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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

1.—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 ½-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 ½-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 tinplate or aluminium is suitable. Tinplate 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 $\frac{3}{8}$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.

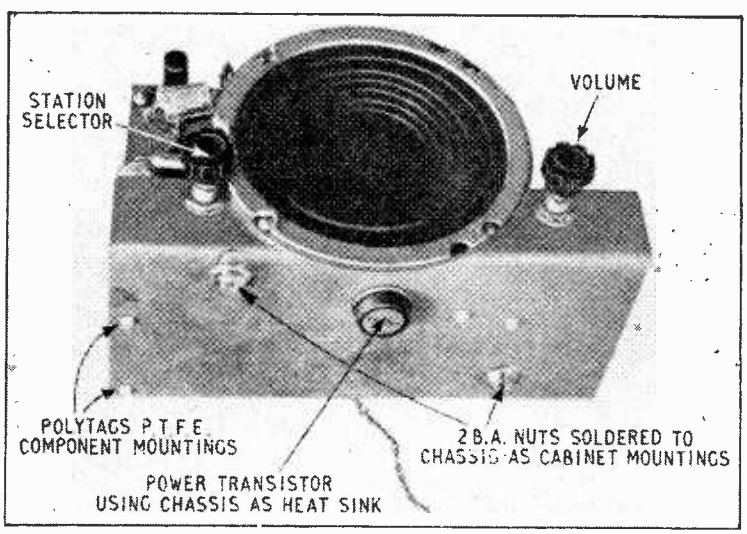
The receiver consumes less power than the average mains radio, costs less to run than a transistor portable and could be used on picnics, with the car battery as a source of power. In an emergency it will run for a few hours from three U2 cells.

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-μF 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-

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

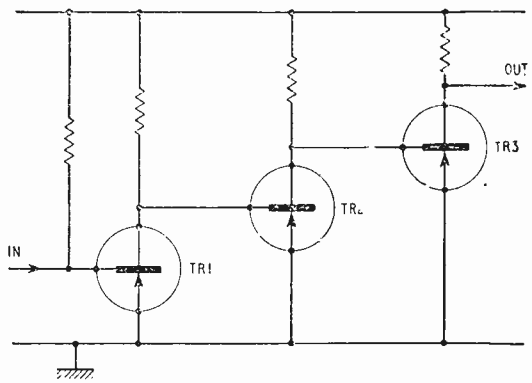


Fig. 2. Basic circuit arrangement of the audio amplifier.

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 $1/\sqrt{3}$A. From this the peak-to-peak current swing will be $(2 \times 1.4 \times 1)/\sqrt{3} = 1.6$A. 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 $0.5 + (0.8 \times 3) = 3$V. A swing of ± 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/

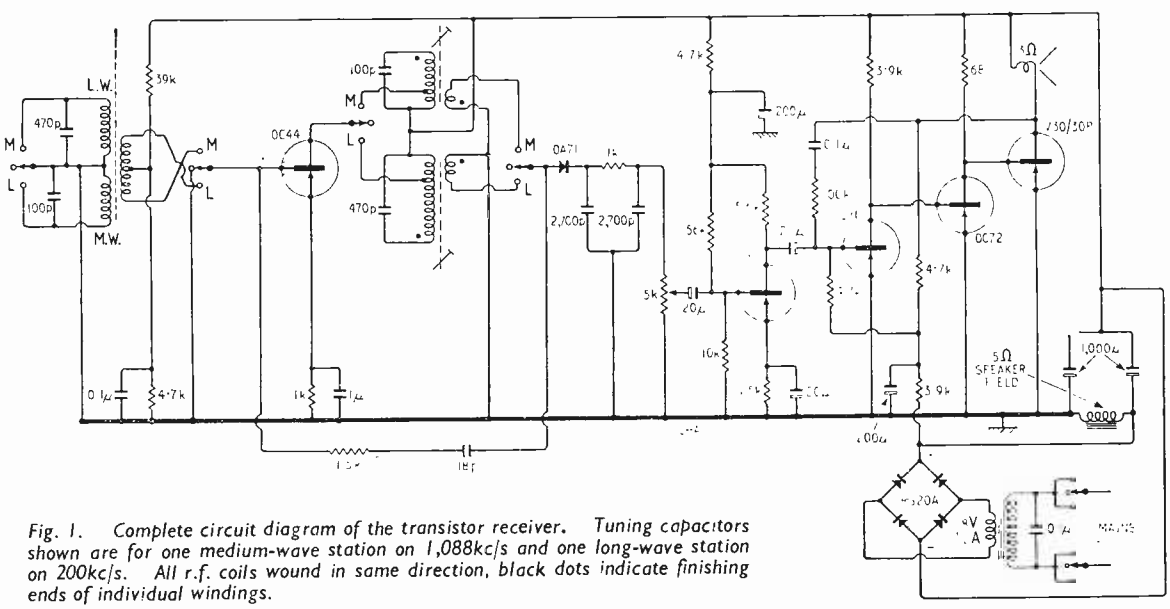


Fig. 1. Complete circuit diagram of the transistor receiver. Tuning capacitors shown are for one medium-wave station on 1,088kc/s and one long-wave station on 200kc/s. All r.f. coils wound in same direction, black dots indicate finishing ends of individual windings.

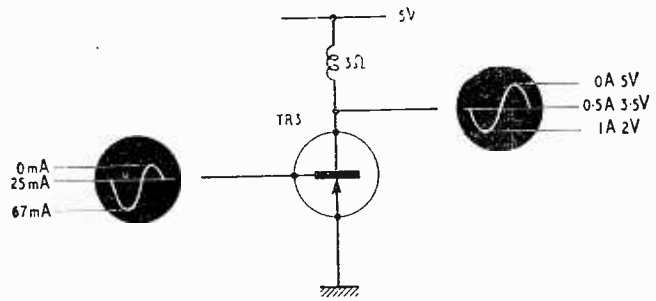


Fig. 3. Base and collector operating conditions in the output stage.

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 $I_c = 0.5$A and to 15 at $I_c = 1.0$A. 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 67 Ω, 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 = 3.9kΩ. 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 × 60 × 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 × 50μA. TR2 and TR3 will amplify this and cause a change of 4 × 50 × 60 × 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:—

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

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

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

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

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

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

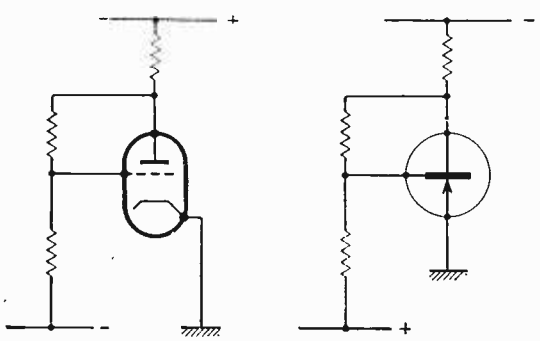


Fig. 4. Valve anode follower and equivalent collector follower transistor stage.

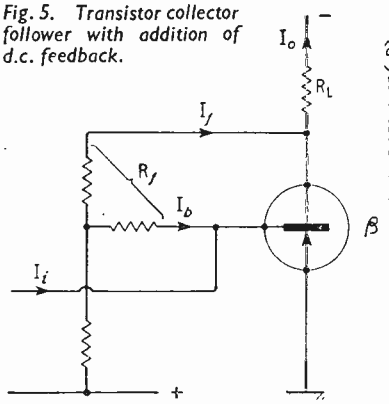


Fig. 5. Transistor collector follower with addition of d.c. feedback.

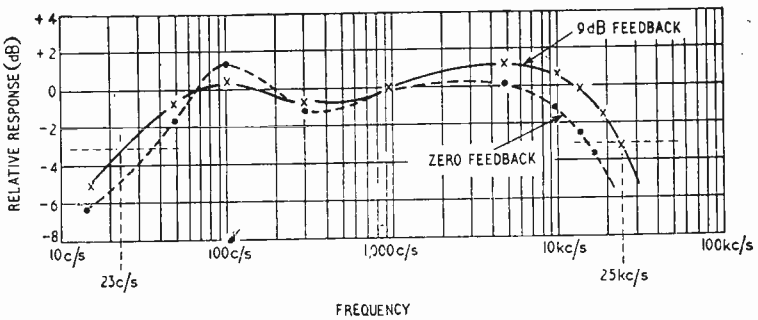


Fig. 6. Response curve of the audio section of the receiver from 15c/s to 30kc/s.

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:—
$R_L = 3\Omega$
$\beta = 60{,}000$ Feedback = 25dB
$R_f = 10k\Omega$

(b) In the a.c. case:—
$R_L = 3\Omega$
$\beta = 60{,}000$ Feedback = 9dB
$R_f = 100k\Omega$ in series with $0.1\mu F$.

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_c of TR3 is 3.5V, the base voltage is almost zero, and the resistance to the decoupled point is $5k\Omega$. So $I_f = 3.5/4.7 = 0.75$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 $4k\Omega$. 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 $2M\Omega$ when the d.c. load can be made approximately $0.25M\Omega$ and still only lightly damp the associated tuned circuit

But in transistor sets the audio amplifier will probably have base-emitter resistors of about $10k\Omega$ and an input impedance of 1 to $10k\Omega$. Thus the d.c. diode load ought to be in the range 250Ω to $2.5k\Omega$, but this gives very poor rectification efficiency as the diode forward impedance is also in this region. So compromising, the diode load can be $5k\Omega$ 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 $\simeq 800\Omega$ at 3mA rising to $3.2k\Omega$ 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 $I_c = 300\mu A$, 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

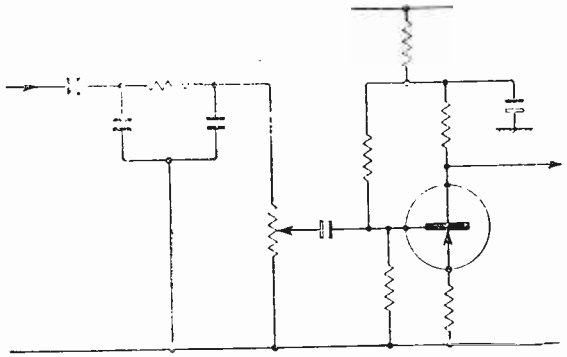


Fig. 7. Coupling arrangement between diode detector and audio amplifier.

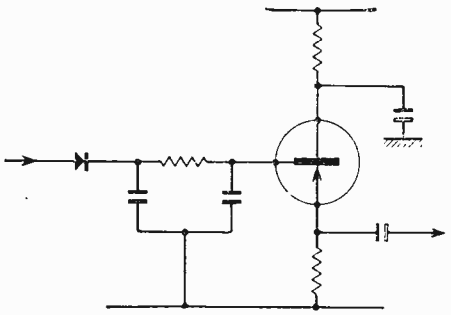


Fig. 8. Diode detector with emitter-follower audio stage.

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 10kΩ input impedance, and this figure is used for calculating the optimum turns ratio of the transformer betweeen the r.f. and detector stages.

The value of the diode filter capacitor, with a 5-kΩ 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 25μA drive so the 300μA 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 50μA, so 4.7kΩ will drop 1.65V, leaving 1.85V for the collector load at 0.3mA giving a load of 6.2kΩ or a preferred value of 5.6kΩ. The base-bias resistors carry 50μA.

