'S UNREPEATABLE VALUE!



R.P.6.
29/6

Elegant cabinet, cloth covered in grey or red with sunken control pane and speaker fret. Size: 13 x 17 x 8in. deep. Takes 2 B.S.R. Monarch 4 speed Autochanger; 7 x 4in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins. 4/6.



R.P.7.
SINGLE PLAYER CABINET
19/6

Smart cabinet. Size: 14½ x 12½ x 6½in. deep. Various 2-tone colour schemes with white handle and piping. Takes T.U.9 B.S.R. single player unit, 4 x 7in. elliptical speaker and amplifier D.1 or D.2. Carr. & Ins. 4/6.

STEREOGRAPHIC CABINET
99/6

Continental style cabinet including extra clip on speaker cabinet, 15½ x 10½ x 24½in. deep. Takes B.S.R. 4-speed stereo autochanger. Printed circuit amplifier. 8in. speaker. Carr. & Ins. 12/6.

STEREOGRAPHIC AMPLIFIER
£7/19/6

12 Months' Guarantee

Beautifully made for portable stereographic record players. Latest design with printed circuit. Dimensions: 3 x 5½ x 9½. A.C. only. Mains isolated. Twin amplifiers each side giving 3-4 watts output. Incorporating ECL82 triode pentode valve. Full tone, volume and balance controls. Complete and ready to fit. Knobs 3/6 per set extra. P.P. & Ins. 4/6.

B.S.R. FUL-FI CRYSTAL TURNOVER CARTRIDGES 19/6

Brand new. Including sapphire needles for L.P. and Standard giving fullest range and finest tone obtainable for any player. Can be fitted to all standard pick-up arms. P. & P. 9d.

MOTORBOARDS, 2/6

For 4-speed Autochangers. P. & P. 1/3.

PHOTOGRAPHIC SLIDE CASE 17/6

(List price £2 10 0)
Rexine covered. Size 8 x 12½ x 2½in. deep. Will hold 150 of those expensive coloured transparencies in numbered partitions. This is the answer to that aggravating search for that particular photograph and will, of course, keep them safe from damage. P. & P. 2/6.



RECORD PLAYER CABINETS

A beautifully styled cabinet. Made by a famous manufacturer. In polka dot cloth with clipped lid and carrying handle. Size: 16 x 14½ x 8½ in. deep. Will take B.S.R. Monarch 4-speed autochanger and 4 x 7in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins. 4/6.

R.P.2.
69/6

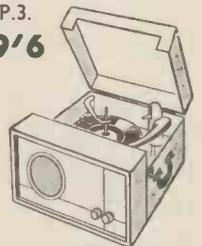


R.P.4.
79/6

Stylish cabinet by famous manufacturer. Cloth covered in contrasting colours red and grey. Grilled front control panel. Size: 15 x 19 x 8½in. deep. Beautifully made—a cabinet of which you can be really proud. Takes 4-speed B.S.R. Autochanger. 6½in. round or 4 x 7in. elliptical speaker. Room for any amplifier of your own choice. Carr. & Ins. 4/6.

A delightful looking cabinet 14½ x 17½ x 8½in. in 2-tone leatherette. Will take a B.S.R. Monarch 4-speed autochanger and 6½in. round speaker. Carr. & Ins. 4/6.

R.P.3.
69/6



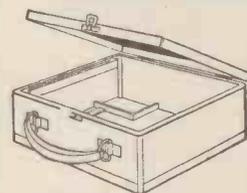
BAKELITE CABINETS
5/9

Brand new. Colour brown. Attractive design. Size 12 x 7 x 5½in. ideal for small receivers, converters etc. P. & P. 3/9.



STURDY CASE 12/6

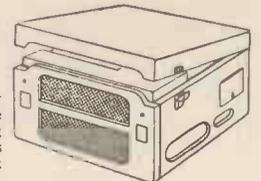
8½ x 7½ x 3½in. deep. Covered in burgundy and grey washable rexine. Strong clasp, hinges and handle. Ideal for Portable Radio chassis or transistor set. Can be adapted as a Record carrying case to hold 18 seven-inch long-playing records. P. & P. 2/6.



A "must" for the build-your-own-tape-reorder enthusiast:—

TAPE RECORDER CABINETS
19/6

Suitable for Truvox Tape recording deck. Less front cast speaker panel. Size 13½ x 15 x 8½in. deep. Detachable lid with compartment for spare tape. Covered in green washable plastic material. P.P. & Ins. 4/6.



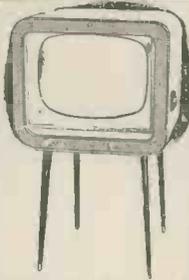
DUKE & CO. CATALOGUE AVAILABLE FREE UPON REQUEST

17" T.V. 19 GNS.

While stocks last

★ FEATURES ★

- ★ Beautiful latest finish cabinet in contemporary style covered and washable.
- ★ Polished legs 18i optional extra for 25/-
- ★ 17in. British Rectangular tube. Guaranteed fully for 12 months.
- ★ 13 channels "Turret Tuned"—ITV/BBC. Extra coils at only 7/6 a pair (with order).
- ★ Chassis. 14 B.V.A. valves—salvaged but re-conditioned and guaranteed 3 months. Carr. and Ins. 30/-.



POWER PACK AND AMPLIFIER. 19/6
R.F. E.H.T. Not tested. Amplifier stage 6V6 with O.P. trans. 3 ohms. matching Smoothed H.T. 350 v. at 250 ma., 6.3 v. at 5 amp., 22 v. at 3 amp., 6.3 v. at 4 amp. and 4 v. centre tapped. Drawings free. Size 14½ x 8 x 7in. Ins., carr. 5/6.

POWER PACK AND AMPLIFIER. 12/6
Tested. Output stage 6V6 with O.P. trans. (3 ohms) choke. Smoothed H.T. 350 v. at 250 m.a., 6.3 v. at 5 amp., 22 v. at 3 amp., 6.3 v. at 4 amp. and 4 v. centre tapped. Less valves. Ins., carr. 5/6.

T.V. AERIALS. 23/6

For all I.T.A. channels. Outdoor or loft. 3 elements. P. & P. 2/6.

AERIALS. 15/6

B.B.C. indoor type. Folded dipole with 12 ft. co-ax. cable fitted. Post 1/9.

T.V. AERIALS. 7/9

For all channels. Complete with co-ax. cable. For use indoors or in the loft. Postage 1/3.

CAR AERIALS. 6/9

Whip antennae Plated. 50in. long collapsing to 11in. One hole fixing. Post 1/-.

CO-AX. CABLE 6d. YARD

Cut to any length. Good quality 1/6 postage on 20 yards.

FAMILY RADIO. 99/6

5 valve (octal) superhet. A.C. 3 waveband and gram. position. 4 controls. Modern attractive cabinet, size 15½ x 18 x 10½in. in cream and brown. Carr. & Ins. 8/6.

★ TRANSFORMERS ★

DROP THROUGH TYPE. 12/9

350-0-350 volts at 250 ma.
6.3 volts at 4 amps. 6.3 volts at 4 amps. 4 volts at 3 amps. 22 volts at 3 amps. 4 volts centre tapped at 1.5 amp. Primary 200-250 volts. 50 cycles. P. & P. 3/9.

MAINS AUTO. 12/6

0-205-225-245 volts at 300 ma.
Isolated windings of 6.3 volts at 2-6 amps., 6.3 volt at 3-6 amps., 2 volts at 1-4 amps. P. & P. 3/9.

MAINS 10/9

425 volts at 300 ma.
Single secondary 6.3 volts at 12 amps., 6.3 volts at 0.6 amp. Screened primary 200-250 volts. P. & P. 3/9.

COLVERN PRESET POTENTIOMETER. 2/9

Brand new. 200 ohms. 10 k. and 20 k. P. & P. 6d.

FOCUS MAGNET. 9/9

Brand new 38 mm. Incorporating picture shift control. P. & P. 1/3.

SCANNING COILS. 10/6

Low impedance. 38 mm. Brand new. P. & P. 1/3.

SCANNING COILS. 15/9

Wide angle 90° 38 mm. Low impedance. P. & P. 1/3.

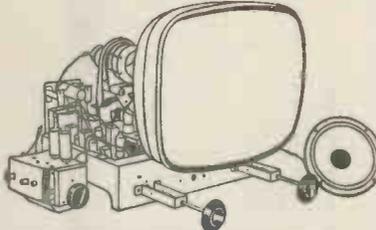
HOME RADIO 79/6



AC/DC. Universal mains 5 valve octal superhet. 3 waveband receiver can be adapted to gram. p.u. In attractive wooden cabinet. 9½ x 18½ x 11½in. Ins., carr. 4/6.

17" T.V. CHASSIS TUBE & SPEAKER 14 GNS.

17in. Rectangular Tube on modified chassis. Supplied as single channel chassis covering B.B.C. channels 1-5 or, incorporating Turret Tuner 50/- extra (chassis purchasers only) giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at 7/6 each. Chassis size 12 x 14½ x 11in. With Tube and speaker (less valves) 16 gns. Complete and working with valves and turret tuner 18 gns. 12 months' guarantee on the Tube. 3 months' guarantee on the valves and chassis. Ins., carr. (incl. tube) 25/-.



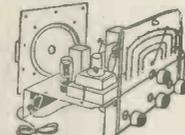
14" T.V. CHASSIS TUBE & SPEAKER 11GNS.

As above, with 14in. Rectangular Tube. 12 months' guarantee on Tube, 3 months' guarantee on chassis and valves. Chassis with tube and speaker (less valve*), 11 gns. Complete and working with valves and Turret Tuner 17 gns. Ins. carr. (incl. tube) 25/-.

★ T.V. CHASSIS AT CLEARANCE PRICES

The Popular 12in. PLESSEY CHASSIS. 9/6

A bargain for anyone wanting to make up their own T.V. at a very low cost. A chassis in one unit. Less valves and tube. Chassis size 12 x 14½ x 11in. I.F.'s 10.5-14 Mc/s. Can be adapted for a 12 channel Turret tuner and modified to take a larger tube. Carr. & Ins. 10/6.



SUPER CHASSIS 79/6

5 valve superhet chassis including 8in. P.M. speaker and valves. Four control knobs (tone, volume, tuning, w/change switch). Four w/bands with position for gram. p.u. and extension speaker A.C. Ins., carr. 5/6

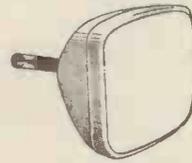
CHASSIS. 1/-
6 or 8 valve latest type midget valve design for A.M. or F.M. Brand new Cadmium plated. Size 12½ x 7½ x 2½in. P. & P. 1/9

SOLO SOLDERING TOOL 12/6

110 v. 6 v. or 12 v. (special adaptor for 200/240 v. 10/- extra) Automatic solder feed including a 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burr. In light metal case with full instruction for use. Post 3/6



REPLACEMENT RE-BUILT T.V. TUBES



£8'10'/-
CASH PRICE
12 MONTHS'
FULL
GUARANTEE

All sizes except 10in. Completely re-built gun assembly, new cathode, heaters etc. giving the high standard required for long picture life, quality and value. Carr. and Ins. 15/6

OR Yours for 8/6 initial payment (plus carr. and ins.) and 19 weekly payment: of 8/6.

★ EXPRESS DESPATCH SERVICE ★

Please phone to confirm Tube in stock Send Telegraph Money Order. Tube despatched Passenger Train same day This service only available with remittance by a Telegraph Money Order and cash sales not terms.

