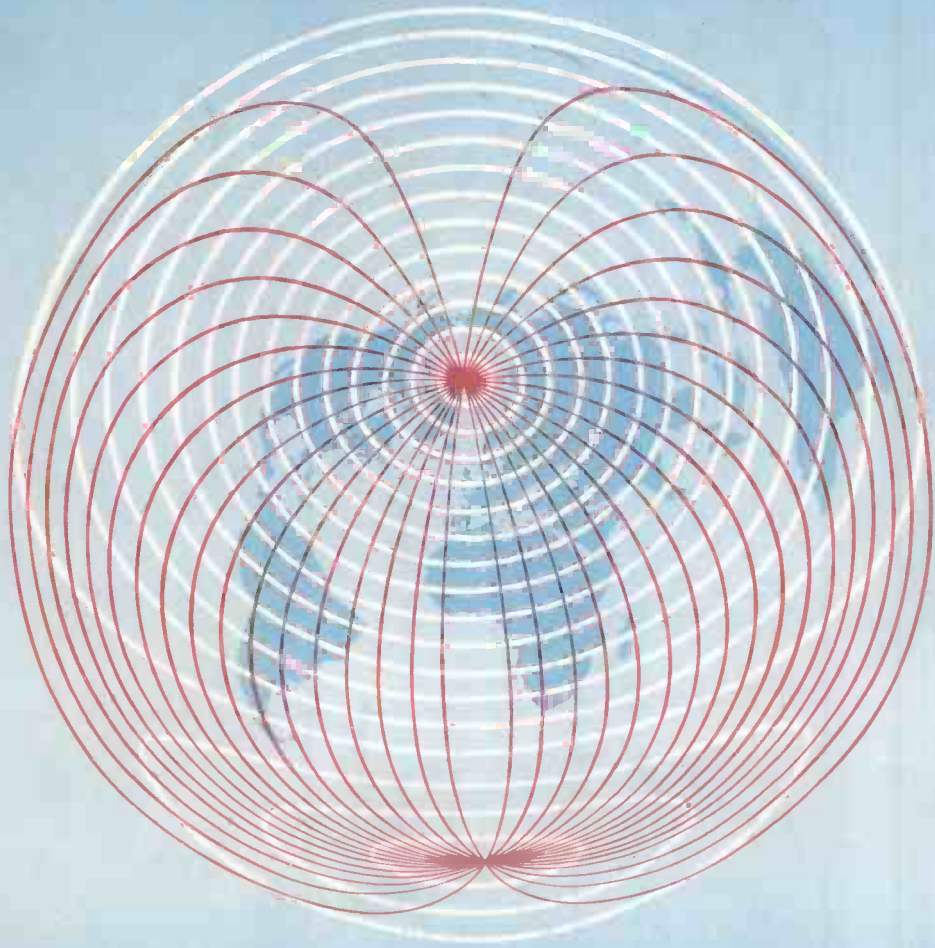


B. J. Smith

Wireless World

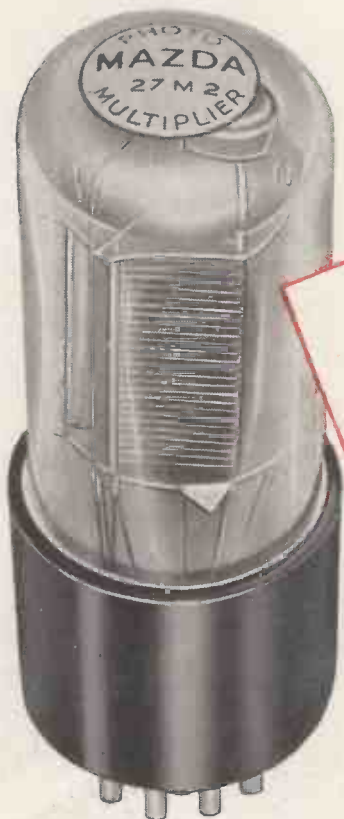
MAY 1954

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Wireless World

RADIO, TELEVISION
AND ELECTRONICS

44th YEAR OF PUBLICATION

Managing Editor : HUGH S. POCOCK, M.I.E.E.
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MAY 1954

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VALVES, TUBES & CIRCUITS

17. PCC84: A CASCODE AMPLIFIER FOR V.H.F TELEVISION RECEIVERS

The Mullard type PCC84 is a double triode designed for use in the R.F. stage of television receivers operating at Band III frequencies. It is primarily intended for connection as a D.C.-coupled cascode amplifier preceding the Mullard type PCF80 used as a frequency changer.

In this type of cascode circuit the first triode is connected as a grounded cathode amplifier, and the second as a grounded grid amplifier. The two sections are connected in series across the H.T. supply, with the anode of the first triode coupled to the cathode of the second. The output from the second stage is coupled either inductively or capacitively to the mixer grid of the frequency changer.

The cascode circuit employing the PCC84 has two attractive features: a low noise level and a low input conductance which allows a high gain. At Band III frequencies the noise contribution of the aerial is small, therefore the inherent noise of the input stage contributes largely to the total noise. If a pentode is employed, the partition noise, caused by the random division of electrons between the anode and the screen grid, is the main source of noise. This is avoided by the use of a triode. The main disadvantage of the triode, however, is the considerable internal feedback via the anode to grid capacitance. This is overcome by the cascode arrangement which permits efficient screening between the output and the input of the stage. Thus it is possible to combine a high stage gain with a very favourable noise factor.

The characteristics of the PCC84 are conventional, but attention is drawn to the high mutual conductance of 6.0 mA/V which is obtained with $V_g = -1.5$ V and $V_a = 90$ V. The low working anode voltage allows the two triodes to be series connected across an H.T. supply of 180 V.

DATA

HEATER

I_h	...	...	...	...	0.3 A
V_h	...	...	...	...	7.0 V

CAPACITANCES (Measured without external shield)

$C_{a'-g'}$	...	...	...	1.1 μF
$C_{in'}$	...	...	...	2.3 μF
$C_{out'}$	...	...	...	0.45 μF
$C_{g'-h}$	...	...	...	< 0.25 μF
$C_{a''-g''}$	...	...	...	2.3 μF
$C_{a''-g''+h}$	...	...	...	2.5 μF
$C_{a''-k''}$	...	...	...	0.16 μF
$C_{k''-g''+h}$	...	...	...	4.7 μF
$C_{h-k''}$	...	...	...	2.7 μF
$C_{g'-a''}$	...	...	...	< 0.006 μF
$C_{a'-a''}$	...	...	...	< 0.035 μF
$C_{a'-k'+h+g''}$	...	...	...	1.2 μF

CHARACTERISTICS (Each section)

V_a	...	...	...	90 V
I_a	...	...	...	12 mA
V_g	...	...	...	-1.5 V
g_m	...	...	...	6.0 mA/V
μ	...	...	...	24

LIMITING VALUES (Each section unless otherwise specified)

$V_{a(b)} \text{ max.}$	...	...	...	550 V
$V_a \text{ max.}$	...	...	...	180 V
$p_a \text{ max.}$	...	...	...	2.0 W
$I_k \text{ max.}$	...	...	...	18 mA
$-V_g \text{ max.}$	...	...	...	50 V
* $V_{h-k''} \text{ (pk) max. (Heater negative)}$	...	...	...	250 V
$V_{h-k''} \text{ max. (Heater positive)}$	...	...	...	90 V
$V_{h-k'} \text{ max.}$	...	...	...	90 V
$R_{h-k} \text{ max.}$	...	...	...	20 k Ω

* Max. d.c. component = 180 V.

BASE B9A $\left\{ \begin{array}{l} a', g', k' \text{—grounded-grid connection.} \\ a'', g'', k'' \text{—grounded-cathode connection.} \end{array} \right.$



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

MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, W.C.2
MVM 272

Wireless World

MAY 1954

VOL. 60 No. 5

Political Television

WHEN the Government's proposals for competitive television were first put forward, this journal expressed the opinion that they lacked the air of reality. We found it hard to visualize the setting-up of a commercial service in the foreseeable future. Worse still, it seemed likely we were to get the worst of both worlds. Commercial television might not become established, but the promise (or threat, depending on one's personal view) of it might hamper orderly technical development by distracting attention from the essentials.

Now, nearly two years after this controversy was started by the issue of a new and "non-exclusive" licence to the B.B.C., Britain seems no nearer the establishment of a successful competitive television service. True, there has been a long succession of White Papers, reports and Parliamentary debates, culminating in the Television Bill now before the House of Commons, but to us and to many others the Government's plans look even less realistic than they did in 1952. There is at present a lull in the functioning of the legislative machine, and so the time seems appropriate for taking stock.

The Government has been widely commended for listening to criticisms of their original ideas and, indeed, they have gone far to meet them. Starting with the idea of full-blooded commercial competitiveness with sponsored programmes almost on American lines, they have gone all the way to the watered-down shadow of the B.B.C. represented by the proposed "Independent Television Authority" proposed in the Bill. Almost every detail of the original scheme has been abandoned except the principle of dependence on advertising revenue by the competitive system. Even that basic principle has been watered down by the proposed grant of £750,000 a year to the I.T.A. to meet the cost of what are called in America "sustaining programmes." The latest scheme seems unlikely to attract the kind of commercial support that is necessary for its success. As the *Financial Times* said, "The Govern-

ment has now spent the better part of two years backing away from its own principles. . . . If all these precautions, in such an endless succession, really are necessary, then the system stands condemned that needs them; if they really are enforced they could condemn the system to which they are applied. . . . Between the political risk and the financial, the companies which put their capital into this will need both courage and imagination."

Though, as we have said, the Government is to be commended for attempting to meet criticism, they cannot be praised for their general handling of the matter. Probably the worst mistake was in the selection of their advisers, the Television Advisory Committee, which we criticized at the time as a queer and ill-assorted body for such a task. The T.A.C. was originally appointed with the widest terms of reference, but, no sooner did its membership come under criticism than we were told it was primarily appointed to advise on technical matters—in spite of the fact that none of the members had technical qualifications! Next, presumably to remedy this deficiency, a strong technical sub-committee was appointed, thus making the advisory machinery unnecessarily cumbersome.

In spite of having tried everything, the Government has failed to produce a scheme for commercial competitive television that arouses the slightest enthusiasm. So far as radio circles are concerned, we have heard little that amounts even to lukewarm approval, whether from the technical or professional branches, from industry or the trade. The scheme is widely considered to be wasteful and inefficient, and unlikely to lead to the healthy development of television. Heated discussion of matters of merely political significance has distracted our attention from the real technical problems. The only genuine supporters of the Bill are probably those who, fearing the effect of television advertising, feel the scheme proposed is foredoomed to failure and so it is in their interest to foster it.

Components Exhibition

Trends in Developments Portrayed at the R.E.C.M.F. Show

We review in these pages the trends in design and manufacture of components and accessories shown at the eleventh annual exhibition organized by the Radio and Electronic Component Manufacturers' Federation. Although a "private exhibition," the show, held in London from April 6th to 8th, again drew large crowds, including many overseas visitors. In addition to describing in detail some individual components, we give under each heading a list of exhibitors and their principal products. Test and measuring equipment, valves and semi-conductors are not included in this review, but will be covered in our survey of the Physical Society exhibition in the next issue. New sound-reproducing equipment will also be described later.

RESISTORS

ONE of the newest developments in resistor construction is the metallized film technique which provides very high stability under conditions of widely varying temperature. The basic principles were illustrated by one exhibit on the Ministry of Supply's stand. A metallic oxide film (tin is one of the constituents) is fired at 600°C on to a small-diameter glass tube or rod, the ends are plated and silvered, and connecting wires soldered on. The metal film is then cut spirally to provide the required resistance value and finally coated or encased to protect the surface. A 4-k Ω resistor of this kind has a temperature coefficient of 0.0003 and showed no change after 2,000 hours' use.

In production form it is exemplified by the Painton "Metholm" and the technique is applied also to attenuator plates and potentiometer tracks. Welwyn also has a range of metal-film, high-stability resistors on glass rods suitably protected.

Apart from detailed improvements and some additions to existing types, several firms, prominent among which is Eric, have developed special sub-miniature ranges of resistors principally for use with transistors. Low current consumption allows the use of $\frac{1}{8}$ - or $\frac{1}{16}$ -watt resistors.

An unusual use of a surge-limiting resistor, such as a Brimistor (S.T.C.), is to protect the contacts on mains switches embodied in volume controls and such-like composite components. A special type (the CZ9A) is available with operating resistance of 5.2 Ω at 1 A and a "cold" resistance of 800 Ω .

Makers*: A.B. Metal (C. W.); Advance (A.); Brit. Elect. Res. (W.); Colvern (W.); Dubilier (C. H. W.); Egen (C.); Electronic Comp. (A. W.); Electrothermal (H.); Erg (H. W.); Eric (C. H. W.); Morganite (C.); N.S.F. (C. W.); Painton (A. H. W.); Plessey (C. W.); Pye (W.); Welwyn (C. H. W.).

* Abbreviations: A, attenuators; C, carbon; H, high stability; W, wirewound.

CAPACITORS

A NEW type of electrolytic capacitor was shown this year by T.C.C. Known as the Superlitic, it has an insulation resistance comparable to that of a paper-dielectric type and so can be used for grid coupling in audio amplifiers where large capacitance in a small volume is required.

New developments in the capacitor field were seen also, among the Ministry of Supply's exhibits where a type was shown described as a "metallized anodic aluminium film capacitor." It consists of a thin aluminium foil coated with a 0.2-mil thick layer of aluminium oxide on which is deposited by evaporation a 0.2-mil thick layer of aluminium. It is said to have self-healing properties and produces 1 μ F of capacitance per 200 square

centimetres of material and shows a good power factor.

The likelihood of Band III television and Band II sound broadcasting coming to fruition shortly has led this year to greater prominence being given to all types of v.h.f. capacitors than might otherwise have been the case. Cyldon has an extensive range of air-dielectric trimmers and variables of less than 1 cu in, which provide capacitances up to 30 pF maximum; Eddystone has a new range of miniature Microdensers, including single, split-stator and butterfly types, the largest being 50 pF, and Eric has a wide range of "high k" ceramic pre-set trimmers, stand-off and lead-through capacitors for direct fixing to the chassis.

By-pass capacitors are usually soldered in place, but the pre-sets generally have a "Spire" or similar type of fitting. Other examples of this type are made by Cyldon, T.C.C. and Wingrove and Rogers.

Dubilier has a new miniature ceramic television by-pass capacitor which possesses practically negligible inductance up to and beyond Band III frequencies. It is suitable for by-pass and lead-through applications and is fixed by soldering to the chassis. The nominal capacitance is 1,500 pF.

A new two-gang tuning capacitor introduced by Plessey has separate sections for tuning the v.h.f. circuits of a combined f.m. and normal broadcast receiver. Extra thick vanes are used to prevent microphony and give stability for the v.h.f. sections, which also have separate rotor connections.

Makers*: B.I. Callenders (P); Cyldon (V); Daly (E); Dubilier (C. E. M. P. V); Eddystone (V); Eric (C. V); Hunt (E. M. P); J.B. (V); L.E.M. (C. M); Mullard (V); Plessey (C. E. V); S.T.C. (E); Stability Radio (C. M); Static Cond (P); Suffix (F); T.C.C. (C. E. F. M. P. V); T.M.C. (F. M. P); Walter (V); Wego (F. M. P); Welwyn (V); Wingrove and Rogers (V).

* Abbreviations: C, ceramic; E, electrolytic; F, plastic film; M, mica, including silvered mica; P, paper; V, variables, including trimmers.

TRANSFORMERS AND COILS

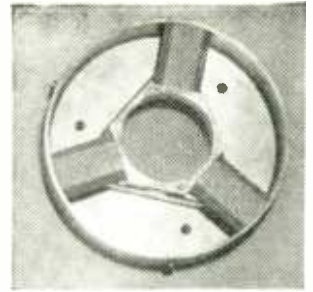
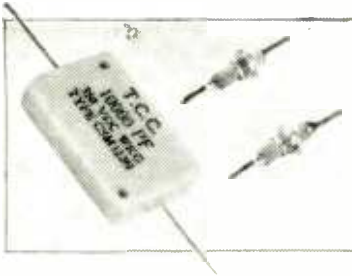
LAST year saw the introduction by Ferranti and Parmeko of iron-cored transformers encased in a particularly tough potting resin. It effectively seals the components and inhibits the ingress of moisture and is especially suitable for tropical conditions.

This year the technique is extended to certain models made by Gresham, Whiteley Electrical and Woden; while the resins are substantially the same in character they differ widely in appearance and each make is quite distinctive. High pillars can conveniently be cast in the moulding process should it be necessary to provide extra long leakage paths for high-voltage terminals.

When v.h.f. broadcasting becomes an established service, transformers for high-quality reproduction will be more in demand than is perhaps the case at present. In anticipation of this Partridge has produced an output transformer with a response characteristic flat to within +0.5 db from 30 to 30,000 c/s. Known as the Type UL2 it has a primary inductance of 200 H in push-pull operation and is rated at 50 W from 60 c/s up and 14 W at 30 c/s.

Radio-frequency coils remain substantially unchanged although Weymouth has a few new miniature types. For f.m. receivers Eddystone has a range of transformers and discriminators for i.f.s of 5.2 and 10.7 Mc/s. They measure $\frac{1}{6}$ in square and $2\frac{1}{2}$ in high and conform well to modern schemes of miniaturization.

Makers: Advance, Associated Electronic, Bulgim, Elac, Ferranti, Gresham, Igranic, Parmeko, Partridge, Plessey, R & A, Rolacelston, T.M.C., Weymouth, W.B., Woden, Wearite.



Left : T.C.C. moulded "Plimoseal" capacitor and v.h.f. lead-through capacitor. Centre : Plessey a.m. f.m. two-gang capacitor with extra rigid v.h.f. capacitor vanes. Right : Interior of James Neill focus unit with three radial magnets.



Eddystone 10.7-Mc s. f.m. discriminator unit.

TELEVISION COMPONENTS

ALTHOUGH hardly components in the accepted sense of the word, television tuners are conveniently dealt with under this heading. They are actually sub-assemblies which accept an r.f. input and provide an i.f. output. Such tuners are new to British television for, although certain models have been shown in previous exhibitions, they have hitherto been intended for the export market. It is the prospect of alternative television programmes that has made it necessary to provide British receivers with some form of rapid station selection.

The tuners exhibited are all fundamentally of the same nature and are of the turret type. Provision is normally made for 12 channels, five on Band I and up to seven on higher frequencies. The valves and main components are assembled on a small and deep chassis with the coil connections terminating on spring contacts. The coils are assembled in a rotating framework—the turret—each coil or group of coils being mounted on an insulating strip bearing contacts which press against the springs. Rotating the coil assembly brings each coil in turn not only into electrical circuit but physically into a position where it is connected by the shortest possible leads.

The electrical circuit usually comprises a double-triode connected as a cascade r.f. amplifier and a triode-pentode acting as a mixer and oscillator. There are three coils for each channel, one for the aerial coupling, one for the interval coupling and one for the oscillator. The interval valve and oscillator coils are usually mounted together on one contact strip, but the aerial coil is separate on a second contact strip. This is done so that screening can be inserted between them.

Screening is actually quite an important matter, not so much to maintain stability as to minimize radiation from the oscillator.

The Cyldon unit has been available for some time in a five-channel form for Band I only and a 12-channel model originally designed for export. The Ediswan-Clix tuner is a newcomer. The coils have brass slugs for trimming. One coil for each channel is mounted longitudinally with its trimmer accessible from the end; the other two are mounted radially and the trimmers can be reached from the outside surface of the turret. In the Plessey tuner, however, all coils are longitudinally mounted and the trimmers are accessible from the two ends, one

core being hollow to permit a tool to pass through to reach the middle one.

An unusual r.f. component is the Labgear television high-pass filter. This is a small unit for inserting in the aerial feeder to the set. In Band I it introduces a loss of 0.7-1 db only but at 35 Mc/s it attenuates by some 20 db and at 30 Mc/s by 40 db. At lower frequencies the attenuation is still higher. Its purpose is to prevent interference from signals on the frequency of the i.f. amplifier.

Little change has taken place in scanning circuits or components for them. Line-scan transformers and deflector coils with ferrite, or similar, cores are now general and changes are in the matter of detail only. More development seems to have occurred in focusing components. The permanent magnet appears to have come to stay and only one example of an electromagnet (Igranic) was noticed. The difficulty with a p.m. system is always to obtain an adjustable field and, hitherto, the favourite method has been to use two ring magnets in opposition. Examples of this are the Electro Acoustic Industries Duomag unit, introduced some time ago, and the new and more compact Duomagnette. In these, the magnets are Magnadur rings and the field strength is controlled by varying their spacing. This same basic form of construction is adopted by Goodmans in a unit which embodies shuffle-plates for picture centring.

A radically different form of construction is adopted by James Neill. Three short bar magnets are mounted radially between a central hollow core and a pressed steel case. The case is in two parts movable with respect to each other. There are two air gaps, one between the core and one half of the case and the other between the core and the other half. One gap is fixed; the other gap is adjustable for focusing by moving one half of the casing. The unit is compact and is claimed to make very economical use of the magnetic material and to have a very small external field; so small in fact that a shuffle plate cannot be used for picture centring. A similar form of construction is adopted by Marrison and Catherall.

Ion-trap magnets and centring magnets are further

Turret of Ediswan-Clix television tuner with some coil units removed to show interior.



devices to which the permanent magnet finds application. In the latter, the tendency is towards the use of a pair of ring magnets which can be rotated to act in opposition or to help each other as a means of varying the field strength. In their simplest form, they are wire rings mounted on cards for adjustment purposes.

*Makers: Cydon (T); Carr Fastener (C); Ediswan-Clix (T); Electro Acoustic Industries (F); Goodmans (F); Igranic (D, F, Tr); Labgear (Fi); Long & Hambly (M); Marrison & Catherall (F); James Neill (Fi); Plessey (D, F, T, Tr); Thermo-Plastics (M); Weymouth (D, Tr); W.B. (D, F, Tr).
*Abbreviations: C, connectors; D, deflector coils; F, focus units; Fi, filters; M, masks; T, tuners; Tr, transformers.

SUB-ASSEMBLIES

WHERE space is at a premium, as it seems to be in most Service equipments, the resin potting technique, as applied to sub-assemblies, has definite advantages. It enables the three-dimensional form of construction to be fully exploited as components can be stacked vertically to any height in a secure fashion, thus saving valuable chassis space. This is well exemplified by the various potted assemblies included in the Gresham and Whiteley Electrical exhibits.

Printed circuitry was not much in evidence, although Hunt had several examples and Erie are using it for various resistance-capacitance units in order to save space and receiver assembly time.

Television suppressors figured among the exhibits of several firms. Dubilier showed a number of new types, also separate components in the form of special capacitors and chokes for fitting inside small electrical tools and domestic appliances. Belling-Lee has various types; one, the "Telefilter," as it is called, is joined in the mains lead to the device and contains a pair of r.f. chokes giving 20-db suppression over 40-70 Mc/s.

AERIALS

DESPITE uncertainty regarding the actual requirements for Band III television, Aerialite, Antiference, Belling-Lee and Wolsey all showed prototype models of new aerials. Most makers seem to anticipate that 4- or 5-element yagis will be the popular type in areas normally served by "H" aerials on Band I. As the polarization question is still fluid no attempt was made to combine Band I and III aerials.

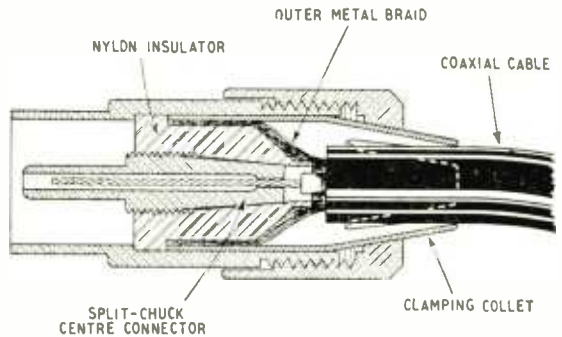
Apart from these prototypes the main changes have been in details only. For example, Belling-Lee has a new flush-fitting coaxial chassis socket, the first departure from the customary stand-off pattern; Wolsey has evolved a solderless coaxial cable plug in which the outer braiding and the centre conductor are simultaneously secured by tightening the milled head. The insulator is nylon. Wolsey also has added a "delta" matching section to its "X"-type aerials fitting conveniently in the angle of one of the two "Vs." As the centre impedance of this type of aerial is rather low, the better matching to the feeder must lead to a worth-while improvement.

Some extremely attractive miniature coaxial plugs and sockets were seen on the Transradio stand and Pye was showing a sealed coaxial plug and socket for television and radar use, as well as a range of the more elaborate design which has become familiarly known as the "Pye" plug and socket.

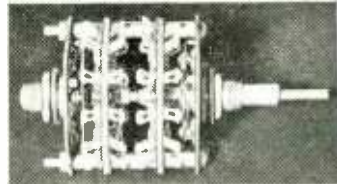
Makers: Aerialite (B, C, S, T); Antiference (B, C, S, T); B.I. Callenders (C); Belling-Lee (B, C, S, T); Henleys (C); Pye (S); Transradio (C, S); Wolsey (C, S, T).
Abbreviations: B, sound broadcast; C, cables and feeders; S, socketry; T, television.

SWITCHES

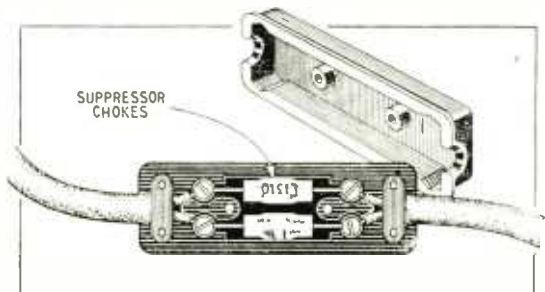
A DOUBLE rotary switch with its two wafers independently controlled from the same shaft was an interesting feature of the Walter Instruments display this year. The trick is accomplished with concentric spindles, an outer one controlling the near wafer while a thin inner one passes right through its middle to the second wafer



Wolsey "no soldering" coaxial cable plug.



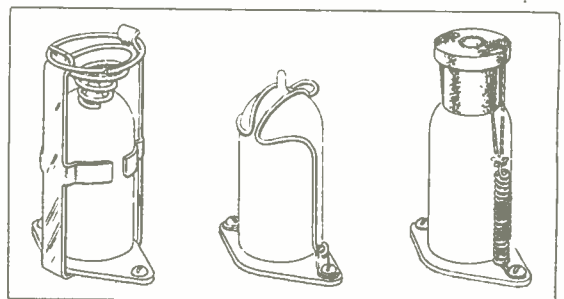
Rotary switch by Walter Instruments with independent coaxial spindles controlling two wafers.



Belling-Lee "Telefilter" appliance suppressor.



Painton miniature plugs and sockets.



Different methods of retaining valves as exemplified by (left to right) McMurdo, Spear and Electrothermal.

behind. Another similar device was a rotary switch with a hollow spindle designed to accommodate the shaft of a potentiometer; versions were shown by both Walter Instruments and Plessey. High insulation resistance was the main feature of a new rotary switch by N.S.F., which had almost all its working parts, except the wafer, moulded in Nylon. The well-known micro-switches made by Bulgin have now been incorporated in a new kind of multiple switch. They are ganged together and operated by Bakelite cams on a rotating control shaft; up to 12 units can be assembled in this way.

Makers: A.B. Metal Products; Belling-Lee; B.E.R.C.O.; Bulgin; Diamond H Switches; Electronic Components; Electrothermal Engineering; Eric Resistor; N.S.F.; Painton; Plessey; Pye; T.M.C.; Walter Instruments; Whiteley; Wright and Weaire.

CHASSIS FITTINGS

TWO topical items on the Carr Fastener stand were sockets for transistors and valveholders for printed circuits. The transistor holders were basically the same as B5A sub-miniature valveholders, only with three sockets (or four for the new tetrodes) instead of the usual five. The valveholders, moulded in a thermo-setting material called Mikacin, have short tags which get through holes in the printed circuit base-plate and are bent over and soldered on to the printed "wires." Some multi-way plugs and sockets shown by this firm also had bodies moulded in Mikacin. A special feature of these was the design of the socket unit, which had 16 spring fingers gripping the inserted plug pin, thereby giving very low contact resistance. A set of spring fingers was also used in an anode-cap connector intended for the more recent cathode-ray tubes with recessed caps.

On the subject of making connections, Belling-Lee were showing a new terminal which will make contact with cables without the necessity of stripping their insulation. A set of teeth inside the terminal pierces the insulation and grips the conductor when the top is screwed down. Another interesting connecting device, shown by McMurdo, was a multi-way tag-strip in rod form which can be built up as required from double-ended soldering tags sandwiched between Bakelite spacers on a screw or rod.

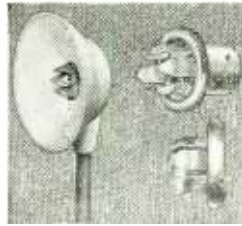
There were quite a few different types of valve retainers to be seen, perhaps the simplest being an ingeniously bent piece of wire on the Spear Engineering stand. For securing flying-lead valves McMurdo had a PTFE holder, with tags to which the leads are soldered, with a metal envelope-clamp, made in two interlocking sections, which grips the bulb along its entire length and helps to conduct the heat away.

The unit-construction principle was represented in two different ways. First, by a "honeycomb" type of steel rack, on the Hassett and Harper stand, designed to accommodate a large number of small slide-in chassis of miniaturized equipment. Secondly, by an interesting type of valve-circuit assembly which carries the valve and all the associated components required for a complete functional unit—say a binary counting stage. The valve-circuit components are wired between the base of the valveholder and a circular platform, containing soldering tags, mounted below it on a central supporting column.

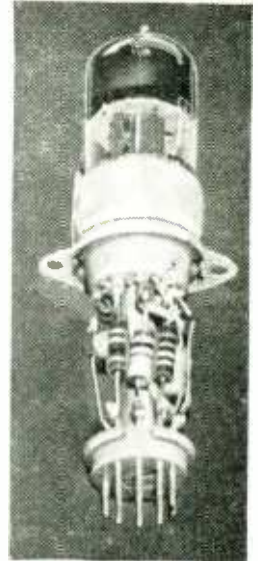
An unusual type of ceramic coil former shown by the United Insulator Company was fitted with dust-core tuning slugs and adjusting screws at both ends, the design being suitable for an i.f. transformer. This firm also had an insulated lead-through with the extra feature of a metal flange round the ceramic tube for fixing it to the chassis.

VIBRATORS AND RELAYS

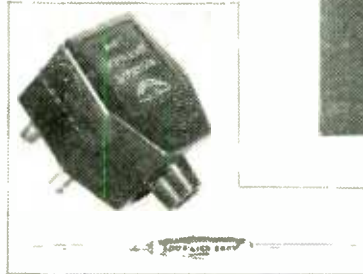
IN order to produce a really light-weight vibrator power supply for the airborne units of a radar sonde, Wimbledon Engineering have designed a vibrator which weighs less than 1 oz. It has no bob on the vibrating armature and operates at about 400 c/s. Working from a



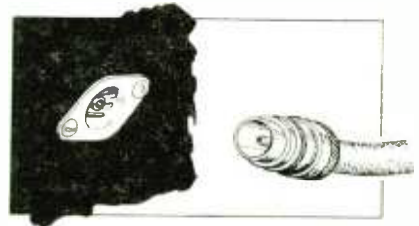
(Above) Anode-cap connector for c.r. tubes with recessed caps (Carr Fastener).



(Below) Dubilier suppressed mains plug and television suppression choke for small electric appliances.



(Above) McMurdo valve-circuit support.

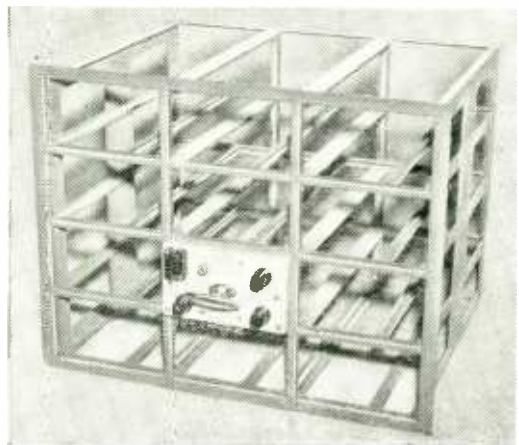


(Right) Belling-Lee flush-fitting coaxial socket.



(Left) Coil former with dust-core tuning slugs at both ends, made by United Insulator Company.

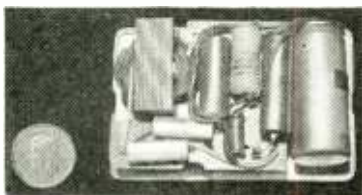
(Below) Hassett and Harper "honeycomb" rack for miniaturized equipment.





(Left) Miniature relay shown by the Ministry of Supply.

(Right) Wimbledon light-weight vibrator power pack compared with a florin for size.



(Left) Solenoid-type balanced relay by Pye.

6-V or 12-V battery, it will give an h.t. supply of up to 50 mA at 100 V, 0.6 mA at 800 V or 3 μ A at 1,000 V, and has an average life of about 200-250 hours. It is a non-synchronous type, the rectification being done by selenium rectifiers following a step-up transformer. The complete power pack weighs under 8 oz.

For airborne units of a more deadly type the Ministry of Supply were showing what must be one of the smallest relays in existence. Fitted into its case, it measures approximately $\frac{1}{2}$ in cube and weighs $\frac{1}{4}$ oz. The armature is in the form of a partially rotating shaft and requires an operating power in the energizing coil of 700 mW. The platinum contacts will switch circuits carrying up to 300 mA or 100 V, while the whole device will withstand accelerations of up to 12 g.

Another relay designed for operation under conditions of high acceleration was shown on the Pye stand. This works on the solenoid principle, the contacts being operated from the sliding-rod armature through a lever mechanism. One advantage of this type of action is that it avoids contact sticking. The contact combination has two poles normally open and two poles normally closed and will carry up to 20 A at 24 V.

Other influences which can affect the operation of a relay are changes in temperature and external magnetic fields. In the Plessey voltage regulating relay (designed to maintain constant the input voltage to vibrator power supplies) temperature compensation is provided by an external swamp resistance of zero temperature coefficient and a bimetallic strip which varies the tension of the control spring. The effects of magnetic fields are eliminated by a screening container. In addition the Radiometal armature is balanced for stability under mechanical shock.

Makers*: Plessey (V), Pye (R); S.T.C. (R); Stratton & Co. (V); T.M.C. (R); Walter Instruments (R); Wimbledon Engineering (V); Wright & Weaire (V).

*Abbreviations: V, vibrators; R, relays.

MATERIALS

FULL advantage is being taken by wire manufacturers of new synthetic plastic insulants in producing improved coverings for "enamelled" wire. In addition to the

established oil-based and vinyl acetal, coatings are now available in silicones for high-temperature working, and development is proceeding with a new substance—polyurethane—which, in addition to possessing the primary properties of good flexibility and abrasion resistance, has favourable characteristics as a soldering flux. For purposes where a woven textile covering is required, Terylene fibre is now offered as an alternative to silk and cotton. In addition to its improved moisture temperature and abrasion resistance, Terylene is immune from attack by fungi and bacteria.

Methods of extruding p.v.c. sleeving in striped multiple colours for wiring identification have been developed by several firms, and H. D. Symons were showing coloured silicone sleeving with bores ranging from 0.5 to 12 mm.

Resistance wire made by Vactite is now drawn to a diameter of 0.0005 in—half the thickness of 50 s.w.g.

Fine meshes for valve electrodes, fabricated by Murex in molybdenum and tantalum, include an expanded metal mesh which is an outstanding example of the art of the stamper and piercer.

Among cables for high frequencies a new helical-membrane 75- Ω coaxial of $1\frac{1}{4}$ in diameter (Type HM7A1) is being made by Telcon, who are also adding a duplicate series of 50-ohm cables to the range. B.I. Callender's Cables showed a range of couplers for their r.f. cables which includes the Mark IVa which is smaller than those used for television camera cables and has been designed for centimetre communication equipment. Screened "quad" cables for television relay distribution were shown by Telcon.

The special properties of nickel in forming a close bond with ceramic materials is being exploited by many of the insulator manufacturers in producing more reliable bushes for hermetically sealed components. Barium titanate ceramics for supersonic transducers are available from Plessey under the trade name "Casonic."

A new ceramic insulator "Faradex H₁" with a permittivity of 3,200 has been developed as a dielectric for bypass capacitors by Steatite and Porcelain Products, who have also introduced "Frequentite S," a steatite-type material with a loss (tan δ) of less than 0.0002. It is free from porosity and can be used as an envelope for e.h.f. valves.

Silvering solutions for depositing electrodes on ceramic insulators are now available from the United Insulator Company.

A mica-loaded vitreous material, "Mycalon," developed by the Mycalox Company contains a low-melting-point glass which enables it to be injection-moulded. It complies with Inter-service Specification R.C.S.11 (accelerated tropical humidity) and its initial surface resistivity of 10^{12} is recovered within $1\frac{1}{2}$ to 2 hours.

Multicore solders now contain five cores, and "362" fast-flux cores and extra-fast "366" can be supplied, if required, without extra cost. One of the problems of efficient soldering is to ensure rapid release of the flux core, and in the latest Enthoven special solder washers the sheet material from which they are stamped contains a striped flux core which leaves microscopic vents at the edges from which the flux can escape before the solder melts.

Makers*: Associated Technical Manufacturers (B, C, IM, IS, W); Bakelite (IM); Geo. Bray (CE); B.I. Callenders (C, CO, IS, W); British Moulded Plastics (IM); Bullers (CE); Clarke (CF, IM, IS); Connollys (IM, W); Creators (IS); De La Rue (IM); Duratube and Wire (C, CO, IS, W); Enthoven (S); Fine Wires (W); Hellerman (IM, IS); Henley's (CO, IM, W); London Electric Wire (CO, W); Long and Hambly (IM, IS, RP); Magnetic and Electrical Alloys (L, M); Morrison and Cathrall (M); Micanite and Insulators (CF, B, CO, IM, IS); Mullard (DC, M); Multicore (S); Murex (RM, M); Mycalox (IM); James Neill (M); Plessey (CE); Reliance Wire (B, C, CO, IS, W); Salford (DC, M); Geo. L. Scott (L); S.T.C. (M); Steatite (CE); Suffex (B, CO, IM, IS, W); Swift Levick (M); H. D. Symons (IM, IS); Telcon (C, DC, L, M, RM, W); Thermo Plastics (CF, IM); Transradio (C, IS, W); Tufnol (M); United Insulator (CF, CE, IM); Vactite Wire (RM, W).

*Abbreviations: B, braiding; C, cables, CE, ceramics; CF, coil formers, bobbins; CO, cords; DC, dust cores; IM, insulating materials; IS, insulating sleeving; L, laminations; M, magnets and magnetic alloys; RM, refractory metals; RP, rubber products; S, solder; W, bare or covered wires.

Band III Converter

Simple Circuit for Adapting Band I Television Sets

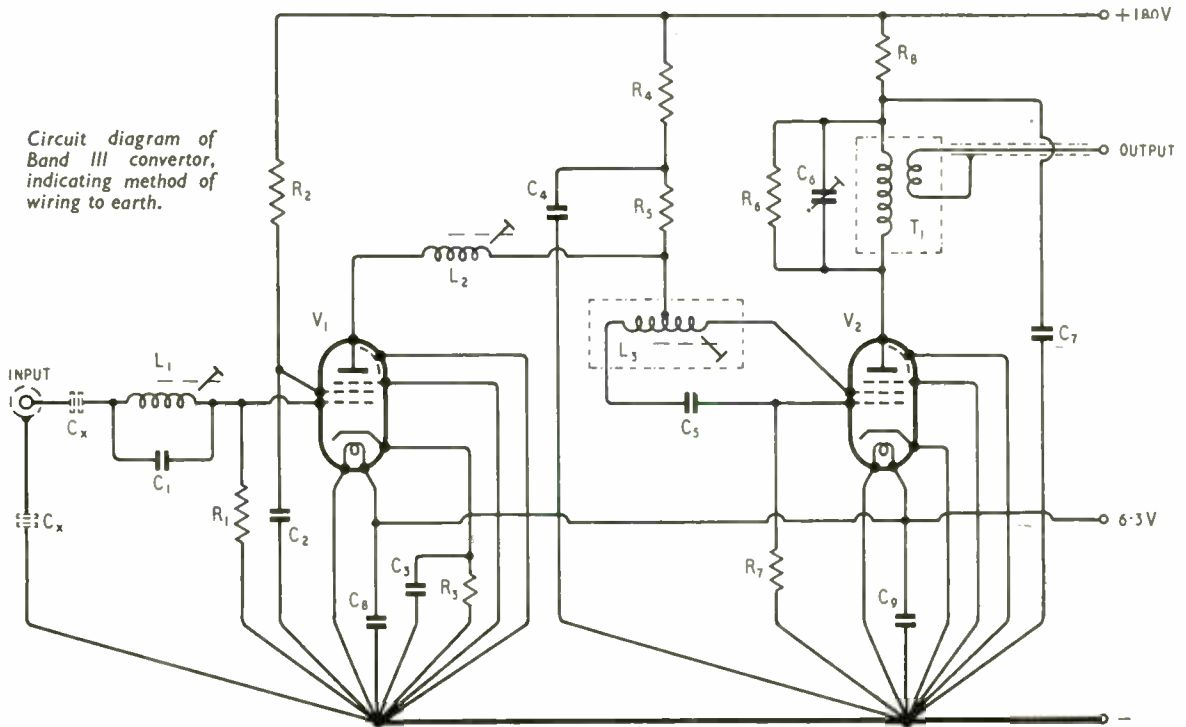
By G. H. RUSSELL, Assoc. Brit. I.R.E.

VARIOUS Government pronouncements of recent date have made it clear that television broadcasting on Band III is imminent. For this purpose two channels have been made available between 186 and 196 Mc/s. It is also apparent that no further channels in this band will be placed at the disposal of television broadcasting for some considerable time, and this limitation means that for some years only one programme in Band III will be receivable in any given area. Receivers capable of covering both Bands I and III are appearing in the shops in increasing numbers, and in due course only this type of receiver will be available. In the meantime, large numbers of perfectly good single-band receivers will require converters if their owners are to receive the alternative programme.

As the two available channels are adjacent to one another and as only one of these will be required in any one location, it is possible to construct an extremely simple pre-set-tuned converter. It is obviously desirable that no re-tuning of the receiver should be necessary when changing stations. To achieve this the converter intermediate frequency must be tunable over the greater part of Band I,

and the converter must be capable of tuning to either of the two channels in Band III with an i.f. corresponding to any one of the five channels in Band I. It is also highly desirable, if not essential, that the sound and vision signals be presented to the receiver in their normal relationship, that is, with the sound signal lower in frequency than the vision signal. Otherwise trouble may be experienced with sound rejection. This requirement necessitates the oscillator frequency being on the low side of the signal frequency. From the foregoing the following facts can be derived. The converter i.f. should be tunable between the approximate limits of 45 and 68 Mc/s and the oscillator between 120 and 150 Mc/s.

The circuit of a converter that will satisfy these requirements is shown in Fig. 1. A self-oscillating type of mixer (which is very efficient) is used and its output is fed to the receiver via the step-down i.f. transformer T_1 . The primary of this transformer is tunable over the required range with an air-spaced trimmer and is shunted by a resistance to ensure adequate bandwidth. The oscillator is a conventional Colpitts circuit with the screen grid of the valve acting as the oscillator anode, the tuning



Circuit diagram of Band III converter, indicating method of wiring to earth.

capacitance being provided by the internal capacitances of the valve and the external capacitances of the valveholder and wiring. Tuning is effected by means of an iron-dust core, and as the range will be affected to a considerable extent by the wiring it may be necessary to adjust the turns-spacing of the coil and to add a small capacitor, between 1 and 3pF, across the coil if it is desired to cover the whole range. On the other hand, as it will almost invariably be required to cover only a part of the range for any given reception area, adjustment of the coil should prove sufficient by itself. It is of interest to note that to achieve the wide tuning range by means of an iron-core adjustment a comparatively large coil is necessary, and this is made possible because the stray capacitance across the coil in this circuit is some 6.5 pF.

The output of the r.f. amplifier is taken to the mixer via a π -filter and is injected into a centre-tap on the oscillator coil. This being a "dead" point as far as the oscillator is concerned, very little "pulling" between the r.f. and oscillator circuits takes place. To keep this effect to a minimum the centre-tap should be made very carefully. The use of the π -filter has the great advantage of placing the r.f. output and mixer input capacitances in series, resulting in a total tuning capacitance of about 3 pF.

The r.f. input circuit is untuned as little is to be gained by tuning it. The coil that would be required for this purpose would of necessity have to be very small and no step-up between the aerial and the grid would be possible. In fact, at these frequencies it usually results in a loss. Instead a resistance of 100 Ω is used, and this, in conjunction with the valve damping, results in an input impedance of some 80 Ω .

One of the greatest difficulties that may arise with a combination such as this, where the receiver remains tuned to the Band I frequency, is to obtain sufficient attenuation of the Band I signal when receiving the Band III signal. To assist this attenuation the filter L_1C_1 is inserted and tuned to the appropriate Band I frequency. In this respect it is necessary to emphasize very strongly that great care must be taken with

screening to prevent stray pick-up. The whole of the underside of the chassis must be completely screened, as well as such obvious components as the i.f. transformer and the oscillator coil. Quite apart from the problem of preventing unwanted pick-up of the Band I signal, these precautions are necessary from the point of view of oscillator radiation. Particular attention must be paid to the lead connecting the convertor to the receiver. Good screening, in conjunction with the filter, results in an attenuation ratio better than 40 db.

Being an extremely simple device, there are bound to be occasions when it may prove inadequate, but with a little thought these inadequacies may be overcome. For example, should it be used in an area where it is subject to an exceptionally strong signal from Band I and a rather weak signal from Band III, a further filter can be added in series with L_1C_1 , which would increase the attenuation ratio to about 60 db. Alternatively, as the second-channel rejection properties are rather poor greater interference may be experienced from this source than from the Band I signal, and under these conditions it may be more advantageous to have a filter tuned to the image frequency. Similarly, if difficulty is experienced with oscillator radiation, a further filter tuned to the oscillator frequency can be inserted. It is rather too early to assess what sort of conditions will prevail, but it is fairly safe to assume that for the vast majority of cases the convertor should prove adequate as it stands.

There is, however, one other possible cause of interference which should be mentioned here. If the convertor is used with a receiver in which the oscillator radiation is of a high order, it is possible that with an unfortunate combination of circumstances the Band III signal may suffer interference from harmonics of the receiver oscillator. In this event the simplest cure is to detune the receiver and retune the convertor accordingly. This is unfortunate, as it detracts somewhat from the simplicity of operation, but as it is only likely to occur in a few instances it can hardly be said to depreciate the usefulness of the convertor.

Alignment Procedure

A signal generator is unnecessary for aligning the unit if a Band I signal and a Band III signal are available. The procedure is as follows. Connect power supplies to the convertor and its output to the input of the receiver, after disconnecting the Band I aerial from the receiver. Connect the Band I aerial directly to the grid of the r.f. valve (via isolating capacitors if the chassis is live). Increase the contrast control of the receiver, if necessary, to obtain a picture. Then adjust the air-spaced trimmer C_6 for maximum response, readjusting the contrast control as required in order to maintain the signal at about the same level. Transfer the Band I aerial to the convertor input socket and adjust L_1 for minimum signal, again adjusting the contrast control as required. Next disconnect the Band I aerial and replace it with the Band III aerial. Tune in the Band III signal by adjusting the iron core in the oscillator coil and finally adjust L_2 for maximum response. The gain of the convertor is unity, so if the two signals are approximately equal in strength no readjustment of controls will be necessary when changing stations.

A few words about power supplies. The low-tension requirements are 6.3V, 0.6A and the high-tension 180V, 20mA. The unit will operate satisfac-

Coil Winding Data

L_1	..	..	10 turns, 26 s.w.g. enamelled copper wire, close-wound on Neosid former 356 8BA or 358/8BA.
L_2	..	..	2½ turns, 18 s.w.g. tinned copper wire wound 8 turns per inch. Former as for L_1 .
L_3	..	..	5½ turns, 18 s.w.g. tinned copper wire wound 8 turns per inch and centre-tapped. Former (Neosid 5000A) 0.3in diam, 1in min. length.
T_1	..	..	Primary: 7½ turns, 26 s.w.g. enamelled copper wire, close-wound. Secondary: 2½ turns, 26 s.w.g. enamelled copper wire, close-wound. Spacing: $\frac{1}{16}$ in. The secondary is wound nearest to h.t. end of primary. Former as for L_3 .

For L_3 and T_1 a top plate is required (Neosid 5001) to secure vertical wires to which the coil ends are soldered. A standard can $\frac{1}{8}$ in square by $1\frac{1}{2}$ in long will also be required for each former. Iron-dust cores: Neosid 500 500.

List of Components

V_1, V_2	.. ..	Mullard EF80.
C_1, C_5	.. ..	10 pF $\pm 10\%$, N750K Ceramicon.
$C_2, C_3, C_4, C_7,$ C_8, C_9	.. ..	0.001 μ F, 350 V, Hunts type W99.
C_6	.. ..	Air-spaced trimmer, 2-8 pF, Mullard.
C_x	.. ..	470 pF $\pm 20\%$, 1.75-kV working, Erie Isolator Ceramicon type CD9P/101. (Only necessary with "live" chassis.)
R_1	.. ..	100 Ω $\pm 10\%$, type RMA9.
R_2	.. ..	15k Ω $\pm 20\%$, type RMA9.
R_3	.. ..	180 Ω $\pm 10\%$, type RMA9.
R_4	.. ..	470 Ω $\pm 20\%$, type RMA9.
R_5, R_8	.. ..	2.2k Ω $\pm 10\%$, type RMA9.
R_6	.. ..	2.7k Ω $\pm 10\%$, type RMA9.
R_7	.. ..	22k Ω $\pm 20\%$, type RMA9.

torily but with some loss of gain down to 100V h.t., and at this figure the consumption is 10.5mA. It may be an advantage to operate the unit at this lower figure where the signal strength is high and the available power is limited. If the convertor is used in conjunction with an a.c. receiver, that is, one where the chassis is isolated and the heaters are in parallel, it will usually be found that the small amount of power required can be taken from the receiver with little trouble; but when used with the more common a.c./d.c. type of receiver a certain amount of manoeuvring may be necessary. The heater chain in the receiver can be broken at some convenient point, and the heaters of the convertor inserted there, after having observed the following precautions. The convertor's heaters must be wired in series. There are usually very good reasons why valve heaters are placed in a certain order, and those which lie closest to chassis potential should on no account be interfered with. Generally speaking, it will be safe to insert the convertor's heaters about half-way along the receiver heater chain. The valves used in the convertor are capable of withstanding 150V between cathode and heater. Lastly, it will be essential to ensure that the current flowing through the convertor's heaters is 0.3A. If the current is not correct resistance shunts will have to be used, either in the convertor or in the receiver. It would be far safer and more practical, however, to provide a separate power supply for the convertor heaters.

Regarding h.t. supplies, it will usually be found that in a.c./d.c. receivers every available milliamp is used and that there is nothing to spare. In that case a small high-tension unit can be built into the convertor. A suggested combination would be a selenium rectifier such as the S.T.C. DRM1, a 16+16 μ F capacitor for the reservoir and smoothing and a 2.2-k Ω resistor to complete the smoothing.

It should be unnecessary to add that the mains tapping must be adjusted to make up for the extra voltage required. As the unit adds an extra 12.6V to the receiver chain and as the mains tappings are usually arranged in 5- or 10-volt steps, the tappings will have to be placed 10V lower than is usual.

As it stands, changing from Band I to Band III simply involves disconnecting the Band I aerial from the receiver and connecting the converter output in its place. The Band III aerial can be left connected permanently to the convertor. This changing of connections may

be considered a nuisance but is probably the safest method. If a switch is used great care will have to be taken against stray pick-up of the Band I signal when using Band III and vice versa. The switch will have to be of high quality: one that will introduce the least possible leakage across the contacts. It will have to be mounted on top of the convertor chassis if the screening precautions are not to be defeated. Coaxial leads to the switch must be used with a minimum of exposed inner conductor.

The wiring of the convertor should, of course, conform to normal v.h.f. practice, with short, straight leads. It is really unnecessary to leave more than $\frac{1}{4}$ in of wire between a component and its connecting point, although it is unwise to reduce it much further as the component may become overheated during soldering. Soldering tags should be mounted close to the valve-holders they are associated with, and must make positive contact to chassis. The unit should be mounted in the receiver cabinet, or on the back as close to the receiver aerial socket as is convenient, and a short lead (coaxial or screened twin-feeder) used for the connection. Do not place the convertor in a position where it would interfere unduly with the receiver ventilation. Neither should it be mounted in a particularly warm area as this might cause trouble due to oscillator drift. In a relatively cool position with reasonable ventilation no trouble has been experienced with oscillator drift after the initial warming-up period of five to ten minutes.

Film on Valve-making

ANYONE who has been round a valve factory will appreciate the difficulties of putting valve manufacturing processes on the cinema screen. One usually leaves with one's head in a whirl, trying hard to remember things from the welter of machinery one has just seen, but not very successfully. This problem of extracting order out of apparent chaos must have been a real headache in the making of the new Mullard educational film "The Manufacture of Radio Valves," for here the whole business is compressed into the space of about 25 minutes.

The part of the film which sticks in the memory best of all is the introductory sequence, showing the individual parts of a valve and how they are assembled by hand, working from the heater outwards. This is all done slowly and deliberately and gives plenty of time for the images to sink in. The remainder is taken in the factory, starting with the raw materials and ending with the finished product. Here, however, the presentation is rather less effective, perhaps because the individual shots are not quite long enough—their average length being about five seconds. With such a rapid succession of different images of whirling and reciprocating machinery, one tends to become hypnotized and to lose sight of what is really happening. It might have been better to have selected just a few of the more important processes and given more time to them, filling in the details with the spoken commentary.

The film was made by National Screen Services and is available to technical colleges, schools and scientific associations from the Mullard Educational Service, Century House, Shaftesbury Avenue, London, W.C.2.

"Band III Television Aerials"

The effective radiated power of the transmitters to give the results shown in Fig. 2 on page 182 in last month's issue is 50kW. This should have been included among the other relevant data in the left-hand column.

“Grounded Grid” A.F. Amplifier

Possibility of Increased Undistorted Output

By THOMAS RODDAM

THERE is a peculiar difficulty which confronts the writer when he embarks on an article about cathode input valve amplifiers: the term grounded grid is almost universally used for this circuit arrangement* and the inverted amplifier seems to be a purely English name for a high-level version. Against this general acceptance of the more familiar “grounded grid,” however, we must set the general prejudice against the use of “ground” instead of “earth.” Between the Anglophiles and the Americophages the path is narrow; fortunately my shoulders are broad, broad enough to withstand even the whips of comment on this confusion of metaphors, and I propose to write “grounded grid” throughout this article.

I have not checked through the literature, but so far as my memory goes the grounded-grid amplifier was first introduced for use in medium-power broadcast transmitters. A typical arrangement was this: the broadcaster would start operations with a 2-kW “packaged” transmitter, and as his finances improved would add first a 10-kW grounded-grid package, and then a 30-kW grounded-grid package. Obviously this mode of operation was not a normal Western European one, but it suited, and still suits, the conditions in North and South America very well.

During the war the problem of receiver noise began to get the attention it deserves, and a new use appeared for the grounded-grid amplifier. When, in order to obtain a required range in radar, transmitter powers start approaching the megawatt order, even one decibel at the receiver becomes of critical importance, and amplifier circuits like the cascode find their application.

Special Case

The purpose of this article is to describe a much more pedestrian use of the grounded-grid circuit. It arose from one of those highly artificial problems which appear in some fields of telecommunications: I required to obtain the maximum possible output from one triode of a 12AT7 operating at 130 volts. The supply voltage will tell many readers at once that the equipment was to operate from telephone repeater station batteries. The restriction of valve type was to enable a piece of equipment to be designed using a single type throughout, so that the number of spare valves held in stock could be kept down. The power which can be taken out from a 12AT7 operated under normal Class A conditions with 130 volt supplies is about 25 mW, which was insufficient for the application in question. In a desperate search after more power the grounded-grid circuit was tried, and it was

found that the available output power could be raised to more than 100 mW. With the addition of local positive feedback a circuit which seems to have great potentialities was obtained. But let us start at the beginning.

The basic circuit of the grounded-grid amplifier is shown in Fig. 1(a). The input is applied between cathode and grid, and the output is taken between anode and grid. The grid is earthed. This description of the circuit, which follows the circuit diagram, is obviously nonsense, because the valve cannot possibly deliver any energy across the grid-anode terminal pair. The circuit has therefore been rearranged slightly, in Fig. 1(b), to show that the actual arrangement is a series one, the input, the anode-cathode path of the valve and the load being all in series. Rearranging again, in Fig. 1(c), we can get a rather different view of the circuit. Perhaps the sooner we go to the equivalent circuit the better.

Fig. 2 shows the equivalent circuit, consisting of the generator e with internal impedance R_1 , connected to the valve of parameters μ, ρ and the load R_2 . Round the loop there is a current i , which must satisfy the equation

$$e - \mu e_g = i(R_1 + \rho + R_2)$$

The grid-cathode voltage, e_g , is given by the equation

$$e_g = iR_1 - e \quad \text{so that}$$

$$e(1 + \mu) = i[(1 + \mu)R_1 + \rho + R_2]$$

The output voltage is equal to iR_2 , so that the voltage amplification of the circuit is

$$\frac{iR_2}{e} = \frac{(1 + \mu)R_2}{\rho + R_2 + (1 + \mu)R_1}$$

It is instructive to compare this expression with the corresponding form for the conventional grounded-cathode amplifier, with a resistance R_1 in the cathode lead:

$$m = \frac{\mu R_2}{\rho + R_2 + (1 + \mu)R_1}$$

The only difference is that the grounded-grid stage contains the term $(1 + \mu)$ instead of μ in the numerator. It is not quite the same as if the valve had a $\mu' = (1 + \mu)$ because the term $(1 + \mu)R_1$ is not altered.

The impedance seen by the load is, as can easily be calculated, $\rho + (1 + \mu)R_1$ but although mathematically this is exactly the form found for the usual grounded-cathode valve, R_1 has a rather special meaning in the grounded-grid stage: it is the source impedance of the input generator, which means that it depends on the previous valve in the circuit.

At low frequencies we never bother about the input impedance of a normal valve amplifier, because the resistance needed to provide the grid bias connection determines the input loading. Matters are very different in the grounded-grid amplifier. Facing

* In *Wireless World* it is generally called “earthed grid”—Ed.

the generator we have a load which is obviously equal

$$\text{to } e, i \text{ and } \frac{e}{i} = R_1 + \frac{\rho + R_2}{1 + \mu}$$

The R_1 term is the impedance of the generator itself, so that the input impedance of the grounded-grid valve circuit is

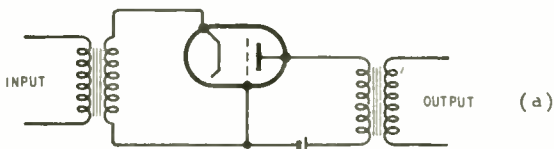
$$\frac{\rho + R_2}{1 + \mu}$$

In a typical circuit, R_2 will be somewhere between ρ and 2ρ so that the order of magnitude of R_{in} can be seen by taking

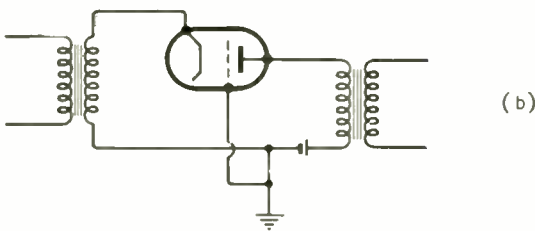
$$R_2 = 1.5\rho \text{ and then} \\ R_{in} = \frac{2.5 \cdot \rho}{1 + \mu} \approx \frac{2.5}{g_{in}}$$

and for a valve with $g_{in} = 5 \text{ mA/V}$, $R_{in} = 500 \text{ ohms}$.

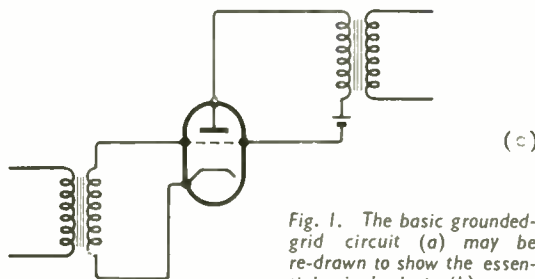
Here we see the limitation of the grounded-grid stage: instead of the relatively high input impedance of an ordinary grounded-cathode valve, we must produce the grid swing voltage across a rather small resistance. To get some idea of the orders of magnitude involved let us take as the approximate valve parameters $\mu = 50$ and $\rho = 10,000 \text{ ohms}$, with a load resistance $R_2 = 15,000 \text{ ohms}$. As we have seen, the input impedance is then 500 ohms. For full drive we shall need about 2 volts, which means that the power fed in at the cathode is 8 mW. This 2-volt input will produce a current through the loop of 4 mA, so that the power in the anode load will be $4^2 \times 15 = 240 \text{ mW}$. The power gain is only 30 times, or 14.8 db. The most immediate consequence of this result is that the preceding stage must be designed as a power amplifier rather than as a voltage amplifier.



(a)



(b)



(c)

Fig. 1. The basic grounded-grid circuit (a) may be re-drawn to show the essential single loop (b) or to obscure the circuit (c).

It is natural to ask why this relatively low-gain stage should be used at all: we can get very much more amplification from this particular valve by operating it in a conventional way. When we examine the valve characteristics, however, we find that provided the resistance in the grid circuit is low enough we can work a 12AT7 triode up to about $e_g = +3$ volts with excellent linearity. We can hardly get a lower grid resistance than by a direct earth connection, so that in a grounded-grid stage we can operate with very little standing bias and drive the valve across a very much larger part of the anode-current, anode-voltage characteristic. The low anode voltage which was one of the design conditions makes it certain that the anode dissipation will not be exceeded: the limitations are emission and grid heating. Subject to these limitations, the triode will give the sort of efficiency we usually associate with a pentode.

Grid Current Loading

In the circuit as shown, the grid current must be supplied by the signal source, as is usual in valve amplifiers, and the extra grid current loading is a cause of distortion. This changing input impedance distortion is one which we encounter in transistor circuits, too. Some reduction in the distortion from this cause, and other material advantages, can be obtained by using positive feedback. If we feed energy back from the output to the grid circuit the grid current loading is imposed on the output side, where more power is available, and the fractional loading is less. The use of feedback in the grounded-grid stage present one very interesting feature: there is

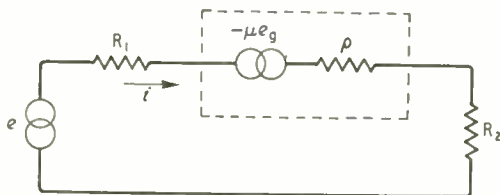


Fig. 2. The equivalent circuit is extremely simple.

complete separation of the input circuit and the feedback loop, until grid current flows.

Let us go back to the basic equation:

$$e - \mu e_g = i(R_1 + \rho + R_2)$$

and now let us add to the normal value of e_g a fraction of the anode voltage, kiR_2 so that we now have

$$e_g = iR_1 - e + kiR_2$$

from which

$$e(1 + \mu) = i[(1 + \mu)R_1 + \rho + (1 + \mu)kR_2]$$

This equation leads us to the following results, which need not be derived in detail:

$$\text{voltage amplification} = \frac{iR_2}{e} = \frac{(1 + \mu)R_2}{(1 + \mu)R_1 + \rho + (1 + \mu)kR_2}$$

$$\text{input impedance} = \frac{\rho}{1 + \mu} + \frac{1 + \mu k}{1 + \mu} R_2$$

$$\text{output impedance} = \frac{(1 + \mu)R_1 + \rho}{1 + \mu k}$$

If the feedback fraction k is zero, these results

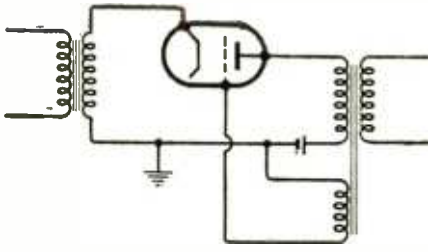


Fig. 3. To apply feedback, an additional winding is provided on the output transformer.

reduce to those which were obtained earlier, as we might expect. Positive values of k will reduce the gain, increase the input impedance and reduce the output impedance, as we should expect for negative voltage feedback. Our concern here is with positive feedback, for which we must consider negative values of k . In

the region $|k| < \frac{1}{\mu}$ the term $1 + \mu k$ is still positive,

but is becoming smaller as we apply more feedback. The voltage amplification and the output impedance will both rise, while the input impedance falls. At the particular value $k = -1/\mu$, $1 + \mu k = 0$ and the output impedance will become infinite, the input impedance will be $\rho/(1 + \mu)$ while the voltage amplification will be $(1 - \mu)R_2 / [(1 + \mu)R_1 + \rho]$. When we put in the typical numbers, the input impedance is seen to be about 200 ohms instead of 500 ohms : the voltage amplification must be considered rather more carefully, because the change in input impedance means that the generator must be matched to a different load. We can see, however, that to drive the original $4\frac{1}{2}$ mA into the loop we now need only 0.8 volts, so that the power delivered to the cathode has been reduced to 3.2 mW and the power gain is $240/3.2 = 75$, or 18.8 db.

One of the important features of this analysis is the advantage gained by working in terms of the loop current. Although I have given the voltage amplification expression above, it is a rather awkward concept, because if we try to use it we must introduce the generator impedance, and this means that we must allow for the negative feedback produced by this impedance, which is in the cathode circuit. The grounded-grid amplifier is essentially a power amplifier operating by virtue of the impedance level change introduced in a loop carrying a single current. It resembles therefore a grounded (earthed) -base transistor circuit with a transistor having unity alpha. Clearly, then, the power gain is simply the ratio of load impedance to input impedance, or

power gain = $\frac{(1 + \mu)R_2}{\rho + (1 + \mu k)R_2}$ which reduces to

$g_{m1}R_2$ approximately when $k = -1/\mu$. This agrees with the result already obtained :

power gain = $15,000 \times 5 \times 10^{-3} = 75$.

As the amount of positive feedback is increased further the power gain continues to rise smoothly

until $k = -\frac{1}{\mu} \left(\frac{\rho}{R_2} + 1 \right)$ when it becomes infinite. This,

of course, means that the circuit delivers an output in the absence of any input : the amplifier has become an oscillator. The input impedance has been decreasing with the increased feedback, but this critical value corresponds to zero input impedance. The

output impedance, which reached infinity for $k = -1/\mu$,

jumps sharply to minus infinity for $k = -\left(\frac{1}{\mu} + \delta\right)$

where δ is a small quantity, and then remains negative, although increasing (i.e., tending towards zero) as the feedback is increased.

The actual circuit arrangements needed to provide this positive feedback are shown in Fig. 3. An additional winding is provided on the output transformer and this is connected in series with the grid lead, providing either negative or positive feedback according to the sense of connection. The step-down of $\mu : 1$ in this transformer means that the grid winding will have relatively few turns, so that the direct-current resistance will be small and will not cause any appreciable grid-current biasing.

As always when positive feedback is used, it will be essential to provide negative feedback round several stages, which in our particular case means the two stages we obtain from a single envelope using a double triode. The low input impedance of the grounded-grid stage forces us to an intervalve transformer, so that we shall only avoid a very tricky feedback amplifier design if we take the feedback from the anode of the grounded-grid stage : to take it from the output winding would mean two transformers in tandem in the loop, a serious complication. This negative feedback will reduce the output impedance, of course, which may prove important in some applications where regulation or load matching is needed.

This outline of a particular grounded-grid problem is intended to act as a guide for the design of a more advanced amplifier. I have in mind as a typical application the construction of a high-power, grounded-grid amplifier to be tacked on after an existing unit, the conversion of, say, a 3-watt audio amplifier to a 20-watt system. Quite a different application of the theory is found in the negative impedance convertor, a very simple device which can be connected in series with a line to provide amplification in both directions impartially.

“Television Receiver Servicing”

SERVICING technicians are having a hard job nowadays keeping up with television circuit techniques, which grow in complexity with every new model. To help them find their way through this proliferous jungle of circuitry, a new book is being published for *Wireless and Electrical Trader* in two volumes. This is “Television Receiver Servicing” by E. A. W. Spreadbury, M.Brit.I.R.E., the Technical Editor.

The first volume, on time bases and their associated circuitry, has now appeared, while volume two, on receiver and power supply circuits, is still in preparation. The book is not a catalogue of known faults and their remedies, but aims to familiarize the reader with the various sections of the television receiver and the waveforms associated with them. At the same time there are quite a few references to the circuitry of particular models as practical examples.

Volume one begins simply with a chapter headed “Symptom: Blank Screen” then works its way through time bases, sync separators, synchronization techniques (including flywheel sync), interlacing, h.t. boost, picture shift, e.h.t. and deflection circuits, d.c. restoration and finally the use of test gear. Published by the Trader Publishing Company, it is obtainable from booksellers, price 21s, or direct from the distributors, Iliffe & Sons, at 21s 8d.

160-Metre Transistor Transmitter

Encouraging Results Obtained With Very Low Power and Crystal Control

By A. COCKLE* (G3IEE)

TRANSMITTING radio amateurs were quick to take up the challenge of the transistor, and the first recorded amateur contact using transistor equipment is that of G. M. Rose (K2AH) of New Jersey, just over a year ago¹ when he obtained a range of 25 miles on 144 Mc/s, with a power input of 30 mW on c.w. In this country G3CMH (Yeovil) and G3CAZ (Haslemere) appear to hold the distance record (90 miles) with transistor equipment using 30 mW at a frequency of 3.5 Mc/s².

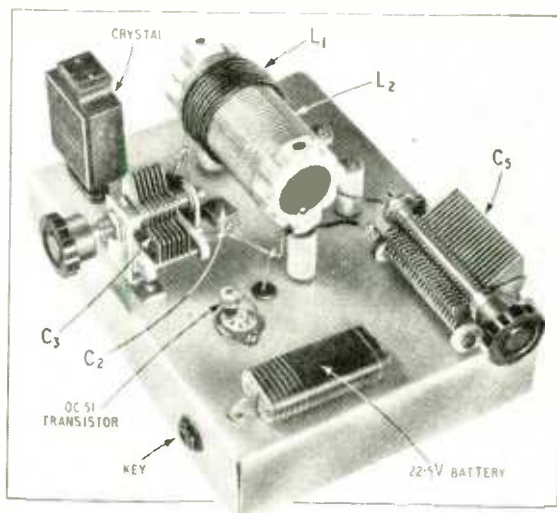
Home construction of transistors has already been successfully achieved, as described by P. B. Helsdon³ and J. M. Osborne⁴. Now that the 30-shilling transistor is on the market it is anticipated that still more amateurs will be investigating the new techniques.

The details given here are of a transistor transmitter constructed by the writer and which is in constant use on the 160-metre band, mainly for morse code speed practice. It used a Mullard OC50 originally but recent experience has shown that the OC51 gives more consistent results at 1.8 Mc/s, owing, no doubt, to its higher "alpha" cut off[†], i.e. 1.5 Mc/s. With the aid of crystal control, a useful output is obtainable up to 3.8 Mc/s although the OC51 is described as an unstable switching transistor.

The circuit employs the well-known negative resistance, base oscillator principle, locked over approximately a kilocycle by a 1.8-Mc/s crystal. With the crystal removed, oscillation is maintained, but the very fine keying characteristics are lost and noise modulation can occur at some frequencies. The value of C_1 is a little critical and should be adjusted for optimum power output. C_2 is adjusted until the oscillation is locked by the crystal and this results in good keying characteristics; by varying C_2 a useful output up to 3.8 Mc/s has been obtained.

The aerial in use is a $\frac{1}{4}$ -wave horizontal wire loaded against earth; the loading of the aerial is not quite so easy as with higher powers. An absorption wavemeter using a 50- μ A indicator is really necessary, but the ex-R.A.F. S.B.A. Visual Indicator, Type 3, already described in this journal⁵, is an excellent substitute movement; 30 μ A will then give a large deflection.