Teaching and Development Aid

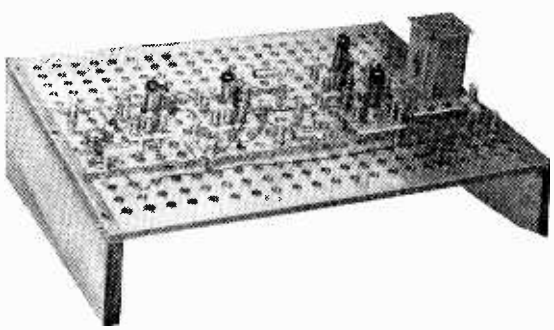
FAST ASSEMBLY FOR "BREAD-BOARD" CIRCUITS

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.

* 15, Maswell Park Road, Hounslow, Middlesex.



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.

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.

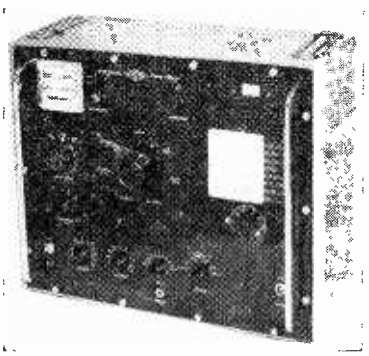
AERIALITE

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



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 100kc/s to 30Mc/s in seven ranges, a double superhet arrangement being used above 1Mc/s. The two i.fs. are 800kc/s and 85kc/s respectively and good image-signal rejection is therefore ensured, particularly at the higher frequencies; the makers claim 100dB or better throughout. Crystal calibrator, b.f.o., precision tuning with scales effectively 4ft long are a few of its special features.

Airmec Ltd., High Wycombe, Bucks.

ALAN-MARKOVITS

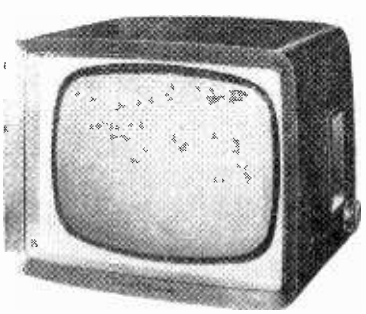
Decorative metal fittings for radio cabinets, escutcheons, cut-out and die-stamped name plates in a wide variety of designs were shown by this firm.

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 3¾in/sec, provides for high- and low-level mixing and permits

Alba T656 17-inch television receiver.



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.

ANTIFERENCE

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.

Antiference, 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 2×4-watt amplifier and 8in×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.

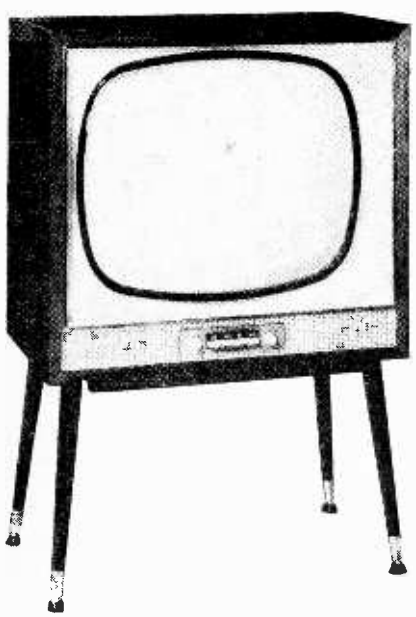
This stand was devoted to the export sound and television receivers of the British Radio Corporation, including models by Ferguson, H.M.V. and Marconiphone. A variety of battery and a.c. mains sound receivers was on view, all with two or three short-wave bands as well as medium waves. Economy switches 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 2×11-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 8¼-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 × 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.

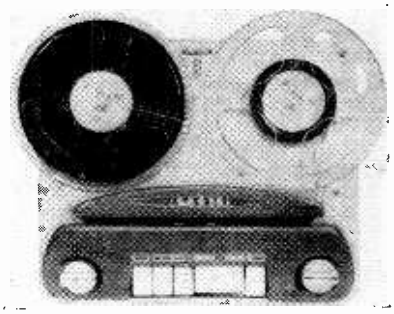
CAREERS

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, 3¾ or 7½in/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 that 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 × 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 × 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.

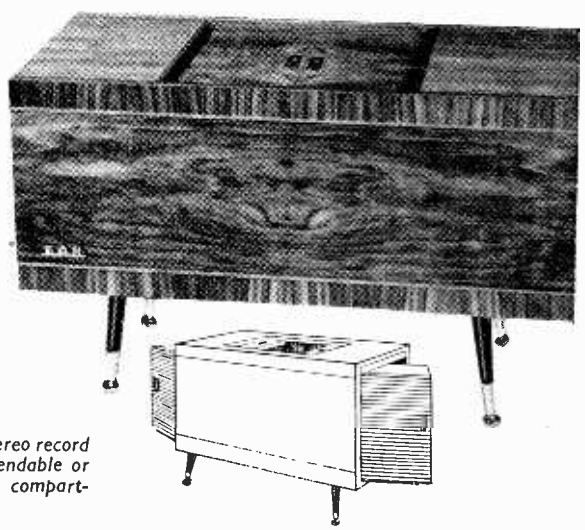
Transistorized models include the "Romany" 4-speed record reproducer and the "Nomad" receiver. Features of the "Nomad" are a loudspeaker as large as 7 by 4¼in and provision of a tone control.

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 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.



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

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 $3\frac{3}{4}$in/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 ($10\frac{1}{2}$in × 9in × 6in) and weight (12lb). Two speeds ($1\frac{7}{8}$ and $3\frac{3}{4}$in/sec) are provided and up to $3\frac{1}{4}$-in-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 $1\frac{1}{4}$lb and measuring $5\frac{3}{4}$in × $3\frac{1}{4}$in × $1\frac{7}{8}$in, 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 Berec "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

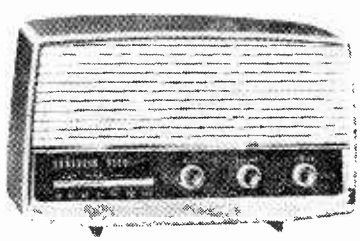
A third model, the "Stereofon III," was added to the Stereofon series of gramophones. This has the same general specification as the Stereofon II—2 × 8-watt ultralinear stereo amplifier, switched bass boost and treble cut control and an f.m. tuner—but it uses an Expert pickup arm and a transcription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

The Expert column-shaped loudspeaker 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.

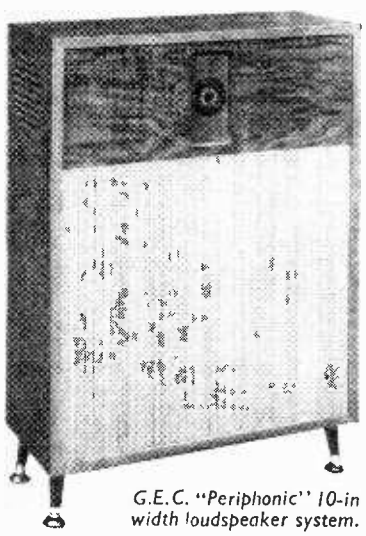
Ferranti Radio and Television Ltd., 41-47, Old Street, London, E.C.1.

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 × 4in loudspeaker is included and the overall size is 17in × 13½in × 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.

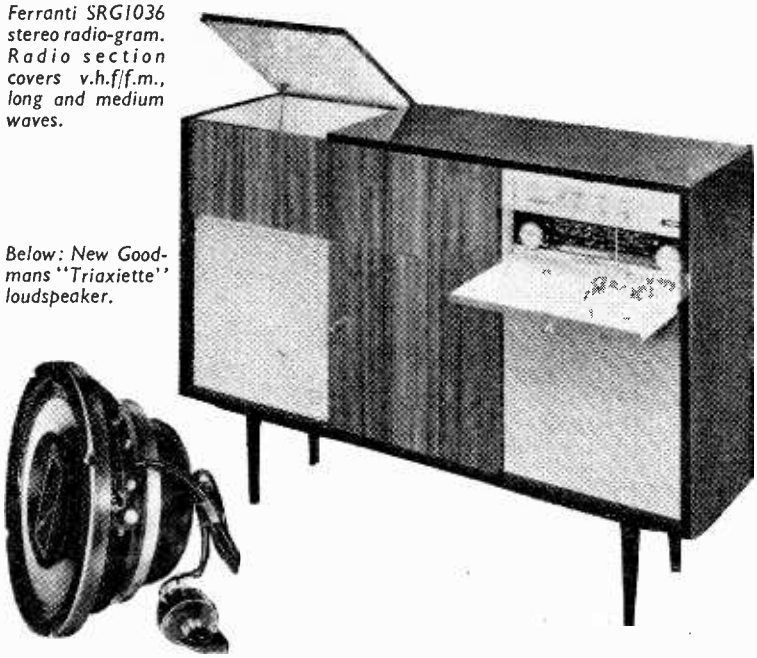
Fidelity Radio Ltd., 11-13, Blechynden Street, London, W.11.



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 × 12in × 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 consolette 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 aniversary 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 (3¾in/sec).

The Garrard range of record changers and single-channel and stereo crystal pickups (which includes a new stereo ceramic turnover 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 × 11½in × 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 × 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 × 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 3¾-in deep by 7in × 9in, this medium- and long-wave receiver is slim enough to stand on the mantelshelf.

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

J-BEAM

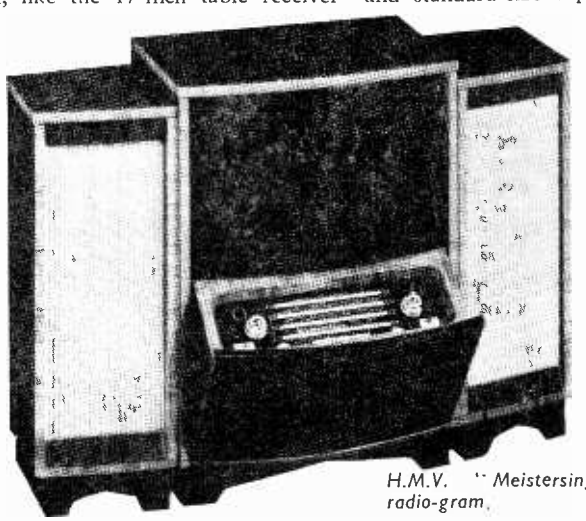
This company, who have always been slot-aerial protagonists, were showing a new wide-band slot aerial, called the Omnislot, for all Band-III channels. The New Omnibeam is a single-channel Band-I aerial combined with a broad-band slot covering the whole of Band III. This is available in two versions—with 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

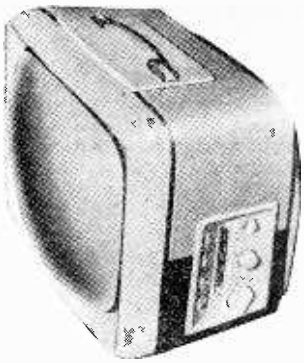
Decorative trims in metal and metal-covered plastic for cabinets and radio furniture being the speciality of this firm, their stand was devoted to a comprehensive display of fittings of this kind.

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



H.M.V. "Meistersinger" stereo radio-gram.

TV trolley fitted with Shepherd casters (Le Grest).



McMichael MP18 17-inch portable receiver.

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 "Stereovox," 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.

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 "solophone" 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 × 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.