SOUND/VISION AND I.F. STRIP. 7/9
Plessey. I.F.'s 10.5 Mc/s. sound. 14 Mc/s. vision. 8 valve holders. Less valves. Size 8½ x 5 x 4½in. Circuit incl. The tuner unit plugs directly into this chassis. P. & P. 2/6.

SOUND/VISION AND I.F. STRIP. 2/9
Salvaged. Complete sound and vision strip. 8 valve holders. Less valves. I.F.'s 16-19.5 Mc/s. Size 8½ x 4½ x 4½in. Drawings free with order P. & P. 2/6.

SOUND/VISION AND I.F. STRIP. 2/9
Salvaged. Superhet. 8 valve holders. Less valves I.F.'s 7.25 Mc/s. sound. 10.75 Mc/s vision. Vision complete from input up to video output. Sound complete from input to A.F. Amplifier. P. & P. 2/6.

TIMEBASE. 2/9

Containing scanning coils, line transformer etc. less valves. Drawings free with order. P. & P. 2/6.

RECTIFIERS. 2/9

250 volt. 100 ma. Full or half wave. Salvage guaranteed P. & P. 1/3.

R.F. -E.H.T. COIL 7/9

7-10 KV. R.F. frequency approx. 22 Kc/s. Uses 6V6 or P61 as osc. suitable for Ultra model V600, V700 and many other sets or replacing E.H.T. mains transformers. Ideal when using a larger tube Size 4½ x 2 dia. Base 4 x 4½in. Circuit drawings available with order. P. & P. 2/6

T.V. MASKS. 1/9

12in Round. Soiled. P. & P. 1/6.

T.V. MASKS. 7/9

17in. Brand new. Grey plastic. P. & P. 2/-.

T.V. MASKS. 10/9

Brand new. Latest pastel shades. Pink and blue. P. & P. 2/-.

T.V. MASKS. 14/9

21in. as above. P. & P. 2/-.

INSULATING TAPE. 1/6

Finest quality. 75ft. x ½in in sealed metal container. Postage 9d.

GANG CONDENSERS. 1/9

Salvage guaranteed. Standard size two gang. 0003 and .0005. All tested and guaranteed. P. & P. 1/3.

DUKE & CO.

(Dept. C.9.) 621/3, Romford Road, Manor Park, E.12.

Tel. ILF. 6001/3.

Deferred terms to suit all pockets.

Monthly credit terms or weekly easy payments—Details on request.

DO-IT-YOURSELF! NO EXTRAS NEEDED; FREE LISTS ON ANY MODEL:

All Components sold separately

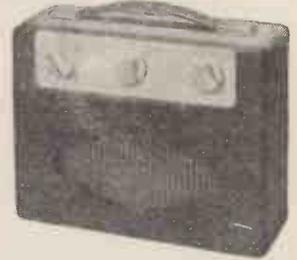
AFTER SALES SERVICE

PRICES DOWN !! "THE TRANSISTOR-8"

**Combined Portable/Car Radio
Push-Pull Portable Superhet**

- ★ Tunable over medium and long wavebands
 - ★ 250mW output push-pull
 - ★ Internal Ferrite aerial
 - ★ Highly sensitive and selective
 - ★ 7in. x 4in. high flux speaker
 - ★ All components identified and carded
 - ★ EDISWAN transistors throughout
 - ★ Easy-to-follow layout diagrams
- Car radio components 8/-; A.V.C. 4/3;**
Size 9in. x 7in. x 3½in. Weight 4 lb.

Complete set of parts including cabinet and all components. **Now £10.19.6**
P. & P. 2/6
All parts sold separately
FREE BOOKLET



325mW version £11/11/6. P. & P. 2/6.

"THE MINOR"



The smallest transistor radio offered on the market. Case size only 3 x 2 x ½in. Variable tuning over medium waves. Uses a three-stage reflex circuit of high efficiency. Total cost including Personal

phone; transistor; long life miniature battery circuit and complete layout diagrams and all components:

- ★ Internal ferrite aerial
- 49/6 P.P. 1/6.**

All components sold separately

Circuit, layout diagram; and shopping list free.

RED-SPOT TRANSISTORS
5' - EACH
WHITE-SPOT
8/6

CAR RADIO 2-watt Amplifier

- ★ 7 x 4in. high flux speaker.
 - ★ V15/10P power transistor.
 - ★ Overall size 6 x 4 x 3in.
 - ★ Works off car 12-volt battery.
- MAY BE USED WITH ANY BATTERY PORTABLE WITH 15-OHM OR 3-OHM OUTPUT TRANSFORMER.**
Complete set of parts 65/- P. & P. 2/6
Unit built-up and tested 77/6. P. & P. 2/6
IDEAL FOR TRANSISTOR-8
USE YOUR PORTABLE IN YOUR CAR!

AUDIO GENERATOR

- ★ Ediswan XB104 Transistor. ★ Size only 2½in. x 1½in. x 1in.
 - ★ Large output from special transformer.
 - ★ Special chassis. ★ Layout diagrams.
- COMPLETE WITH ALL COMPONENTS, 25/-, p. & p. 1/-**
IDEAL POCKET TEST INSTRUMENT

SENSATIONAL OFFER—LIMITED QUANTITY ONLY

SUPER SIX TRANSISTOR PLUS DIODE SUPERHET

- Sensitivity—1 mV. for 50 mW. output.
- Mullard Transistors—OC44, OC45(2), OCT1.
- 150 Ω 3in. loudspeaker.
- Power output—180 mW.
- OC72 (matched pair), OA70.
- Push-pull output.
- Low consumption.
- Printed circuit.
- Completely detailed Instruction manual.
- Wareband coverage—MW and LW—550 kc/s. to 1500 kc/s.—150 kc/s. to 270 kc/s.
- Internal hi-Q Ferrite aerial.
- Easy to build.

Recommended by us as being the easiest to build 6-Transistor printed circuit superhet receiver ever offered.
FREE LIST ON REQUEST

COMPLETE SET OF PARTS INCLUDING ATTRACTIVE CABINET SIZE 7x4½x2in. CAN BE SUPPLIED FOR

£9-10-0

Post and packing 2/6
(ALL ITEMS SOLD SEPARATELY)

MAJOR-2

(Two-transistor Pocket Radio)



69/6 COMPLETE POST 1/6
NEW BOOKLET FREE: All components sold separately.
GOOD RECEPTION ANYWHERE!

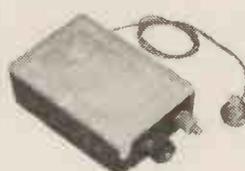
- ★ 4-stage reflex!
- ★ Medium wave; tunable!
- ★ Very sensitive!
- ★ No aerial or earth!
- ★ Complete layout!
- ★ Over 6 months on one battery.
- ★ 4½ x 3 x 1½in.
- ★ Weight only 4 ozs.
- ★ Personal 'phone.

SIGNAL TRACER

RF, IF AND AUDIO TRACING

- ★ 2-Ediswan Transistors
 - ★ New Chassis; Improved Design
 - ★ Easy to Use; Small Size
 - ★ A must for the Amateur and the Professional
- Complete set of parts including headphones, transistors, etc. **37/6 P.P. 1/6**
FREE DIAGRAM ON REQUEST

MAJOR-3



(AS DESCRIBED IN "R.C." SEPT. '59)
COMPLETE 87/6 P.P. 1/6.
FANTASTIC OUTPUT. TERRIFIC RECEPTION GUARANTEED ANYWHERE.

- ★ 5-stage Reflex Circuit.
- ★ No Aerial or Earth.
- ★ Min. Volume Control.
- ★ 3 Ediswan Transistors.
- ★ Medium Wave Tuning.
- ★ Size 4½ x 3 x 1½in.
- ★ Personal 'phone'.

MULTIMETER TYPE 666H: TRIPLET

1000 ohms per volt:
AC, DC 10, 50, 250, 1000, 5000 volts.
DC mA 10, 100, 500.
Resistance 300/250K.
79/6 P.P. 2/- with battery and leads.
NEW CONDITION: INCLUDES INSTRUCTIONS

POCKET MULTIMETER



MODEL A10: 500 Micro-amp Movement.

- ★ AC/DC voltages, 2000 ohms per volt; 10, 50, 250, 500 and 1000 volts. ★ Resistance 10kohms and 1 Megohm.
- ★ D.C. current 0.5 mA; 25 mA; 250 mA. ★ Decibel range. ★ DC ± 2% accuracy; AC ± 3%.

INCLUSIVE OF TEST PRODS. ILLUSTRATION BOOK AND BATTERIES

Size 5½ x 3½ x 1½in.
Weight 17 ozs. **£4/17/6 P.P. 1/1**

BRAND NEW AND GUARANTEED
Free Leaflet by Return.

HENRY'S RADIO LTD. 5, HARROW ROAD, PADDINGTON, W.2
OPEN MONDAY-SAT. 9-6, THURSDAY 1 O'CLOCK PAD 1008/9

V.H.F. TRANS/RECEIVER TYPE TRI920

★ 9.72 MC/S IF ★ 4-CHANNEL CRYSTAL CONTROLLED
 ★ 40 KC/S BANDWIDTH ★ 100 to 120 MC/S COVERAGE
 Unit complete with 21 valves; crystal; 24 volt rotary power unit, etc., in metal case. In new condition with full circuit diagram.
 £6/19/6. Carriage 10/6. Circuits separately, 1/9 post free.

V.H.F. TRANS/RECEIVER TYPE 1986

★ 9.72 MC/S IF ★ 10-CHANNEL CRYSTAL CONTROLLED
 ★ 23 KC/S BANDWIDTH ★ 124.5 to 156 MC/S COVERAGE

Sub-units	Type	With valves	Less valves	P.P.
TRANSMITTER	81	60/-	25/-	2/6
RECEIVER	114	25/-	7/6	2/6
IF Amplifier	476	32/6	12/6	2/6
Modulator	105	20/-	—	2/6
24 v. Rotary unit	3	15/-	—	2/6
10-way Control unit	382	6/-	—	9d.

All the above are in absolute new condition Full circuits available, 1/9 post free.

CRYSTAL CALIBRATOR No. 10



A superb Crysta Controlled Wavemeter just released by the Ministry of Supply. Has directly calibrated dial for nominal coverage of 1.5-10.0 Mc/s, but may actually be used from 500 Kc/s up to 30 Mc/s. Complete with 500 Kc/s. Crystal, 2 valves type IT4, 1 of IR5 and 1 of CV286 (Neon Stabiliser), and instruction Book. Size 7 x 7 1/2 x 4 in., weight 5lb. Used but in first-class condition.

ONLY 59/6
 (Carriage 3/6)

QUARTZ CRYSTALS
 FROM 5/- EACH
 From 6 Kc/s-47 Mc/s. FT243, FT241, 10XJ and B7G
 Send for list 500 types.