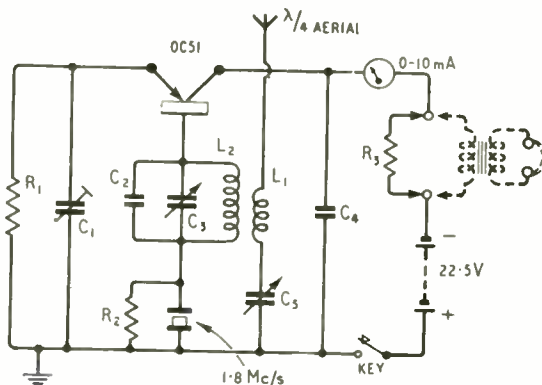
So far, with this transmitter, results have been very encouraging; on the 1.8-Mc/s band a total of 20 con-



tacts has already been made using between 20 and 100 mW. Reports have ranged from RST599 at 3 miles to RST339 at 30 miles.

The circuit, as shown, has been used as a receiver for local c.w. communications but, in this case, the principle of the oscillating detector is used. With headphones inserted in the collector circuit results were quite encouraging and "break-in" procedure could be adopted.

The author wishes to acknowledge the patient assistance given by R. Penfold (G3DHZ), and V. Brand (G3JNB) of the QPR Society, during the development of the transmitter.



Circuit of the low-power, crystal-controlled transistor transmitter described by the author.

COMPONENT VALUES

- R_1 , 4.7 k Ω $\frac{1}{4}$ W.
- R_2 , 1 k Ω $\frac{1}{4}$ W.
- R_3 , 1 k Ω $\frac{1}{4}$ W (instead of 'phones).
- C_1 , 100 pF (trimmer).
- C_2 , 315 pF (160m Band), 47 pF (80m).
- C_3 , 100 pF (variable)
- C_4 , 1,000 pF.
- C_5 , 350 pF (variable).
- L_1 , 7 turns overwound on L_2 .
- L_2 , 32 turns 16 s.w.g. tinned copper, 1 $\frac{1}{2}$ in dia former 2 $\frac{1}{2}$ in winding length.
- OC51, Mullard transistor.
- Crystal, 1.8-Mc/s Band.

* E.M.I. Engineering Development.

[†] The frequency at which the current gain is 3 db down.

¹ QST, January 1953, p. 53.

² R.S.G.B. Bulletin, March 1954, p. 409

³ Wireless World, January 1954, p. 20.

⁴ Short Wave Magazine, March 1954, p. 10.

⁵ Wireless World, September 1951, p. 376.

Instrument Error Curves

By M. G. SCROGGIE, B.Sc., M.I.E.E.

Presenting Calibration Data in Most Convenient Form

CALIBRATION curves are, at best, a nuisance. Ideally, instruments should have direct-reading scales that are correct. But it is unusual for a direct-reading scale to be as near correct as it could be. The better the quality of the instrument, the more unusual. That may sound paradoxical, but the reason is this; if owing to poor quality the deflection or value of an instrument at any point is liable to vary between somewhat wide limits, then it is relatively easy to provide a direct-reading scale that comes within those limits. A high-precision high-stability instrument, on the other hand, must have a correspondingly precise scale if the full accuracy of the instrument is to be gained without referring to calibration data. It is surprisingly difficult—as anyone who has tried it will testify—to make a scale that does not itself introduce perceptible error.

Considering, then, instruments that have (or could be given) direct-reading scales, there are several reasons why these scales may not conform exactly to the latest and best calibration:

(1) There may be appreciable errors in the drawing or engraving of the scale itself.

(2) Since the scale was made, a later calibration may have revealed appreciable changes.

(3) If a scale is used for more than one range, it is unlikely that it will fit the calibrations of all the ranges perfectly. This is especially true of a.c. meters. On the other hand, one is reluctant to provide a number of separate scales unless the differences in shape are so great that there is no alternative.

In any of these circumstances, one has to choose between tolerating the errors or referring to calibration data. Obviously if full use is to be made of a precise instrument, the latter is the choice, and as stated before it is a nuisance. How much or how little of a nuisance it is depends on the form in which the data are presented; and that is the subject of this note.

Assuming that the instrument is continuously variable (e.g., a voltmeter, or a variable air capacitor) a table of values is perhaps the least convenient of all, for in general it necessitates some system of interpolation, which not only takes time and trouble but introduces considerable risk of mistakes. One therefore tends to think of a calibration curve. The most obvious form of this is a graph of "true values" against scale reading. Fig. 1 is a typical example.

Now although in theory this may seem to do the job, in practice it does it very badly. One has first of all to find the correct point on the "Scale Reading" scale; then to follow this by eye up to the curve, and along to the "True Value" scale; and lastly to convert the position on that scale into figures. Unless this is done carefully and accurately, a greater error may be introduced than one is seeking to correct. Moreover, since the error to be corrected is likely to be a very small fraction of the maximum scale reading, the graph has to be drawn on a large sheet of paper

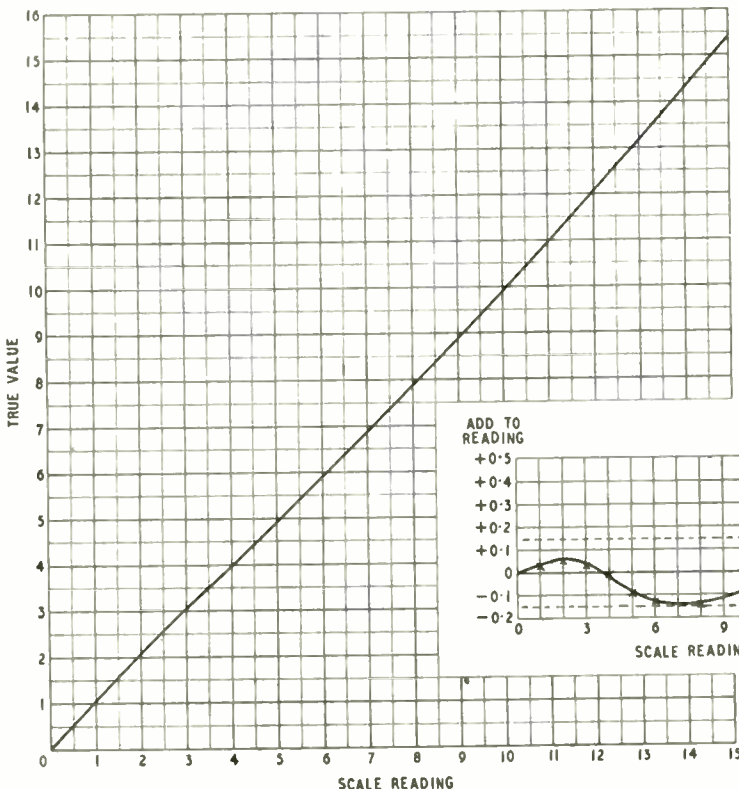


Fig. 2 (inset). More than all the information given in Fig. 1 is here presented more conveniently and precisely in a small fraction of the space.

Fig. 1 (left). Conventional calibration curve, which occupies a large piece of paper and is inconvenient in a number of ways.

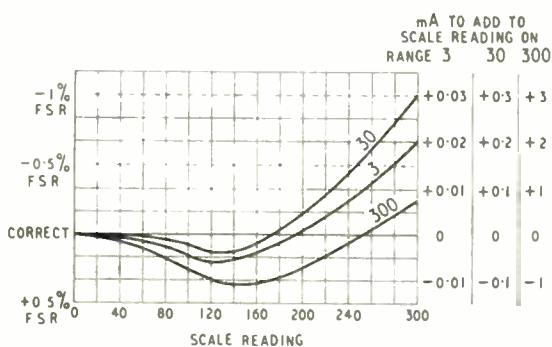


Fig. 3. Example of a correction graph for a multi-range instrument.

for it to show up clearly. This makes the graph inconvenient to use; it cannot be attached to the instrument or kept in a handy small book, and it uses a lot of bench or desk space. The paper is most inefficiently employed, because the only informative part, other than the scales themselves, is in the form of a more or less diagonal line. Most of the paper is not only doing nothing useful, but is actually increasing the risk of error by interposing large eye-confusing distances between the informative zones. These difficulties exist even if a discreet choice has been made of the relationship between the squaring of the graph paper and the divisions of the scale marked on it, and are greatly aggravated by the fiends (thinly disguised as technicians) who perpetrate such horrors as making ten squares represent three scale divisions.

Fig. 2 shows how the same information can be presented more precisely and conveniently in a much smaller space, by plotting only the error against the scale reading. Of course whenever errors are specified it is necessary to make sure that there is no misunderstanding about their sign. Does an error of -0.04 V mean that the true value is 0.04 V less than the scale value, or vice versa? This ambiguity can be completely excluded by marking the error scale "Add to Scale Reading." Then there is no doubt that " -0.04 V" means subtract 0.04 V from the value read on the instrument scale.

The advantages of this presentation are:

- (1) The basic shape of the graph is horizontal instead of diagonal, and so can be accommodated on a relatively small strip of paper.
- (2) Despite the reduction in size of paper, the information sought, being of a lower order of magni-

tude, can be plotted on a much larger scale and so is easier and quicker to read.

(3) The horizontal scale too can be reduced in size, because it does not have to be read precisely, since the error does not normally change rapidly with scale reading. Often a quick glance at the graph shows what correction (if any) is due to be made.

(4) Because of the great reduction in size, combined with removal of the need for close scrutiny, it becomes practicable to have the correction curve in or on most instruments, thus ensuring that it is always available for use.

(5) The form of the error as a function of instrument scale reading is much easier to see, and errors in calibration thereby easier to detect. Calibration points that fall well off a smooth error curve would naturally be suspected until confirmed.

(6) Defined tolerances (such as percentage of full scale reading) can be shown.

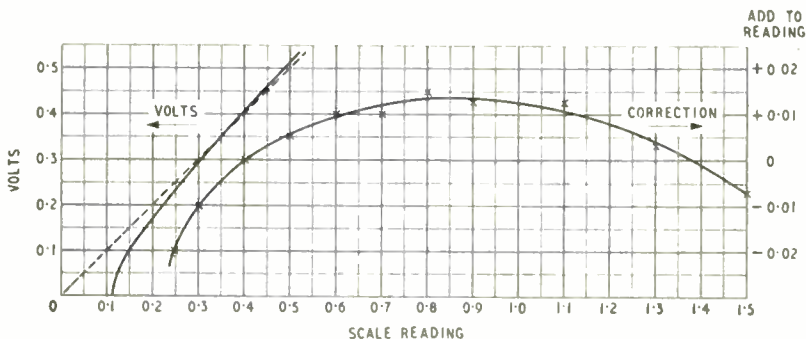
To some workers all this may seem too obvious to need mentioning, but there may be others who have not realized the superiority of the Fig. 2 form over the conventional calibration curve.

It is, of course, possible to plot correction curves for several ranges on one graph, and Fig. 3 shows an example of this. The vertical scales are placed on the right because that is where most of the correcting is required.

Offset Zero Scales

It has been assumed so far that the scale-reading and true-value curves coincide at least at zero. A means of zero adjustment is provided for making this true of most meters, but of course it does not usually apply to scales of such things as frequency, capacitance and attenuation. Nor does it apply to meters in which the zero is deliberately offset to enable all except the curved foot of the calibration to fit a linear scale. An example is the valve voltmeter described in the March 1952 issue, p.93. The lower and most curved part of the scale on every range, except the lowest, can be ignored, because it is covered by the next lower range. But since this cannot apply to the lowest range, which in any case fits the scale least well of any, a slight compromise is advisable if it is desired to use the calibration right down to zero. In this region, the correction actually becomes greater than the true value, and the recommended presentation consequently absurd. Fig. 4 shows an example of a calibration curve taking over from the error curve to meet this exceptional condition, the additional curve being on the left.

Fig. 4. Special case of the lowest range of an a.c. voltmeter having a displaced zero to make all except the lowest part of the calibration fit a linear scale. The unavoidable "bottom bend" is covered by a short calibration curve.



Quartz Crystal Testing

Evaluation of Quality in Frequency Range 50kc's to 2 Mc/s

By R. ROLLIN*

THE quality of quartz crystal used to be assessed in terms of some oscillator circuit parameter, the value of which was dependent on circuit conditions and component stability. During recent years, however, many manufacturers and users of quartz crystals have become accustomed to a new method of assessing their quality for use as oscillators and filters. This method makes use of a variable "loss" element which is substituted for the crystal unit in a suitable oscillator circuit. Accuracy of measurement is therefore almost entirely dependent on the substituted element and is independent of changes in the remainder of the oscillator circuit. The first commercial and service versions of the new test set were suitable for evaluation of crystal quality in the frequency range 1 to 20 Mc/s.

The test set described here uses similar principles but is intended for use in the frequency range 50 kc/s to 2 Mc/s. Its use is specified in Quartz Crystal Specification RCS.271. Before proceeding with a description of the working principles and design it is interesting to tabulate the main features of the new set in comparison with those of the earlier, higher-frequency, tester. (See Table.)

In the case of the higher-frequency model it was possible to use a simple single valve oscillator of an aperiodic type in which the effective negative resistance is largely independent of frequency over the range for which the test set is used. This is made possible by the comparatively small magnitude of spurious responses close to the operating frequency occurring in high frequency quartz plates. In the case of lower frequency quartz plates, however, it is common for spurious responses of relatively large magnitude to be present at frequencies remote from the fundamental response but still within the frequency range of the test set. Of necessity therefore, the circuit arrangements in this set are different from its lower-frequency companion in that simple selective tuning is employed to ensure operation at the correct frequency. In other respects the new tester is equally simple to use and gives a direct reading of equivalent parallel resistance without calculation or reference to charts.

General Description:—
The complete test set may be regarded as comprising the following items:

- (1) a special two-valve oscillator circuit with band switching and input capacitance switching;
- (2) a calibrated variable impedance substitution element;
- (3) an amplitude measuring valve voltmeter;
- (4) a meter overload prevention device;
- (5) power supplies.

A simplified schematic diagram of the instrument is shown in Fig. 1. Frequency range switching, input capacitance switching, details of amplitude measuring circuit and power supply circuits have been omitted for simplicity.

Operation of the circuit may be understood by supposing a voltage to be applied at the terminals marked "X." Neglecting for the moment the presence of resistor R_1 , the voltage across the primary of T_1 will be substantially equal to and in phase with

TABLE
Comparison between the two models

Frequency Range	1 Mc s to 20 Mc s	50 kc's to 2 Mc's
Range of E.P.R. (equivalent parallel resistance)	4 to 130 k Ω	30 to 600 k Ω
Available input capacitances	20, 30 and 50 pF	30, 50 and 100 pF
Weight	24 lb	40 lb
Height	5½ in	8½ in
Width	19 in	19 in
Depth	8½ in	11 in
Power requirement ..	35 watts	50 watts

* Salford Electrical Instrument..

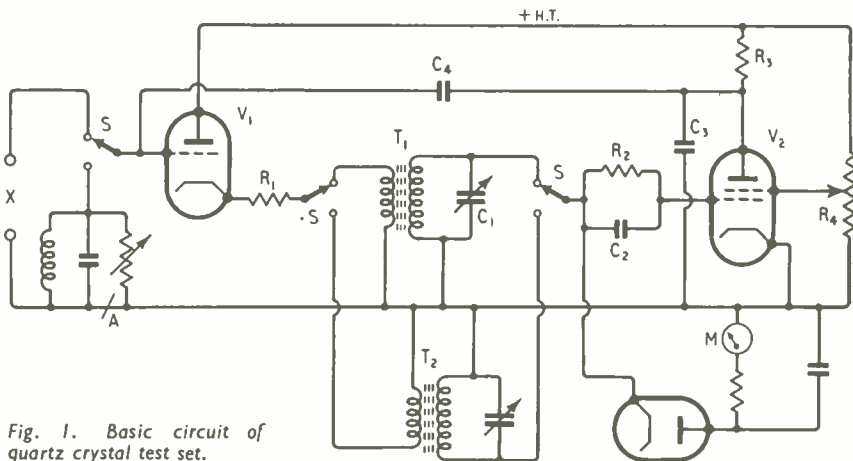


Fig. 1. Basic circuit of quartz crystal test set.

that at the terminals X. The transformer windings are arranged so that the secondary voltage of T_1 is in anti-phase with that of the primary and this voltage appears at the grid of V_2 via the grid leak and condenser R_2, C_2 . The anode of V_2 has a capacitance anode load C_3 and the small feedback capacitor C_1 passes some of the voltage appearing at the anode of V_2 to the grid of V_1 . This circuit arrangement presents a negative input conductance across the terminals X which is a function of the step-up ratio of T_1 , the mutual conductance of V_2 and the ratio of capacitance C_1, C_2 , all of which factors are made independent of frequency in order that this component of negative conductance is practically constant over the frequency range of the set.

Clearly the action of the variable capacitor C_1 across the secondary of transformer T_1 will cause the circuit to oscillate at a selected frequency and this is desirable when using lower frequency quartz crystals. Operation at the resonant frequency of this tuned circuit will be dependent on the dynamic resistance appearing across the terminals X. Under given conditions at X, the amplitude of oscillation will therefore be determined by the variable resistor R_1 which controls the screen voltage of V_2 . Changing over the switch S substitutes transformer T_2 for T_1 and replaces the unknown impedance across X by a calibrated internal circuit A of variable impedance. Under these substitution conditions the circuit will operate at a fixed frequency dictated by the internal variable impedance circuit, to which frequency transformer T_2 is permanently tuned.

It is worth noting that under conditions of low amplitude of oscillation when the voltage swing on V_2 anode is small, a change of impedance measuring range may be brought about by changing the value of C_3, C_1 provided that the reactance of these capacities is kept small enough to avoid affecting the anode characteristic linearity, with consequent limiting in V_2 .

This point has been taken advantage of in the design of the final tester, where a change of feedback ratio is used to create apparent alteration of about 2 to 1 in the impedance range measured by the internal

Fig. 2. Scale shapes typical of the impedance ranges.

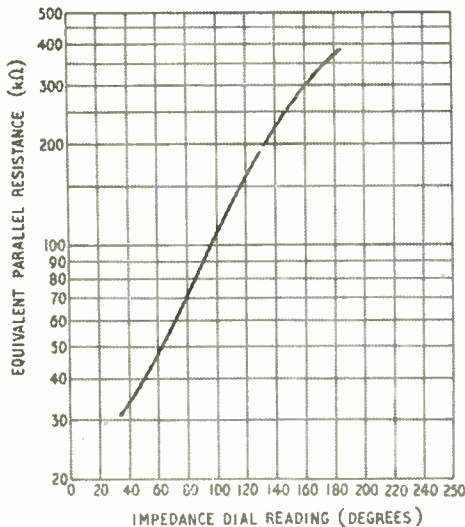


Fig. 3. G.E.C. Quartz Crystal Test Set Type QC166.

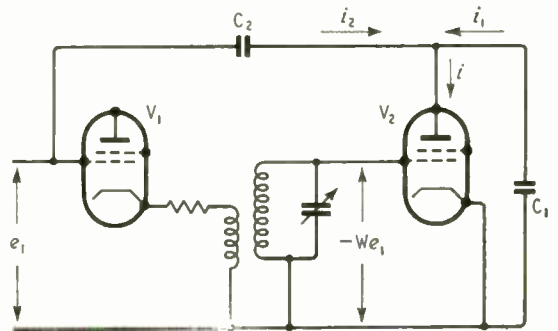


Fig. 4. Simplified circuit for analysing operation of tester.

variable circuit. Thus on frequency bands 1, 2 and 3 covering 50 to 800 kc's, the impedance range is approximately 47 to 650 kΩ and on frequency band 4 covering 800 to 2,000 kc s, it is approximately 30 to 370 kΩ. Fig. 2 shows a typical scale shape of the impedance ranges.

Method of Operation:—Figure 3 shows the control panel of the test set. Operation is extremely simple. The crystal under test is plugged in and one of the three input capacitances available (30, 50 or 100 pF) is selected. The frequency range on which the crystal will oscillate is then selected and the frequency tuning control adjusted until the meter gives a peak reading. Next, the amplitude control is adjusted to give a convenient reading; for high equivalent parallel resistance values measurement can be made at any amplitude of oscillation and a suitable setting is 50 mA, whereas with the lowest equivalent parallel resistance values a suitable setting would be 30 mA.

The selector switch is now turned to the "Z" position and the equivalent parallel resistance dial is rotated until the original meter reading, as above, is obtained. Rapid switching between crystal and "Z" will then give an accurate comparison between the two amplitudes of oscillation. Subsequent adjustments to the crystal amplitude are made by the amplitude control, while adjustments to the "Z" amplitude are made by the equivalent parallel resistance control. When the meter gives the same indication for both, the equivalent parallel resistance can be read directly from the equivalent parallel resistance dial. This incorporates two scales: one for crystals operating in the first three frequency ranges, the other for crystals on frequencies of from 800 to 2,000 kc/s.

The test set can also be used for other applications, such as measuring parallel tuned circuits.

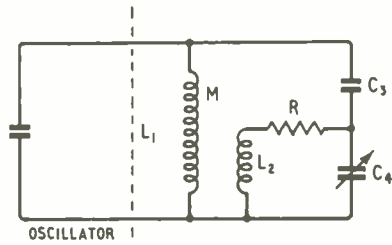


Fig. 5. Basic circuit for calibration.

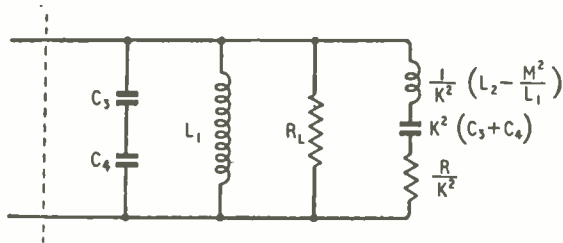


Fig. 6. Theoretical equivalent circuit of calibrator.

Simplified Theory of the Oscillator:—The operation of the oscillator may be analysed by reference to the simplified circuit diagram in Fig. 4.

Let a voltage e_1 be applied to the grid of the first valve. This will result in a voltage of say $-We_1$ at the grid of the second valve, the factor W being introduced to account for the action of the cathode follower stage and the phase changing transformer. This factor will in general be complex, but in the special case of the transformer being tuned to resonance, which is the case corresponding to the setting of the oscillator tuning for a maximum amplitude, W will be real and approximately equal in magnitude to the step-up ratio of the transformer. The voltage and currents at various parts of the circuit are shown in Fig. 4. It is clear that the following relationships for the circuit will hold:—

$$e_1 - i_2/j\omega C_2 + i_1/j\omega C_2 = 0 \dots\dots(i)$$

$$i - g_2 We_1 = i_1 + i_2 \dots\dots(ii)$$

“ g_2 ” is the mutual conductance of the second valve. The elimination of i_1 using (i) and (ii) gives:—

$$e_1 - i_2/j\omega C_2 - (g_2 We_1 + i_2)/j\omega C_1 = 0$$

or

$$e_1 \left(1 - \frac{g_2 W}{j\omega C_1} \right) = i_2 \left(\frac{1}{j\omega C_1} + \frac{1}{j\omega C_2} \right)$$

The input admittance “ Y ” at the grid of the first valve follows thus:—

$$Y = \frac{i_2}{e_1} = \frac{1}{1/j\omega C_1 + 1/j\omega C_2} - \frac{g_2 W/C_1}{1/C_1 + 1/C_2}$$

This expression gives the input admittance in two parts; the first part of the expression is merely the admittance due to the two capacitors C_1 and C_2 in series, whilst the second part is that due to the oscillator proper. Designating this second component by “ Y_0 ” we have:—

$$Y_0 = -\frac{g_2 WC_2}{C_1 + C_2} \dots\dots(iii)$$

Equation (iii) shows that the oscillator will produce a negative resistance dependent only upon the mutual conductance of the second valve, the ratio of the coupling transformer and the ratio between the load and feedback capacitors.

This simple theory shows that when a number of

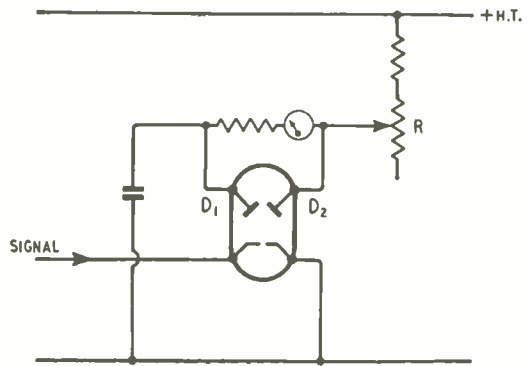


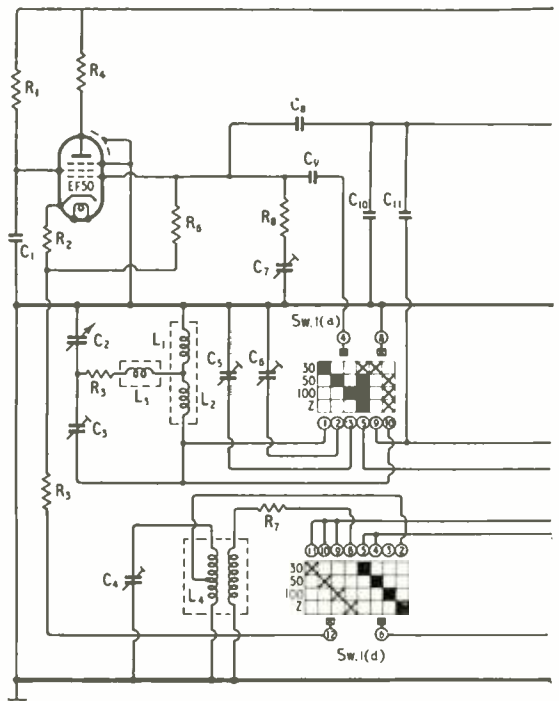
Fig. 7. Overload prevention circuit.

coupling transformers are used with switching to give a wide range of frequency coverage, the value of “ W ” must be held constant from band to band and also over the range in each band. Stray capacitance across transformer windings is also of importance but this has been found to remain sufficiently constant when powder cores are used.

Internal Variable Impedance Circuit:—The basic circuit is illustrated in Fig. 5 and it can be shown that this is equivalent to that in Fig. 6 where K is a factor the value of which is given by:—

$$K = \frac{(L_1 - M)M - C_3/C_3}{L_1 M (1 + C_1 C_3)}$$

The important consideration in the design of this internal circuit is the resistance range it is desired to cover. The operating frequency must therefore be such that dynamic resistances of the desired magnitudes may be presented by the circuit. For correct design these conditions may be achieved for an operating frequency which is well within the extreme



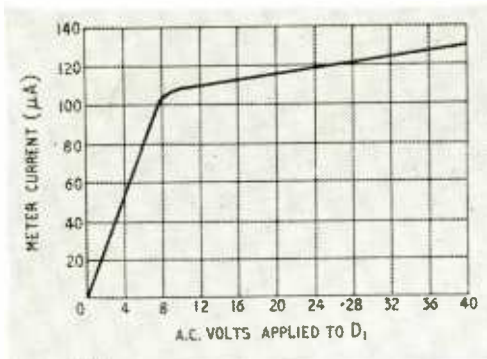


Fig. 8. Characteristic curve of overload prevention circuit.

frequency limits of the instrument. In the final arrangement varying the single component C_4 gives a continuous range of impedance from 30 to 650 kΩ. The other constants in the variable impedance circuit have been chosen so that the operating frequency remains fairly constant throughout at about 300 kc/s.

Meter Overload Prevention:—In changing from a low-impedance crystal to a high-impedance crystal across the input terminals without adjusting the gain control, it would be possible to apply a serious overload to the output measuring diode circuit. Consequently a limiting circuit has been employed as shown in Fig. 7. Diode D_2 is connected in series with the meter and is in a conducting condition to the current flowing through it from the h.t. line via the variable resistance R . The current through the diode D_1 will be in reverse direction to the standing current in D_2 and the limiting diode will only conduct so long as the D_1 diode current is less than this standing value. For relatively higher values of voltage at D_1 diode D_2 will be an open circuit and the change of

meter current for these higher voltages will be very small. The value of voltage at which limiting takes place is controlled by varying the resistance R . A typical characteristic of the overload limiting circuit is shown in Fig. 8.

Use of the Tester:—It will be clear from the foregoing explanation that the test set provides an unambiguous means of assessing crystal quality, the accuracy and stability of its measurement depending on the minimum number of factors. In practice care has been taken to ensure the maximum stability of the internal variable impedance circuit with the result that long-term and short-term inaccuracies have been reduced to fractional percentages. The ability to measure crystal quality at three different input capacitances, and at a variety of drive levels, is of obvious value to quartz crystal designers and users. A complete circuit of the tester is shown in Fig. 9 and from the accompanying illustration it can be seen that the layout of controls is simple and self-explanatory. A coupling connection is provided giving a small signal for the purpose of frequency measurement and alternative types of crystal sockets are provided.

Reference:—*J.I.E.E.* Volume 93. Part 3. No. 21. January 1946 "The Measurement of Activity of Quartz Crystals."

Acknowledgements:—The Author wishes to acknowledge the original fundamental work carried out on the design of the original tester by Dr. A. J. Biggs and Mr. G. M. Wells, G.E.C. Research Laboratories, Wembley, Middlesex.

British Patents:—597,430 "Improvement in two terminal electrical oscillatory circuits having adjustable dynamic resistance." (G.E.C. and Biggs.) 597,439 "Improvements in electric oscillatory circuits comprising active networks." (G.E.C. and Biggs.)

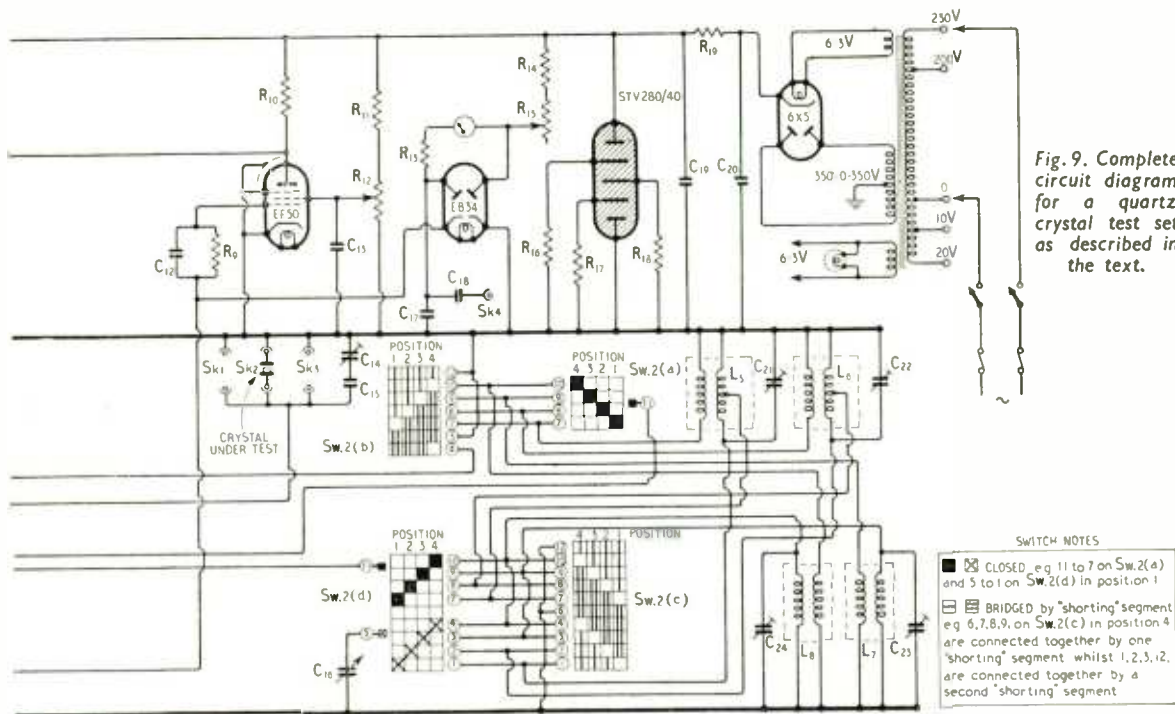


Fig. 9. Complete circuit diagram for a quartz crystal test set as described in the text.

LETTERS TO THE EDITOR

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

"Midget Sensitive T.R.F. Receiver"

I WAS very interested in the design of J. L. Osbourne's receiver described in your April issue. I think he does well to point out the limitation to the stable stage gain of an r.f. amplifier caused by anode-grid capacitance; this is a point which tends to be overlooked.

I am surprised, however, that he did not mention the diode which is built into the envelope of the 6F33 valve. The diode anode is internally bonded to the suppressor grid and has the very desirable effect of preventing the suppressor-grid potential from rising appreciably above the cathode potential. If, due to adjustment of the a.g.c. control, the suppressor-grid potential tends to rise above that of the cathode, the diode conducts and its resistance falls to a value very low compared with that of the resistor (1.5M Ω) connecting the suppressor grid to V2 anode, thus effectively stabilizing the potential of the suppressor grid near that of the cathode. The diode does not affect a.g.c., however, because its impedance becomes infinite when the suppressor-grid potential is driven negative with respect to the cathode.

The "Sensitive T.R.F. Receiver" described in the issue for November, 1951, does not include such a diode and, if the suppressor-grid potential appreciably exceeds that of the cathode, electrons may arrive at the suppressor grid with sufficient velocity to cause secondary emission. The secondary electrons are collected by the screen grid and the anode and if, as often happens, the number of secondary electrons released exceeds the number of primary electrons received from the cathode, the suppressor-grid potential rises. This rise accentuates secondary emission and further accelerates the rise in suppressor-grid potential which ultimately reaches h.t. positive value; this process is similar to that by which the target in television camera tubes is stabilized at the potential of the electron-gun cathode or second anode. The rise in suppressor-grid potential can occur only in circuits such as this in which the external suppressor-grid circuit is of high resistance and normal conditions can be restored by applying a short-circuit between suppressor grid and cathode. The diode in the 6F33 applies such a short-circuit automatically when the suppressor-grid potential tends to go positive with respect to the cathode and prevents the potential from rising. Although with careful adjustment of the "Sensitive T.R.F. Receiver" this rise in suppressor-grid potential can be avoided, the inclusion of a diode would prevent it completely.

With a diode in circuit the a.g.c. control can be set to make V2 anode a few volts positive with respect to V1 cathode. This is desirable for two reasons. First, it delays the a.g.c., permitting use of the full sensitivity of the receiver on weak signals. Secondly, it permits the anode potential of V2 to "wander" by a few volts without effect on the receiver performance. Such "wandering" may result from a number of causes but perhaps the most obvious is variation in the mains voltage.

Kenton, Middx.

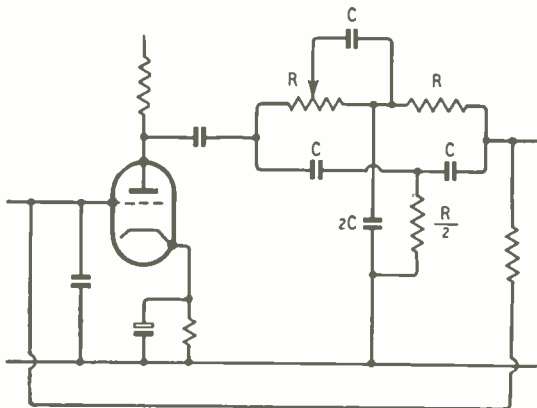
S. W. AMOS.

Williamson Tone Compensating Unit

IN reply to John J. Clark's enquiry (April issue, p. 177) concerning tone compensation, I would point out the modification he suggests, whilst providing means of adjusting the equalizing characteristic, would also considerably alter the gain of the amplifier.

In a good design the equalizing control should affect the gain only at those frequencies at which compensation is necessary. It will be observed that, in the circuit in

which Mr. Clark is interested, in order to vary the operating frequency of the parallel T filter alternative values of the capacitive elements are selected by means of a switch. A similar result might have been achieved at a somewhat smaller cost by switching alternative values of the resistive elements, except for the fact that the gain of the amplifier would vary with each switch position.



A means of realizing Mr. Clark's objective is to replace one of the "R" components of the filter with a potentiometer of equivalent value and a capacitor of value "C," where at the critical frequency X_c equals R.

It is, perhaps, an unnecessary elaboration to gang-switch this additional capacitor so that its value might equal C at each switch position. Ample variation of the equalizing characteristic should be possible using a capacitor of 150 pF, assuming the remaining circuit values to be those shown in the original circuit diagram.

Bridgnorth, Salop.

C. ROBINSON.

"Plug and Socketry"

AN "n-pole free (male moulding) socket"

Means hard work for storemen who stock it;

Why not use the word "sug"

For a "fixed (female) plug,"

And call a free socket a "pocket"?

M. F. R.

Baby Alarms

THE usually prophetic vision of that seer, "Free Grid," seems to have been subject to a local fade-out in the region of baby alarms. The type in which the microphonic signals received from the infant are reproduced on the TV screen as mere visual interference is, of course, quite outmoded, owing to the inability of even the contemporary mother to interpret them accurately, the result being a fruitless visit to the fridge instead of to the airing cupboard (or *vice versa*). In the preferred type of alarm the sounds proceeding from the cot are analysed by suitable filter circuits and, according to their character, actuate one of several relays controlling the outputs from monoscope tubes, so that the appropriate caption is superimposed on the TV picture. Suitable instructions are thereby conveyed in verbal terms which the most obtuse baby-sitter cannot fail to understand.

An optional accessory records the messages delivered in this way during an evening.

Incidentally, "Free Grid" misquotes the Bard: "puling" is a mere synonym for "mewling"; the word is "puking," which, as the dictionary indicates, is a very different kettle of fish.

"CATHODE RAY."

Ignition Interference

THE experiences of T. A. Dineen in South Africa (your January issue) does not agree with mine. There is a very high percentage of cars on these roads equipped with "all wave" receivers, at least 50 per cent being British, and I can definitely state that no more trouble is experienced in suppressing them than the modern American car. Also, I would like to know the basis for Mr. Dineen's statement that "the average British small car produces . . . ten times as much interference as practically any American car."

Westonaria,
Transvaal, S. Africa.

D. J. BRUYNS.

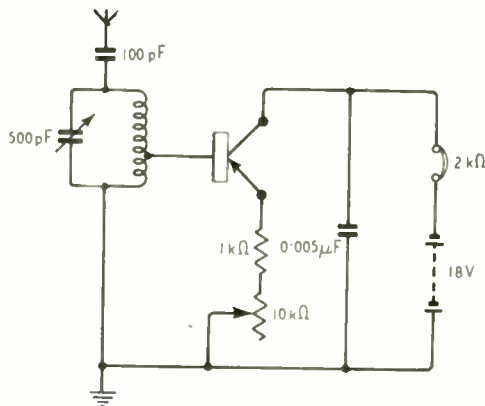
Single-Transistor R 1-7

THE receiver described by W. Grey Walter and Karl Walter, on p. 127 of your March issue would seem to be unnecessarily complex in that it has two tuned circuits. A simpler arrangement which I have found quite satisfactory is given in the accompanying diagram.

Positive feedback is obtained by having an earthed-emitter circuit. The tap on the coil is about one-quarter of the way up and is selected to give approximately the desired amount of feedback. The variable resistor in the emitter then serves as a reaction control.

A 1-k Ω safety resistor is included in the emitter lead and this, together with the headphone resistance, is

ample to prevent any excessive currents being passed. One point to note with this circuit is that it gives r.f. feedback without adding any a.f. or d.c. feedback.



Using a Mullard 0C51 point-contact transistor, this circuit will give good results over the entire m.w. band.

LORIN KNIGHT.

Letchworth, Herts.

Un-Decoupled?

IN your issue for April, 1954, on page 171, Fig. 5 bears the words "By decoupling the screen to the cathode." This is, surely, the limit of technician's slang: how can you decouple something to?

May I suggest "By connecting the screen decoupling condenser (*sic*) to the cathode. . . .?"

L. BAINBRIDGE-BELL.

London, S.W.19.

New Television Camera Tube

Improved Image Orthicon Giving Better Picture Quality

THE improvement of television pictures is in the main a gradual process of development in all links of the chain. At times, however, there occur more marked steps and one of these is the introduction of a new image orthicon camera tube by the English Electric Valve Company. Having an overall diameter of 4½ in compared with the 3 in of the earlier model,* the tube has roughly three times the target area and as a result is capable of much higher resolution.

The resolution is claimed to be adequate for the French 819-line television system and it can, therefore, easily meet 625- and 525-line requirements. At first sight, therefore, it would seem that the tube would be of unnecessarily high performance for British 405-line television. There is, however, an indirect benefit to be gained from the increased resolution. The new tube will give full resolution on 405 lines with little or no high-frequency compensation; as a result, a higher signal-to-noise ratio can be obtained. Further advantages claimed for the tube are better rendering

of grey tones and a reduction of halo, edge effect and ghosts.

In its basic operating principle the new image orthicon is much the same as the earlier English Electric 3-in tube. The main difference is in the use of a larger target with a working area three times as big as



English Electric 4½ in image orthicon camera tube.

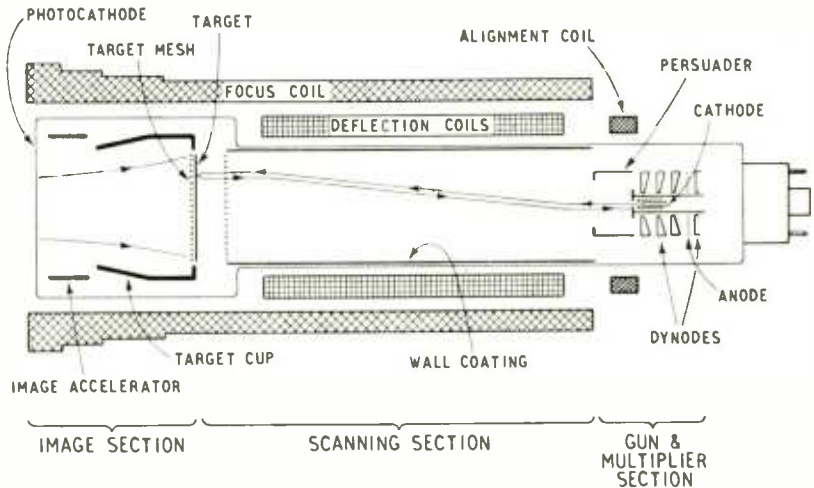
* *Wireless World*, May, 1950, p. 162.

the present one. This means, in the first place, that the scanning beam is smaller in relation to the size of the target charge pattern, so that the resolution is increased. Secondly, the increase of area results in the mesh of the target being relatively finer. Both these things mean improved definition. Furthermore, the use of a larger target gives an increase of storage capacitance, and this, in turn, improves the signal-to-noise ratio, which becomes about 6 db better than with the older tube.

As an outcome of this greater signal-to-noise ratio it will be possible to obtain a more pleasing gradation of grey tones. The gamma of the tube, representing the light-input/signal-output relationship, is claimed to be unity, and it will now be possible to reduce this electrically to a value which will offset the high gamma of the receiving c.r. tube.

Normally, an increase in the size of the target would call for a corresponding increase in the size of the photo-cathode, and as a result larger and more expensive lenses would have to be used to form the optical image. This has been avoided in the new tube by keeping the photo-cathode the same size as before and putting an electron-optical magnifying lens between it and the target. The spread-out of the photo-electron pattern from the photo-cathode is actually achieved by a combination of electrostatic and electromagnetic fields.

In order to introduce this magnification (a three-fold



Simplified diagram showing the main features of the new 4½-in English Electric image orthicon.

increase in area) it has been necessary to make the image section of the tube somewhat longer than before. An incidental advantage of this is that the photoelectrons from the photo-cathode now perform two complete spirals under the influence of the focusing coil instead of coming to a focus at the end of the first one. As a result "ghosts" or displaced duplicate images, due to secondary emission, are eliminated from the picture.

Commercial Literature

Vulcanized Fibre and other insulating materials. An illustrated brochure giving physical and electrical characteristics and forms in which it is available, from the Anglo-American Vulcanized Fibre Company, Cayton Works, Bath Street, London, E.C.1.

Moulded Connector Blocks, up to 12-way and in current ratings up to 60 amps. Leaflet from Precision Components (Barnet), 13, Byng Road, Barnet, Herts.

German Radio Catalogue of components, accessories, tools, test gear, etc., from Walter Arlt Radio Verband, Karl-Marx-Strasse, 27, Berlin-Neukölln 1; price one mark.

Television Components for the servicing trade, with details of a transformer rewinding service. Mail order catalogue from Direct TV Replacements, 134-136, Lewisham Way, New Cross, London, S.E.14.

Radio-gramophone with 13½ in elliptical loudspeaker, 7-valve, 4-waveband receiver with push-pull output, and 3-speed auto-changer. Descriptive leaflet of the "Fidelity" Model 1619A from the Gramophone Company, Hayes, Middlesex.

Transportable and Console Tape Recorders made by Kenton Laboratories, 273, Brixton Road, S.W.9, and incorporating the Truvox Mark III tape mechanism, are described in a leaflet issued by Jonathan Fallowfield, 74, Newman Street, London, W.1.

Ohmmeters, direct-reading, wide-range. Four models: 0.001Ω to 6Ω in 6 ranges, 1Ω to 1MΩ in 12 ranges, 1MΩ to 1,000MΩ in 5 ranges and 1Ω to 1,000MΩ in 17 ranges. Leaflet from the Clare Instrument, Co., Rickmansworth, Herts.

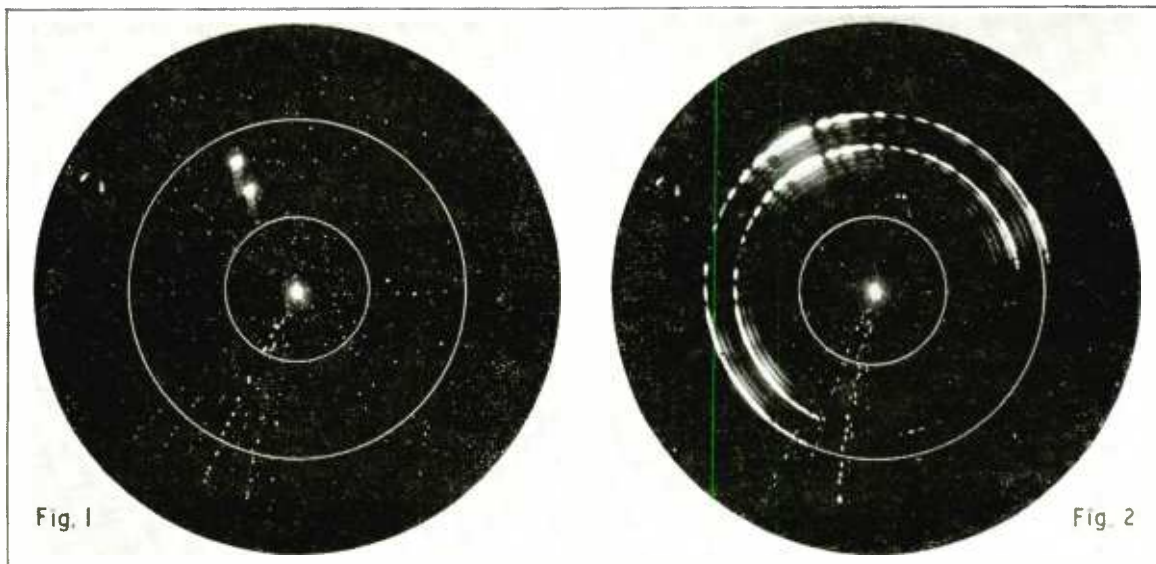
Government Surplus: a "Bargains Bulletin" of selected equipment, components and accessories, available from Lyons Radio, 3, Goldhawk Road, Shepherd's Bush, London, W.12, on receipt of a 1½d stamp.

Sound Reproduction Equipment: a price list from Gramplan Reproducers, Hanworth Trading Estate, Feltham, Middlesex.

American Valves of all makes at lower than normal prices; a brochure describing the sales and service organization of State Labs, 649, Broadway, New York 12, N.Y., U.S.A.



The final sealing-in of the tube with rotating gas flames.



Secondary Surveillance Radar

As an Aid to Air Traffic Control at Civil Airports

By D. A. LEVELL,* B.Sc., Grad.I.E.E.

P RIMARY radar has, since the war, been extensively applied as an aid to air traffic control at large civil airports. At many of these airports the amount of air traffic handled has progressively increased during the past few years, which has resulted in continual changes of the operational requirements for the radar equipments. Some air traffic control authorities now consider that the order of coverage required for terminal area and long range radars is 60 and 150 nautical miles respectively on all types of aircraft at all altitudes up to 50,000 feet. The performance of current primary surveillance radars falls considerably short of this requirement, and it will probably be some time before a simple and reliable primary surveillance radar of the required performance is available. The required coverage can be more easily achieved by a secondary surveillance radar system for which the aircraft carries a transponder that automatically retransmits the radar signals received at the aircraft. The transponder reply may be made at a response frequency which differs from

the interrogation frequency so that the response may be easily distinguished from primary radar reflections. The secondary radar display will then be free from ground clutter and cloud reflections which degrade the performance of some types of primary radars.

Primary radar alone does not provide sufficient information to identify the replies from a particular aircraft on the display without the need to request special manoeuvres. Auxiliary aids such as VHF/DF and radio beacons have been used to assist identification, but ambiguity is possible when several aircraft are located within the same sector of the plan position indicator. Secondary radar can considerably simplify the problem of identification by means of coding the reply from the transponder. In the simplest case, in response to a request on the radio-telephone, the secondary radar replies from an aircraft can be modified in a way that is distinctly visible on the display. The primary and secondary radar replies of an associated system may be displayed on the same plan position indicator, so that the secondary radar reply overlaps the primary radar reply. A simple means of coding the secondary radar reply is to transmit an additional pulse from the transponder at a predetermined interval after the normal reply pulse. The coding pulse will then appear on the display at the same bearing as the normal reply but at a longer range corresponding to the additional delay (see Fig. 1).

Primary radar alone has been used to determine the heights of aircraft, but equipments at present available

* A. C. Cossor Ltd.

Fig. 1. Typical secondary radar coded responses from an aircraft. The two-pulse reply spaced 45μ sec. shows some after-glow from preceding traces. Sidelobe suppression is used. Range markings have been emphasized.

Fig. 2. Responses from same aircraft as in Fig. 1, but without sidelobe suppression. Range has increased slightly.

are not sufficiently accurate and flexible for air traffic control purposes. Secondary radar could be used to report the readings of the aircraft altimeter to the ground station by means of suitable coding of the transponder replies. Several methods of applying height coding have been proposed, but the extra airborne equipment required is relatively complex.

The main disadvantage of secondary surveillance radar is that every aircraft to be detected has to carry a transponder. It is a matter of economics to decide if the service provided by secondary radar justifies the cost of installation, maintenance and carriage of these transponders. It is economically desirable that an aircraft equipped with a transponder can use it without modification with ground equipments which are located in several different countries. This means that international agreement must be reached on a suitable system, and many discussions on secondary surveillance radar have already taken place at meetings of the International Civil Aviation Organisation (I.C.A.O.) and the International Air Transport Association (I.A.T.A.).

Early secondary surveillance radar systems developed in the United Kingdom and the United States used existing primary surveillance radars as interrogators. Such systems were satisfactory providing that only one primary radar was used as an interrogator but, when universal application was considered, problems arose such as sidelobe suppression, transponder saturation and aerial polarisation. Some of the solutions investigated for these problems gave rise to further problems and increased complexity of the airborne and ground equipments. More satisfactory solutions to these problems have proved to be possible when a separate ground transmitter is used for the secondary radar interrogation. The operating conditions of the secondary radar system can then be chosen for optimum secondary radar performance.

Sidelobe Suppression—The signal amplitude received by an airborne aerial varies with the aspect of the aircraft. Experience has shown that at L-band frequencies (1,000 to 1,500 Mc/s) the polar pattern is liable to vary as much as 16 db throughout the

normal operational conditions for a typical aerial mounted on an aircraft at the lowest point in flight.

In order to ensure a guaranteed range of 60 nautical miles it is necessary to design for sufficient transmitter power to be available to produce this range performance when the aircraft presents an unfavourable attitude to the ground station. This means that an aircraft in a favourable attitude can reply to an interrogation at a range of 380 nautical miles, provided that it is high enough to remain within radio line of sight to the ground aerial. At a range of 38 nautical miles sidelobes of the ground aerial, which are 20 db down on the main lobe, are then capable of interrogating an aircraft which is in a favourable attitude. Similarly sidelobes which are 40 db down produce interrogations at a range of 3.8 nautical miles. The major sidelobes of a typical practical aerial are some 20 db below the main lobe and the average sidelobe level is some 30 db below the main lobe. It follows, then, that sidelobe responses are seen at ranges less than 38 nautical miles, and they may be confused with the responses from other aircraft. At a range of

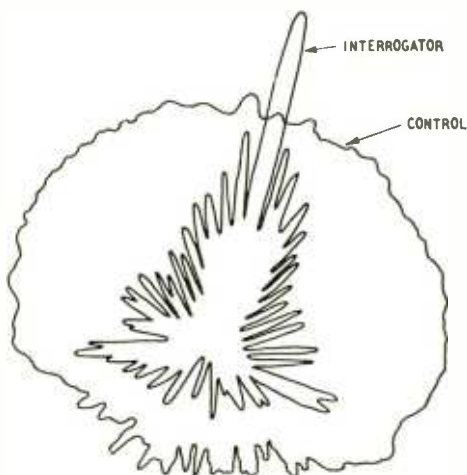
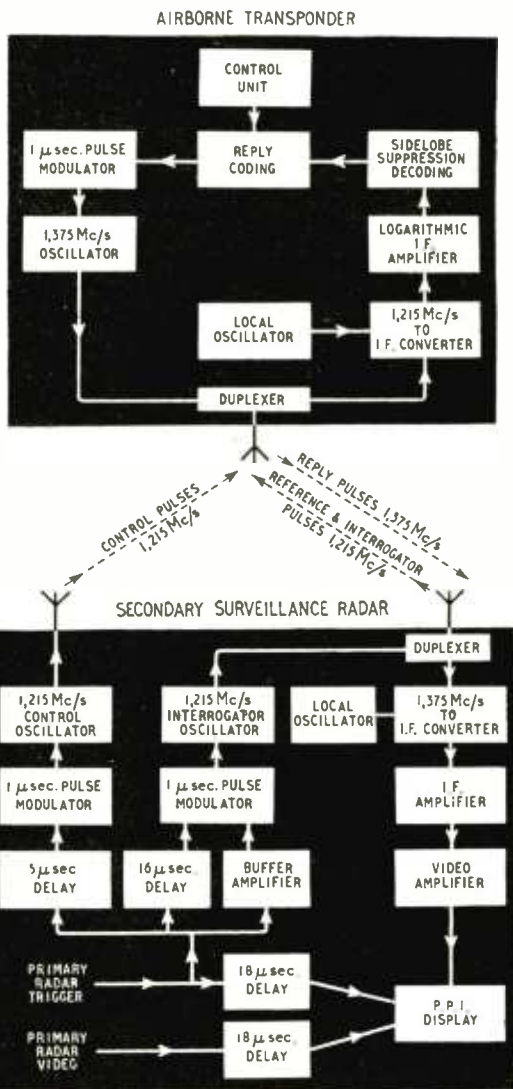


Fig. 3. Horizontal polar pattern of ground aerial system showing interrogator beam and omni-directional control signals.

Fig. 4. Block diagram of Cossor Type 1 secondary surveillance radar.



3.8 nautical miles there are so many sidelobe responses present that an almost solid ring is seen, and it is impossible to determine the bearing of the aircraft (see Fig. 2).

It is possible to prevent sidelobe responses from appearing on the display by suitable suppression on the responder channel. A simple means of providing such suppression is to vary the sensitivity of the ground receiver with time, so that at short ranges the sensitivity of the receiver is reduced and only responses received on the main lobe of the receiving aerial are displayed. At first sight this method seems very attractive, but in practice there are many disadvantages. The airborne transmitted power will not be the same from each transponder-equipped aircraft, the signal received will vary with attitude changes of the aircraft, and the signal received will vary with the angle of elevation of the aircraft from the ground aerial. It is not easy to maintain these variables within acceptable limits.

As an alternative, the transponder may be prevented from triggering by sidelobe suppression on the interrogator channel. A lower rate of triggering is then required from the transponder so that saturation and interference problems become less acute. The requirement is that in some way the trigger sensitivity of the transponder must be controlled so that at all ranges throughout the required coverage the transponder triggers on signals received on the main lobe only of a rotating directional ground aerial pattern. A suitable sensitivity control signal may be derived at the transponder by integrating the signals received during the whole of one scan of the ground aerial system. This method of suppression has been proved to be satisfactory in practice providing that the aircraft is within the service area of only one ground transmitter at any time. When more than one ground transmission is received, the trigger sensitivity will be set by the strongest of the transmissions received and replies may be prevented to main-lobe signals of the weaker transmissions. The transponder is then said to be captured by the strongest interrogator transmission. This trouble may be overcome by employing a separate ground transmitter to provide a control signal pulse to set the trigger sensitivity of the transponder. This control transmission precedes the interrogator transmission by a short time interval. It is suitably related in power to the interrogator transmission and is radiated on a control aerial which has a horizontal polar pattern such that the field strength of the control transmission exceeds that of the interrogator transmission in all directions other than the direction of the main lobe of the interrogator transmission (see Fig. 3). The transponder circuits store the received control pulse for only sufficient time to allow a comparison to be made between the control pulse and the following associated interrogator pulse. The transponder circuits then recover to full sensitivity.

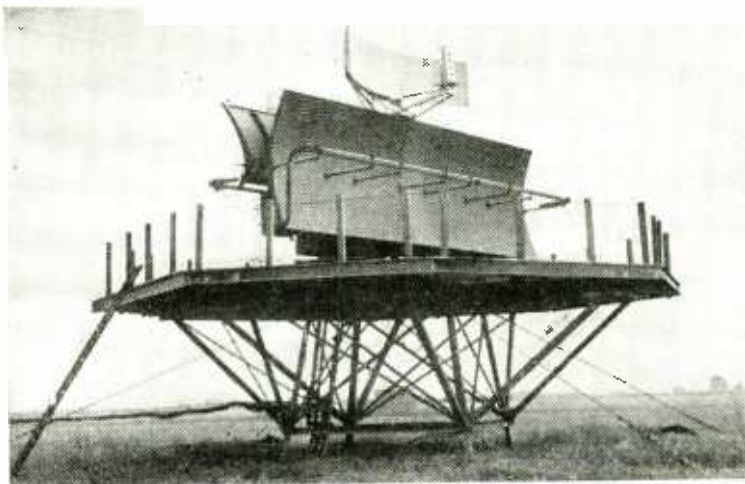


Fig. 5. (Above) Secondary radar scanner mounted on the aerial of an AN CPS-1 primary radar.

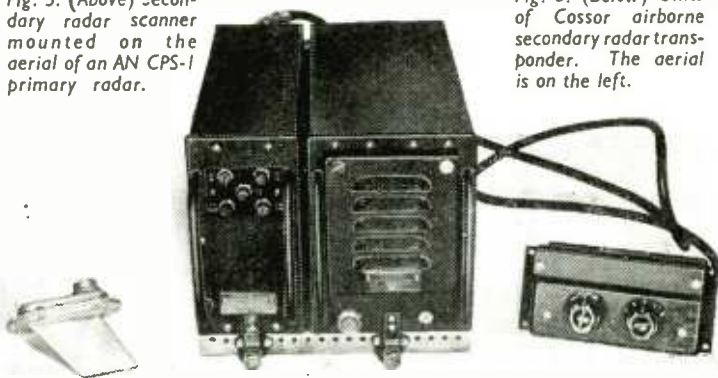


Fig. 6. (Below) Units of Cossor airborne secondary radar transponder. The aerial is on the left.

The time required to perform and recover from each operation may be limited to some $100 \mu\text{sec}$. If the average pulse repetition frequency of each ground station is 200 p.p.s. some 10 or more ground stations with random time relationships can obtain almost capture-free service.

An Experimental Secondary Surveillance Radar System.—The Ministry of Transport and Civil Aviation and Cossor's have recently made preliminary trials at London Airport of the Cossor Type I secondary surveillance radar. A block diagram of the system is given in Fig. 4 and the experimental equipment is shown in Figs. 5 and 6. The system employs frequencies in the L band for both the interrogation and response channels; as an interim measure until an international allocation is made the experimental frequencies of 1,215 Mc/s and 1,375 Mc/s were chosen. Three pulse transmissions, each $1 \mu\text{sec}$ wide, are emitted from the ground equipment for each interrogation of transponders. The first and third of these transmissions are produced by the same oscillator and are emitted on the same directional aerial system. The first is a reference pulse which initiates timed gate circuits in the transponders; the third is an interrogator pulse which passes through the gate circuits to produce interrogation of the transponders. The spacing between the leading edges of the reference and interrogator pulses is $16 \mu\text{sec}$. The second transmission is a control pulse emitted $5 \mu\text{sec}$ after the leading edge of the reference pulse.

The transponder decoding circuits store the amplitude of the control pulse and compare it with the amplitude of the following interrogator pulse. When the received control pulse exceeds the following interrogator pulse by more than 3 db, the interrogator pulse is prevented from passing through the gate. The relative aerial patterns and transmitter powers are arranged so that this condition applies in all directions other than the direction of the main lobe of the interrogator pattern.

The airborne receiver contains a logarithmic amplifier to maintain the decoding characteristic for signal amplitudes up to 50 db greater than the minimum discernible signal. The operating waveforms of the decoder storage and gate circuits are given in Fig. 7.

The block diagram (Fig. 4) shows the secondary surveillance radar associated with a primary radar equipment such as AN/CPS-1 (Microwave Early Warning Radar, often abbreviated to M.E.W.). The reference pulse is emitted at the same time as the primary radar so that the secondary radar replies arrive at the ground station after the primary radar replies. The delay in passing through the transponder is 2 μ sec so that the secondary radar replies arrive 18 μ sec after the primary radar replies. The primary radar signals are, therefore, delayed by the same amount so that the replies from both radars are coincident on the same display unit. When used with some other types of primary radar equipment it may be simpler to emit the secondary radar reference pulse 18 μ sec before the primary radar pulse.

The secondary radar ground aerials and transmitter/receiver equipment were installed on the turntable of the AN/CPS-1 primary radar equipment at London Airport (see Fig. 5). It is possible to similarly mount secondary radar equipment on many other types of primary radar aerial assemblies. This is particularly so since the weight of the secondary radar aerials and equipment can be less than 250 lb. As an alternative the secondary radar can be mounted on its own turntable which can operate either independently or in synchronism with other scanning radar equipment.

An airborne transponder is shown in Fig. 6. The transponder comprises a transmitter receiver unit, a power unit, a junction box, an aerial unit, and a control unit. The equipment units are designed to fit in standard S.B.A.C. racks. The aerial unit is a quarter-wave protruding element which is normally mounted on the aircraft at the lowest point in flight. The control unit is mounted in the cockpit of the aircraft. Alternative forms of power unit are available to suit the aircraft supplies. One form of the equipment will operate from the 19 V \pm 1 V supply which is available

in many civil aircraft. The equipment draws only 2.6 A from this supply. The total weight of the transponder is 30 lb excluding cables, and it contains a total of 11 valves.

During flight trials a transponder-equipped aircraft was tracked out to a range of 150 nautical miles at an altitude of 20,000 ft. The secondary radar performance was then limited by the radio line of sight.

The following are the major characteristics of the equipment:—

Control and interrogator frequencies	1,215 Mc s.
Control transmitter peak power	.. .. 5 kW.
Interrogator transmitter peak power	.. .. 1 kW.
Ground receiver bandwidth	.. .. 10 Mc s.
Ground aerial aperture size	.. .. 12ft \times 3ft.
Ground aerial horizontal beamwidth	.. .. 5'.
Transponder transmitter frequency	1,375 Mc s.
Transponder transmitter peak power	.. .. 200 W.
Transponder receiver bandwidth	.. .. 7 Mc s.
Transponder trigger sensitivity	.. 100 db below 1 W.
All r.f. pulse widths	.. .. 1 μ sec.

Transponder reply coding selected manually by a switch on the control unit—

Code 1	.. ..	Single pulse.
Code 2	.. ..	2 pulses 15 μ sec spacing.
Code 3	.. ..	3 pulses 15 μ sec spacing.
Code 4	.. ..	4 pulses 15 μ sec spacing.

Second-hand Prices

ALLOWANCES for second-hand broadcast and television receivers purchased by radio dealers are tabulated in the booklet "Used Radio and Television Set Values" prepared by the Radio and Television Retailers' Association and issued by the Trader Publishing Company at 2s 9d including postage. The oldest broadcast receivers quoted are a few of 1943 vintage; earlier models than those listed are stated to have no commercial value. In the case of television sets the oldest models quoted are of 1948 manufacture and the value given is based on the need for a new tube to be fitted before a set can be re-sold.

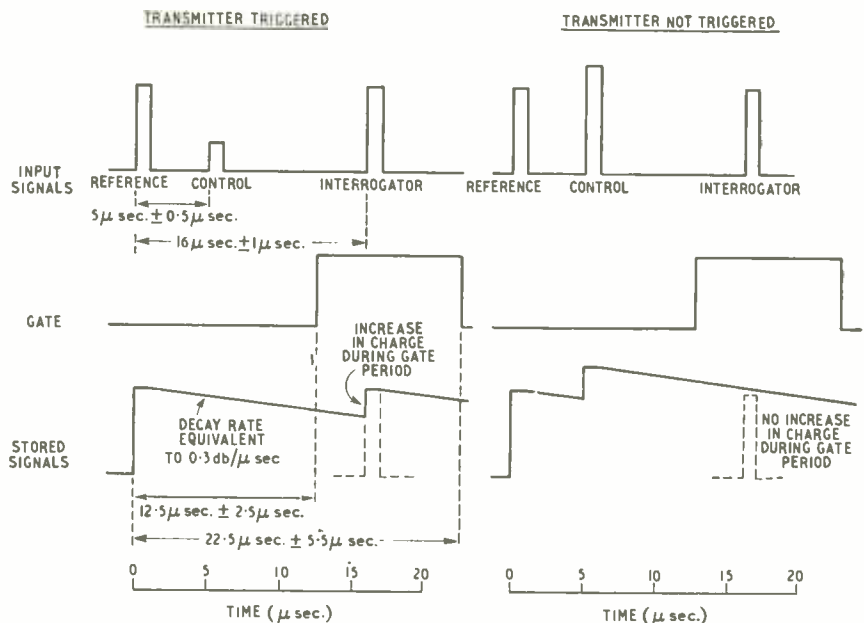


Fig. 7. Waveforms of the decoder-storage and gate circuits.

WORLD OF WIRELESS

Organizational, Personal and Industrial Notes and News

Audio Show

THE SIXTH annual exhibition of sound recording, reproducing and audio frequency equipment, organized by the British Sound Recording Association, will be held at the Waldorf Hotel, Aldwych, London, W.C.2, on May 22nd and 23rd from 10.0 to 6.0 each day. On the preceding day (21st) the annual convention will be held at the Waldorf Hotel at 7.0 when Brian George will give an informal talk, illustrated by recordings from the B.B.C. archives, on "Voices and Sounds from History."

Admission to the exhibition is by catalogue obtainable at the show (price 1s 6d), or by post (1s 8d) from R. W. Lowden, "Wayford," Napoleon Avenue, Farnborough, Hants, after May 8th. A number of the 24 exhibitors listed below will be demonstrating equipment during the show:—

Acoustical Manufacturing; British Ferrograph; Cosmocord; C. T. Chapman; E.M.I.; G.E.C.; Garrard; Goodmans; Grundig; Leak; Leevers Rich; Lowther; Minnesota Mining and Manufacturing; M.S.S.; Mullard; Reproducers (Electronic); Reslosound; Rogers Developments; Simon Sound Service; Sugden; Thermionic Products; Vitavox; Wharfedale; *Wireless World* and *Wireless Engineer*.

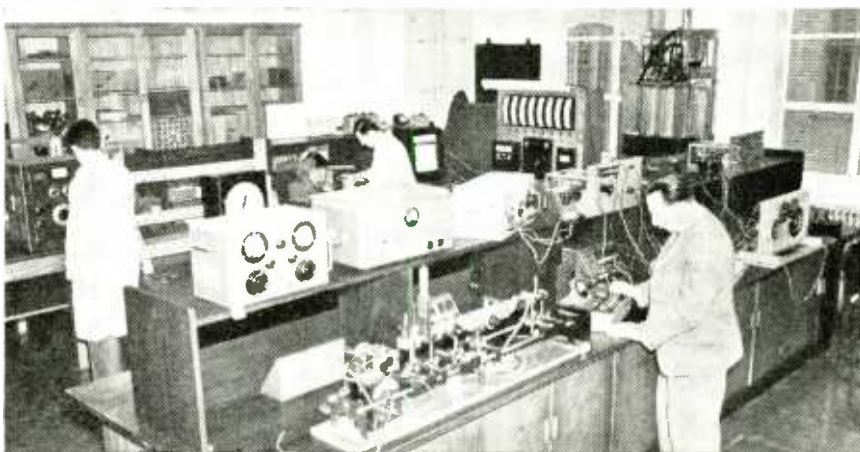
It is hoped to include a review of the exhibition in our July issue.

TV Propagation Tests

REFERENCE was made on page 156 of our last issue to the Cologne meeting of the European Broadcasting Union Working Party concerned with v.h.f. and u.h.f. problems. We were, unfortunately, misinformed regarding the non-participation of the U.K.; the meetings were actually held under the chairmanship of E. L. E. Pawley of the B.B.C.

The Working Party intends to organize international propagation tests in Bands IV and V between Western European countries as soon as sufficient equipment is available. It regards the use of these bands for television in Western Europe as a long-term project, and considers that they would probably be found most useful at first to cover areas that cannot be served conveniently by transmitters using Bands I and III.

BATTERSEA POLYTECHNIC, London, has recently been extended and the new buildings were formally opened by H.R.H. The Princess Royal at the end of March. This *Wireless World* photograph shows one of the new laboratories of the Electrical Engineering Department. There are three laboratories devoted to light current engineering (telecommunications, measurements and electronics). Some of the equipment came from the Polish University College, which was set up in 1945 for Polish ex-servicemen and is now amalgamated with the Polytechnic.



New Television Stations

CONTRACTS for the masts for the permanent medium-power television stations at Rowridge (Isle of Wight), Pontop Pike (near Newcastle-upon-Tyne) and North Hessary Tor (South Devon) have been placed with British Insulated Callender's Construction Company, and for stations at Divis (Northern Ireland) and Core Hill (near Aberdeen) with J. L. Eve Construction Company. The mast for North Hessary Tor will be 750 feet high and the others 500 feet.

Three-stack super-turnstile arrays have been ordered from Marconi's for the Aberdeen and Northern Ireland stations. They are also providing the vision (5-kW) and sound (2-kW) transmitters for each of the five stations.

The B.B.C. has also placed a contract with Marconi's for the "design, supply and setting to work" of the main transmission line system at the new London television station at Crystal Palace. This comprises two transmission lines, each of which will feed sound and vision power to half the aerial system. The contract also covers the development and installation of the vision and sound transmitter output combining units and test loads, together with their associated switchgear.

The Corporation is re-equipping some of the existing television studios and has ordered 16 image orthicon camera channels, 6 vision mixers and associated equipment from Marconi's and 17 improved C.P.S. Emitron cameras and ancillary equipment from E.M.I. Sixty-two Pye picture monitors have also been ordered.

International TV Exchange

AN international exchange of television programmes between eight European countries has been arranged for June 6th to July 4th as a result of a recent meeting at Cannes of technical and programme representatives from Belgium, Denmark, France, Germany, Gt. Britain, Holland, Italy and Switzerland. The B.B.C.'s technical representatives were M. J. L. Pulling and T. H. Bridgewater.

The arrangements are similar to those made at the time of the Coronation transmissions last year, except that the exchange is two-way and Italy and Switzerland have now to be linked to the network. The two countries will be linked by a relay station 10,000 feet up on the Jungfrau. Standards converters will be installed at Dover (819 or 625 to 405 lines), Breda, Holland (405 to 625 and *vice versa*), Paris (405 to 819 and *vice versa*) and possibly at Baden Baden (819 to 625). Transmissions from this country will be picked up near Calais and relayed by radio links to the converter stations at Paris and Breda for linking into the network of 25 stations on the Continent.