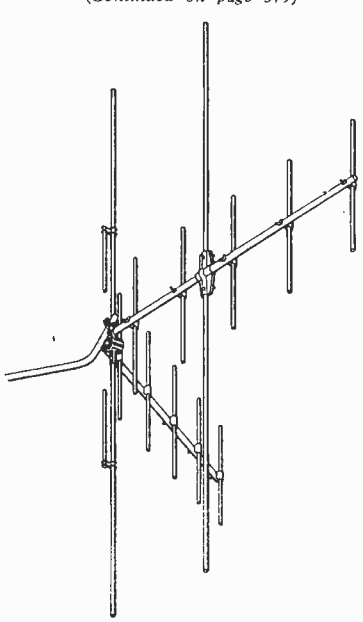
MARCONIPHONE

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.

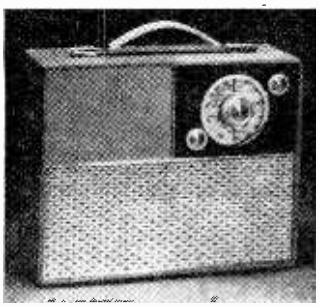
Radio-gram Model RG81 provides stereo reproduction in conjunction with a 4-speed auto-changer and two 8in × 6in speakers housed in integral acoustic chambers. It covers long, medium and v.h.f. wavebands and has provision for use with a tape recorder.

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-playing 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 consolette 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.

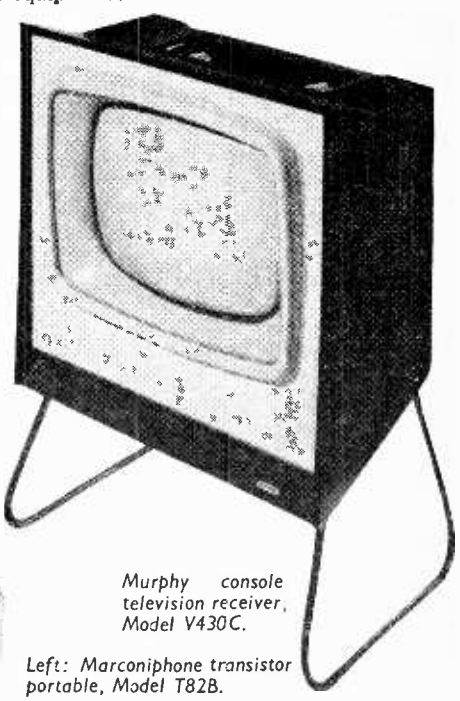
PERDIO

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 "Telerama"—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 × 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.

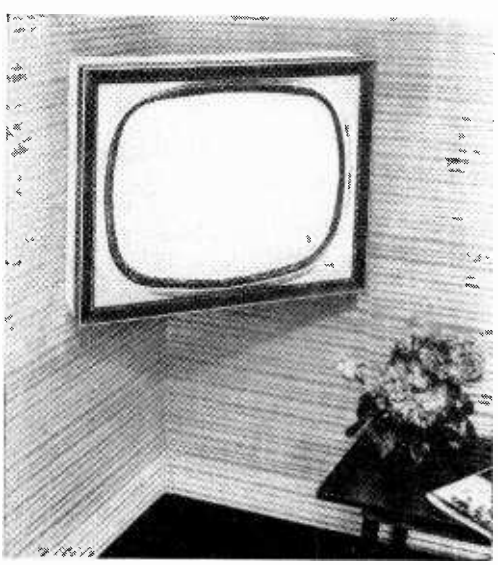
New transistor receivers included a six-transistor set suitable for use in yachts and other small craft. It covers the trawler waveband and has a practical anodised aluminium finish. The output is 450mW into a 5-inch speaker.

Pye, Ltd., Cambridge.

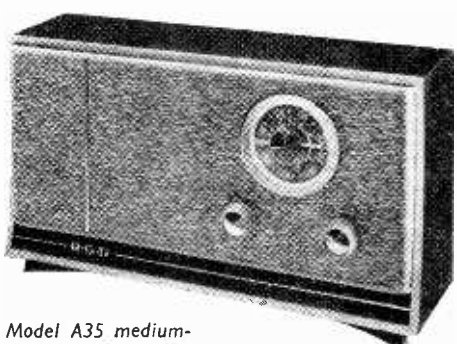
R.A.F.

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

Air Ministry, London, S.W.1.



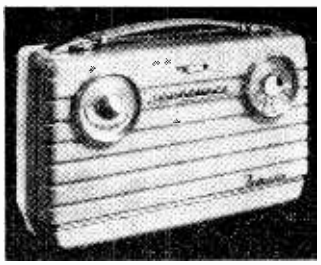
Philco "picture-on-the-wall" television receiver.



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

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 facia-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.

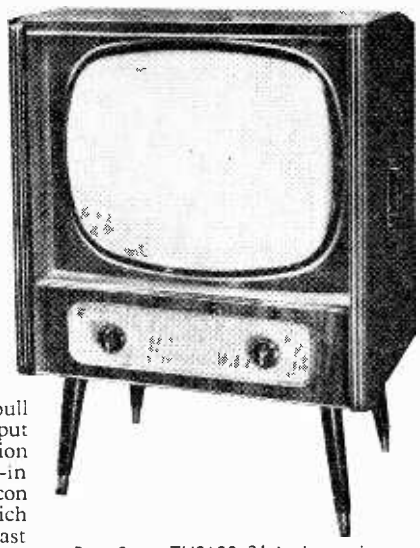
RECORD HOUSING

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 3¾in/sec and there is a 7in×4in 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 6in×4in to 10in×8in including an 8in×2½in 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 14in×22in to 20in×22in 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 3¾-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

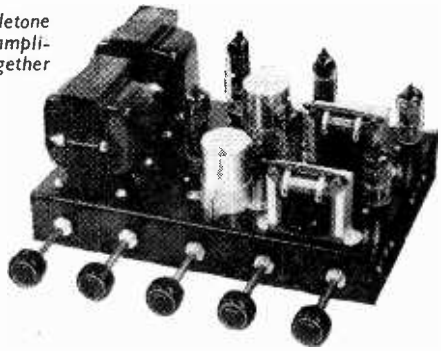
Emisonic-Orthotone a.f. pre-amplifier by S.T.D.

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.

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



Below: New Truvox R7 two-directional tape recorder.

Sound Sonocolor Tape splicer.

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 1¼in 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 valveholder 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 radiogramophones 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 loudspeaker 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 × 8in × 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 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

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-in 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.

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.

Telerection 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.

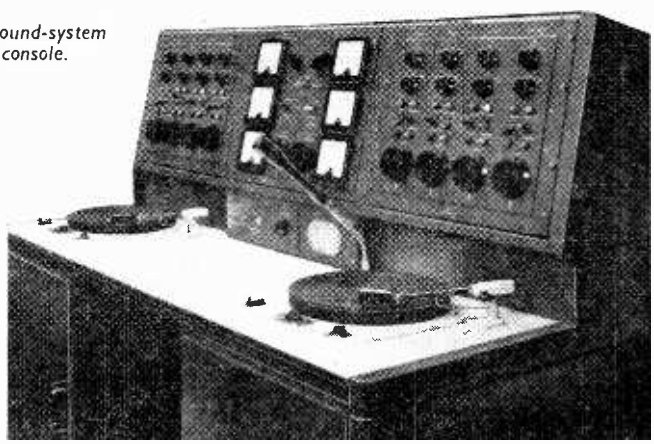
Telesurance Ltd., 14 Windmill Street, London, W.1.

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 sound-system control console.



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-multivibrator timebase with a range of 0.5c/s to 100kc/s and suppressed flyback, are a few of its special features. Repetitive or triggered synchronizing can be employed. It is mains operated, weighs 20lb and measures 12in × 9in × 6$\frac{1}{4}$in.

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 $\frac{3}{8}$in (diameter) by $\frac{5}{16}$in.

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 1$\frac{3}{4}$ 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 "Breakdown" cabinets. "Line source" loudspeaker systems can be obtained for sound reinforcement and public address purposes.

A stereophonic pre-amplifier and 2 × 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 instals 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 gastro-intestinal tract for the purposes of medical examination. The occasion was a session of lectures on electromanometry 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 conventional 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.

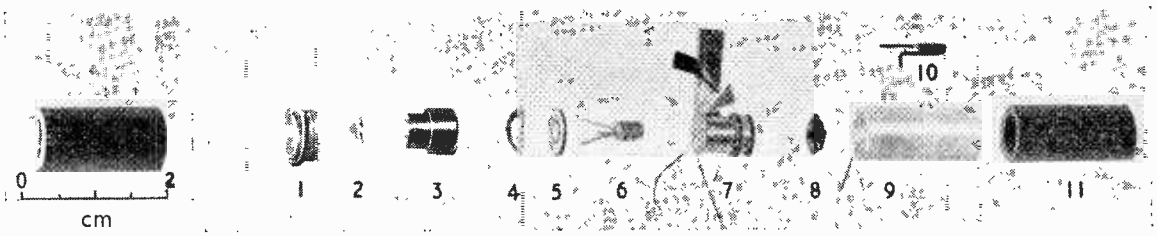
The Elmqvist and Senning pacemaker is a transistor blocking oscillator followed by a transistor amplifier which feeds the stimulating electrode through an RC network. It delivers 2-volt pulses of 1.5msec duration at about 80 pulses per second. The source of power is a small nickel-cadmium accumulator 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. Djourno of Paris. The essentials of this method, in which a small pick-up coil is implanted inside the head, were outlined by Dr. Djourno 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. Djourno 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

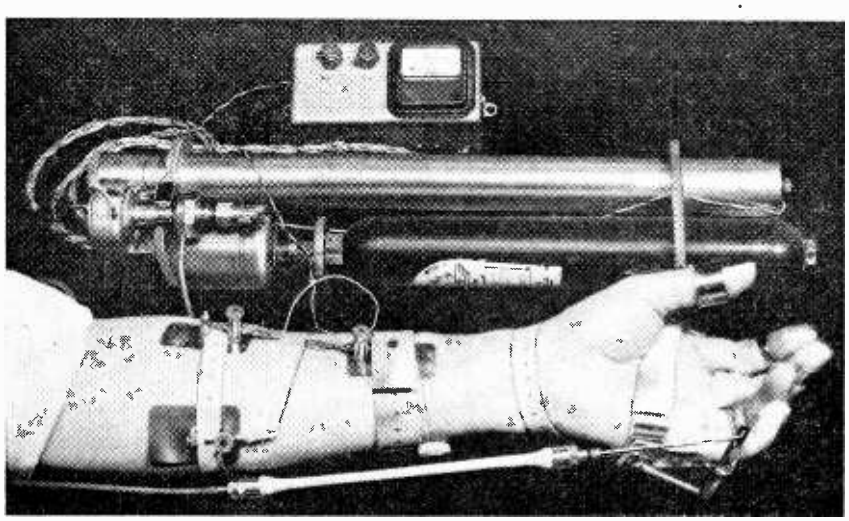
Returning to the endoradiosonde, the particular example described by Dr. Nöller measured only 10mm by 4.5mm (diameter) and was claimed to be the smallest ever made. It is manufactured on an industrial scale and so can be treated as an expendable item. Another, slightly larger, endoradiosonde was the 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 electrostatic 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.