MARCONI No. 19 SET CRYSTAL CALIBRATOR
 CRYSTAL CONTROLLED OSCILLATORS: 10 Kc/s. 100 Kc/s and 1 Mc/s. ON/OFF MODULATOR. With handbook. Unused. ONLY 79/6.
 P.P. 2/6

1933 RECEIVER CONTROL UNIT
 BARGAIN OFFER 18 MINIATURE VALVES!!!! 3-EF91; 6-EF92; 2-EB91; EL91 IF's; RELAYS. ETC., ETC., IN CASE.
 95/- P.P. 3/6

PIRANI CONTROL UNIT
 Includes:
 ★ 6 in. 1 mA. movement meter with mirrored scale.
 ★ Fully set Wheatstone Br. dge.
 ★ Complete in best quality case.
 ★ Built-in galvo-shunt.
 ONLY 85/- P.P. 5/-
 including circuit diagram

PIRANI DETECTOR LEAK
 DETECTOR
 Includes:
 ★ 2-arm Wheatstone Bridge.
 ★ Masses of high quality switches, controls.
 ★ Best quality wood case.
 ★ Galvo-shunt.
 ★ Circuit diagram
 ONLY 49/6 P.P. 5/-

500 microamp.	2in.	M.C.	(DC)	F.R.	12/6
0-1 amp.	2in.	TC	(RF)	F.S.	6/-
0-3 amp.	2in.	TC	(RF)	F.S.	6/-
0-150 mA	2in.	M.C.	(DC)	F.S.	7/6
0-30 mA	2in.	M.C.	(DC)	P.	7/6
0-50 mA	2in.	M.C.	(DC)	F.S.	7/6
0-100 mA	2in.	M.C.	(DC)		10/-
0-30 amp.	2 1/2 in.	M.C.	(DC)		10/-
5-0.5 amp.	2 1/2 in.	M.C.	(DC)	P.	10/-
0-500 mA	2in.	M.C.	(DC)	P.	15/-
0-1 mA	2 1/2 in.	M.C.	(DC)	F.R.	22/6
0-400 mA	3 1/2 in.	M.C.	(DC)	F.R.	59/6
500-0-500 mA	2 1/2 in.	M.C.	(DC)	F.R.	25/-
0-75 amp	2in.	TC	(RF)	P.	6/-

"372" MINIATURE IF STRIP 9.72 Mc/s
 The ideal F.M. conversion unit as described in "P.W.", April/May, 1957. Complete with 6 valves, three EF91s, two EF92s and one EB91, I.F.T.'s, etc., in absolutely new condition. With circuit and conversion data.
 12/6 (less valves) 37/6 (with valves)
 Postage and Packing 2/6 (either type)

BC 906D WAVEMETER
 Complete with vernier dial in black crackle case; 500 UA 2 1/2 in. meter; 150 to 235 Mc/s Battery operated. Includes circuit. 1S5 valve.
 45/- P.P. 5/6

SMITHS 8-DAY CLOCKS
 BARGAIN OFFER!!!!
 BRAND NEW SEALED IN SMITHS CARTONS
 6in. dial 8-day clock with detachable adjustable time switch
 ONLY 95/- P.P. 5/-

AIRCRAFT RADAR TYPE AN/APA-
 Complete scope indicator unit with amplifier; serial switching unit; full scope controls. Includes: 3PB1 Tube; 6SN7GT; 6K6GT; 6G6GT 2X2; 6X5GT.
 BRAND NEW FULL HANDBOOK 97/6 P.P. 3/6

TROBE UNIT
 Complete with: 6-EF50; 5-EA50; SP61, Relays, etc.
 35/- P.P. 7/6

RF UNITS TYPE 25. Switched Tuning 30 to 40 Mc/s. Includes 2 5PS1's.
 Carriage 2/6 10/-

TYPE 26. Variable tuning, 50 to 65 Mc/s. Including 2 EF54's and 1 ECS2
 Carriage 2/6 25/-
 (Circuits in stock for both types 9d.)

DYNAMOTORS AND CONVERTORS
 24 volt D.C. to 230 v A.C. 50 c/s., 100 watts.
 £5/10/0 P.P. 7/6
 28 volts D.C. to 250 volt 60 mA, 12/6. P.P. 2/6.
 12 volts D.C. to 220 volts 165 mA., 22/6 post free

MODULATOR TYPE 20C
 Contains our Post Office type relays; CV189 stabilizer; 4-EF36; 3-EF50 etc., etc.
 ONLY 22/6 P.P. 3/6

U.S.A. 90-VOLT BATTERY
 Tapped at 67 1/2; 45; and 22 1/2 volts.
 ONLY 5/- P.P. 2/-
 Guaranteed 100%

R.C.A. 8in. P.M. SPEAKER
 Black crackle case. Brand new.
 45/- P.P. 3/6

C/R TUBES

2AP1	1in.	25/-
VCR139A	2 1/2 in.	35/-
3BP1	3in.	30/-
3FP7	3in.	12/6
3AP1	2 1/2 in.	30/-
Mullard DG7/5	2 1/2 in.	45/-
5FP7	5in.	20/-
VCR517C	6in.	30/-
VCR97	6in.	40/-
Screen: for VCR97		7/6

182A INDICATOR UNIT
 COMPLETE INCLUDES VCR97 with Mu-metal screen; 3-EF50; 4-SP61; 5U4G; POTS; TRANSFORMERS etc.
 67/6 P.P. 5/-

TRANSMITTER/RECEIVER Army Type 17 Mk. II
 Complete with Valves, High Resistance Headphones, Handmike and Instruction Book and circuit. Frequency Range 44.0 to 61 Mc/s. Range approximately 3 to 8 miles. Power requirements: Standard 120 v. H.T. and 2 v. L.T. Ideal for Civil Defence and communications.
 BRAND NEW 45/- P.P. 5/-
 44-61 Mc/s. Calibrated Wavemeter for same 10/- extra. P.P. 2/-



APQ9 UHF UNIT
 RADAR JAMMING UNIT Includes 2-807; 7-6AC7; 2-8012 4F; gear drives; blower motor.
 £5/10/- P.P. 7/6

SYNCHRONIZER UNIT
 VALVES: 3-6C6M; 12-6AC7; 6Q7; 5-717A; 6-6SN7GT; 6H6.
 BRAND NEW £4/19/6 P.P. 5/-

TS187/AP RF WATTMETER
 RF power output meter; 0/10; 15/30 watts; with photo-cell; lamps; dials; and calibration chart; leads, etc. 200 UA 2 1/2 in. Meter.
 BRAND NEW £8/19/6 Post free

RADAR JAMMING UNIT TYPE 168 3
 Valves: 2-6C4; 832A; 829B; 2-5R4G; 3-6AC7; 6V6GT; 931A photo-multiplier with networks.
 BRAND NEW £6/10/- P.P. 5/-

AN/ARN-5 D. GLIDE PATH RECEIVER
 3-channel U.H.F. Receiver; uses plug-in crystals (not supplied); operating on 332.6; 333.8; cd 335 Mc/s. Unit contains 7-6AJ5; 28D7; 2-12SN7; 12SR7; Relays, etc. BRAND NEW and boxed; a bargain at 59/6 P.P. 5/-

Premier RADIO CO

NOW UNDER ENTIRELY NEW MANAGEMENT



"Petite"
THE PORTABLE
 MAY BE BUILT FOR **£7-7-0**

plus 3/- post & pkg.

Batteries extra.
 H.T. 10/- (Type B126) or equivalent.
 LT 1/6 (Type AD 35) or equivalent.

- ★ Size only 8in. x 8in. x 4½in.
- ★ Weight including batteries 5½lb.
- ★ 4 valves of the economy type.

- ★ High Q frame aerials.
- ★ High sensitivity on both wavebands.
- ★ Medium and long wave superhet circuit.
- ★ Instruction book 1/6.

RECORD CHANGERS

B.S.R. Monarch U.A.8. 4-speed auto changer	£6 19 6
Collaro Conquest 4-speed auto changer	£7 19 6
Garrard R.C. 120 M.K.2. 4-speed auto changer	£8 19 6

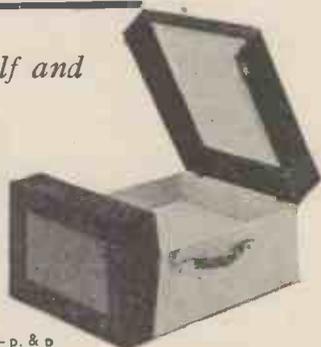
Postage and packing on above units 5/- each.

Assemble it yourself and **SAVE £££'s**

COMPACT GRAM. AMPLIFIER

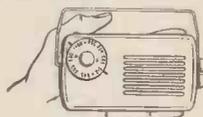
2-valve printed-circuit type for use on A.C. or D.C. 200/250 V. mains incorporating modern miniature valves. Output 2 watts, overall dimensions 6½ x 2 x 3½. Price 59/6, plus p. & p. 2/6.

Amplifier Cabinet. £2/19/6, plus 5/- p. & p. 7 x 4in. Elliptical Speaker. £1/11/6, plus 1/6 p. & p.
 Latest-type Collaro Conquest 4-spd. Changer. £7/19/6, plus 5/- p. & p.



If all the above items are purchased at the same time they can be supplied at £13/15/-, plus 10/- p. & p.

MUSIC IN YOUR POCKET



with the pocket-sized transistor Superhet Receiver. Yours for an unrepeatable price of £8/19/6, p. & p. 2/6. Battery 2/- or 25/- Deposit and 8 monthly repayments of £1/1/10. This Receiver incorporates 6 Selected Transistors and the latest-type printed circuit, it is extremely sensitive on medium waveband only, incorporating an internal Ferrite Aerial and operates on a 9-volt-type P.P.4 Battery.

The Receiver is fully constructed and housed in an attractive plastic Cabinet, in Red. Cream or Blue. Size 5½ x 3½ x 1½in. weight 12 oz.

PREMIER BATTERY ELIMINATOR



Housed in two containers which are to replace AD 35 and P125 Batteries.
MAY BE BUILT FOR 37/6
 Plus 2/- p. & p.
 Only suitable for use with DK96 Series valves.

ALL THESE GOODS CAN BE DESPATCHED FROM STOCK WITHIN 24 HOURS
H.P. TERMS ARRANGED TO SUIT YOUR POCKET

POCKET MULTIMETER Model U-1

A truly efficient meter for the enthusiast. Sensitivity 1,000 ohms per volt.
 Ranges A.C. 10-1000 volts.
 D.C. 2-1000 volts.
 Resistance 1-½ megohms.
 Milliamperes 10-500.
 Complete with test prods and leads. Price **99/6** plus 2/6 p. & p.



THE "MID-FI" A NEW DESIGN 4½ WATT AMPLIFIER KIT

MAY BE BUILT FOR 95/-
 Plus 3/- p. & p.



A new circuit for the home constructor requiring a good-quality medium-powered Amplifier for reproduction of Records or F.M. Broadcasts. Technical Specifications: separate bass and treble controls. Valve line-up EF86, EL84, EZ80. Voltage adjustment for A.C. mains from 200/250 volt, 3 or 15 ohms impedance. Negative feedback. Size 7 x 5 x 2in., overall height 5in. Silver-hammered finished Chassis.

Quality at low cost
STEREOPHONIC AMPLIFIER

A well-designed Amplifier incorporating printed circuit of the latest type using two ECL82 triode/pentode Valves and Metal Rectifier, ganged volume and tone controls and separate balancing control, output 3 watts per channel and suitable for Speakers of 3 ohms impedance. The Amplifier is housed in an attractive black metal Cabinet with Engraved Front Panel, overall dimensions 10½ x 7½ x 4½in.
 Price £8/19/6, plus p. & p. 5/- or 25/- Deposit and 8 monthly repayments of 21/10.



THE "CLARION" Transistorised miniature battery-operated TAPE RECORDER

- ★ Completely transistorised circuit.
- ★ Constant governed speed of 3½ I.P.S.
- ★ Recordings interchangeable with other recorders.
- ★ Remarkable reproduction on both speech and music.

Price complete with **25 GNS.** plus 5/- p. & p.
 Microphone not included.

HI-FI SPEAKER A 12in. Loudspeaker of high-fidelity quality, made by a famous manufacturer 15 ohms impedance, 15,000 lines, with cloth suspended cone. Price **59/6** plus 2/6 p. & p.

★ Replacement components for the MAYFAIR Television. Available from Stock

NO ELECTRICITY?