PERSONALITIES

Sir Vincent Z. de Ferranti is the new president of the Television Society in succession to **Sir Robert Renwick**, who has resigned after holding the office for seven years. Sir Robert, who is also president of the Radio and Electronic Component Manufacturers' Federation and the Mobile Radio Users' Association, is a director of the Associated Broadcasting Development Company and High Definition Films, Ltd. He has been elected an Honorary Fellow of the Television Society. Sir Vincent is chairman and managing director of Ferranti, Ltd., and a past president of the I.E.E.

G. M. Wright, C.B.E., B.Eng., M.I.E.E., the retiring engineer-in-chief of Marconi's Wireless Telegraph Company, joined the company in 1912. After service in the first world war, when he was closely associated with the establishment of the naval d.f. network, he returned to the company's Research Department, of which he subsequently became head. During the last war he was seconded to the Admiralty and became chief scientist at the Admiralty Research Establishment. Mr. Wright returned to Marconi's as engineer-in-chief in 1946. He was a member of the Radio Research Board of D.S.I.R. from 1948 to 1950.

Marconi's new engineer-in-chief is **B. N. MacLarty**, O.B.E., M.I.E.E., who has been Mr. Wright's deputy since 1947, when he returned to the company after 21 years' service with the B.B.C. Mr. MacLarty joined the Development Establishment of Marconi's Aeronautical Department at Writtle in 1921, where he worked with Capt. Eckersley and Sir Noel Ashbridge on the experimental broadcasting transmitter 2MT. He was head of the Design and Installation Department when he left the B.B.C.



B. N. MACLARTY.



R. J. KEMP.

R. J. Kemp, who becomes deputy engineer-in-chief, joined Marconi's in 1917 and from 1930 to 1939 was engineer-in-charge of television research. During the war he was responsible for special research for the Air Ministry at the company's Great Baddow Research Station, of which he became chief in 1948.

The new chief of research at Great Baddow in succession to Mr. Kemp is **Dr. E. Eastwood**, M.Sc., M.I.E.E. He joined the English Electric Company in 1946 and took charge of the Radiation Laboratory. Two years later he was transferred to Marconi's as deputy chief of research.

Dr. G. W. Sutton has rejoined the Siemens Brothers Group of Companies as director of research and education. For the past seven years he has been chief superintendent of the Signals Research and Development Establishment of the Ministry of Supply. After the first world war he was appointed lecturer in electrical theory and measurement at the City and Guilds College. From 1930 until 1942 (when he was lent to the Ministry of Aircraft Production) Dr. Sutton was in charge of Siemens general telephone laboratory. For the latter part of the war he was co-ordinator for technical services between the R.A.E. Radio Department, Farnborough, and T.R.E., Malvern.



DR. G. W. SUTTON.

H. W. Forshaw, O.B.E., has succeeded Dr. G. W. Sutton as chief superintendent, S.R.D.E. Since 1947 he has been assistant director in the Directorate of Electronics Research and Development (Defence).

Colonel A. H. Read, C.B., O.B.E., has retired from the post of director of Overseas Telecommunications (G.P.O.) which he has held for the past four years. He was Inspector of Wireless Telegraphy for three years having previously been deputy inspector for fifteen years. With his retirement the Overseas Telecommunications Department has been discontinued. Its work is now shared by the External Telecommunications Executive, of which **W. A. Wolverson** is director, and the Radio and Accommodation Department, of which **R. J. P. Harvey**, C.B., is director. The Radio and Accommodation Department is now responsible for frequency allocations and the issuing of licences for amateurs and business radio.

J. Blears, B.Sc.(Eng.), A.M.I.E.E., recently appointed chief engineer of the Scientific Apparatus Department of Metropolitan-Vickers, joined the company as a special trainee in 1936 and then entered the physics section of the Research Department. During the war he worked on the design of the proximity fuze and on the development of magnetrons for centimetre wavelengths. In 1948 he took charge of the vacuum physics section, becoming responsible for mass spectrometry and for research work on high vacuum apparatus.

Arthur C. Main, B.E., M.I.E.E., until recently director and works manager of Metropolitan-Vickers' Trafford Park Works, has been appointed director of manufacture. After taking his B.E. degree at Adelaide University, he came to Metrovick in 1925 as a college apprentice. In 1935 he was appointed assistant superintendent Switchgear and Control Departments, and three years later the new Radar Department was included in his duties. He was appointed superintendent of the Switchgear, Control and Radio Departments in 1944 and two years ago became works manager and a director of the company.

H. P. White, B.Sc., has been appointed head of the Data and Publications Section of the Mullard Technical Service Department. He has been in the department since 1949 and was previously in the company's Valve and Applications Laboratories for six years. One of his principal responsibilities will be compiling technical data and information on the applications of Mullard valves and tubes for use by manufacturers, servicemen and home constructors.

Harley Carter, who was until recently head of Mullard's Technical Publications Department (now part of the Data and Publications Section), will in future devote his entire time to the Mullard Educational Service which he introduced in 1948. The object of this service is to make available to lecturers, teachers and instructors, material—including films, film strips, wall charts and technical exhibits—for use in teaching the principles and applications of electronics.

OUR AUTHORS

D. A. Levell, who contributes an article on secondary surveillance radar in this issue, received the B.Sc. special degree in physics with first-class honours in 1947 as an external student of London University. He joined the Research Division of A. C. Cossor, Ltd., in 1947, and, after working for a short time on instrument development, transferred to the design and development of airborne radar equipment. Since 1951, Mr. Levell has been the project engineer in charge of a team working on secondary surveillance radar equipment.

John D. Howells, who describes a thyatron inverter in this issue, served a two-year apprenticeship at the Post Office Research Station, Dollis Hill, before joining the Ministry of Supply in 1949. While in the Ministry, he was working mainly on ground radar and navigational aids. Since 1952 he has been doing research and development work for the English Electric Company at Luton.

Irving Gottlieb, author of the article "Decade Counter" on page 234 was a radar technician in the U.S. Navy before he entered the American radio industry. He has been developing electronic circuitry and designing electro-mechanical devices for radar for various manufacturers and has recently held the post of electronic design engineer of the Lynch Carrier Systems Company, of California, U.S.A. He operates an amateur station with the call W6HDM.

IN BRIEF

Broadcast Receiving Licences in the United Kingdom totalled 13,350,136 at the end of February. The month's increase in television licences was 67,380, bringing the total to 3,173,024. Car radio licences totalled 223,509.

R.E.C.M.F. Council.—In addition to the member firms listed in our last issue as forming the Council of the Radio and Electronic Component Manufacturers' Federation for 1954, the following have been co-opted (the representatives' names are in parentheses): Antiference (N. M. Best); Colvern (R. F. Collinson); Morganite Resistors (S. G. Treganza).

Television Premiums.—At the recent dinner of the Television Society, which was attended by some 300 members and guests, awards were given for papers presented during the past year. Recipients and their papers are: D. Birkinshaw, "Importance of the D.C. Component"; D. D. Jones, "Transistors"; Dr. D. McMullan, "Scanning Electron Microscope"; C. J. Hunt and E. W. Elliot, "Sine-Squared Pulse"; C. A. Marshall, "Adaptors for v.h.f. and u.h.f. Television Reception"; and H. A. Fairhurst, "Flywheel Synchronizing." George Clack, who was until recently secretary of the Society, received an award for his field-strength meter for Band III, shown at this year's exhibition.

Automatic Computing.—A summer school in programme design for automatic digital computing machines, similar to those organized in previous years, will be held in the University Mathematical Laboratory at Cambridge from September 13th to 24th. The course will give basic training in the mathematical use of machines, dealing with the processes employed and their embodiment in programmes which specify the operation in detail. A syllabus may be obtained from G. F. Hickson, M.A., secretary of the Board of Extra-Mural Studies, Stuart House, Cambridge.

To mark the fiftieth anniversary of the publication of the first paper on **Oxide-Coated Cathodes** the Société Française des Ingénieurs Techniciens du Vide is organizing an international convention to be held in Paris on June 24th and 25th. Further details are obtainable from the Society, 44, Rue de Rennes, Paris, 6.

Electronic Control Equipment will be featured by a number of exhibitors at the fourth biennial Mechanical Handling Exhibition, which opens at Olympia on June 9th. As in previous years the exhibition is being organized by *Mechanical Handling* and will be open daily (except Sunday) from June 9th to 19th at 10.0 and close at 6.0, except on the 14th and 17th, when it will close at 9.0. Free admission tickets are available from the exhibition manager, Dorset House, Stamford Street, London, S.E.1.

Sound Reproduction.—An audience of over 1,300 attended the lecture-demonstration recently given by G. A. Briggs, of Wharfedale Wireless Works, in St. George's Hall, Bradford, when the Wharfedale corner three-speaker system was used. For the purpose of comparison piano solos were played and were followed by commercial recordings of the same pieces reproduced by the three-speaker system.

Five Service Trophies—one for each of the television areas—are being offered annually by E. K. Cole, Ltd., to dealers participating in a competition organized to encourage "after-sales service."

INDUSTRIAL NEWS

Ardente Acoustic Laboratories announce that they have granted an exclusive licence to manufacture and sell Ardente p.a. equipment, loud hailers and intercom gear to Easco Electrical, Ltd., of 6/8, Brighton Terrace, Brixton, London, S.W.9 (Tel.: Brixton 4961), to whom all enquiries for such equipment should, in future, be addressed. The company's hearing aids will continue to be handled from Ardente's head office, 21, Wigmore Street, London, W.1.

As part of the refit of the 8,056-ton Post Office cable ship *Monarch* preparatory to the laying of the first transatlantic telephone cable, **Marconi Marine** is installing new radio communication equipment.

Hudson Electronic Devices, Ltd., of Appach Road, London, S.W.2, have received a \$27,000 order for 100 v.h.f. radio telephones from Mott Electric, Ltd., of Vancouver, Canada. The equipment has been specially developed to meet the Canadian specification for radio telephone gear, which is different from that applying in this country.

Sound amplification systems for nine R.A.F. hospitals are being installed by **E.M.I. Sales and Service**. They provide for dual programme operation with a selector switch and volume control by each bed. E.M.I. is also installing sound-reinforcing equipment in the Great Hall of the Royal College of Surgeons, London.

Manioplastics, Ltd., of Mortgramit Square, Hare Street, London, S.E.18 (Tel.: Woolwich 0885), has been formed for the design and manufacture of machinery for use by the plastics industry, and the manufacture of plastic products. The chief engineer is L. G. H. Cattle, who has been with Applied High Frequency, Ltd., and Creators, Ltd.

Pye, Ltd., of Cambridge, have been awarded a £70,000 contract for radio-telephone equipment to be used on R.A.F. aerodromes under Air Ministry jurisdiction. The two-way v.h.f. equipment will be installed in fire-fighting vehicles, ambulances and control towers.

Dawe Instruments, Ltd., whose factory is at Brentford, Middlesex, have moved their offices from 130 to 99, Uxbridge Road, Ealing, London, W. 5 (Tel.: Ealing 6215).

Decade Counter

Feedback Used

By IRVING GOTTLIEB

WITH the type of electronic counter to be described here, it may be said that the desired mode of operation is attained by causing the device to "fool" itself. Its response to stimuli is somewhat analogous to that of a person reacting to an illusory situation. This idea can best be appreciated by supposing that we have been given the job of designing a counter.

In order that the indication may conform to decimal notation, a basic circuit capable of providing two distinct functions is required. First, overall division by a factor of ten must be achieved. Secondly, the dividing process of such a circuit must be such that decade division is obtained, not in one jump, but rather in an orderly sequence of ten stable states, each occurring in a separate part of the circuit. This is necessary in order that a registration for individual counts may be obtained. These requirements call for a frequency dividing technique, but exactly how shall we go about it? A multivibrator can easily be synchronized to perform ten-fold frequency division, but we are faced with a formidable task when we seek points within the circuit to give us our ten discrete modes of stability.

If we wanted to divide by two rather than ten, we would recognize an encouraging feature in the multivibrator. The "scale-of-two" divider delivers a full cycle for every pair of input cycles. Inasmuch as this circuit comprises two valves which alternate in their equilibrium states between conduction and cut-off, it is evident that there are, within the circuits itself, two stable modes of operation. This satisfies the requirement that a unique state exists for each incoming pulse. The only trouble so far is that the circuit behaves as a free-running oscillator. This is fine for frequency halvers, but for counters the circuit must be passive in the absence of incoming pulses. Fortunately, it is not difficult to incorporate some modification to restrict feedback below the point of self-oscillation.

In Fig. 1 is shown a modified form of the well-known Eccles-Jordan circuit. The operation of this circuit, known also as a "binary," will be discussed first. Then we will show how several of these binaries can be connected in cascade in order to achieve a net division of ten.

Suppose that a negative pulse is injected at point A when V_1 is the "off" valve and V_2 is the "on" valve. The anode potential of V_1 is suddenly decreased. (The anode potential of V_2 is practically unaffected because it is held constant by the conduction of V_2 .) The resultant negative transient is communicated through C_1 to the grid of V_2 . This causes reduction of anode current in V_2 with an

accompanying rise in its anode potential. The rapid increase of anode potential of V_2 is transferred through C_2 as a positive pulse to the grid of V_1 . As a result V_1 now draws more anode current, with an attendant decrease in its anode voltage. The result of this sequence of events is that the stimulus responsible for the transient condition is reinforced by the response it has evoked. The circuit is in a regenerative state; a rapid switching action ensues, culminating with an exchange of roles between V_1 and V_2 . There are, from this sequence, seven important cause and effect relationships associated with the binary. They are as follows:

1. Two negative pulses injected at point A produce one full output cycle.
2. Positive pulses applied to A provoke no disturbance of binary equilibrium.
3. A positive pulse injected at B will always tend to make V_2 the "on" valve.
4. The application of a negative pulse to point B will tend to make V_2 the "off" valve.
5. If a positive pulse is impressed at point C, the tendency will be to make V_1 the "on" valve.
6. If a negative pulse is impressed at C, this will tend to make V_1 the "off" valve.
7. If the grid return of V_2 is momentarily opened, V_2 will be made the "on" valve.

No. 7 is an important mode, for it establishes the so-called "original state" of the binaries, i.e., the condition they must be in before counting commences.

We have considered cascading several binaries in order to achieve overall decade division. Inasmuch as each binary in a cascaded chain divides by two, the total division must be 2^n where n represents the number of such cascaded dividers. At once it is seen that division by eight may be obtained from

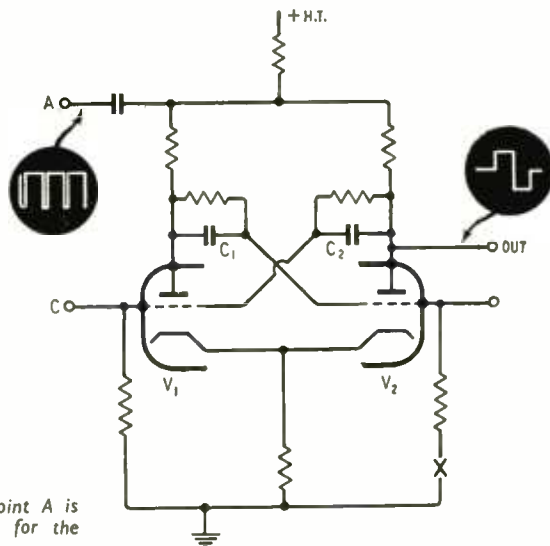


Fig. 1. (Right) Basic circuit of binary counter. Point A is the input of the circuit, while points B and C are for the introduction of feedback pulses.

for Converting Binary to Decade Counting

three stages and that four stages will divide by 16. We cannot resort to fractional stages. How, then, may we accomplish division by ten?

It so happens that four cascaded stages may be arranged (Fig. 2) so that the output of the last stage undergoes one complete cycle of equilibrium change for every group of ten pulses applied to the input of the system. This is brought about by providing feedback paths within the system. Pulses generated when a certain stage is keyed are returned to an earlier stage which cannot distinguish between the returned pulses and the genuine incoming pulses. The net result is that the system "thinks" it has received sixteen counts when only ten have been impressed at the input terminal. How this is accomplished will now be explained.

Operation of the System

Initially, all four binary stages are, or have been caused to be, in their "original" state of equilibrium. Suppose now that four consecutive negative pulses are applied to the input terminal of the system. The first stage will be triggered to produce two negative pulses at its output terminal. In turn, the second stage will generate a single negative pulse. The third stage will be triggered by this single pulse through only a half cycle of equilibrium shift, thereby developing a single positive-going transient at its output terminal. The fourth stage will not be affected, since it can be triggered only by a negative pulse from stage three. So far, the sequence of events conforms to that expected from cascaded binaries. After the third stage has been triggered, however, the operation is considerably modified from that of a chain without feedback.

The feedback path provided by one capacitor returns the positive transient produced by stage three to point C of the second stage. This stage is now

re-triggered through a half cycle of operation, generating a single positive output pulse in the process. The progression of events has now reached a dead end because the input terminal, point A of the third stage, is not responsive to positive-going transients.

Consider now the introduction of two additional pulses at the input of the system. As a result of the preceding train of four pulses the first stage has been left in its "original" phase of operation. The second stage has been left in its half-triggered phase, this being likewise true of stage three. The fourth stage is, of course, still in its original operational state.

When the two additional pulses are applied to the system input, the first binary will undergo one complete flip-flop cycle. The negative pulse from this transition will trigger the second stage through the second half of its operational cycle. In turn, the transient generated by the second stage will trigger the third stage through the second half of its operational cycle. This time, a negative pulse will be returned to point C of stage two. Inasmuch as the second stage is already in the phase of equilibrium in which the feedback pulse tends to drive it, no disturbance will be initiated. However, the negative pulse which is delivered from stage three to stage four will trigger the last-mentioned stage through one half of its operational cycle. In this instance a negative pulse will be returned from the fourth stage to point B of stage three. The pulse is negative-going because it has been derived from the "V₁" valve of stage four which has just been triggered to the "on" condition. The third stage will be re-triggered through one half of its operational cycle. In turn, the positive transient generated by the third stage is fed back to point C of the second stage. Having been in its "original" phase prior to this feedback pulse, stage two is now triggered through one half an operating cycle.

Six pulses have thus far been injected at the input

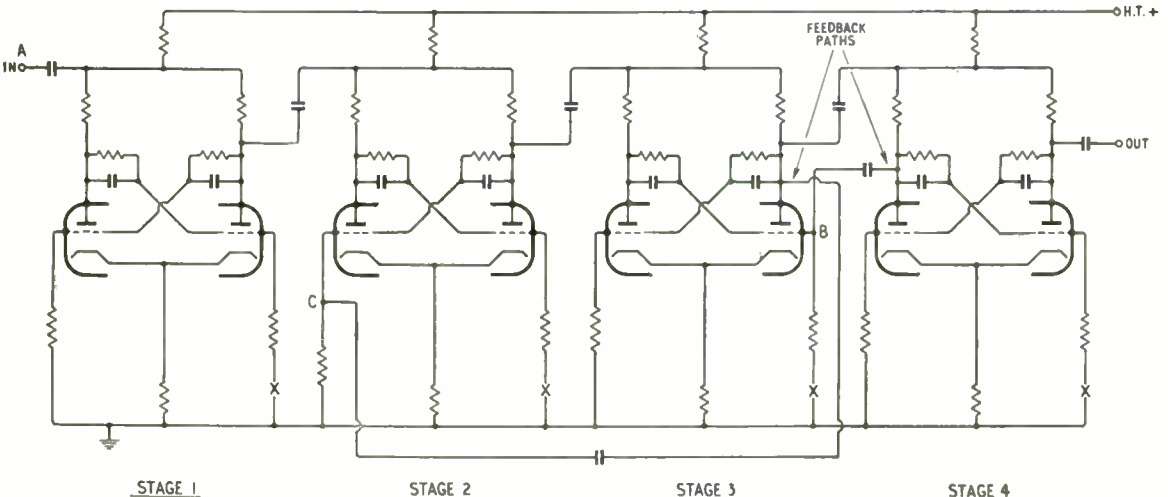


Fig. 2. Complete circuit of decade counter. The two feedback paths cause the four binary stages in cascade to produce ten stable states instead of the sixteen which would occur with no feedback.



Fig. 3. Decade counter of the type described, built as a plug-in unit for use in a commercial instrument.

of the system. The state of equilibrium of each stage is now as follows:

- Stage 1—original state (V_1 “off,” V_2 “on”).
- Stage 2—original state.
- Stage 3—half cycle completed (V_1 “on,” V_2 “off”).
- Stage 4—half cycle completed.

By applying four more negative pulses to the system input, we shall have supplied a total of ten pulses. The first stage will generate two negative pulses which, in turn, will cause the production of a

single negative pulse at the output of stage two. This negative transient will trigger the third stage through the second half of its operational cycle, again developing a negative transient. Finally, the fourth stage will be triggered in the same fashion. In so far as the fourth stage is concerned, the transients communicated by the two feedback paths will not have produced any further disturbance. Observe now that ten input cycles have resulted in one complete operational cycle being executed by the fourth stage which as a consequence delivers a single negative-going transient.

Thus we have accomplished decade division through a transition of ten unique stable states. By connecting neon lamps at appropriate circuit points and designating them numerically a visual indication of the counts is made possible.

Decade counters themselves may be connected in cascade in order to provide a maximum counting capacity of 10^n where n represents the number of decade counters so arranged. After each decade counter has performed a ten-fold division its “slate is wiped clean” by momentarily opening the grid returns of all “ V_2 ” valves. As already pointed out, this re-establishes all stages in the original operating phase and the system is ready for the subsequent ten-count. Fig 3 shows a decade counter unit from a commercial instrument. Five such counters are utilized in this particular model, permitting a maximum count of one hundred thousand. The instrument automatically times the duration for which the counters may receive pulses for precise one-second periods. Consequently the indication is in cycles per second.

NEWS FROM THE CLUBS

Basildon.—The recently formed club for employees of the Marconi Wireless Telegraph Company at its new works at Basildon, Essex, has a membership of 35. It is proposed to build a club transmitter, as soon as suitable accommodation has been found, and to start morse classes. The secretary of the Marconi (Basildon) Amateur Radio Club is E. F. Slec.

Cleckheaton.—Dr. G. N. Patchett, who is well known to readers of *Wireless World*, will lecture on colour television to members of the Spen Valley and District Radio and Television Society on May 5th. The meeting will be held at 7.30 at the Bradford Technical College where Dr. Patchett is head of the Electrical Engineering Department. At the club meeting on May 19th at 7.30 at the Temperance Hall, Cleckheaton, A. Thompson (G2FCL) will speak on “144 Mc/s.” Sec.: N. Pride, 100, Raikes Lane, Birstall, Near Leeds.

Coventry.—At the next meeting of the Coventry Amateur Radio Society (G2ASF) on May 10th, David HARRIES (G3RF) will describe a valve voltmeter. Meetings are held at 7.30 on alternate Mondays at 9, Queens Road, Coventry. Sec.: K. Lynes (G3FOH), 142, Shorncliffe Road, Coventry.

Southend.—Among the subjects scheduled for future meetings of the Southend and District Radio Society, which meets at 7.30 on alternate Fridays at the Municipal College, Victoria Circus, Southend, are: “Ferranti Electronic Computer,” “Marine Echo Sounding” and “Application of X-Ray to Physics.” Sec.: J. H. Barrance, M.B.E., 29, Swanage Road, Southend-on-Sea.

B.A.T.C.—The British Amateur Television Club now has a membership of 300. One of the members, R. L. Royle (G2WJ/T), is regularly transmitting pictures on 436 Mc/s that should easily be received within a radius of 40 miles of Dunmow, Essex. Sec.: M. Barlow (G3CVO), Cheyne Cottage, Dukes Wood Drive, Gerrards Cross, Bucks.

British Two-Call Club.—Membership of the British Two-Call Club, which is open to all British subjects in the Commonwealth who have held call signs in two or more countries, is now 124. Major J. M. Drudge-Coates (DL2RO) has been elected president for 1954 and Major D. A. Macdonnell (G8DK) vice-president. Sec.: G. V. Haylock (G2DHV), 63, Lewisham Hill, London, S.E.13.

I.R.C.M.S.—The Coventry Radio Controlled Models Club has become the Coventry group of the International Radio Controlled Models Society and will continue to meet at 8.0 on the first Wednesday of each month at the Allied Airmen’s Services Club, 78, Holyhead Road, Coventry. The I.R.C.M.S. now has five groups; the others being in London, Birmingham, Manchester and on Tyneside. Group Sec.: P. Haselock, 25, Wainbody Avenue, Coventry.

QRP.—New sections have recently been introduced by the QRP Society for members especially interested in low-power v.h.f. transmission and reception, direction finding and t.r.f. reception. Space is devoted in each issue of the Society’s monthly duplicated journal, *QRP*, to matters of interest to these and other sections of the Society. Sec.: J. Whitehead, 92, Rydens Avenue, Walton-on-Thames, Surrey.

THYRATRON INVERTER

Giving 100 Watts at 240 V, 50 c/s

from D.C. Mains

By J. D. HOWELLS, B.Sc. (Eng.)

ALTHOUGH most of the country is now supplied with the standard 240 volt a.c. mains, there are still many localities where the only available supply is d.c. Readers in such areas will, no doubt, have found difficulty in constructing gear to operate from their mains supply. In fact, many items, such as automatic record changers, are virtually unobtainable for d.c. operation. Quite a usual technique is to use some form of d.c.-a.c. converter, the most common type being the rotary transformer. A second, and less common type is the thyatron inverter, and this is the subject of the present article.

The Thyatron Valve.—The simple thyatron valve is essentially a triode structure in an envelope containing an inert gas (generally argon) at low pressure. The introduction of this small amount of gas so changes the operation of the device that it should no longer be regarded as a "valve" in the electronic sense of the word. In fact, the "equivalent circuit" of a thyatron, shown in Fig. 1(b), consists merely of a switch in series with an e.m.f. of about 16 volts. The action of the grid is only to close the switch, and this can be done only provided the supply voltage, V , is greater than 21 volts.

Once switched on, the anode voltage drop is equal to the e.m.f. of the "equivalent" battery (about 16 volts) and is independent of the magnitude of the anode current. The current through the valve is thus determined only by the values of the supply voltage, V , and the anode resistor, R_L , Fig. 1(c).

We must now look more closely at the switching function of the grid. Referring again to the circuit of Fig. 1(c), let us assume that the grid is first made negative, and then that the anode voltage is applied. Provided the grid is sufficiently negative, the valve will remain "off," and the anode voltage, V_a , will be equal to the supply voltage V . As the grid is made progressively less negative, a point will be reached where the potential is insufficient to keep the valve cut off. The valve then "fires," or "strikes" (corresponding to a closing of the switch of Fig. 1(b)) and V_a falls to 16 volts. The voltage drop across R_L is then $(V-16)$ and the anode current is $(V-16)/R_L$. The grid potential at which the valve fires or "strikes" is termed the "critical grid voltage," V_c , and its value depends upon the initial anode voltage, $V_a (= V)$. It must be pointed out that once conducting, the grid is no longer effective. We cannot cut the valve off again by merely making the grid more negative. The only way in which we can switch off the thyatron is by reducing the anode supply to below 16 volts.

The relation between V_c and V_a may be represented graphically, and a typical curve is shown in Fig. 2. For any values of V_c and V_a which give a point in the shaded region of the graph, the valve will remain non-conducting. If we change V_c so as to approach

the curve, the valve remains "off" until we reach the boundary of the shaded area. The valve then strikes, V_a falls to 16 volts, and the graph is no longer applicable.

To illustrate the operation, we can give a numerical example. Let $R_L = 1 \text{ k}\Omega$ and $V = 240$ volts.

Suppose V_g is set to -12 volts, and then the h.t. supply connected. Since $V_a = 240$ and $V_g = -12$ corresponds to point P in the shaded area of Fig. 2,

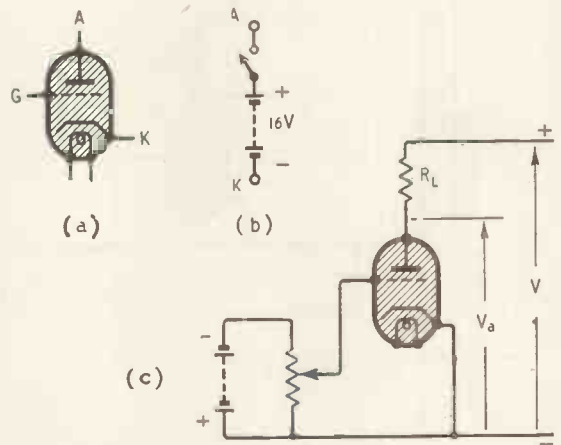


Fig. 1. Thyatron symbol (a), equivalent circuit (b), and basic test circuit (c).

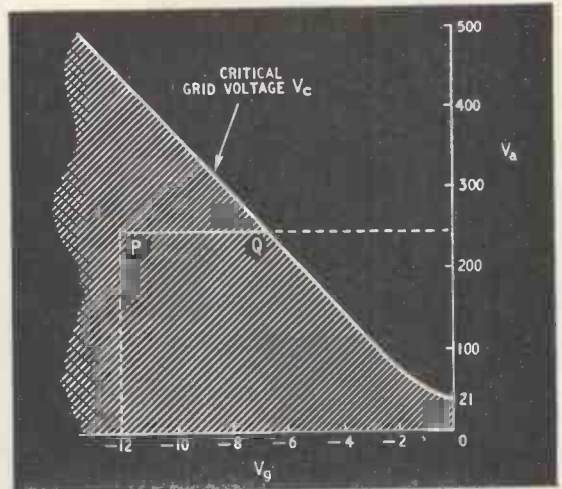


Fig. 2. Typical thyatron control curve.

the valve will not draw any anode current, and V_a remains at 240. If now V_g is reduced, we shall proceed along the line PG in the graph, until we reach point Q. The valve then strikes, and V_a falls to 16, leaving a potential drop of 224 volts across the 1-k Ω load. The anode current thus becomes 0.224 amps, and is independent of any further change in V_g .

The main characteristics of a thyatron may therefore be summarized as follows:—

1. There are two states only, conducting and non-conducting.

2. When conducting, V_a is constant, the current being determined by the anode circuitry.

3. The valve may be changed from the non-conducting to the conducting state (i.e., switched on) by decreasing the negative grid voltage to a critical value.

4. The valve can be switched off only by reducing the anode supply voltage until no anode current flows.

We are now in a position to consider the theory of a thyatron inverter.

Inverter Circuit Theory.—Fig. 3 shows the circuit of a simple inverter. R_{L1} and R_{L2} are the

loads (assumed equal and resistive) into which the alternating power is to be developed. A 50-c/s switching wave is fed, push-pull fashion, to the thyatron grids. Due to a small grid current, the condenser C_1 will receive a negative charge, and a bias voltage, equal to the peak value of the switching wave, will be built up across R_1 . Grid stoppers are included to limit the peak grid current.

Now, let the anode voltage be applied. As the grid of one valve, say V1 reaches V_c from a negative potential, that valve will strike. At once, 224 volts appear across R_{L1} , and C charges exponentially towards 224 volts via R_{L2} . Half a cycle later, V_{g2} reaches V_c , causing V2 to strike. V_{a2} then falls by 224 volts, and this voltage drop is communicated to V_{a1} by C. This sudden fall in V_{a1} causes V1 to be extinguished, and C begins to charge in the opposite direction. V1 remains off until its grid potential again reaches V_c , when it strikes, and the cycle is repeated. The condenser C arranges for the switching off of the valves, and is called the "commutating" condenser.

Fig. 4 shows the grid and anode voltage waveforms

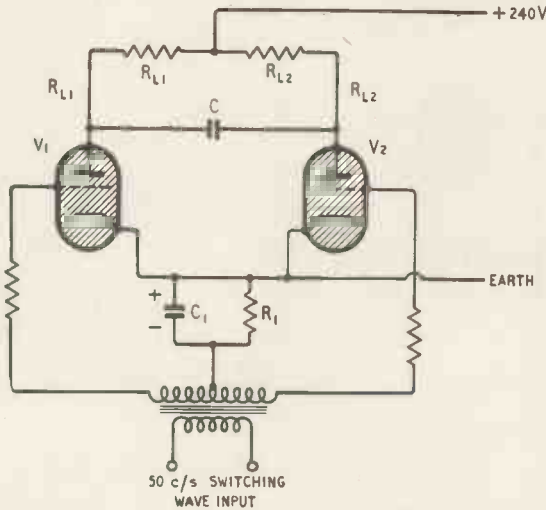


Fig. 3. Circuit arrangement of a simple thyatron inverter.

Fig. 4. (below). Waveforms of anode and grid voltage in the circuit of Fig. 3.

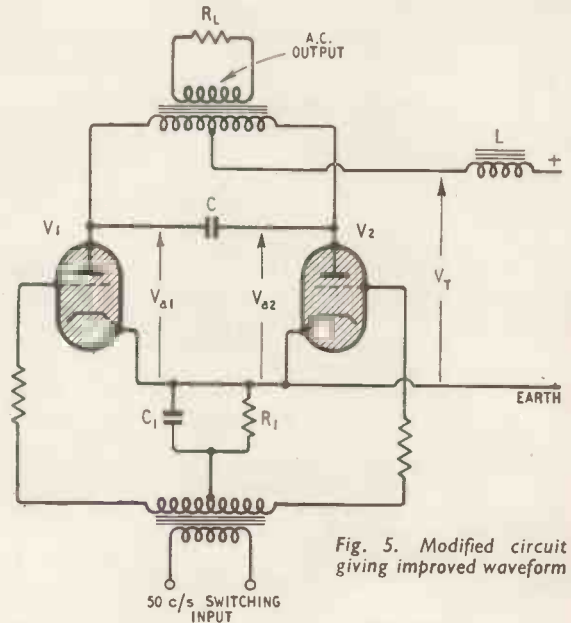
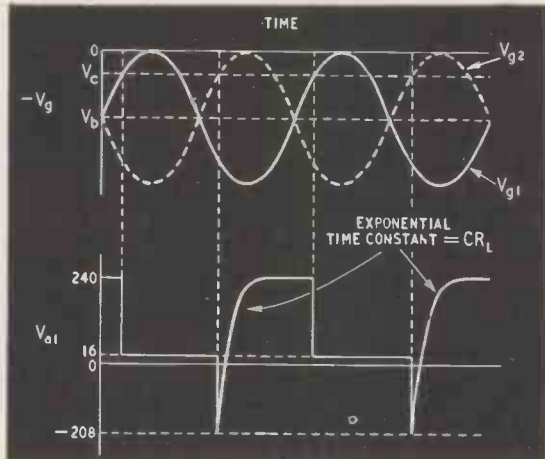


Fig. 5. Modified circuit giving improved waveform

of V1. A sine-wave switching voltage is assumed for convenience, V_c is the critical grid voltage for $V_a = 240$ and V_b is the self-bias voltage appearing across $C_1 R_1$ ($C_1 R_1 >> 1/50$).

Thus the currents flowing in the loads R_L are certainly alternating, but the waveform is square and peaky. However, by using the circuit of Fig. 5 this waveform may be turned into something very nearly sinusoidal. To understand fully the working of this circuit (which is a good deal more complicated than would appear) involves a long and difficult mathematical analysis. Since such an analysis is outside the scope of this article, we shall give a word picture of the operation, based on the results of the mathematical treatment.

In the circuit of Fig. 5 we see that here the load is now a single resistance R_L , and is in the secondary circuit of the output transformer, a far more useful arrangement than the previous case. Also, there is an impedance common to both anodes, the choke L.

This is necessary to allow commutation to take place, and also to get rid of the "spike" at the point of commutation.

Referring to the circuit, when a valve strikes, both anodes fall in potential by the same amount, due to coupling by C. Since we have a "push-pull" transformer, clearly the centre tap must fall through the same potential. Thus the commutation spike now appears across the common impedance L, and not across the transformer winding. In the previous example (Fig. 3) we saw that after commutation, C discharged exponentially through R_L. In the circuit of Fig. 5, since the entire commutation voltage appears across L, C now discharges along a curve determined by L and C. Thus the curve, by suitable choice of components, may be made part of a damped sine wave, giving a sine wave voltage across C (i.e., across the transformer primary). It is therefore the values of L and C which determine the waveform of the output, the circuit acting as a resonant circuit, which receives an impulse every half cycle. L and C are chosen such that the frequency at which they cause the circuit to resonate is equal to the frequency of the switching wave.* We should note that the primary inductance of the transformer plays no part in the resonant circuit.

A complete set of waveforms for the circuit is shown in Fig. 6. They show clearly that at each point of commutation both anodes swing negative by the same amount (a) and (b) and all of this swing appears across the choke L. The curve (c) showing the voltage V_T across L is a series of first half cycles of a heavily damped oscillation. These damped half cycles are identical in shape to those appearing across C (the other component of the resonant circuit). Condenser C charges in opposite directions on alternate half cycles, therefore reversing the direction of current flow in the output transformer primary. This inverts the waveform after each commutation, and the resultant output is the near-sinusoid shown in Fig. 6 (d).

To sum up the action, we should regard the thyratrons as feeding current into the resonant circuit LC. The circuit "rings," and the decay current flows through the transformer primary, giving the near-sinusoidal output.

A further point which can be deduced from Fig. 5 is the effect of loading the transformer secondary. It is clear that when power is drawn from the transformer, an effective resistance appears across C. A load therefore reduces the effective circuit Q, and consequently affects the output voltage. We shall therefore expect the inverter to have poor regulation and the waveform to deteriorate slightly as the load is increased. We might add here that bad regulation is about the most serious failing of the inverter.

Practical Circuit.—In the foregoing we have discussed the inverter circuit in principle; a practical arrangement is shown in Fig. 7. For ease of description the circuit is broken down into three parts, each of these will now be described.

(a) *Thyratron grid circuit.*—Throughout the previous arguments we have assumed a switching wave to be available to drive the thyratrons. The use of a separate oscillator in this design may surprise some

* This does not mean that $LC = \frac{1}{\omega^2}$. This is only true for a simple high-Q tuned circuit. Here we have a 2:1 transformer between L and C, so that the effective capacity is 4C giving (approximately) that $4LC = \frac{1}{\omega^2}$.

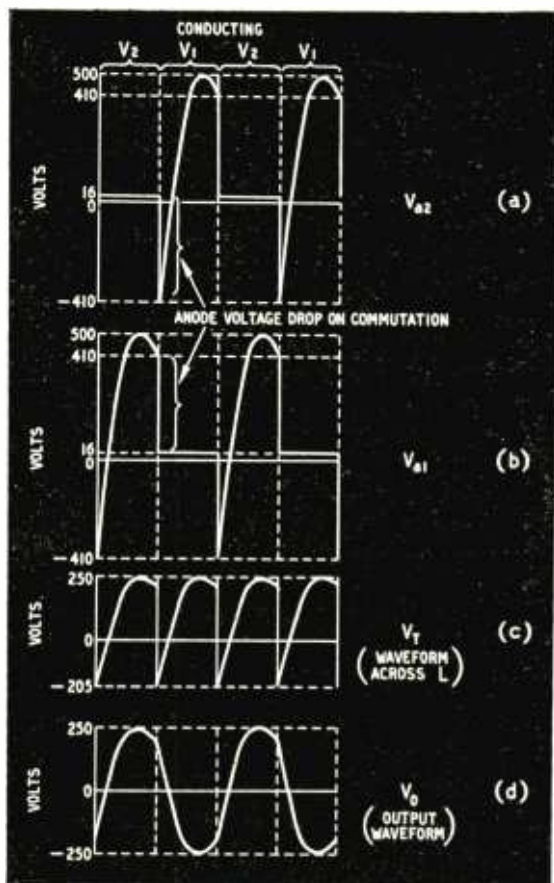


Fig. 6. Waveforms in the circuits of Figs. 5 and 7.

readers who have seen inverter circuits published using self-excitation. At first sight self-excitation appears quite attractive, but there are many pitfalls. One of the biggest snags is starting the operation in the first place. Some authors, in fact, state that a separate (a.c.) source is required to start the action, after which the inverter will run free. Since such a source is required at all, it appears only logical to use it all the time; we then have the added advantages of better frequency stability, and definite frequency control.

The form of driving oscillator incorporated here is a multivibrator using a 6SN7. The outputs from the two anodes are square waves in antiphase; these are applied via self-biasing circuits to the respective thyatron grids. The sharp leading edges of the waveforms trigger the thyratrons at a perfectly fixed time, and ensure a stable, jitter-free output.

(b) *Thyratron anode circuit.*—The thyatron selected for use in this inverter is the Marconi or Osram GT1C. It is a small and easily obtainable valve, a pair of them giving a useful power output of some 100 watts (after subtraction of required heater power). The power is limited by the maximum mean cathode current, 0.3A, the maximum permissible anode voltage, 500, and the maximum waveform distortion we are prepared to tolerate.

Using the component values given, the full 100 watts can be obtained with no difficulty, and without undue distortion of the waveform (see Fig. 8).

The circuit diagram specifies a 240-V winding for the output, but of course any secondary winding can be used, e.g., a 6.3-V supply for valve heaters.

As already pointed out, the regulation is poor, and we therefore include a series dropping resistance in the h.t. line to adjust the a.c. output voltage for each different load.

A very good scheme, where the inverter is required for intermittent use, or for use on several pieces of gear, is to set R so that the inverter just runs its own heaters. A resistance R' located in the gear itself plugs into the inverter in parallel with R. With the external apparatus switched on, R' increases the current to the thyratrons, and the inverter is able to cope with the increased load. A graph giving approximate values of R' for outputs up to 100 watts is drawn (Fig. 9). This graph also gives the power dissipated in R', together with other data on the performance of the unit.

As a safety precaution for the thyratrons, the makers recommend the use of a 1-amp circuit breaker in the H.T. supply. If the inverter action fails, the thyatron current (usually limited by the transformer primary inductance and L) can rise to several amps, and this will damage the valves. The use of a fuse is not recommended as its action is too slow.

A functional diagram of a simple breaker is given

in Fig. 10. The coil carries the normal supply current for the thyratrons (0.6A maximum), and this is insufficient to pull the lever arm over. If, however, the current rises to about 1 amp the lever is attracted to the pole piece, causing the contacts to be released. The supply to the thyratrons is then broken, and can only be restored manually. The device must never be reset with S₂ of Fig. 7 in the "on" position. The current at which the cut-out operates can be adjusted by variation of the spring tension. A reasonably well constructed home-made unit is quite adequate, but suitable cut-outs may also be purchased.

(c) *The switching circuit.*—Before the inverter can be started the heater current must be supplied for the valves. This is done by a series dropper from the mains. The 6GT1C heaters take 1.3 A at 4 V, and the 6SN7 takes 0.6 A at 6.3 V. Using the series-parallel combination shown, the total heater drain is 1.9 amp at 8 volts (15.2 watts), and a very useful form of dropper is a 500-watt iron element of fire bar. The heaters should be left to run for about a minute. This allows sufficient time for the cathodes to heat up, and for the multivibrator to start functioning. In the first instance it is as well to check (with a high-resistance meter) that each thyatron grid is 10 or 20 volts negative to earth, indicating the presence of a switching waveform. After the warm-up time S₂ may

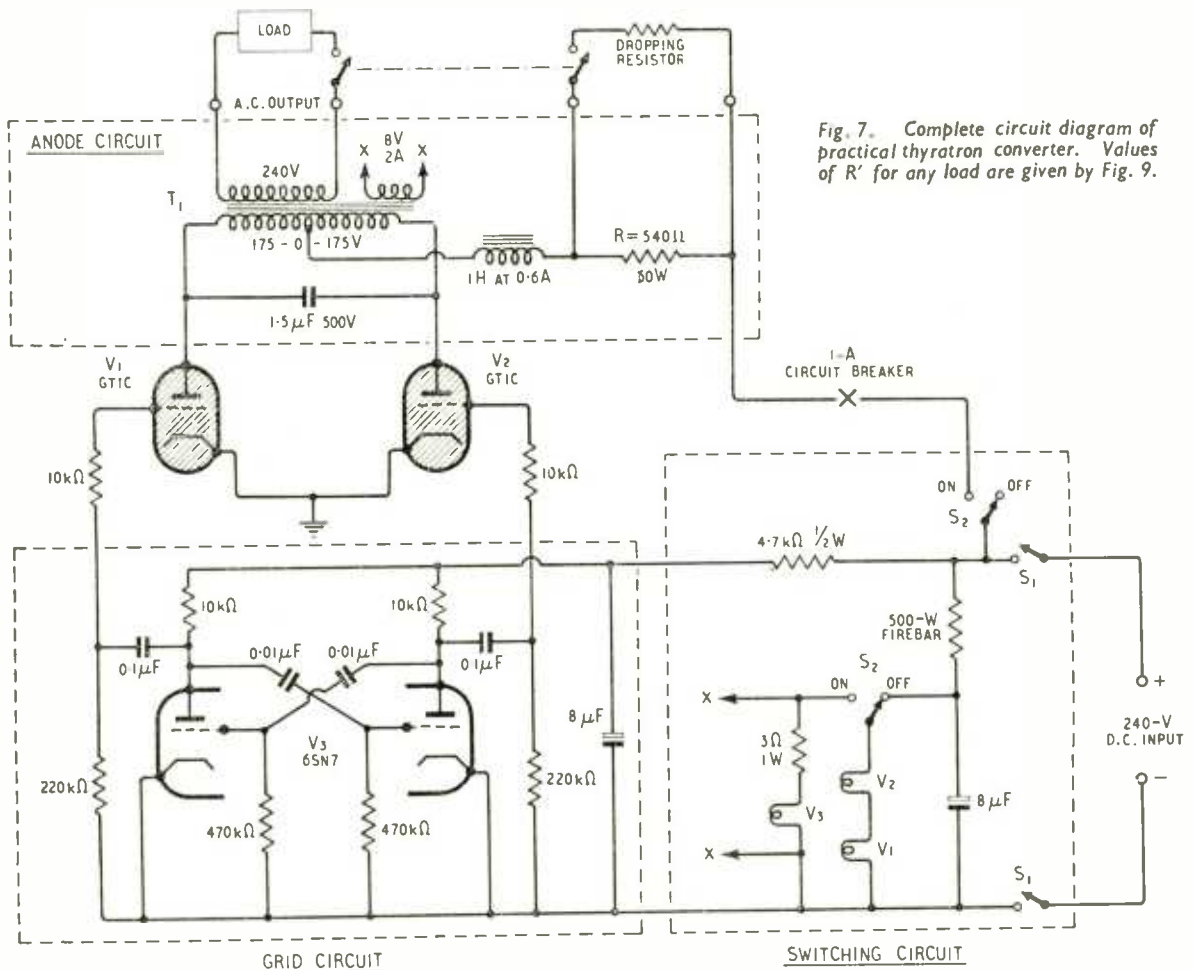


Fig. 7. Complete circuit diagram of practical thyatron converter. Values of R' for any load are given by Fig. 9.

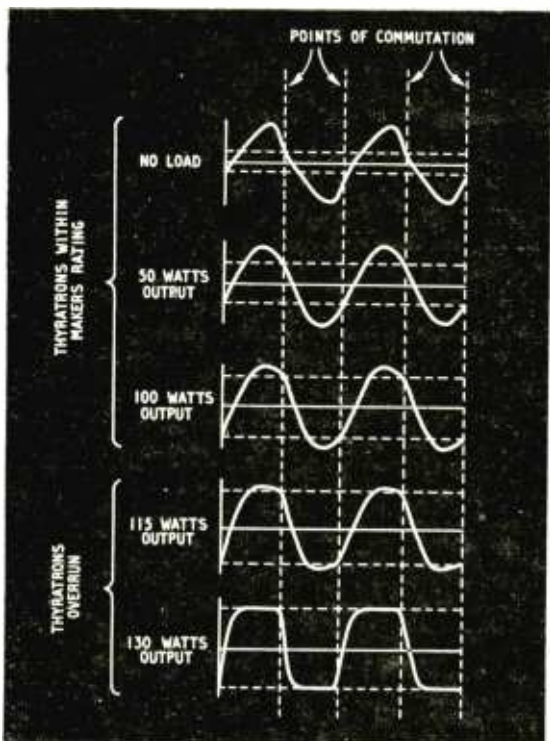


Fig. 8 Output waveform distortion with increase in load. Intersection of broken lines indicate points of commutation.

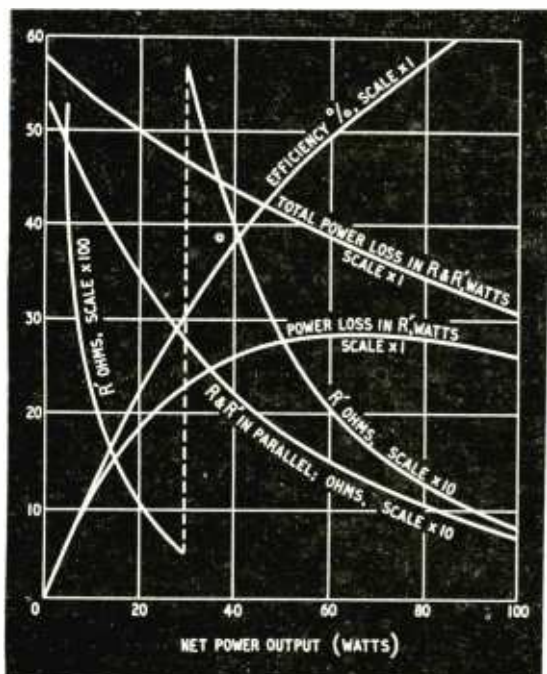
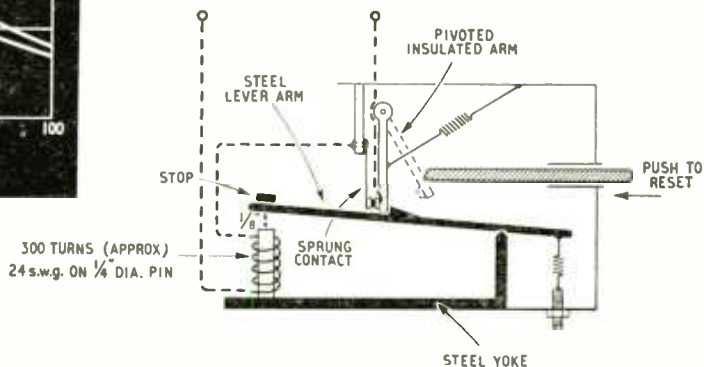


Fig. 9 Approximate values of series resistor and other data on the circuit of Fig. 7.

Fig. 10. (right) Functional diagram of simple circuit breaker.



be thrown to the "on" position, the inverter should then work, and maintain the heater current. Some adjustment of R will probably be necessary to correct the heater voltage.

Additional loads may be added to the inverter by use of resistance R' as already described. Care should be taken that the thyatron heater voltages are never allowed to fall below 4 volts on each valve.

Conclusion.—As a summing up, it may be useful to enumerate in the accompanying table the properties of the thyatron inverter, particularly as a comparison with a rotary transformer.

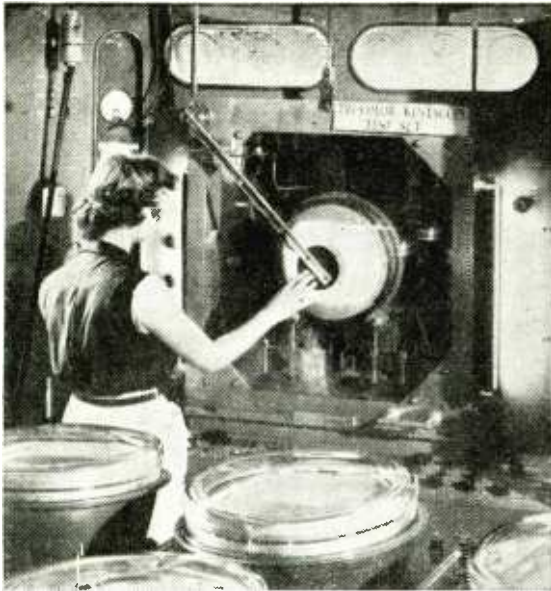
The author has found the circuit described to be reliable and in every way suited for experimental work. A particularly useful feature for many applications has been the availability of 6.3 volts for use on "lash-up" chassis. In these cases the mains direct has been used for h.t. supplies.

TABLE

	Inverter	Rotary Transformer
1	Entirely electronic, no moving parts, consequently silent in operation.	Mechanical device, continuous wear on moving parts, noisy.
2	Several output voltages of any desired value may be obtained.	Generally wound for only one output voltage.
3	Frequency easily controlled, can be locked electronically to, say, television frame time base.	Frequency predetermined, liable to vary with loading.
4	Regulation very poor. Some form of adjustment is necessary, involving considerable power loss.	Regulation fairly good. Adjustment, if required, can be applied to generator field winding, and it is necessary to control only a small proportion of the total current.
5	Full-load efficiency about 65 per cent. If overloaded, thyatron heaters are liable to be underrun, with consequent damage or failure.	Full-load efficiency probably about 50-60 per cent. No serious damage results from overloading.

COLOUR

Three Primary Colours from Screen of Phosphor Dots



Testing the completed tubes for phosphor-dot brightness with a photo-electric light meter on a swinging arm.

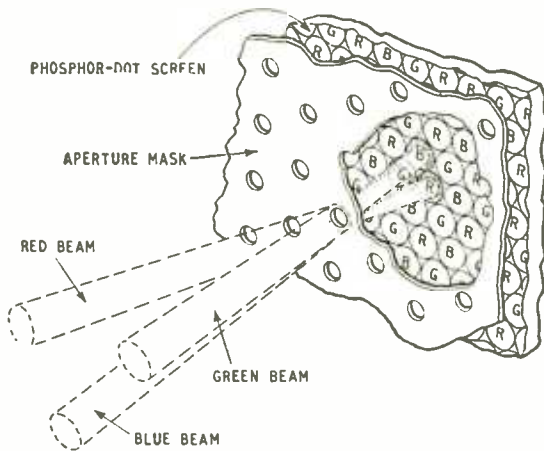


Fig. 1. Showing how the three electron beams are arranged to fall only on their own particular phosphor dots.

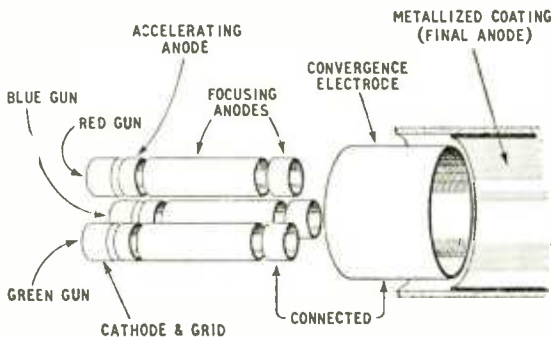


Fig. 2. Sketch (not to scale) of the three electron guns and beam-converging arrangement in the tube neck.

AS part of the general surge of activity on colour television in the United States, quite a number of experimental designs for tri-colour cathode-ray tubes have been brought out in the past year or so. The first of these, though not necessarily the best, has now emerged from its developmental chrysalis as a bright and shining production model and become available on the general market. It is a 15-in tube, type 15GP22, made by R.C.A., giving a colour picture approximately $11\frac{1}{2}$ in \times $8\frac{3}{8}$ in.

The 15GP22 is, in effect, three tubes in one. It has three independent electron guns and three sets of phosphors on the screen which emit respectively red, green and blue light when energized. From each gun the electron beam only energizes one particular phosphor, so that the guns themselves can be labelled "red," "green" and "blue," and in the receiver the signals representing the red, green and blue components of the colour picture can be applied to them appropriately. Much the same effect can be obtained by using three separate cathode-ray tubes with red, green and blue screens respectively and combining their images in an external optical system—but here, of course, it is all done in one envelope.

Masking Principle

The method by which each electron beam is made to fall only on its own particular phosphor is most ingenious. Put into practical form and adapted to mass-production techniques, it amounts to a considerable feat of engineering skill. Fig. 1 illustrates the general principle. The three phosphors are applied to the screen as three "interlaced" sets of phosphor dots, which are arranged in triangular groups of three (red, green and blue) as shown. Altogether there are about 195,000 of these dot trios on the screen, or 585,000 individual dots. Behind the screen, at a distance of about $\frac{1}{8}$ in, is a thin metal mask perforated with tiny holes—one for each phosphor-dot trio on the screen. The three electron beams from the guns are made to converge on this mask, so that when they pass through a hole each beam falls on a particular phosphor dot in the associated trio. Wherever the beams are swept across the mask by the scanning system the same thing happens at every hole.

As the beams encounter each dot trio in turn they are modulated individually by the incoming signals, and the dots are energized accordingly. Since, however, the individual dots in a trio are too small and closely-spaced to be seen separately by the eye, they are blended together to produce a single continuous colour. The actual hue of this colour mixture depends, of course, on the proportions of the red, green and blue primary-colour components specified by the modulating signals. In effect the whole screen is presenting three independent images in the three

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primary colours, slightly displaced from each other. The displacement is so very slight, however, that the three images are virtually coincident to the eye of the viewer and the colours are blended together. It will be noted that the definition of the tube is limited by the number of dot trios on the screen, or holes in the mask, and each dot trio can be considered as a picture element.

In an early experimental model of the tube the three beams were made to converge simply by inclining the electron guns towards each other. In the 15GP22, however, the guns are mounted with parallel axes and the converging process is done by an electrostatic lens. Fig. 2 shows the general arrangement. Around each gun cathode is the normal cylindrical control grid (operating at about -45 V to -100 V for beam cut-off) and this is followed by an accelerating electrode working at about 200 V . Next come a long cylinder (working at about 3 kV) and a short one (at about 9 kV) which between them form an electrostatic lens for focusing the beam. After this all three beams pass together through a common, large-diameter cylinder which is connected to the previous three small ones (at 9 kV). This large cylinder and the metallized coating on the inside of the tube neck (operating at 20 kV) together form a second electrostatic lens which causes the three beams to converge. The mechanism here is much the same as the convergence of individual electrons in an ordinary focusing lens, and, indeed, the three beams do receive a certain amount of extra focusing at this point. The degree of convergence, or focal length, of the lens is controlled by varying the potential on the large cylinder.

After leaving the converging lens the beams pass through the magnetic fields of the scanning coils (which are mounted at the usual position on the tube neck) and on to the mask and screen assembly. From here the return path of the beam current is via the internal metallized coating, which constitutes the final anode of the tube. The 20-kV e.h.t. supply is connected to this coating by a circular metal flange round

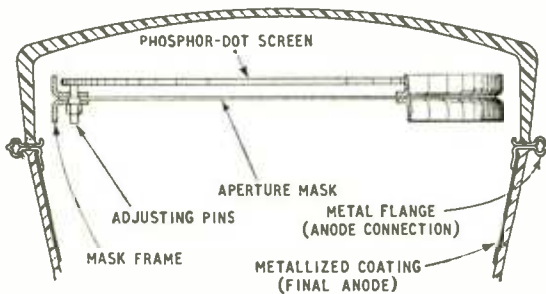


Fig. 3. Mechanical details of the mask and screen assembly.

(Right) A process in manufacturing the phosphor-dot screen. For each set of dots the fluorescent material in paste form is squeezed through a gelatin stencil on to the glass backing plate.

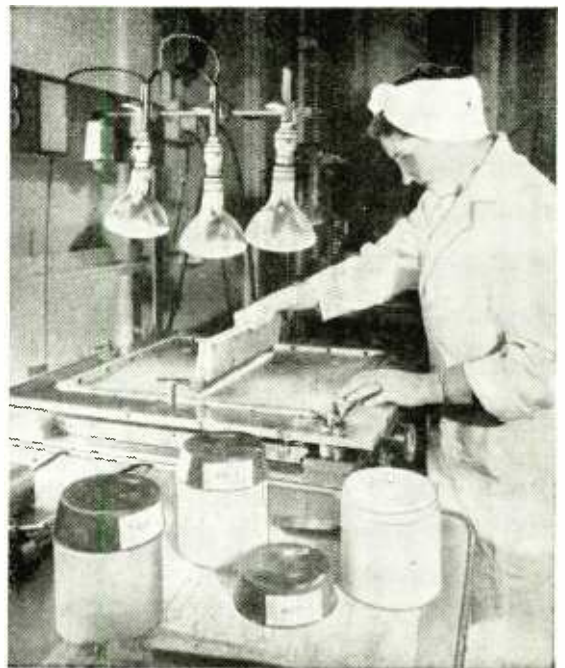


the outside of the envelope, which is actually a welded joint between the face-plate section and the main body of the tube.

Mechanical Design

The tube is 26 in long, has a neck diameter of 2 in and weighs 25 lb . Its deflection angle is approximately 40 degrees. Other constructional details can be seen from Fig. 3. The phosphor-dot screen is deposited on a tinted glass plate and is metallized on the back in the normal way. The mask is made from a copper-nickel alloy, approximately 0.003 in thick, and is clamped in a rigid circular frame which also serves to support the phosphor-dot screen.

One fundamental difficulty in this particular design is that, owing to the screen being flat, the beam-path length from the converging lens to the mask varies



with the angle of scan. Consequently, if the three beams are made to converge (and focus) correctly at the centre of the mask they will not do so at the outer edges. This means that, to obtain correct convergence at all points, the focal length of the converging lens must be made to vary in accordance with the angle of scan. In practice this can be done by deriving a voltage from the line and frame scanning circuits and using it to vary the potential applied to the large-cylinder convergence electrode.

Apart from this, there are one or two other auxiliary devices needed to make the tube work properly. First of all, it has to be protected from extraneous magnetic fields (including that of the earth) by a magnetic shield

round the cone. A field-neutralizing coil, wound round the rim of the face-plate and fed with d.c., may be needed as well for this purpose. Next, the three beams have to be properly aligned with respect to the mask and screen assembly by magnetic deflection from a coil round the neck of the tube. Correct alignment is obtained by rotating this coil and adjusting the current through it. Finally, to align the three beams with respect to each other, three small deflecting magnets have to be mounted round the neck at 120-degree intervals and adjusted individually. All this amounts to a considerable clutter of bits and pieces round the tube, but no doubt future designs will dispense with a lot of it.

BOOK REVIEW

Principles of Transistor Circuits. Edited by R. F. Shea. Pp. 535 + xxx. Chapman and Hall, 37, Essex Street, London, W.C.2. Price 88s.

Those wishing to acquaint themselves with the subject of transistor circuits are overwhelmed by the volume of papers at their disposal and, until this recent work by Shea and his colleagues, have had no textbook to turn to for guidance in their reading. In the circumstances almost any book would be welcome; that this particular one contains a considerable amount of useful material and is well written by engineers experienced in transistor circuits makes it highly acceptable.

The book itself is likely to be of most value to engineers actively interested in transistor circuits. It is too detailed for casual reading and the extensive algebraic analysis makes it too unwieldy if one is merely interested in obtaining a general idea of the principles. Engineers already at grips with transistor circuits will find the names of many of the co-authors familiar, since part of the book is based on their published work. Each chapter has a general introduction, which is both useful and interesting, and a number of examples so that engineers and students may practise the principles discussed in the chapter; the only difficulty with this is that no answers are given, thus leaving the keen student to devise some method for checking that his answer is correct.

Over half the book is devoted to transistor amplifiers; because of its highly linear amplification and relative freedom from noise limitations, the junction transistor is the chief device discussed. The analysis is mainly mathematical and is as generalized as possible in order that the book shall not become out of date too rapidly as new types of transistors appear. Thus, in the chapters on high-frequency amplifiers, when frequency is considered it is always expressed in terms of $\omega \ll 0$ (the frequency at which α , the current gain, is 3 db down from its value at low frequency). This approach is to be recommended even though it may involve some mental efforts to translate the result to a practical circuit.

The chapters on low-frequency amplifiers are very detailed and many useful parameters such as input and output resistances and operating gain are tabulated for easy reference. Three chapters on high-frequency circuits (high is, of course, a relative term and often disappointing to engineers experienced in thermionic valve circuits) include one on narrow-band tuned amplifiers, a very neglected topic in transistor circuits.

A chapter on bias stabilization and one on d.c. amplifiers indicate methods of overcoming a very serious difficulty met with germanium junction transistors; namely, the variation of I_{co} (the collector current when the emitter current is zero) with temperature.

The chapter on power amplifiers barely mentions the possibilities of circuits using both $n-p-n$ and $p-n-p$

transistors at the same time (complementary symmetry) or of those using specially made junction transistors where the role of emitter and collector can be interchanged by merely reversing the sign of the bias applied. Evidently the book was completed before these interesting and important possibilities were fully appreciated.

The chapter on oscillators is disappointingly scanty. The chapter on transistors in computer circuits is also very brief though this weakness is somewhat mitigated by a chapter on transient analysis where the difficulties of switching a transistor amplifier from low to high conduction and *vice versa* are discussed in some detail.

Duality between transistors and thermionic valves, matrix methods of network analysis, noise, the measurement of the parameters of the small signal a.c. equivalent network, and semi-conductor devices other than transistors are all discussed in separate chapters. A somewhat compressed introductory chapter indicates the physical principles of semi-conductor devices.

The book is well produced and contains an extensive bibliography. All the symbols used, as well as the first page they appear in the text, are listed at the beginning. Its chief limitation is its very high price. D. D. J.

BOOKS RECEIVED

Applied Electronics Annual 1953/54. Edited by R. E. Blaise, A.M.Brit.I.R.E. International directory of manufacturers of radio and electronic equipment, prefaced by articles on recent developments in many branches of the art. Pp. 257 with numerous illustrations. Price £1. British-Continental Trade Press, 222, Strand, London, W.C.2.

Einschwingvorgänge Gegenkopplung, Stabilität, by J. Peters. Theoretical foundations and application of feedback in amplifiers, mechanical and electro-mechanical systems, and their stabilization. Pp. 181 + xv; Figs. 130. Price DM27. Springer-Verlag, Reichpietschufer 20, Berlin, W.35.

Radio Control of Model Aircraft, by G. Sommerhof. Outline of basic principles of radio control, with constructional details of a transmitter and receiver, and associated electro-mechanical devices. Pp. 164; Figs. 87. Price 9s 6d. Percival Marshall and Company, 23, Great Queen Street, London, W.C.2.

How to Use Meters, by John F. Rider. Description of principal types of pointer instruments, valve voltmeters and their use in maintenance and experimental work. Pp. 156; Figs. 153. Price \$2.40. John F. Rider, Publisher, 480, Canal Street, New York 13.

TV Trouble Shooting and Repair Guidebook, Vol. 2, by Robert G. Middleton. Deals particularly with r.f. and i.f. amplifiers, detectors and audio stages. Pp. 156; Figs. 187. Price \$3.30. John F. Rider, Publisher, 480, Canal Street, New York 13.

Vacuum Lamp Interference

R.F. Oscillations from Electric Light Bulbs

By "CATHODE RAY"

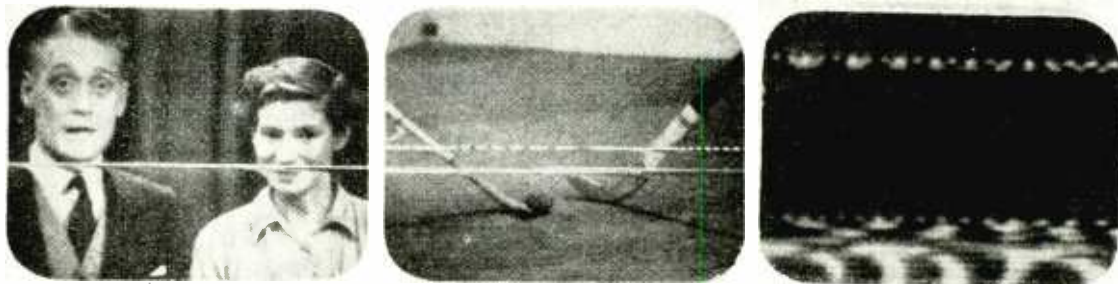


Fig. 1. Example of lamp interference on television pictures.

IF you think you have seen Fig. 1 before somewhere, you are quite right. It appeared as recently as the March issue, p. 102, to illustrate a short note summarizing the findings of 1953 *Wireless World* correspondence on lamps as sources of interference with television. The main point put on record was that gas-filled lamps may interfere when they are so near the end of their life that a microscopic break occurs in the filament, across which an arc is produced, but vacuum lamps can radiate interference throughout their life. No explanation was offered of how vacuum lamps managed to perform this remarkable but objectionable feat, so I have looked into the matter to see if it could be explained.



Fig. 2. Typical tungsten filament in vacuum lamp.

long been displaced by the gas-filled lamp for domestic purposes, but apparently is used to this day for a few special applications, mostly connected with transport. As a matter of fact I had to poke around for some time in a dusty old junk box near the ceiling before I could find one. It was an authentic specimen of the kind that must be familiar to all in what I will tactfully refer to as the upper age groups; a long zig-zag filament suspended between two sets of glass-mounted spokes as in Fig. 2. In case it is of interest

to anybody, here is the information it carried on the bulb:

3.1.18
Pope "Elasta"
British Made
200-32

The 200 presumably refers to the voltage, and the 32 takes one back to a still earlier era when the carbon-filament lamp reigned supreme, and as the less that was said about its consumption the better it was usually rated not in watts but in candle-power—8, 16, or 32.

Having found my vacuum lamp, I plugged it in and brought it near the television receiver; but with no effect on either picture or sound. The next thing was to dig out the v.h.f. super-regenerative receiver described in the January, 1947, issue, and put near it the lamp connected to a variable source of 50-c/s a.c. To give it a better chance I put a pair of r.f. chokes in the leads close to the holder, and a by-pass capacitor, as in Fig. 3. This worked right away, producing a broad band of interference. By varying the voltage, the centre of the band could be shifted, from about 75 Mc/s at 200V to 56 Mc/s at 145V, below which oscillation ceased altogether. The lack of TV interference in the preliminary test was thus explained, for the local station is Channel 1, 45 Mc/s.

Varying C in Fig. 3 from 0 to 500 pF had only a minor effect; the less the capacitance the higher the frequency, but the whole variation was only a mega-

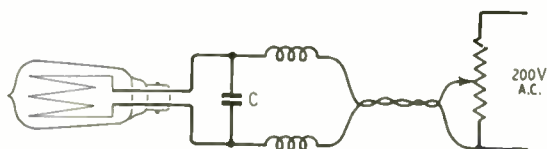


Fig. 3. First experimental lamp oscillator. This proved to be needlessly elaborate.

cycle or so. With 500pF, oscillation seemed a little less ready than with, say, 25 or 50. Removing the chokes made no noticeable difference. In other words, the lamp interfered at least as merrily when connected in the ordinary way at the end of a piece of flex as with any combination of tuning components. The only thing having a substantial effect on the frequency was the voltage. Remember, there is a good vacuum in this kind of lamp, so there is no question of gas discharge, as with the interference caused by neon lighting and a small proportion of fluorescent lamps. It is genuine v.h.f. oscillation, modulated in amplitude and frequency at 50 c/s.

Just to complicate the problem, oscillation ceased every time I drew my hand rapidly away from the bulb, and was stimulated by moving it towards the bulb. Let me emphasize that *holding* the hand at any point within this range of movement—about $\frac{1}{2}$ in to 6 in from the bulb—did not produce the effects mentioned; they depended entirely on movement. An exception was that actually touching the bulb about its middle invariably stimulated oscillation, and in fact was the most certain way of reviving it when it had petered out, as it was apt to do on slight provocation, such as shifting the position of the lamp. Various arrangements of wires and metal plates, earthed, un-earthed, or connected to either lamp terminal, produced sundry effects, but none so marked as with the hand.

Since the main factor controlling frequency was voltage, which with an a.c. supply is varying all the time, it was obviously going to simplify the situation somewhat if the lamp were fed with d.c. This was rigged up with the aid of a mercury rectifier and a smoother that left enough ripple to be heard on the receiver. The general results were very similar to those obtained with a.c., except that as expected there was less frequency modulation, so interference was confined to a narrower band. The tendency for oscillations to fade out was more marked, and it was difficult to keep them going at all unless the lamp holder was connected straight to the supply, without any chokes, etc. The voltage required to tune to a given frequency was nearly 30% higher than the r.m.s. voltage with a.c. (but somewhat lower than the peak voltage), and with 135V ceased altogether, the last measured frequency being 42 Mc/s.

One-Electrode "Valve"

Some months ago* I extolled the marvels of the magnetron, which, though a mere diode, oscillates to such intense effect in the centimetre wavebands. We might feel sure that two was the absolute minimum number of electrodes for true electronic oscillation. Yet here we have a "valve" consisting of filament only, so presumably classifiable as a monode, working as a complete v.h.f. transmitter, without the aid of anything except an ordinary domestic a.c. or d.c. supply. How does it do it?