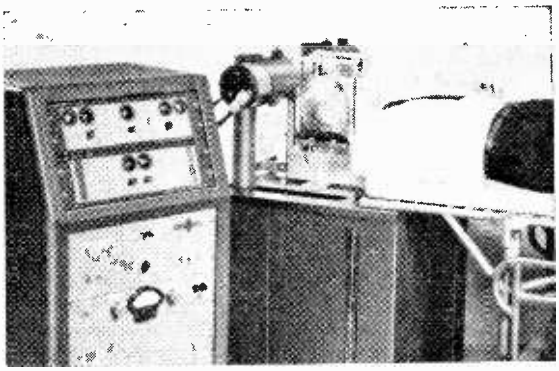
The principle of applying artificial aids to inoperative organs (known as prostheses), as exemplified by Dr. Djourno's work on hearing, came up again in a paper on artificial muscles by L. H. Montgomery and S. E. Stephenson (U.S.A.). Here the idea is that the non-functioning muscles are replaced by mechanical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

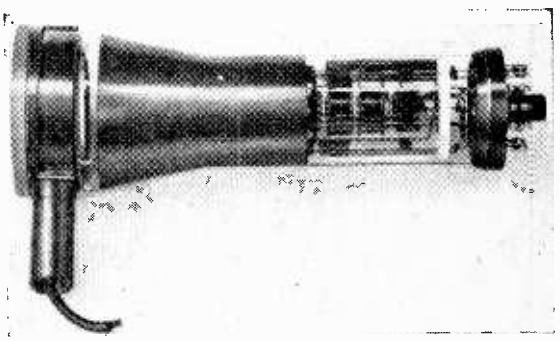
Solid-state light amplifiers for X-ray fluoroscopy, based on photoconductive and electroluminescent layers, were the subject of a paper by B. Kazan (U.S.A.). Experimental panels measuring 12in × 12in have given images 100 times brighter than those obtained from conventional fluoroscope screens. In another 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. Lamport 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 magneto-striction 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 & Mfg. Co.
M.S.S. Recording Co.
Mullard
Orthotone
Pamphonic Reproducers
Philips Electrical
Pye Records
Recording Devices
R.G.D.
Simon Sound Service
Steelman Phonograph & Radio
Sugden & Co.
Trix Electrical
Walters (Sales)
Welmec Corp.
Wharfdale 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.).

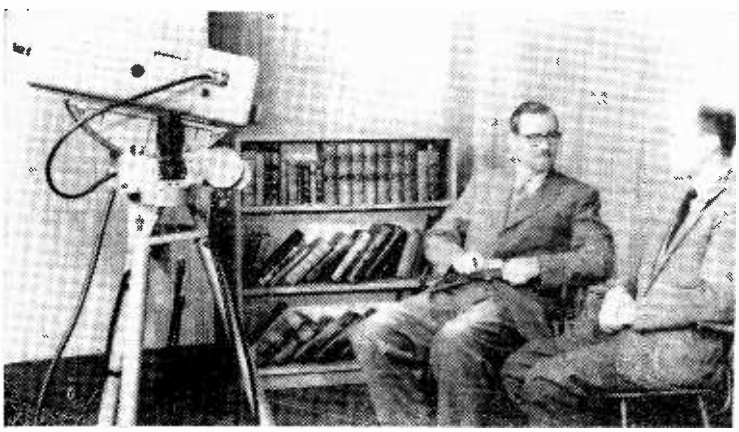
The scheme, which provides for up to six 25-guinea awards a year, is aimed at encouraging members of the industry and others to write more freely about their work.

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.

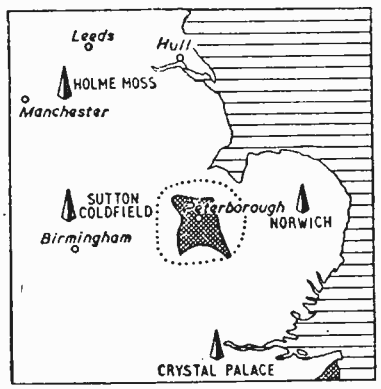
Special Short Courses (6-12 weeks) covering colour television, electronics in industry, transistors, etc., are being provided at the Norwood Technical College, London, S.E.27. These are in addition to established full-time courses covering the C. & G. certificates in telecommunications. There are also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

Telectronic 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, Honywood 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.

A Triode-Pentode Timebase

"Utility" Single-Valve Design Providing Fast Flyback

By J. F. YOUNG,* A.M.I.E.E., A.M.Brit.I.R.E.

A number of timebase circuits are described, each of which uses only a single triode-pentode valve. The best of these gives a linear output of large amplitude suitable for direct application to the deflection plates of a cathode-ray tube. In addition, a pulse suitable for fly-back blanking is obtained.

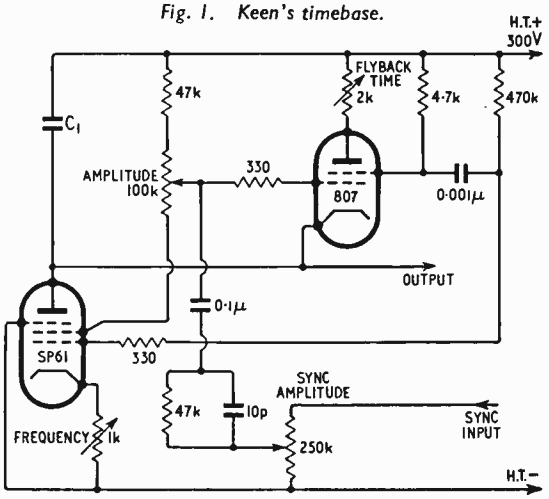
In some applications a timebase is required to give a good performance while occupying a minimum of space and dissipating a minimum amount of power. A typical example of this kind is a timebase for electrostatic deflection of a cathode-ray tube in the display section of a miniature analogue computer designed to give repetitive solutions. In such a case it is required that the timebase should give a linear change of output voltage with time, with a peak-to-peak amplitude large enough to produce full screen deflection on the cathode-ray tube (when sufficient e.h.t. is applied to give a bright trace), and the shortest possible flyback time. The switching which changes the frequency range should not be complicated, and it is an advantage if the timebase provides a negative pulse suitable for application to the grid of the tube for flyback suppression. So that the space and power requirements may be met only one valve should be used in such an application and this valve should be preferably a type which is readily available.

Many single-valve timebase circuits have been developed in the past. The most basic, and the earliest, was the neon-tube timebase. Some time later, the neon tube was supplanted by the thyratron. While these are simple circuits, they have an exponential rather than a linear output. Blocking-oscillator timebases have been extensively used, but they have the disadvantage that a coil or transformer is required, and it is not always easy to cover a wide range of frequencies. While it is practicable to construct timebases having linear outputs using double valves with one half acting as a blocking oscillator, it is desirable to eliminate the transformer. The Miller-transitron timebase gives an almost linear output at low impedance and it is basically quite simple: however, in practice it is usual to add one or more catching diodes to the circuit to improve the scan-to-flyback ratio. Attree[1] has described a method of shortening the flyback time by adding a cathode follower to a Miller timebase. Unfortunately this cannot be used with the most suitable types of triode-pentode valve, because the suppressor grid is not available as it is connected internally to the cathode. The construction of bootstrap repetitive timebases using double valves is feasible, but they have the disadvantages that either a large feedback capacitor or a neon tube is necessary in the feedback path and the output is rather limited. Various types of cross-coupled and cathode-coupled multivibrator timebases have been used widely since double triodes became available: these all give exponential rather than linear outputs.

The well-known timebase developed by Puckle used a multivibrator together with a pentode linear-sweep generator. This made it possible to obtain both a linear output and a fast flyback. Keen[2] devised the form of Puckle's timebase shown in Fig. 1, in which only two pentodes are used. One valve functions as a constant-current charging device and the other as a rapid-discharge circuit. In addition, the screen grid of each valve is connected to the grid of the other, so that the two valves operate together as a multivibrator. The anode of the discharge valve is free, and it is therefore possible to take the positive feedback from here instead of from the screen grid. As the screen grid is not then necessary to the operation of the circuit, a triode can be used as the discharge device, as was done in Puckle's original circuit. In this case only a single triode-pentode valve is required in the timebase. The circuit of such a simplified, single-valve version of Keen's timebase is shown in Fig. 2.

The operation of this triode-pentode circuit is as follows:—Assuming the capacitor C_1 is initially discharged, it charges in a linear manner from the h.t. supply, through the pentode. As C_1 charges, the cathode of the triode is carried negative. The grid of the triode is initially held negative to its cathode by the screen grid of the pentode: therefore the

Fig. 1. Keen's timebase.



* Switchgear Division, G.E.C., Ltd.

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 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-to-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 pentode[2] 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 multivibrator[3], 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

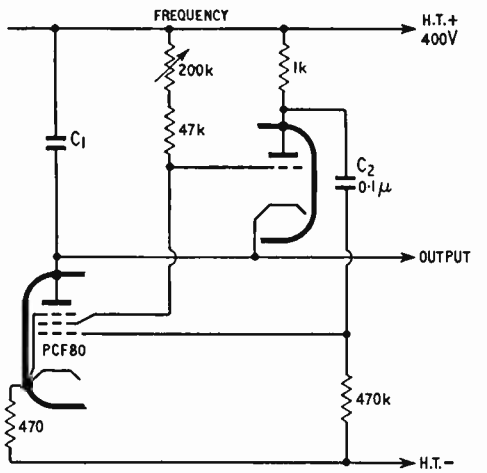


Fig. 2. Simplified version of Keen's timebase.

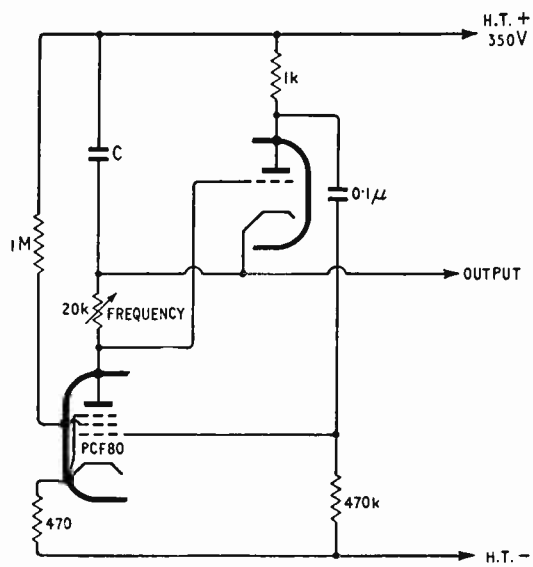


Fig. 3. Alternative method of coupling to triode.

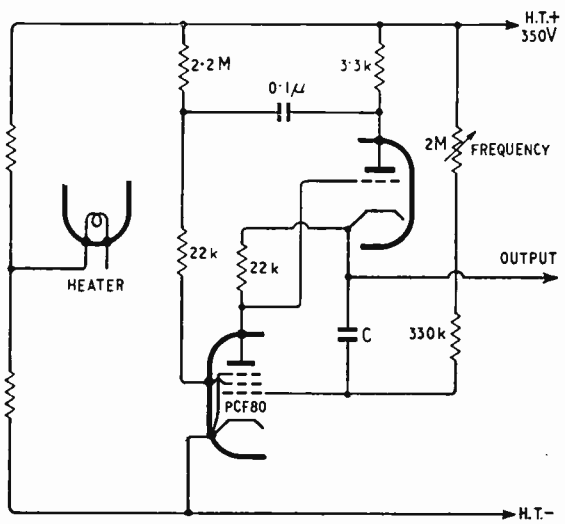


Fig. 4. Preferred triode-pentode timebase.