Here's your answer

THE BERIC

BATTERY RECEIVER
 For **99/6** plus 5/- p. & p. or £10/0 Deposit and 5 monthly repayments of 19/-.



This receiver is ideally suitable for use in the home or where normal electricity supply is not available, remarkable reception on both medium and short wavebands, incorporating the following latest-type miniature Battery Valves: DK92, DF96, DAF96, DL96 and operates on an external B.103 Battery or equivalent. The receiver is housed in an attractive two-tone metal case. Size 11½ x 7½ x 5½in.

This receiver can also be supplied with 2 short wavebands instead of medium and short, covering 2.5-7 Mc/s. and 6.5-17 Mc/s.
 Price 79/6.

BENEFIT FROM WHOLESALE BUYING ! GET EQUIPMENT THAT'S IN TIP-TOP CONDITION. GET IT FROM IRONGATE—ENGLAND'S LEADING EQUIPMENT WHOLESALERS

**HEAVY DUTY
L.T. SUPPLY UNIT** by S.T.C.

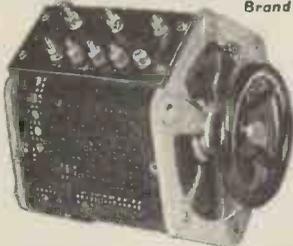


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Essential equipment for Electronic Engineering, research laboratories, schools, etc. Guaranteed for 20 amps.
Output: D.C. Variable up to 20 amps, and 24 V or trickle charge 125/350/700 ampere hours.
Input: A.C. 100/260 volts 45/65 cycles.
Size: 16 x 24 x 32in. High.
Available in Grey Cabinet.

£22-10-0

ex-Warehouse (includes circ. diag. and instructions, when with 'named separately for 10/- deposit)

VARIAC TRANSFORMERS
Brand New



OUTPUT (2KVA) Completely Variable 0 to 270 volts. 9 amps.
INPUT 230 volts, 50/60~
A SHROUDED FULLY VARIABLE TRANSFORMER FOR BENCH OR PANEL MOUNTING.
SIZE:— APPROXIMATELY 8 1/2 CUBE.
WEIGHT:— APPROXIMATELY 30 LB.
PRICE:—RIDICULOUS ONLY—£15.0.0
PLUS 12/6 CARR. SUPPLIED NEW AND BOXED

CONSTANT VOLTAGE TRANSFORMERS

FERRANTI 7 1/2-KVA MOVING COIL.
Stabilized output voltage in the range 200-250 v. Plug-board tapings. The selected output voltage is constant with $\pm 1\%$, at all loads 0 to 30/37 1/2 amps, when the supply voltage is varying over the range $+8\%$ to -12% .
● Frequency compensated 45-55 and 54-66 c/s.
● Excellent output wave-form.
● Can be used as a variable transformer.
● Unused. Complete with spares and instruction book at a fraction of the normal cost, only 6/65.



ROTARY CONVERTORS. 12 v. D.C. input, 230 volt A.C. 150 watts, 50 cycles output. Housed in wooden case and fitted with voltage control slider resistance, switch, plugs and A.C. mains voltage output check meter. Supplied in perfect condition, individually tested. £9/19/6 each. P/P 10/-.

**WORLD FAMOUS
TELEPHONES "F" Type**



IN ATTRACTIVE CASE

The best portable telephone ever made. With a range of up to 5 miles is ideal for

FACTORIES, BUILDING SITES, FARMS, CIVIL ENGINEERING PROJECTS, OUTSIDE BROADCAST UNITS AND OFFICES.

2 perfect sets in individual carrying cases, complete with long life batteries, bells, magneto and 100ft. telephone cable.

£7.10.0 per pair Carr. 9/6.

Tele "F" High Power as above but complete with amplifier. £6/10/- each Carr. 12/6
DON MK. V TELEPHONES. Few remaining, complete with 100ft. telephone cable £5/11/- per pr. Carr. (G.B.) 9/6.
D3 STRANDED TELEPHONE CABLE, NEW. Mile drum 85/-, Carr 17/6.



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P. A. SYSTEM



Complete with amplifier unit, 4 speakers, microphones, headphones and all spares packed in wooden cases. 6 and 12 volt D.C., handling capacity 8 watts, ideal for cars, boats, factories, etc.

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TRUVOX NEW LOUD HAILERS. Impedance 7 1/2 Ω. Handling capacity 8 watts, 18/6. P. & P. 3/6. Or 35/- per pair. P. & P. 7/-.

AERIAL MASTS

IMPROVED TYPE 50 MK. II
36ft. HIGH



Kits comprise—4 3/4in dia. Tubular Steel sections of 6ft. length, top-section and base, sockets, Guy and Fittings. YOU can purchase this normally expensive MAST for a fraction of its cost. Please add £1 for (returnable) wooden carrying case. The MAST is particularly suitable to take aerials for Tr., Bx., P.M. and T.V. (especially COLMERIC) and has many other uses. Extra 6ft. sections can be supplied at 17/6 per section.

£8.10.0 only Carr. 15/6

U.S.A. Typ. 45ft. TELECOM. AERIAL MAST. (7 sections. 6ft 8in. x 2 1/2in., guys, etc.) This entirely complete set in carrying case 12 1/2 Gns. Carr. 17/6. Or 2 sets for £25. Carr. extra. British Manufacture only.

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CREED-TELEPRINTER 7B Reperf. Type 7TR/3

COMPUTERS

ENGLAND'S LARGEST STOCKS OF TELEPHONE EQUIPMENT

U.S.A. D-9B/A/P - Radio Receivers First class for conversion, originally designed for R.D.F. Valve line-up: 1-4E N7GT 4-6SK7G 1-6SA7GT, 1-VR10 1-30-1-5U4G, 1-6B GT 1-6SL7GT, 3-6B4G 3-7B7B-2 1-6XJ7GT. Chassis size 20 x 8 x 1 1/2in. Weight 26lb. Brand new. Components plus transformers, condensers, resistors, etc. for exceeds this remarkable low price. Buy now! Only 150 sets available.



85/-
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TAKE ADVANTAGE OF OUR SPECIAL WHOLESALE OFFERS!!

MINIATURE RELAYS SIEMENS
High Speed Sealed one platinum change-over
H88A, 2.2Ω + 2.2Ω 15/6 Each
H88B, 50Ω + 50Ω 17/6 Each
H88C, 145Ω + 145Ω 19/6 Each
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H88E, 1,700Ω + 1,700Ω 25/- Each
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Vibrators 12 v. Malloy (new and boxed) 48/- Each
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Microphones—1P/12570 with switch 30/-
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ROTARY TRANSFORMERS. IT 12/24 v. —O/P 965 v. 120 v./A or 500 v. 28 mA/A (made by Delco) 27/6

GUARANTEED METERS (New & Boxed)

5. Micro amp. M.C. 2in. flush circ. Scale Rotagen 49/6 Each
100 Micro amp. M.C. 2 1/2in. flush square. Scale 0-150-0-500 v. 22/6
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MICRO SWITCHES



BURGESS BRAND NEW MINISTRY RELEASE (M.K. & BR. METAL BODY) UNIVERSAL CONTACT A.M. Rel. 5C/4098

Compare this remarkable almost half-price offer.

78/- per Doz. (min. quantity) £25 per 100

DYNAMO EXPLUDER Mk. II

For detonating explosive charges. A must for mining, demolition, road building and construction operations. May also be adapted as photo-flash generator giving 1,800 volts D.C. across o/p. terminals.



Price 8 1/2 GNS. each.

(Usual price 17 gns.)

P. & P 5/-

THE IRONGATE (M.O.) CO.,

2/4 IRONGATE WHARF ROAD, PRAED STREET, LONDON, W.2.

PAD. 2231/2/3

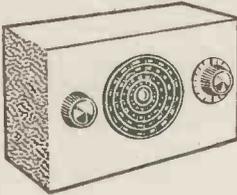
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VERDIK QUAD
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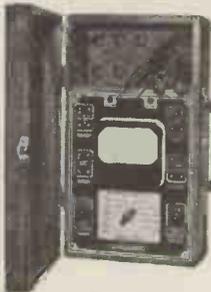
6 Transistor Plus Diode Pocket Superhet Radio
 Easy to build, using 6 Mullard transistors; OC44, OC45(2), OC71, matched pair OC72, OA70. Medium and long wave bands. Printed circuit. Built-in HIQ Ferrite Aerial. Push-pull output. 150 ohms 3in. loudspeaker. Circuit and layout diagram. Low consumption. Power Output 150 M.W. Sensitivity—1MV for 50 MW output. Circuit line up; mixer stage, 2 I.F. stages, Germanium detector, AF driver stage and push-pull output.

ALL COMPONENTS COMPLETE LESS CABINET AND BATTERIES AT THE SPECIAL PRICE OF

£7 - 19 - 6

Post and packing 2/6. All parts available separately. Cabinet available in parts to be assembled. With tuning knob and scale. 18/6 plus 1/6 post and packing.

**A GIFT FOR THE SERVICE MAN
 BRAND NEW IN WOODEN CASE**



The Weston Model 772 Type 6 super sensitive analyser. This precision designed multi-range test instrument has a large visible finely divided scale giving some of the range shown.

Range: D.C. volts 20,000 ohms per volt or 1,000 per volt. 2.5 volt range 50,000 ohms. 10 volt range 200,000 ohms. 50 volt range 1 megohm. 250 volt range 5 megohms. 1,000 volt range 20 megohms. Ohms: 0-3,000 ohms, 0-30,000 ohms. 0-3 meg. 0-30 meg. D.C. milliamps: 10, 50, 250 IM/A or 50 microamps. A.C. volts: 1,000 ohms per volt. ONLY £12/10/- plus cost and pkg. 7/6.

THE ALPA MULTI-RANGE POCKET METER

IDEAL FOR ROVING SERVICE MAN.
 Resistance ranges: 0-20K ohms, 0-2 Meg ohms
 Voltage ranges: 0-6 v. D.C., 0-12 v. D.C., 0-60 v. D.C., 0-300 v. D.C., 0-1,200v. D.C., 0-6v A.C., 0-12 v. A.C. (23 DB), 0-60 v. A.C. (37 DB), 0-300 v. A.C., 0-1,200 v. A.C.
 Current ranges: 0-300 v.A.-D.C., 0-30MA.-D.C., 0-300 MA.-D.C.
 complete with test leads £6/19/6 and batts. Post and packing 3/6.



SOMETHING NEW FOR THE CONSTRUCTOR
 Etch your own printed circuits; complete kit with instructions comprising 3 laminate sheets, copper faced etching bath, 4 bottles, etchant, resist solvent and cleanser and brush. 19/6 complete. P. & Pkg. 1/6.

FOUR ASTOUNDING TV TUBE OFFERS

All brand new in famous maker's cartons.
 (1) 17in. rectangular aluminized 6.3 HTRS. .3A current; max anode voltage 16 kV. Crating and carr. 15/-.
 Usual price £17/5/- OUR PRICE £9/19/6.
 (2) 14in. rectangular Tube, 6.3 heaters; .3 amp current; max. anode 14KV; ion trap; external conducting coating; B12A base. £8/17/6. Crating and carriage 12/6.
 (3) Ferranti T12/44 and T12/549 12in. magnetic white fluorescence; 4 v heater; max. anode 10 kV. As used in many TV receivers. Original price £17/5/- OUR PRICE £4/19/6. Crating and carr. 12/6.
 (4) Ferranti 9in. Tube round white fluorescence. 4 v. heater, max. anode voltage 7 kV. OUR PRICE £2/19/6. Crating and carr. 11/6

LIMITED NUMBER AVAILABLE BRAND NEW AND GUARANTEED

The Famous **COLLARO Mk. 3** Transcripator Tape Deck. Twin track. 2 record/playback, 2 erase heads on 2 levels, pause control, digital counter, 3 speeds. 2 balanced motors of low wattage input. 15 gns. **WHILE STOCKS LAST.** Crating and carr. 17/6.
Build yourself a HI-FI TAPE RECORDER
 The Collaro pre-amp and bias oscillator complete with power pack for the above deck, with instructions Price £12/19/6. Post and pkg. 7/6.
 The above two items at a special price of £28/10/- Carr. and pkg. 22/6 the two units
 The **Linear Tape Deck Amplifier** with power pack and oscillator incorporated. Switched for 3 $\frac{1}{2}$ and 15in. per sec. Suitable for the Mk. 3 Deck. 12 gns. only. Post and pkg. 3/6.