The best clue was given by A. Q. Morton in a letter in the July, 1953, issue—his reference to an article by P. S. Rand in *CQ*, July, 1952. This article is worth reading not only for the information presented but for the ingeniously humorous manner of presentation. The vital essence, however, is a reference to Barkhausen and Kurz. Old hands will no doubt have their mental bells set ringing by the mere mention of those magical names, but the younger may experience no

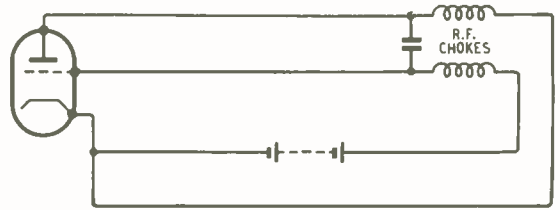


Fig. 4. Barkhausen-Kurz oscillator circuit.

reaction. Barkhausen and Kurz created a considerable stir in highbrow circles from 1920 onward by their disclosure of the type of oscillation named after them. It is obtained with a triode having a positive voltage applied to the grid, and zero or slightly negative anode. The oscillatory circuit consists of parallel Lecher wires, as in Fig. 4. The object of tuning these leads is not to vary the frequency—for their effect on it is slight—but to facilitate oscillation at the frequency set by the grid voltage.

Electrons and Fields

A tremendous lot has been written and talked about Barkhausen-Kurz oscillations, and one can soon get tangled up in a confusion of complication; but there seems to be general agreement about the main essentials of the story. It has much in common with the one I told about magnetrons in "Valves for Microwaves." The underlying principle is that if an electron (or any other electrically charged body) moves *with* an electric field, it *receives* energy, and this energy is manifested as acceleration; if it moves *against* the field it *gives up* energy and consequently loses speed. In the magnetron, electrons are attracted by the h.t. from the cylindrical cathode to the surrounding anode, and this anode is divided into segments by resonant cavities, which have oscillatory voltages superimposed on the common h.t. Those electrons that happen to come under the influence of the oscillatory field in such a phase as to be moving with the field draw energy from it, but use it to their own destruction, or at least their speedy removal from the arena. Those that arrive against the field give up some of their energy (which has been given them by the h.t.) to help keep the oscillations going, and thanks to the subtle interplay of electric and magnetic fields they are able to continue doing this for some time as they dance around. So their contributions of energy far outweigh that taken away by the drone electrons in their much shorter lives.

Something of the same kind is responsible for B-K oscillations. The electrons leaving the cathode are attracted by the positive grid and accelerate violently towards it. But because it is a grid, there is plenty of space between its wires for electrons to go through, and most of them do this. They then find themselves confronted with a negative or at most zero-potential anode, and the positive attraction is now backward. So they are first retarded to a stop and then accelerated back to the grid. Again some go through, and the whole process is repeated until sooner or later they get caught. If you like the rolling-ball analogies we used recently, you can picture the zero-potential cathode and anode as ridges with the positive grid as a trough in between. The balls released at the cathode ridge gain speed as they roll down to the grid, and a few of them are collected there, but most go past and their momentum carries

* "Valves for Microwaves," Sept., 1953.

them nearly to the top of the anode ridge; then they roll back, and continue with a sort of to-and-fro pendulum movement. For a given weight of ball, the time for each to-and-fro cycle depends on the distance between the ridges and on the depth of the trough. Similarly the time for a cycle of electronic oscillation depends on the distances between the electrodes and on the grid voltage.

Assuming now, as we did with the magnetron, that the grid potential is oscillating above and below the steady h.t. voltage, at the same frequency as that of the electrons in and out of the grid wires, the electrons that leave the cathode just as the grid is becoming more positive are accelerated more than they would have been without the oscillatory potential. This extra acceleration is at the expense of that potential. And because of the synchronization of frequency, by the time the electron has gone beyond the grid the grid potential has reversed and so the electron is retarded less than it would have been. The net result of greater speed and less braking is that the electron fails to pull up before it reaches the anode, into which it crashes and is thereby removed from the event on the first lap. This, of course, is just what it deserves for stealing energy from the grid oscillation.

Electrons that start just as the grid is beginning its negative half-cycle are accelerated less than with the h.t. alone; and when they get beyond the grid they are retarded more. So all the time they are giving up their energy to the grid and their swing becomes less and less every half-cycle. There is consequently no risk of being collected by the anode, and they have a sporting chance of clearing the grid several times in succession (Fig 5). So, as in the magnetron, if conditions are favourable the energy-giving electrons are more effective than the one-lap energy-taking electrons, and the net result is a build-up of oscillation.

Oscillator Components

What has all this to do with lamps? Well, the only major frequency-controlling factor in the B-K oscillator is the grid voltage. The only major frequency-controlling factor in the lamp oscillator is the applied voltage. This voltage is applied between one end of the filament and the other. Every part of the glowing filament emits electrons and is in a vacuum, so is potentially a valve cathode; and every part is likewise a grid because it is that shape. So when a suitable voltage is applied between one end and the other (either continuously or alternately) the

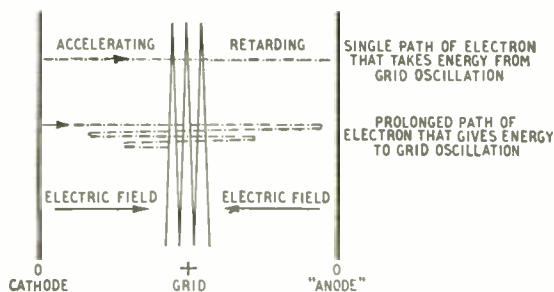


Fig. 5. In a B-K oscillator, electrons that come at the right moments to build up grid oscillation tend to have longer runs than those that damp it down, and so they prevail.

negative end is a cathode and the positive end is a positive grid. The rest of the filament forms a zig-zag loop between the two, having distributed inductance and capacitance. So all the parts of the B-K oscillator seem to be present and correct except the anode. Another difference is that the "tuned circuit" is connected to the cathode instead. As far as potential is concerned there is nothing wrong with that. And the only purpose of the "anode" (it is really no such thing in this case) is to be at somewhere near cathode potential so as to ensure that the space between it and the grid has an electric field that is positive gridwards. P. S. Rand gets over the missing electrode problem by saying "The plate being negative does nothing and might as well be left out." That seems to me just a little too glib. My theory is that the bulb is the "anode."

Unauthorized Anode

After all, it wouldn't be the first time. Quite a long while ago* an article appeared by K. A. Macfadyen entitled "A Form of Distortion Known as the 'Buzz Effect'." This showed very convincingly that a certain hitherto mysterious buzz superimposed on sound reproduced by some pentode output valves was caused by the getter—the metallic layer deposited on the inside of the bulb during manufacture—acting as the anode in a dynatron. Only last month, in "Relaxation Oscillators," we had occasion to refer to an anode-current/anode-voltage diagram with the dynatron kink in it, and a load line cutting it at three possible working points, one of which we found to be impossible—at least for any period of time exceeding zero. Mr. Macfadyen uses exactly the same diagram to show that the unauthorized getter anode goes through sudden violent jumps up and down in potential as the real anode (which unbeknown is acting as the second grid in a dynatron) is trying to execute nice smooth ellipses to give nice smooth bass notes to the loud speaker but is frustrated therein by the said jumps working back via capacitance coupling to the control grid and injecting nasty spiky noises into the programme. Don't waste too much time puzzling this out—the details are not important just now. The main thing is the bulb acting as an electrode. (Incidentally, I usually back the British term "anode" against the American "plate," but with so many electrodes in disguise or playing the wrong roles it is becoming a little difficult!)

You may say that that is all very well, but lamps don't have metallic coatings on the insides of their bulbs—they would stop the light getting out. Certainly lamps wouldn't be very saleable if they were gettered like valves; but for our present purpose we are not looking for a dynatron anode but only for somewhere that can be at about zero potential, and I seem to remember that the whole subject of electronics is generally reckoned to have begun in 1883, when Edison, who had been trying to find a cure for the bulbs of his lamps blackening on the inside with use, discovered that an electric current could pass across the vacuum between filament and bulb. Presumably some trace of metallic coating accumulates, even in more modern lamps, and electrons shot against the bulb by the field we have already discussed tend to charge it negative and so establish a retarding field as required for B-K oscillations.

* *Wireless Engineer*, June, 1938, p. 310.

As it happened, looking up Macfadyen's article I found (what I had completely forgotten) that he goes on from buzz distortion to explain radio interference from vacuum lamps! But apparently the interference he explained was different from the kind we are trying to explain: first, because his interference occurred throughout the band 3 to 30 Mc/s; and secondly, because the dynatron effect was stopped by an earthed coating outside the bulb, whereas that invariably stimulated our kind of interference to greater achievements. No; the interest of this article for our present enquiry lies in its confirmation that the inner surface of a vacuum lamp bulb can act as an electrode. Incidentally, according to a formula quoted by F. E. Terman, giving the frequency of B-K oscillation in terms of voltage and electrode spacing, the spacing in my lamp works out at about 2 cm, which is just about what it is.

So now we have accounted for the whole B-K outfit. What is more, unless I am mistaken we have accounted for the Mystery of the Moving Hand. If an earthed body (mine, in this case) is suddenly moved to a charged body, the capacitance of the charged body to earth is increased, and in accordance with the relationship $Q=VC$ the potential of the charged body is lowered. And vice versa when I move my body away. My theory is therefore as follows. The inner surface of the bulb, on the opposite side of the positive end of the filament ("grid") from the negative end ("cathode") is being bombarded with the electrons that miss the "grid." It therefore becomes negatively charged with respect to the "grid," until the charge is sufficient to keep away the retarded energy-contributing electrons and B-K oscillations can begin. The energy-receiving electrons that crash into it probably cause secondary emission that results in the potential becoming stabilized at a level that is still slightly more positive than "cathode." Bringing a hand quickly towards the bulb causes the potential to drop nearer zero ("cathode")—a condition that favours the oscillation. But when the hand comes to rest the newly increased value of capacitance charges up to the original potential and oscillation reverts to normal. Taking the hand rapidly away raises the potential enough to stop oscillation altogether, but when that incident is over the bulb comes back once more to normal. Holding the bulb firmly, on the other hand, keeps the inner surface at a lower potential by conduction through the warm glass as long as it is held.

If you have a better story, don't hesitate to send it in for general information.

CODES OF PRACTICE

ARRANGEMENTS have been concluded whereby with effect from April 1st, 1954, the preparation and publication of all Codes of Practice will in future be the responsibility of a council within the framework of the British Standards Institution. Hitherto such codes were prepared by the Ministry of Works or the professional institutions concerned, but they were often issued by the B.S.I.

Essentially, codes of practice are concerned with setting out tried and proved methods of operation, installation and maintenance of plant, machinery and equipment, etc., as opposed to manufacturing require-

ments and processes which take place before plant and equipment leaves the factory. Codes are thus closely related to, although quite distinct from, the standard specifications which form a large part of the work of the British Standards Institution.

The structure of the B.S.I.'s Council for Codes of Practice will be a broad one; its members will be drawn from the professional institutions and such Government departments that may be concerned. It will have a total of 51 members. Much of the work will be carried through by small specialist committees and panels with members drawn from institutions primarily concerned with the subjects to be considered.

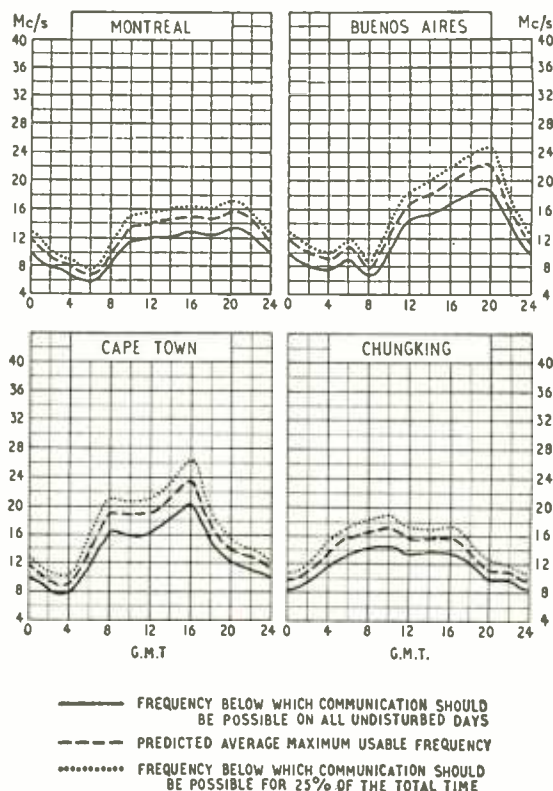
A recent example which has just appeared is a code of practice on "The Use of Electronic Valves," CP 1005: Parts 1 & 2: 1954. This has been prepared by a joint committee of the I.E.E. and the B.S.I. and covers receiving valves, cathode-ray tubes, rectifiers and thyatrons. It is issued as a small booklet of 38 pages by the British Standards Institution, 2, Park Street, London, W.1, and costs 6s.

Short-wave Conditions

Predictions for May

THE full-line curves given here 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 May.

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



Transistor Mortality

Symptoms and Causes of Early Failure

ABOUT two years ago a paper by J. A. Morton (*B.S.T.J.*, May, 1952, pp. 411-442) included an estimate of the average life of transistors. The figure was a heartening one, 70,000 hours, and most equipment designers must have been impressed by the contrast between this figure and the conservative 1,000 hours of the valve manufacturers. On a 24 hour a day basis, 70,000 hours is just about eight years, though the evidence was not enough to indicate whether the life would be eight years or 70,000 hours of operation. The transistors for which this estimate was given were operating as Class A amplifiers, in the laboratory, and had already run for 20,000 hours. Users were therefore rather alarmed when their own transistors appeared to be liable to much earlier death. Increased temperature and increased humidity, in particular, cause quite a lot of trouble, and a new survey of transistor reliability by Ryder and Sittner (*Proc. I.R.E.*, Feb., 1954, p. 414) discusses the present status of "transistor toxicology." Four main ailments are listed in this paper, and we cannot do better than repeat the description given by Ryder and Sittner:

1. A very gradual drift in the characteristics with time. Particularly affected are the reverse currents of the collectors, both point and junction. This disease was the factor which limited the life to 70,000 hours in the original life tests; since it ordinarily takes a long time to become appreciable, it is known as the "slow death."

2. A gradual development with time of what appears to be a leakage path between the collector and emitter. Not very noticeable in most point-contact transistors, this disease is more virulent in junction transistors, particularly grown types which normally have very high resistance levels; it shows up as a variable floating potential on the emitter when the current is cut off. Since the ailment concerns

emitter current cutoff conditions, it is called "sleeping sickness."

3. In some point-contact transistors the current multiplication factor, alpha, may become markedly reduced, particularly at low voltages. Though normally rare, this occurrence has at times reached an incidence as high as 25 per cent for some types. Since this disease may occur quickly without previous warning, it goes by the name "sudden death."

4. Sometimes loss of alpha has occurred prior to receipt of the transistor by the customer. Such units are declared "dead on arrival."

"Slow death" appears to be caused by changes in the surface conditions as a result, mainly, of water vapour. Exposure of an unprotected *n-p-n* junction unit to 54 per cent relative humidity, which is not a very damp climate, causes the current to rise from 2 to 1,000 μ A. The change is rapid and reversible. Normally, of course, the transistor is enclosed in wax and some sort of protective case, but the wax and plastic cases used merely slowed down the effect, and slowed down the reversal. An increase of ambient temperature by 10 deg C doubles the rate at which water vapour diffuses through the wax, and in another type of junction transistor the current doubled after 80 hours at 45 deg C and 100 per cent humidity. Point-type units remained good after 2,500 hours at 55 deg C and 100 per cent humidity.

These point types, however, were liable to "sudden death." Fig. 1 shows, for the benefit of those who are lucky enough not to have encountered this effect, the change in characteristics which takes place. There has been a very large drop in the value of alpha, and the "dead" transistors would clearly be of no use in switching circuits. Investigation has shown that the effect is due to very small rocking of the contact points, most probably because of slight warp-

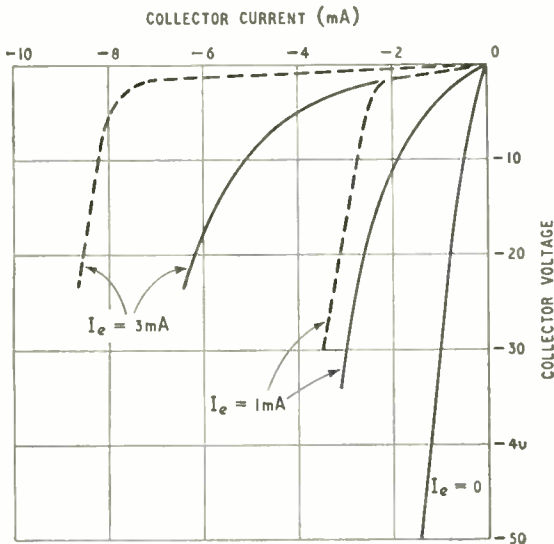
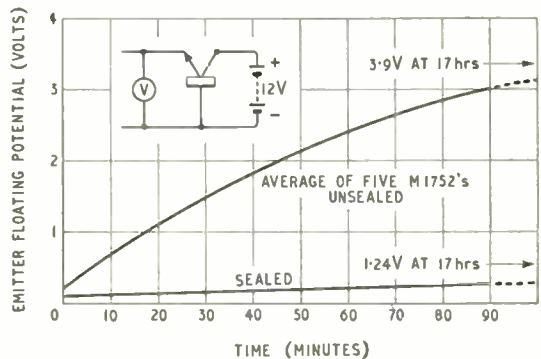


Fig. 1. (Left.) Point transistor characteristic (full lines) before and (dotted lines) after "sudden death."

Fig. 2. (Below.) Effect on emitter floating potential ("sleeping sickness") of sealing grown *n-p-n* junction transistors.



ing of the plastic supporting insulator resulting from moisture absorption. Design changes which have been introduced appear to have cured this trouble, and it seems likely that if a 24-hour accelerated ageing process is used to eliminate faulty units the particular point type studied might be regarded as immune from humidity troubles.

"Sleeping sickness" affects the grown junction types, and the method of measurement and the results obtained are shown in Fig. 2. The emitter is left open-circuited and the normal collector bias applied: in a "good" transistor the emitter should float at about 0.05 volts, but if there is any leakage across the base, which in the grown junction units is very thin, the emitter will drift up to a much higher

potential. Water is probably the main trouble again, but here cleaning, surface treatment and great care to avoid sealing in troublesome ions are required. In the alloyed type of junction transistor the trouble is much less serious, because of the longer leakage path.

The authors of this paper express their belief that hermetic sealing may not be necessary for all applications, and that plastic cases and new surface treatments may suffice for the more pedestrian circuit functions.

Acknowledgments. Fig 1 is based on Fig. 6, and Fig. 2 on Fig. 16 of "Transistor Reliability Studies," by R. M. Ryder and W. R. Sittner, *Proc. I.R.E.*, Vol. 42, No. 2, Feb., 1954.

V.H.F. DEMONSTRATION VAN

THE illustration shows the interior of a van especially fitted to enable "on the spot" demonstrations to be made of the General Electric Company's v.h.f. communications equipment. It is generally used in conjunction with a mobile satellite consisting of a radio equipped shooting brake.

Radio equipment comprising six transmitter-receivers of various types (f.m. and a.m.) are installed in three 6-ft enclosed racks inside the van; two occupy a position backing on to the driver's compartment, while the third is on the near side adjacent to a tall cupboard. All racks are mounted on shock absorbers.

Fixed to the near-side of the van between the equipment racks is a small folding table which serves as the operating position and is fitted with a microphone and loudspeaker control panel.

On the off-side of the van is a well-equipped workbench and above it a cupboard extending the full length of the van. Below the cupboard is stowage space for the sections of a portable 55-ft light-alloy mast.

At the front end of the workbench facing the operator's table is a power distribution panel from which radiate a.c. and d.c. lines operating the radio equipment, supplying light in the van and such other purposes as may be required.

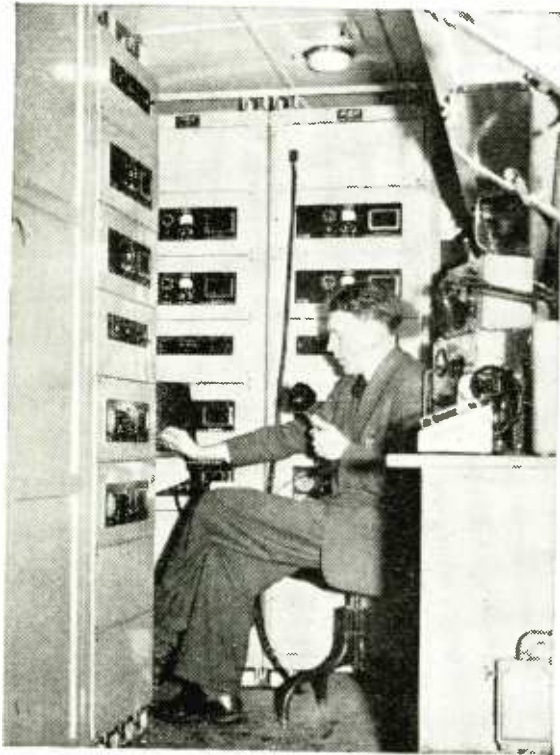
Failing access to a mains electric supply two alternative sources of power are available. One is a 24-V battery-driven d.c.-to-a.c. converter for short-period operation; the other is a portable petrol-electric generator for use when several days are spent at an isolated site. A battery charger is also included.

Higher Technology

IT is not surprising to learn that one of the most successful specialized courses of lectures, if not the most successful, in London and the Home Counties was that on "Crystal Valves and Transistors" recently held at the Borough Polytechnic. There were over 300 applications and the demand was such that the course was repeated.

The success of this course was instanced by the Regional Advisory Council for Higher Technological Education as indicative of what can be achieved when industry makes known its needs for specialized courses of instruction. The Council for London and the Home Counties is anxious that the radio and electronics industry should know that in addition to publicizing courses introduced by colleges and institutes the Council is willing to sponsor advanced short courses for scientists and technologists in industry. There are advisory councils in each of the other nine regions who would doubtless similarly co-operate.

Details of the special courses available in the spring and summer terms this year are given in Part 2 of the Bulletin issued by the London Regional Advisory Council. It is obtainable from Tavistock House, Tavistock Square, London, W.C.1, price 1s 6d.



Interior of the v.h.f. demonstration van equipped by the General Electric Company.

MAY MEETINGS

Institution of Electrical Engineers

Radio Section.—"The Reflection and Absorption of Radio Waves in the Ionosphere" by W. R. Piggott, B.Sc., and "Some Notes on the Absorption of Radio Waves Reflected from the Ionosphere at Oblique Incidence" by W. J. G. Beynon, Ph.D., D.Sc., at 5.30 on May 5th at Savoy Place, London, W.C.2.

North-Eastern Centre.—Faraday Lecture on "Electro-Heat and Prosperity" by O. W. Humphreys, B.Sc., at 7.0 on May 4th at the City Hall, Newcastle-upon-Tyne.

South-West Scotland Sub-Centre.—Faraday Lecture on "Electro-Heat and Prosperity" by O. W. Humphreys, B.Sc., at 7.0 on May 6th at the Royal Technical College, Glasgow.

British Institution of Radio Engineers

London Section.—"Microwave Measuring Equipment" by P. M. Ratcliffe at 6.30 on May 5th at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1.

Merseyside Section.—Annual general meeting followed by programme of technical films at 7.0 on May 6th at the Electricity Service Centre, Whitechapel, Liverpool, 1.

British Sound Recording Association

London.—"Voices and Sounds from History" by Brian George, illustrated by recordings from B.B.C. archives, at

the annual convention at 7.0 on May 21st at the Waldorf Hotel, Aldwych, London, W.C.2.

Royal Society of Arts

"Colour Television" by Cdr. C. G. Mayer, O.B.E., (R.C.A.) at 2.30 on May 5th at John Adam Street, Adelphi, London, W.C.2.

Television Society

London.—"Receiver Design for 625-line Systems" by Dr. A. J. Biggs (G.E.C. Research Laboratories) at 7.0 on May 14th at the Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, London, W.C.2.

Institute of Practical Radio Engineers

Midlands Section.—"Sobell Television Receivers" by C. W. Sheffield (Sobell) at 7.30 on May 3rd at the Crown Hotel, Broad Street, Birmingham.

Electro - Physiological Technologists' Association

London.—The annual general meeting, followed by a series of papers and demonstrations, will be held this month. Particulars from the secretary, G. Johnson, Hurstwood Park Hospital, Haywards Heath, Sussex.

Institute of Navigation

"Visual Aids to Bad-Weather Approach" by Dr. E. S. Calvert at 5.0 on May 21st at the Royal Geographical Society, 1, Kensington Gore, London, S.W.7.

Versatile Industrial Receiver

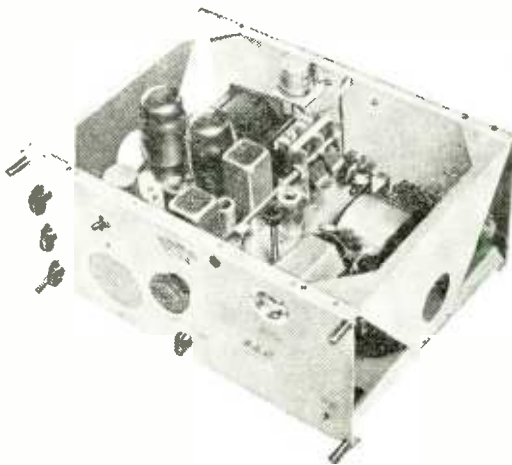
A RADIO receiver designed especially for use in medium-sized industrial premises, in hotels, hospitals and clubs has been introduced by the General Electric Company, Kingsway, London, W.C.2. It is of unit construction consisting of a sensitive superheterodyne radio receiver, a 15-watt audio amplifier capable of operating up to 30 extension loudspeakers and an a.c. power supply unit.

A centrally placed selector switch gives choice of medium- and long-wave broadcast, gramophone reproduction or microphone input for announcements and paging. In addition to the customary tuning control there are controls for output, tone and an on/off switch for a built-in 3½-in monitor loudspeaker.

The output transformer is designed to work into a 250-ohm line; it is centre-tapped and balanced to earth with an electrostatic screen between primary and secondary. Two sets can therefore be used to

supply over a 4-core cable the choice of two programmes without fear of "cross-talk."

The receiver is available in two styles, a chassis model in a grey enamelled steel cabinet (BCS2353) and a rack-mounting model (BCS2354). The former costs £53, the latter £51 10s and the U.K. purchase tax in both cases is £3 15s 9d.



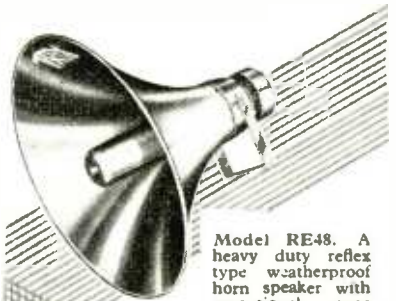
G.E.C. industrial receiver, Model BCS2353, withdrawn from its cabinet.

SOUND

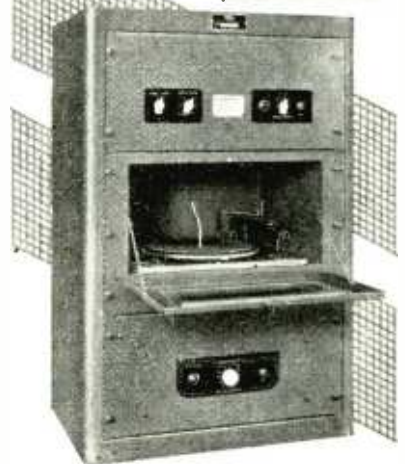
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RANDOM RADIATIONS

By "DIALLIST"

Proof by Nine

HERE is an arithmetical curiosity that I haven't come across in this country, though on the other side of the Channel everyone, from school-children to stockbrokers, makes much use of it. The French call it "La preuve par neuf," or proof by nine. This is how it works. You have multiplied, let us say, 729,534 by 835 and want a quick means of checking the correctness of your result, 609,160,890. Draw a large X. Add the digits of the multiplicand, leaving out any nines: $7+2=9$; drop this 9 and the third digit, which is also 9; then $5+3+4=12$. Go on adding: $1+2=3$. Write 3 in the top angle of the X. Add the digits of the multiplier in the same way: $8+3+5=16$; $1+6=7$. Write 7 in the bottom angle. Multiply together the two numbers now in the X and add the digits as before: $7 \times 3=21$; $2+1=3$. Write 3 in the right-hand angle. If your answer is correct, its digits, continuously added and with the nines dropped, will come to the same number as that in the right-hand angle (3). We have then: $6+1+6+8=21$; $2+1=3$. The answer is right, unless, of course, you have made several blunders whose combined effect is to make the digits add up to 3.

Any Suggestion?

It ought to be possible to show algebraically why the proof by nine works. The key seems to be that in the continuous additions you're using not a decimal but a nonal system, for nine is your highest number, being replaced by nought whenever it is reached. I've dim recollections of seeing a process called "casting out the nines" or something of that kind in an ancient arithmetic book. Was that, perhaps, the same thing? I hope, anyhow, that some mathematically minded reader will send us the proof.

Just the Thing

THE IDEA that occurred to me as I was looking through J. L. Osbourne's article on the making of a miniature t.r.f. receiver for the medium waves in last month's *Wireless World* may also have inspired a good many others who read it. There's bags of room in the loud-

speaker compartment of my console television receiver and I have been meaning for some time to fit a small medium-wave radio set into it for reception of the local stations. With certain small modifications (no dyed-in-the-wool wireless man can resist making them!), this little set seems to be the very thing one was looking for. My television receiver has, alas, a live chassis as nearly all have to-day. That will mean using a 4-pole change-over switch: one pair of its contacts will take charge of the mains leads; the other pair will connect the existing loudspeaker to the appropriate output transformer. This switch, as well as the knob of the tuning capacitor and that of the gain control, will be out of sight at the back of the cabinet, but easily accessible. The chassis of the radio receiver will naturally be isolated from that of the television set.

TV Screens Too Big?

THOUGH each passing year brings TV receivers with bigger and bigger screens, it does not also bring larger and larger rooms in which to use them. I'm not at all sure, in fact, that we haven't reached (or even possibly passed) the maximum size for 405-line domestic viewing. I

happen to live in a house built over thirty years ago in which the living rooms are considerably bigger than those of more modern homes. In two of them, for instance, one's eyes could be up to 20 feet from the screen. I've had sets with screens of all sizes from 9 to 17 inches working in the house and my considered opinion, with which Mrs. Diallist entirely agrees, is that the 12-inch screen has it every time. With spot wobble we find screen sizes up to 15 inches acceptable so far as picture quality is concerned.

The Ideal Receiver

Now, I've talked over this question of screen size with quite a lot of discriminating people, people who know what they want and don't care two hoots about "keeping up with the Joneses"—for that, I think, is mainly what incites to the use of quart-sized television receivers in pint-sized rooms. I've found a remarkably large majority in favour of the 12-inch screen. And please don't jump to the conclusion that that's because they can't afford the bigger sets. On the contrary, many of them would be quite willing to pay a good deal more for absolutely first-rate 12-inch sets, if they could get them. Here are the things that they want and I believe firmly that any manufacturer who has the courage to market a *de luxe* 12-inch receiver will reap a golden harvest. The set must be a console with full-length doors. The a.f. stages and the loudspeaker must do full justice to the quality of



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the transmitted sound. The vision circuits must include fully effective amplification of the d.c. component, genuine 3-Mc/s definition, true interlace, a.g.c. that can take charge of aeroplane flutter, suppression of line flyback and absence of ringing effects and of the "drizzly" picture reproduction, which betokens too often either time base instability, or interaction between line and frame time bases. Add either spot wobble, or spot elongation by controlled astigmatism, and I believe that the luxury 12-inch set would sweep the board.

A TV Complaint

NO ONE COULD be more strongly in favour of the standardization of things in general use than I. I can't for the life of me see why in bathrooms the "h" and "c" shouldn't *always* be in the same relative positions. Or why you can't get out of any taxi by pushing *down* the same kind of thing in the same sort of position? It annoys me to find that what looks like the door handle is the thing that works the window, and that, when found, the door handle must be pushed *up*. So with television receivers and their controls. Not only are makers unable to label them with standard names, but each has his own ideas about those which should be placed at the front of the cabinet, at one of its sides, at the back of it, or inside it. Even when I have succeeded in memorizing their positions, I detest those rows of controls at the back of the set. Unless you can develop a swan-like neck, or arms like an orang-outang's how can you adjust line-linearity or contrast properly by means of knobs at the back of a cabinet measuring the best part of a couple of feet deep?

Running Riot?

THE NOTE in the April issue of *W.W.* on the latest edition of the British Standard on valve bases frankly horrified me. That BS448: 1953 should have to include at least 25 types of British valve bases is surely a rather awful thing. We seem to be getting farther and farther from any kind of rationalization and the existence of this unconscionable number of different valve bases can't be doing anybody (including those who make them) very much good. It can lead only to needlessly high costs, to waste of time and to other far from desirable consequences in the assembly and maintenance of electronic gear. Here, certainly, is a problem that should be tackled without delay.



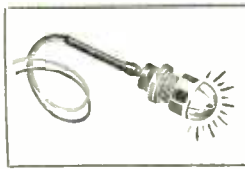
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Leadless Listening

ONE OF THE most interesting developments of recent years is the "wireless headphone" system of reception installed a few months ago in Worthing Hospital whereby patients can hear the B.B.C. programmes without any wired link between their headphones and the hospital receiver set.



A copper band around the ward feeds the programme inductively to special headphones worn by the patients. The system has many other applications and is used in the United Nations H.Q. as reported in *W.W.* in February last year.

I am, however, far more interested in it from a domestic point of view as I am a great believer in listening to certain types of programme by means of headphones rather than the loudspeaker. The great disadvantage of headphones, of course, has been that if you get up hurriedly, such as to put the cat out and speed it on its way when it suddenly signals that its journey is really necessary, you are apt to strangle yourself with the phone cords.

These *wireless* phones would avoid this and, provided that every room was properly fitted with the necessary copper band, also enable you to roam the house at will and even to take a bath without interrupting your reception of the programme. I haven't actually put my ideas into practice but shall undoubtedly have done so by the time you read these words.

A Modern Jeroboam

HAVING BEEN very carefully brought up in my youth I always hold my elders and betters in great respect and never venture to contradict them. This applies as much to my technical as to my moral or ethical betters and even when one of them makes a statement which is contrary to my own knowledge and

experience I naturally assume that I am the one at fault.

There have been occasions, however, when I have been so pig-headedly convinced that I have been right that I have momentarily felt rebellious. An instance of this occurred recently when I read a statement which was to the effect that constant switching on and off of an electric lamp made little or no difference to the life of its filament.

Since this statement could obviously be applied also to valve filaments I was at once interested more especially as it was made by a man who is, among other things, an A.M.I.E.E., and with whom, therefore, it would ill become me to disagree. Had he been outside the pale of that august assembly I should not have hesitated to contradict him for during the war when new valves were hard to get I held the opposite opinion so strongly that I left the heaters of my valves permanently on, putting in a special switch to cut off the h.t. when not using the set.

My reason for doing this was to help the national economy as I thought that the country could afford the extra electrical energy better than the additional valve replacements I should have needed if I had shortened filament life by constantly switching the l.t. supply on and off. I was, of course, labouring under the delusion that the repeated expansion and contraction of the filaments would lead to their early demise; in my ignorance I imagined that the effect would be the same as when you get hold of a piece of tinplate

and bend it backwards and forwards in order to break it.

Unfortunately, I published my heretical opinions in these columns and advised my readers to follow my evil example. In thus leading my fellow countrymen astray I am, therefore, no better than "Jeroboam, the son of Nebat, who caused Israel to sin," and you know what happened to him. I suppose—perish the thought—that it isn't just possible that I may have been right after all?

Polarized Polyphony

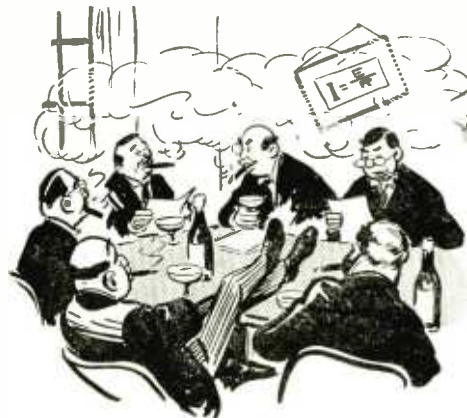
AS YOU MAY have noticed I rarely remove my bowler. This is because it houses my personal portable which enables me to keep in touch with world affairs at all times, bone conduction being used in place of ugly and conspicuous earphones.

Recently, however, I felt compelled to remove it for a moment as a tribute to the sheer genius of the radio correspondent of a well-known London evening newspaper. He has invented or discovered the existence of—he does not make it quite clear which—a truly remarkable television set which has two screens and two loudspeakers facing in opposite directions. Now, you may rightly think that there is nothing very remarkable in that but you will change your opinion when I tell you that the two sections of the set operate simultaneously on *different programmes* without the slightest mutual interference.

So far as the vision side of the set is concerned there would obviously be no trouble but it was a long time before my rather limited intelligence was able to work out how it was possible for two forceful speakers to hold forth within a few feet of each other without causing acoustic chaos.

There is no suggestion of earphones being used with this remarkable new set and had I not had some experience of stereoscopic projection I might not have solved the problem. As you may know, in one method of stereo projection a vertical polarizing filter is placed in front of one of the two lenses and a horizontal one over the other and the wearing of similarly polarized glasses enables the two pictures to be separated.

When I remembered this, everything at once became clear to me. I am a bit rusty in acoustics but I suppose it must now be possible to apply this polarizing principle to sound. Obviously each loudspeaker has its own acoustic polarizing filter over its grille, and listeners wear filters in their ears corresponding to the loudspeakers to which they wish to listen.



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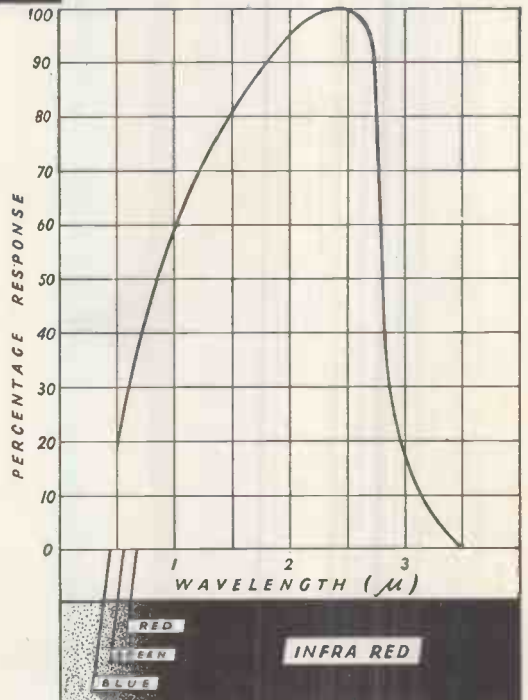


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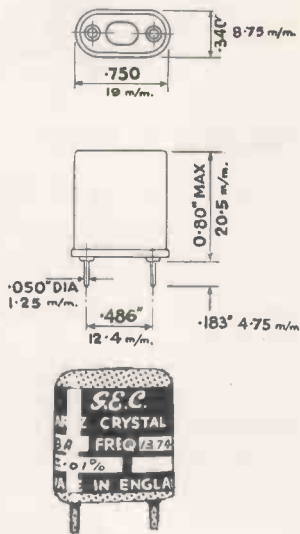
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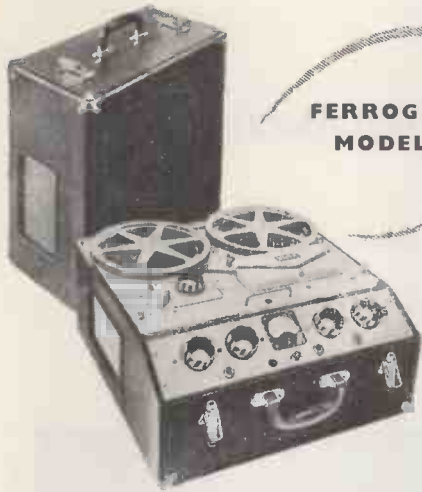
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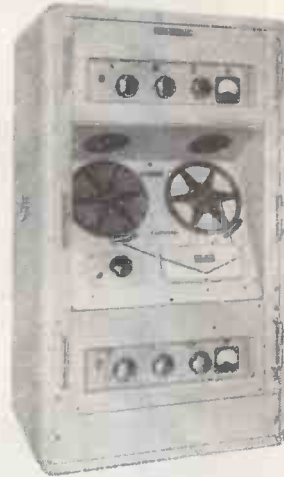
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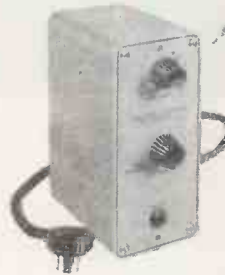
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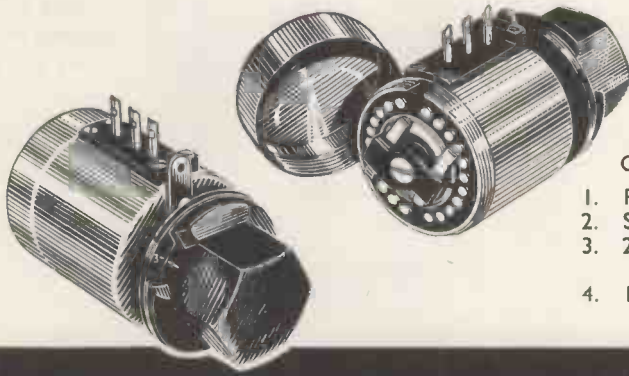
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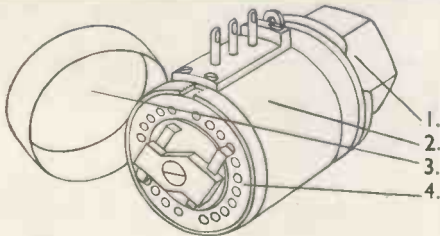
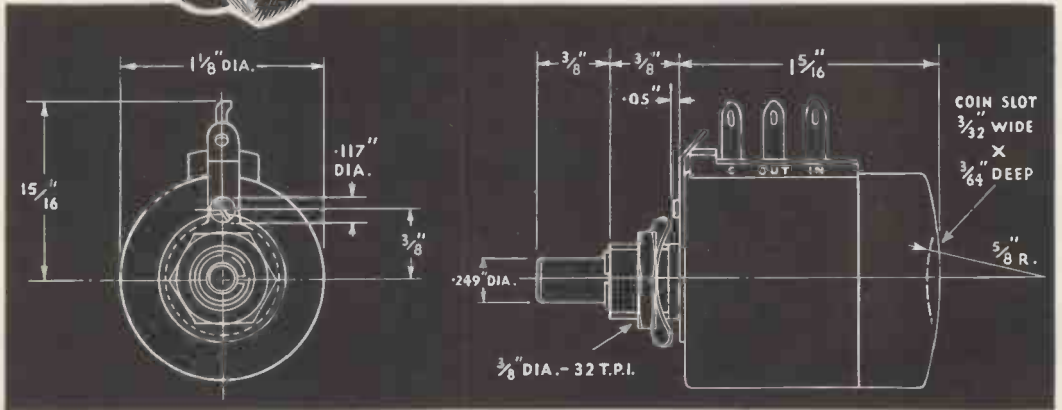
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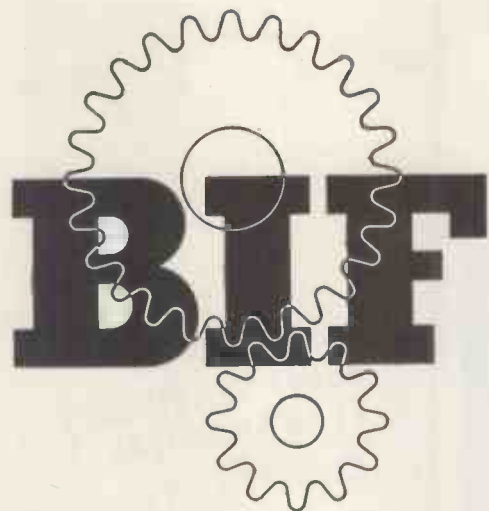
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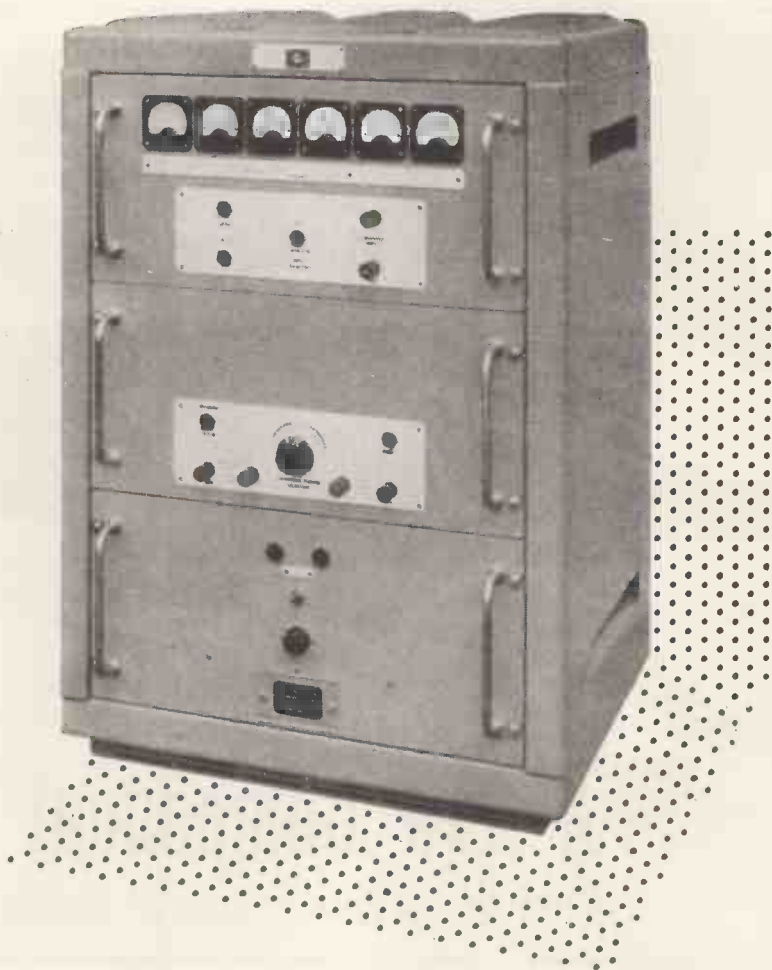
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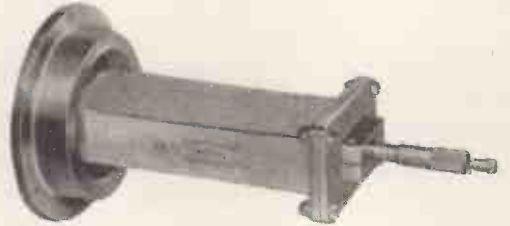
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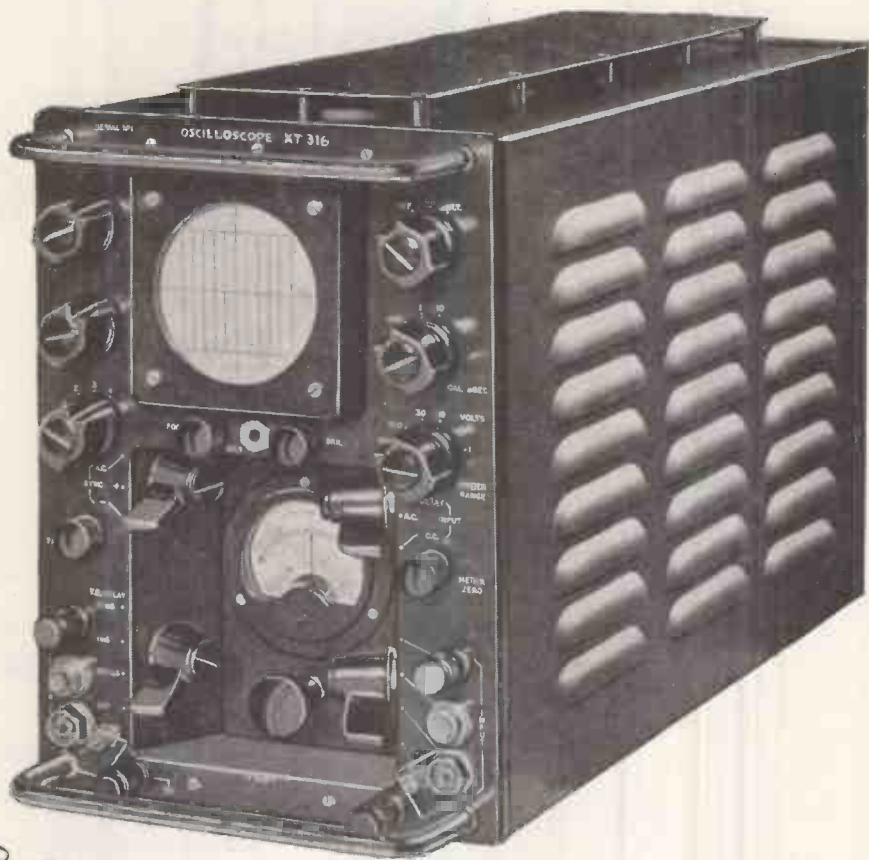


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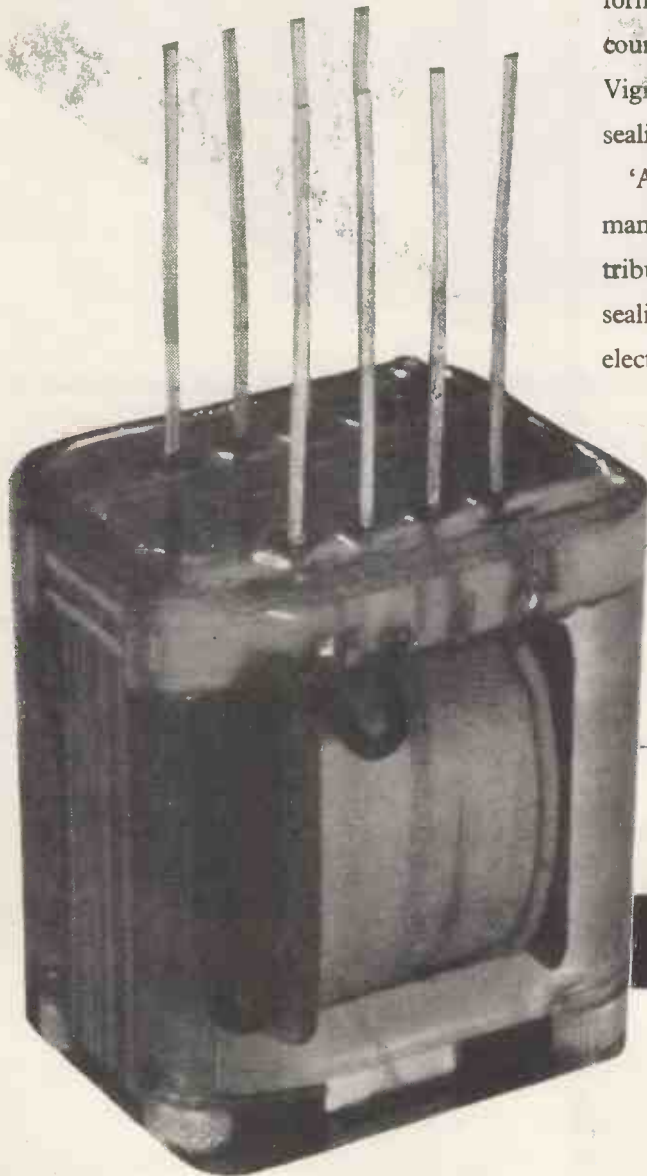
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The specification

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SENSITIVITY

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DIMENSIONS Overall length $3\frac{3}{8}$ " Max. dia. 3"

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FINISH Polychromatic Old Gold, Front cover
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*Incorporating recessed
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The presentation

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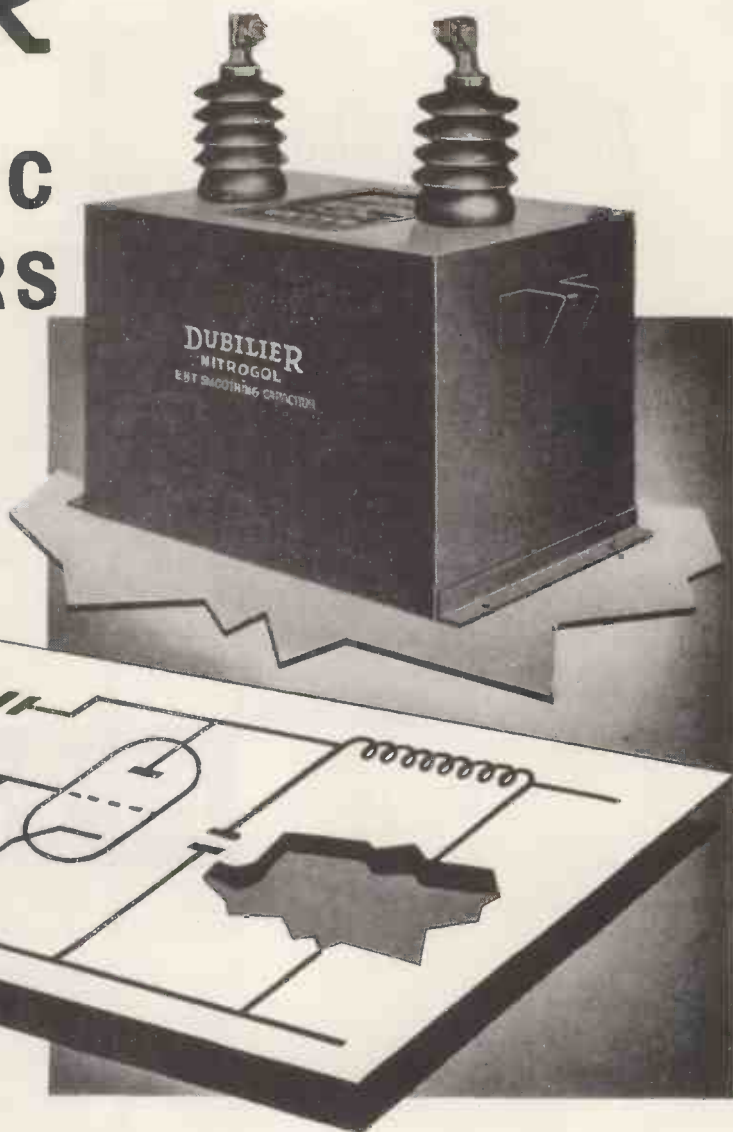
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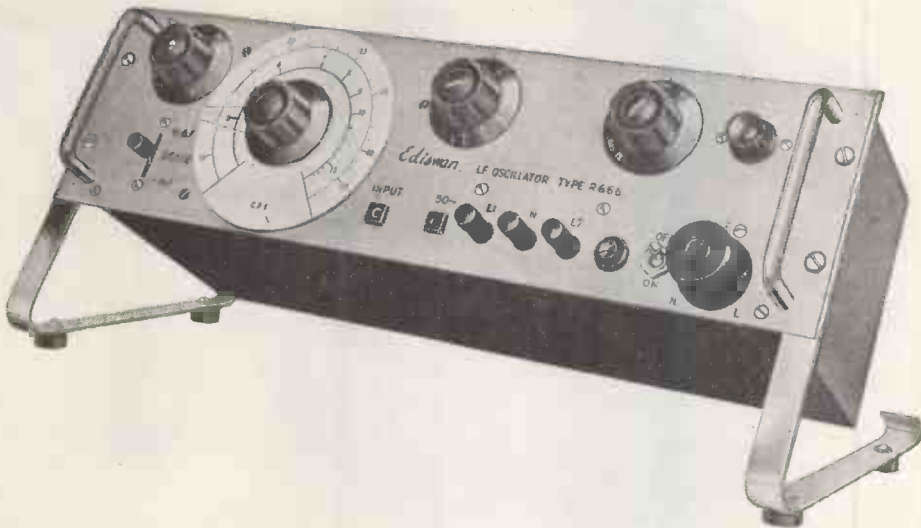
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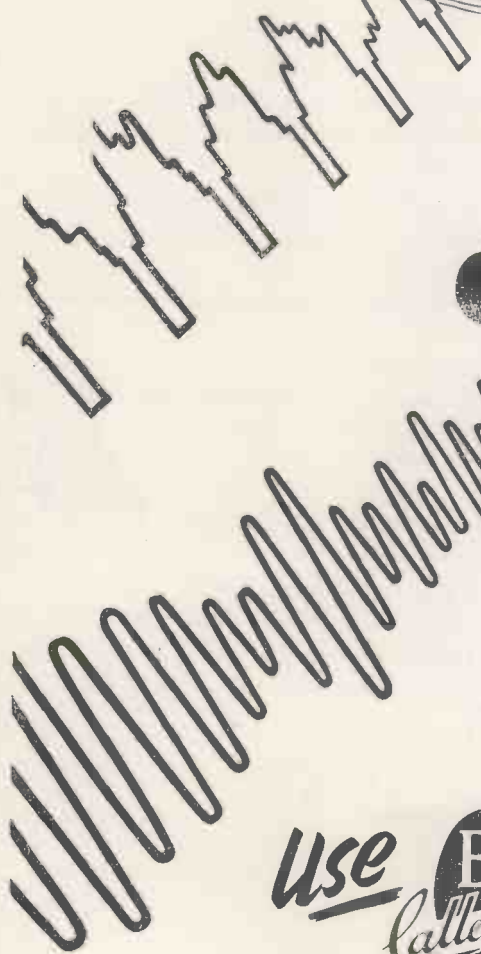
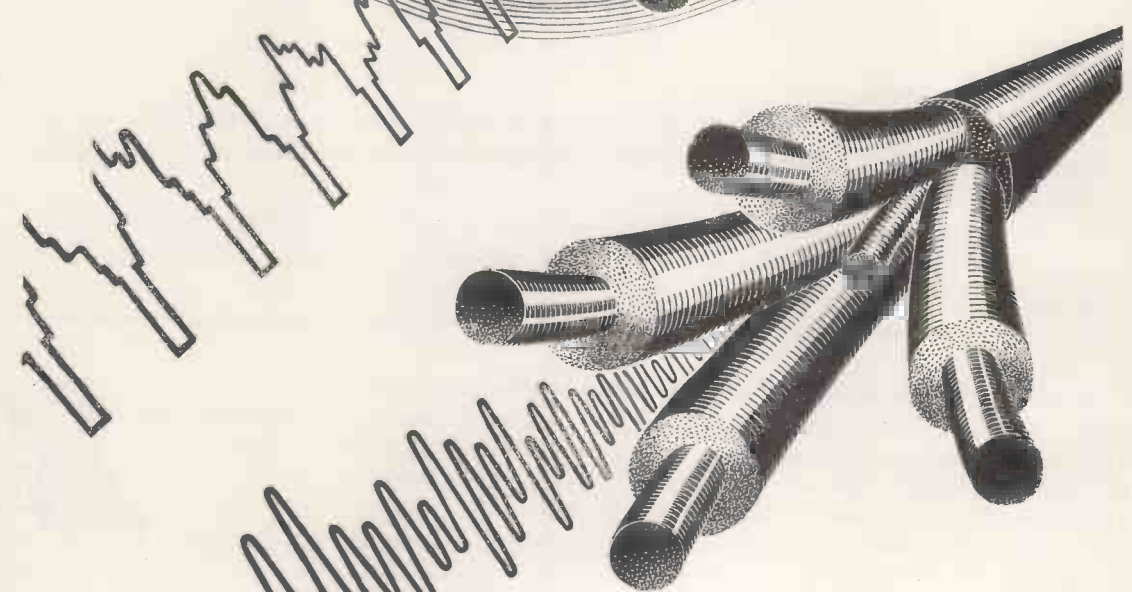
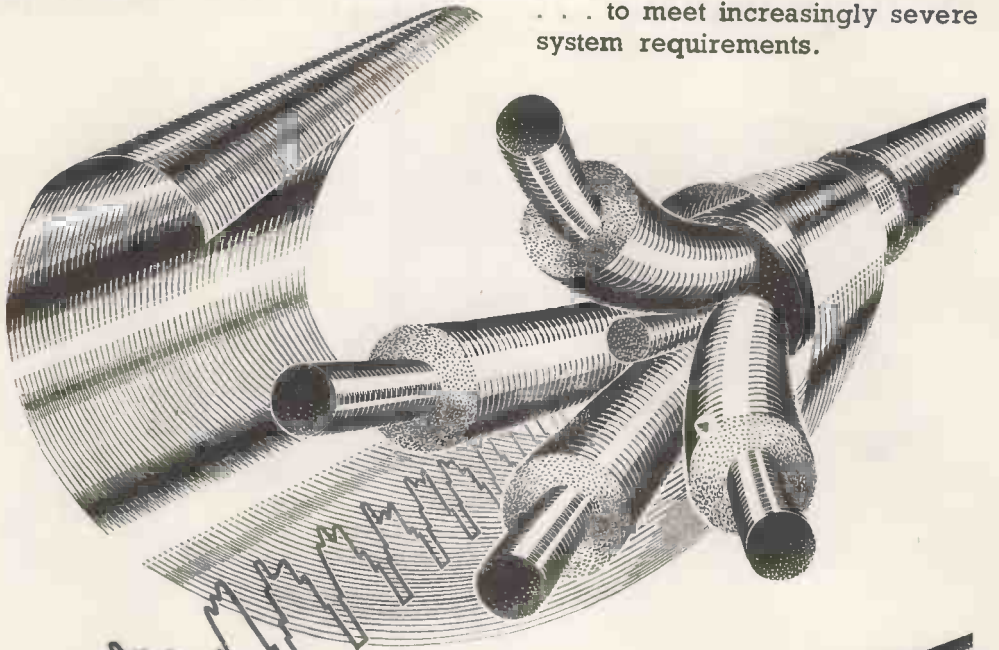
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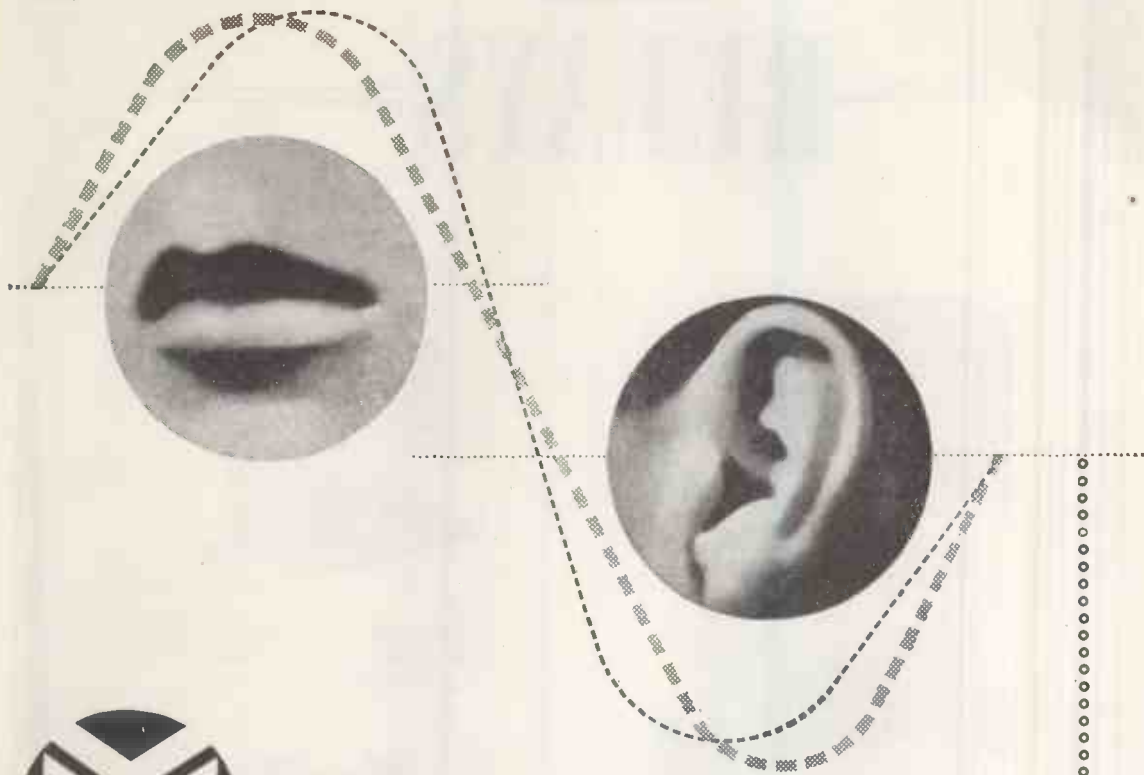


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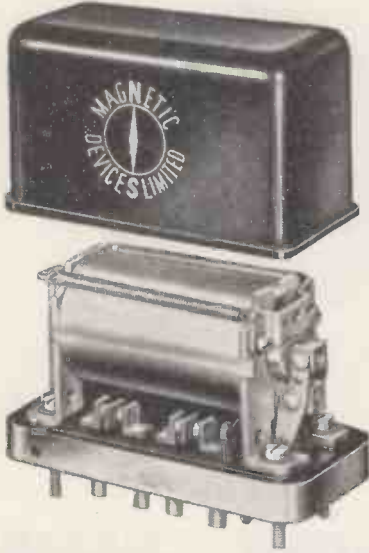
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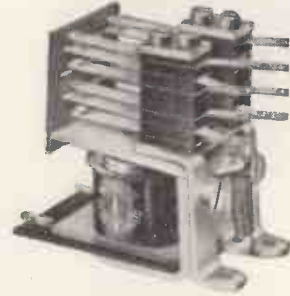
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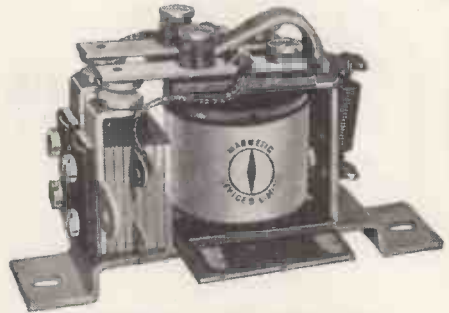
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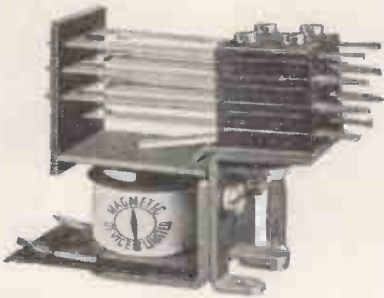
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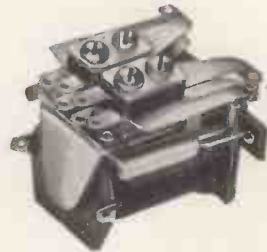
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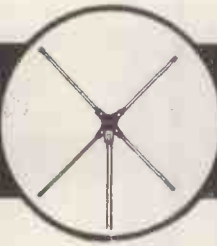
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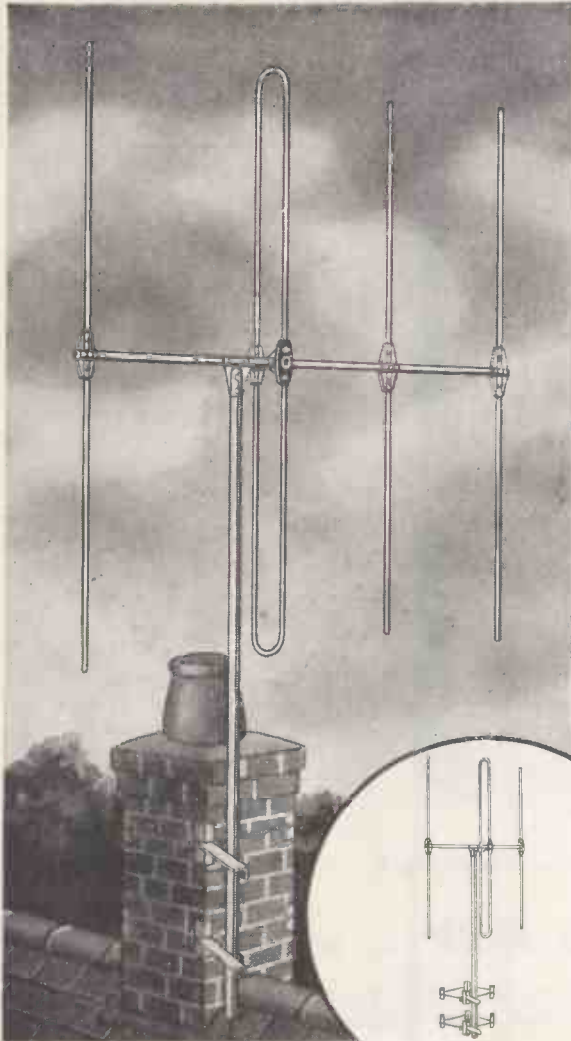
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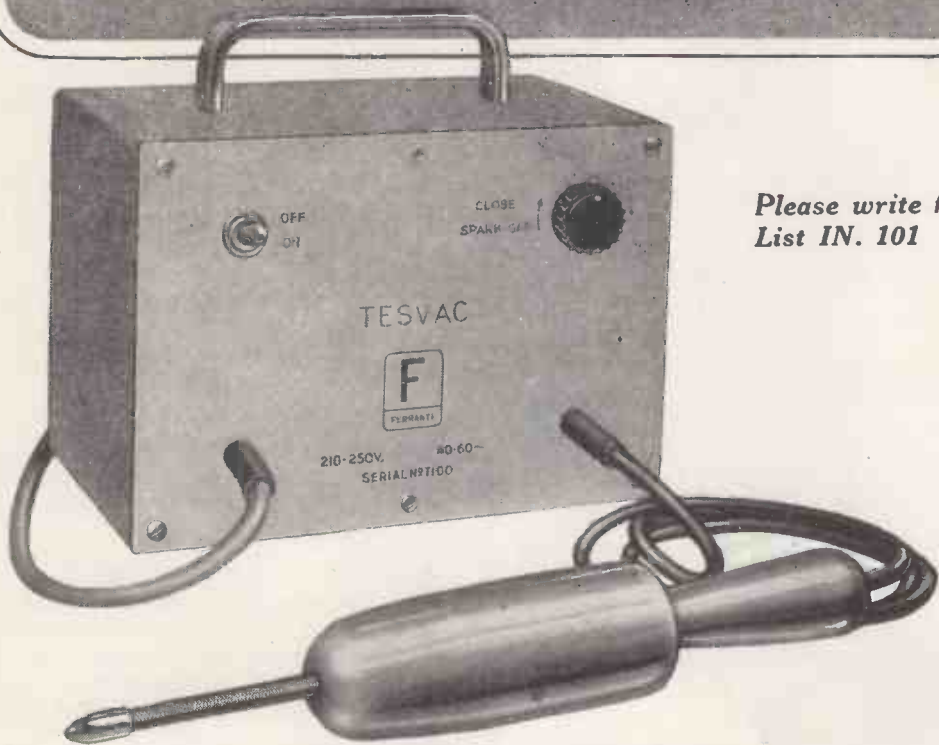
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H.P.W.
(Ph.D., A.M.I.E.E.).