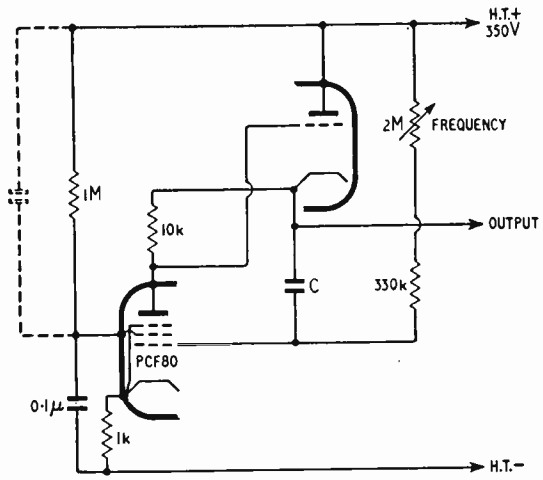


Fig. 5. Cathode coupling to pentode screen grid.

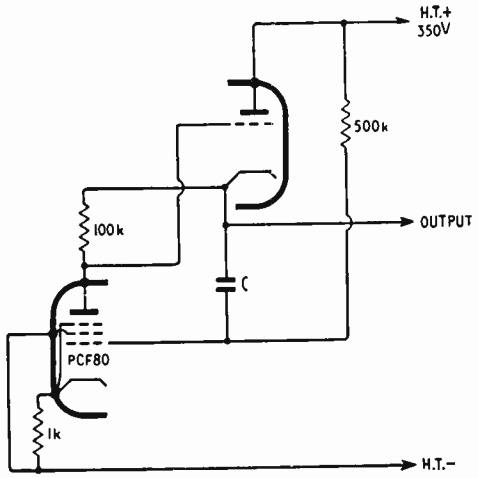


Fig. 6. Simplified cathode-coupled circuit using PCF80.

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

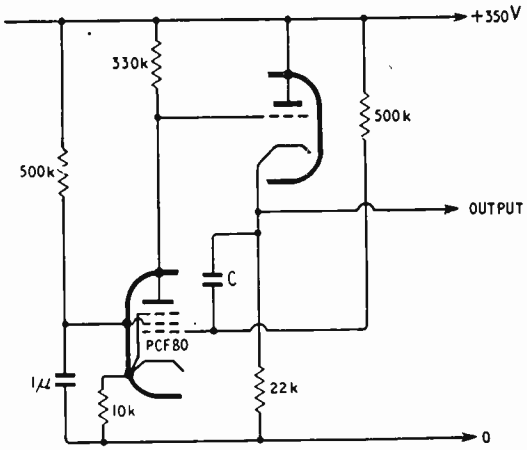


Fig. 7. Circuit using cathode follower and cathode-coupled screen-grid switching.

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 Attree[1] 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 frequency control shown, the fixed 330-kΩ 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-kΩ 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-kΩ series amplitude control at the minimum amplitude position, the currrent 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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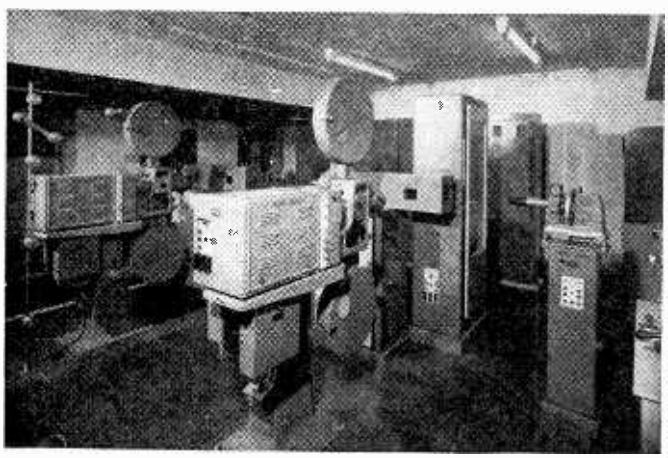
[1] V. H. Attree, "Improving Flyback Time on a Miller Timebase" *Electronic Engineering*, Vol. 20 (March), p. 97, 1948.

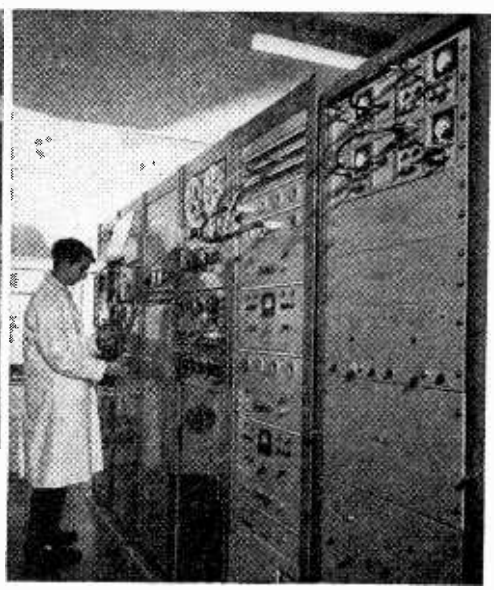
[2] A. W. Keen, "Linear Saw-tooth Generators" *Wireless Engineer*, Vol. 25 (July), p. 210, 1948.

[3] G. Fruhauf, *Archiv fur Elektrotechnik*, Vol. 21, p. 471, 1929.

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. Distribution 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 photoconductive 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 ungullible 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 dissentient—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 aurual 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

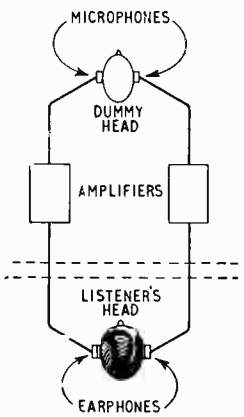


Fig. 1. A true binaural sound transmission system (provided the dummy moves his head in synchronism with the listener)

perfect apparatus, this system should give perfect binaural hearing—with one important exception, often forgotten. A listener to sounds 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

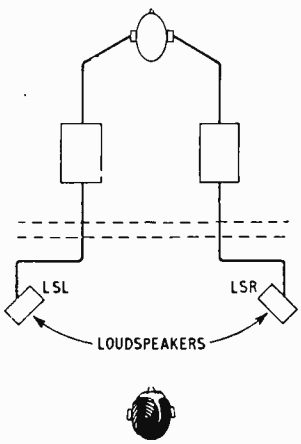


Fig. 2. The same as Fig. 1 at the pick-up end, but earphones replaced by loudspeakers at the receiving end. This entirely alters the listening conditions.

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 $8/\sqrt{2}=5\frac{3}{4}$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

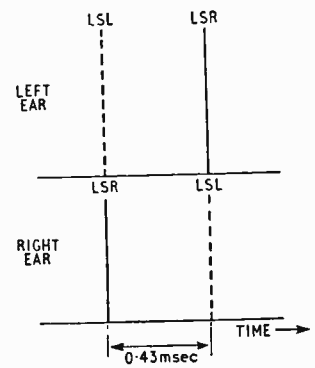


Fig. 3. In this and the following diagrams the amplitude of sound reaching the two ears from the left-hand loudspeaker is represented by the height of the dotted lines; that from the right-hand speaker by full lines. The relative times of arrival are indicated by horizontal spacing. This diagram refers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

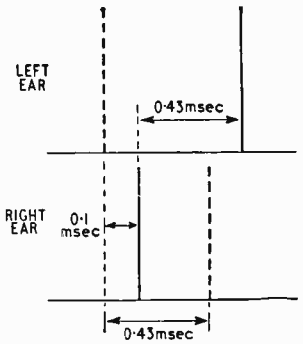


Fig. 4. Here, the sound is coming from a source 10° to the left of straight ahead of the dummy.

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

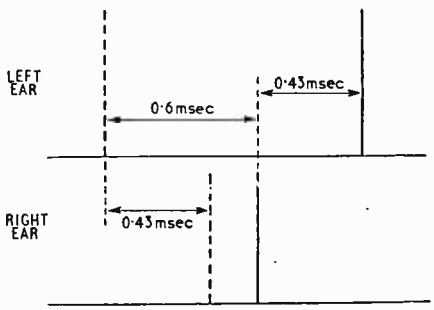


Fig. 5. The angle of sound direction to the left is here increased to 90°; straight into the dummy's left "ear."

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

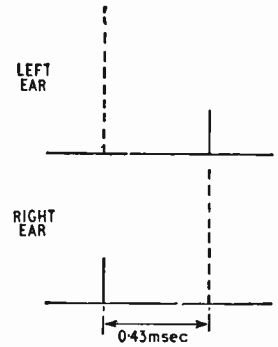


Fig. 6. Here again the sound is coming from left of straight ahead, but the microphones are placed together and are directional so that one receives more strongly from sounds to the left and the other from sounds to the right.

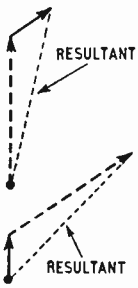


Fig. 7. This vector diagram shows more clearly than Fig. 6 that differences in amplitude of sounds coming from different directions with phase displacements affect their resultant phase. In this example the sound would apparently reach the left ear in advance of the right.

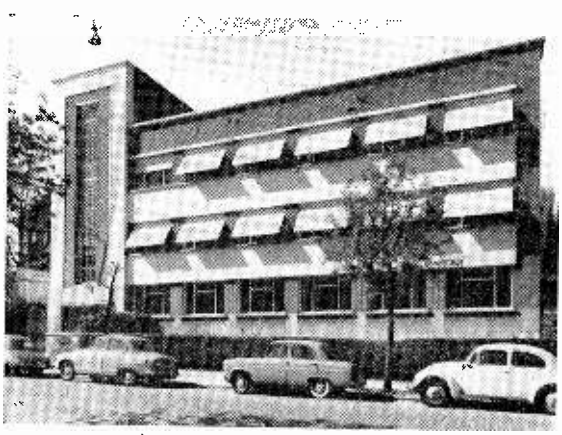
more than very little about microphones and loudspeakers the thought will immediately occur that it is one thing to prescribe that their directional characteristics must be such and such, and a very different matter to make them so—at all audio frequencies. This technical difficulty no doubt accounts 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-Masnuy 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 mircrophones, 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 multiodic 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, tetrodically, or multiodically. 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-I 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 kMHz 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.

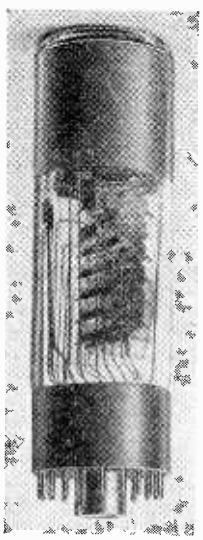
Unfortunately, I, like so many others, have been floundering along for years on a hit-and-miss basis, whereas a little technical assistance from a fellow constructor might provide the answers to some of the problems which are worrying me. On the other hand, I have made quite a lot of interesting discoveries 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. Catherines Road, Chingford, London, E.4
(SILverthorne 4884.)