Brand new Acos featherweight p/up with clover crystal H.G cartridge. Few only 29/6. 1/6 P. & Pkg. with LP and Std. stylus.

STOP PRESS FEW ONLY BRAND NEW by famous manufacturer. 9 x 5 elliptical speaker. 3 ohm impedance. Only 18/6. P & Pkg. 1/6.

A REPEAT OFFER! ASTOUNDING VALUE

The **VERDIK** QUALITY SYSTEM

10 WATT PUSH-PULL ULTRA LINEAR FEEDBACK

Reduced from makers price of 20 gns. Now only

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complete Fully guaranteed for valves and service. Post & Pkg. 7/6. Fully guaranteed

AMPLIFIER AND PRE-AMPLIFIER

Beautifully finished in Grey-Green Stove Enamel. Provision for tuner, bass and treble, 5-position selector for radio mic. tape, LP and std. records.

HI-FIDELITY TAPE HEADS
 Made by famous manufacturer. Brand new Upper or lower track record/play-back high impedance giving up to 12,000 c.p.s. at 7 $\frac{1}{2}$ I.P.S. output 5 m/volts at 1 KC at 7 $\frac{1}{2}$ I.P.S. Erase heads low impedance Only 39/6 per pair. Post 1/- State upper or lower track.

ANOTHER SNIP OFFER
 Acos 39/1 Crystal Pencil Mic. List price 5 gns. —our price 39/6. Post and packing 1/6.

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 Telephone: FLE 2833
 Business hours: weekdays 9-6. Saturdays 9-1.

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F.S.D.	Size	Type	Price
50 Microamps	2 1/2 in.	MC/FR	70/-
100 Microamps	3 1/2 in.	MC/FR	70/-
500 Microamps	2 in.	MC/FR	25/-
500 Microamps	2 1/2 in.	MC/FR	37/6
1 Milliamp	2 in.	MC/FS	27/6
1 Milliamp	2 1/2 in.	MC/FR	35/-
30 Milliamps	2 in.	MC/FR	12/6
100 Milliamps	2 1/2 in.	MC/FR	12/6
200 Milliamps	2 1/2 in.	MC/FR	12/6
500 Milliamps	3 1/2 in.	MI/FR	30/-
5 Amperes	2 in.	MC/FS	27/6
15 Amperes	2 in.	MC/FR	10/6
25 Amperes D.C.	2 1/2 in.	MI/FR	7/6
50-0-50 Amp.	2 in.	MC/FS	12/6
30-0-30 Amp.	2 in.	MC/FR	15/6
20 Volts	2 in.	MC/FS	10/6
40 Volts	2 in.	MC/FS	10/6
300 Volts	2 1/2 in.	MI/FR	25/-



CROSS POINTER METERS. 2 separate 100 microamp movements, 22/6.
MICROAMMETERS. 50 F.S.D. 2 1/2 in. proj. round. Sealed 10 Milli-rontgens, 45/-.

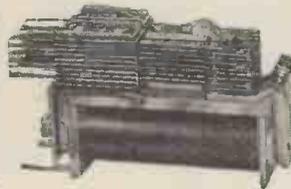
MICROAMMETER. 250 F.S.D. 3 1/2 in. F.R. Sangamo Mod. S.37. Scaled for valve voltmeter. Circuit available free. 55/-.

Postage 1/6 extra for above meters.

CATHODE RAY TUBES. 2AP1, 25/-, 139A 35/-, 5BP1 55/-, Post 3/-.
TRANSMITTER TUBE. 212E. 70/-, Post 3/6.

TEST PRODS. Retracting points, fused, flex and terminals, 5/6. Post 6d.
ONE POLE PLUG AND SOCKET. Fully shrouded, one hole fixing, 6 pr. 18/-, Post 1/-.

RELAYS P.O. TYPE 3000.



Built to your own specification

Keen Prices

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MINIATURE RELAYS:

Siemens High Speed.		S.T.C. and G.E.C. Sealed.	
2.2Ω + 2.2Ω H98A	15/6	2 C O	4184GA 18/6
145Ω + 145Ω H96C	19/6	700 Ω	2 C O
500Ω + 500Ω H98D	22/6	2500 Ω	1 make HD 4186EE 22/6
1700Ω + 1700Ω H98E	25/-	2700 Ω	2 C O
100Ω + 100Ω H85N	15/-	180 Ω	2 m 2 b
1000Ω + 1000Ω H95A	17/6	870 Ω	4 C O
1700Ω + 1700Ω H85L	17/6	2500 Ω	1 C O
		5000 Ω	2 C O

Comprehensive range available from stock.

SWITCHES. 1 hole fixing, 3 amp 250 volt. 1/6 each, 12/- doz.

RACKS—POST OFFICE STANDARD. 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base, 4ft. 10in. in stock.

ROTARY CONVERTERS. Input 12 D.C. Output 230 A.C. 50 cy. 135 watts. In fitted case with variable resistance, 0/300 voltmeter. The ideal job for television where A.C. mains are not available. £10, carr. 15/-.

SOLENOIDS. 12 volt D.C. with 3 1/2 in. lever. Ideal for remote control, model railways. 5/- ea., post 1/6. 26in. unit £4/6/8.

NIFE BATTERY. Nickel cadmium. 6 volts 75 amp., crated and connected. Alkaline filled. Brand new, £7/10/-. Carr. 15/-.

LOUDSPEAKERS. Elac 5in. round 15/6, post 1/6. Axiom 150 dual cone 12in. 15 watts 15 ohms, fully dustproof, £7/19/6, post 7/6. Pye 10in. portable 3 ohms 50/-, carr. 7/6.

JACK PLUGS. Cylindrical bakelite screw-on cover, 2 contact 2/6, post 6d.

SOCKETS. One hole fixing for above, 3/6. Post 6d.

TELEPHONE PLUGS TYPE 201 with headphone cord. Brand new available in quantity cheap.

VARIAC TRANSFORMER. Input 230 volts. Output infinitely variable 0-230 volts and 0-270 volts. 9 amp., bench or panel mounting. £15, cge. 12/6.

TERMINAL BLOCKS. 2-way 4/- doz. or box of 50 for 15/-, 3-way 6/- doz. 50 for 22/6. Post 1/6.

AIR BLOWER. 230 volt A.C. 15in. fan. Volume of free air at max. r.p.m. is 1,250 cu. ft. per min. At maximum efficiency 900 cu. ft. per min. Brand new £25. Carr. 20/-.

XPELPAIR EXTRACTION FANS. 7 1/2 in. blades, Baffle outlet 190/-, Cge. 5/-

HEADPHONES. Balanced armature type DLR5. 10/6 pr., post 1/6.

HEADPHONES. Balanced armature type DHR, 17/6 pr., post 1/6.

LOUDHAILERS RE-ENTRANT TYPE all-metal 15in. diameter with mounting bracket £6/10/0, carr. 10/-.

LOUDHAILERS RE-ENTRANT TYPE all-metal 15in. diameter with mounting bracket, £5/10/-, carr. 10/-, 18in. long by 12in. dia. with mounting bracket £5/10/-, carr. 10/-.

A LARGE AND COMPREHENSIVE STOCK OF WIRELESS AND ELECTRONIC COMPONENTS

TELEPHONES

Easy to Fix

Wiring diagram Free



Telephone Set Type "A" Ringing and speaking both ways on a 4-core cable. Very loud and clear over any distance. The handsets are as illus. and the set is complete except wire. 4-core at 8d. per yard or 2-core at 3d. per yard extra. Price 75/- set, post 3/6. Set B. Two headphones connected to breast microphones, with leads, plugs and fitted carrying cases. Join instruments together with two wires and 1 1/2 volt battery for a super Intercom, 25/-, post 3/6. Set No. 9. Modern Design Desk Telephone with press-button on front for ringing other instruments. Two complete units ready for use. Ideal for the office, £8/11/6, post 7/-.



10 AMP BATTERY CHARGER

HERE IS YOUR CHANCE TO PURCHASE A BRAND NEW UNIT WORTH £40! FOR OUR SPECIAL PRICE **£17.10.0**

Carriage 20/-
Input 200/250 v. A.C. 50 cy. Output 10 amps., 22 volts D.C. Controlled by two 4-position switches for fine and coarse control which enables 8 to 24 volt batts. to be charged. Brand new with 0/12 ammeter. Fused A.C./D.C.

BATTERIES. Portable Lead Acid type, 6 volts 125 ampere hours. In metal case 16in. x 8in. x 11in. Two will make an ideal power supply for our 12 volt Rotary Converters. Brand New. Uncharged, £6/10/-, carriage 15/-.

"TINY TIM" PETROL ELECTRIC Battery Charger. Brand New in maker's original packing. 12 volts 300 watts. Push button start and 30-0-30 ammeter etc., £26/0/0 each, carr. 20/-.

UNI-PIVOT GALVANOMETER by Cambridge Instruments, 50-0-50 microamps., dia. 4in. Knife pointer, mirror scale. Complete with leather carrying case. Ideal for laboratory use. £10, carriage 3/-.

FLIGHT TO GROUND SWITCHES. 5C/2828 as used on aircraft. Very robust, will carry a very heavy current 25/- each; or in pairs with auxiliary switch 50/-, post 3/-.

ONE POLE PLUG & SOCKET shrouded. One hole fixing, ideal for test equipment etc., 3/- per pair, post 6d.

GREED TELEPRINTER RECEIVING RE-PERFORATOR. No. 7TR/3, 24 volts brand new. Three only available. £50 each.

OSCILLOSCOPE. Type 43. With 3 1/2 in. C.R.T. 138A, 4—6J7, 3—VR54, 5Z4, VU120. Brand New with usual controls., power-pack and leads. Suitable for 230 volts, £10/10/-, carr. 12/6.

MOTORS 12/24 volts D.C. 0.3 Amps. 3500 r.p.m. Size 2 1/2 in. x 1 1/2 in. 14AA/2142, 15/6, post 1/6.

MOTORS 12 volts D.C. approx. 3,000 r.p.m. Size only 2in. x 1 1/2 in. with speed governor fitted in end cap. OS/2195a, 12/6, post 1/6.

MOTORS. 12 volts D.C. Reversible. 2in. x 1 1/2 in. Spindle 1/2 in. x 1/2 in., 10/6 each, post 1/6.

SYNCHRONOUS MOTOR. 200/250 volts A.C. 60 r.p.m., suitable for electric clocks, etc., 25/-, post 2/6

SYNCHRONOUS MOTOR. 200/250 volts A.C. 50 cycles with gear train driving 5 dials 1/10th hr.—10,000 hrs., 35/-, post 2/6.

MAINS MOTORS. Capacitor 230 volts A.C./140th h.p. 1,400 r.p.m., 55/-, post 3/-.

SMALL MOTORS. 12 volts D.C. 3,000 r.p.m. with speed governor in end cap, 2in. x 1 1/2 in., 12/6, post 2/-.