OMNI-DIRECTIONAL 3-Speaker System

W.15/CS SUPER 8/CS SUPER 5

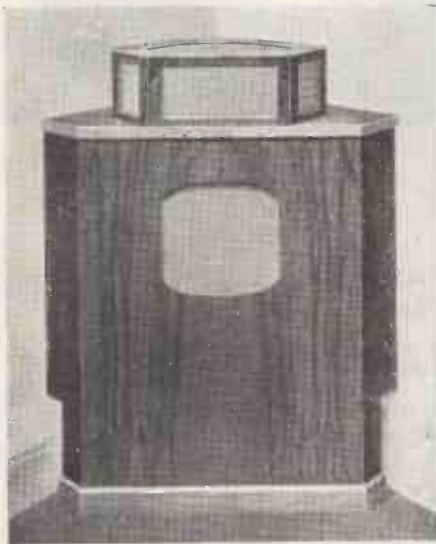
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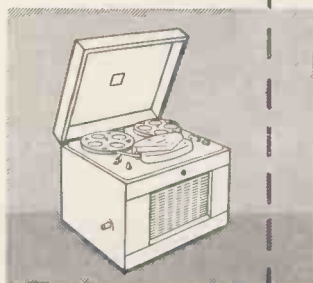
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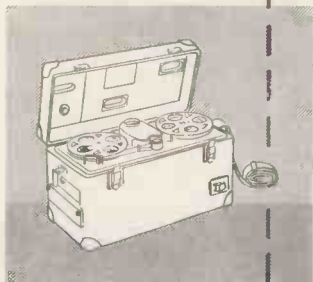
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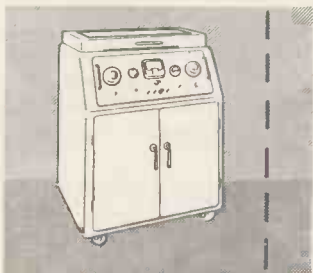
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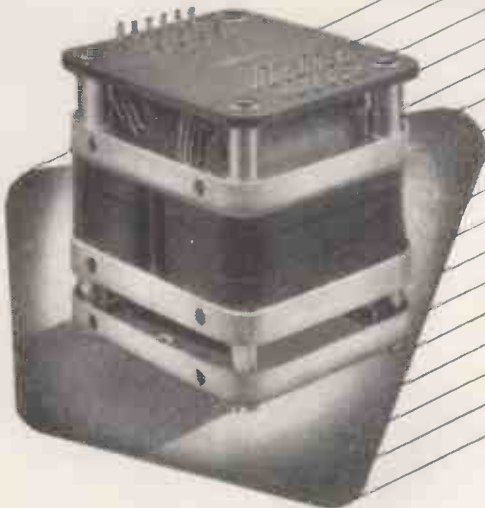
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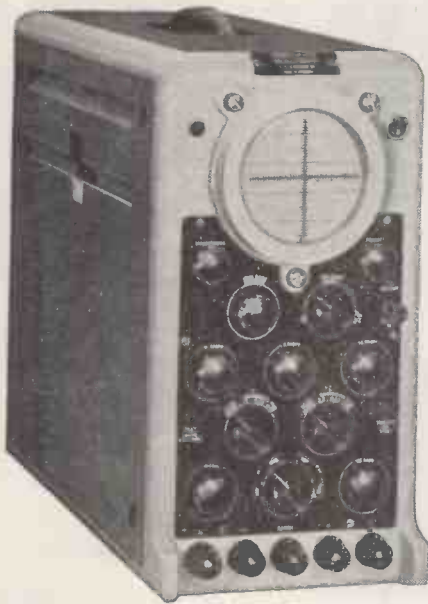
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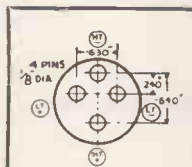
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Special features of the GFR 552 include a high order of oscillator stability and freedom from cross-modulation through which cross-talk between channels or inter-modulation between wanted and unwanted signals might occur. A brief technical summary is given below. More detailed information supplied on request.

FREQUENCY RANGE—4-30 Mc/s.

NOISE FACTOR—better than 7 dB over the band.

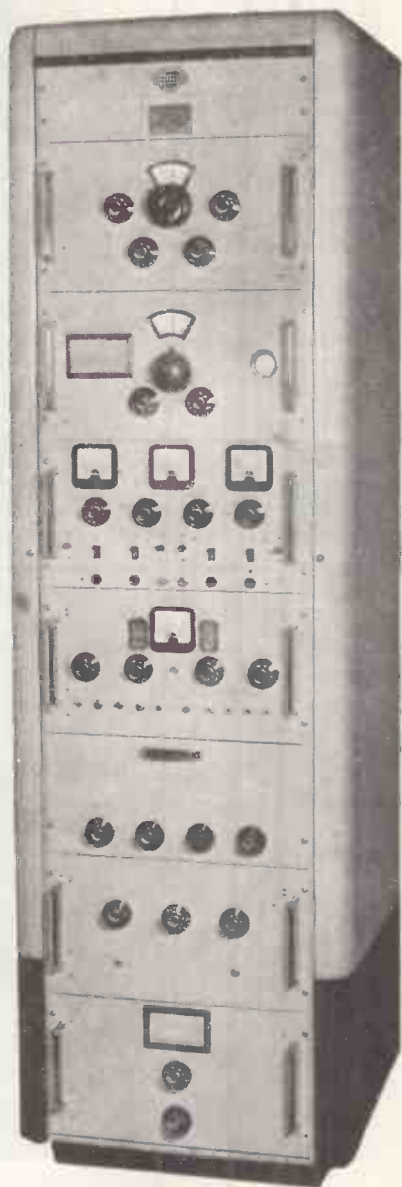
SIGNAL TO NOISE RATIO—25 dB for 4 microvolts peak sideband input over the band.

SELECTIVITY—The response is flat within 2 dB for sideband frequencies between 100 c/s and 6000 c/s. At 10 kc/s from the carrier frequency the response is -60 dB relative to the pass band.

A.F.C.—The a.f.c. system operates effectively with a pilot carrier level of -26 dB relative to 1 microvolt (which corresponds to a peak sideband level of 1 microvolt and a signal to noise ratio of 15 dB).

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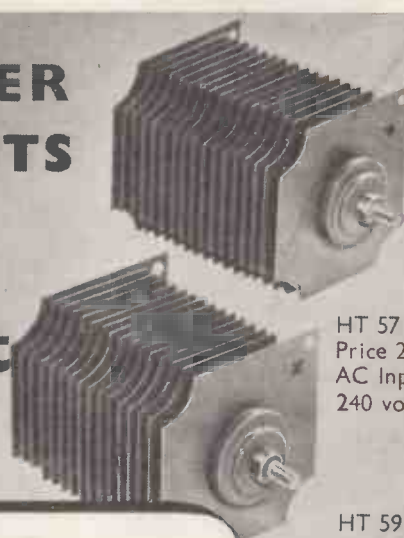
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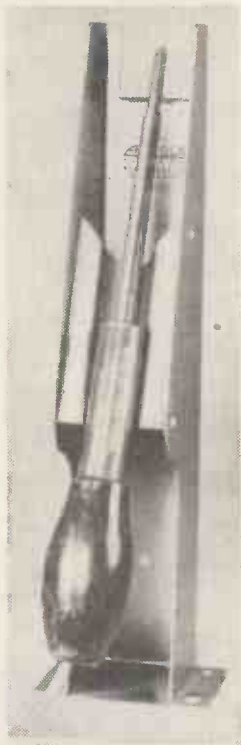
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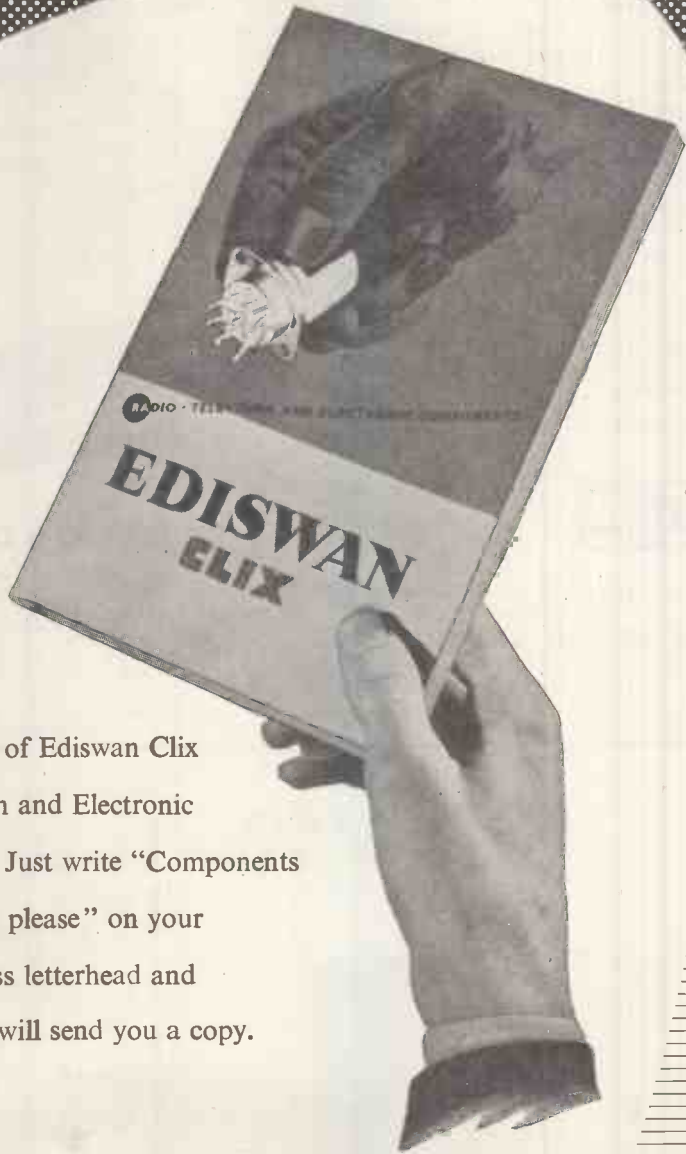
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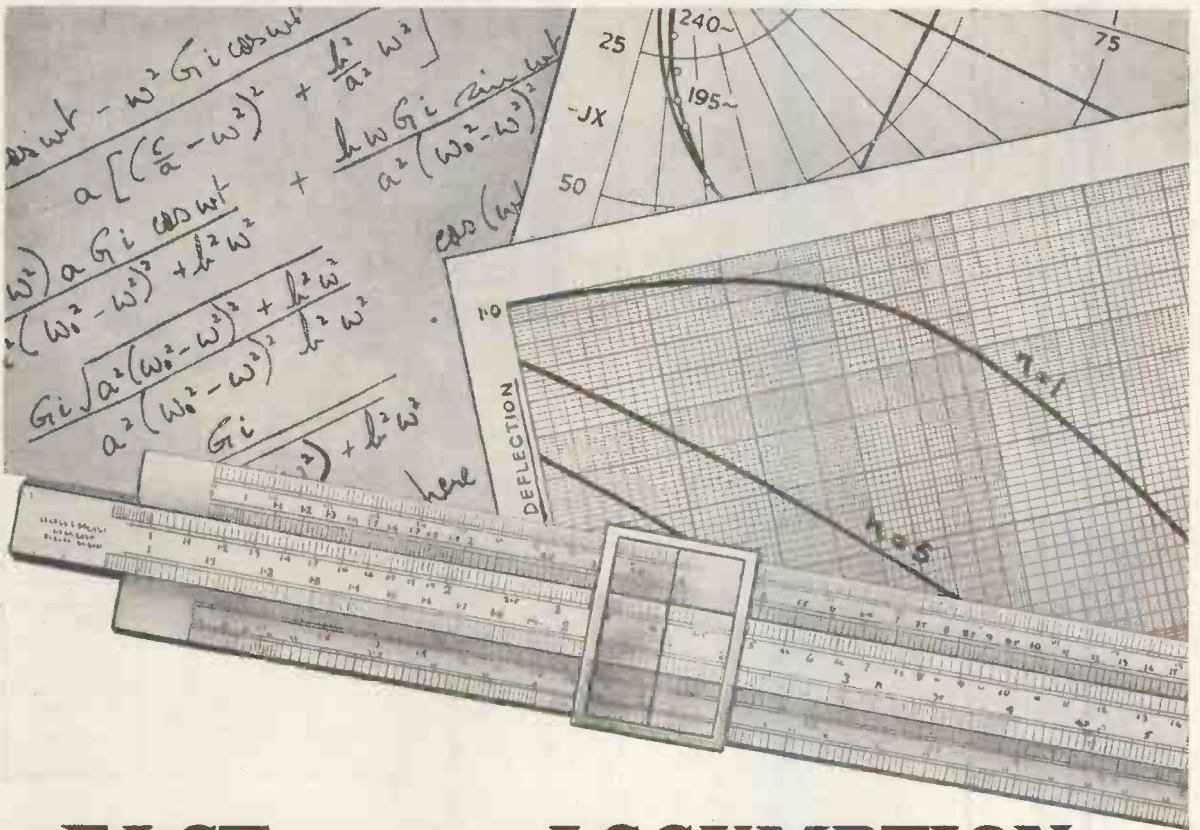
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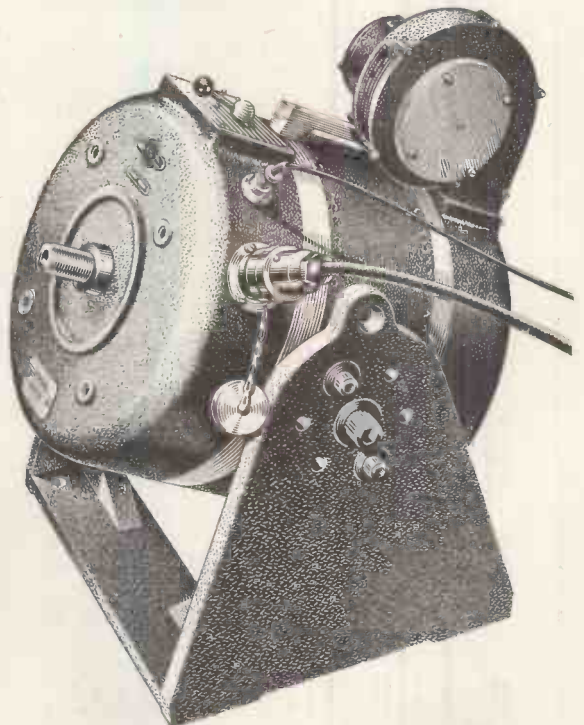
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On this occasion we think the introduction should be general, a sort of "meet the family" gesture, in order to give readers an overall picture of ourselves and our products.

First, we think, comes our loudspeaker. There is one model only which we term the Hartley-Turner 215. This is a 9in. diameter cone speaker, very freely suspended and capable of very wide excursions, without distortion. The cone itself is divided into two sections which are coupled by a unique mechanical compliance while the speech coil assembly is also a two-part system designed to reproduce faithfully a very wide range of frequencies indeed. It is still, in our view, the very best loudspeaker of its kind in the world.

The second item, complementary to the HT 215, is our world renowned BOFFLE, a non-resonant Box Baffle which provides a very suitable enclosure for the 215, while remaining in size only 18in. cube.

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Front/back Ratio
21.6 dB
Acceptance
Angle 55°



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Model 77
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Model 83
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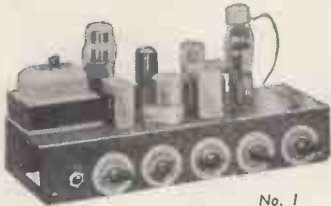
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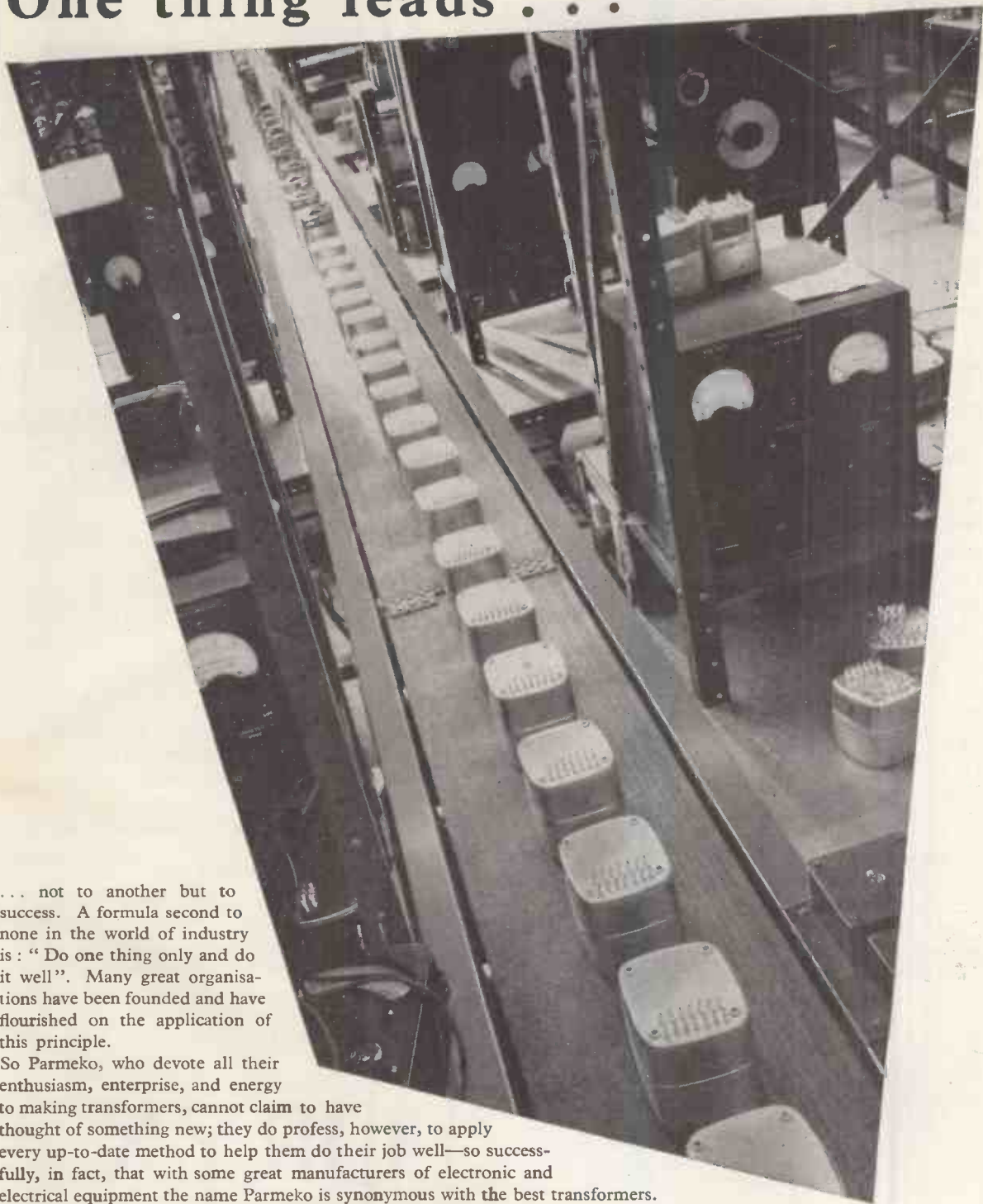
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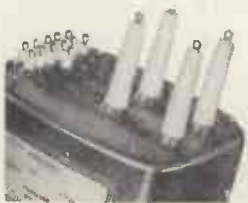
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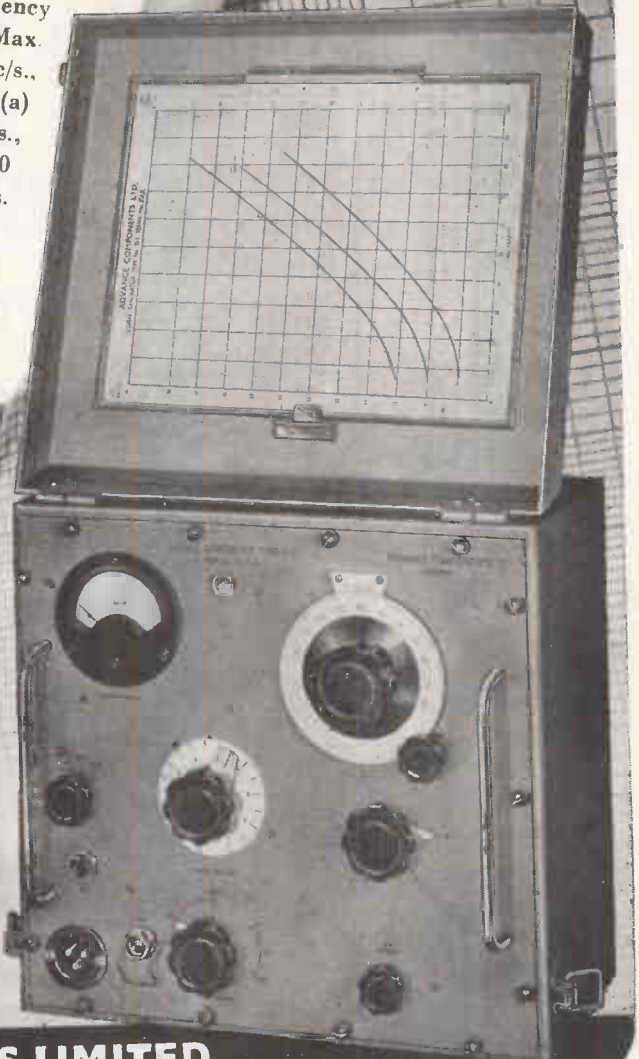
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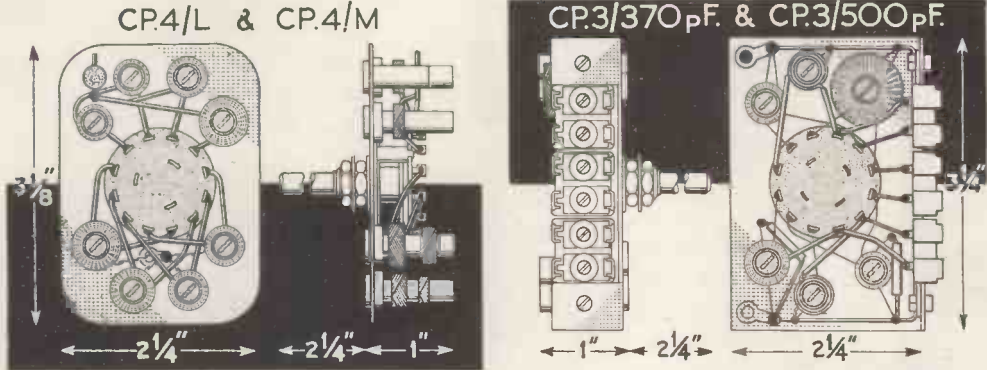
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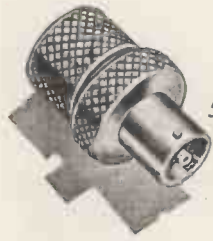


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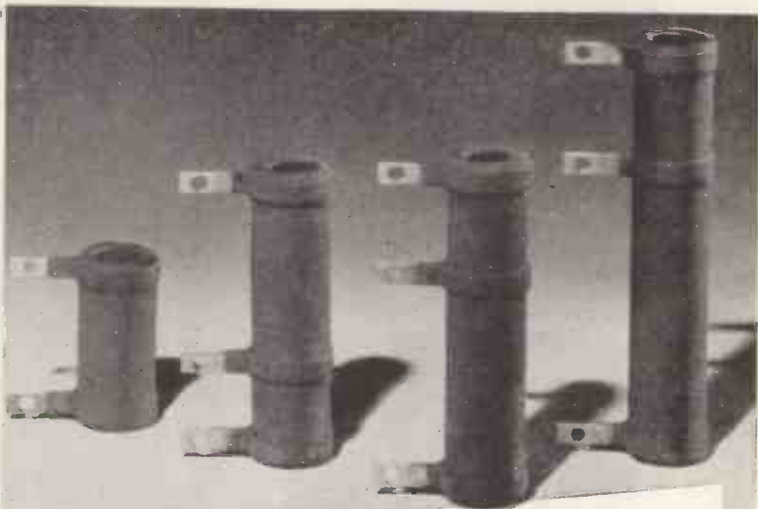
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Tel: Low Fell 76057.



TYPE	31	32	33	34
WATTAGE ..	10	18	25	40
RESISTANCE ..	10-6,000	10-12,000	10-15,000	10-30,000
OHMS ..	1 9/16in.	2 13/16in.	3 1/16in.	3 13/16in.
LENGTH ..	11/16in.	11/16in.	11/16in.	11/16in.
DIAMETER ..	1	2	3	4
MAX. TAPS				



FREQUENCY STANDARD TYPE 761

THIS instrument has been designed to fill the need for a self-contained compact frequency standard of moderate cost and very high accuracy.

Sine wave and pulse signals are produced at five standard frequencies, the pulse waveforms being extremely rich in harmonics.

An oscilloscope complete with X and Y amplifiers is incorporated for visual frequency comparison, and a Beating circuit and loudspeaker for aural checking. Standard frequencies are switched to these two circuits internally, and their employment is therefore unaffected by connections made to the output plugs.

A synchronous clock driven from a voltage of standard frequency provides a time standard which may be maintained accurate to within a few seconds a year.

The instrument is enclosed in one of the Airmec range of cases which is suitable either for bench use or forward mounting on a 19in rack.



- **Master Oscillator :** Crystal-controlled at a frequency of 100 kc/s. The crystal is maintained at a constant temperature by an oven.
- **Outputs :** Outputs are provided at 100 c/s, 1 kc/s, 10 kc/s, 100 kc/s, and 1 Mc/s.
- **Waveform :** The above outputs are available, simultaneously with sinusoidal or pulse waveform from separate plugs.
- **Stability :** Four hours after switching on a short term stability of considerably better than 1 part in 10^6 is obtained.

Full details of this or any other Airmec instrument will be forwarded gladly upon request.

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Cables : Airmec, High Wycombe.

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14 reasons why *those concerned*
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FERROVOICE

MAGNETIC RECORDING TAPE

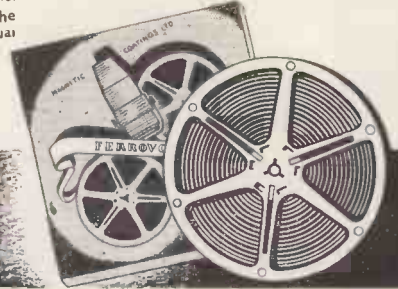
- 1 Does not curl—lies flat on the transducer head, giving better frequency response, and smooth tracking.
- 2 Has the lowest possible surface friction—reducing wear on transducer heads, and guide pillars.
- 3 Has the best possible dispersion of oxide particles, free from coagulation, and flocculation ensuring low noise level.
- 4 Is correctly heat-dried to preclude "blocking" and sticking, layer-to-layer, under storage conditions.
- 5 The Lacquer is formulated to attain the maximum adhesion to the base material.

- 6 Gives the highest possible signal-to-noise ratio—excelling in high-frequency response.
- 7 Has a superlative dimensional stability—negligible stretch, and the highest possible tensile strength.
- 8 Discourages static collection during fast forward, and fast re-wind operations.
- 9 The Kraft Paper base has been selected after careful development with the paper manufacturers—flexibility, and supercalendering being prime considerations.
- 10 The Lacquers are pigmented with the highest grade powder. The individual particle size is less than one micron (0.000039 inch).

- 11 The pigment is dispersed and milled, with the highest degree of control, thus ensuring a uniform dispersion of the oxide particles within the binder.
- 12 The spools were designed to incorporate the "universal" hub, perfect balance, and negligible rotation noise.
- 13 "FERROVOICE" products are subject to continuous development by our technical staff.
- 14 "FERROVOICE" has a Coercivity of 270 oersteds (BHC) remanence = 730 gauss, when subjected initially to a magnetising force of H = 2,000 oersteds.

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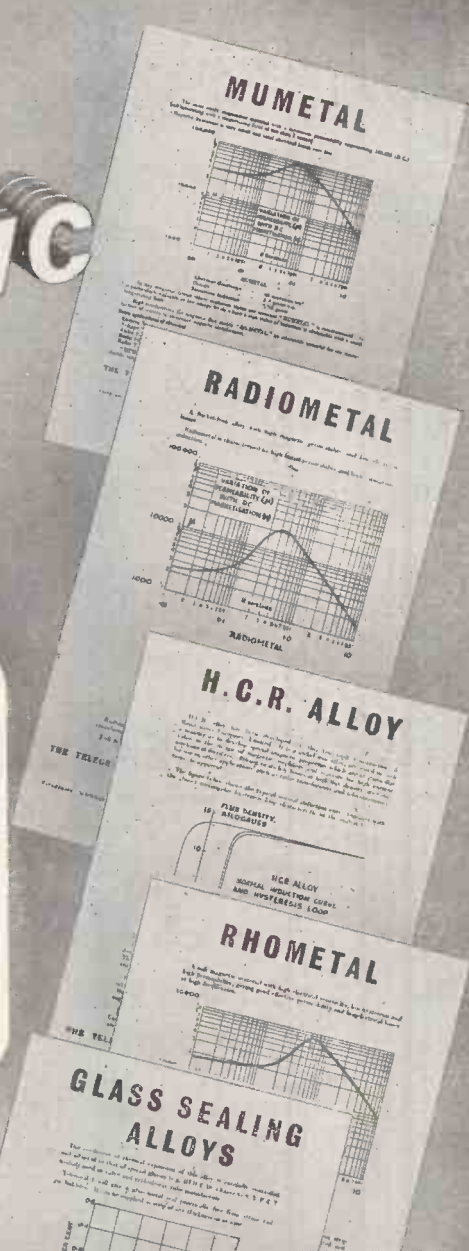
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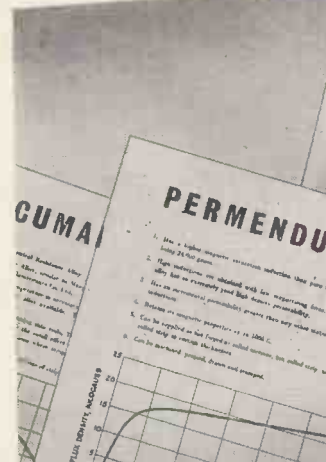
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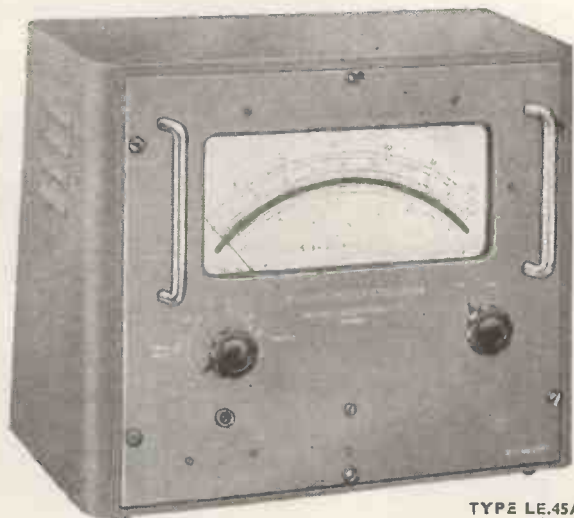


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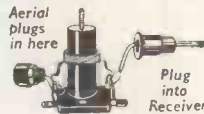


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Plug into Receiver

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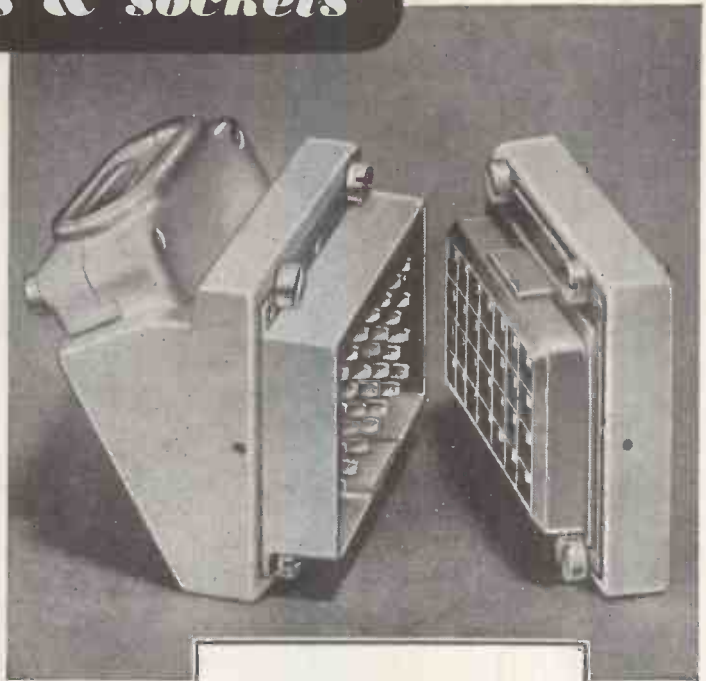
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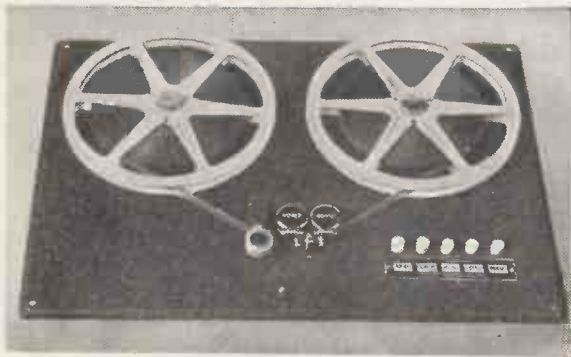
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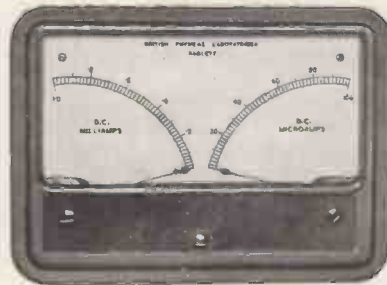
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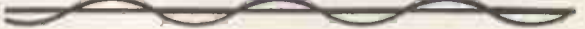


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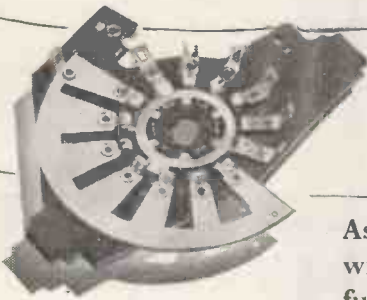
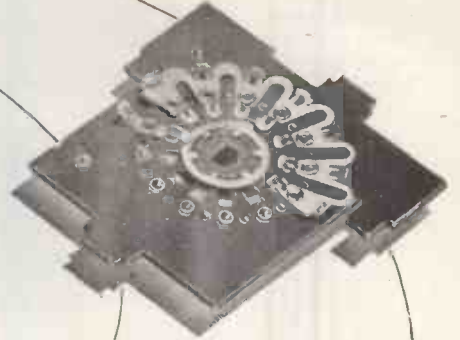
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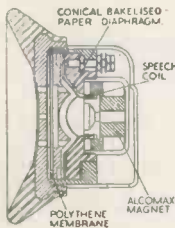
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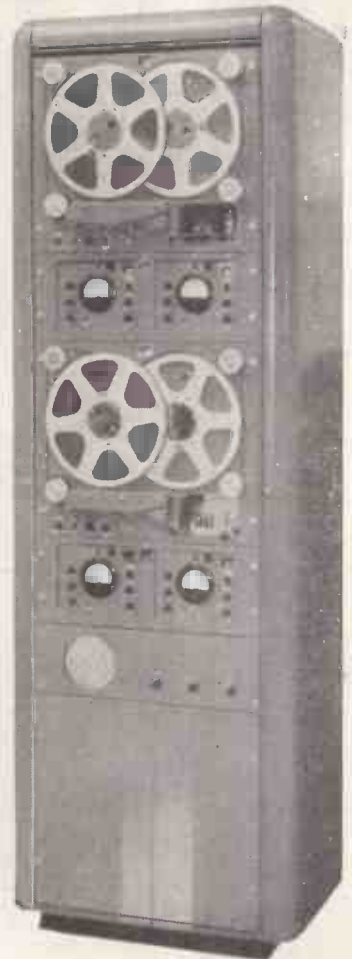
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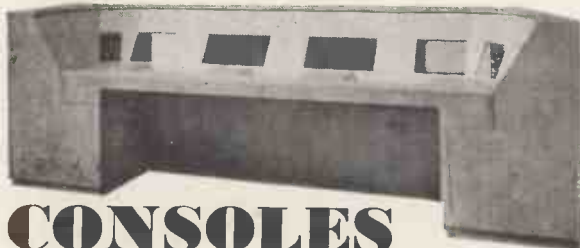
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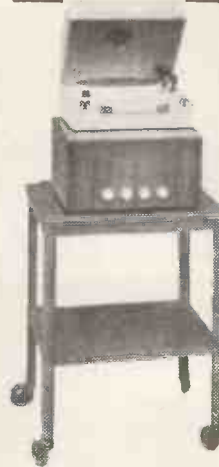
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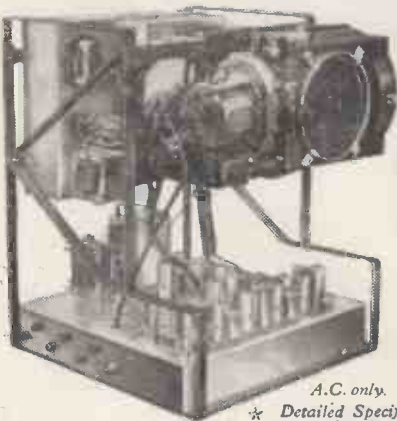
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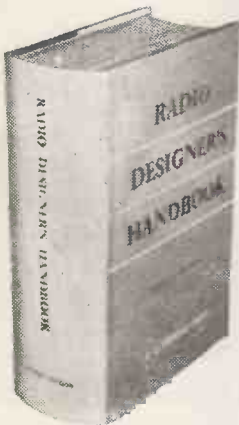
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Radio Designer's Handbook

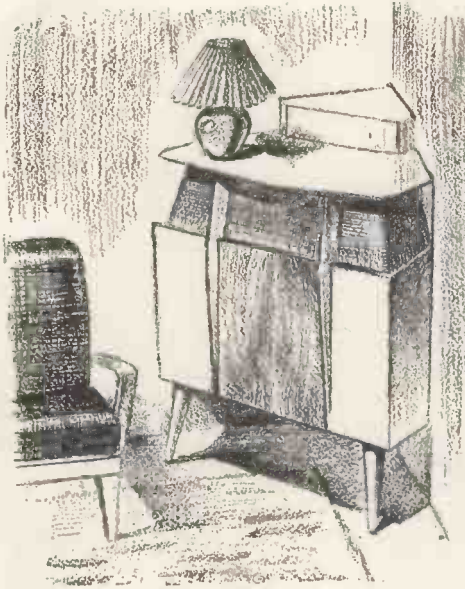
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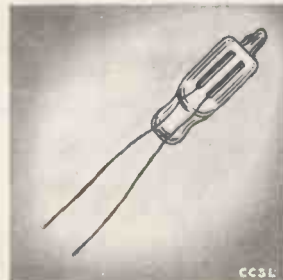
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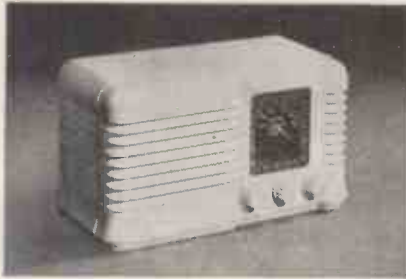
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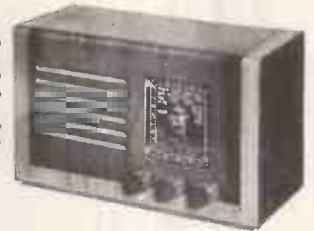
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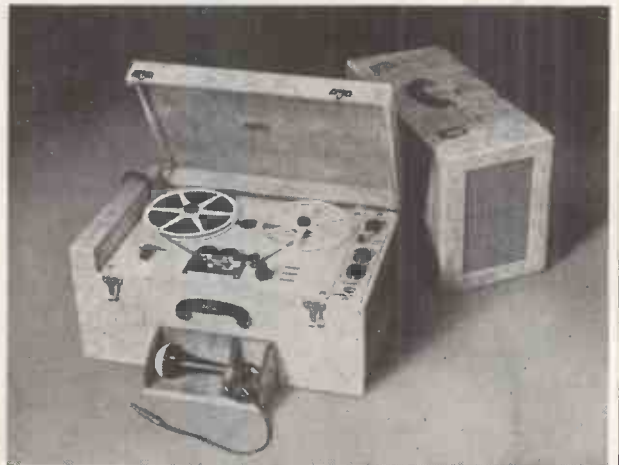
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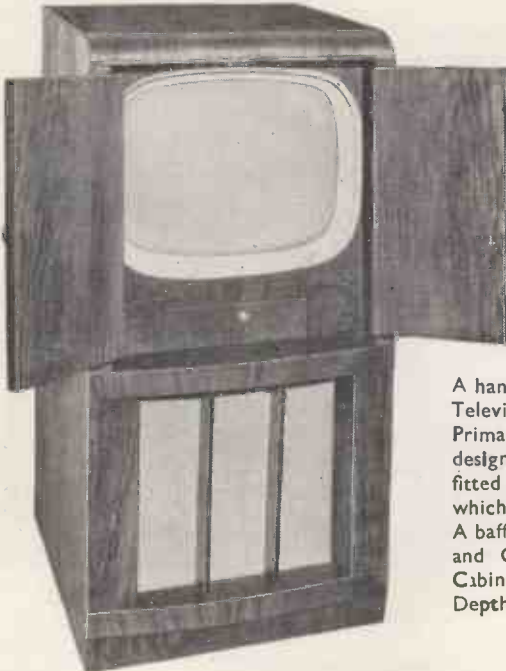
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.. K3/40	3.2 kV.	1 m.A.	6/-
.. K3/45	3.6 kV.	1 m.A.	8/2
.. K3/50	4 kV.	1 m.A.	8/8
.. N3/160	12 kV.	1 m.A.	21/6
Type RM1		E.T. Type S.T.C.	
.. RM2	125 v.	60 m.A.	4/-
.. RM3	125 v.	100 m.A.	4/6
.. RM4	125 v.	125 m.A.	5/6
	250 v.	250 m.A.	18/-
		L.T. Type Full Wave	
6 v. 1 amp.			4/-
12 v. 1 amp.			8/-
12 v. 2 amp.			10/9
12 v. 4 amp.			15/-

A.C.R.I. C.R. TUBES

5 1/2 in. screen. 4 volt Heater. This Electrostatic Tube is recommended as eminently suitable for Television. 15/- plus 2/6 Pkg., carr. and ins. Data sheets supplied.

SUPER QUALITY TELEVISION MAGNIFYING LENS

5in. lens suitable for 6in.	17/6
6in. lens	25/-
10in. lens	22/10/-
12in. lens	23/10/-

ALUMINIUM CHASSIS 18 s.w.g.

Substantially made from Bright Aluminium, with four sides

7 x 8 1/2 x 2in.	4/9	10 x 9 x 3in.	7/-
7 x 3 1/2 x 2in.	3/9	12 x 10 x 3in.	7/9
9 1/2 x 4 1/2 x 2in.	4/3	14 x 10 x 3in.	7/11
10 x 8 x 2 1/2 in.	5/6	16 x 10 x 3in.	8/3
12 x 9 x 2 1/2 in.	7/6	16 x 8 x 2 1/2 in.	8/-
14 x 9 x 2 1/2 in.	7/6		

ALUMINIUM PANELS 18 s.w.g.

7 x 6in.	1/3	7 x 4in.	1/-
9 1/2 x 6in.	1/8	9 1/2 x 4in.	1/5
10 x 9in.	2/2	10 x 7in.	1/11
12 x 9in.	2/8	12 x 7in.	2/5
14 x 9in.	3/2	14 x 7in.	2/11
16 x 9in.	3/8	16 x 7in.	3/5
20 x 9in.	4/8	20 x 7in.	4/5
22 x 9in.	5/2	22 x 7in.	4/11

H.T. ELIMINATOR AND TRICKLE CHARGER KIT

All parts to construct an eliminator to give an output of 120 volts at 20 m.A., and 2 volts to charge an accumulator. Uses metal rectifier, 37/6.

Famous Manufacturer's Surplus of ANTI-INTERFERENCE AERIALS

offered at a fraction of original cost



The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long/medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wave bands. The equipment enables the installation of an 8.3 Mc/s flatly-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable.

COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising one each: Aluminium transformer, Transformer clip, Rubber sucker, 1/2 in. x 1/4 in. brass screw, 4AB x 1/4 in. brass bolt, 4B x nut.
Receiver Transformer. Complete with Insulators, clips, etc.; Porcelain Insulators, 2 each, 60ft. Insulated Aerial Wire, 60ft. Screened Co-Axial Down Lead.
Installation instruction leaflet included.
LESS CO-AXIAL CABLE & AERIAL WIRE, 15/-, plus 1/8 pkg. and carr.
COMPLETE 35/-, plus 1/6 pkg. and carr.

GARRARD Rim Drive 78 r.p.m., complete with magnetic pick-up and turntable 25/19/6
Packing and carriage on the above until 2/6

MAINS NOISE ELIMINATOR KIT

Two specially designed chokes with three smoothing condensers with circuit diagrams. Cuts out all mains noise. Can be assembled inside existing receiver, 4/11 complete, plus 6d. pkg. and carr.

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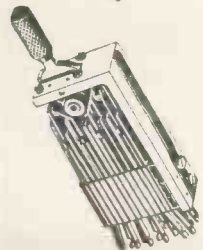
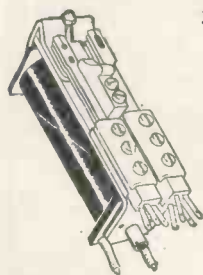
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AUTOMATICALLY
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TURNTABLE
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ELIMINATING
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AND RECORD
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MONARCH

Only the Monarch Autochanger has *all* these features. Its record performance, fidelity reproduction and absolute reliability are acclaimed by music lovers and record enthusiasts everywhere—it's the first choice of the experts.



WORLD'S FINEST AND MOST WANTED AUTOCHANGER

Birmingham Sound Reproducers Limited, Claremont Works, Old Hill, Staffs.

Wireless World

RADIO, TELEVISION
AND ELECTRONICS

44th YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK, M.I.E.E.
Editor: H. F. SMITH

MAY 1954

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VALVES, TUBES & CIRCUITS

17. PCC84: A CASCODE AMPLIFIER FOR V.H.F TELEVISION RECEIVERS

The Mullard type PCC84 is a double triode designed for use in the R.F. stage of television receivers operating at Band III frequencies. It is primarily intended for connection as a D.C.-coupled cascode amplifier preceding the Mullard type PCF80 used as a frequency changer.

In this type of cascode circuit the first triode is connected as a grounded cathode amplifier, and the second as a grounded grid amplifier. The two sections are connected in series across the H.T. supply, with the anode of the first triode coupled to the cathode of the second. The output from the second stage is coupled either inductively or capacitively to the mixer grid of the frequency changer.

The cascode circuit employing the PCC84 has two attractive features: a low noise level and a low in put conductance which allows a high gain. At Band III frequencies the noise contribution of the aerial is small, therefore the inherent noise of the input stage contributes largely to the total noise. If a pentode is employed, the partition noise, caused by the random division of electrons between the anode and the screen grid, is the main source of noise. This is avoided by the use of a triode. The main disadvantage of the triode, however, is the considerable internal feedback via the anode to grid capacitance. This is overcome by the cascode arrangement which permits efficient screening between the output and the input of the stage. Thus it is possible to combine a high stage gain with a very favourable noise factor.

The characteristics of the PCC84 are conventional, but attention is drawn to the high mutual conductance of 6.0 mA/V which is obtained with $V_g = -1.5$ V and $V_a = 90$ V. The low working anode voltage allows the two triodes to be series connected across an H.T. supply of 180 V.

D A T A

HEATER						CHARACTERISTICS (Each section)					
I_h	...	...	...	...	0.3 A	V_a	...	...	...	90	V
V_h	...	...	...	...	7.0 V	I_a	...	...	...	12	mA
CAPACITANCES (Measured without external shield)						V_g	...	...	...	-1.5	V
$C_{a'-g'}$	...	...	...	...	1.1 $\mu\mu\text{F}$	g_m	...	...	...	6.0	mA/V
$C_{in'}$	...	...	...	...	2.3 $\mu\mu\text{F}$	μ	...	...	...	24	
$C_{out'}$	...	...	...	...	0.45 $\mu\mu\text{F}$	LIMITING VALUES (Each section unless otherwise specified)					
$C_{g'-h}$	...	...	...	...	< 0.25 $\mu\mu\text{F}$	$V_{a(b)} \text{ max.}$	...	...	...	550	V
$C_{a''-g''}$	...	...	...	...	2.3 $\mu\mu\text{F}$	$V_a \text{ max.}$	...	...	...	180	V
$C_{a''-g''+h}$	...	...	...	...	2.5 $\mu\mu\text{F}$	$p_a \text{ max.}$	...	...	...	2.0	W
$C_{a''-k''}$	...	...	...	...	0.16 $\mu\mu\text{F}$	$I_k \text{ max.}$	...	...	...	18	mA
$C_{k''-g''+h}$	...	...	...	...	4.7 $\mu\mu\text{F}$	$-V_g \text{ max.}$	...	...	...	50	V
$C_{h-k''}$	...	...	...	...	2.7 $\mu\mu\text{F}$	* $V_{h-k''} \text{ (pk) max. (Heater negative)}$	...	...	...	250	V
$C_{g'-a''}$	...	...	...	...	< 0.006 $\mu\mu\text{F}$	$V_{h-k''} \text{ max. (Heater positive)}$	...	...	...	90	V
$C_{a'-a''}$	...	...	...	...	< 0.035 $\mu\mu\text{F}$	$V_{h-k'} \text{ max.}$	...	...	...	90	V
$C_{a'-k'+h+g''}$	...	...	...	...	1.2 $\mu\mu\text{F}$	$R_{h-k} \text{ max.}$	...	...	...	20	k Ω

* Max. d.c. component = 180 V.

BASE B9A $\left\{ \begin{array}{l} a', g', k' \text{—grounded-grid connection.} \\ a'', g'', k'' \text{—grounded-cathode connection.} \end{array} \right.$



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

MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, W.C.2
MVM 272

BRITISH MADE
BRIMAR
VALVES

more reliable
than **EVER!**



Brimar's long experience in the manufacture of special-quality TRUSTWORTHY valves is now being reflected throughout the entire Brimar range.

Improved production methods, new and better assembly jigs, tighter control on the composition of materials, and the closer supervision of vital processes have resulted in valves with more uniform characteristics, greater mechanical strength and a higher standard of reliability as shown in the 12AT7.

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The 12AT7 is a very reliable frequency changer and is widely used in modern TV receivers, VHF and UHF communications equipment. It is also frequently employed in industrial equipment, computers, navigational aids and test equipment.

Use the **BRIMAR 12AT7**
with improved performance
at **NO EXTRA COST**



now is the time

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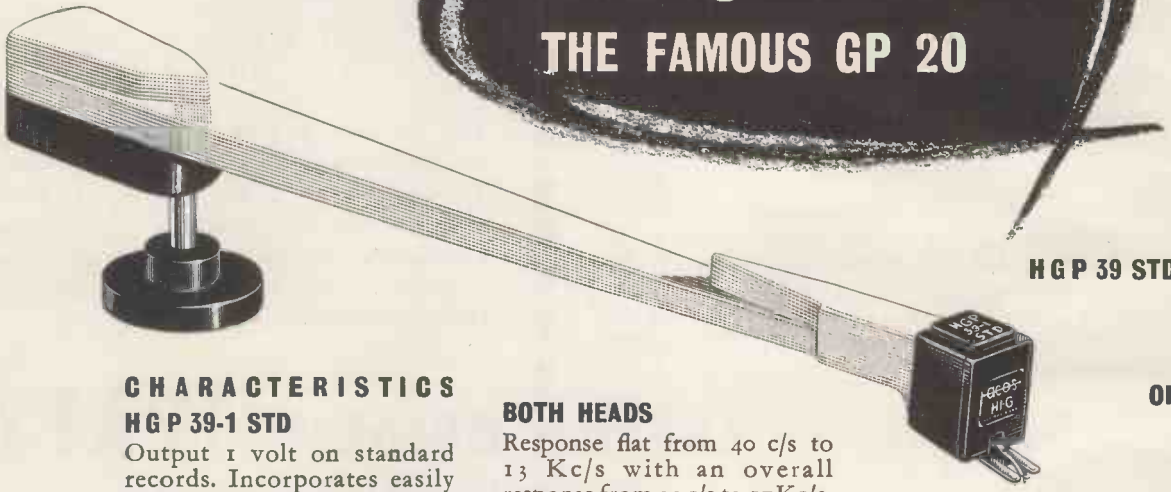
FOOTSCRAY · SIDCUP · KENT

FOOTscray 3333

BRIMAR	MULLARD	MARCONI OSRAM	COSSOR EMITRON
12AT7	ECC81	B152 & B309	12AT7

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...and NOW YOU CAN GET
**ACOS Hi-g HEADS FOR
 THE FAMOUS GP 20**



HGP 39 STD

OR

HGP 39 LP

CHARACTERISTICS

HGP 39-1 STD

Output 1 volt on standard records. Incorporates easily changeable 0.0025" sapphire stylus.

HGP 39-1 LP

Output 1/2 volt on microgroove records. Incorporates easily changeable 0.001" sapphire stylus.

BOTH HEADS

Response flat from 40 c/s to 13 Kc/s with an overall response from 20c/s to 17Kc/s. Tracking weight 8 grammes.

PRICE

STANDARD OR LP HEAD ONLY

£1 · 12 · 0 (Plus 10/3 P.T.)

GP 20 Hi-g COMPLETE PICK-UP WITH EITHER HEAD £2·12·0 (Plus 16/8 P.T.)



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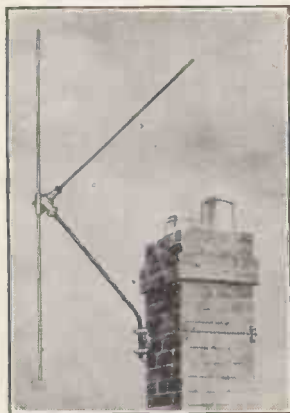
ACOS devices are protected by patents, patent applications, and registered designs in Great Britain and abroad.

"BELLING-LEE" NOTES

There are two classes of questions that we are called upon to answer very frequently. The first relates to Band III and there is not much we can say.

The higher the frequency, the greater is the field strength per meter over a given distance, but as the aerial is reduced in physical dimensions, less signal is transferred to the receiver. Further, the potential effect of random reflections and shadows is so serious, that until we know the site of the alternative T.V. transmitter and the polarisation, it is just not possible to say if the buyer of a T.V. receiver with built-in facilities for Band III reception will be able to get along with an indoor aerial, or if he will require a five element outside aerial or even if he will be able to receive a signal at all.

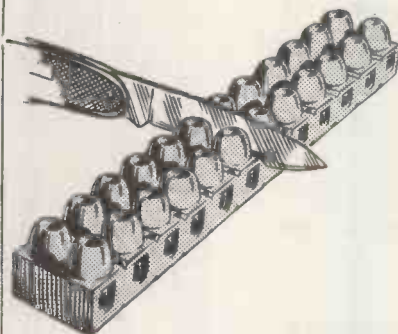
Very constant reception is to be expected where the receiving aerial can "see" the transmitting aerial, but a hill in the way may be much more serious, than on Band I. About the extreme service range of a transmitter, we expect there will be a sharp cut off in "field strength," the signal will not fade out gradually as on the lower frequency, i.e., the fringe will probably be narrow. In spite of this, freak reception over comparatively long distances may be more common, all of which indicates the fickle nature of the higher



frequencies. Many of our correspondents write as though Band III programmes would be on the air in a month or two. The whole scheme is "in the air" and it would appear that it will remain so for some time. We do not expect to see Band III transmissions in England for at least a year, in Scotland probably not for two years, although we believe these dates are conservative. Nothing would please us more than to be proved wrong.

Flexible in design Versatile in application

Bend it flat, bend it edgewise, hit it, overtighten the screws, the insulant will not break. Turn it upside down and shake it, the screws cannot fall out. Take a penknife and cut off the number of "ways" you require, it will not let you down. This is the most useful terminal strip ever offered to a long suffering industry, and it complies with all the appropriate specifications. B.S.415 (1941) and the International specifications I.E.C.65. C.E.E.I.



- ★ UNBREAKABLE
- ★ CUT WITH A KNIFE
- ★ FITS ODD CORNERS
- ★ FITS A CIRCLE
- ★ COMPLIES WITH
TECHNICAL
SPECIFICATIONS

Please write for
leaflet P378/W.W.

BELLING & LEE LTD

GREAT CAMBRIDGE ROAD, ENFIELD, MIDDXX., ENGLAND

The second most popular query is of the type where we are asked by a dealer say thirty miles from Norwich if we think he will receive the proposed Norwich transmitters better than Sutton Coldfield. Now the plan only allows 2KW for Norwich vision power, and at 30 miles reception will certainly be under fringe conditions. So if we were getting a good picture from Sutton Coldfield we would not change till we were sure.

Incidentally many know that between Norwich and the Wash there are sites where Holme Moss gives a better picture than Sutton Coldfield, although it is well over a hundred and twenty miles distant.

"Kayrod" Director Aerial

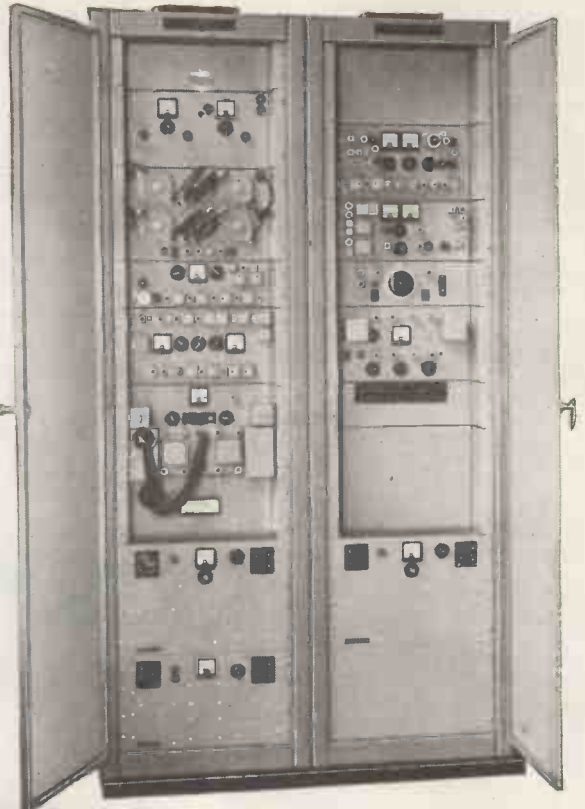
We are indebted to many viewers and wireless dealers for most encouraging reports sent in describing the wonderful results obtained on the new "Kayrod" director aerial (illustrated on the left). Although naturally we carried out most exhaustive tests in notoriously difficult reception areas in many parts of the country, we still appreciate hearing from users that the performance is "better than they dared to expect." We are conservative in our designs and conservative in our claims, and we would not have departed from the orthodox unless there had been technical reasons for so doing.

Advertisement of
BELLING AND LEE LTD.
Great Cambridge Rd., Enfield, Middlesex.
Written 24th March, 1954.

Marconi VHF FM Multichannel Terminal and Repeater Units

HM 100 AND 150 SERIES

Marconi VHF multichannel systems provide reliable and economical communication. Up to 48 telephone channels can be provided simultaneously and some of these may be further sub-divided by VF telegraph channelling equipment to give either 18 or 24 telegraph channels. The equipment operates in conjunction with carrier apparatus which is the same as that already standardised for use on line systems. Such a radio system can operate over hundreds of miles by placing repeater units at suitable points along the route.



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★ The equipment will operate entirely unattended and changeover is automatic in duplicate systems

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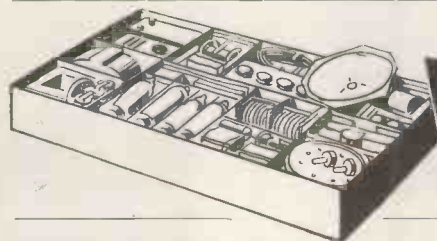
Specially prepared sets of radio parts with which we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio sets. Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business—these Practical Courses are intended for YOU—and may be yours at very moderate cost.

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With these outfits, which you receive upon enrolment, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to complete Radio and Television Receiver Testing and Servicing.

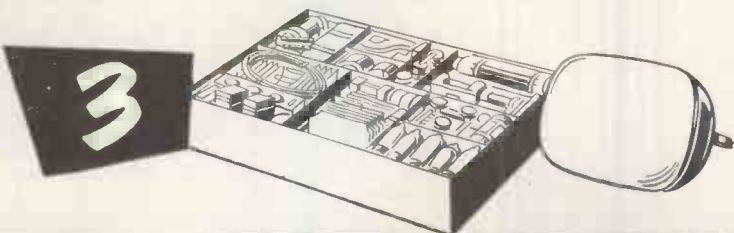


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SenTer-Cel Types M1 and M3 rectifiers are low in cost and offer many advantages. They replace equivalent thermionic valves and can be wired directly into circuit; wiring is reduced and valve-holders are eliminated.

Both types operate at minimum input levels of 0.5 volts, type M1 at frequencies up to 5 Mc/s and type M3 up to 100 kc/s.

APPLICATIONS

AGC rectifiers: muting circuits: contrast expansion and compression: level indicators: modulation depth indicators: limiters: automatic frequency control.

Type M1
Average Characteristics

Self Capacitance22 pF
Forward Resistance at 5 V D.C. 10 kΩ
Reverse resistance at 5 V D.C. 1,000 MΩ
Maximum Peak Inverse Voltage...68 V
Minimum A.C. Input0.5 V
Maximum Frequency5 Mc/s.

Type M3
Average Characteristics

Self Capacitance65 pF
Forward Resistance at 5 V D.C. 1.2 kΩ
Reverse Resistance at 5 V D.C. 45 MΩ
Maximum Peak Inverse Voltage...68 V
Minimum A.C. Input0.5 V
Maximum Frequency100 kc/s



Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, W.C.2

RECTIFIER DIVISION: Warwick Road, Boreham Wood, Hertfordshire

Telephone: Elstree 2401

MODERN TELEVISION TECHNIQUE

A Precision Aligned, Narrow Beam Focus and Scanning System for Television Receivers

In modern television receivers capable of giving pictures of excellent contrast and definition, the quality of the picture is determined to a considerable extent by the uniformity of focus of the scanned electron beam in the cathode ray tube and the intrinsic size and shape of the scanning spot.

Despite the general improvements that have been made in cathode ray tube guns, focus magnets and scanning coils, the commercial television receiver electron lens does not compare with a quality optical (light) lens, and is probably analogous to the curved glass surface of the bottom of, say, a wine bottle. Such a bottle could, however be greatly improved as a light lens if a selected small portion only of the surface were utilized. The principle of the "His Master's Voice" aligned, narrow beam, focus and scanning system is to utilize small selected areas of the electrostatic and magnetic lenses.

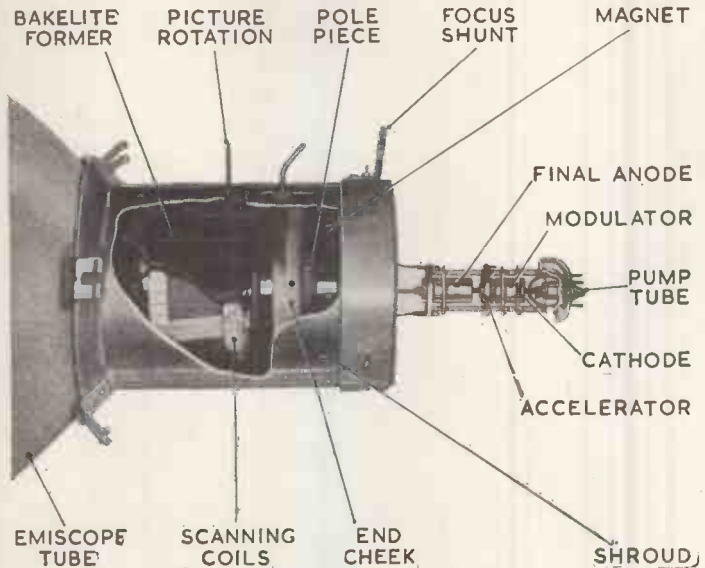
These considerations are embodied in the new "His Master's Voice" 14" and 17" 'Highlight' receivers, and the principles and mechanics of the system are outlined in the following notes.

The divergent electrons are constricted into a thin pencil-like beam, and directed by careful mechanical alignment of all the elements through the exact centre of the focus and deflection system. The photograph of the system indicates the cathode, grid, the beam constricting electrode and accelerator, and the final anode mounted centrally on the base and sealed co-axially into the glass neck by accurate location of the pump tube during assembly. The angular accuracy is better than 1°.

The angular deflection of the beam due to the earth's field is some 2° and this may be accentuated by as much as 5° in steel framed buildings. This deflection would completely nullify the purpose of accurate alignment, and hence a weak magnet (not in the illustration) is placed over the grid exactly to cancel the effects of this external field.

The end cheeks of the focus magnet are accurately tooled for outside diameter to be a push fit into the shroud, and the inner pole pieces coined to be smooth, free from mechanical distortion and co-axial. The magnets are ground to fine limits to ensure parallelism of the cheeks. The assembly is carefully rotated during magnetising.

The external shunt is a machine fit on the outside



periphery of the shroud and hence avoids serious distortion of the focus field in adjustment.

In this way it is possible to ensure an area of diameter about 4 mm. at the centre of the focus field, substantially free from aberration, to accept the electron beam of diameter about 2 mm.

The scanning coil fields are similar to the focus field in that irregularities increase rapidly towards the edges. Hence, if the beam passes centrally through the field the greatest area of the picture will be free from spot deformation.

The scanning coils are located in the bakelite former, which while capable of rotation within the shroud for picture shift, retains absolute concentricity with the shroud.

It will be seen, therefore, that providing the shroud is aligned to the glass neck the aim of the design is achieved.

The mould for the glass of the cathode ray tube is shaped to provide a circular periphery at the point where the coned end of the shroud is clamped firmly against the bulb. By adjustment of the four locking screws the remote end can be accurately jugged.

"HIS MASTER'S VOICE"

THE GRAMOPHONE COMPANY LIMITED • HAYES • MIDDLESEX



Life line of communication . . .

Marconi's fitted the first ship with wireless and by 1907 200 ships and more than 100 shore stations had been equipped. Today practically every vessel that ventures on the high seas carries wireless. All radio approach and marker beacons around the British Isles have been designed and manufactured by Marconi. The mariner is warned of hazards and guided into safe channels by Marconi equipment in nearly every principal shipping lane of the world.

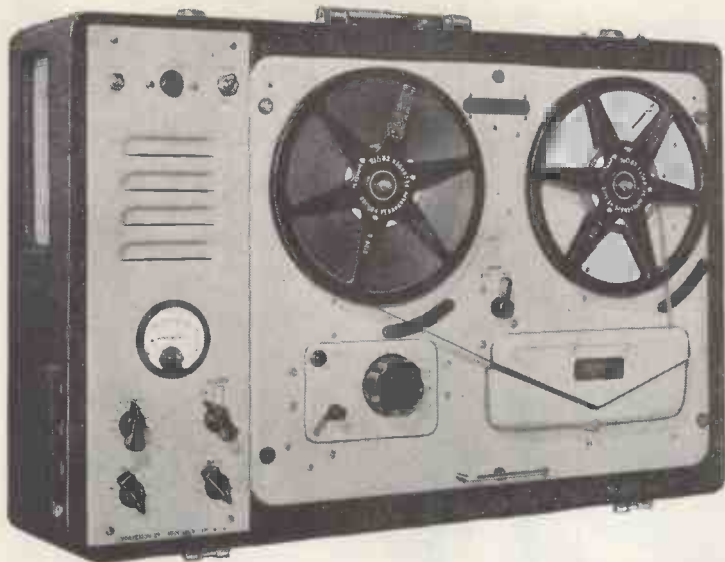


**MARINE BEACONS
AND
NAVIGATIONAL AIDS**

MARCONI

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED • CHELMSFORD • ESSEX

VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures $8\frac{1}{2}$ in. x $22\frac{1}{2}$ in. x $15\frac{3}{4}$ in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ The noise level is extremely low and audibly the hum level and Johnson noise of the amplifier and deck are approximately equal. Only 25% of this small amount of hum is given by the amplifier alone.

★ Extremely low distortion and background noise, with a frequency response of 50 c/s.—10 Kc/s., plus or minus 1.5 db. A meter is fitted for the measurement of signal level and bias level.

★ Sufficient power is available for recording on disc, either direct or from the tape, without additional amplifiers.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ Facilities are provided for using the amplifier alone and using power output or headphones while recording or to drive additional amplifiers.

★ The unit may be left running on record or play back even with 1,750 ft. reels with the lid closed.

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE** £18 0 0.

FOUR CHANNEL ELECTRONIC MIXER

is almost essential for the professional or semi-professional where a number of different items have to be mixed on one tape recording.

It is recommended by a number of tape recorder manufacturers for this purpose.

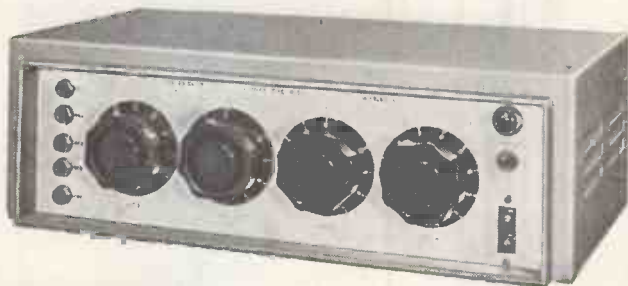
Any normal input impedance can be supplied to order, balanced or unbalanced, the standard being 15-30 ohms balanced.

The normal output is 0.5 volt on 20,000 ohms or less, but 600 ohms is available as an alternative.

The steel stove enamelled case is polished and fitted with an engraved white panel suitable for making temporary pencil notes.

An internal screened power pack and selenium rectifier feed the five low noise non-microphonic valves.

Used in many hundreds of large public address installations and recording studios throughout the world.



PRICE
£36.15.0

Manufactured by

VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3

Telegrams: "Vortexion, Wimble. London."

ENDORISING 3-D RADIO

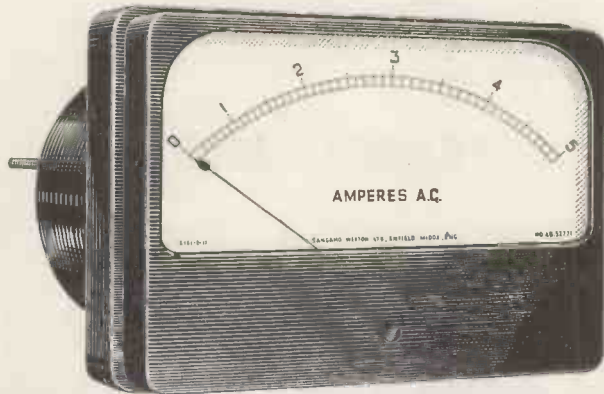
As the originators of the reflex cabinet speaker we are proud to print one of the many letters we receive. This one is from Mr. B. Tillotson of Barnoldswick, Lancashire, who says :

"I have just obtained one of your 12 in. Speakers, Type 6G 4955. I wish to compliment you on your great achievement in reproduction of sound at it best."

Phase Inverter Speaker, complete with cabinet £14.10.0
S.S. Auditorium Speaker, unit only £8.13.4



SOUND SALES LTD., WEST STREET, FARNHAM, SURREY. Farnham 6461-2-3
LONDON AGENTS: WEBB'S RADIO—HOLLEY'S RADIO



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PANEL INSTRUMENTS · PORTABLE TEST SETS ·
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THE WESTON RANGE OF RECTANGULAR INSTRUMENTS

Supplied as D.C. moving coil, A.C. rectifier and H.F. thermocouple types ; also A.C./D.C. moving iron types. Four sizes are available with scale lengths of 2.5in., 3.2in., 4.2in. and 6.25in.

Front of panel or back of panel mounting may be adopted as desired, and if the former method is used there is complete interchangeability with existing round models. The 3.2in. and 4.2in. scale instruments are available with either illuminated or non-illuminated dials ; the 2.5in. and 6.25in. scale instruments being available only with non-illuminated dials.

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**The new Mk. III Camera
with 4½" or 3"
image orthicon
tube . . .**

The use of the new Marconi camera BD 687 with 4½" or 3" image orthicon tube and the employment of better circuit techniques in the camera channels have reduced to a negligible degree such faults as black halos, edge effects and electronic ghosts; whilst resolution, grey scale and signal-to-noise ratios are greatly improved. Ingenious design has led to simplicity of control and provided for fully remotely controlled applications.

Besides the camera the channels BD 808/809 comprise a Camera Control and Preview Monitor, Regulated Power Supply Unit and Focus Supply Unit.