Technical Notebook

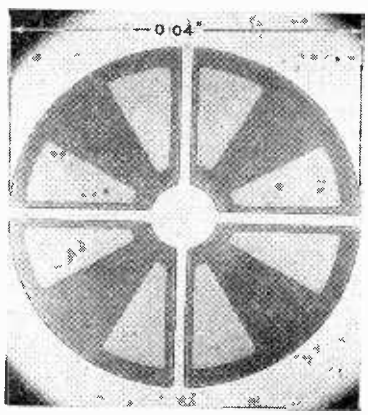
High Definition Photomultiplier tube, introduced by Mullard, is designed for use when exceptionally high definition is required in scintillation counting and nuclear radiation spectrography. The most important requirement of a photomultiplier intended for very high definition work is that differences 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.

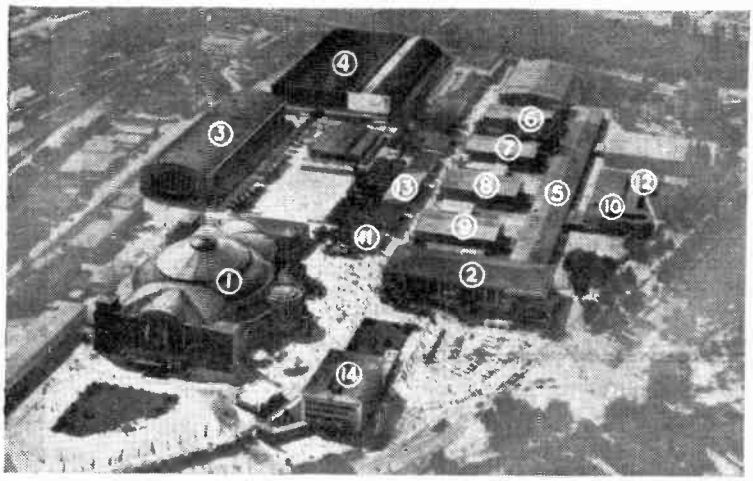
TV Bandwidth Reduction by a method of frequency interleaving was demonstrated by E. A. Howson and D. A. Bell at the recent Brit.I.R.E. Television Convention. The method is analogous to that used in the N.T.S.C. colour television system and obtains a bandwidth reduction of a black-and-white video signal 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. Consequently, 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



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.*

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 taken out so far in Germany, compared with more than 15 million sound broadcast licences. (The U.K. figures are roughly 9½ 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.

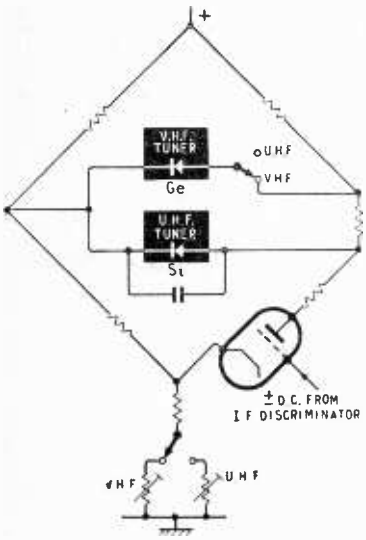
At the moment only a few stations are working in Band IV but it is expected that by the end of 1960 there will be full coverage of the centres of population in West Germany with a second television programme.

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.

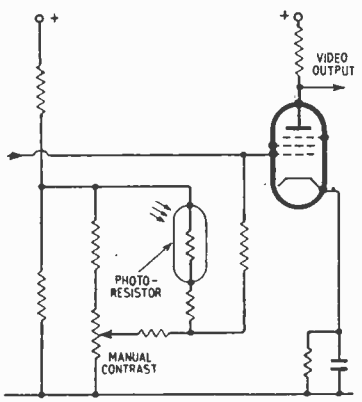
In Germany one looks for a *leitmotiv* and in television receivers this year it is *Vollautomatik*—fully automatic operation. This cult is pursued with Teutonic thoroughness, and sales literature enumerates as

Youth is served—the Siemens "Stereo Bar."

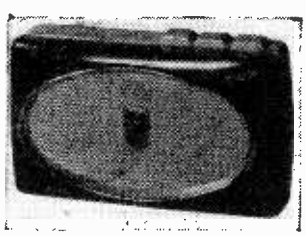
many as 15 or 20 circuit features which are self-regulating. Most of these, such as thermistor control of picture size, e.h.t.. regulation, etc., are common to British sets. Not so common is *automatische scharfabstimmung* (automatic sharp tuning) which is universal in German TV sets working in Band 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 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.



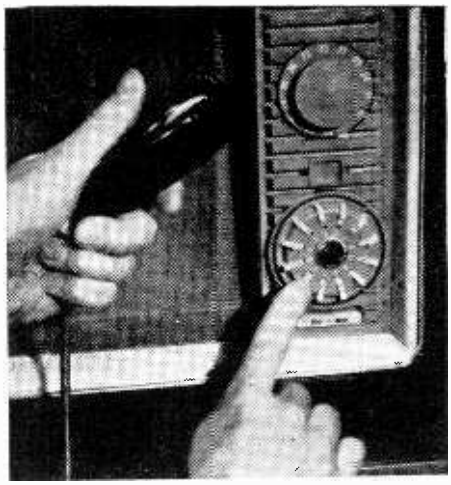
The high-impedance silicon diode is left in circuit when the set is switched to v.h.f. in the automatic tuning circuit developed by Graetz.



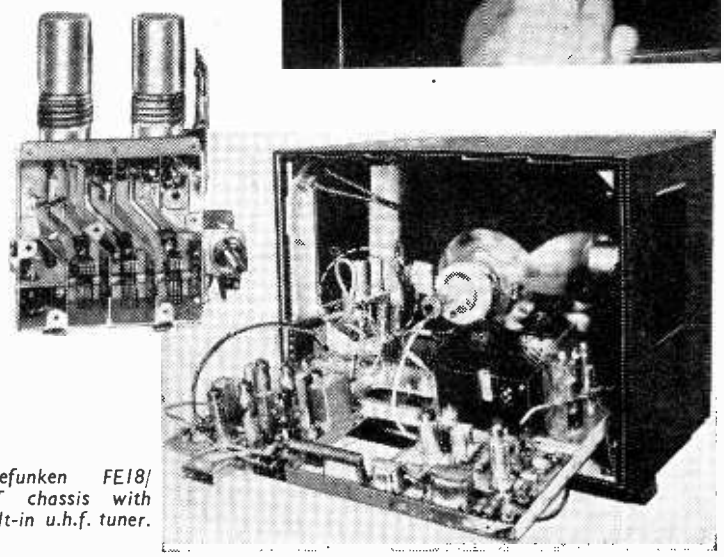
Simplified circuit (for negative modulation) of automatic contrast control (Loewe-Opta).



Above: Grundig ultrasonic remote control unit for television receivers.



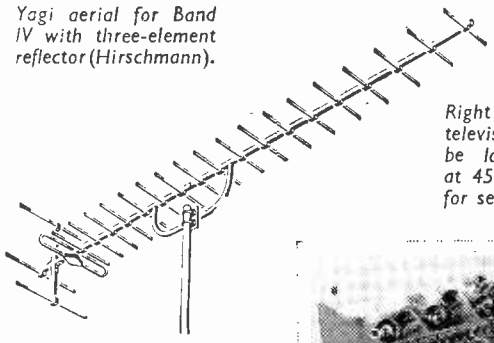
Right: Remote control of preset channel selection in the Telefunken FE20 television sets.



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

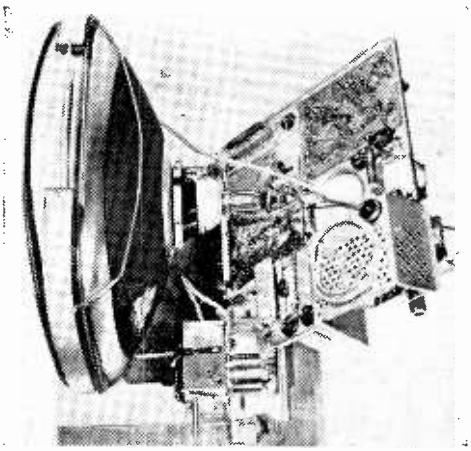
Automatic contrast control according to the level of the ambient light in the room is now accepted as a normal feature in all but the cheapest German television receivers. It is simple and effective in automatically maintaining picture quality when the curtains are drawn or a light is switched on. The 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.

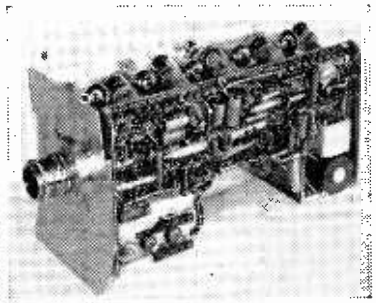
Such external controls as are necessary—for example channel selection—are mechanized and remotely controlled from the viewers' position. Grundig were showing a system which does not require a connecting cable and operates by supersonic sound pulses from a small transistorized hand unit. Frequencies used 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

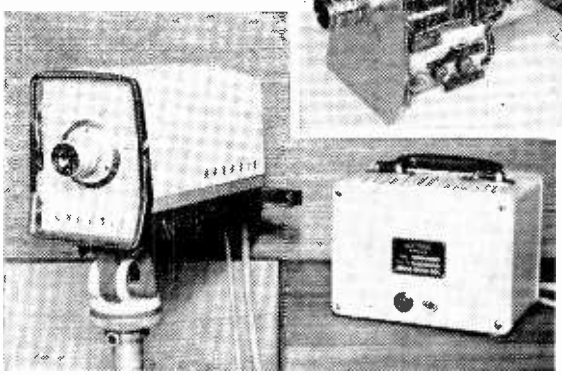


Yagi aerial for Band IV with three-element reflector (Hirschmann).

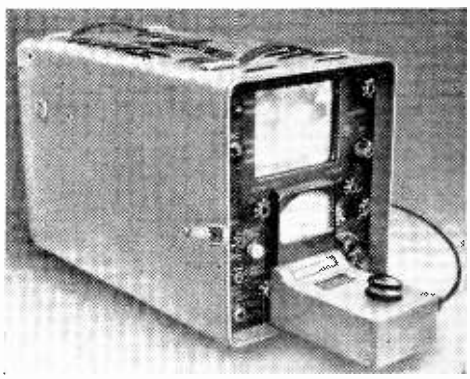
Right: The Loewe-Opta television chassis can be locked vertically, at 45° or horizontally for servicing.







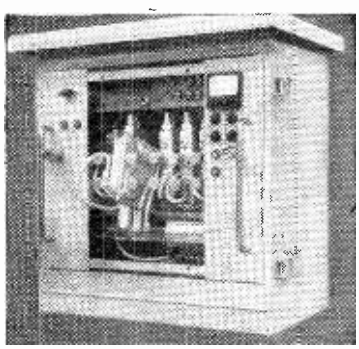
Grundig FA40 general purpose television camera, costing the equivalent of £170.



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

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



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.

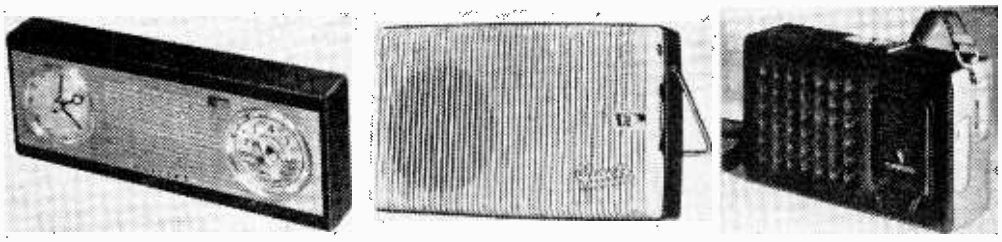
Aerials. As in 1957, the aerial manufacturers' section of the industry arranged a collective outdoor exhibit of their latest designs—this in addition to individual displays on their stands. The main interest was in Band IV aerials for the forthcoming second-programme network from stations now in course 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.