GEARED MOTORS for the model maker, small but powerful, 12/24 volts A.C./D.C. 4/8 r.p.m., 35/- post. 2/6.

GEARED MOTORS. 220/240 volts A.C. 175 r.p.m. Torque, 15lb. in Klaxon. £10, carriage 15/-.

MAINS TRANSFORMER WITH RECTIFIER mounted on top. Giving a D.C. output of approx. 30 to 40 volts 1 amp. Price 27/6 each, post 2/6.

SELENIUM METAL RECTIFIERS.
Charging Rectifiers
12 Volts 1 Amp 8/6 each
12 Volts 2 Amps 13/6 each
12 Volts 3 Amps 16/6 each
12 Volts 4 Amps 20/- each

Full Wave Bridge
24 Volts 1 Amp 13/- each
24 Volts 2 Amps 24/- each
24 Volts 3 Amps 28/- each
24 Volts 4 Amps 38/- each

Discounts for quantities of above charging rectifiers.

MAINS TRANSFORMERS to suit above rectifiers
12 Volts 1 Amp 12/6 each
12 Volts 2 Amps 24/- each CT109
12 Volts 2.5 Amps 22/- each MT5B

12 Volts 4 amps MT5 25/- each
12 Volts 4 Amps CT107 29/6 each
24 Volts 3 Amps 25/- each



ELECTRO-MAGNETIC COUNTERS
COUNTING UP TO 9999
Type 16A
2300 ohms 75/230 v. D.C., 15/- each. Post 1/6.
Type 17A
3 ohms 2/6 v. D.C., 15/- each. Post 1/6.

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D. C. OSCILLOSCOPE

A.C. MAINS
200-250 Volts

AS SIMPLE AS TT
HERE'S THE ANSWER

SIMPLIFIED SERVICING PROBLEMS

WHEN USING THE

'TESTGEAR' SCOPE

3" D. C. OSCILLOSCOPE



Size
Height 10"
Width 6 1/2"
Depth 9"
Weight 11 1/2 lbs.

Engineered to precision standards, this high-grade Instrument is made available at **THE LOWEST POSSIBLE PRICE**, incorporating the essential features usually associated with luxury instruments.

This "SCOPE" will appeal particularly to Service Engineers and Amateurs. A **HIGH GAIN, EXTREMELY STABLE DIFFERENTIAL Y AMPLIFIER (30 mV/C.M.)**. Provides ample sensitivity with A.C. or D.C. inputs. Especially suitable for **MEASUREMENT of TRANSISTOR OPERATING CONDITIONS** where maintenance of D.C. LEVELS is of paramount importance. Push-pull X Amplifier; Fly-back suppression; Internal Time-base Scan Waveform available for external use; **PULSE OUTPUT** available for checking T.V. LINE O/P TRANSFORMERS, etc.; Provision for external X I/P and CRT. Brightness Modulation.

FULL 12 MONTHS' GUARANTEE INCLUDING VALVES and TUBE.

Full Technical Information on receipt of S.A.E.

RADIO & T.V. COMPONENTS (ACTON) LTD.

23 HIGH STREET, LONDON, W.3

Goods not despatched outside U.K.

£15.15.0

Plus P. & P. 7/6

TRADE ENQUIRIES INVITED

Or 30/- deposit, plus 7/6 post & packing and 12 monthly payments of 26/6.



NEW PRIMAX 60 watts and PRIMAXA 100 watts

Soldering guns with Spotlights

Ready for use in 6 secs., and you see what you solder

PRIMAX 60w. PRIMAXA 100w.

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One Year's Guarantee except on bits and lamps.

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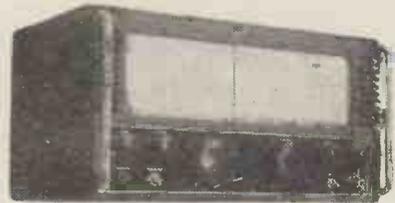
S. KEMPNER LTD.

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The Primax 60 and Primaxa 100 is supplied in all voltages.

EDDYSTONE COMMUNICATION RECEIVERS



Model 840A illustrated

HIRE PURCHASE TERMS

Model No.	Cash Price	Deposit	12 Monthly Payments	24 Monthly Payments
870	£33	£3	£2/13/9	£1/9/6
840A	£55	£5	£4/9/7	£2/9/2
888A	£110	£10	£8/19/2	£4/18/4
880X	£120	£10	£9/17/1	£5/8/1

Carriage paid per passenger train.

These sets are the choice of the discerning professional and amateur users. Descriptive literature gladly forwarded.



The **Eddystone Specialists**

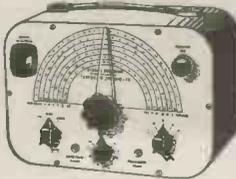
RADIO SERVICES LTD.

55 COUNTY ROAD, LIVERPOOL 4

Telephone: AINTREE 1445

ESTAB. 1935

SIGNAL GENERATOR

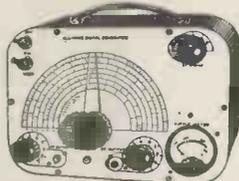


Coverage 100 Kc/s.-100 Mc/s. on fundamentals and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. x 6in. x 5in. grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F. output continuously variable 100 millivolts C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

£6/19/6 Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/- extra.

SIGNAL GENERATOR

Coverage 120 Kc/s.-230 Kc/s., 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Kc/s., 2.75 Mc/s.-8.5 Mc/s., 8 Mc/s.-28 Mc/s., 16 Mc/s.-56 Mc/s., 24 Mc/s.-84 Mc/s. Metal case 10in. x 6in. x 4in. Size of scale 6in. x 3in. 2 valves and rectifier A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. Output continuously variable 100 millivolts C.W. and mod-switch variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. **£4/19/6** Accuracy plus or minus 2%.

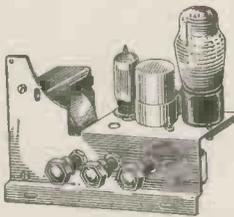
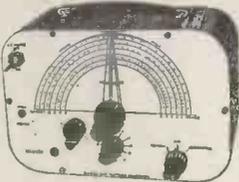


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SIGNAL & PATTERN GENERATOR

£6/19/6 P. & P. 5/-

Or 25/- deposit. P. & P. 5/- and 6 monthly payments of 21/6. Coverage 7.5 Mc/s.-210 Mc/s. in five weeks, all on fundamentals, slow motion tuning audio output. 8 vertical and horizontal bars, logging scale. In grey hammer finished case with carrying handle. Accuracy $\pm 1\%$ A.C. mains 200-250 v.



PORTABLE AMPLIFIER

Size 6in. long, 5in. high, 2in. deep. Will suit any type of crystal pick-up. Output approx. 2 watts. Incorporated ECC 83 double triode. Cossor 142BT output pentode and contact-cooled rectifier. Fully isolated mains transformer for 250-250 A.C. mains. Bass, treble and volume controls

49/6 Plus P. & P. 3/6.

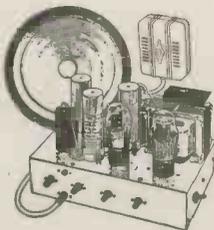
5" SPEAKER WITH O.P. TRANSFORMER

purchased with the above 18/6. Plus P. & P. 1/6.

F.M. TUNER UNIT

Permeability tuned, by famous German Manufacturer. Coverage 88-100 Mc/s. Complete with ECC85. Size 4in. x 2in. x 2in. Circuit diagram 1/- (free with unit).

25/- Plus P. & P. 1/6.



8 WATT PUSH-PULL AMPLIFIER COMPLETE WITH CRYSTAL MIKE AND 5in. LOUDSPEAKER

A.C. mains 110/250 v. Size 10in. x 6in. x 2in. Incorporating 6 valves, H.F. pen., 2 triodes, 2 output pens., and rectifier. For use with all makes and types of pick-up and mike. Negative feed back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. For use with Std. or L.P. records, musical instruments such as Guitars, etc. Response flat from 40 cycles to 15 Kc/s. ± 2 Db; 4 Db down at 20 Kc/s. Output 8 watts at 5% total distortion. Noise level 40 Db. down all hum. Output transformer tapper for 3 and 15 ohm. speech coils.

£4.19.6 Plus P. & P. 7/6.

Or £1 deposit, Plus P. & P. 7/6 and 4 monthly payments of 23/-.



PLAYER CABINET

Finished in 2-tone leatherette, will take B.S.R. UA8, with room for amplifier and 7in. x 4in. speaker. Overall size 18in. x 13in. x 9in.

£2.19.6 Plus 5/- P. & P.

COLLARO MIXER 4-SPEED AUTOMATIC CHANGER

Model 457. Type "O" Pick-up, size 12in. x 13in. Minimum clearance above baseboard 5in., below 2in., 10 records. A.C. mains 200-250 v. Turnover crystal bead. BRAND NEW. Fully guaranteed.

Cash **£8/19/6**

Plus P. & P. 5/-.

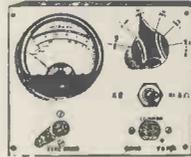


13 CHANNEL TUNER INCREMENTAL TYPE

34 to 38 Mc/s. complete with PCF80 and POC84. Tested and guaranteed. Complete with fitting instructions and knobs.

39/6 Plus 3/6 P. & P.

AC/DC POCKET MULTI-METER KIT



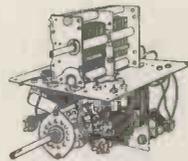
Comprising 2in. moving coil meter, scale calibrated in A.C./D.C. volts, ohms and milliamps. Voltage range A.C./D.C. 0-50, 0-100, 0-250, 0-500. Milliamps, 0-10, 0-100. Ohms range, 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting), toggle switch, resistors and rectifier. Basic movement, 2 mA. In grey hammer finish case.

19/6 Plus P. & P. 1/6. Built and tested 7/6 extra. Point-to-point wiring diagram 1/- free with kit.

6 watt PUSH-PULL AMPLIFIER

A.C. mains 220/250 v. incorporating 4 valves and metal rectifier, 2 inputs, high and low, and controls for same. Separate controls for Bass and Treble lift. Size of chassis 11in x 4in. x 2in.

59/6 Plus P. & P. 5/-.



4 WAVE BAND COIL UNIT

Complete with tuning condenser. Separate sections for short wave. Coverage 10-21 m., 21-45 m., 44-100 m., and 190-545 m. I.F. 470 Kc., BRAND NEW by famous manufacturer. Completely assembled on sub-chassis. Plus circuit diagram. **19/6** P. & P. 3/6.

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Comprising case, chassis, top plate, scale, 5in. P.M. speaker with O.P. trans., twin gang, 2 470 Kc/s. I.F.s, trimmers, four valve holders, wavechange switch and volume control with switch.

39/6 Plus 3/6 Postage and packing.



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By famous manufacturer. 14 Kv. Complete with built-in line and width controls. Winding for EY81 Rectifier.

19/6 Plus P. & P. 2/6.

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All with tapped primaries 200-250 volts. 0-160, 180, 200 v., 60 ma., 6.3 v. 2 amps, 10/6. 320-0-320 v. 75 ma., 6.3 v., 2.5 amp. 5 v., 2 amps, 10/6. 350-0-350 250 ma., 6.3 v. 7 amp., 5 v. 2 amp., 10/6. Postage and packing on the above 3/-.