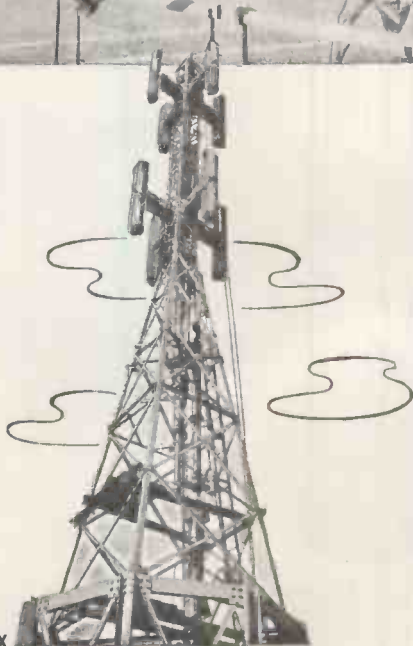


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**Complete Broadcasting
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CLEARLY the Best of P.A. Speakers



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Ideal for critical installations where clear speech reproduction is of first importance. Gives three or four times the coverage of conventional cabinet speakers. Excellent as a local intensifier. Handles up to 3 watts.



The world-famous range of Truvox Public Address loudspeakers includes many models designed for widely varying applications. But all have in common the clarity of reproduction, absolute dependability and magnificent performance under the most exacting conditions which are characteristic of Truvox loudspeakers. The model illustrated is just one example from an infinitely varied range. Write to-day for descriptive folder and price list.

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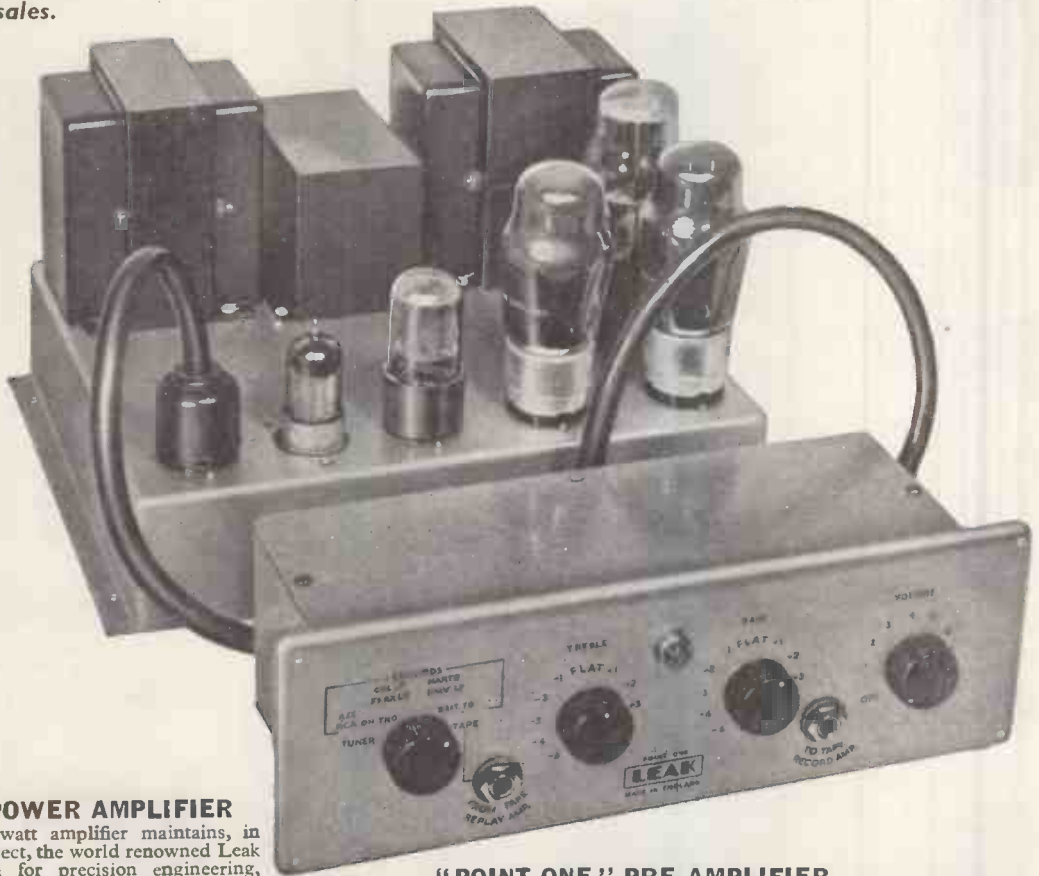
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AMPLIFIER & PRE-AMPLIFIER

27 GNS. COMPLETE
A price made possible
only by world wide
sales.

by

LEAK



TL/10 POWER AMPLIFIER

This 10 watt amplifier maintains, in every respect, the world renowned Leak reputation for precision engineering, fine appearance and fastidious wiring.

SPECIFICATION

Circuitry

A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.

Maximum power output: 10 watts.

Frequency Response: ± 1 db 20 c/s to 20,000 c/s.

Harmonic Distortion: 0.1%, 1,000 c/s, 7.5 watts output.

Feedback Magnitude: 26 db, main loop.

Damping Factor: 25.

Hum: -80 db referred to 10 watts.

Loudspeaker Impedances: 16 ohms, 8 ohms, and 4 ohms.

"POINT-ONE" PRE-AMPLIFIER

The handsome gold escutcheon plate contributes to the elegant appearance, and blends with all woods.

★ Pickup

The pre-amplifier will operate from any pickup generally available in the world. A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.

★ Radio

The radio input sockets at the rear permit the connection of any tuner unit. An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier.

★ Distortion

Of the order of 0.1%

★ Hum

Negligible, due to the use of recently developed valves and special techniques.

★ Input selector

Radio, tape, records; any and all records can be accurately equalised.

★ Treble

Continuously variable, +9 db to -15 db at 10,000 c/s.

★ Bass

Continuously variable, +12 db to -13 db at 40 c/s.

★ Volume Control and switch

The switch controls the power supply to the TL/10 power amplifier.

★ Tape Recording Jacks

An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use with Tape Recorders which have built-in (low level) amplifiers.

★ Write for leaflet W ★

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ELECTRONIC PRECISION EQUIPMENT LTD.

CABINET BARGAIN

THE EMPRESS



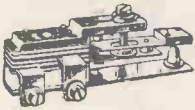
Elegantly veneered walnut. Highly polished control board is raised, but is not cut or drilled. Motor board, again uncut, measures 16in. x 14in. deep and has a clearance of 5in. space for recordings storage. Size 3ft. wide, 2ft. 8in. high, 1ft. 4in. deep. Price £15/15/- or £5/5/- deposit.

SOMWEAVE



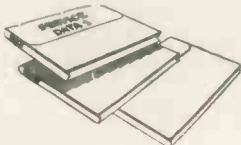
This really lovely loud-speaker fabric we offer at approximately a third of today's cost. It is 42in. wide and our price is 12/- per yard or panels 12in. x 12in., 1/9 each.

New 5 AMP. THERMOSTAT (MINIATURE)



2 1/2 x 1 x 1 1/4 in. high

Useful for the control of appliances such as convectors, gluepots, vulcanisers, hot plates, etc. This thermostat is adjustable to operate over the temperature range 50-550 deg. F, fitted with heavy (5 amp. A.C.) silver contacts size 1 1/2 in. long x 1/4 in. wide, price, 8/6, post 6d.; 1 amp. type, 3/6, 2 amp. type, 5/6.



SERVICE DATA

100 service sheets, covering British receivers which have been sold in big quantities, and which every service engineer is ultimately bound to meet. The following makes are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster-Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Philips, Pye, Ultra. Price £1 for the complete folder. Our folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers "all dry" etc., which have been imported into this country. Names include Sparton, Emmerson, Admiral, Crossley, R.C.A., Victor. etc. Each sheet gives circuit diagrams and component values, alignment procedure, etc., etc. Price for the folder of 100 sheets is £1. Post free.

BEDROOM-NURSERY MAINS MIDGET RADIO

All the parts, bakelite cabinet, valves, knobs, back—in fact everything will cost you only £3/15/- (plus 2/6 postage) which, we think you will agree, is not too much to spend on your dear ones. The set is economical to run, too, for it uses only three valves in a special reflex T.R.F. circuit which gives ample power combined with good tone. Circuiting and construction data free with parts or available separately at 1/6.



HUGE NEW PURCHASE

We have purchased another large quantity of the Collaro Auto Record Changer, type R.C. 3/521, three speed suitable for all types of records and with the latest type crystal pick ups. Buy one this month as you will not be able to again at this special price of 11 gns. plus 7/6 carriage and insurance. H.P. Terms £4



deposit and balance over 12 months.

THE STROLLER

This month we offer a new booklet for Constructors. It shows how to make a sensitive and powerful superhet battery portable which will be just the thing to take on a day out or on your holidays. The booklet also shows how to make the Picnic Player, a useful non-mains record player. Most readers will have experienced a difficulty in obtaining good results on radio, particularly around the Coast, so it is often more reliable to take a record player. The price of the booklet is 2/6, which is returnable if component parts are purchased.



A RADIO UNIT FOR SUPERIOR 15



A circuit for a radio unit to fit into our Coronation Console Cabinet has now been completed and thoroughly tested. All the parts are available. The total cost is £5/19/6. Data is included free with orders for parts, or can be supplied separately; Price 2/6. Note: This radio unit incorporates T.V. control and is also highly suitable for fitting into other televisions. The Superior 15 Corner Cabinet illustrated is also available now in light oak, or medium oak to suit your furnishings, and it really does look impressive. The price is £18, plus carriage. H.P. terms £6 deposit, balance over twelve months. About the Superior 15 itself, if you have not already ordered your set of parts for this, be advised and do so immediately. We are definitely getting down to the last batch of the 15 in. tubes and once these are gone the Super 15 T.V. cannot be repeated. At £37/10/- for all the parts (including 15in. Cossor Tube) this represents the finest value ever offered to the home constructor. If you doubt your ability to make it then send 7/6 for the data and study this first.

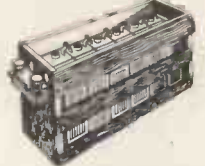
CHASSIS ASSEMBLY



3 colour, 3 waveband scale covering standard Long, Medium, and Short wavebands, scale pan, chassis punched for standard 5 valve superhet, pulley driving head, springs, etc., to suit. Scale size 14 1/2 in. x 3 1/2 in. Scale size, 15 in. x 5 in. x 2 in. deep. Price 15/-, plus 1/6 post.

Note: This is the one that fits our 37/6 table cabinet.

BARGAINS TO CLEAR



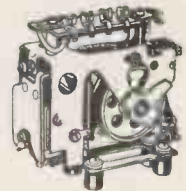
12-CELL ACCUMULATOR

This accumulator can be coupled up to give 24 v. with all cells connected in series or 12, 6 or 2 volts in series parallel arrangements. They were originally made for the Admiralty by a leading manufacturer, have never been filled, and are in excellent condition. Each is contained in a wooden crate as illustrated. To clear 10/- each. Post and insurance 2/6.



VIBRATOR UNIT

This unit gives 150 v. at 50 mA. from 4 or 6 v. car battery, also gives L.T. supply, suitable for all dry valves. IT4, IR5, etc. Ex-W.D. Price 15/-, plus 2/6 post.



RE-MOTE CONTROL

With only one pair of wires and a simple push button you can select any one of four stations without leaving your armchair. This is just one of the many applications of our impulse relay. There are many other purposes to which it can be put. Note they are somewhat soiled, due to storage but mechanically O.K. Price 2/6.

THE PORTA-RADIO

This is ultra-modern, two-tone, bakelite with integral moulded handle. We can supply, where required, the metal chassis, dial, and all other parts necessary to make a Mains or Battery portable. Note: All of these cabinets have slight imperfections; these are hardly noticeable, however, and will not impair the performance or safety of the set. Price 10/- each, post and ins. 3/6.



TWO-VOLT ACCUMULATORS

Made for the Forces by one of the most famous firms in the world. 15 amp.-hour size approx. 6in. x 1 1/2 in. square in ebonite case, pre-charged, only need filling with acid, 4/9 each, plus 9d. post and insurance.

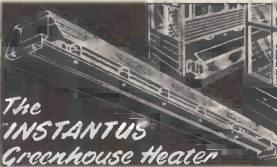


PLUGS AND SOCKETS

The following types are in stock and enquiries are invited:—
 10H/701—Pye Plug Type 213.
 10H/774—2 Point Socket.
 10H/4542—6 Point Socket.
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 10H/425—4 Point Socket.
 10H/1291—6 Point Plug.
 10H/1238—2 Point Socket.
 10H/4535—4 Point Socket.
 10H/4538—6 Point Socket.
 10H/1262—2 Point Socket.
 10H/431—2 Point Socket.
 10H/1598—2 Point Socket.
 10H/420—2 Point Socket.
 10H/1599—Double Connector, 4 Point.
 10H/418—Double Connector, 18 Point.
 10H/517 } Double Connector,
 10H/518 } 18 Point.
 10H/416—Double Connector, 12 Point.
 10H/14298—60-Axial Cable Connector with Clip No. 10H/1774 and two Pye Plugs No. 10H/701
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Soil heating means mature plants weeks earlier, yet only costs 3d. per day to operate. ELPREQ safe (low voltage) equipment includes, transformer and two heating wires (warms 50 sq. ft. or two average garden frames). Only 47/6, plus 2/6 carriage, or send only 10/-, then 10/- per month for five months. Free trial offer. Return for full cash refund if after three months' trial you are not 100 per cent. satisfied.



THE INSTANTUS GREENHOUSE HEATER

The heater with the lowest possible thermal capacity, 4ft. long made from heavy gauge sheet steel (galvanised) 1 kw., suitable A.C. or D.C. Price only £2 or with thermostat £3/15/- Note: The thermostat mounts separately and will control up to three heaters.

THIS T.V. CONSOLE CAN BE YOURS FOR £8-13-0 DEPOSIT.



THE TELEVISOR CHASSIS

The Televisor is the Practical T.V. Simplex, all components for which we will supply for only £15. The Simplex does not entail converting or adapting ex-Government units and has been designed for construction by the novice. For £15 (carriage 7/6) you would receive all the parts, including 14 valves and V.C.R. 517 6in. cathode ray tube. The metal chassis would be supplied but undrilled. Alternatively, these can be supplied for a small extra charge, drilled and prepared.

THE CABINET

The cabinet is our standard Regina which would be supplied with a smaller cutout. This can of course be bought separately at £7/17/6, carriage 10/-.

THE INTERNAL ENLARGER system is our special line. It comprises a veneered and polished wooden surround with a specially shaped mask, oil-filled enlarger, and four chrome headed secret fixing screws, it is suitable for any cabinet. The price of the enlarger outfit separately is 39/6, postage and packing 2/6.

The three items above and an 8in. speaker will be supplied for £25/12/-, or £8/13/- deposit, balance over 12 months plus 15/- carriage.

NEW CABINET and BEETHOVEN RECEIVER

Fine Walnut veneered and polished cabinet to take the Beethoven 5-valve Superhet with 8in. loudspeaker, thus making a really excellent table model. Worth £18-£20. Price 49/6, carriage and packing 5/- extra. If bought with the Beethoven chassis, the hire purchase deposit is £3/15/8, carriage 10/-.



BEETHOVEN 5-VALVE SUPERHET

Complete with valves and ROLA loudspeaker, ready to work off A.C. Mains—three wave (L. M. and S.)—large dial. Slow motion drive, stout cored, coils, etc., etc. £8/17/6, or £3 deposit (balance over 12 months), carriage 7/6.

THREE OUTSTANDING BARGAINS

CONSOLE CABINET

Beautifully veneered and polished. Price £11/10/-. Plus £1 carr. and ins., or H.P. terms £3/16/8 deposit.

ALL-WAVE RADIO CHASSIS 5-valve superhet for A.C. only. Coloured Edge-lit dial, usual refinements, good output on long, medium and short waves, as well as on gram. Price £9/19/6, plus 7/6 carriage and insurance. Or H.P. terms £3/6/6 deposit.

AUTO CHANGE RECORD PLAYER

Three-speed with famous Studio pick-up for all records. Price £11/10/-, plus 10/- carr. and packing. Or H.P. terms £3/16/8 deposit.

BALANCE OF H.P. ACCOUNT IS SPREAD OVER 12 MONTHS BOOKLET OF PHOTOS, CIRCUIT DIAGRAMS, etc., 2/6 (returnable).



CONNECTING WIRE SNIP
 P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/9 each. Colours available: Black, Brown, Red, Orange, Pink, Yellow, White, Transparent. 4 coils for 10/-.

14 DAYS' FREE TRIAL

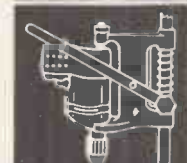
SEND ONLY DEPOSIT—REFUNDED IF TOOL NOT APPROVED.



Robust tool with trigger switch and self-centring chuck. Drills, sands, polishes, grinds, sharpens. Also, with attachments drives: lathe, saw bench, rise and fall, grinder, buffer, etc.



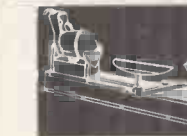
Price—£5/19/6 cash, or 40/- deposit Carriage and Packing 2/6.



HORIZONTAL STAND—17/6, post 1/6.



VERTICAL BENCH STAND—£3/7/6, post 2/6.



LATHE STAND—£5/5/-, or 35/- deposit Carriage and packing 5/-.

THE FOUR ITEMS

£15-9-6 or £5-3-2 Deposit.

FREE BOOK

Our booklet "Handy Hints" gives tips for Carpenters, Mechanics, Engineers and



Gardeners. Fully illustrated and it is yours for the asking. Send stamp today.

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 Phone: RUISLIP 5780. Half-day, Wednesday.

152-153, FLEET STREET, E.C.4.
 Phone: CENTRAL 2833. Half-day, Saturday.

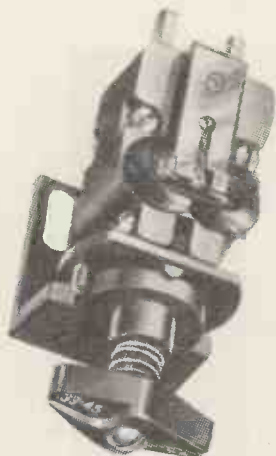
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 Half-day, Thursday.



INTRODUCING the *Goldring*

Variable-Reluctance pick-up cartridge
— No. 500 —
with twin styli for standard and L.P. records

A new and spectacular advance in the realm of High Quality disc-record reproduction!



Featuring:—

Easily replaceable sapphire or diamond styli.
Low playing weight — 6 to 8 grams.
Very low dynamic mass and high compliance.
Frequency response 15-20,000 cps.
Output 3mV per cm/sec.
Suitability for use in all climates.

Designed specifically for applications requiring the highest attainable fidelity.

For full details of this product and of its applications, write to

The GOLDRING MANUFACTURING CO. (Gt. Britain) LTD.
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IMMEDIATE DELIVERY RADIO and T.V. SPARES

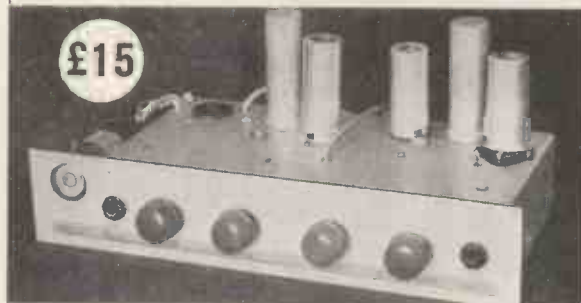
- STANDARD & WIDE-ANGLE "VIEW MASTER" COMPONENTS
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SERVICE & SPEED
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Recommended and approved by TRUVOX

For the TRUVOX Mk.III TAPE DECK



EAP 3 TAPE RECORDER AMPLIFIER

TECHNICAL SPECIFICATION: Frequency range 90-9,000 c/s. * 3 watts output on Play back. * Separate High and Low Gain inputs with Mixer Control. * "Magic Eye" Record Level Indicator. * Variable tone control. * Amplifier can be used for high-fidelity reproduction from gramophone or Radio Feeder Unit.

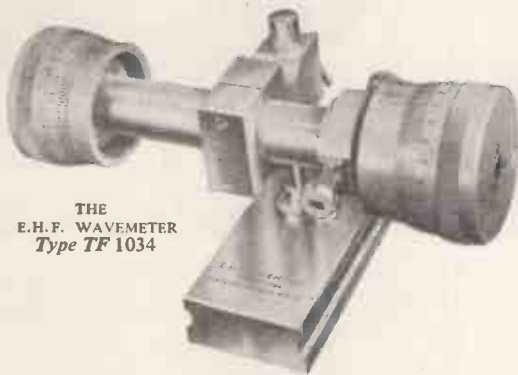
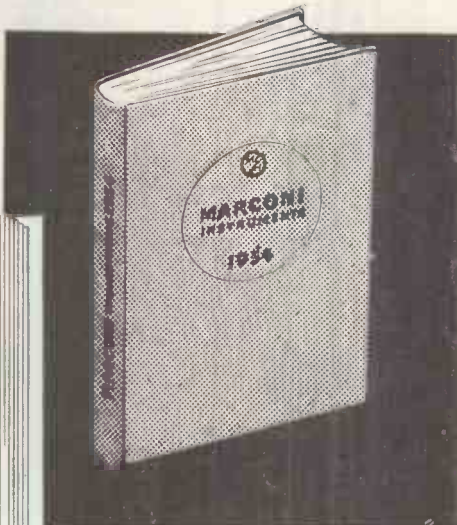
Separate Power Pack, supplying instantaneous braking voltage. * Miniature valves. * Size: (main chassis) 10½ in. x 5½ in. x 2 in. (power pack) 5½ in. x 3½ in. x 2½ in.
PRICE: £15 (carriage extra).
Trade Enquiries Invited.
Model EAP 2, with similar specification, is available for use with the MOTEK and LANE Tape Units.

Write for full details to:—

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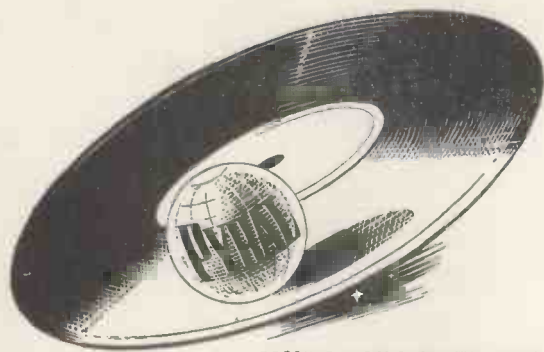
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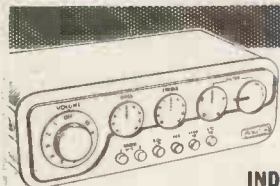
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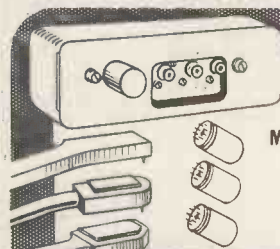
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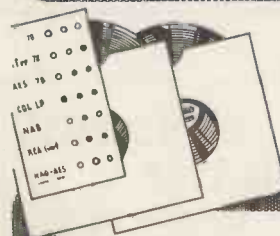
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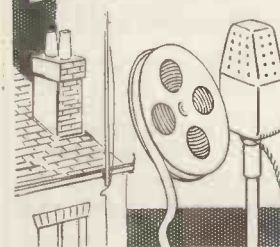
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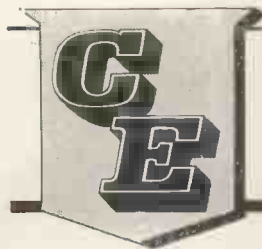
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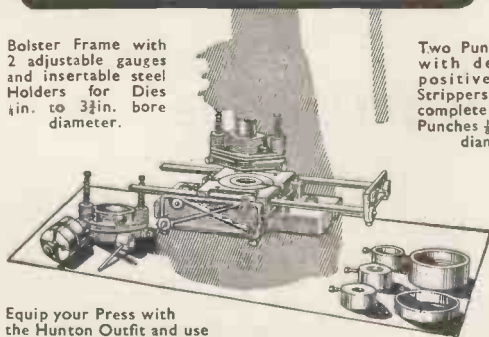
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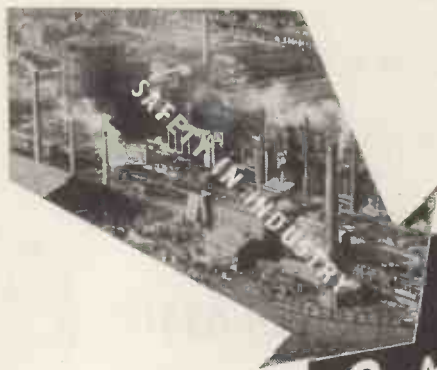
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- Fundamental Resonance 35 c/s
- Flux Density 14,000 gauss
- Nett Weight 12 lb. 13 oz.
- PRICE (Tax free) £10/5/6



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"Your model Axiom 150 loudspeaker has provided me with tremendous pleasure, and its performance has never been short of perfect. In my opinion, I think it is the finest over innumerable other speakers.

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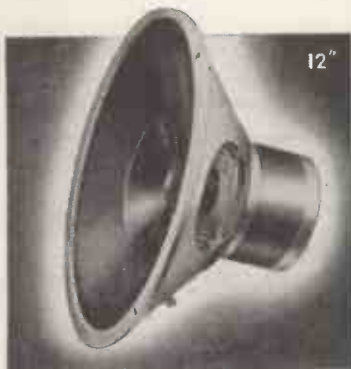
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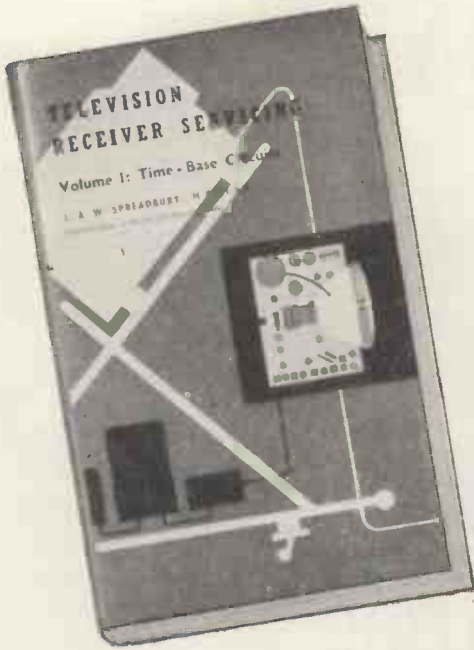
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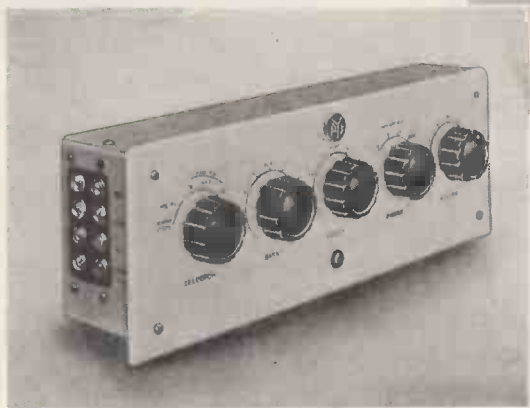
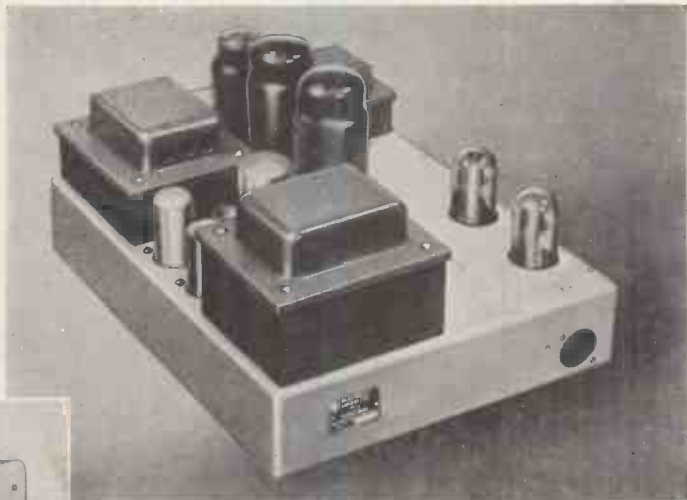
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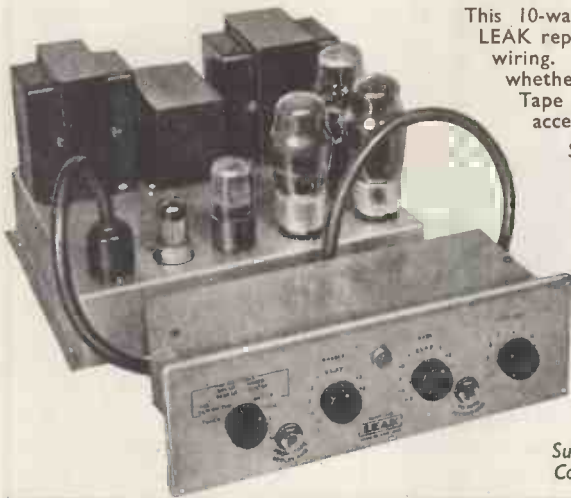


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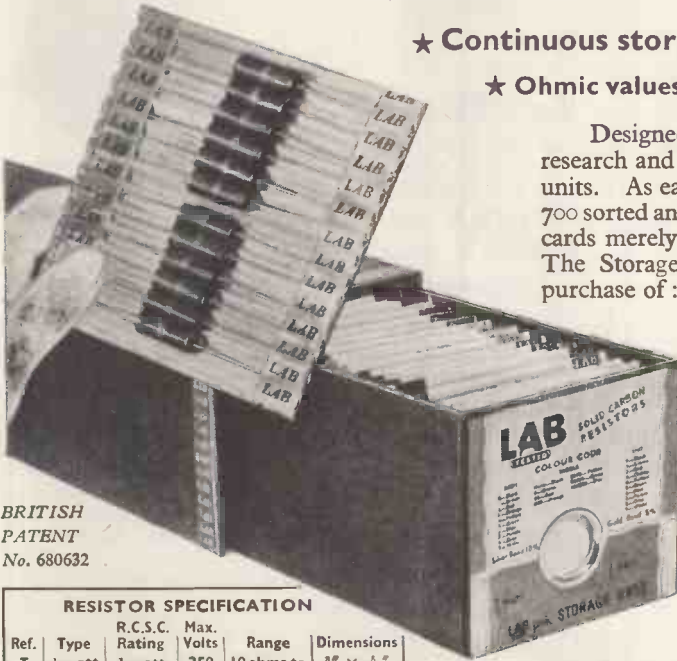
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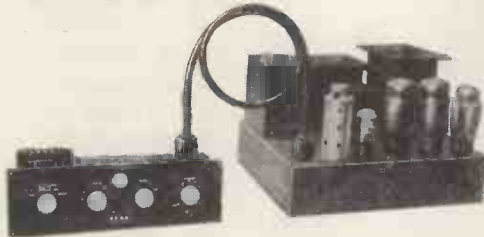
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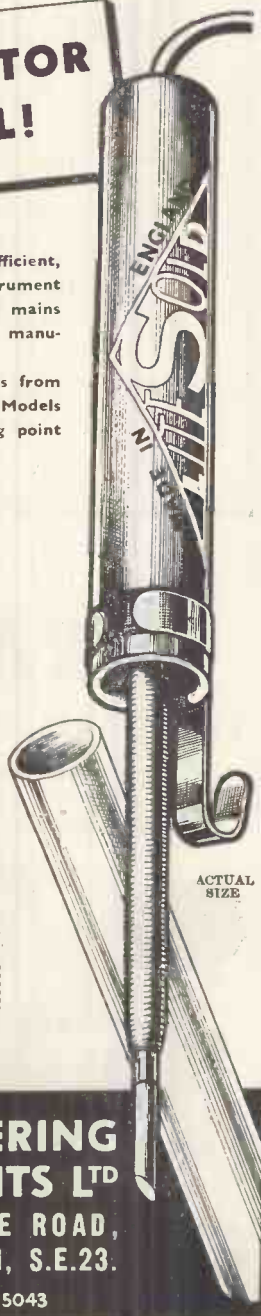
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The unit is directly interchangeable with the RD JUNIOR MK. II pre-amplifier, so enabling its use with the RD BABY de-luxe MK II main amplifier, the pair presenting a performance which at £29 is quite unsurpassed by anything at present on the market.

The RD SENIOR Control Unit has however been primarily designed for use with the new RD SENIOR Main Amplifier which is shortly to be introduced and full details of which will appear in our next month's advertisements. These two together provide a performance to satisfy the most exacting requirements and will, we believe, prove to be one of the finest designs so far introduced in this country.

Many unique features have been incorporated in the design and may be summarised as follows: ★ As well as a two position Low Pass Filter a High Pass Filter (Motor Rumble Filter) has also been included, so that for the first time in a unit of this price class, both ends of the scale are under complete control. ★ Comprehensive record compensation is provided which together with the filter and tone controls enables optimum results to be obtained from practically any records that are likely to be encountered, from pre-electric recordings to the latest L.P.s.

★ A microphone and two radio inputs are also provided, so that an alternative radio source such as FM or TV may be used if desired. ★ Input and Output jacks have been fitted on the front panel, so providing means of using the unit with all its facilities both for tape recording and playback through your Hi Fi system. ★ All Filters and Tone Controls operate on all inputs and all are completely independent of one another. ★ The frequency response of the unit is rapidly attenuated below 25 cps. and above 20 kcs., so providing a cleaner aural performance by eliminating sounds beyond the audible range. ★ A constructional feature which has never before been seen on a unit of this nature is the use of translucent material for the engraved control panel. This is evenly illuminated from behind so that when the unit is switched on the control markings themselves stand out clearly, enabling the unit to be operated in subdued lighting. ★ By the use of specialised construction and the inclusion of the new Mullard EF86 valve, hum and noise have been reduced to negligible proportions. A totally enclosed construction is used all inputs being provided with co-axial sockets.

★ The input sensitivity is extremely high, averaging 6 mV on LP and thus enabling the majority of pick-ups to be used without a matching transformer. ★ Close tolerance high stability components are used throughout, ensuring a stable and accurate performance.

PRICES :

RD SENIOR Control Unit, with translucent panel and connecting lead	£15 0 0
RD SENIOR Control Unit, with RD BABY de-luxe MK. II amplifier	£29 0 0.
RD SENIOR Control Unit and Main Amplifier	£43 0 0

A leaflet describing the SENIOR Control Unit in great detail will gladly be forwarded post free on request. Available from leading dealers in London and the Provinces, or if in any difficulty, please apply direct.

Trade and Export enquiries invited.

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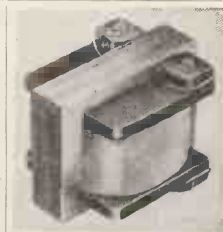
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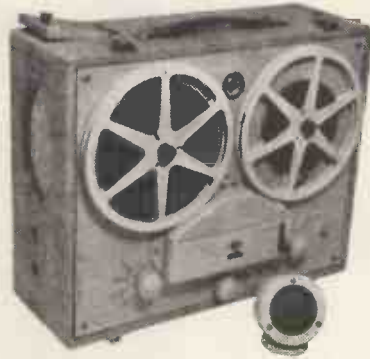
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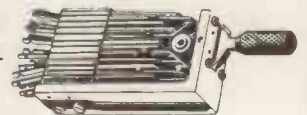
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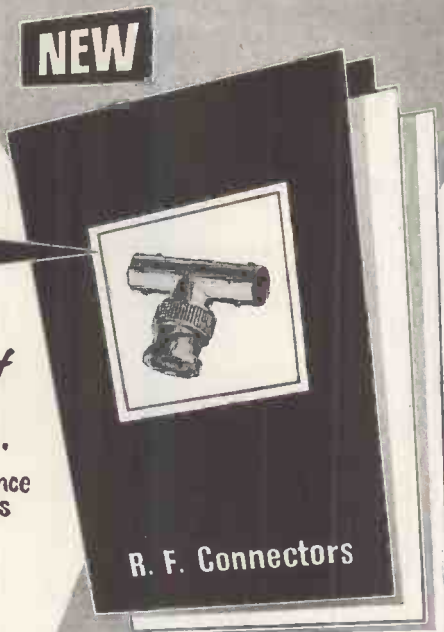
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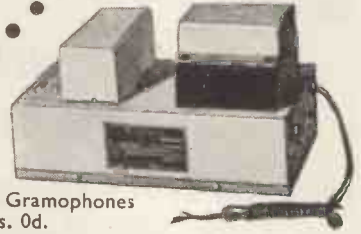


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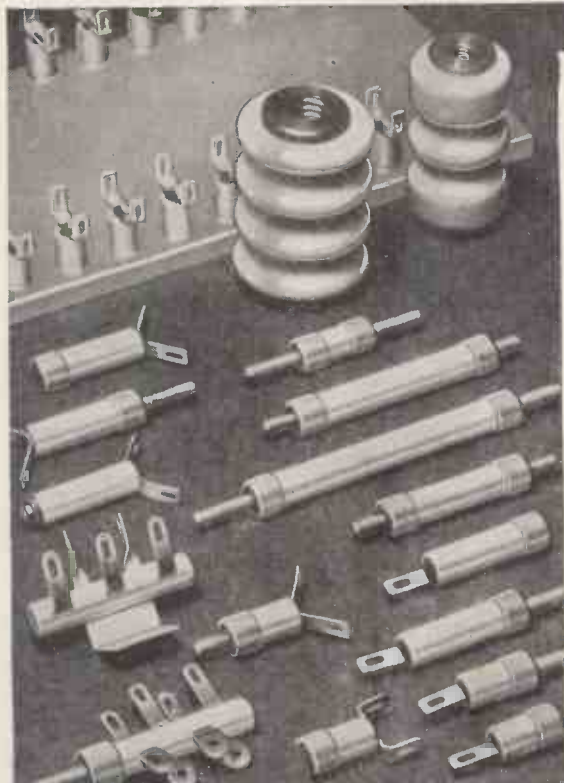
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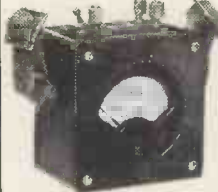
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PLEASE NOTE Carriage and Postal charges refer to the U.K. only. Overseas freight, etc., extra.

EX-R.N. LOUD HAILER MADE BY ARDENTE, 10/15 WATTS OUTPUT.

Comprises 4 valve 3-stage amplifier. Carbon Hand Mic. and bell shaped power projection loudspeaker. With instruction book, less accumulator, designed for 12 v. D.C. input. A FEW ONLY.
ASK FOR **£25.0.0** each CARRIAGE PAID
X/H948

I.F.F. RECEIVER R3109, REF.: 10DB/506

Contains: Motor Generator input 24 v., 1.8 a., D.C. output 480 v., .04 a. D.C. with a gearbox operating a switching mechanism to detune the receiver at time intervals. Plus: 4/VR65A (SP41), 2/VR92 (EA50), 2/CV6 (Det. 20) Valves, etc. Metal case dim.: 12in. x 12in. x 8in. Wgt. 24lb.
ASK FOR **19/6** each CARRIAGE PAID
X/H961A

BRAND NEW. INDICATOR UNIT TYPE 305. REF. 10QB/6504

Contains: VCR524A-VCR525, 7 EF50, 2 VR54, 6.3 volts 5 amps., 0-210 volts 14mA. 0-460 volts 200 mA. Size: 5 1/2in. x 5in. x 4 1/2in. or 5in. x 4 1/2in. x 4in.
ASK FOR **£4.19.6** each CARRIAGE PAID
X/H943

MAINS TRANSFORMER

Primary 0-230-250 volts A.C. 50 cycles, Secondary 6.3 volts 5 amps., 0-210 volts 14mA. 0-460 volts 200 mA. Size: 5 1/2in. x 5in. x 4 1/2in. or 5in. x 4 1/2in. x 4in.
ASK FOR **13/6** each POST 1/6 EXTRA
X/E527

SUPPLY UNIT RECTIFIER FOR NO. 43 TRANSMITTER

Ex-Canadian Army in original wood case. Input 110 volts A.C. 50/60 c/s, 1.7 kVA. Output (HT1) 2,100 v. 375 mA. (HT2) 500 v. 400 mA. plus HT lines, 450 v. 265 v. also 383 v., regulated and neg. bias 250 v. 150 v. 80 v. Making 3 complete power supplies all fed via double choke condenser. Input circuits. Valves are 4/866A/866, 5Z3, 6SJ7, 2/6A3, VR150/30 (Stab) and IV. (Time delay). The complete unit mounted in metal case with lid shock mounted. Dim.: 2ft. 6in. x 1ft. 6in. x 1ft. Finish Olive Drab. Wgt. 420lb.
ASK FOR **£25.0.0** each CARRIAGE PAID
X/H26

CHOKO. Adm. Patt. 1800, 20H., 300 m/s. Test volts 3,000. Wgt. 14lb. Dimensions: 6 1/2in. x 4 1/2in. x 4 1/2in.

ASK FOR **15/-** each POST 1/6 EXTRA
X/H45

BC-456 SPEECH MODULATOR UNIT

Part of SCR-274-N "Command Equipment" U.S.A., with valves, less dynamotor. In original carton.
ASK FOR **27/6** each POST PAID
X/E42A

Also BC-456, as above, but loose stored.

ASK FOR **17/6** each POST PAID
X/E42

RI155 Receiver Unit. Reconditioned and Tested, used, good condition. In Transit Case.

ASK FOR **£8.19.6** each CARRIAGE PAID
X/H916
Also RI155 as above, but loose stored.
ASK FOR **£5.19.6** each CARRIAGE 7/6 EXTRA
X/H898
Circuit and Data 2/3

Receiver Unit Type 25, Ref.: 10P/1L. Part of TR1196. Range 4.3-6.7 Mc/s.

ASK FOR **35/-** each POST PAID
X/H299

WS-18 Receiver Chassis, with valves.

ASK FOR **25/-** each POST PAID
X/H22
Circuit and Data 2/3

WS-18 XMTR/RECEIVER CHASSIS

Partly stripped by the M.O.S.
ASK FOR **33/6** each CARRIAGE PAID
X/H349
Circuit 4/6.

TRANSMITTER TUNING UNITS, Loose stored

TU7B. Range 4,500-6,200 Kc/s. Ask for X/H29.
TU8B. Range 6,200-7,700 kc/s. Ask for X/H30.
TU9B. Range 7,000-10,000 kc/s. Ask for X/H467.
EITHER **10/-** each CARRIAGE 2/- EXTRA
UNIT

AMPLIFIER A1368, for battery operation. Less valves.

ASK FOR **4/6** each POST 6d. EXTRA
X/E898
Circuit 1/3.

ROTARY CONVERTER TYPE 195

Input 24 volts D.C. Output 230 volts A.C. 100 watts.
ASK FOR **£5.19.6** each CARRIAGE PAID
X/H914

F24 AIRCRAFT CAMERA

With Sin. f/4 lens.
ASK FOR **£4.19.6** each CARRIAGE PAID
X/H302

Order direct from:—
CLYDESDALE SUPPLY CO. LTD. 2, BRIDGE STREET, GLASGOW · CS.
Phone: South 2706/9.

You're SURE to get it at

STERN'S

ESTABLISHED 25 YEARS

**FOR HOME
CONSTRUCTORS
A 5 VALVE
3 WAVEBAND
SUPERHET RECEIVER
for £10/10/-**

For use on A.C. Mains 200 to 250 volts. The following are outstanding features:

- A superhet circuit designed for high efficiency on all three wavebands.
- A 3 1/2 in. P.M. speaker accurately matched for good quality reproduction.
- The latest range of new 6-volt B.V.A. miniature valves.
- Built-in frame aerial with provision for external aerial for distant stations.
- A white plastic cabinet of very attractive appearance, overall size 7 1/2 in. x 5 1/2 in. x 5 1/2 in.

Send 2/6 for the fully descriptive stage by stage assembly and wiring diagrams, with which complete price details are given.



A SPECIAL BARGAIN

GENUINE QUALITY EQUIPMENT AT A GREATLY REDUCED PRICE.

- A 4 stage superhet feeder unit, incorporating an E.F. stage and covering Long, Medium and Short wavebands, fully assembled, aligned and ready for use and
- A quality push pull amplifier also fully assembled and ready for use and
- A matched high fidelity 10 in. W.B. Stentorian "Cambric Coned" P.M. Speaker.

FOR ONLY 22 GNS.



BRIEF SPECIFICATIONS:

(A) FEEDER UNIT. Complete up to and including Audio stage, A.V.C. being applied to both I.F. and E.F. stage. Incorporates a "Magic Eye" tuning indicator and a Gram position on the wavechange switch. A separate Tone Control is provided on a "Flying Lead." Valve line up, 3F39, ECH35, EF39, and EBC33. Overall size of unit 8 in. x 8 in. x 9 1/2 in. high. Glass dial 8 in. x 6 in. (aperture required 6 in. x 5 1/2 in.). An escutcheon is supplied.

(B) A quality PUSH PULL AMPLIFIER designed and matched for use with the above feeder unit. Has two EL35s in push pull to produce maximum 8 watts, and an EBC33 as phase inverter. Incorporates power supplies for both units, and provides for high impedance Pick Ups. Overall size 11 in. wide x 11 in. x 7 in. high. THIS EQUIPMENT IS ABSOLUTELY NEW and is supplied ready for immediate use. Send S.A.E. for complete details.



**CONSTRUCTORS say
"IT'S STILL THE BEST MAINS or
BATTERY PORTABLE SET"**

A Midget 4-valve Superhet Portable covering medium and long wavebands. Designed to operate on A.C. mains 200/240 volts or by an "Alldry" battery. The set is designed so that the main section can be supplied as a separate unit, and can be added at any time. The set supplied as an "Alldry" battery Superhet can be accommodated in the attaché case illustrated (size 9 1/2 in. x 4 1/2 in. x 7 in.). This is attractively finished in lizard, maroon, dark green or blue rexine.

As a combined Mains/Battery Superhet Portable a polished cabinet is available to accommodate both Mains Unit and Batteries. Circuit incorporates delivered A.V.C. and selective Audio Feedback. The Set is complete in every detail and includes ready-wound frame aerials, fully aligned I.F. transf. and drilled chassis, etc. Overall size of assembled chassis 8 in. x 4 in. x 2 1/2 in. This receiver, as illustrated,

can be completely built for approx. £10 (plus Mains Unit if required). Send 1/9 for the fully descriptive Assembly Book which includes Practical Layouts and complete Price list of Components. Attaché case available separately, 3/7/6.

A COMPLETE KIT OF PARTS TO BUILD A 3-4 WATT HIGH GAIN AMPLIFIER

For operation on

A.C. or D.C. Mains, 200-250 volts. This amplifier will give 3 watts output for the small input voltage of only 75 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H/F Magnetic type.

A tone control is incorporated and the quality produced is excellent. The overall size of chassis is 9 in. x 5 in. x 7 in. and valve line-up 25Y5-baH7-25L6. Price of complete kit, including drilled chassis and valves, £4/2/6, plus 6 in. P.M. (which fits on chassis), 18/-, or 8 in. P.M., 18/9.

Price of fully assembled chassis ready for use, £5/5/- (plus cost of speaker).

Copy of assembly instructions and components price list available for 1/3.



AN AMAZING OFFER! A COMPLETELY ASSEMBLED 4 VALVE T.R.F. CHASSIS

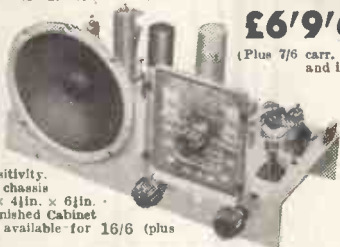
Including a 5 in. P.M. SPEAKER and VALVES

FOR ONLY

£6/9/6

(Plus 7/6 carr. and ins.)

This receiver is of the very latest design and is for use on A.C. or D.C. Mains. It covers both Long and Medium Wavebands, and includes the modern BVA miniature valves. The line up being 12 BA6-12AB6-12AC6-35W4. It incorporates Permeability Tuned Coils, thus ensuring excellent selectivity and sensitivity. The overall size of the complete chassis including speaker is 10 1/2 in. x 4 1/2 in. x 6 1/2 in. An attractive Bakelite Ivory finished Cabinet size 11 1/2 in. x 5 1/2 in. x 6 1/2 in. is available for 16/6 (plus 2/6 carriage and insurance).



"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build Midget "Alldry" Battery Eliminator, giving approx. 60 volts and 1.4 volts.

This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 60 volts.

The Kit is quite easily and quickly assembled and is housed in a light aluminium case size 4 1/2 in. x 1 1/2 in. x 3 1/2 in. Price of complete Kit with easy-to-follow assembly instructions, 42/6. In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled unit 7 in. x 2 1/2 in. x 1 1/2 in. Price 47/6.

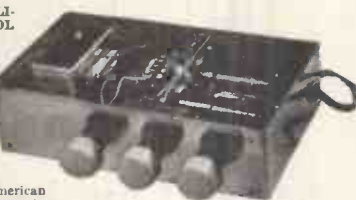


DUAL-CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides a full control of bass and treble in conjunction with a main Volume/Mixer Control.

It can be used with any amplifier and with any pick-up, the range of frequency control provided by the unit affording ample compensation for all types of pick-up and all natures of recordings, i.e., English, American and long-playing, without recourse to pick-up correction. The extreme flexibility of the bass and treble control is such that the level of bass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier advt.

The unit measures only 7 in. x 4 in. x 2 in., including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price including drilled chassis, valves (68N1 and 6J5), £3/16/9. Complete assembly data are available separately for 1/-. Completely assembled and ready for use, £5/5/-.



The DENCO M.T.O.I. Modulated Test Oscillator £3/15/-

(Plus 2/- carr. and ins.) Has Frequency range continuously variable from 170-475 Kc/s. and 550-1,600 Kc/s. Battery operated and thereby completely self contained.

BATTERY PORTABLE

THE "MINI TWO-THREE"

An "Alldry" Battery Portable of midget size, 6 1/2 in. x 4 1/2 in. x 3 1/2 in. designed to cover medium waveband 190-550 metres, with use of short trailer aerial.

The simple design of this Receiver is so arranged that either a 3-valve set or a 2-valve (afterwards easily converted to the 3-valve) can be made.

Consists of a T.R.F. circuit using a regenerative detector with H.F. stage and a high gain output pentode. Valve line up 1T4-1T4-D124.

The 2-valve set can be completely built for £4/3/6 (less case), and the 3-valve for £5/3/- (less case). Each price includes valves, speaker and drilled chassis.



Send 2/- for the assembly instructions; they include simple and complete practical component layouts and diagrams which enable the most inexperienced constructor to successfully build either set. All components are available for separate sale, a price list being supplied with assembly instructions.

A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR

11 1/2 in. x 4 1/2 in. x 3 1/2 in.

A design of a complete 5-VALVE SUPERHET RECEIVER employing an E.F. stage and incorporating a separate VIBRATOR PACK size 4 1/2 x 2 1/2 x 6 1/2 in. for use on 6 or 12 volt D.C. supplies.

We can supply all components to build this complete Receiver and Vibrator Pack including a Metal Case, Valves, Drilled Chassis and 5 in. P.M. Speaker for £12/19/6. (Carr. and Ins. 5/6 extra.) Or the receiver Components for £9/19/6 and the Vibrator Component for 2/.

This is NOT an EX-GOV'T. Receiver, it is a new design employing new Components. Send 2/8 for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and PRACTICAL LAYOUTS, including a complete individual Component Price List.



THIS IS A STERN'S ADVERTISEMENT

Constructors everywhere are amazed!

AT THE EXCELLENCE OF

The **"TELE-VIEWER"**

5 CHANNEL TELEVISOR
DESIGN OF A COMPLETE 12" SUPERHET T.V. RECEIVER

PERFECT PICTURE QUALITY
SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY

PERFECT FRINGE AREA RECEPTION
BETTER RECEPTION AT HALF COMMERCIAL COST



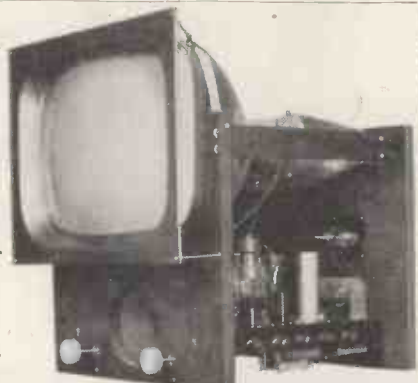
This complete TELEVISOR including all Valves, can be built for only **£28/16/4** (Plus cost of C.R.T.)

- Here are some of the features which combine to make this such a fine receiver.
- The Superhet circuit easily tuned to any of the five channels, i.e., LONDON, SUTTON COLDFIELD, HOLME MOSS, WENVOE and KIRK-O-SHOTT'S. (The extreme ease of tuning is accomplished by the provision of pre-aligned I.F.T.s.)
 - A liffelike, almost stereoscopic, picture quality made possible by the following factors:
 - a. Excellent band width of I.F. circuits.
 - b. A really efficient video amplifier.
 - c. C.R.T. Grid modulated from low impedance source.
 - d. High E.H.T. voltage (approx. 10 kV.).
 The picture brilliance is also much above the average and enables comfortable viewing with normal room lighting or daylight.
 - FIRM picture "HOLD" circuits (Frame-Line) ensures a steady picture, free from bounce or flicker even under the most adverse conditions met with in "fringe" areas and excellent "interlace" ensures the absence of "liney effect."
 - Negative feedback is used in the audio frequency circuits which provide 2/3 watts of High Quality Sound.
 - Entire receiver built on two chassis units each measuring 14½" x 6½" x 3½".

- Rigid C.R.T. mounting enables entire receiver to be safely handled with tube in position.
- All pre-set controls are mounted on side of chassis enabling all adjustments to be carried out whilst facing the C.R. Tube. As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage) thus enabling hire purchase interest rates to be avoided. The complete set of ASSEMBLY INSTRUCTIONS is available, price 5/-. The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE. A table-model cabinet is available at £6/19/6.

NOW available at **Stern's**
The **"WIDE ANGLE" TELE-VIEWER**

- A design that retains all the distinctive features of the 12in. Televisor but with increased Time Base efficiency, producing 15 to 16 kV. E.H.T., with ample scanning power for C.E. Tubes up to 17in.
- It can be completely built including supply of all valves for **£33** (plus cost of C.R.T.) and is as simple to construct as the 12in. model.
- This is the most efficient "WIDE ANGLE" large screen design yet offered to constructors, and yet it can be built for almost half the cost of similar designs.
- Complete assembly instructions, diagram, etc., available for 5/-.

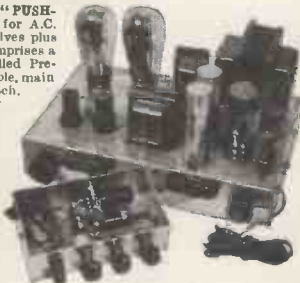


!! AMPLIFIERS !!
EASY TO BUILD KIT OF PARTS

A 4-VALVE QUALITY "PUSH-PULL" 6-8 watt AMPLIFIER for A.C. mains. Incorporating Negative Feedback. Filter Input Circuit and provided to enable either a magnetic-crystal or lightweight pick-up to be used, and is suitable for use with Standard or long-playing records. A tone control is incorporated, and the 10-watt output transformer is designed to match 2 to 15 ohm speakers. The overall size of the assembled chassis is 10in. x 8in. x 7½in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, **£8/17/6**. Price of assembled chassis, supplied ready for use, **£8/12/6**. Plus 5/- Carr. & Ins. Full descriptive leaflets are available separately for 1/-.



A 12-watt HIGH FIDELITY "PUSH-PULL" AMPLIFIER designed for A.C. mains 200 to 250 volts employs 6 valves plus rectifier with negative feedback, and comprises a main amplifier chassis and a remote controlled Pre-volume or mixing control, and a radio, gram, microphone, selector switch. This control unit measures only 7 x 4 x 2½in. The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 5 amps. and 30 mA. H.T. is provided for tuning unit, etc. Price of complete kit, including drilled chassis and valves, **£14**. Complete specification and layout, 2/-. We can also supply completely assembled and ready for use at **£17**. H.P. Terms (Assembled Chassis Only), **£5/13/6** Deposit and 12 months of **£1/1/4**. Plus 7/6 Carr. and Ins. **THIS AMPLIFIER COMPARES WELL WITH THE WILLIAMSON AND SIMILAR DESIGNS AT THE FRACTION OF THEIR COST.**



VARLEY HEATER TRANSFORMER
Input 200-250 volts. Output 4 14/9
volts (tapped at 2 volts) 5 amps. (1/- post.)

FILAMENT TRANSFORMER
6.3 v. 1½ a. 5/9
4 v. 1½ a. 5/9

SPECIAL OFFER
NEW C.R.T.s.

Unused 12in. C.R.T.s by one of the leading manufacturers. 6.3 volt heater, 7-9 kV. standard size. Supplied in maker's sealed cartons. **£12/19/6** (Plus 15/- Carr. & Ins.)

BRAND NEW C.R.T. MASKS
Latest aspect ratio for 12in. "Round" tubes, finished Ivory. **12/6** (Plus 1/- postage.)

HALF WAVE MAINS TRANSFORMERS
Primary 200/220, 220/240 volts.
Secondary 250 volts 50 mA.
6.3 volts 1½ amps. **16/9**
(Plus 1/- postage.)

SPEAKER BARGAINS

PLESSEY, 10in. 3 ohm V/coil	£1 5 0
TRUVOX, 12in. 3 ohm V/coil	£2 9 6
ROLA, 12in. 3 ohm V/coil	£3 19 6
BAEYERS, 12in. 15 ohm V/coil	£4 12 6
GOODMANS, 12in. 15 ohm V/coil	£5 5 0

(Carriage & Ins. 1/6 extra.)

THE NEW W. B. "STENTORIAN" HI FI SPEAKERS ARE IN STOCK

Model H.F. 6-inch	£2 10 6
Model H.F. 9-inch	£3 7 0
Model H.F. 8-inch	£3 0 8
Model H.F. 10-inch	£3 13 6

These speakers are of the very latest design and provide quality reproduction for the lower-price range. 3 or 15 ohm models are available.

RECEIVER CHASSIS

Modernise your old Radiogram

RECORD PLAYERS

COMPLETE RADIOGRAM EQUIPMENT—QUALITY AT LOW COST

THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

- Model B.3 A 5-valve 3-waveband Receiver.
- Model B.3.P.P. A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.
- Model B.3.P.P./R.F. A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The three Receivers are for operation on A.C. mains 100/200 volts and 200/250 volts, and employ the very latest miniature valves. They are designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram. and radio, making them the ideal replacement chassis for that "old Radiogram," etc.

Brief specifications: Model B.3.—Valve line-up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4—waveband coverage short 16-50 medium 187-550, long 900-2,000 metres. Controls: (1) volume with on/off; (2) tuning (flywheel type); (3) wavechange and gram.; (4) tone (3-position switch operative on gram. and radio). Negative feedback is employed over the entire audio stages. Chassis size: 11 x 7½ x 8½ in. high. Dial size 8½ x 4½ in. Price complete and READY FOR USE, excluding speaker, £12/12/- (carr. and Ins. 7/6 extra).

H.P. Terms: £4/4/- deposit, 12 months at 15/9. Model B.3. P.P. This model is the B.3 Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price £15/15/- (plus 7/6 carr. and ins.) or £5/5/- deposit, 12 months at 19/8. Model B.3. P.P./R.F. This model is similar in appearance and has same waveband coverage as the Model B.3, but in addition it incorporates an R.F. STAGE together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6BW6 in Push-Pull. This makes for a really sensitive receiver with genuine quality reproduction. Price £18/18/- (plus 7/6 carr. and ins.) or £6/6/- deposit, 12 months at 23/7.

This AUTOCHANGE UNIT by a famous Manufacturer is offered for £11'14'6 (Plus 7/6 Carr. and Ins.)

Hire Purchase Terms £3/17/6 Dep. and 11 Months at 16/- (Normal price is £16/10/-)

- These units will autochange on all three speeds, 7in., 10in. and 12in.
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 14in. x 12½in., with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.



The COLLARO 3RC/521 3-SPEED AUTO CHANGE UNIT £9'19'6 (Plus 7/6 Carr. and Ins.) H.P. Terms £3/6/0 Deposit and 10 months at 15/-

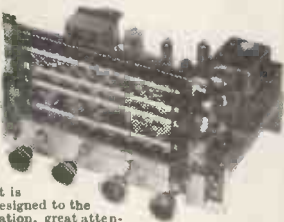
Normal price £18/10/-

- Complete with High Fidelity Crystal "Turnover" Head which incorporates separate stylus for L.P. and 78 r.p.m. Records.
- Will autochange on 7in., 10in. and 12in. records not inter-mixed.
- Minimum Base plate size 15in. x 12½in., with height above 4½in. and below baseplate 3in.
- Brand new in Maker's Cartons, complete with Mounting instructions.



A NEW DESIGN FOR HOME CONSTRUCTORS The STERNS "SUPER SIX"

A compact and highly efficient Superhet Radio—Badiogram Chassis of outstanding quality, far above any other design yet offered to the HOME CONSTRUCTOR. YOU can build it for



£10/7/6

- It is designed to the very latest specification, great attention having been paid to the quality of reproduction which gives excellent clarity of speech and music on both radio reception and record playing. A few brief details:—
- Covers 3 Wavebands 16-50 metres, 190-550, 800-2,000 metres
- Employs 6 Valves having PUSH-PULL for 6-watts OUTPUT
- DELAYED A.V.C. on all WAVEBANDS.
- PRE-SELECTIVE FEEDBACK.
- 4 POSITION TONE CONTROL.
- REAL QUALITY ON BOTH RADIO AND GRAM.
- PROVIDES INDEPENDENT MAINS SUPPLY FOR RECORD PLAYER (if required).
- FOR A.C. MAINS SUPPLY 200-250 Volts, 50 Cycles.
- Size of assembled CHASSIS 12in. long x 8in. x 8in. Dial Aperture 8½in. x 4½in.

THE ASSEMBLY MANUAL IS AVAILABLE FOR 2/-. This gives very detailed practical drawings and layouts and includes a component price list. THE COMPLETE RECEIVER CAN BE BUILT FOR £10/7/6 with the OCTAL VALVE LINE UP or for £12/7/6 with Miniature Valves.

A Replacement RADIO-RADIOGRAM CHASSIS

- MODEL AW3-5. A 5-Valve Superhet Receiver covering the standard 3 wavebands, 16-50, 190-550, 900-2,000 metres. PRICE COMPLETELY ASSEMBLED AND READY FOR USE £10'10'-. (plus 7/6 carr. and ins.)

H.P. Terms £3/10/- Deposit and 10 Months at 15/9. This receiver is for operation on A.C. Mains 200-250 volts. It contains the latest MULLARD VALVE LINE UP, being ECH42 (Freq. Ch.), EF41 (I.F.), EBC41 (Det. 1st Audio), EL41 (Output) and EZ41 (Rect.). It incorporates Negative Feedback and delayed A.V.C., the four controls being (1) Tuning, (2) Wavechange and Gram. Switch, (3) TONE, (4) VOLUME-OFF. It provides really good reproduction on both Gram. and Radio and gives an exceptionally good range of station selection. Overall size 13½in. x 7in. high x 8in. deep. Dial aperture 10in. x 4½in.



SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY

Select a RECORD PLAYER and CHASSIS, and we will supply it TOGETHER WITH AN 8inch or 10inch P.M. SPEAKER as follows:

	CASH PRICE	DEPOSIT	MONTHLY
THE £11/14/6 AUTOCHANGER WITH A SPEAKER AND —			
(a) With Model B.3 Chassis	£25	£8/8/8	12 of £11/1/3
(b) " " B3PP/RF	£28/4/-	£9/8/-	12 of £11/5/3
(c) " " Super Six (Assembled chassis only)	£31/7/-	£10/9/-	12 of £11/9/2
(d) " " AW3-5	£28/4/-	£9/8/-	12 of £11/5/3
(e) " " AW3-5	£22/19/-	£7/13/6	12 of £11/8/8
THE COLLARO AUTOCHANGER MODEL 3RC/521 WITH A SPEAKER AND —			
(a) With Model B3 chassis	£23/6/-	£7/15/6	12 of £11/9/2
(b) " " B3PP	£26/9/-	£8/16/6	12 of £11/13/1
(c) " " B3PP/RF	£29/12/-	£9/17/-	12 of £11/17/0
(d) " " Super Six (Assembled chassis only)	£28/9/-	£8/16/6	12 of £11/13/1
(e) " " AW3-5	£21/4/-	£7/1/4	12 of £11/6/6
THE COLLARO 3-SPEED UNIT MODEL 3/514 WITH A SPEAKER AND —			
(a) With Model B3 chassis	£21/9/-	£7/3/4	12 of £11/6/6
(b) " " B3PP	£24/9/-	£8/3/6	12 of £11/10/1
(c) " " B3PP/RF	£27/12/-	£9/4/-	12 of £11/14/6
(d) " " Super Six (Assembled chassis only)	£24/9/-	£8/3/6	12 of £11/10/1
(e) " " AW3-5	£19/4/-	£6/8/-	12 of £11/4/0

An Additional Charge of 10/- is made in each case to cover Carriage and Insurance.

The COLLARO MODEL 3/514 3-Speed Non-Auto Change Unit

£7'19'6 (Plus 6/- Carr. and Insur.) Normal Price £12/17/6

- Complete with High Fidelity Crystal "TURNOVER" Head which incorporates a separate stylus for L.P. and Standard Records.
- Will play 7 inch, 10 inch and 12 inch Records.
- Brand New and Complete with mounting instructions.



When submitting orders, please include post and packing

STERN RADIO Ltd. 109 & 115, FLEET STREET, E.C.4

Tel.: CENTRAL 5812-3-4

SPECIAL PURPOSE VALVES.

EF8, 8/8; 6G6G, 6/6; 9004, 8/3; VR136, 7/-; VR56, 3/9; VUPDA, 3/8; 9002, 6/3; VR53, 7/6; VR91, 6/-; 807, 8/-; 5Z3, 8/6; 6Y6G, 8/-; 955, 4/-; TT11, 6/8; VR116, 4/-; VR56, 7/-; 954, 2/-; CV71, 1/-; VR137, 5/-; VR55, 7/3; VT105, 4/-; 2T15, 2/-; 83AT, 9/-; ATF4, 6/9; VU111, 3/6; 9001, 6/3; VU39, 8/6; VR65A, 3/8; 956, 3/8; 2X2, 5/8; VR55, 3/8; 6887, 8/-; 1A5GT, 7/6; 6877, 8/-; 7Q7, 8/6. 220V5G, 6/9.

MAINS TRANSFORMERS

3-way Mounting Type.

MTL. Primary 0-210-230-250 v. Secondary, 250-0-250 v. 80 mA., 6.3 v. 4 amps., 5 v. 2 amps., with taps at 4 v. on filament winding. Price 17/6 each.

MT2. Primary 0-210-230-250 v. Secondary, 250-0-250 v. 80 mA., 6.3 v. 4 amps., 5 v. 2 amps. Both filament windings tapped 4 v. Price, 17/6 each.

MT3. 30 volt 2 amp. tappings as follows: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 v. 17/6 each.

CARDBOARD COVERED WIRE ENDED CONDENSERS

8 mfd. 500 v., 2/3 each. 16 mfd. 500 v., 3/6 each. 25 mfd. 25 v., 1/9 each. 50 mfd. 50 v., 2/3 each. 8 x 8 mfd., 500 v., 4/- each.

LOUDSPEAKER UNITS.

6 $\frac{1}{2}$ in. R. & A. 1500 Ω Field. Mains Encapsulated, 17/6. 8in. R. & A. or Plessey P.M. Type, 18/6 each. 10in. Plessey P.M. Lightweight, 19/6 each. 10in. Rola Type Z10DB, 26/6 each. 6 $\frac{1}{2}$ in. Truvox Water unit 14in. deep, 20/-; Plessey 5in. at 13/3. Etc. 6 $\frac{1}{2}$ in. at 14/6. Etc. 10in. at 22/6.

CONDENSERS. STANDARD CAN TYPES. ALL BY WELL-KNOWN MAKERS.

12 x 4 mfd. 450 v., 2/- each. 24 x 8 mfd., 350 v., 2/9 each. 16 x 8 mfd. 350 v., 3/6 each. 32 x 32 x 8 mfd. 350 v., 6/9 each. 32 x 32 mfd. 350 v., 25 mfd. 25 v., 6/8. 64 mfd. 350 v., 2/- each. 16 x 16 mfd. 350 v. 2/9 each. 20 x 20 mfd. 600 v. 4/3 each. 32 x 16 mfd. 350 v., 3/9 each.

MIDGET CAN CONDENSERS.

8 mfd. 500 v., 3/6 each. 250 mfd. 12 v., 1/9 each. 8 mfd. 350 v., 1/1 each. 100 mfd. 25 v., 1/9 each. 16 x 16 mfd. 450 v., 4/6 each.

VOLUME CONTROLS

WIRE WOUND CONTROLS
50 Ω ; 200 Ω ; 2K Ω ; 5K Ω ; 10K Ω ; 10K Ω Double; 25K Ω ; 20K Ω ; 50K Ω ; 30K Ω ; all 2/4 each.
COLVERN CLR901, 1,000 Ω , 1/9 each.

CONTROLS WITH DOUBLE POLE SWITCH

25K Ω ; 2 Meg Ω ; $\frac{1}{2}$ Meg Ω ; 1 Meg Ω ; LOG; $\frac{1}{2}$ Meg Ω ; 1 Meg Ω ; 60K Ω ; 20K Ω ; all at 3/9 each.

EX-GOV. CONTROLS, ALL CARBON TRACK

500 Ω ; 600 Ω ; 1,500 Ω ; Double type; 2K Ω ; 5K Ω ; 10K Ω ; 20K Ω ; 25K Ω ; 50K Ω ; 200K Ω ; 100K Ω ; 100K Ω ; $\frac{1}{2}$ Meg Ω ; 1 Meg Ω ; 1 Meg Ω ; 2 Meg Ω ; 25K Ω Double type; 50K Ω Double type, 1/2 each.

VOLUME CONTROLS, SINGLE POLE SWITCH

500 Ω Wire Wound, 2/10 each. 5K Ω ; 10K Ω ; 100 K Ω ; $\frac{1}{2}$ Meg Ω ; 1 Meg Ω LOG; 1 Meg Ω ; 1 Meg Ω ; 1 Meg Ω LOG; 2 Meg Ω ; all 3/9 each.

STANDARD CONTROLS, LESS SWITCH

50K Ω ; $\frac{1}{2}$ Meg Ω ; 1 Meg Ω ; all 2/6 each.

CLEM TRAVELLING IRONS. Suitable for all voltages 100/250 volts A.C./D.C. Supplied with flexible lead and bayonet cap adaptor. Ready for use. Price 21/- each, an ideal present.



LOUDSPEAKER CABINETS

Available for 6 $\frac{1}{2}$ in. and 8in. speaker units. Polished walnut finish. A very attractive cabinet at quarter of to-day's prices. Price, 6 $\frac{1}{2}$ in. Type Cabinet, 15/6 each. Price, 8in. Type Cabinet, 19/6 each.

RECEIVER 1132A

Contains EK32; 4 EF39; 6H6; 6J5; 3 SP61; P61 in good condition. Fitted with tuning meter. Slow-motion drive calibrated dial complete with circuit diagram. 49/8 each. Carriage and packing 7/6.

HAND MICROPHONE BY "REAGENT"

complete with screened lead and plug—Crystal insert, nickel chrome plated head, listed at 2 gns. Our price, 21/- each.

VALVE HOLDERS

AMPENOL MOULDED TYPES
Octal 6d. each, B7G, 9d. ea.; B8A, 9d. ea.; British 5 pin, 1/- ea.; B9A, 9d. ea.
PAXOLIN TYPES
British 4 pin, 3d.; British 5 and 7 pin, 5d. ea.; UX 4pin, 6d.; UX 12 pin, 6d. ea.; Loctal, 31d. ea.

MOULDED BAKELITE H.V. CONDENSERS

.1 mfd. 1,000 volts, 1/ each. .01 mfd. 4 kV, 1/8 each. .001 mfd. 4 kV, 1/ each. .001 mfd. 6 kV, 3/8 each.