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

An interesting aerial measuring equipment (SAM317/bW) was shown working by Siemens and Halske. It combines a valve voltmeter with a range of 10μV to 2.5V and a picture tube (95 × 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 TP1, 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 pick-up 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 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.

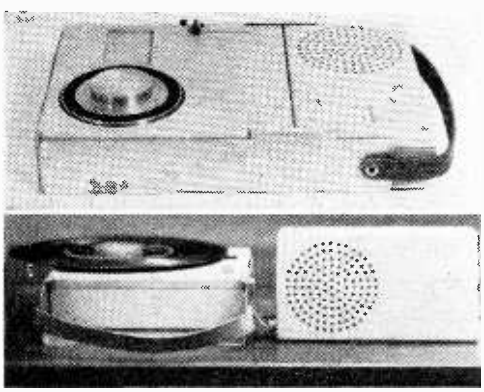
Most sets over the 350DM (£30) mark are fitted with stereo amplifiers and loudspeakers, and the larger stereo radio-gramophones undoubtedly give something better than the *raumklang* or 3D to which the German buying public has been accustomed now for many years. In their "New York" radio-gramophone "with 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.

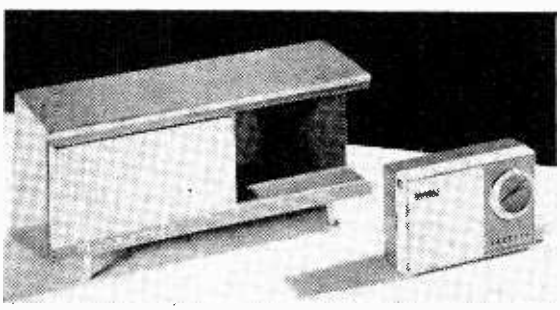
The same principle of a variable base line is applied in some of the more expensive equipments, notably the Siemens STR 30 stereo radio-gramophone in which the loudspeakers, installed in thick front doors are not only adjustable for angle but can also be pulled out to increase the base line if the size 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-mu 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.

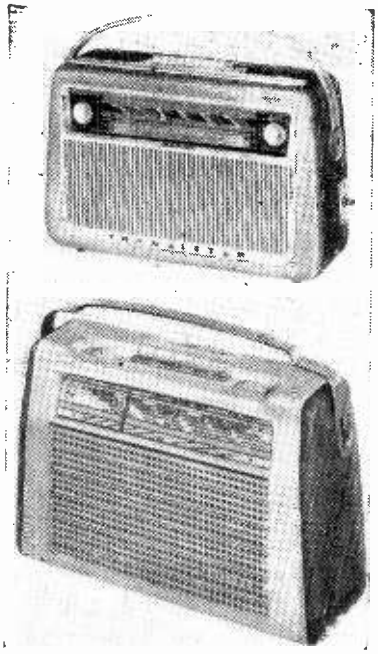
Another impressive performance was given by the Braun Studio 2 high-quality equipment costing 2,000DM (£170) which comprises stereo amplifier, record player and radio receiver units, in the now



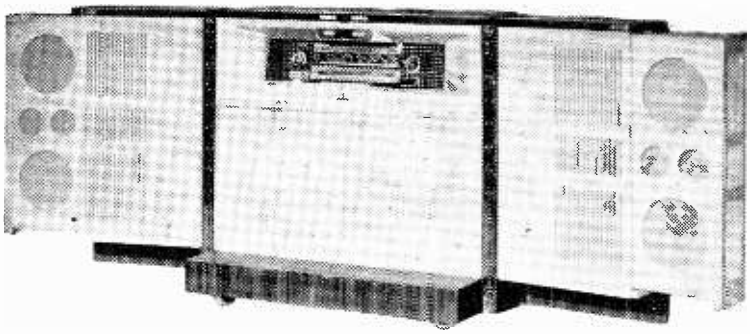
Braun TP1 pocket radio-gramophone. The two sections can be used independently.



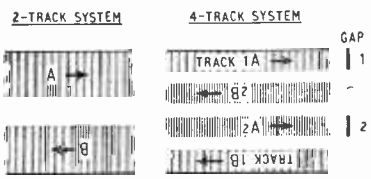
Grundig "Micro-Transistor-Boy" with larger loudspeaker cabinet for home use.



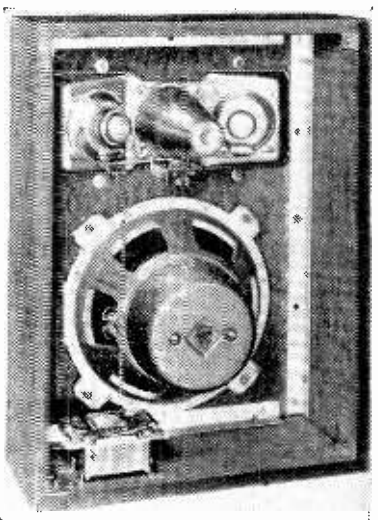
Two representative all-transistor all-wave (including v.h.f.) battery portables. (Above) Graetz "Joker" and (below) Deutsche Philips "Colette."



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.



Isophon wide-range loudspeaker (G3037).

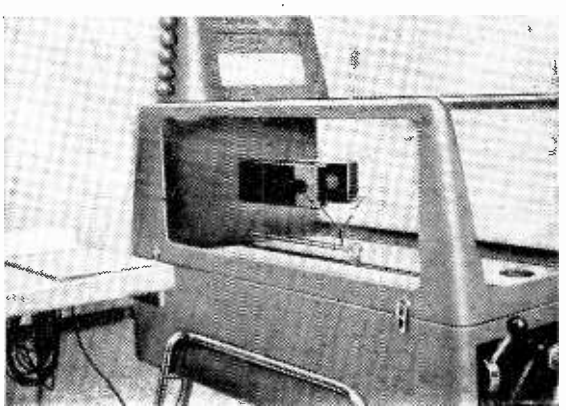
world-famous Braun styling, together with type LE1 electrostatic wide-range loudspeakers, the latter made under exclusive licence from the Acoustical Manufacturing Company ("Quad").

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 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.

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

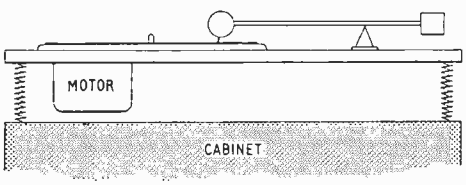
Correct Distribution of Mass to Minimize Pickup Disturbance

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 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).



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

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 ± 2mm 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

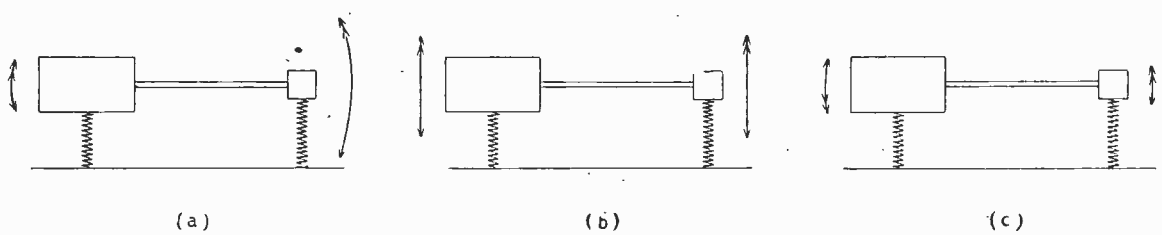


Fig. 2. Simplification of Fig. 1. The actual motions in Fig. 2(a) are equivalent to the combination of the linear motion in Fig. 2(b) with the rotational motion in Fig. 2(c).

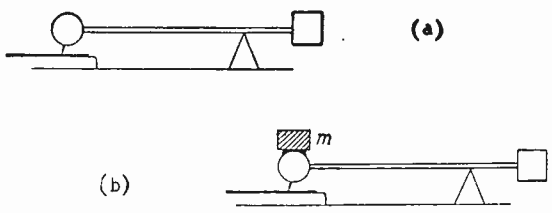


Fig. 3(a). Perfectly balanced pickup arm. (b) To obtain the required stylus force, the arm of Fig. 3(a) is loaded with m gm on its head.

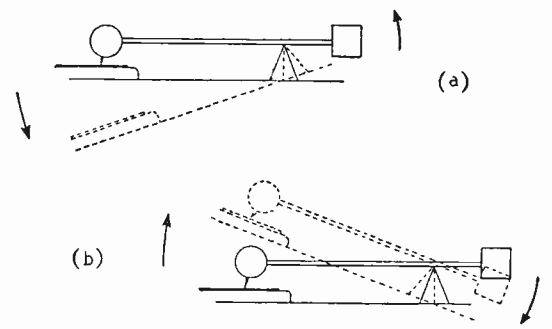


Fig. 4. Perfectly balanced arm acted on by anti-clockwise (Fig. 4(a)) or clockwise (Fig. 4(b)) rotations of the playing desk.

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!

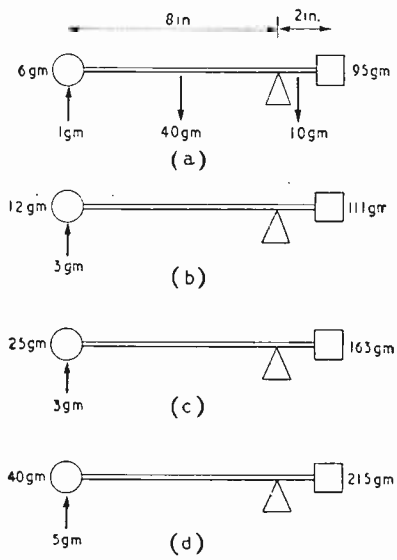
Now consider the rotational component in the vertical plane (Fig 2c). Here the *direction in space* of the *whole* arm is being altered. Therefore it resists with its *whole* inertia. The stylus tip takes almost the whole brunt of this type of disturbance. To clarify this argument, consider a perfectly 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 ± 2mm 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/sec^2.

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/sec^2.

Lest anyone feels these figures are unduly large, consider the motor board motion to be ± 1½mm on the left, and ± 2½mm 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 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.

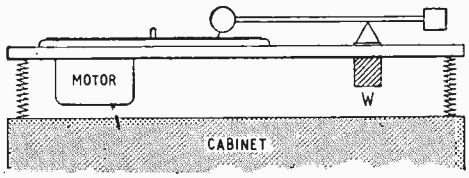


Fig. 6. Adding the weight W to Fig. 1 makes the centre of gravity of the suspended system coincide with the geometric centre of its suspension, and thus minimizes the disturbance to the pickup.

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.