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AC6PEN	6/6	ECC83	9/-	EL41	11/-
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AZ1	10/-	ECC85	9/6	EL81	7/-
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CL4	12/6	ECH81	9/-	EY51	10/-
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PCB84	9/-					IT4	6/6	6C31	7/6	6U4GT	12/-	12K7GT	7/6
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PCF82	12/6					3A4	7/-	6D6	5/-	6U5G	8/6	12Q7GT	7/6
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PL38	17/6					3Q4	8/-	6FM6	7/6	6V6GT	7/9	12S17	6/-
PL36	15/-					3Q5GT	9/6	6F1	14/-	6X4	7/6	12SK7	6/-
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PY83	8/6					5Y3GT	8/-	6J6	6/-	7C6	8/-	20L1	26/6
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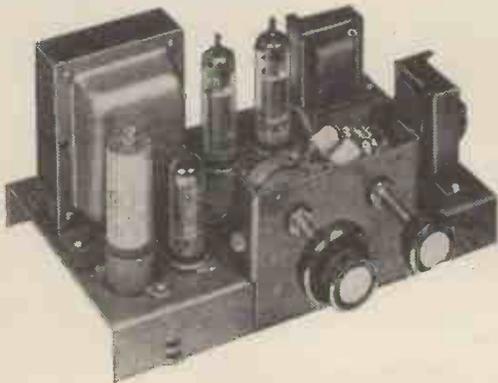


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TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 1/-; 20/- add 1/6; 40/- add 2/-; £5 add 3/- unless otherwise stated. Minimum C.O.D. fee and postage 3/-. All single valves postage 6d. Personal Shoppers Monday-Friday 9 a.m. to 5 p.m. Saturday 10 a.m. to 1 p.m.

STEREO £7.7.0

Independent twin channel amplifier with excess of 3 watts per channel.
Concentric volume control (optimum balance arranged immediately without additional knobs).
Choice of volume and tone controls separately fixed or integral with chassis and having continental styled knobs (brown and gold).
Stoved grey or blue hammer chassis 9 1/2 in. x 5 1/2 in. x 6 in.
Input suiting most modern crystals; output matching 3 ohm speaker each channel.
For operation on AC mains 200/250 v.

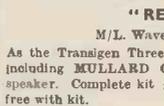


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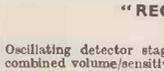
"RECO" PUSH-PULL FIVE KIT
M/L Waves & Trawler Band. (size: 6 1/2 in x 4 1/2 in x 1 1/2 in)

As the Transigen Three but with Push-Pull output stage. Uses five transistors, including MULLARD OC45 and EDISWAN Transistors. New Improved 3in. speaker. Complete kit 28/19/6. P.P. 2/6. Easy-build practical wiring diagrams free with kit.



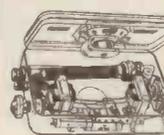
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(M/L Waves and Trawler Band.)

Entirely self contained (no external aerial required), R.F. stage with MULLARD OC45 and two EDISWAN transistors. Combined volume and sensitivity control. On test (50 miles from London) tuned in the Home, Light, Third and in the evening Radio Luxembourg. A.F.N. and many others. Attractive pale blue polystyrene case with red grille. This receiver will operate a speaker in good reception areas. Complete kit with easy build diagrams and battery, 79/8. P.P. 2/6.



"RECO" TRANSIGEN TWO KIT
(M/L waves)

Oscillating detector stage for sensitivity. Fine for good reception areas. Has combined volume/sensitivity control. Complete kit with 3-volt pencil, easy build diagrams and EDISWAN TRANSISTORS, 59/6. P.P. 2/6.



"RECO" PUSH-PULL FOUR KIT
(M/L or M/S Waves)

Four EDISWAN transistors. Volume control. 3in. speaker (now mounted at end of case and not as shown). Gleaming pale blue polystyrene case with red speaker grille. Complete kit with easy build diagrams and battery, 25/5/- P.P. 2/6.
Parts price list and circuits for the above kits 2/6 set of four.

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A superb Crystal Controlled Wavemeter just released by the Ministry of Supply. Has directly calibrated dial for nominal coverage of 1.5-10.0 Mc/s. but may actually be used from 500 Kc/s. up to 30 Mc/s. Complete with 500 Kc/s. Crystal, 2 valves type 1T4, 1 of 1R5 and 1 of CV286 (Neon Stabiliser), and Instruction Book. Size 7ins. x 7½ins. x 4ins., weight 5lbs. Used but in first class condition.

ONLY £2.19.6 (Carriage 3/6)

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A First Grade Moving Iron Instrument with 6ins. Mirror Scale, reading up to 150 Volts A.C. at 400 and 1,200-2,400 Cycles. In substantial Oak case with removable lid, overall size 8½ins. x 8½ins. x 5½ins. Recently made for the Air Ministry by Everett Edgcumbe, and in perfect order. Brand New and Unused. ONLY £7/10/-. Can be supplied modified for 50 cycles, use either 0-150 or 0-300 volts, 20/- extra.



RCA AR 88 RECEIVERS. Re-conditioned and in perfect working order. "LF" Model, covers 75-140 Kc/s. and 1.2-30 Mc/s., ONLY £50. "D" Model, covers 500 Kc/s-31 Mc/s., ONLY £55 (Carriage etc., 25/-).

POWER UNITS TYPE 234: Primer 200/250 v. 50 cycles. Outputs of 250 v. 100 mA., and 6.3 v. 4 amps. Fitted double smoothing. For normal rack mounting (or bench use) having grey front panel size 17in. x 7in. BRAND NEW. ONLY 59/6 (carriage, etc., 7/6).

MARCONI SIGNAL GENERATOR TF-517-F/1. Cover 10-18 Mc/s., 33-58 Mc/s. and 150-300 Mc/s. In good, used condition, with charts. Checked before despatch. Complete with power pack for normal A.C. mains. ONLY £12/10/- (carriage etc., 20/-).

MAINS TRANSFORMERS. Normal Primaries 250-0-250 v. 80 mA. 6.3 v. 3 a., 4 v. 4 a. 0-4-5 v. 2 a., 20/-; 350-0-350 v. 80 mA., 6.3 v. 3.5 a., 4 v. 4 a., 0-4-5 v. 2 a., 20/-; 0-30 v. 2 a., tapped to give 13 different voltages, 20/-.

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TCS TRANSMITTERS

These magnificent American units cover 1.5-12.0 Mc/s in 3 switched bands. Complete with 7 valves: 3 of 12A6 Osc.; 162B Buffer; 2 of 162B PA; 162B VFO. Provision for Crystal Control, C.W. or B.T. Has Plate and Aerial Current Meters. New Condition internally, but externally store soiled. ONLY £7/19/6 (carr. etc. 15/-).

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This Ministry of Supply Monitor 61 is a First Grade Synchroscope, readily convertible to a General Purpose Oscilloscope. Employs 3½ins. CRT type YCR 138A and built in Mains Power Unit for 115/230 volts nominal. Very modern design. Full modification data supplied. Size 10½ins. x 12½ins. x 19in. Condition as new. ONLY £7/19/6 (carr. etc. 15/-).

0-1 mA. DESK METER. A 2½ins. Flush circular 0-1 mA. Meter mounted in bench stand with sloping panel for easy reading. Fitted with terminals. Brand New and Unused. ONLY 30/- (post etc. 2/6).

COMMUNICATIONS RECEIVER R.1155. The famous Bomber Command Receiver known the world over to be supreme in its class. Covers 5 wave ranges: 18.5-7.5 Mc/s, 7.5-3.0 Mc/s, 1,500-600 Kc/s, 800-200 Kc/s, 200-75 Kc/s, and is easily and simply adapted for normal mains use, full details being supplied. All sets thoroughly tested and in perfect working order before despatch, and on demonstration to callers. Fitted with latest type Super Slow Motion tuning assembly. Have had some use, but are in excellent condition. ONLY £7/19/6.

A.C. MAINS POWER PACK OUTPUT STAGE. In black metal case to match receiver, enabling it to be operated immediately by just plugging in, without any modification. With built-in 6½in. P.M. Speaker £5/10/-, or De Luxe version with 8in. speaker £6/10/-.

METERS

F.S.D.	SIZE AND TYPE	PRICE
25 microamps D.C.	2½in. Flush circular	69/6
25 microamps D.C.	2½in. Proj. circular	59/6
50 microamps D.C.	2½in. Flush circular	59/6
50 microamps D.C.	3½in. Flush circular	80/-
1 mA. D.C.	2in. Flush square	22/6
1 mA. D.C.	2½in. Flush circular	25/-
1 mA. D.C.	3½in. Flush circular	50/-
150 mA. D.C.	2in. Flush square	7/6
200 mA. D.C.	2½in. Flush circular	12/6
20 amps. D.C.	2in. Proj. circular	7/6
40 amps. D.C.	2in. Proj. circular	7/6
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300 volts A.C.	2½in. Flush circular	25/-
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DEDUCT 10/- IF PURCHASING RECEIVER AND POWER PACK TOGETHER. Send S.A.E. for illustrated leaflet, or 1/3 for 14-page booklet which gives technical information, circuits, etc., and is supplied free with each receiver. Add carriage 10/6 for Receiver, 5/- for Power Pack.

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Manufactured for the Admiralty in 1952 by Burnpedt, this utilises 4 valves Leach 624G, 6V6G, 6J7G, 6J5G, and high quality components such as "C" Core Transformers and Block Paper Smoothing Condensers. Has A.C. Mains Pack for nominal 110/230 volts. Provision for 600 ohms or High Impedance input, and has Output to 600 ohms Line. For normal use only requires changing Output Transformer. Can be used for Speech or Music, giving High Quality Reproduction. Output approximately 4 watts. Enclosed in metal case, and designed for Standard 19in. Rack Mounting, having grey front panel size 19in. x 7in. with Chromium Handles. All connections to rear panel, front having "On/Off" Switch, Gain Control, Indicator Light, Fuses and Valves Inspection Panel. BRAND NEW IN MAKER'S PACKING. ONLY £4/9/6 (carriage 10/6).

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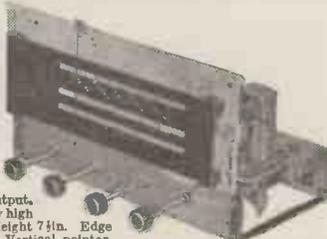
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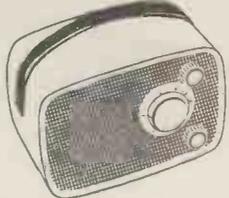
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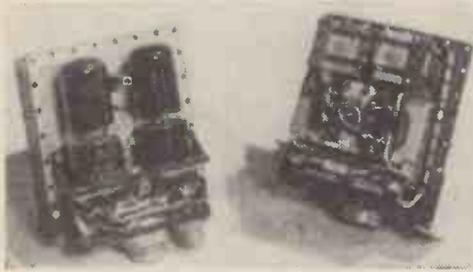
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Can transform your existing transistor receiver or amplifier into a really high volume set. Comprising 1 pair matched GET15 power transistors, correct push pull input and 3 ohm output transformers, with instructions. 49/- set.

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250 v. 80 ma., 5/-; 250 v. 250 ma., 9/-; 500 v. 50 ma., 6/6; 500 v. 150 ma., 9/8; 1,000 v. 40 ma., 8/6; Contact cooled, 250 v. 50 ma., 7/-; 250 v. 250 ma., 19/6; 250 v. 300 ma., 23/6.

AVO Standard Twin Unit

Valve Tester £9/-/- Carr. 5/-
G73: Signal generator and wavemeter; 100 kc/a. 1 meg. crystal calibrator, precision attenuator. Top make £9/10/- Carr. 6/-

SIGNAL GENERATORS:

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B.S.R. L050A. LF. 30 c/s-18 kc/s £9/10/-
POWER PACKS: 2 separate double smoothed outputs of 375, 550 or 620 v. at 200/250 mA. and 6.3 v. 5 a. 4 0U4 valves. Complete in transit case. £7/10/- Less valves £6/10/-

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By Evershed and Vignoles. Sensitivity 1.275 MMS per micro amp. at 100 CM scale distance. 45 second period. Brand new, boxed with spares. A school laboratory—must order now.