METAL RECTIFIERS

FULL WAVE.
12 volts 1 amp., 4/9. 12 volts 2 amps., 8/- . 12 volts 3 amps., 13/9. 12 volts 5 amps., 18/6.
HALF WAVE.
2 volts 1 amp., 3/- . 12 volts $\frac{1}{2}$ amp., 1/6. 250 volts 45 mA., 6/9. 250 volts 76 mA., 7/6. 300 volts 60 mA, 7/6.

HEADPHONES

Type CLR 120 Ω , 7/6 pair. Type CHR, 4,000 Ω , 11/- pair. Type DHR, 13/9 pair. AMERICAN PHONES. 1,200 Ω , each ear-piece 13/6 pair. HEADBANDS WIDE TYPE, 1/9 each.

THE IDEAL CABINET FOR ALL MIDGET RECEIVERS



Complete with drilled chassis, dial, back plate, pointer, dial drive and drum, etc. Price 27/6. Post 2/-.

ELECTRON TRANSFORMERS.

Type LV9
Ratio 1/1.25 giving 25% boost on tube heater. Capacity between windings 16 pF. Secondary to frame, 6 pF. Suitable for High Definition Receivers.

LV9/A 2 volts 19/6 ea.
LV9/C 6.3 volts 13/6 ea.
LV12. A low capacity Heater Transformer with mains input and universal output. Suitable for use with all C.R. Tubes. In medium definition receivers. Input 0.220-240 volts. Boost 1-Boost 2. Output 0, 2, 4, 6.3, 7.3, 10, 13 volts. Price 22/9.

O.P.A. Dual purpose 12-watt output transformer. Primary tapped for 2-6V6 or 2-6L6 in Push-Pull. Secondary, 3, 8, 15 ohms, 23/6 each.

SPECIAL OFFER CO-AXIAL CABLE

Best quality grade "A" cable solid 1/822 70 ohms, 7jd. yd.
Best quality Grade "A" cable stranded 7/0076, 8jd. yd.
Best quality Grade "A" cable air spaced 1/036, 1/- yd.

HALF WAVE 1 MA PENCIL RECTIFIERS

K3/25 685 V 5/8
K3/40 4kV 7/6
K3/45 1.140 KV 8/2
K5/90 1.260KV 8/8
K5/10 1.5KV 10/6
K3/100 2.550 KV 14/8

STANDARD S.T.C. RECTIFIERS.

RM1 125V 60ma 3/11 each
RM2 125V 80ma 4/3 each
RM3 125V 100ma 6/- each
RM4 250V 250ma 16/- each

IRON LEADS suitable for all modern types of flat irons, standard length, bonded ends, 1/3 each.

PORTABLE RECORDING CASES.

Rexine covered. (Ready for carrying 15in. x 9 $\frac{1}{2}$ in. x 13 $\frac{1}{2}$ in.). Internal dimensions, 14in. long, 11 $\frac{1}{2}$ in. deep, 5 $\frac{1}{2}$ in. front height, 8 $\frac{1}{2}$ in. rear height. Weight 8 $\frac{1}{2}$ lb. Price 13/6 each. Postage and Packing 2/-.

RECTIFORM BATTERY CHARGER. 12 and 6 volts 4 amps. Complete with fuse and meter. Changeover switch from 6 to 12 volts, in an attractive grey crackle cabinet, mains lead and output leads and two battery bulldog clips, 84/- each, carriage 2/6.

NS/12 VIBRATORS. 4 Pin UX, 12 V, 6/6 each. **MULTICORE SOLDER.** 60/40, swg 18, 5/- per cartan. **YAXLEY SWITCH.** 3 pole 3 bank 3 way, 1/8 each. **P.K. SELF TAPPING SCREWS.** No. 4 5in., 31d. doz. **LINE CORD.** 3 amp. 3 core, 1/6 per yd. **RUBBER GROMMETS,** mixed sizes, 6d. doz. **STANDARD ADAPTABLE IRON ELEMENTS,** 1/8 each. **BRASS SPINDLE COULERS,** 6d. each. **CERAMIC COIL FORMERS,** 5in. dia., 1 $\frac{1}{2}$ in. long, 4 ribs, 5d. each. **CRYSTAL DIODES,** 1/8 each. **EPICYCLIC FRICTION DRIVE** with brass drum for use with steel drive wire, 1/9 each. **BATTERY CHARGER BULLDOG CLIPS,** 3in. long, 6d. each. **AERIAL AND H.F. T.R.F. COILS,** with circuit 5/6 pair. 1 mfd. 250 v. A.C. CONDENSER, flexible leads, 1/3 each. **EX-CANADIAN ARMY EXIDE HYDROCELLS,** in case, 7/9 each. **RED AND BLACK WANDER PLUGS,** 1/6 doz. 3 amp. or 2 amp. **DROPPERS,** with sliders, 3/9 each. **VARNISHED COTTON SLEEVING,** 1 $\frac{1}{2}$ yd. **SINGLE STRAND P.V.C. COVERED WIRE,** various colours, red, green, blue, etc., 5/6 per 100 yd.

ENGRAVED KNOBS

1 $\frac{1}{2}$ in. dia. for 5in. splindles, available Cream or Brown as follows—
"Focus," "Contrast," "Brilliance,"
"Brightness," "Brilliance On/Off,"
"Wavechange," "On/Off," "Tuning,"
"Volume," "S.M.L. Gram,"
"Tone," "Vol. On/Off," "Radio Gram," "Bass," "Trebble," "Record-Play," Also Plain Knobs to match, 1/6 each.

ENAMELLED COPPER WIRE ON 1 LB. REELS.

14 S.W.G.	1/6 ea.
16 " " " " " "	1/8 " "
18 " " " " " "	2/1 " "
20 " " " " " "	2/2 " "
22 " " " " " "	2/7 " "
24 " " " " " "	2/9 " "
28 " " " " " "	2/11 " "
30 " " " " " "	3/1 " "
32 " " " " " "	3/3 " "
34 " " " " " "	3/5 " "
36 " " " " " "	3/7 " "
38 " " " " " "	3/11 " "
40 " " " " " "	4/2 " "

HEATER TRANSFORMERS

230 v. Input 2 volt 5 amp. 4/6
230 v. Input 2 volt 3.0 amp. 7/9
230 v. Input 4 volt 1.5 amp. 5/-
230 v. Input 4 volt 3.0 amp. 10/-
230 v. Input 5 volt 2.0 amp. 10/-
230 v. Input 6.3 volt .5 amp. 5/-
230 v. Input 6.3 volt 1.5 amp. 6/-
230 v. Input 6.3 volt 3.0 amp. 9/-
230 v. Input 12 volt .75 amp. 5/-
230 v. Input 6.3 volt 1.5 amp. and 5 volt 2 amp. 14/3

DIAL BULBS, ETC.

6.5 v. 1.5 15 mm. Ball
Type M.E.S. 61d. ea.
6.5 v., 3 A., 10 mm. Tubular
Type M.E.S. 84d. ea.
Car Headlamp or Spot Bulb.
6-7 volts, 15 watts 1/-
6 v., 3 A. M.B.C.T. 5d. ea.
6.5 v., 3 A. M.B.C.T. 5d. ea.
2.5 v. Empire Round 31d. ea.
2.5 v. Flashlight Empire Half
Opal 34d. ea.
3.8 v. Clear Spot Bulb 11
mm. 31d. ea.
2.5 v., 9 mm. Tubular 31d. ea.

ONE VOLT TYPE CARBON

1K Ω	150K Ω	330K Ω	620K Ω
1.5K Ω	2.5K Ω	39K Ω	69K Ω
15K Ω	27K Ω	35K Ω	60K Ω
1M Ω	200K Ω	47K Ω	68K Ω
2.5 v. 7 mm. Tubular	270K Ω	40K Ω	750 Ω
	12K Ω	290 Ω	47K Ω
	100 Ω	250 Ω	50 Ω
	100K Ω	350K Ω	6.5K Ω
	150 Ω	3.3K Ω	56K Ω
	1M Ω	390K Ω	68K Ω
	1.3Meg Ω	33K Ω	6K Ω
	1.5Meg Ω	30K Ω	6K Ω

All 6d. each.

RESISTORS ETC.

1/2 and 3 watt. Please note at this special price we send whichever rating is available at the time of despatch.

180K Ω	12Meg Ω	33K Ω	56 Ω
150 Ω	12K Ω	330K Ω	5K Ω
100 Ω	27K Ω	330 Ω	56K Ω
180K Ω	2.2K Ω	3.3K Ω	5.9K Ω
10Meg Ω	25K Ω	350 Ω	500K Ω
130K Ω	2.2Meg Ω	30K Ω	51K Ω
10K Ω	270K Ω	39K Ω	60K Ω
1.5K Ω	20K Ω	4.7K Ω	68K Ω
1.8Meg Ω	20K Ω	4K Ω	68K Ω
15K Ω	270K Ω	4K Ω	68 Ω
1.5K Ω	220K Ω	470 Ω	68K Ω
10K Ω	25K Ω	40K Ω	6.8K Ω
100K Ω	2.7K Ω	50K Ω	8.2K Ω
120K Ω	33 Ω	56Meg Ω	

All 3d. each.

TWO WATT RESISTORS CARBON

150K Ω 16K Ω 1Meg 500 Ω
270K Ω 20 Ω 6.8K Ω 680 Ω
8d. each.

FIVE WATT CARBON

$\frac{1}{2}$ Meg Ω 9d. each.



FOR SPEEDY DELIVERY

OR RETURN POST SERVICE

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 9d.; 20/- add 1/-; 40/- add 1/6; 75 add 2/- unless otherwise stated. Minimum C.O.D. fee and postage 2/3.

MAIL ORDER ONLY

ALPHA RADIO SUPPLY CO.
5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

WHEN ORDERING PLEASE QUOTE "DEPT. W.W."

R.1155 RECEIVERS

BRAND NEW AERIAL TESTED BEFORE DESPATCH

These well-known ex-Air Ministry Receivers need no further introduction. Supplied complete with 10 valves, and full circuit data.

LASKY'S PRICE **£11. 19. 6**
USED MODELS £7. 19. 6

Carriage 12/6 per unit extra, including 10/- returnable on packing case. 10s. 0d. rebate will be given on power packs for the R.1155 when purchased with the receiver.



Fully Assembled Power Pack and Output Stage, for R1155 Receiver. For use on 200-250 volts. A.C. mains. LASKY'S PRICE **79/6** Carriage 5/- extra.

The above power pack fitted with 6in. speaker. LASKY'S PRICE **£5. 5. 0** Carriage 5/- extra.

METAL RECTIFIERS	
6 or 12 volt. F.W. Bridge	
2 amps	9/-
3 amps	9/11
4 amps	12/11
6 amps	21/-
10 amps	32/6
6 volts	12 volts
1/2 amp. 2/6	1/2 amp. 3/11
1 amp. 4/6	1 amp. 6/6

AERIAL ROD SECTIONS	
Steel, heavily copper plated. 12in. long, 1/4in. diameter.	
PRICE 2/6 per doz.	
POST FREE.	
CRYSTAL DIODES	
Glass type, wire ends. 1/6.	

CAR RADIO AERIALS
 Chrome 2 section telescopic. Extends to 75 inches. 2 bolt side fixing. Complete with 48 inches of co-axial cable. Suitable for t.v. use. LASKY'S PRICE **15/-**. Postage 3/6 extra.

1-lb. REELS OF RESIN CORED SOLDER.
 LASKY'S PRICE **7/6**.

SUPERHET COILPACKS.
 For 465 Kc/s. No. 1 L.M.S., 29/6. No. 2 M.S.S., 16/-.



RESISTANCE AND CAPACITY BRIDGE
 For A.C. mains 200/250 volts. Complete with valve rectifier and 6H6 and EM34 (magic eye) valves. Uses external standard.

Ranges: Ohms Factor of 0.1 to 10. In metal case, black crackle finish, 12 x 6 x 8 1/2 inches. Without handles. This unit is ideal for breaking down and rebuilding as another type of instrument.

LASKY'S PRICE **45/-**
 Carriage 3/6 extra.

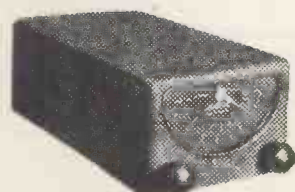
R.1132A RECEIVERS
 For V.H.F. 100 to 124 Mc/s. Uses 11 valves, 5 m/a. meter. Large slow motion tuning dial. In grey metal cabinet, size 18 x 10 x 11in. LASKY'S PRICE **20/-** less all valves. Carriage 7/6 extra.

R.1132 RECEIVERS WITH VALVES
 Grade 1. New 79/6. Grade 2. Soiled 49/6. Grade 3. Secondhand, 39/6, Carriage 10/- extra.

TEST PRODS
 Fully fused with retractable points. 4/11 PER PAIR. (1 red, 1 black).

TRIMMERS
 Paxolin. Up to 100pf. 6d. each, 5/- per doz. Ceramic. Up to 100pf. 9d. each. 7/6 per doz.

CAR RADIO SPECIAL—Partly assembled car radios.



Small size case, 12 x 4 x 6in. Will fit most cars. For either 6 or 12 volts, depending on vibrator. Chassis supplied with 5 octal valve holders, medium wave aerial and oscillator coils, output transformer, volume control, sundry resistances and condensers, dial and knobs. Case

finished in brown crackle. Dial calibrated 150-550 metres. 5 valves to suit. One each, either GT or metal: 6SA7, 6R7, 6V6, 6K7, 0Z4.

LASKY'S PRICE **£5/5/-**. Carriage 5/- extra. Or less valves, 69/6. Carriage 5/- extra.

Other chassis in various conditions of completion are available for personal callers only. **CIRCUIT** for 5 valve car radio, using above chassis. PRICE 1/6.

SOLON SOLDERING IRONS

220-250 volts
 Latest model instrument iron 19/8
 Standard model 19/-

PORTABLE RECORD PLAYERS

Containing a new Plessey single speed automatic record changer, (78 r.p.m.). Magnetic pick-up and 2-valve amplifier, with metal rectifier. For use on 200-250 v. A.C. mains. Amplifier uses EF.36 and EL.32 giving 3-watts output, tone and volume controls, 5in. speaker. In rexine-covered cabinet, size: 17 x 17 x 8in. With carrying handle. Though store soiled, these players are new and every one is fully tested before despatch.

The cabinet available separately, soiled. PRICE 25/-. Carriage 5/- extra.

LIMITED QUANTITY. LASKY'S PRICE **£10/19/6**
 Carriage 10/6 extra.



HEARING AIDS



By well-known Manufacturer. In metal case, size: 2 1/2 in. x 4 1/4 in. x 1 in. Complete with batteries and 3 sub-miniature valves. Only two controls: volume and on/off. Fitted with internal crystal microphone.

Used condition. Suitable for reconstruction into midget. radio receiver.

MADE TO SELL FOR 22 GNS.

LASKY'S PRICE **49/6**
 Postage 3/6 extra.

Earpiece and cord for use with hearing aid. LASKY'S PRICE 17/6.

MINIATURE 2 GANG TUNING CONDENSER.

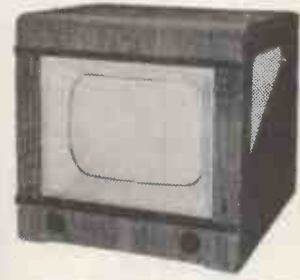
.0005 mfd. With trimmers. LASKY'S PRICE 6/6. Other types in stock.

MINIATURE SINGLE HEADPHONE,

on spring steel headband. Size 1/2 in. diam. 200 ohms resistance. Fitted with 30in. twin cord. PRICE 17/6 complete.

HIGH VOLTAGE CONDENSERS

.001 mfd. 12.5 kV 7/6
 .001 mfd. 15 kV 10/-
 .1 mfd. 10 kV 12/6
 .1 + .1 mfd. 3.5k V5/11
 .04 mfd. 12.5 kV 7/6



TANNOY PRESSURE UNITS
 10 watts. 7.5 ohms impedance. Last few only. PRICE **59/6**

Carriage 4/6 extra.

TABLE TELEVISION CABINETS

For 12 and 14 inch c.r. tubes. Beautifully finished in polished medium walnut veneer. Complete with mask glass, speaker-fret, Internal dimensions:—15in. wide, 16in. deep, 14in. high.

LASKY'S PRICE **39/11** Carriage 7/6 extra.

Also available in unpolished veneer.

LASKY'S PRICE **19/11** Carriage 7/6 extra.

PLESSEY RECORD PLAYERS

Slightly Soiled. For use on 200-250 v. 50 c.p.s. mains. Complete with 10in. turntable and magnetic pick-up. Auto stop and record selector start. 78 r.p.m.

LESS THAN HALF PRICE. LASKY'S PRICE 69/6. Carriage 2/6.

MAGNETIC RECORDING TAPE. SPECIAL OFFER



Plastic Tape by famous British manufacturer. On Cyldon metal spools. 600ft., 8/11. 1,200ft., 14/11.

Postage 1/6 per reel extra.

BUY NOW AND SAVE CASH—LIMITED QUANTITY ONLY

"THE HARROW" Baffle Radio Cabinet



Build a second set to be proud of. Pleasing design cabinet, with drilled chassis, dial, drive and back. Finished in satin mahogany veneer. Outside dims.: 17 1/2 in. wide, 11 1/2 in. high, 5in. deep. LASKY'S PRICE **36/6** Carriage 2/- Receiver design uses 2-6K7, 6V6 and 5Z4. Total cost to build is less than £5/10/- Circuit for receiver 1/6.



A LASKY'S RADIO ADVERTISEMENT. SEE OVER.



TRIPLEX DARK SCREEN FILTERS

14 x 12 1/2 x 3/8 in. 7/6
15 1/2 x 13 1/2 x 3/8 in. 9/6
Postage and packing 5/- per piece extra.

J/RA/3 AMPLIFIER
12-15 watts. Cine projector type with case, as previously advertised. A FEW ONLY LEFT. PRICE £9/19/6. Carriage 15/- extra.

VCR97 C.R. TUBES, new unused. 35/- Carriage 5/-.

Screen Enlarger for VCR97. Filter or clear, 17/6. Postage 2/6.

C.R.T. Neck Protectors, 2/6.

10 K.V. METROSIL E.H.T. REGULATORS. By Metrovick. Pencil type, 5/- each.

S.T.C. SENTERCEL RECTIFIERS

R.M.1. 3/10 K3/40, 3.2 kV. 6/-
R.M.2. 4/3 K3/45, 3.6 kV. 8/2
R.M.3. 5/- K3/50, 4.0 kV. 8/8
R.M.4. 18/- K3/100, 8.0 kV. 14/8
R.M.4. 18/- K3/160, 12.8 kV. 21/6

6- AND 12-VOLT VIBRATORS

4-Pin type. Soiled. S/H. 4/6
New 9/6
W/W 12/6
State voltage required.

BRIMISTORS. CZ.3. 10 1/2 d. each. 9/- per dozen.

R.F. E.H.T. OSC. COILS
For use with 6V6 valve, and EY51. Circuit and full data supplied.
6-10Kv. PRICE 19/6
6-18Kv. PRICE 25/-

R.F. OSC. COIL KITS
Consisting of R.F. oscillator E.H.T. coil with EY51 heater winding, EY51 rectifier, 6V6 valve and base. All necessary condensers and resistances. Full circuit and data supplied.
6-9Kv. LASKY'S PRICE 47/6
9-15Kv. LASKY'S PRICE 53/6

WIDTH AND LINEARITY CONTROLS. On one panel. 5/11 complete.

SPECIAL C.R.T. OFFER
Brand new and unused 12in. ion trap cathode ray tubes. 6.3 volt heater, 7-9 Kv. E.H.T. 35 mm. neck. Black and white picture. By famous manufacturer.
PERFECT £12.19.6
Carriage and insurance 15/- per tube extra.

MANUFACTURERS' SURPLUS T.V. COMPONENTS

Wide Angle Scanning Coils. Low imp. line and frame pair 19/6
Scanning Coils. 35 mm. Low imp. line and frame 12/6
Frame output transformer. Standard 10/6
Focus Coil. 35 mm. electro magnetic 12/6
Line or Frame B.O. transformer. Auto 4/6
Wide Angle Frame B.O. trans. 10/6
P.M. Focus Magnets. With vernier, 35 mm. Tetrode 15/-
Triode 17/6
Wide Angle P.M. Focus Unit. For all 38 mm. tubes. With vernier and picture shift, Ferroxdure 25/-
P.M. Focus magnet. 12/6

Co-Axial Cable. 70-80 ohms impedance. Single core, 8/- doz. yards. Twin core, 12/- doz. yards. Twin feeder, 6/- doz. yards. Co-Axial Connectors. For standard 1/2 in. cable, 1/6.

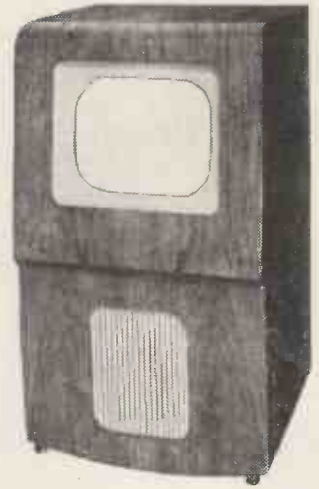
WX6. WESTINGHOUSE MINIATURE RECTIFIERS
Wire ends. 1/6 each.

C.R.T. MASKS Brand New LATEST ASPECT RATIO
9in. 7/-
10in. 7/6
12in. 15/-
12in. Flat Face 15/-
12in. Old Ratio 9/6
14in. Rectangular 12/6
15in. Cream rubber 17/6
15in. With fitted safety glass 22/6
16in. Plastic, white 12/6
16in. Double D 31/6
17in. Rectangular 15/-

Duodecal (B12A) bases. VCR139 c.r.t. bases. 1/- each. 10/6 dozen.

DE LUXE T.V. CABINETS
Our new 12 inch model. Mark II

This cabinet is now supplied complete with mask, glass, castors, shelf, bearers, c.r.t. neck end protector, back, speaker fret and baffle board. Finished in beautiful figured medium, light or dark walnut veneer, with high polish. Suitable for most home constructor T.V. receivers, including the "Viewmaster," "Practical Television," "Tele-King," "Magnivision," "Wireless World," etc. Can be supplied with cut-out for 16in. c.r. tube at no extra cost.



An allowance of 4s. 6d. will be made if the mask is not required. Inside Dimensions: Depth 16 1/2 in.; width 17 1/2 in.; height 28 in. Overall height 32 in. and width 18 1/2 in.

WHY NOT CONVERT YOUR TABLE RECEIVER TO A CONSOLE MODEL.

Adaptor frames for fitting 9in. or 10in. c.r. tubes can be supplied if required.

LASKY'S PRICE £8.10.0
Carriage 12/6 extra.

CONDENSERS. Electrolytics.

Table with columns for Cans, Tubular, and various capacitor values and prices.

COLLARO 3-SPEED AUTO CHANGERS

Model 3RC/521. New and unused in maker's carton.



Cream or fawn finish. Complete with hi-fidelity "studio" turn over crystal pick-up.

LASKY'S PRICE £9.19.6
Carriage Free.

I.F. TRANSFORMERS

465 Kc/s Iron dust cores in cans, midget type. Size 1 1/2 in. x 1 in. x 2 1/2 in. By Plessey. 8/6 per pr.

WEARITE TYPE 550. 445-520 Kc/s. 8/6 per pr.
WEARITE TYPE 500. 450-470 Kc/s. 8/6 per pr.

Latest Miniature Type. Size: 3/4 x 1/2 x 2 1/2 in. 465 Kc/s. PRICE 9/6 pr.

PERSPEX. 13 1/2 in. x 10 1/2 in. x 1/2 in. Neutral shade slightly marked, 4/11 per piece.

TOGGLE SWITCHES, BULGIN
S.P.S.T. 1/6
D.P.S.T. 2/6
D.P. Change over 3/6

TYPE AT/9 T.V. MAINS AUTO TRANSFORMER
200, 220, 250 and 375 volt tappings. 250 mA. Also 5 v. 3 a.; 6.3 v. 7 a.; and 6.3 v. 3 a. secondaries. Price 25/-.

ION TRAPS
All types. Price 3/- State tube type number when ordering.

ELAC DUOMAG FOCALISERS
For wide angle c.r.t. tubes. Low medium & high flux 37/6 each.

INTERCOM UNITS
4-station operation. For use on A.C./D.C. mains 200-250 volts. Supplied complete, with 3 new valves, ready for immediate installation. Fitted in attractive plastic cabinet. Suitable for use as baby alarm. MASTER UNIT, £5/19/6. Carr. 5/- extra.

LASKY'S LINE TRANSFORMER
RF.EHT for line flyback. 6-8 Kv, with EY51 heater winding. Suitable for home construction T.V. 19/6 each.

PLASTIC ESCUTCHEON SAFETY MASKS

Incorporating dark screen filter.
12in. Round Face 12/6
12in. Double D. 12/6
Round Face 15/-
16in. for metal tubes 25/-

SOILED, NEW ASPECT RATIO MASKS
9in. 5/-
12in. 7/6
12in. with fitted armour plate glass, cream. 11/6
12in. do. Black 8/6

ARMOUR PLATE GLASS
16in. Actual size 1 1/2 x 15 1/2 x 1/2 inch 7/11
15in. Actual size 1 1/2 in. x 13in. x 1/2 in. 6/11
12in. Actual size 1 1/2 in. x 10 1/2 in. x 1/2 in. 4/-
9in. Actual size 9in. x 8in. x 1/2 in. 3/-

TELEVISION TABLE TROLLEY



Superb walnut finish. High polish. Size: Top, 20 x 24 in. Height from floor, 26 1/2 in. Large size castors for easy running, rubber tyred. Will take the largest table T.V. with ease. Packs flat when required.

Lower shelf suitable for books, radio receiver, Radio Times, etc.

LASKY'S PRICE 69/6
Carriage 5/- extra

THE TELE-KING 16" 17"

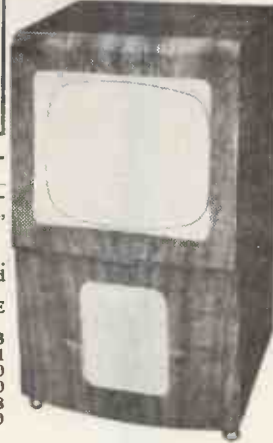
A practical 5-channel
SUPERHET TELEVISION RECEIVER

Using the new 16 and 17 inch cathode ray tubes and wide angle components for the home constructor.

Complete instructions, wiring diagrams and 32-page descriptive booklet.

6/- POST FREE

Alexandra Palace,
Sutton Coldfield,
Holme Moss,
Wenavoce,
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Kirk o'Shotts.



NOTICE TO ALL PURCHASERS OF THE ENGLISH ELECTRIC 16 inch C.R.T. TYPE T.901
The first and only reconditioning service. By English Electric. A reconditioned 16in. metal tube costs £12 and carries maker's full guarantee. Write for further details.

ALL COMPONENTS IN STOCK WRITE FOR LIST

ALLEN WIDE ANGLE COMPONENTS

DC. 300. C. latest type Ferroxcube Coils 39/6
GL. 16 Coil 7/6
GL. 18 Coil 7/6
Focus Coil 31/-
FO.305
trans. 21/-
Fram B.O. transformer 15/-
Line E.H.T. transformer 40/-

CHASSIS

Power pack Sound-vision and Scan chassis.
PRICE 11/- each. All other metal work available from stock.
CONDENSERS
All condensers as specified. Manufacturers' surplus. £3/16/-
COILS 13 all exactly as specified. Price 44/6.

RESISTANCES. 72 Resistances, all exactly as specified, 18/-.

CABINET
As illustrated here. £8/10/-
Carriage 12/6 extra. Supplied with mask and glass.
WIDE ANGLE CATHODE RAY TUBES
14in. MW36-22 £19 9 3
14in. C14B £20 10 1
16in. MW41-1 £22 4 10
16in. T901 £22 4 10
17in. MW43-64 £23 12 8
17in. C17BM £24 13 0
Carriage and insurance extra.

NOW IN STOCK
MULLARD
PCC84 23/3
PCF80 24/7

P.M. LOUDSPEAKERS
All with 3 ohm speech coil.
2½in., 15/-; 4in., 12/6; 6½in., 15/-; 3in., 14/6; 5in., 14/6; 8in., 19/11; 10in., 19/6.

TWO SUPER SCOOPS BRAND NEW AND UNUSED. Below Makers Cost



CYLDON 5 CHANNEL T.V. TUNERS

Uses two valves, EF80 (6BW7) as R.F. amp. and ECC81 (12AT7) as frequency changer. Instant and positive selection of any channel by switching incremental inductances. Power gain 24dB, I.F. frequency output 9.5-14 Mc/s or 15.5-22 Mc/s. With full details and circuit diagram. Supplied less valves. Size:—4½ x 2½ x 2½ins.

12/6

POST 2/6

3-WATT MIDGET AC/DC AMPLIFIERS



Push pull, very high gain

4 valves: 2 U141 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 AC/DC. Very easily converted to 230 volts. Supplied with circuit diagram and full details. Size:—9 x 4 x 4 inches. Uses 2 metal rectifiers, 1 each RM2 and RM3. Ideal for ships record players, tape recorders, home record players, baby alarms, etc., etc. Supplied complete, fully assembled and wired, with 4 valves.

69/6

CARRIAGE 3/6

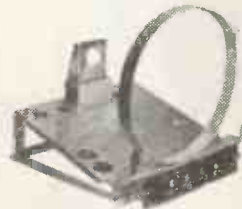
LASKY'S T.V. CONSTRUCTORS' PARCELS

No. 1. All brand new components by Igranic. Comprises E.H.T. flyback line transformer, 7-10 Kv. with ferroxcube core and rectifier heater winding; scanning coils; frame output transformer; Elac focus unit with vernier adjuster, U37 E.H.T. rectifier, 12in. mask and glass.

LASKY'S PRICE FOR THE COMPLETE PARCEL, 79/6 Carriage & packing 3/6 extra.

WIDE ANGLE CONSTRUCTORS' PARCEL. Comprises ferroxcube line E.H.T. transformer, one pair scanning coils with ferroxcube core, p.m. focus magnet with ferroxcube core OR electromagnetic focus coil and frame transformer, linearity and width controls, frame blocking oscillator transformer.

LASKY'S PRICE COMPLETE 95/11. Carriage 3/6 extra.



No. 3. Complete set of metalwork, as illustrated here. Unassembled. Comprising main chassis, tube supports and valveholders. (Less sound-vision chassis.) **PRICE 25/-.** Carriage 3/6 extra.

No. 4. RESISTANCES. Watt. 85 resistances your choice. **PRICE 18/-.** POST FREE.

LASKY'S RADIO

Lasky's (Harrow Road) Ltd.,

370 HARROW ROAD, PADDINGTON, LONDON, W.9
(Opposite Paddington Hospital)

MAIL ORDER AND DESPATCH DEPARTMENTS, 485/487 HARROW ROAD, PADDINGTON, LONDON, W.10
Telephones: CUNningham 1979 and 7214. ALL DEPTS. Hours: Mon. to Sat. 9.30 a.m. to 6 p.m. Thurs. half day 1 p.m.

TERMS: Pro forma, Cash With Order or C.O.D. on post items only. Postage and packing on orders value £1-1/- extra: £5-2/- extra: £10-3/6 extra. Over £10 carriage free, unless specifically stated otherwise.

SAMSON'S SURPLUS STORES

LONDON'S GREATEST DEALERS IN RADIO AND ELECTRONIC EQUIPMENT

30FT. AERIAL MASTS TYPE 55. Comprising 9 ashwood sections and 1 metal mast top section with aerial clamp attachment. Complete with base plate, guys, and rings. Dia. of first section 1 1/2 in. Dia. of top section 1/2 in. Supplied new in makers transit cases with instructions, 65/-, carr. 5/-

12in. COPPER PLATED AERIAL RODS. Push-in sleeve joint, 8/6 per half gross, 15/- per gross. P.P. 1/6. SPECIAL PRICE FOR LARGER QUANTITIES.

LOOK! CO-AXIAL CABLE—LOWEST PRICE EVER. Super quality Ex Govt. 80 ohm, 100 yards, 55/-, carr. 4/-, 1,000 yards £18/10/-, carr. 15/-.

Amazing offer! First time on Surplus Market. MINIA-TURE ACCUMULATORS made by Willard Co., 36 v. 0.2 amp. Size 3 1/2 x 1 1/2 x 1. Weight 5 1/2 oz. 5/-, P.P. 6d. 6 v. 1.2 amp. Size 3 1/2 x 1 1/2 x 1. Weight 4 1/2 oz. 7/6. P.P. 6d.; or set of three 36 v. and one 6 v. in sealed container, £1, P.P. 1/3. Brand new and uncharged. Easily filled with hypodermic syringe.

BRAND NEW EX-ARMY HYPODERMIC SYRINGES. Complete with 1 needle. 4/3, P.P. 6d. Extra needles 6d. ea.

L.T. SUPPLY UNITS. Brand new AM type 8B Ref. 5P/2399 input tapped 200-250 v. A.C. Output 36 v. 50 amp. at 35 deg. C. Built in metal cabinet size 3 1/2 in. x 1 1/2 in. x 1 1/2 in., complete with starter switch, £25.

L.T. SUPPLY UNITS. S.T.C. Type 13. Input 100-250 v. A.C. Output tapped 12-24 v. D.C., 3 amps. continuous rating. Completely shrouded in metal case with Fuses, Switch and O.P. Sockets. £4/10/-, carr. 5/-.

S.T.C. BATTERY CHARGERS. A.C. Input, 200-250 v. Output 60 v. 10 amps. Incorporating selenium rectifier, ammeter, fuses control switching. Built in grey metal cases measuring 1 1/2 in. x 1 1/2 in. x 10 1/2 in. Supplied brand new at a fraction of the maker's price. £22/10/-.

FIELD TELEPHONE. TYPE D.V. Complete with hand set, single headpiece and batteries. Built in strong metal containers. Suitable for farms, building sites, garages, etc. 52/6. Carr. 2/6. **E.A.F. FIELD TELEPHONES.** hand generator type. Complete with hand set or head and breast set and batteries, 47/6 each. Carr. 2/6. State which type required.

TELEPHONE CABLE. Single D.3. One mile drums, 55/-, carr. 5/-; Commando Assault telephone cable, P.V.C., 1,000 yard drums, very useful for the garden, 15/- per drum, Carr. 2/6.

OFFICE INTER-COM SETS. Special offer of manufacturer's surplus includes master and 2 extensions, built in highly polished wood cabinets operates from 200-250 A.C. Valve line up: 1 UF41, 1 UL42, and metal rectifier. Brand new in maker's cartons. £8/19/6. Originally sold at 16 gns.

PACKARD ROLLS ROYCE COOLANT PUMPS. A Turbine type pump driven directly from a splined socket. Brand New in maker's cartons, 35/-, carr. 2/6.

DOUBLE ANGLE SERVO UNIT ASSEMBLY for bomb sight computer T1, comprising 27 volt double ended geared motor and reversing assembly. Brand new in maker's cartons 32/6. P. and P. 2/-.

PAINTON ATTENUATORS. Standard 1/2 in. dia. spindle 500 ohm or 5,000 ohm 10/6. P.P. 1/-; **BANKS OF FOUR RESISTANCE MATS.** 690, 150 and two at 80 ohms. Size of each mat 8 x 6 1/2 in., 10/6 per set. P.P. 1/6. U.S.A. 20 Amp. **OVERLOAD SWITCHES,** 5/6. P.P. 6d. **VARLEY 6 VOLT DELAY SWITCHES.** 5/-, P.P. 6d. **SUNWIG CONTROL TYPE 002A,** 4 pin Hot Wire replacement tubes, 7/6. P.P. 9d. **FERRANTI 5 AMP KWH METERS,** less case, Brand New, 13/6. P.P. 1/6.

SLIDING RESISTANCES. 3-4 ohm 12 amp. 22/6. 1 ohm 12 amp. 12/6. 50 ohm 1 amp. 10/6. 20 ohm 7 to 1.5 amp. with geared drive, 37/6. P.P. on all types, 2/-.

AMERICAN VALVE TESTERS. By Radio City Products. A.C. 200-250 v. Will test practically all types of International valves. Brand new in maker's cartons, £11/10/-, Carr. 5/-; **MASTER VOLTMETERS.** By Metro-Vickers. 0-20 volts A.C. 50 cy. Moving iron. Six inch mirrored scale. 25/-, P.P. 2/-.

STORAGE BATTERIES. Pritchett and Gold 12 v. 75 AH Batteries built in Teak cases, £4/10/6. Carr. 7/6. 6 v. 100-125 AH as above, £4/19/8. Carr. 7/6. American 6 v. 90 AH 15 Plate Car Batteries, 9in. x 9in. x 7in., £3/17/6. Carr. 5/-; Exide 10 v. 5 AH Glass Accumulators suitable for HT unit construction, 8/6 each. P.P. 1/6.

WE HAVE LARGE STOCKS OF HEAVY DUTY TRANSFORMERS, SLIDING RESISTORS, SMOOTHING CONDENSERS, METERS, AND EX-GOV'T. SPECIAL PURPOSE VALVES. LET US KNOW YOUR REQUIREMENTS. ALL LETTERS ANSWERED.

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MAGNETIC RELAYS

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TYPES 3000 and 600
HIGH SPEED and A.C. to 400 VOLTS
TROPICALISING—IMPREGNATING

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SWITCHES

From 3 to 8 Bank—All Resistances

KEY SWITCHES

Several types
in stock



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JACK DAVIS (RELAYS) LTD.
36 PERCY STREET · LONDON · W.1
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1 KW TELEGRAPH TRANSMITTERS. Two HF 300's output. Operation 3.5 mc. to 16 mc.

BC610 TRANSMITTERS with speech amplifier, aerial tuning unit, etc. Brand new.

RCA TRANSMITTERS. Type ET-4336. Complete with original speech amplifier, crystal multiplier and VFO units. Unused and re-conditioned. Can be supplied with very large quantity of spares.

RCA TRANSMITTERS. Type ET-4332 modified by R.A.F. for use on crystal or master oscillator. Complete with speech amplifier.

MAGNETO 10 LINE U.C. TELEPHONE SWITCH-BOARDS (complete).

SCR510's, complete with Power Pack and telescopic aerial.

SCR536 (BC611) in excellent condition.

A.R.88D's, A.R.88LF's, A.R.77's, S27's, HRO, R.109 and others.

METAL RECTIFIERS, Type 1B, D.C. output 10 amps at 22v. input 220/250v., 50 c/s.

All above items in excellent working condition.

Working demonstration upon request.

SPARES A large selection available for SCR399 (BC610), ET4336, SCR610, EEB Telephones, and Tele. printers type 7B.

TX VALVES 805, 807, 813, 861, 866A, 100TH, 250TH, and many others.

Large stock of Tx condensers, crystals and other components. Alignment and repair of communication receivers and all other short-wave equipment undertaken.

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New Address, Offices and Works:

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MAINS TRANSFORMERS

Primary, 200-250 v. P. & P. 2/-.
300-0-300 100 mA., 6 volt 3 amp.,
5 volt 2 amp., 22/6.
Drop thro' 350-0-350 v. 70 mA., 6 v.
2.5 amp., 5 v. 2 amp., 14/8.
Drop thro' 250-0-250 v. 80 mA., 6 v.
3 amp., 5 v. 2 amp., 14/8.
280-0-280, drop through, 80 mA.,
6 v. 3 amp., 5 v. 2 amp., 14/8.
250-0-250 80 mA., 6 v. 4 amp., 14/-.
Fri. 230 v. Sec. 200-0-200 35 mA.,
6 v. 1 amp., 8/6.

Drop thro' 280-0-280, 200 mA., 6 v.
5 amps., 5 v. 3 amps., 27/6.
Drop thro' 270-0-270 80 mA., 6 v.
3 amp., 4 v. 1.5 amp., 13/6.
Drop thro' 270-0-270 60 mA., 6 v.
3 amp., 11/6.

Auto Trans., input 200/250. H.T.
350 v. 350 mA. Separate L.T. 6.3 v.
7 a., 6.3 v. 1 1/2 amp., 5 v. 3 amp., 25/-
P. & P. 3/-.

Heater Transformer. Pri. 230-250 V.
6 v. 1 1/2 amp., 8/-; 2 v. 2 1/2 amp., 5/-.

Used Resistance and Capacity Bridge in
leatherette covered case with carrying
handle. size 12 1/2 x 8 1/2 in. 10 pF
to 100 mfd. in 3 ranges. 1 to 10 meg.
in 3 ranges. Power factor check. 200.
300, 400 and 500 v. flash test. Magic
eye, rectifier, triode and neon. These
require re-checking. 23/19/6. P. & P. 4/-.

P.M. SPEAKERS (closed field):

	with trans.	less trans.
2 1/2 in.	15/6	15/8
3 1/4 in.	18/6	17/6
6 in.	16/6	12/6
6 1/2 in.	18/6	12/6
8 in.	18/6	15/-

P. & P. on the above 1/- each.

10in. less trans., 19/6. P. & P. 1/6.

Truxov Bx11. 12in. P.M. 3 ohm speech
coil, 45/- P. & P. 3/6.

6in. M.E. Speaker, 1,000 ohm field,
15/- P. & P. 1/6.

R. & A. T.V. Energised 6 1/2 in. speaker
with O.P. trans., 6V6 matching, field
coil 175 ohms. Requires a minimum
150 mA. to energise, maximum current
250 mA., 15/- P. & P. 2/6.

Extension Speaker Cabinet, in contrast-
ing walnut veneer, size 15 x 10 1/2 in.
Will take 6 1/2 or 8 in. speaker, 17/6
P. & P. 2/-.

Completely built All-dry Mains Unit
by famous manufacturer, 200/250 v.
Metalcase size 8 x 5 x 3 in., incorporating
Westinghouse metal rectifiers, 3 500
mfd., 16 x 24 mfd., mains trans., 3
smoothing chokes, output 90 v. 10 mA.,
1.4 v., 0.25 amp., 39/6. P. & P. 2/6.

Volumes Controls. Long spindle less
switch, 50K, 500K, 1 meg., 2/6 each.
P. & P. 3d. each.

Volumes Controls. Long spindle and
switch, 1/4, 1 and 2 meg., 4/- each;
10K and 50K, 3/6 each. 1/2 and 1 meg.,
long spindle double pole switch, miniatur-
e, 5/- P. & P. 3d. each.

Trimmers, 5-40 pt., 5d.; 10-110, 10-250,
10-450 pt., 10d.

Line Cord, 2-way 0.3 amp., 60 ohms
per foot, 1/3 per yard.

Twin-Gang .0005 with feet, size
3 1/2 x 1 1/2 in., 6/6.

3-gang, .0005, with feet size 4 1/2 x 3 1/2 in.,
7/6.

T.V. Coils, moulded former, iron-cored,
wood for re-winding purposes only.
All-size 1 1/2 x 1 1/2 in., 1/- each; 2 iron-cored
all-cau 2 1/2 x 1 1/2 in., 1/6 each.

Used Metal Rectifier. 250v., 150 mA.,
6/6.

Metal Rectifier. 250v., 250 mA., 12/6.

Metal Rectifier. 230v., 45 mA., 6/-.

PERSONAL SHOPPERS ONLY. 9in.
Enlarger, 17/8; 12in., 27/6.

Germanium Crystal Diode, 1/8, post
paid.

Television Masks. White Rubber 9in.
with glass, 7/8. Cream Rubber, 12in.,
with armour-plate glass, 15/-; 15in.
Cream, 17/6, plus 1/6 P. & P.

T.V. Width Controls, 3/8.

T.V. Sub Assembly, all-chassis, 12in. x
3 1/2 in. with frame osc., line osc., 12 mfd.
275 wkg. Metrosil, 8 condensers, 4
resistors and tag panel, 15/- P. & P. 1/6.

Amplifier Case, black re-line covered,
leather carrying handle, chrome plated
corners, rubber feet, felt lined, detach-
able lid. External dimensions 13 1/2
x 9 1/2 in., 11. P. & P. 2/6.

D. COHEN RADIO AND TELEVISION COMPONENTS

Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/- up to 10/-, 1/6 up to £1, and 2/- up to £2. All enquiries, S.A.E., lists 5d. each.

SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE.

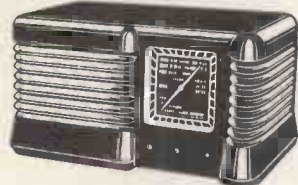
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Used 12in. C.R. Tube, aluminised, E.H.T. maximum 10 Kva., heaters 2-volt, with heater cathode short, guaranteed for 3 months. Complete with rubber mask, Elac P.M. focus unit, scan coils, low line, low frame and frame o.p. trans. £5/10/-, P. & P. 7/6.

HIGH-IMPEDANCE PLASTIC RECORDING TAPE, by famous manufacturer. 600ft. on aluminium spool, 8/-; 1,200ft. on aluminium spool, 17/8, post paid.



CABINET, as illustrated, 11 1/2 x 6 1/2 x 6 1/2 in., in walnut or cream, complete with TRF chassis, 2 waveband scale, station names, new waveband, backplate, drum pointer, spring, drive spindle, 3 knobs and back, 22/6. P. & P. 3/6.

AS ABOVE, with superhet chassis, 23/6. P. & P. 3/6.

AS ABOVE, complete with new 5in. speaker to fit, and O.P. trans., 35/- P. & P. 3/6, with superhet chassis, 36/- P. & P. 3/6.

Used metal rectifier, 250 v. M. & L. TRF coils, 5/-; 2 obsolete ex-Govt. valves, 3 v/h and circuit, 8/8; heater trans., 6/-; volume control with switch, 3/8; wave-kit, 4/-.

change switch, 2/-; 32 x 32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-.

M. & L. Superhet Coils with circuit, 8/8; Iron cored 465 IF's, 7/8; min. gang, 5/8; volume control with switch, 4/-; wave-change switch, 2/8; heater trans., 7/8; 4 v/h, 1/6; 4 obsolete ex-Govt. valves, metal rectifier and Xtal diode with circuit, 14/8; 25 x 25 mfd., 1/-; 16 x 16 mfd., 3/3; condenser kit (17), 7/6; resistor kit (14), 3/6.

FULLY SHROUDED MAINS TRANSFORMER, input 110/260, sec. 350-0-350 175 mills., 6.3 v. 7 amp., 5 v. 3 amp., 35/- P. & P. 3/-.

FULLY SHROUDED PUSH-PULL TRANS. Pri. 6,000 ohms, sec. 15 ohms (2 L66) 5in push-pull). £1. P. & P. 2/6.

FULLY SHROUDED CHOKE, 15 Henry 180 mills., 15/- P. & P. 2/-.

FULLY SHROUDED CHOKE, 5 Henry 120 mills., 8/6. P. & P. 2/-.

These last four items by very famous manufacturer.

USED C.R. TUBES. Heater cathode short, 9in., 45/-; 12in., 75/-; Ion burn, 9in., 35/- 12in., 55/- P. & P. on each 7/6.

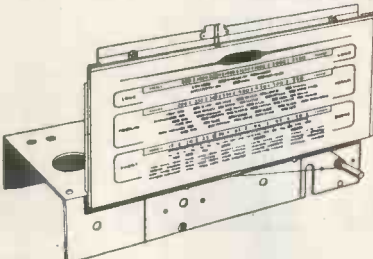
COMPLETELY BUILT SIGNAL GENERATOR



Coverage 120 Kc/s-320 Kc/s., 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8.5 Mc/s.-25 Mc/s., 17 Mc/s.-50 Mc/s., 25.5 Mc/s.-75 Mc/s. Metal case 10 x 6 1/2 x 4 1/2 in. Size of scale 6 1/2 in. x 3 1/2 in., 2 valves and rectifier. A.C. mains 230/250 v. Internal modulation 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated. R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel, £4/19/6. Or 34/- deposit and 3 monthly payments of 25/- P. & P. 4/- extra.

CONSTRUCTOR'S PARCEL No. 1 comprising chassis 12 1/2 x 8 x 2 1/2 in., cad. plated 18 gauge, v/h., IF and trans. cut-outs, backplate, 2 supporting brackets, 3 waveband scales, new wave-length station names. Size of scale 11 1/2 x 4 1/2 in., drive spindle drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs and pair of 465 IF's, 16/6. P. & P. 1/9.

AS ABOVE, but complete with 18 x 16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 80 mA., 8 v. 3 amp. Pri. 200-250, and twin-gang, 31/6. P. & P. 3/-.



CONSTRUCTOR'S PARCEL. As No. 1, plus 16 x 16 mfd. 350 wkg., semi-shrouded drop thro', 250-0-250 80 mA., 6.3 v. 3 a., 5 v. 2 a. twin gang, and 6 L.M.3. superhet coils complete with trimmers and tracking condensers with circuit. 22/5/-, plus 3/8 pt and pkg.

R.I. MAINS TRANSFORMERS, chassis mounting, feet and voltage panel

Primary 200/250.
300-0-300 60 mA. 6.3 v. 1 a., tapped at 4 v. 6.3 v. 2 a., tap 4 v. 13/6.
350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., 13/6.
350-0-350 70 mA. 4 v. 5 a., 4 v. 2.5 a. C.T. 18/8. P. & P. on the above transformers, 2/-.

500-0-500 125 mA. 6.3 v. O.T. 4 a., 6.3 v. C.T. 2 a., 5 v. C.T. 2 a., 27/8.
500-0-500 125 mA. 4 v. O.T. 4 a., 4 v. C.T. 4 a., 4 v. C.T. 2.5 a., 27/8.
500-0-500 200 mA. 4 v. C.T. 5 a. 4 v. C.T. 2 a., 4 v. C.T. 4 a., 39/8.

P. & P. on the above transformers 3/-.

Line and E.H.T. transformer 9KVA. using ferracore core complete with built-in line and width control. Mounted on small all-chassis. Overall size 4 1/2 x 1 1/2 in., EY51 core winding, 27/6. P. & P. 2/6.

Valve Holders, moulded octal Mazda and local, 7d. each. Paxolin, octal. Mazda and local, 4d. each. Moulded B7G, B8A and B9A, 7d. each. B7G moulded with screening cap, 1/6 each. 32 mfd., 350 wkg. 2/-; 16 x 24, 350 wkg. 4/-; 4 mfd., 200 wkg. 1/3; 40 mfd., 450 wkg. 3/6; 16 x 8 mfd., 500 wkg. 4/8; 16 x 16 mfd., 500 wkg. 5/9; 16 x 16 mfd., 450 wkg. 3/9; 32 x 32 mfd., 350 wkg. 4/-; 32 x 32 mfd., 350 wkg., and 25 mfd., 25 wkg. 6/6; 25 mfd., 25 wkg. 11d.

250 mfd., 12 v. wire ends 1/-; 16 mfd., 200 wkg., wire ends 3/3; 8 mfd., 500 v. wkg., wire ends 2/6; 8 mfd., 350 v. wkg., tag ends 1/6; 50 mfd., 25 v. wkg., wire ends 1/9; 100 mfd., 350 wkg. 4/-; 100 x 200 mfd., 350 wkg. 6/6; 16 x 16 mfd., 350 wkg. 3/3; 50 mfd., 180 wkg. 1/9; 65 mfd., 220 wkg. 1/6; 8 mfd., 150 wkg. 1/6; 60 x 100 mfd., 280 wkg. 7/8; 100 mfd., 12 wkg. 2/4; 32 x 32 mfd., min., 275 wkg. 4/-; 50 mfd., 50 wkg. 1/9; Miniature wire ends moulded, 100 pt., 500 pt., and .001. 7d.

Combined 12in. mask and eusechcon in lightly tinted Perspex. New aspect, edged in brown. Fits on front of cabinet, 17/6. P. & P. 2/-.

Frame Oscillator Blocking Trans., 4/6 Tube Mounting Bracket, size 9 1/2 x 4 1/2 in., 12in. tube clamps, 2/-.

Smoothing Choke, 2 Henry 150 mA. 3/6; 250 mA., 10 Henry 10/8; 5 Henry 250 mA., 60 ohms, 8/6.

P.M. Focus Unit for any 9 or 12in. tube except Mazda 12in., with Vernier adjustment, 15/- P. & P. 1/6.

P.M. Focus Unit for Mazda, 12in., with vernier adjustment, 17/6. P. & P. 1/6.

Wide Angle P.M. Focus Units, Vernier adj., state tube, 25/- P. & P. 2/6.

Energised Focus Coil, low resistance mounting bracket, 17/6, plus 2/- P. & P.

Scan Coils, low line low impedance frame, complete with O.P. transformer, 17/8. P. & P. 2/-.

Ion Traps for Mullard or English Electric tubes, 5/-, post paid.

485 kc. IF's, size 2 1/2 x 1 1/2 in. Q.110 removed from American equipment. 5/- per pair. Standard 465 Kc. iron-cored IF's, 4 x 1 1/2 x 1 1/2 in., per pr. 7/8. Weairite standard iron-cored 465 Kc. IF's, 3 1/2 x 1 1/2 in., per pr. 9/8.

Iron-cored 465 Kc. Whistle filter, 2/6.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 4/9; 42.1 with extra feed-back windings, 4/3. Miniature 42.1, 3/3. Multi-ratio 3,500, 7,000 and 14,000 5/8. 10-watt push-pull, 6V6 matching, 7/-; 90-1 3 ohm speech coil, 6/6.

PUSH-BACK CONNECTING WIRE. Duz. yds. 1/6, post paid.

STANDARD WAVE-CHANGING SWITCHES. 4-pole 3-way, 1/8; 5-pole 3-way, 1/8; 3-pole 3-way, 1/9; 9-pole 3-way, 3/8; Miniature type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. P. & P. 3d.

465 Kc. MIDGET IF's. Q.120, size 1 1/2 in. long, 1in. wide, 1in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair, 12/6.

Mains Droppers. 0.3 amp. 460 ohms, tapped 280 and 410, 1/6; 0.2 amp., 717 ohms, tapped at 100 ohms, vitreous, 1/8; 0.3 amps., 950 ohms, tapped 700 and 825, 2/6; 0.2 amp., 1,000 ohms, vitreous, tapped, 2/8; Vitreous, 0.3 amp. 700, tapped 650, 640 800, 3/6. P. & P. on each 3d.

GARLAND BROS., Ltd.

"UNITELEX PRIMA" PORTABLE TAPE RECORDER: We are appointed stockists for this recorder. Features include ultra modern cabinet design, giving exceptional lightness and portability without sacrifice of quality. Push-button control on mechanical side, twin-track heads, dual-speed (7½ in. and 3½ in. per sec.), giving up to two hours playing on one reel of tape; latest type miniature valves used; genuine 10 kcs. response; separate bass and treble controls; magic eye recording level indicator; provision for use as straight playback amplifier from record players or changers; 4-watts output to internal 10in. elliptical high-flux speaker, with provision for feeding two external speakers or amplifiers. Price, complete with filter cell microphone housed in recorder, and with 1,200ft. reel of high coercivity tape, 57 guineas. H.P. terms 19 gns. deposit, 12 monthly payments of £3/13/2. Send 2½d. stamp for illustrated brochure.

GARLAND AMPLIFIER ACII. Seli-contained general-purpose amplifier, providing 3.5-watts output. All power supplies derived from mains transformer, ensuring isolated chassis. Standard valves throughout. Volume and Tone Controls incorporated. Negative feedback loop. Price £6/12/6 plus 5/- carriage, etc. Weight 10lb.

THE LATEST LANE TAPE TABLE. Incorporating three heavy duty Lane motors; fast rewind and wind-on without tape handling; automatic braking; high impedance half track heads; hub locking device. Tape speed 7½ in. per second. Price £17/10/-. Carriage 10/-.

TRUVOX TAPE DECK MARK III. Incorporating high impedance mu-metal twin-track heads. Two-speed capstan, for tape speeds of 7½ and 3½ inches per second. Three heavy-duty motors allowing for fast forward and rewind facilities without tape handling. All controls operated by electrically and mechanically interlocked push buttons. Price £23/2/-. Send S.A.E. for full particulars. Plus 10/- carriage, etc. Delivery from stock. Send 2½d. stamp for details of this and of suitable amplifier.

BRENETTE MICROPHONES. Large sales of these popular microphones has enabled us to make substantial reductions in the prices. The following range is available: **Type 9ND:** Multi-directional ball-type, in black and chrome, £2/2/-, post 2/-. **Type 7D:** Directional type, for instrumental or vocal use: black and chrome, £3/15/-, post 2/6. **Type IIA:** A wide-frequency-response microphone, in brown cast case with chrome grille, £5/5/-, post 2/6. **Type I3U:** A highly sensitive studio microphone with outstanding frequency characteristics. Flexible mounting enables it to be used directionally or not as required. Black and chrome finish, £6/6/-, post 3/6.

MAGNETIC TAPE. Now available, the new Scotch Boy High Coercivity Tape MC2-III with higher output and signal-to-noise ratio. Price 35/- per 1,200ft. reel. Still available: Scotch Boy MC1-III: 1,200ft., 35/-; 600ft., 21/-; 300ft., 12/3. Spare 7in. spools, 4/3. Ferrovoice, the new kraft-based medium coercivity tape: 1,200ft., 22/6. Spare 7in. spools, 4/6. Magnetophone Tape: £2 per 1,200ft. reel.

VARLEY MAINS TRANSFORMERS. Primary 10-0-200-220-240 volts. Secondary 300-0-300 volts at 150 mA., 5 volt at 3 amps., 6.3 volt at 4 amps., 6.3 volts at 1 amp. Open type construction. Price 45/-, post 2/6.

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Practical Radio for Beginners	3/3
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High Fidelity Radio	3/9
The Midget Radio Instructors Manual	3/9
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Tape and Wire Recording	2/9
Mullard Valve and Service Reference Manual	5/6
Mullard Amateurs Guide to Valve Selection	1/9
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Tele-King Envelope	6/4
The Oscilloscope Book	5/4
Magnetic Recording (Quartermaine)	4/10

(Prices are post paid in all cases.)

ARTICLE	Cash Price	Deposit	6 monthly payments	12 monthly payments
T.V. Enlargers. 9in.	£2 10 0	16 8	6 2	—
T.V. Enlargers. 12in.	£3 10 0	£1 3 4	8 8	—
De Luxe T.V. Enlargers. 12in.	£3 15 0	£1 5 0	9 2	—
Bremi Microphones IIA	£5 5 0	£1 15 0	12 10	—
Amplion Testmeter. 10 ranges A.C.-D.C. up to 500 v. resistance ...	£5 19 6	£2 0 0	14 7	—
Collaro AC514	£6 5 11	£2 2 0	15 1	7 10
Bremi Microphone I3U	£6 6 0	£2 2 0	15 1	7 10
Goodmans Axiom 101. 8in. L/Spkr.	£6 12 1	£2 4 1	15 9	8 1
Garland Amplifier ACIIA	£6 12 6	£2 4 2	15 9	8 1
Collaro AC47	£6 13 4	£2 4 6	15 11	8 2
Wharfedale Golden CBS. 10in. speaker	£8 6 7	£2 15 7	19 11	10 2
Goodmans Audiom 60 Speaker	£8 12 6	£2 17 6	£1 0 8	10 7
B.S.R. 3-speed single player. GU4	£9 5 0	£3 1 8	£1 2 2	11 4
Connoisseur Pick Up, 2 heads	£9 5 6	£3 1 10	£1 2 2	11 4
Leak Pre-amplifier	£9 9 0	£3 3 0	£1 2 7	11 7
Wharfedale W12/cs. 12in.	£9 15 0	£3 5 0	£1 3 4	11 11
Goodmans Axiom 150, Mk. II	£10 5 6	£3 8 6	£1 4 7	12 7
Stella 3-speed Single Player	£10 10 0	£3 10 0	—	12 10
Leak "Varislope" Pre-Amplifier	£12 12 0	£4 4 0	£1 10 2	15 6
Collaro Auto-changer. 3RC/531	£15 3 10	£5 1 4	—	18 8
B.S.R. "Monarch" 3-speed Auto-change	£16 10 3	£5 10 1	£1 19 6	£1 0 3
Lane Tape Desk, Mk. IV	£17 10 0	£5 16 8	£2 1 10	£1 1 5
Collaro auto-changer. 3RC/532	£17 10 0	£5 16 8	—	£1 1 4
Connoisseur 3-speed unit	£23 8 11	£7 16 4	—	£1 8 8
Truvox Tape Deck, Mk. III	£23 2 0	£7 14 0	£2 15 3	£1 8 3
Leak "Point One" Amplifier	£28 7 0	£9 9 0	£3 7 9	£1 14 8
G.U.A.D. Amplifier with pre-amplifier	£35 0 0	£11 13 4	£4 3 8	£2 2 9
Unitelex "Prima" Tape Recorder. (Described above)	£59 17 0	£19 19 0	£7 3 0	£3 13 0

ALL GOODS NEW AND UNUSED (except where otherwise stated).

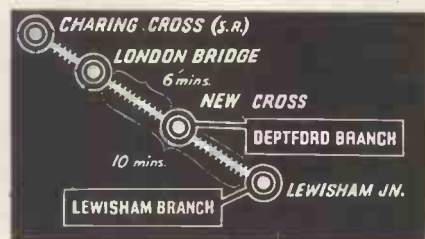
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CLYNE RADIO LTD.

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MUSEum 5929/0095.

All goods specially selected for quality and value. Prompt service—Money-back guarantee—It will pay you to visit our new rebuilt shop premises. Situated 50 yds. only from Tottenham Court Road Tube! (Genuine.)

TAPE RECORDER CABINETS. We can offer a well-constructed cabinet handsomely finished in grey or brown realine, made specifically to take Truvox or Wearite Tape Decks. Measures 22in. x 14in. x 9 1/2in. deep. Completely portable, shows attractive speaker grille at end, and made to take up to 8in. Speaker. We guarantee satisfaction and will be pleased to refund cash if dissatisfied. Ample room for suitable amplifier. Price 79/6, plus 2/6 packing and carriage. N.B.—We can supply from stock the latest Truvox and Wearite Tape Decks at 22 guineas and £35 respectively. Reduction of 20/- on cabinet if purchased at the same time as either of these tape decks!

JUST ARRIVED! Tape recorder cabinet as above but adapted to take the Elpico AC/54 Mk. II amplifier. This amplifier is available from stock at 16 gu. complete, and has been approved by Truvox Engineering Ltd. for use with their Tape Deck. Price 79/6, plus 2/6 packing and carriage.

EX-W.D. CATHODE RAY TUBES. Guaranteed full picture. VCR97 at 40/-, VCR517C at 35/-. Also VCR99—ideal for oscilloscope, 2 1/2in. screen at 35/-. We also have VCR97 with slight cut-off, very suitable for oscilloscope, testing purposes, etc., at 16/6 only. All these tubes are brand new in original packing, and tested before despatch. Please add 2/6 packing and carriage for any of the above tubes.

R.F. UNITS. All new condition and complete. Case size 9 1/2in. x 7 1/2in. x 5in. Type 24. 20-30 Mc/s., 15/-. Switched Tuning. Type 26—40-50 Mc/s., 19/6. Switched Tuning. RF28 at 45/-. We also have some RF28, not new, but in perfect condition, at 35/-. Type 27—64-88 Mc/s., 45/-. Variable Tuning.

We have a limited supply of RF27 new condition and complete, but tuning dial damaged. Price 30/- each only. ALL these units Post Free!!

LATEST PLESSEY 3-SPEED AUTO-CHANGER. We have just purchased a very limited quantity only of these small A.C. changers. Require only 5in. above and 2 1/2in. below motor board. Complete with turnover crystal head. £9/19/6 only, tax paid.

THE NEW R.C. "UNIVERSAL" AMPLIFIER. A small 3-watt gramophone amplifier for 110-250 v. A.C./D.C. operation. Negative feedback-loop, hum-level, chassis isolated. Suitable for either crystal or magnetic pick-up, and carbon or moving-coil microphone. Two controls; Volume/on/off and variable tone control. Chassis size 8in. x 6in. x 2 1/2in. Only £4/19/6, absolutely complete, plus 5/- packing and carriage.

RADIOGRAM CHASSIS. 3 wave-band superhet, long, medium and short waves. Standard 6 volt valve line-up. Gram. position on switch. Provision for extension speaker. For A.C. Mains 110/250 v. Absolutely complete with very attractive black, red and green horizontal scale. Chassis size 13 1/2 x 5 1/2 x 2 1/2in. Dial size 10 x 4 1/2in. Excellent quality on either radio or gram. We will gladly demonstrate to personal callers. Price £10/5/-, plus 5/- to cover packing, carriage and insurance.

We can also supply and demonstrate any of the "Dulci" well-known gram Chassis advertised by the makers elsewhere in this issue, at list prices—or illustrated Dulci leaflet available on request.

DECCA LIGHTWEIGHT PICK-UP. Complete with standard crystal insert, 32/6 only! Spare inserts for either Standard or L.P. at 2/6.

SINGLE PLAYING UNIT, by very famous manufacturer, cream, 3-speed, complete with Decca X.M.S. plug-in C. and D. heads for L.P. and Standard, £9/9/6 only!

G.E.C. RECORDING TAPE. 1,200ft. on metal spool, at bargain price of 17/6 per spool.



THE NEW R.C. HIGH-FIDELITY AMPLIFIER. P.P. 6V6 output. Freq. 25-18,000 cps.—40db at 6 1/2 watts. Treble boost and cut—Bass boost—L.F. correction. Provision for Feeder Unit Max. UNDISTORTED OUTPUT 8 1/2 watts. Price 16 gu plus 7/6. NOW AVAILABLE. Kit of Parts, complete with fully illustrated instructions 13 gu., plus 5/- carriage. Illustrated booklet available separately at 2/6. Attractive metal cover, now available. With built-in carrying handle, 19/6.

METERS

F.S.D.	Size	Type	Fitting	Price
50 microamp	D.C. 2 1/2in.	M.C.	R.P.	50/6
250 "	D.C. 2 1/2in.	M.C.	F.R.	40/-
500 "	D.C. 2 1/2in.	M.C.	R.P.	13/6
500 "	D.C. 2 1/2in.	M.C.	F.R.	18/6
1 mA.	D.C. 2 1/2in.	M.C.	F. Sq.	17/6
1 mA.	D.C. 2 1/2in.	M.C.	F. Sq. (scale callib. 1.5 kv)	15/-
1 mA.	D.O. 2 1/2in.	M.C.	F.R.	22/6
1 mA.	D.O. 2 1/2in.	M.C.	Desk Type	27/6
5 mA.	D.C. 2 1/2in.	M.O.	F. Sq.	7/6
10 mA.	D.C. 2 1/2in.	M.C.	R.P.	10/-
15 mA.	D.C. 2 1/2in.	M.O.	F.R.	7/6
20 mA.	D.C. 2 1/2in.	M.C.	F.R.	7/6
50 mA.	D.C. 2 1/2in.	M.C.	F. Sq.	8/6
200 mA.	D.O. 2 1/2in.	M.C.	R.P.	10/-
500 mA.	D.O. 2 1/2in.	M.C.	R.P.	6/6
500 mA.	D.C. 2 1/2in.	M.O.	F.R.	8/6
0.5 amp.	R.F. 2 1/2in.	Thermo	F. Sq.	4/6
1 amp.	R.F. 2 1/2in.	Thermo	R.P.	8/6
3 amp.	R.F. 2 1/2in.	Thermo	F. Sq.	7/6
5 amp.	D.C. 2 1/2in.	M.C.	F. Sq.	13/6
6 amp.	R.F. 2 1/2in.	Thermo	F.R.	7/6
20 amp.	D.C. 2 1/2in.	M.C.	F. Sq.	10/6
50-0-50 amp.	D.C. 2 1/2in.	M.C.	F. Sq.	7/6
10 volt	D.C. 2 1/2in.	M.C.	R.P.	8/6
15-0-15 volt	D.C. 2 1/2in.	M.O.	F.R.	17/6
150 volt	D.C. 2 1/2in.	M.C.	F.R.	15/-

R.P. = Round projection.
F. Sq. = Flush Square.
F.R. = Flush Round.

Thermo = Thermo-couple.
M.C. = Moving Coil.
M.I. = Moving Ion.



THE "SUPERIOR" FOUR KIT. Our new four-valve receiver. A.C. mains. 200/250 v. M. and Long Waves. As with our very successful "Economy Four" all required components are supplied. Valves line-up: 2 6SG7, 6X5GT and 6V6GT. Chassis ready drilled. Cabinet size: 10 1/2in. high x 10 1/2in. wide. Maximum depth at base, 5 1/2in., tapering to 3 1/2in. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete instruction booklet with practical and theoretical diagrams is provided. Booklet available at 1/6, post free. Our price for complete kit, £8/9/6!!! Please add 2/6 packing and carriage. If preferred, we can supply Cabinet Assembly only, complete Cabinet and back, drilled chassis and bracket, wavechance switch, dial, pointer, drum pulleys, drive spindle, drive spring and knobs, at 45/-. plus 2/6 packing and carriage.

N.B.—Our Kits are even supplied with sufficient solder for the job!

METER RECTIFIERS. 1 mA. by G.E.C. at 11/8, also 5 mA. by Westinghouse at 8/8. I.F. TRANSFORMERS. SPECIAL OFFER. All iron-cored 465 Kc/s. By Weymouth. Size 3 1/2in. x 1 1/2in. x 1 1/2in., 8/6, or Phillips, size 2 1/2in. x 1 1/2in. diameter (cylindrical) 7/6 pair. By Iwatts—Cylindrical, 2 1/2in. x 1 1/2in. diameter, 8/6 per pair. Also, our own special ultra-midget, size 1 1/2in. x 1 1/2in. x 1 1/2in. Only 9/6 per pair. By Wearite, Type 501 and 502, 12/6 per pair.

VERY SPECIAL HIGH-QUALITY RADIOGRAM CHASSIS. We have purchased a limited quantity of these chassis by Britain's leading manufacturers of quality radiograms. Circuit is a 3-waveband five-valve superhet with A.V.C. Valves 6K8G frequency-changer, 6B8G 1.F. amplifier, detector and A.V.C. 6SL7GT. Combined pick-up amplifier and A.F. Amplifier on Radio and Gram. 6V6G, beam-power output tetrode; 5Z4G full-wave rectifier, employing a special circuit for gramophone pre-amplification. A continuously variable tone-control provides ample treble correction without accentuating the bass. Large glass dial, horizontal tuning measuring 1 1/2in. x 3 1/2in. Chassis measurement: 1 1/2in. x 9 1/2in. x 8 1/2in. This is a superior chassis designed to sell originally in a radiogram costing £79. Our price is £13/19/6 only, tax paid, plus 5/- packing and carriage. We will gladly demonstrate this chassis or any other working item from our stocks to personal callers.

INTRODUCING L.T. RECTIFIERS TYPE R.K. A newly manufactured range, fully guaranteed for 18 months, 6 v. 1 a. Centre tapped, 5/- each.

6 or 12 v. 1 a. F.W. bridge type... 7/6
6 or 12 v. 2 a. F.W. bridge type... 11/6
6 or 12 v. 3 a. F.W. bridge type... 12/6
6 or 12 v. 4 a. F.W. bridge type... 15/-
6 or 12 v. 6 a. F.W. bridge type... 23/6
6 or 12 v. 10 a. F.W. bridge type... 37/6

CHARGER TRANSFORMER. High grade wax dipped, 220/240 v. input, 6/12 v. 2 a., at 11/8 only. Also 6/12 v. 4 a., at 17/6.

THE "ECONOMY FOUR" T.R.F. KIT A three-valve plus metal rectifier receiver. A.C. mains 200/250 v. M. and Long waves. We can supply all required components

right down to the last nut and bolt. Five line-up, 6K7, 6J7 and 6V6. Chassis ready drilled—Cabinet size 12in. long by 6in. high by 5in. deep—Choice of ivory or brown Bakelite, or wooden, walnut finish cabinet. Complete instruction booklet with practical and theoretical diagrams. Each component brand new and tested prior to packing. Our price £5/15/- complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver—booklet available at 1/- post free—this is allowed if kit is purchased later—Please, 2/6 packing and carriage for complete kit.

CABINETS. We can supply a cabinet for every requirement, Table Model, Portable Speaker, Portable Player, Console, even for Projection T.V.I. Why not call and see us?

LIGHTWEIGHT CRYSTAL HEADPHONES. Brand new, by Rothenel. List price 70/0. Our Price 25/-!! Limited supply.

HEADPHONES. Brand new, ex-Govt. by S. G. Brown, Type OLB. Low resistance, 7/6 per pair. Type CHE high resistance, 12/6 per pair. We can also supply very special brand new American ex-Govt. light-weight high resistance phones by Trimm at 15/- per pair.