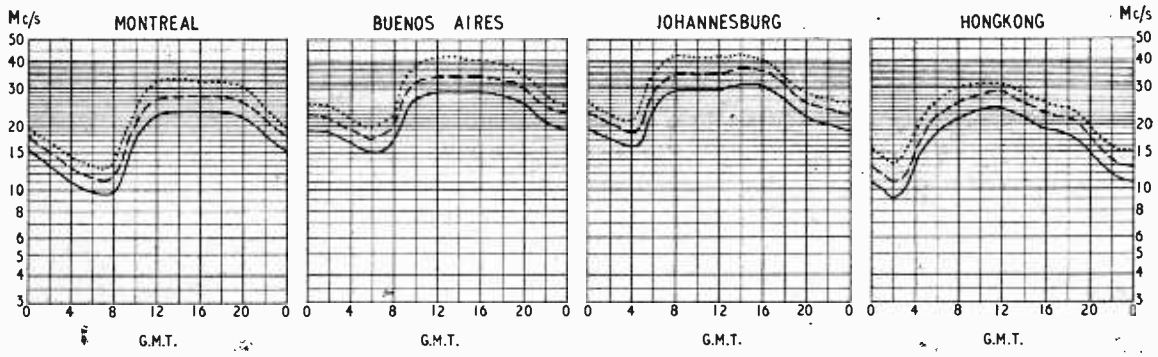
British Instruments Directory and buyers' guide to electronic, nuclear, navigational and survey, optical, engineering and general measuring instruments prepared by the Scientific Instrument Manufacturers' Association. Includes a glossary in English, French, German and Spanish. Pp. 322. Price £2 2s. United 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, spacistors, 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.

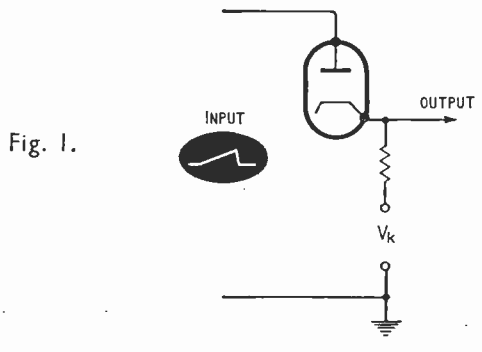


Fig. 1.

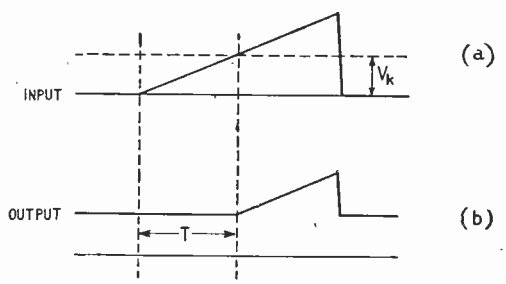


Fig. 2.

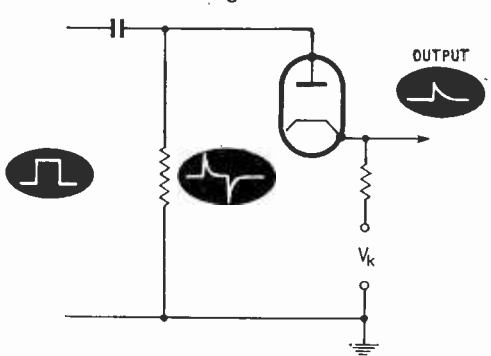


Fig. 3.

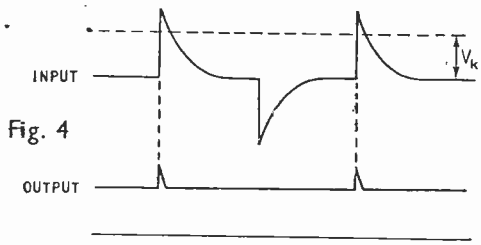


Fig. 4

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-

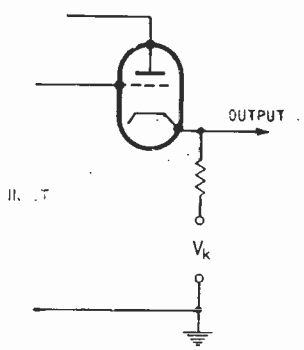


Fig. 5.

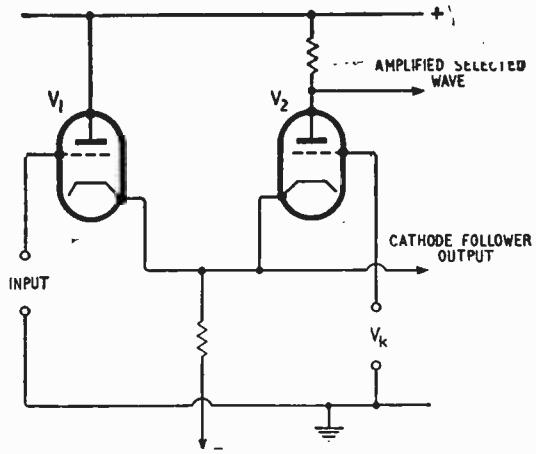


Fig. 6.

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

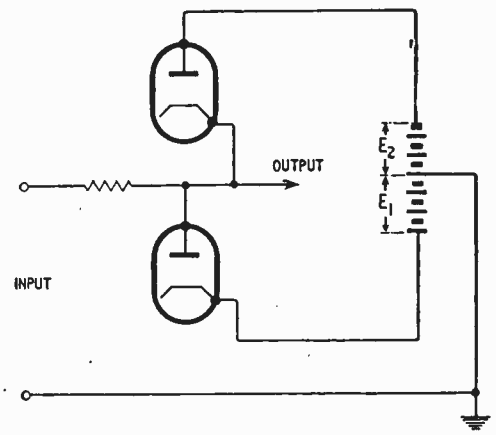


Fig. 7.

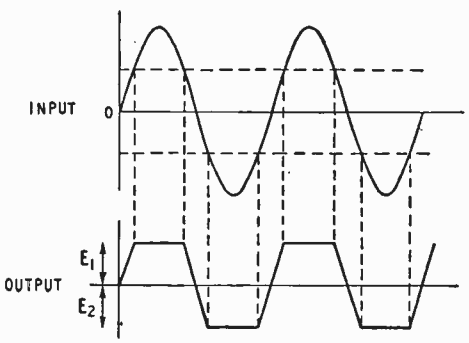
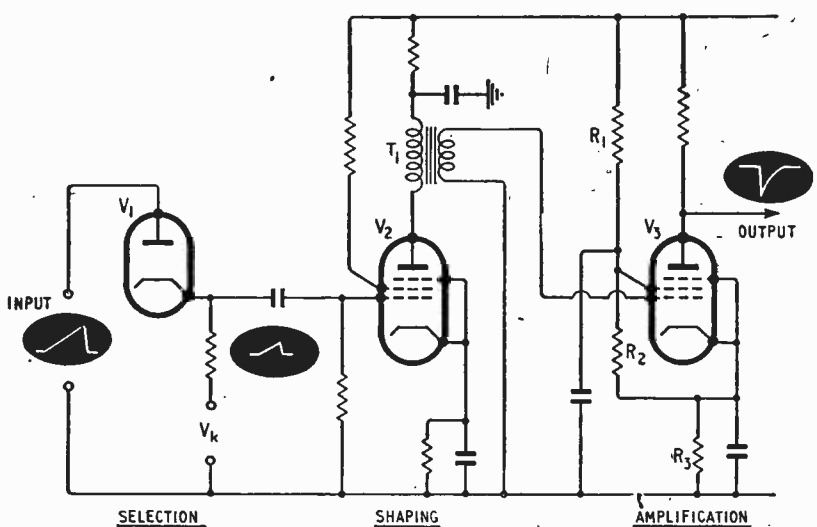


Fig. 8.



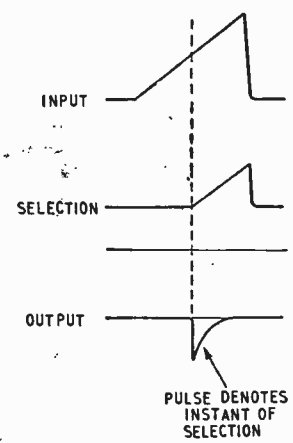


Fig. 9.

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_1, R_2, R_3) 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

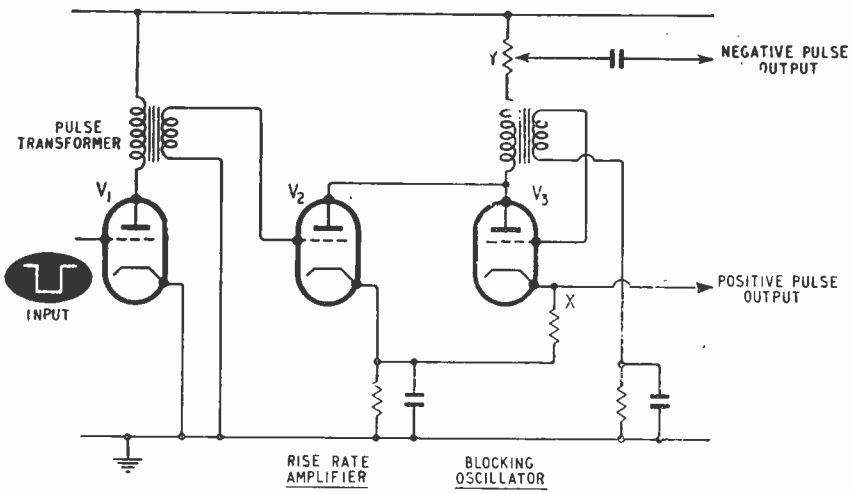
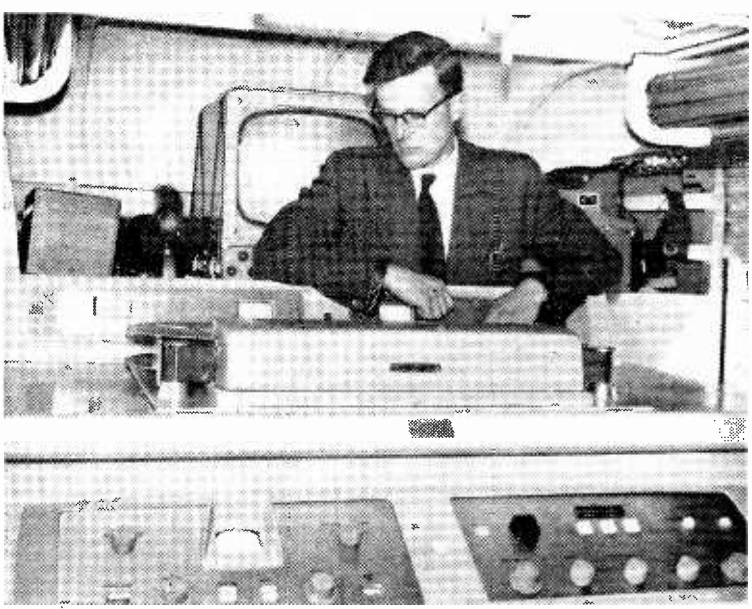


Fig. 10.

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.



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.

F NNAGLE'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 scribblings 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: France[1], Algeria[2], Germany[3], China[4] and, of course, the inevitable Russians[5]. 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.

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 Dŷddyll, 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.

[2] 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 test 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.

[3] 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.

[4] The Chinese have claimed the discovery for a pre-Confucian named 弗老哥 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.

[5] 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 psychical 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 (Spares, 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 Raymund 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.

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

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.

UNBIASED

By FREE GRID

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" (ἀδη) meaning a song or ode, whereas the word I suggested comes from the Greek "hodos" (ὁδος) 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.

"Sinister" remarks

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" (ἀυδη) 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?