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£6/10/- Carr. 5/-
808s modulating 808s, 100-150 M/cs. Ideal for conversion to 2 metres. Transmitter receiver. U.S.A. SCR522: standard aircraft type. 100-140 Mc/s., less valves. 25/- Carr. 5/-

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Suitable for charging. 230 v. in. 24 v. 1.2 A. bridge. 35/- Carr. 4/-
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RECTIFIERS: bridge, 12 volt 3-4 amps. 9/6. Carr. 1/- 25 per doz.

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10% DISCOUNT SPECIAL OFFER OF any SIX VALVES marked in black type (15% in dozens). Post: 1 valve, 6d.; 2-11, 1/-.

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25, 50, 100 PER TYPE OR MIXED PARCELS.

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1A5GT	6/1	6BJ6	6/9	6L6G	7/6	10C2	12/6	2E40G	9/6	B38	8/6	EBL31	22/6	EL33	9/6	LL152	3/6	SP41	4/6	UCH82	15/6
1A7GT	12/6	6BR7	10/6	6L7M	6/-	10C14	6/3	2E40G	9/6	B-5	4/9	EC52	3/9	EL38	12/6	LZ319	7/9	SP18	2/6	UCH83	13/6
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1D5	18/6	6BW7	7/9	6L19	11/6	10F9	7/8	2E40G	7/9	CCY31	7/6	EC91	4/6	EL42	9/6	N37	11/-	SU250A	4/6	UF42	8/6
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1T4	3/9	6C4	3/6	6LD12	7/9	10LDB	8/3	30C1	7/9	CL33	19/3	EC93	3/9	EL85	11/-	N108	11/-	TH30C	12/6	UF85	9/6
1N5GT	9/6	6C5	5/6	6LD20	8/6	10LD11	12/6	30P8	7/6	CS21	9/6	EC93	7/6	EL91	4/9	1062	10/6	U14	5/-	UF86	16/-
1R5	7/-	6C6	4/3	6P15	8/3	10LD12	9/-	30P11	9/6	D63	1/6	EC94	9/6	EL95	9/6	P41	4/5	U18	9/6	UF89	8/6
184	9/-	6C9	9/6	6P25	9/-	10L13	12/-	30L1	7/9	D77	4/-	EC95	6/9	EM34	9/3	P61	2/3	U22	6/6	UL41	7/6
185	6/6	6C10	8/9	6P28	9/6	10P14	12/-	30P4	13/6	D152	6/6	EC98	6/9	EM80	9/3	PABC80	9/6	U24	7/6	UL44	12/6
1T4	6/3	6C10G	17/-	6Q7G	7/6	10P18	8/3	30P12	11/6	DA30	12/6	EC98	6/9	EM81	9/3	PC84	7/9	U25	12/-	UL46	9/6
2D21	4/6	6C86	11/-	6Q7GT	9/3	12A6	5/6	30P16	7/6	DA100	25/-	EC98	7/6	EM84	10/6	PC85	9/6	U26	12/-	UL54	8/3
3A4	6/-	6D2	4/-	6SA7	6/-	12A75	8/6	30P11	13/6	DAC32	9/6	EC98	9/6	EM85	10/6	PC89	18/-	U31	7/9	UM90	9/6
3A5	9/6	6D3	9/6	6SD7	9/-	12A77	6/6	30P16	9/6	DAP91	6/6	EC98	8/6	EN31	16/-	PC80	7/9	U33	11/-	U06	9/6
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5R4G	9/6	6E6M	7/-	6SK7	5/-	12B6B	9/-	42	7/6	DF96	8/3	EC93	6/6	EZ35	6/6	PCF84	12/6	U50	6/6	UY41	6/6
5U46	6/3	6E12	4/-	6SL7GT	6/9	12BH7	9/6	50C5	10/6	DH63	7/6	EC94	8/9	EZ40	7/6	PCF85	5/6	U52	6/3	UY85	7/3
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5Y3G	6/-	6F14	9/6	6SS7	6/6	12E1	12/6	50L6GT	9/6	DK91	7/6	ECL80	8/6	EZ80	6/9	PCF86	5/6	U78	6/-	W17	5/3
5Y9GT	9/-	6F15	8/6	6U4GT	10/6	12J9GT	3/6	53KU	10/6	DK92	8/6	ECL92	11/-	EZ81	7/6	PEN383	9/-	U191	9/6	W91	9/9
6A7	9/6	6F16	8/6	6V6G	5/9	12K7GT	6/-	54KU	9/6	DK96	9/6	EP38	4/6	GTIC	12/6	PL38	8/-	U281	8/6	W76	8/6
6A8G	3/6	6E8	2/-	6X6G	5/-	12K8GT	6/-	61BT	11/-	DL35	10/6	EP37	6/6	GZ32	8/6	PL38	13/6	U282	22/7	W77	4/6
6AB9	8/6	6J5	2/3	6X6GT	6/6	12K87	5/6	78	4/6	DL82	17/6	EP39	4/6	GZ34	12/6	PL38	14/6	U301	9/6	W81	5/6
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6A15	6/6	6J8GT	3/6	7B5	12/6	12SN7GT	8/6	83	9/6	DL96	8/3	EP42	8/6	HABC80	9/6	PL32	7/9	U403	9/6	X63	8/6
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6AT6	7/6	6J7GT	7/6	7C5	7/6	30D1	9/6	723A	35/-	EB41	7/-	EP54	3/6	KT38	9/6	PCY32	12/6	UB41	8/-	X79	14/6
6AT6G	9/6	6J8GT	6/9	7C6	7/6	20P2	9/6	807	5/-	EB91	4/-	EP65	7/6	KT45	9/6	PCY32	7/6	UB41	8/3	X63	6/-
6BT	5/9	6K7G	2/3	7H7	7/6	20L1	12/6	808	15/-	EB33	9/-	EP86	11/-	KT91	9/6	PCY33	8/6	UBF80	9/6	Z83	5/6
6BSG	3/6	6K7GT	5/3	7K7	8/-	20P1	11/6	813	55/-	EB33	5/-	EP89	8/6	KT66	12/6	PCY33	8/6	UBF89	9/6	Z86	8/6
6BA6	6/6	6K8G	6/6	7S7	9/6	20P3	12/6	2050	3/6	EB41	8/9	EP91	4/-	KTW81	5/8	R18	12/6	UC85	8/9	Z77	4/-
6BE6	6/6	6K8GT	9/6	7Y4	7/6	20P4	15/-	5763	10/-	EB41	11/-	EP92	4/9	KTW63	5/8	R19	12/6	UCF90	16/-	Z152	5/6
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 15 watt 25 ohms 10,000 ohms 2/16
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GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 A. 22/6

ALADDIN FORMERS and cores, 4in. 8d.; 5in. 10d.
 0.3in. FLOWERS 5837 or 8 cans T71 or 2, 4in. sq. x
 2 1/4 in. or 4in. sq. x 1 1/4 in. 2/- with cores.
SLOW MOTION DRIVES. Epicycloid ratio 6:1, 2/3.
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 REMPLOY INSTRUMENT IRON, 230 v. 25 w., 17/-
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 750 ohms, 4/3. 2 amp., 1,000 ohms, 4/3.
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 per foot, 2 way, 8d. per foot, 3 way, 7d. per foot.

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 Precision engineered. Size only 1/2" x 1/2" x 1/8"
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 6in. x 4in. Rola, 18/- 7in. x 4in. R.A. 21/-
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 465 ko/s. slug tuning machine can 2 1/2" x 1" x 1in. High
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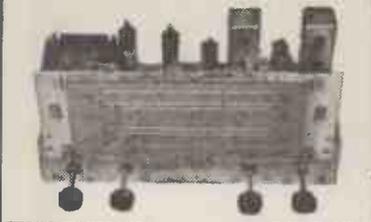
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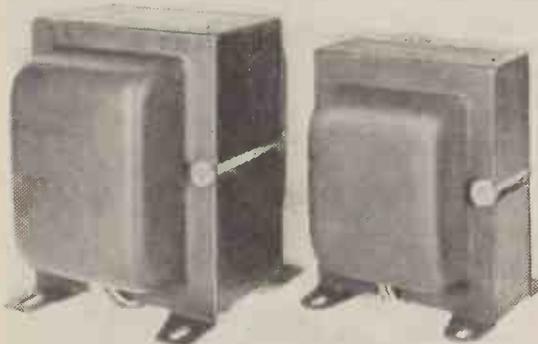
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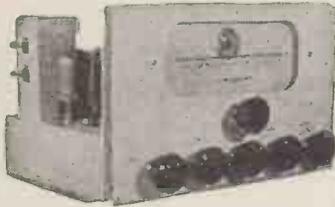
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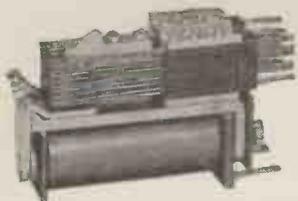
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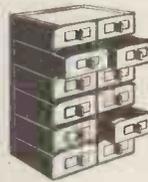
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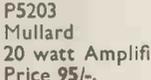
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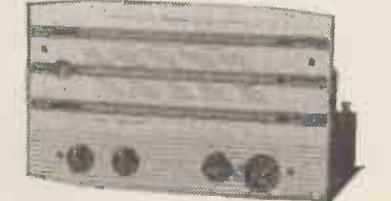


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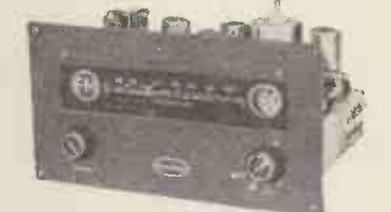
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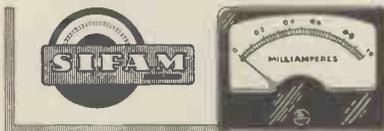
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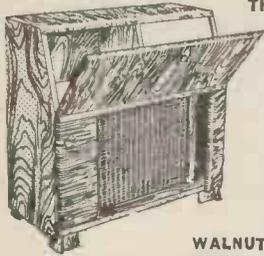
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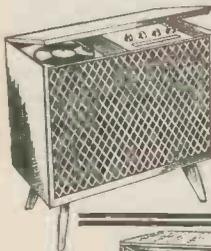
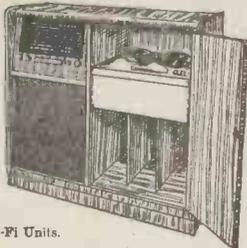
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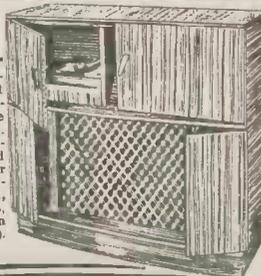
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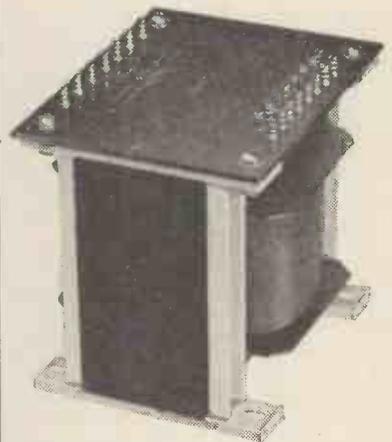
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