TESTMETER—EX-ARMY. Direct readings 15 v. and 3 v. D.C. 6 mA. and 60 mA. D.C. Current, 500 ohm and 5,000 ohm resistance ranges. Complete in Bakelite case with web carrying strap. 19/6, plus 1/6 p. & p.

VIBRATOR PACK. Brand new, by Mallory. 12 volt input, 150 v. 40 mA. output. Complete with synchronous vibrator, 27/6. T1154 TRANSMITTER UNIT. Medium/high powered for C.W.-M.C.W. R/T. 3 ranges, 10-5.5 Mc/s., 5-3.3 Mc/s., 500-200 Kc/s. Absolutely complete; 4 valves, 2 meters, hundreds of resistors, condensers, etc., in wooden transit case. Price 39/6, plus 7/6 carriage and packing.

ACOS CRYSTAL MICROPHONE INSERTS. We have a few of these taken out of units in good condition at 4/6 only.

22 SET POWER UNIT NO. AMKI ZA10478. Complete with 4 metal rectifiers each 250 v. 60 mA Two 12 v. 4 pin Mallory Vibrators, transformers, condensers, resistors, signal lamp indicator, etc., etc., in good condition. Complete in metal box size 10 1/2in. x 6in. x 8in. Weight 19lb. 27/6 plus 5/- P. & P.

VALVES. We have a very comprehensive stock of special purpose surplus valves at competitive prices. A stamp will bring Valve Price List.

Please add postage under £1. C.O.D. or Cash with order. C.O.D. charge extra—Open 9 a.m.—6 p.m., Monday to Friday. Sorry but we close at 1.0 p.m. on Saturday.

R.S.C. MAINS AND OUTPUT TRANSFORMERS

Fully Guaranteed, Interleaved and Impregnated

FILAMENT TRANSFORMERS

Primaries 200-250 v. 50 c/s.			
6.3 v. 1.5 a.....	5/9	6.3 v. 2 a.....	7/6
6.3 v. 3 a.....	9/6	0.4-6.3 v. 2 a.....	7/9
12 v. 1 a.....	7/11	6.3 v. 6 a.....	17/6
0.2-4.5-6.3 v. 4 a.	16/9	12 v. 3 a. or 24 v.	
		1.5 a.....	17/6

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s Primaries: 0.9-15 v. 1.5 a., 12/9; 0.9-15 v. 3 a., 16/9; 0.9-15 v. 6 a., 22/9; 0.4-9-15-24 v. 3 a., 22/9; 0.9-15-30 v. 3 a., 23/9.

TOP SHROUDED DROP THROUGH TYPE

Primaries 200-230-250 v. 50 c/s.			
250-0-250 v. 70 mA., 6.3 v. 2.5 a.....	12/11		
280-0-280 v. 70 mA., 6.3 v. 3 a., 5 v. 2 a.....	14/11		
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.....	16/9		
350-0-350 v. 80 mA., 6.3 v. 3 a., 4 v. 2.5 a.....	14/11		
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.....	23/9		
300-0-350 v. 100 mA., 6.3 v. 4 v., 4 a., c.t., 0-4-5 v. 3 a.....	23/9		
350-0-350 v. 100 mA., 6.3 v. 4 v. 4 a., c.t., 0-4-5 v. 3 a.....	23/9		
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.....	29/11		
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.....	29/11		

E.H.T. TRANSFORMERS. 2,500 v. 5 mA.,

2-0-2 v., 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 or ACR2X 36/6
5,000 v. 5 mA. 2 v. 2 a..... 39/6

VOLUME CONTROLS with long spindles. all values less switch, 2/9; with S.P. switch, 3/9.

WIRE WOUND POTS: 30 ohms, 500 ohms, 1,000 ohms, 5K, 20K, 50K (medium length spindles), 2/9. 220 ohms, 2K, 10K, 20K, 50K Preset type, 1/9 ea.

AMMETERS. Moving coil. G.E.C. 0—5 amps., 2in. scale, 11/9.

ELECTROLYTICS (Current production.)

NOT ex-Govt.			
Tubular Types		Can Types	
8μF 450 v.....	1/11	10μF 450 v.....	2/9
16μF 350 v.....	2/3	24μF 350 v.....	2/11
16μF 450 v.....	2/9	32μF 350 v.....	2/11
16μF 500 v.....	3/9	32 mfd. 450 v.....	4/9
24μF 350 v.....	3/3	64 mfd. 450 v.....	4/9
32μF 350 v.....	3/9	8-8μF 350 v.....	3/9
32μF 500 v.....	5/9	8-8μF 450 v.....	3/11
8-16μF 500 v.....	4/11	8-8mfd. 500 v.....	4/9
25μF 25 v.....	1/3	8-16μF 450 v.....	2/11
50μF 12 v.....	1/3	16-16μF 450 v.....	4/11
50μF 50 v.....	2/3	16-32μF 350 v.....	4/9
Can Types		16-32 mfd. 450 v.....	4/9
8 mfd. 450 v.....	2/3	32-32μF 350 v.....	4/9
8 mfd. 500 v.....	2/9	32-32μF 450 v.....	5/11
16 mfd. 350 v.....	1/11	60-100 mfd. 450 v.....	7/9

MISCELLANEOUS EX-GOVT ITEMS

Slydelock Fuses, 15 amp., 1/9. Bulgin octal type moulded Bakelite, 5-pin or 7-pin Plugs and Sockets, 1/11 pair. Earphones (Single), low resistance, 1/3.

EX-GOVT E.H.T. SMOOTHING CONDENSERS

.02 mfd. 5,000 v. Bakelite Tubulars.....	1/6
.02 mfd. 8,000 v. Cans.....	1/11
.1 mfd. 2,000 v. Blocks.....	2/9
.25 mfd. 5,000 v. Blocks.....	4/9
.5 mfd. 3,500 v. Cans.....	3/3
.1mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated).....	9/6

EX-GOVT. ACCUMULATORS with non-spill vents.

Unused and guaranteed. 2 v. 16 A.H., 5/9 each, or 3 in wood carrying case 9—7—5in., 14/9, plus 2/6 Carr.

P.M. SPEAKERS. All 2-3 ohms, 3 1/2in. Goodmans

(Ex New Units), 10/9. 5in. Goodmans, 15/6. 6 1/2in. Goodmans, 16/9. 8in. Plessey, 15/9. 8in. R.A. Heavy duty, 18/9. 10in. Rola, 27/9. 10in. Plessey, 18/6. 10in. Rola with Trans., 29/6. 12in. Truvox, 49/9.

M.E. SPEAKERS. All 2-3 ohms, 6 1/2in. Rola-field

700 ohms, 11/9. 10in. R.A. field 600 ohms, 23/9. 10in. R.A. field 1,500 ohms, 23/9. 10in. R.A. field 1,000 ohms, 23/9.

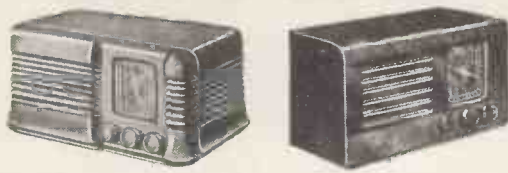
FULLY SHROUDED UPRIGHT MOUNTING

Primaries 200-230-250 v. 50 c/s.	
250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a., Midget type 21-3-3in.....	16/9
300-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.....	18/9
350-0-300 v. 60 mA., 12 v. 1.5 a., c.t.....	18/11
250-0-250 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a.....	25/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a. for R1355 conversion.....	31/6
300-0-300 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a.....	25/9
350-0-350 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a.....	25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.....	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.....	33/9
350-0-350 v. 100 mA., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a.....	45/9
350-0-350 v. 250 mA., 6.3 v. 6 a., 4 v. 8 a., 0-2-6 v. 2 a., 4 v. 3 a., for Electronic Eng. Televisor.....	67/8
425-0-425 v. 200 mA., 6.3 v. 4 v. 4 a., c.t., 6.3-4 v. 4 a. c.t., 0-4-5 v. 3 a., suitable Williamson Amplifier, etc.....	49/9
425-0-425 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a.....	65/8

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000pfd. (.001μF), .002 mfd. (2,000 pfd.). All at 5d. each; 3/8 dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., 6/9 doz. 6.5 v. 0.15 a., 6/9 doz.

BAKELITE AND WALNUT VENEERED CABINETS



Size approximately 12in. x 6 1/2in. x 5in. Bakelite type available in Brown or Cream. Price of Cabinets, 17/6 ea., carr. 2/6.

Suitable fully punched T.R.F. 3-valve and rectifier chassis.....	3/9
Suitable fully punched superhet chassis (4 valves and rect.).....	4/9
Dial Scales, 2 colour, 2 waveband, station named, glass.....	1/6
Dial Scales, 3 colour, 3 waveband, station named, glass.....	1/9
Suitable coloured Metal Backplates.....	1/3
Pointers, Double ended.....	4d.
T.R.F. Coils, 2 waveband with circuit.....	6/9
Drum Drives, complete.....	2/6

THE SKY CHIEF T.R.F. RECEIVER

A design of a 4-stage, 3 valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in any of cabinets illustrated above. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode. The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinary low level of distortion. Point to point wiring diagrams, instructions, and parts list, 2/6. This receiver can be built for a maximum of £4/16/- including cabinet.

SELENIUM RECTIFIER

L.T. Types		H.T. Types H.W.	
2/6 v. 4 a.h.w. 1/9		70 v. 20 mA.	2/11
F.W. Bridge Types		90 v. 20 mA.	3/6
6/12 v. 1 a.....	5/9	120 v. 40 mA.....	3/11
6/12 v. 2 a.....	9/9	250 v. 50 mA.....	5/9
6/12 v. 4 a.....	14/9	350 v. 50 mA.....	7/9
6/12 v. 6 a.....	19/9	250/350 v. 80 mA. 8/9	

CO-AXIAL CABLE. 75 ohms 1/2in., 7d. yard.

SPECIAL PURPOSE EX-GOVT. VALVES (GUARANTEED)

VR01, 5/9, SP61 (VR65), 2/9, VR563/11, 807 6/11, 6J6 10/6, 6SH7Met 6/11, 12SC7GT 6/11, VU120A 2/9, VS110 1/9.

SMOOTHING CHOKES

250 mA., 7-10 H. 200 ohms Shrouded.....	16/9
250 mA., 3 H. 50 ohms.....	11/9
100 mA., 15 H. 350 ohms.....	7/6
80 mA., 10 H. 350 ohms.....	5/6
60 mA., 10 H. 400 ohms.....	4/11
50 mA., 40 H. 1,000 ohms Potted.....	10/9

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s. 120 v. 40 mA.....	7/11
120 v. 40 mA. 5-0-5 v. 1 a.....	14/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66 : 1 for 3S4, etc.	3/6
Small Pentode, 5,000Ω to 3Ω.....	3/9
Standard Pentode, 5,000Ω to 3Ω.....	4/9
Standard Pentode, 8,000Ω to 3Ω.....	4/9
Standard Pentode, 10,000 ohms to 3 ohms	4/9
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull.....	5/6
Push-Pull 8 Watts 6V6 to 3 ohms.....	8/9
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω	15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω.....	16/9
Push-Pull 20 Watts high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω ...	47/9

MICROPHONE TRANSFORMERS

100 : 1.....	5/9
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EX-GOVT. AUTO TRANSFORMERS 50 c/s

Double Wound 100 watts, 5-0-115-125 v. to 10-0-10-210-230 v. or reverse.....	18/9
15-10-5-0-215-235 v. 200 watts.....	25/9
Double Wound 220/240 v. input. Output 51 v. to 250 v. 21 amps. in steps of 11 v.....	89/6

EX-GOVT MAINS TRANSFORMERS

All 230 v. 50 c/s. input 48 v. 1 a. output ...	9/6
Outputs 250-0-250 v. 40 mA., 6.3 v. 2 a., 5 v. 2 a.....	10/9
350-0-350 v. 150 mA. 5 v. 3 a.....	17/6

EX-GOVT. SMOOTHING CHOKES

250 mA., 10 H. 50 ohms.....	14/9
250 mA. 20 H. 250 ohms. Tropicalised.....	13/9
250 mA. 10 H. 100 ohms.....	14/9
250 mA. 3 H. 50 ohms. Potted.....	7/6
150 mA. 10 H. 50 ohms.....	10/11
100 mA. 10 H. 100 ohms. Tropicalised.....	6/9
100 ma. 5 H. 100 ohms. Tropicalised.....	4/6
90/100 mA. 10 H. 100 ohms. Potted.....	8/9
70 mA. 5-10 H.....	3/9
50 mA. 5-10 H.....	2/9
L.T. type 1 amp.....	2/9

EX-GOVT. T.V. TYPE TRANSFORMERS. All

230 v. 50 c/s input.	
1250-0-1250 v. 250 mA., 4 v. 3 a.....	25/-
400 v. C.T. 150 mA. 4 v. 6 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a.....	22/9

EX-GOVT. BLOCK PAPER CONDENSERS

4 mfd. 500 v.	2/9	10 mfd. 1500 v. 7/9
4 mfd. 1500 v.	4/9	
4 mfd. 400 v. plus 2 mfd. 250 v., 1/11.		

EX-GOVT. CATHODE RAY TUBES

VCR517 (guaranteed full picture) (carr. 5/-) 29/6 ea.

EX-GOVT. TRANSMITTER-RECEIVER TYPE TR9D

complete with all valves, only 47/9, plus carr. 6/-.

GH 558

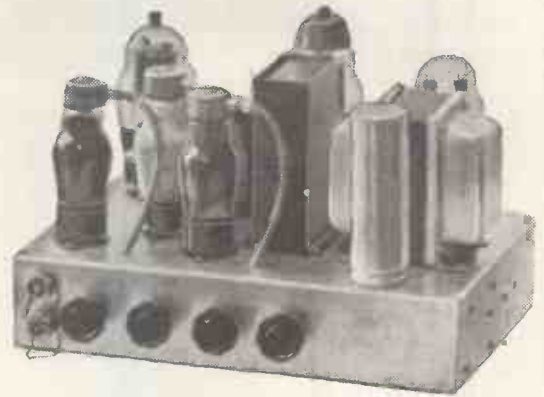
18 s.w.g. undrilled aluminium amplifier type (4-sided)	16 s.w.g. aluminium, receiver type.		
12in. x 6in. x 2 1/2in.	6/11	12in. x 8in. x 2 1/2in.	5/3
14in. x 6in. x 2 1/2in.	6/11	16in. x 8in. x 2 1/2in.	7/6
14in. x 10in. x 3in.	7/11	20in. x 8in. x 2 1/2in.	8/11
16in. x 10in. x 3in.	8/3		
18 s.w.g. aluminium receiver type.		16 s.w.g. aluminium, amplifier type, 4-sided.	
6in. x 3 1/2in. x 1 1/2in.	1/11	12in. x 6in. x 2 1/2in.	7/11
7 1/2in. x 4 1/2in. x 2in.	2/9	16in. x 8in. x 2 1/2in.	10/11
10in. x 5 1/2in. x 2in.	3/3	20in. x 8in. x 2 1/2in.	13/8
11in. x 6in. x 2 1/2in.	3/11	14in. x 10in. x 3in.	13/6

R.S.C. 25 WATT "PUSH PULL" AMPLIFIER

Now firmly established and proving extremely popular, our A11 Quality Amplifier we consider to be the best value in amplifiers offered to-day. The volume of its high fidelity reproduction is completely controllable, from the sound of a quiet intimate conversation to the full glorious volume of a great orchestra. Its sensitivity is so high that in areas of fair signal strength it can be operated straight from a crystal receiver. Entirely suitable for standard or long playing records in small homes or in large auditoriums. For electronic organ or guitar or for garden parties or dance bands.

The kit is complete to the last detail, and includes easy to follow point-to-point wiring diagrams.

Twin volume controls with twin input sockets allow SIMULTANEOUS INPUTS for BOTH MICROPHONE and GRAM, or TAPE and RADIO. SEPARATE BASS and TREBLE CONTROLS giving both LIFT and CUT. FOUR NEGATIVE FEEDBACK LOOPS with 15 db in the main loop from output transformer to voltage amplifier. Frequency response ± 3 db. 50-20,000 c.p.s. Hum and distortion LESS THAN 0.5 per cent. measured at 10 watts. This is comparable with some of the highest priced amplifiers. Six B.V.A. valves, Marconi-Osram KT series output valves. A.C. only, 200-230-250 v. 50 c/s. input. 420 v. H.T. LINE. Paper reservoir condenser. Compact chassis. Matched components. OVERALL SIZE 12 x 10 x 9in. approx. Output impedances for 3 and 15 ohms speakers.



Available in kit form at **9 gns.** Plus the amazingly low price of carriage 5/-

Or ready for use 50/- extra.



COLLARO 3-SPEED AUTOMATIC RECORD CHANGERS (brand new), type RC3521, complete with 2 plug-in Crystal P.U. heads for long playing or standard records 7, 10 or 12in. Not intermixed. Mains input 200-250 v. Limited number available at only **£9/15/-**, plus carr. 5/-.

COLLARO RECORD PLAYER UNIT. Type AC/514. Standard 10in. turntable. Speed normal 78 r.p.m. Crystal pick-up. Mains input 200-250 v. A.C. Brand new cartoned **£3/19/6**, plus 5/- carr.

COLLARO TAPE DESK MOTORS. Shaded pole type. Clockwise or anti-clockwise. Mains input 110-200-250 v., **31/6**.

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/s. To charge 6 v. accumulator at 2 amps., **25/9**.



To charge 6 v. or 12 v. accumulator at 2 amps., **31/6**.

To charge 6 v. or 12 v. accumulator at 4 amps., **49/9**.

ABOVE KITS CONSIST OF BLACK CRACKLE LOUVRED STEEL CASE, MAINS TRANS-

FORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT. The mean charging rates are as indicated above, and complete safety is ensured by fusing of both input and output. Chargers supplied assembled and tested for 6/9 extra.

A PUSH-PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £3/12/6. plus carr. 2/6. For mains input 200-250 v. 50 c/s. Complete kit of parts including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick-up. Output is for 2-3 ohm speaker. (We can supply a very suitable 10in. unit by Rola at 27/9.) The amplifier can be supplied ready for use for 25/- extra. Full descriptive leaflet 7d.

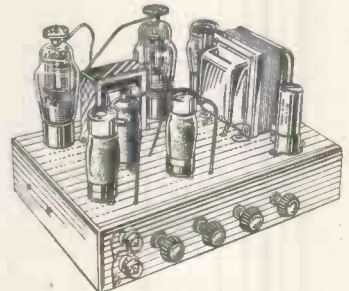
R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 "Listen-Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Brown Bakelite cabinet is included. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT "ALIVE." Ideal also for use as "Baby Alarm." Sound amplification 4 watts. Price only **£5/19/6**. "Listen-Talk Back Unit" as illustration can be supplied at 30/- each. Full descriptive leaflet 10d. The Master Unit can be supplied assembled and tested for 30/- extra.

PERSONAL SET BATTERY SUPERSEDER KIT.

All parts for an "All Dry" Battery Eliminator. Complete with case. Supplies 90 v. 10 mA. and 1.4 v. 250 mA. fully smoothed, from normal 200-250 v. 50 c/s. mains. For 4-valve superhet receivers. Price with circuit **35/9**. Or ready for use, **42/6**. Size of unit **6½-4-1½in.**

BATTERY SET CONVERTER KITS. All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only **48/9**. Supplied ready for use for 7/9 extra.

R.S.C. 10-watt "Push-Pull" HIGH-FIDELITY AMPLIFIER A3



Complete with integral pre-amp. Tone control stage (as A11 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. **8x Negative Feedback Loops.** Completely negligible hum and distortion. Frequency response ± 3 db. 30-20,000 c.p.s. Two independently controlled inputs. Six B.V.A. valves. A.C. mains 200-230-250 v. input only. Outputs for 3 or 15 ohm speakers. Kit of parts complete in every detail, **£7/19/6**, plus 5/- carriage, or ready for use, **45/-** extra. Descriptive leaflet 1/-.

FOUR STAGE RADIO FEEDER UNIT. Design of a HIGH FIDELITY, L and M. wave T.N.F. Unit with self-contained heater supply and thorough H.T. decoupling. Only 250-400 v. 15-20 mA. H.T. required from main amplifier. Three valves and Low Distortion Germanium Diode Detector. Flat topped response characteristic. Loaded H.F. coils. Two variable Mu controlled H.F. stages, 3 gang condenser tuning. Cathode follower output stage. Switch position for Gram. and Gram. input and output sockets. Performance comparable with the best in Feeder Units. For A.C. mains 200-230-250 v. operation. Size 11-6-7½in. Full set of easy-to-follow wiring diagrams and instructions, and individually priced parts list 2/8. This unit can be built for only **£3/15/-**, including Dial and Drive Knobs and every item required.

R.S.C. TONE CONTROL-PRE-AMP. UNIT. A complete set of parts for the construction of a very efficient but simple pre-amplifier and tone control unit. For use with any amplifier and pick-up. Fil. supply self-contained. Size 7½-5-5½in. approx. Descriptive leaflet 9d. Price, inc. wiring diagrams, **37/6**. Ready for use, 15/- extra.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT with case. Mains input 200-250 v. Output 120 v. 40 mA. and 2 v. ½ a. Price with circuit **29/6**. Or in working order, **37/6**.

Radio Supply Co. (LEEDS) LTD.

32 THE CALLS. — LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-, 1/6 extra under £2, 1/11 extra under £3. Full Price List 6d. Trade List 5d. Open to Callers : 9 a.m. to 5-30 p.m. Saturdays until 1 p.m.

GW. SMITH & CO.

(RADIO) LIMITED

American Rotary Transformers. 12 volts D.C. input. Output 255 volt at 65 M/A. Size 4½ in. x 2½ in. For Car Radio Operation. Also suitable for running Electric Shavers from your car supply, 22/6 each. Brand new.

Muirhead Switches. Precision built. 8 pole 2 way. Key switch action, brand new, boxed, heavy contacts, 4/6 each.

Ceramic Transmitter Switches. With extra heavy duty silver-plated contacts, 3 bank single pole 6 way, spacing between contacts 1 in., spacing between wafers 1½ in. and 5 in., 9/6 each.

Mains Isolation Transformers for industrial purposes. 230 volt A.C. 50 cycles input. Output 230 volt 50 cycle 1,000 watts, supplied complete in heavy duty metal case, size 13 in. x 10½ in. x 8 in. Price £6/10/-.

Smoothing Chokes. Heavy duty. 20 Henry 300 M/A., 2,000 volt insulation test. Admiralty rating will pass 500 M/A., 17/6 each.

Mains Transformers. 230 volt Primary, Secondary 500 x 500 at 170 M/A., 4 volt 4 amp. C.T. W.D. rating insulation test 3,000 volts. Ample space for additional 6.3 winding if required, 22/6.

H.R.O. 6 volt Vibrator Power Packs. Output 165 volt 80 M/A., 6.3 volt at 3 amps., 6 x 5 rectifier. Choke condensers smoothed, complete in self-contained crackle cabinet size 7 in. x 7½ in. x 6 in., battery leads with croc. clips supplied. Brand new, 29/6.

Ceramic Switches. Standard spacing, 4 pole 3 way 3 bank. Special price 6/6 each. Brand new and boxed.

Smoothing Chokes. Ex-W.D. 15 Henries at 275 M/A. Ministry rating, resistance 125 ohms, 10/6 each.

Meter Switches. Standard Taxley Wafer Type, 8 bank, single pole 9 way, 11 way or 12 way. Size 2½ in. diameter, switch length 5½ in. plus spindle, 2½ in. Price 7/6 each.

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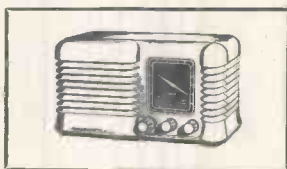
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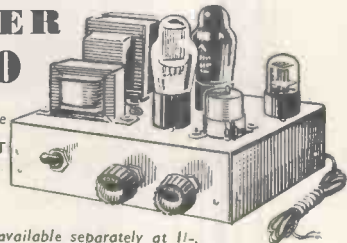
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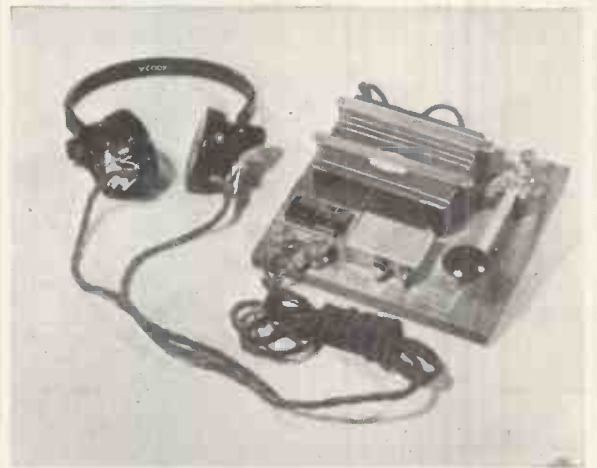
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50 mA.	M.C.	2½in.	Square 7/8
150 mA.	—	2½in.	Square 7/8
200 μA.	M.C.	2½in.	Flush 10/-
300 μA.	M.C.	2½in.	Round 10/-
500 mA.	M.C.	2½in.	Flush 12/8
G.E.C.	1 mA.	Meter Rect.	11/8

M.C. = Moving Coil. M.I. = Moving Iron.
 T.C. = Thermo-Coupled.
 All Meters are Brand New and in original cartons.

No. 38 "WALKIE TALKIE" TRANS-RECEIVER, complete with Throat Mike, phones, Junction Box and Aerial Rods in canvas bag. Freq. range 7.4 to 9 Mc/s. Range approx. 5 miles. All units are as new and tested before despatch, £4/10/-.

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 Containing 4-EF50, 2-SP61, 2-EA50, 1-EB34, 2-single-gang .0005 tuning condensers. W/W volume/controls, switches, condensers and resistors. Size 12in. x 9in. x 5in. New condition, 35/-, carr. 3/-.

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 20-30 Mc/s.
 Switched Tuning.
 With 3-SP61
15/- EACH
 BRAND NEW.

Type 25
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 With 3—SP61.
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Type 26
 50-65 Mc/s.
 Variable Tuning.
 2—VR136 1—VR137
45/- EACH
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VCR138.....	£1 10 0
3BP1, with shield suitable for T/V or scope (carr. 1/6).....	£1 5 0
MU-METAL SCREENS for VCR97 or 517. P.P. 1/6.....	10 0
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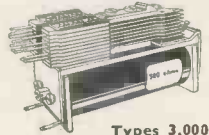
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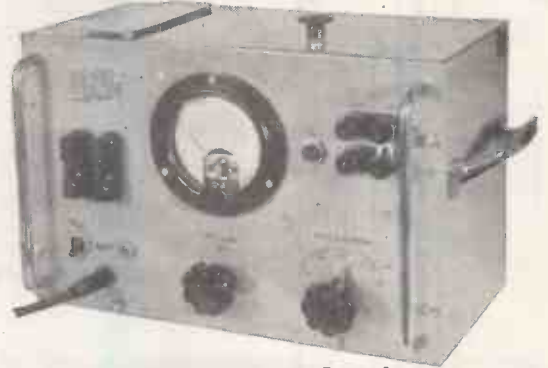
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THESE INSTRUMENTS ARE BRAND NEW, COMPLETE WITH ALL VALVES IN ORIGINAL TRANSIT CASES AND ARE TESTED PRIOR TO DESPATCH. PRICE £15, plus 7/6 carriage.

NOTE that some of these instruments have a "x10 multiplier" and these will be supplied free with the first orders received.

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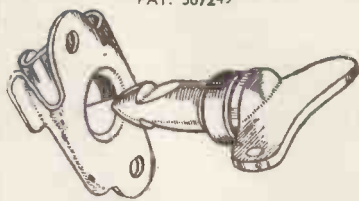
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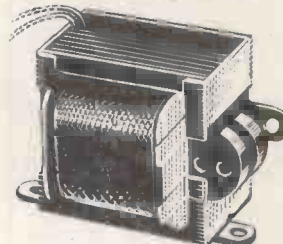
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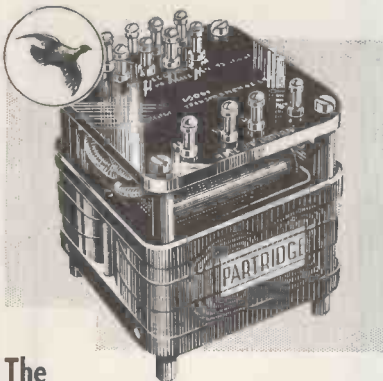
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NEW RECEIVERS AND AMPLIFIERS
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EDDYSTONE 750 receiver, S meter; £47; as new.—Box 4440. [2709]

R1155, wide/narrow band, power pack, £9/10.—35, Upper Richmond Rd., S.W.15. [2773]

WILLIAMSON amplifier, Goodsell tone control unit, 12in P.M. walnut corner cabinet speaker; offers.—Box 4047. [2657]

HALLICRAFTER SX28 in mint condition, manual and spare mains transformer, offers.—Box 4293. [2695]

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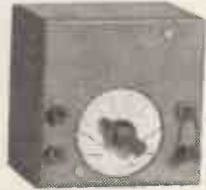
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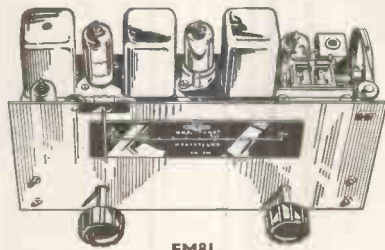
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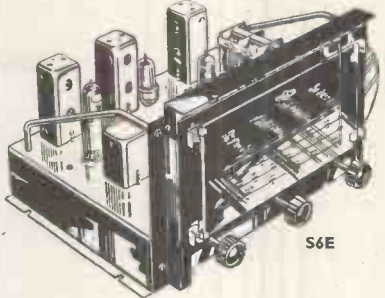
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WANTED, Wilcox Gay V.F.O. units in new or modified condition. McELROY-ADAMS MFG. GROUP, Ltd., 46, Greyhound Rd., London, W.6. Tel. Fulham 1138/9. [0194]

WANTED, receivers A.P.R.4, also T.N. 16, 17, 18, 19, etc., and any radio test gear. LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176]

WANTED, R.C.A. transmitters, all types or any R.C.A. components, including chassis and metal work. McELROY-ADAMS MFG. GROUP, Ltd., 46, Greyhound Rd., London, W.6. Tel. Fulham 1138/9. [0195]

WANTED TCS/6 or TCS/12 transmitters in mint condition; also control boxes for same. McELROY-ADAMS MFG. GROUP, Ltd., 46, Greyhound Rd., London, W.6. Tel. Fulham 1138/9. [0195]

WANTED, HRO coils, Rxs, etc., A.R.88s, BC348s, S27s, etc.—Details to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163]

WANTED, set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components. LOWE BROS., 5, Fitzroy St., London, W.1. Tel. Museum 4389. [2703]

WANTED, BC-610 Hallcrafters, RCA-4356 transmitters SX-28, AR-88, S-27, HRO receivers and spare parts for above; best prices.—P.C.A. Radio, Office and Works, Beavor Lane, Hammersmith W.6. Tel. Riv. 8006. [0080]

NO. 10 headsets or No. 13 microphones large or small quantities required top prices paid.—Industrial Suppliers (Cambridge) Ltd., 15a-17, Brecknock Rd., London, N.7. Gulliver 5891. [2018]

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Earris, 95, Wardour St., W.1. Tel. Gerrard 2504. [2661]

ALPHAM RADIO CO. pay highest prices in the trade for all American equipment, including test sets, transmitters, receivers, etc.—Jersey House, Jersey St., Manchester, 4. Tel. Central 7834-5-6. [0228]

WANTED, R.C.A. speech amplifiers, type MI-11220, J or K, and aerial tuning units BC 939a.—Offers, stating quantity and price to P.C.A. Radio, Office and Works, Beavor Lane, Hammersmith, W.6. Tel. Riv. 8006. [0079]

WANTED, good quality communication rxs., domestic radios, test equipment, etc.: top prices paid, established since 1937.—Miller's Radio, 38a, Newport Court, 1 min. from Leicester Sq. Tube, Tel. Riv. 8006. Call, wire or send. Hours of business 10-6 p.m. Open all day Saturday. [0199]

WANTED, signal generators types 30, 31, 51, 53, 54, 56 and 101; also any American test equipment with prefix TS or BC. American receivers' types AR88, APR4 or similar.—Send price and details to Hatfield Instruments, Ltd., 125, Exbridge Rd., Hanwell, W.7. Tel. Ealing 0779/9657. [0037]

VALVES

500 Valves type DET12 (VT62), for sale, 11/- each.—Pype Hayes Radio, 606, Kingsbury Rd., Birmingham, 24. [2786]

VALVES WANTED

ALL types valves wanted; state price and quantity available.—Box 4441. [2710]

WANTED, surplus Thyratrons, types PG27A and 393A.—Quantities and prices to Mason, 42, North Bar, Banbury. [2692]

ALL types of valves required for cash; state quantity and condition.—Bentley, Ltd., 38, Chalcut Rd., N.W.1. Primrose 9090. [2715]

PROMPT cash paid for any quantities of VR75A's, ARF26's equivalent—Radio Supply Co. (Leeds) Ltd., 32, The... [2607]

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Table with columns: METERS, Now and bored, Price. Lists various meter types and prices.

RL155, slow motion drives, 7/6; B.F.O. box, 4/-; I.F. Filter, 2/6. T.V. Pre-amps, with 1/V1R136, 7/-; with 2 VR91, 17/6; with 1/V1R91, 1/5Z4G and 80c. power pack, 45/- (carr. 6/-). Trans. Input 110/240 v. Outputs 350-0-350 120 mA. 6.3 v. 4 A. 4 v. 2 A. new 18/6. Metal Rectifiers, HW 270 v. 80 mA., 6/- 480 v. 80 mA., 600 v. 30 mA., 6/6; HW CT 12 v. 1 A., 1/6. B0810 Tank Coils, 5/- POTENTIOMETERS 3in. dia., 30k. 10 w. 3/- CONDENSERS 15 kv ceramic, 1 each 800 pF and 250 pF in sealed case, 5/- COILS, Eddystone Tx types 'P' and 'Q' 5-pin bor. base, each 3/6; DYNAMOTORS, solled cases, D.C. (approx. 250 v. 80 mA. at 6 v.), 8/6. 24 v. to 250 v. 100 mA. (twice), 17/6. RELAY 12 v. actuating toothed basket wheel, 2/6. R3170A, 160/220 mcs. 14 valves. Brand new, 75/- (carr. 7/6). WAVEMETERS, new, 3/VR92, 3/VR136, 1/6/5. 140/250 mcs. 30/-, I.F.T.s. new, canned 7 mcs. (RL385) or 10/13 mcs./s. 1.8. R.F. UNITS type 24, 15/-; 25 17/6; 26 45/-; 27 45/-; (26 and 27 with broken dials, 35/-). Universal Atomer, replacement front panels, 7/6. GLOKES LR 9H 100 mA. 7/6; 5H 200 mA. 4/6; 50H 30 mA. 4/6. CR100 Power Packs (Rotary) 6 v. D.C. to 200 v. 80 mA. smoothed, suppressed, 17/6 (carr. 7/6). NOISE GENERATORS, new, with valves, 4/VR85, 1/6V6G, 1/6V172, 30/- (carr. 6/-) with transit case, 7/6 extra. NOISE SUPPRESSORS, with valves, 1/6/5, 4/EB34 and 10 spares, 230 v. 80 c. input, 30/- (carr. 6/-).

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"WESTALITE" (BRIDGE), 12-15 v. D.C., 1.2 a., 15/10; 2.5 a., 27/8; 5 a., 31/9; 10 a., 54/6; 20 a., 99/6; 30 a., 144/10; 50 a., 257/-; 24 v. 1.2 a., 15/10; 2.5 a., 27/8; 5 a., 51/-; 10 a., 92/7; 20 a., 176/2; 36 v. 1.2 a., 27/8; 2.5 a., 51/-; 5 a., 69/10; 10 a., 130/9; E.H.T. RECTS., 14D, 134, 22/-; 36 E.H.T. 60, 31/10, all post extra.

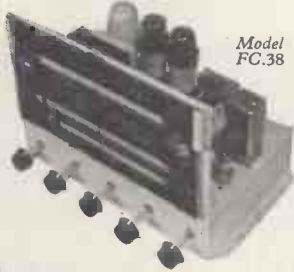
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60/- paid for 725A/Bs, 45/- 813s, also required types 808, 707B, 832, etc., any quantity.—Write/tel. Pype Hayes Radio, 606, Kingsbury Rd., Birmingham, 24, Erdington 4942. [2456]

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MODERN CONTACT LENS CENTRE, 7(J.1), Endsleigh Court, W.C.1. Deferred terms. Booklet sent. [0211]

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LEWIS RADIO have the best selection and finest finish.—See page 140. [0224]

WALNUT radiogram cabinets; details.—Cabinetware, 1a, Heyes St., Blackburn.

WALNUT radiogram and television cabinets, soundly constructed; stamp for details.—R. Shaw 69, Fairlop Rd., Leytonstone, E.11. [2462]

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THE ELECTRICAL INSTRUMENT REPAIR SERVICE, 329, Kilburn Lane, London, W.9. Tel. Lad. 4168. [2011]

24-HOUR service, 6 months' guarantee, any transformer; rewind, mains outputs and i.f.s., etc.; all types of new trans., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth. [2526]

AUDIO Equipment repaired/rebuilt or modified, disk or tape reproduction, amplifiers/sound projections, quotations without obligation, extended payments available above £15.—Bernard J. Brown, 33, Goldhawk Rd., London, W.12. [0025]

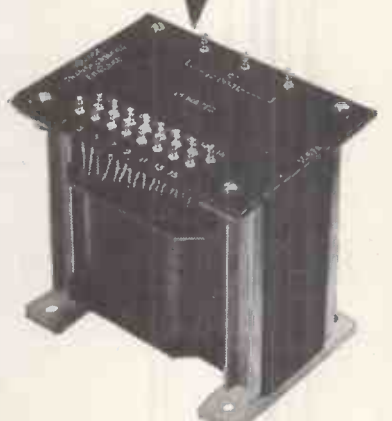
REWINDS and conversions to mains and output trans, pick-ups, fields, clock coils, etc., from 4/6; FP equipment a speciality; all work guaranteed.—N.L. Rewinds, 173, High Rd., Willesden Green, N.W.10. Tel. Wordsworth 7791. [2769]

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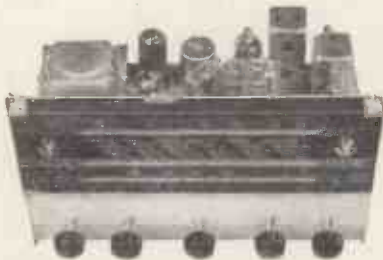
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ELECTRONIC sub-contracts and prototypes: modern miniature technique, exp. government work, skilled labour only.—Astria Radio and Television, Electra House, Haslemere, Surrey. Tel. Haslemere 1134. [2606]

CAPACITY AVAILABLE
STABILISED power units, for development and research; plastic castings and "potting," single or repetition; sub-contract wiring and assembly wanted.—Newtown Industries, Lymington, Hants. [2654]

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CABLE round twin rubber 23/36 in 100yd coils, 36/100yds, £15 per 1,000.—Radiovox, Ltd., Oxford Place, Leeds, 1. [2763]

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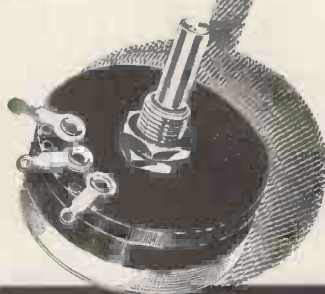
PATENTS
THE proprietor of British Patent No. 567462, entitled "Electronic Tube," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern & Carlberg, 14, E. Jackson Blvd., Chicago, 4, Illinois, U.S.A. [2602]

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(magnetic) " " " " " " "	£9 10 2
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SITUATIONS VACANT
ELECTRONIC Technicians.

ELECTRONIC Technicians (Tech. Grades I & III) are required at Atomic Weapons Research Establishment, Aldermaston, Berkshire, to comprise a team responsible for the maintenance and efficient operation from the electronic aspect, of an electronic digital computer. A recognized engineering apprenticeship or equivalent training in an appropriate trade is essential, together with a wide knowledge and experience of electronic work, in particular pulse techniques. A period of training with a firm of electrical contractors will be necessary. SALARY: Tech. Grade I. £702 rising to £848. SALARY: Tech. Grade III. £480 (at 26) rising to £597. HOUSING accommodation available within a reasonable time for successful candidates. If married—Applications to Administrative Officer Recruitment, A.W.R.E., Aldermaston, Berkshire, quoting ref. 43/W.G.E. [2675]

HER MAJESTY'S COLONIAL SERVICE.

APPLICATIONS are invited from radio engineers for eventual appointment as broadcasting engineers in Colonial Government broadcasting services. Applicants should be over the age of 28 and be Graduates of the Institution of Electrical Engineers or in possession of an Engineering Degree or Diploma recognised as granting exemption from Sections A and B of the Institution's examination. Experience in the radio industry or in the radio branches of Her Majesty's Services for at least two years is necessary but applicants need not have experience directly related to broadcasting. SUCCESSFUL applicants will receive operational training in the B.C. and at any time within two years after initial engagement, they will be required to take up contract appointments with a Colonial Government in any part of the world, as broadcasting engineers. Choice of territory will be given where possible, but is not guaranteed. TOTAL emoluments during training in the U.K.—£800 per annum Salary on appointment to a Colonial territory will not be less than £1,000 per annum plus such allowances as are prescribed under the regulations of the Colony concerned.

APPLY in writing to the Director of Recruitment, Colonial Office, Great Smith St., S.W.1, giving briefly age, qualifications and experience. Mention the reference number CDE 96/02. [2705]

E. K. COLE, Ltd. (Malmesbury Division):

The Malmesbury Division of E. K. Cole, Ltd., is engaged in the development and production of radar and communication equipment associated with high priority defence projects. Vacancies exist in the Development Department for project engineers, engineers and assistant engineers with training and experience in the following fields:—

- PULSE circuits.
- Pulse modulators, strobe systems, Video amplifiers, time base generators, etc.
- MICROWAVE technique.
- Aerial design for radar scanners and waveguide components for high power T/R units.
- H.F. and V.H.F. Communication.
- Airborne and ground receivers, transmitters and aerial systems.
- TRANSFORMER design.
- High frequency power transformers for airborne equipment.
- MECHANICAL engineering.
- Light mechanisms and structures for radar scanners.

APPLICANTS should have had technical training to Degree or Higher National Certificate standard and in the case of project engineers and engineers appropriate technical design experience is necessary. Commencing salaries will be dependent on qualifications and experience, and will compare favourably with scales prevailing in the radio industry. Housing accommodation may be available in the near future for successful married applicants. A superannuation scheme is in operation, together with canteen and full welfare facilities. Applicants should apply in the first instance for a technical staff application form to Personnel Manager, E. K. Cole, Ltd., Malmesbury, Wilts. [2792]

RADIO Officer (Technician) required by the

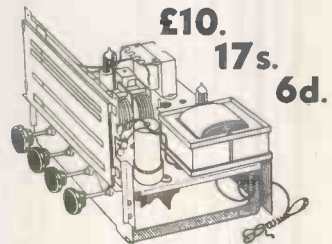
DESERT Locust Control, East Africa High Commission, for one tour of 24-48 months in the first instance. Salary, etc. £742 rising to £1,433 a year (including allowances which vary according to posting), plus gratuity of at least £96 a year. Outfit allowance £30. Free passages and liberal leave on full salary. Candidates must have a thorough practical knowledge of the working and maintenance of HF and VHF radio equipment and also of the smaller I/C engine-generator sets for power supply.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name, in block letters, full qualifications and experience, and quote M2C/30442/WF [2669]

MULLARD Research Laboratories require experienced WIREMEN for interesting work on electronic equipment. Applicants must be able to work from theoretical wiring diagrams. High frequency wiring experience with a knowledge of components assembly preferred. Staff conditions of employment. Salary according to age and experience. 5-day week. Pension scheme.—Apply Mr. G. A. Taylor, Mullard Research Laboratories, Cross Oak Lane, Salfords, Near Redhill Surrey. [2682]

MONEY BACK GUARANTEE DUKE & CO
621 ROMFORD ROAD, LONDON, E.12
CWO or COD • TEL: GRA 6677

T.V. TUBES £5-12"

3 months' guarantee. Not ex-W.D. Had some hours use. Various types and makes. Picture shown to callers. Carriage and Insurance 15/6 extra. No catch. Special Offer of tubes with burns for testing and spares at 30/- each.



Latest show, band spread tuning, feed-back, all brand new. 6-waveband (illustrated), 15 guineas, with 6-position tone control. 3-waveband (B3) at 12 guineas. £10/17/6 (X9), similar to above but by another Manufacturer. All models have 5 valves (latest miniatures), flywheel tuning, negative feed-back, gain switch, extension speaker and pick-up sockets. Post 3/6.

AMPLIFIERS. Push-pull. 77/6. 7 watts output. A.C. or Universal. 4 valves and 1 rec. Post 2/6.

AMPLIFIERS. 57/6. 4 watts output. 3 valves. A.C. or A.C./D.C. Post 2/6.

AMPLIFIERS. 9/6. Bargain. Brand new (ex-W.D., unused). Contain EF36, two transformers, 400 ohm relay, volume control, various conds., resistors, etc. Case measures 5in. x 5in. Also less valves at 4/9. Post 1/6. WITH FREE DRAWINGS.

SPOTLIGHTS. 8/9. Butlers, new but ex-W.D. 7 1/2 in. dia., 6 1/2 in. deep. Post 1/3.

SIDELIGHTS. 1/9. Infra-red glass. Easily changed for clear or red. Ideal tail lamps. New, ex-W.D. Post 9d.

RECTIFIERS. 8/9. T.V. type. Salvage, guaranteed. 300 volt at 200 mA. Also 180 volt at 40 mA. 3/9. Post 1/-.

TELESCOPIC MASTS. Ex-W.D. but unused. Extend to 7ft. 6in. Base diameter 3in., tip 1/2 in. Closed length 15in. Ideal aerial GIFT PRICE 5/9. Post 1/3.

ROTARY CONVERTER. 12/6. Ex-W.D., new. In 24 v., out 200 v., at 50 mA. Post 2/6.

MICRO-SWITCHES. New American miniatures, 250 volts, 3 a., 3in. x 1 1/2 in. **BARGAIN OFFER,** 3/6 each, post 4d.

CRYSTALS. Germanium. Brand new made by B.T.H. Give first-class results. **SPECIAL OFFER,** 1/9, post 6d.

DUNLOPILLO EX-COACH SEATS. 3 1/2 in. x 16in. x 4in. With back (19in.). 37/6. Ideal for cars, caravans, utilities. Carriage 4/6.

TRANSFORMERS. Car Radio trans., 5/9, 6 v. and 12 v. Post 2/-. Microphone trans., 2/9, ex-W.D., fully shielded. Post 1/-. Pick-up trans., 2/9. E.M.I. type, fully shielded case. Post 1/-. [2675]

EXTENSION SPEAKERS. 37/6. In polished cabinet with 8in. speaker. Post 2/6.

EXTENSION SPEAKERS. Brand new 6 1/2 in. P.M. speaker (low impedance). Mounted on polished and veneered baffle stand, gold fret, 5ft. lead ready connected. **ONLY 19/9.** Post 1/9.

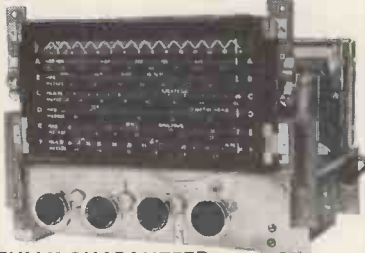
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DIRECT FROM THE MANUFACTURER

Dulci Radio/Radiogram Chassis

A/C 100-120 & 200-250 VOLTS.

All chassis 11 1/2 in. x 7 in. x 8 1/2 in. high. Latest type valves 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Flywheel tuning. Negative feedback over entire audio section. Engraved knobs. 3 Tone position for Radio and Gram.



- FULLY GUARANTEED**
- Model B3, Long, Med., Short (5 Valves) **£12. 12. 0**
 - B3 Plus Push Pull Stage (6 Valves) **£15. 15. 0**
 - B3 Double Feature P/Pull & RF Stage (7 Valves) **£18. 18. 0**
 - Model B6 Six Wavebands Med. L. 4 Short (Bd-Spread) **£15. 15. 0**
 - B6 Plus Push Pull Stage (6 Valves) **£18. 18. 0**
 - B6 Double Feature P/Pull & RF Stage (7 Valves) **£23. 2. 0**

ALL PRICES TAX PAID

Escutcheon for 9 in. x 5 in. dial, 4/9 extra. Matching speakers P.M. type 3 ohms 8 in or 10 in available. Money back guarantee. Free particulars from the Manufacturers.

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Quick y and Accurately Forms

Angles, Channels, Sections, Boxes, Lids, Trays, Tanks, Chassis Brackets, Clamps, Clips, Shrouds, Chemical, Electronic and Electro Medical apparatus. Used by leading Radio Manufacturers. Invaluable to Servicing Engineers, Hospitals, Universities and Research Workers.

For 6 page Folder write to:—



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197a Whiteacre Rd., Ashton-u-Lyne

SITUATIONS VACANT AERONAUTICAL Radio Engineers.

MARCONI'S WIRELESS TELEGRAPH Co., Ltd., are continually expanding their already wide activities in the field of aeronautical radio. There are posts available for development, project, field and sales engineers on all aspects of airborne and ground communications and radio and radar navigational aids for both civil and military purposes. Any engineer who is interested in this field should apply in confidence, giving details of his experience, etc., and quoting reference S.A.44, to The Manager, Aeronautical Division, Marconi's Wireless Telegraph Co., Ltd., Dept. C.P.S., 356-7, Strand, W.C.2. [2743]

TECHNICAL assistants required by the

NIGERIA Government Broadcasting Department for one tour of 18/24 months with option of appointment (a) on agreement with prospect of permanency with salary, etc., according to experience in scale £750, rising to £1,035 a year, or (b) on agreement on temporary terms with salary, etc., in scale £807 rising to £1,115 a year plus gratuity of up to £150 a year; outfit allowance £60; free passages for officer and wife; assistance towards cost of children's passages or grant of up to £150 annually for maintenance in U.K.; liberal leave on full salary; candidates should have good experience in the engineering division of the B.B.C. Those selected will be required to undertake operational duties relating to the control and maintenance of radio equipment at radio distribution studios and to assist in the general technical duties.

WRITE to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30188/WF. [2729]

EXPERIENCED Microwave Engineers

ARE invited to apply to Decca Radar, Ltd., to join the Company in its extensive work in a wide field of microwave link and radar development; the Company offers excellent starting salaries and first-rate opportunities for men to exploit their initiative and to rise rapidly to responsible posts; graduates without industrial experience who are prepared to undertake intensive training are also invited to apply for junior posts; applicants must be of British nationality.—Apply, Ref. ELA/14, Decca Radar, Ltd., Research Laboratory, 2, Tolworth Rise, Surbiton, Surrey. [2509]

THE NATIONAL HOSPITAL, Queen Square, W.C.1.
YOUNG technician required to assist in construction, maintenance and use of electronic equipment for medical research project being carried out during the next year; previous experience desirable but not essential.

APPLY in writing to Director, Neurological Research Unit. [2738]

FERGUSON RADIO CORP., Ltd., have vacancies for:—

SENIOR Engineers with initiative and sound technical background for work on a wide range of projects in the field of electronics, including Television, Radio, Communications and Test Equipment. Permanent posts for men able to carry responsibility in rapidly expanding departments offering exceptional promotion and long-term prospects.

JUNIOR Engineers of ability for work on Development projects offering a wide experience in the fields of Television, Radio, Communications and Test Equipment, with excellent prospects for advancement.

VACANCIES exist in Laboratories situated both at Enfield and Spennymoor Co. Durham. These Laboratories are well equipped and working conditions excellent. Successful applicants eligible for Company's Pension Scheme. Housing assistance considered in appropriate cases. Applications, specifying the post for which application is made and giving full particulars as to age, qualifications and experience, etc., to Employment Manager, Ferguson Radio Corp., Ltd., Gt. Cambridge Rd., Enfield, Middlesex. [2747]

ATOMIC Energy Research Establishment, Harwell.

URGENTLY requires skilled **INSTRUMENT Mechanics (Electrical & Mechanical)**, **INSTRUMENT Makers**, **MACHINE Tool Fitters**, **TOOL Makers**, **MECHANICAL Inspectors**, **ELECTRICIANS**.

TO serve as R. & E. mechanics (special). The commencing rate of pay for 44-hour five-day week is 139/4 plus merit pay of 26/-. There are prospects of advancement to higher rates of merit pay.

SINGLE accommodation is available immediately and every effort will be made to house suitable married applicants as houses become available.

APPLY in writing, giving particulars of apprenticeship, training (including Forces training), qualifications and experience to Director, A.E.R.E., Harwell, Didcot, Berks, marked "For the attention of Senior Labour Manager." [2724]

ELECTRONIC and Magnetic Amplifier Engineers. **INTERESTING** progressive research positions are offered to men of initiative and research ability in the above fields. The positions are tenable in London. Qualifications preferably a degree in Electrical Engineering, but alternative qualifications will be considered.

APPLY in writing to the Chief Development Engineer, Westinghouse Brake & Signal Co., Ltd., 82, York Way, London, N.1. [2698]

SPECIAL OFFERS

R.F. UNITS TYPE 26. 50-65 Mc/s. Variable tuning, complete with valves. A fortunate purchase enables us to offer these units at the special low price of 35/-, post 2/6.

RECEIVER R.1355. Specified for "Inexpensive Television." In original packing, with all valves, 38/6, carriage 7/6.

AMPLIFIERS. A high fidelity unit with separate Bass and Treble controls, constant impedance attenuator for setting volume level. In metal case with handles, 15 watt output, for 200/250 v. A.C. Mains operation. Intended for use with the Gaimont British Projector. Ideal for P.A. work, dances, etc. Less valves. £12/10/-. Or complete with all valves, £15/12/6. Cge. 10/-.

SPEAKERS P.A. Goodmans P.M. 12 in. 15 ohms. Type T.2. A high class speaker at a low price. Ideal for above amplifier, £5/10/-.

SPEAKER CASE, suitable for above. 19 x 17 x 13 in. With lock, carrying handle, compartment for cable. £3/10/- Cge. 10/-.

RECEIVER R1132A, 100/124 Mc/s with 200/250 v. A.C. Power Pack and all valves, £6/15/-, carr. 10/-.

ROTARY CONVERTERS. Input 24 volts D.C., output 230 volts A.C., 50 cycles, 100 watt, 92/6 each. Also available with 12 volt input, 102/6, carr. 5/-.

VOLTMETERS. For A.C. mains 50 cy. 0/300 v. Surface type 5 inch open scale, 60/-, worth double.

MOVING COIL METER with 1 M/A movement, 2 1/2 in. flush, rectifier type, scaled 0/100 volts A.C. Resistance 100 k. ohms. A very useful basic meter, 30/-.

VALVES. VU111 3/-, SP61 5/-, VR150/30 10/-, VR105/30 11/-, EF50 7/6.

Full lists available.

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EUREKA & CONSTANTAN RESISTANCE WIRES

Prices per ounce

SWG	Enam.	DASC.	SWG	Enam.	DASC.
16	1/6	1/6	28	2/1	2/6
17	1/6	1/6	29	2/2	2/6
18	1/6	1/6	30	2/2	2/6
19	1/6	1/6	31	2/3	2/8
20	1/6	1/6	32	2/3	2/8
21	1/6	1/6	33	2/4	3/-
22	1/6	1/8	34	2/6	3/-
23	1/6	1/10	35	2/8	3/3
24	1/8	2/-	36	2/9	3/6
25	1/10	2/2	37	3/-	3/9
26	2/-	2/4	38	3/3	4/3
27	2/-	2/4	40	3/6	4/9

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SWG	2ozs	4ozs.	2ozs.	4ozs.
16	1/4	2/-	1/4	2/-
18	1/4	2/2	1/4	2/2
20	1/5	2/4	1/5	2/4
22	1/6	2/6	1/6	2/6
24	1/7	2/8	1/7	2/8
26	1/8	2/10	1/8	2/10
28	1/9	3/-	1/9	3/-

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POST RADIO SUPPLIES

33 Bourne Gardens, London, E.4

MAINS TRANSFORMERS. Input 200/240 v. Output 350-0-350, or 250-0-250 v. both with 6.3 v. and 5 v. tappings. 21/-, postage 9d.

OUTPUT TRANSFORMERS. Standard size. 6/9 each, post 6d.

HALF WAVE METAL RECTIFIERS. 125 v. 60 mA, 4/3, 100-mA, 4/9; 125 mA, 5/6; 250 v. 250 mA, 1/6, post 6d.

METAL RECTIFIERS. 12 v. 3 A, 10/-, 12 v. 2 a., 9/-, post 9d.

.0005 TWIN GANG TUNING CONDENSERS, 6/6 each. Ditto midgets, 7/6 each, post 9d.

SPEAKERS. All brand new, permanent magnet. 3 1/2 in., 16/6, 5 in., 16/9; 6 1/2 in., 15/9; 8 in., 21/6. Postage 1/-.

SPEAKER CABINETS. Polished wood, metal grilles, 6 in., 16/6; 8 in., 19/6, post 1/-.

AMPLIFIERS. 3 valve A.C. Mains complete, brand new, 44/10/-, post 2/-.

SHORTWAVE RECEIVERS. R.103A for use on 100/110 and 230/50 volt A.C. and 12 volt battery. Comprising 6 valves and built-in vibrator pack covering 1.7 Mc/s to 7.5 Mc/s. Brand new in perfect working order, 49/15/- each.

EARPHONES 60 ohm C.L.R., 5/- per pair, 4,000 ohm, 17/6 per pair, post 9d.

Government Surplus. **2 VALVE AMPLIFIERS.** Type A.1134A, with valves. Not guaranteed. Working. 15/- each, post 2/-.

SOLDER. 1 lb. reels 40/60, 5/- reel, post 1/-.

50 MFD. MOTOR CAPACITORS. Brand new. 10/6 each, post 9d.

BRAND NEW AND BOXED METERS. 0/2 Hot wire ammeters, 2 in. square, 5/6 each. 0/6 Thermo-Couple ammeters, 2 1/2 in. 10/-.

0/30 mA A.C. D.C. 2 1/2 in. flush, 9/- each.

0/15 volt A.C. M.I. 2 1/2 in. flush, 12/6 each.

0/200 mA D.C.M.C. 2 1/2 in. flush, 9/- each.

0/300 mA D.C.M.C. 2 1/2 in. flush, 9/- each.

0/1 mA M.C.D.C. 2 in. Square flush, 12/6 each.

0/1 Thermo-Coupled Ammeters 2 1/2 in. projecting R.F., 6/- each.

—0/3,500 volt D.C.M.C. 3 in. scale, 4 in. projecting, 17/6 each. Post 9d. all meters.

SIMMERSTAT VARIABLE CONTROL SWITCHES. For use on 230/50 volt A.C. at 2,500 watts, 17/6 each, post 9d.

CUT OUTS. 12 volt 60 amp and 24 volt 60 amp, 7/6 each, post 9d.

TAPE DECK CABINETS. Finished in imitation lizard skin, colours green, red, grey, blue, size 14 1/2 in. x 16 in. x 1 1/2 in. deep, 43/7/6 each, carr. 2/-.

Please state alternative colour.

SMALL WOUND CARRYING CASES. 12 in. x 8 in. x 5 in. deep, fitted leather handle and lid clasp, 7/6 each, post 1/6.

ELECTRIC BOWL FIRES. Brand new. Cast Base, highly polished aluminium bowl. 750 or 600 watt at 200/50 volts A.C. and D.C., 33/- each, carr. paid.

Obtainable from:—

J. & S. KAYE SUPPLIES
(Dept W.W.)
(Late Universal Engineering Co.)
11, St. Anns Road, Harrow, Middx.
Tel: HAR. 1432
Shop hours: 9 to 6 Mon. to Sat. Half-day Wed

SITUATIONS VACANT
M.L. AVIATION Co., Ltd., White Waltham, nr. Maidenhead, Berks.

VACANCIES for experienced AIRCRAFT electrical draughtsmen for a wide range of high priority experimental and development work; salary according to experience APPLY stating age, experience and salary required to The Chief Draughtsman. [2519]

THE Telegraph Construction and Maintenance Co., Ltd., require:
1. Graduate electrical engineer or physicist to work on the development of polythene insulated high voltage cables; this will include developing suitable testing methods and equipment; direct or relevant experience in these fields desirable.
2. Qualified electrical engineer to work on the design of cable fittings; the work involves the development of fittings for polythene insulated high-voltage cables; practical experience of cable accessories desirable.
THESE posts are pensionable and carry salaries of £550—£600 upwards.—Details to Staff Officer, Telcom Works, Greenwich, S.E.10 [2759]

DEVELOPMENT engineer required, design experience of HF and VHF transmitters essential.
GOOD theoretical background and knowledge of production methods desirable.
APPLY with full details to Personnel Manager, Pye Telecommunications, Ltd., Ditton Works, Cambridge. [2343]

ELECTRIC & MUSICAL INDUSTRIES, Ltd., have the following vacancies in their Record Engineering Dept. at Hayes:—
(1) ENGINEER, Graduate or H.N.C. with experience in design and development of recording equipment.
(2) JUNIOR Engineers for work in the above field.
APPLICANTS should be near completion of or exempt from National Service.

RADIO Research Department, Junior technical assistant able to assist in as many as possible of the following:—
ELECTRICAL and radio measurements, construction of prototype apparatus, preparation of reports, technical records, etc., generally to be used in a small laboratory. Ability to use metal and wood-working tools with some degree of accuracy is desirable, and a knowledge of typing could be advantageous. Good education to matriculation standard and some knowledge of electrical theory is essential. Female applicants would be considered if possessing typing experience and good training in radio theory (e.g., ex W.R.N.S.) etc.
FULL details of age, education, experience and salary required to: Box 590, Era Publicity, Ltd., 7 Fitzroy Square, London, W.1. [2668]

TELEVISION service engineer required, good references essential.—Write W. L. & F. M. Jones, Ltd., High St., Cobham, Surrey. [2719]

RADIO engineer, licensed, required by Morton Air Services, Ltd., Croydon Airport.—Apply in person or writing. [2734]

TECHNICAL Staff are required by The English Electric Co., Ltd., Luton, for the following vacancies on work of national importance.
(1) TECHNICAL Assistants with sound knowledge of physics and electrical theory and experience in Electronics Industry, to assist on ground testing.
(2) LABORATORY Technicians for repair and calibration of electronic laboratory test equipment. Must have wide experience in this work.
(3) COMPUTOR, must be to G.C.E. standard in Mathematics, but advanced or higher level preferred.

THESE positions are permanent and progressive, with attractive salaries. A Staff Pension Scheme is in operation.—Applications to Dept. O.P.S., 336-7, Strand, W.C.2, quoting Ref. S.A.42. [2678]

RADIO service mechanics required by Smiths (Radiomobile), Ltd., for many parts of the country.—Write details of experience and qualifications to Personnel Officer, Goodwood Works, North Circular Rd., London, N.W.2. [0342]

FERRANTI, Ltd., Manchester, have staff vacancies in connection with long-term development work on an important radio tele-control project at their new laboratories at Wythenshawe, South Manchester.
(1) ENGINEERS for research and development work in the following fields:
RADAR radio and electronic circuits, micro-waves, vacuum and/or high voltage techniques, servo control and electro-mechanical devices and testing equipment associated with the above.

QUALIFICATIONS include a degree in Physics or Electrical Engineering or Mechanical Science, or equivalent qualifications, and at least two years previous experience. Salary according to qualifications and experience in the range £500-£1,000 per annum.
PLEASE quote reference WE.
(2) TECHNICAL assistants for experimental work in the fields listed in (1) above.
QUALIFICATIONS required: a degree or Higher National Certificate in Electrical or Mechanical Engineering or equivalent qualifications. Salary in the range of £400-£600, according to age and experience.
PLEASE quote reference WT

PERMANENT staff appointments with pension benefits.
APPLICATION forms from Mr. R. J. Hebbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs.
PLEASE quote appropriate reference. [2664]

H. FRANKS
58 NEW OXFORD STREET
LONDON, W.C.1
PHONE: MUSEUM 9594

One minute from Tottenham Court Road Stn.

VALVE VOLTMETERS, triple range. 50/200/500 volts, input voltage, 80 v. 400/2000 cys.—115 v. 400/2000 cys.—110 v. 60 cys.—180 v. 500 cys.—230 v. 50 cys.—230 v. 400 cys., fitted in instrument case, 14 x 8 1/2 x 9 in. £5/10/- each.

CANADIAN FULLY SMOOTHED ROTARY TRANSFORMERS, housed in metal case 8 1/2 x 6 x 4 1/2 in. Input 12 v. 2.5 amps. Output 220 v. D.C. 60 mA. Price 40/- each.

HOOVER BLOWER MOTORS, ref. No. 10KB/15 for 12/24 volts A.C./D.C., ideal for car heaters, cooling, etc. 27/6 each.

STEPDOWN TRANSFORMERS, input 180/230 volts A.C., 50 cycles, output 4.2 + 4.2 volts, 10 amps., ideal for low voltage soldering. 35/- each.

HEAVY 3-CORE FLEXIBLE 50-AMP. CABLE, in 150ft. lengths. Fitted 3-pin 50-amp. Nipham plug and socket each end. This cable is braided, rubber and waterproofed sample piece on request. Price £8/10/- per coil.

RECTIFIER UNITS, type 58, input 200/250 v. A.C. 50 cys., output 20/24 volts D.C. 3 amps, smoothed, continuous rating, fitted in metal case 12 x 20 x 8 in., £4/10/- each, carriage 10/- extra.

WESTINGHOUSE RECTIFIER SETS. Style 228/G.P.O. Input, 200/250 volts A.C., 50 cycles, output 50 volts D.C., 1 1/2 amps. £3/10/- each, carriage 10/-

VARIABLE RHEOSTATS. Graduated 1/2 amp. to 2 amps., 45 ohms. Ideal for chargers, voltage control, etc. Ref. 50/728. Fitted in Bakelite case 4 in. square 1 1/2 in. deep. 12/6 each.

SPERRY'S CONSTANT SPEED 115 volts 50 cycles motors, 2,400 r.p.m., 3 1/2 in. diam., 6 in. long, 5/16 in. spindle, 1 1/2 in. long. Serial No. LB1931. 37/6.

COLD CATHODE RELAY UNITS. Fitted two S.T.C. Cold cathode tubes, No. G240/2D, two Siemens High Speed Relays, 1700/1700 ohms, size of unit approx. 6 in. x 7 in. x 4 in. £3/2/6 each.

MINIATURE CLOCKWORK TIMERS Variable, 10 seconds to 3 minutes. Ideal for model work, photographic timing, etc. With slight modifications will run 15 mins. full wind, size 1 1/2 x 1 1/2 x 9/16 in. 3/6 each.

50 ONLY, 19 in. METAL RACKS, complete with covers, standard racking, as new. Price to clear the lot 15/6 each.

SANGAMO MOTOR UNITS, model 7, final speed one revolution per seven days, 200/250 v. A.C., 50 cycles. Price 30/- each.

HEAYBERD, DOUBLE-WOUND STEPDOWN TRANSFORMERS, input 200/250 volts A.C., 50 cycles, output 110 volts, 1,100 watts, housed in metal case size 10 in. x 9 in. x 7 1/2 in., fitted carrying handle £7/10/- each.

TEST METERS in teak case, size 4 in. x 4 in. x 2 in. with carrying handle, 3 in. dial, reading 5/0/5 amps. D.C., moving coil, 25/- each.

INFINITELY VARIABLE-SPEED GEARBOXES. Fitted 1/2 in. diam. shafts, mounted in ball-races, adjustable torque, reversible, overall size 5 in. x 5 in. x 4 in. approx. Precision made, 47/6 each.

Ditto, smaller type, overall size 3 in. x 3 in. x 3 in. approx. 40/- each.

"BULL" 1/10th h.p. INDUCTION MOTORS, 230/250 volts A.C., 50 cycles, capacitor start, 1,425 r.p.m., reversible, overall size 7 in. long, 5 in. diam., spindle 1/2 in. diam., £3/15/- each.

PORTABLE FIELD TELEPHONE SETS, type D, fitted handset, extra headset, tuned buzzer, Morse tapping key, etc. £5/10/- the pair.

PRECISION DIFFERENTIAL GEARBOXES, fitted 1/2 in. diam. spindle, 48 d.p. gears size 2 in. diam., 2 1/2 in. deep, 8/- each.

CONSTANT SPEED MOTORS, 115 volts A.C. 1/70th H.P. 3,000 r.p.m., governor controlled, continuous rating, size 5 1/2 in. x 3 1/2 in. x 3 in., 1/2 in. diam. spindle. 40/- each.

"STANCOR" U.S.A. 2.5 K.V.A. 50/60 cycle auto-transformers. Input 115/250 v. Output, 110 v. Completely shrouded. £11 each.

G.P.O. type 3,000 and 600 relays, assorted contacts and coils. Siemens High Speed Relays, Uniselectors, Telephone Keys, Handsets, etc.

Mailing Lists. Price 6d. each.

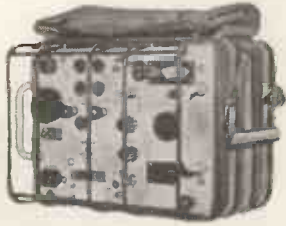
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This is an 8-valve ex-Army receiver, in new condition, complete with built-in power supply and loudspeaker and four spare valves. Frequency range on 2 bands, 1.8-3.9 mc/s, 3.9-8.5 mc/s. This is 36. 15-108 metres continuous and coversome of the shipping band. This unit is designed to operate from a 6 v. battery, no other power supply required. The whole is contained in a waterproof metal case with waterproof canvas cover over front panel. Front panel measurements 13 by 10 1/2 in. Supplied complete with diagram. Price £5/19/6 each. Carriage Paid.

UNISELECTORS. Minor type. 2 Banks of 10 contacts, will operate from 24 v. or 12 v. with slight adjustment, has electro-magnetic release when wipers reach end of the bank. Resistance of drive coil 50 ohms, release coil 70 ohms. These are ideal for sequence switching, model radio control, 25/-, post 1/6.

ANEBROID CAPSTULES. Brass. Ideal for making barometers, etc., 2 mounted on bracket. Price 3/6 per pair, postage 1/3.

SEISSIN MOTORS with heavy water-tight brass case. Type 60 10K/440 heavy duty. 1 1/2 in. x 5 1/2 in. spindle. Price 50/-, post 2/6.

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PONDERS END WORKS,
REQUIRE DESIGNERS AND DRAUGHTSMEN AS FOLLOWS:

- Designer Draughtsman with good mechanical background but familiar with layout of electrical components and circuit diagrams. Age 26-40 years.
- Designer Draughtsman used to design of special purpose machinery in connection with the lamp and valve making industry. Age 26-40 years.
- Draughtsman used to detailing mechanical assemblies, working out electrical layouts and cast work. Ability to understand electronic circuit diagrams essential. Must be quick and neat worker. Age 26-40 years.
- Draughtswoman for detail draughting of interesting and varied light engineering work. Hours of work 8.30 a.m. to 5.30 p.m. but slightly reduced hours would be considered.

PLEASE APPLY TO THE PERSONNEL OFFICER.

SITUATIONS VACANT
VACANCIES occur for

DESIGN and development engineers for an engineering company whose modern and well-equipped laboratories are dealing with interesting work in connection with microwave, servo and electronic development; these vacancies offer attractive possibilities to men with an appropriate degree and/or a wide industrial experience in this field; salary range up to £1,100 per annum to men with proven experience who are capable of carrying through projects from development to production stages under the supervision of the chief engineer; London area.—Please reply, in confidence, quoting ref: WW/012, giving full details of qualifications and experience, to Box 4460. [2722]

FORCES Broadcasting Service (War Department employment).

APPLICATIONS are invited by the War Office from men, British only, for junior technical appointments in the Middle East for a minimum period of three years; salary scale £330-£505 per annum, plus foreign service allowance (free of income tax) to cover the extra cost of living at overseas stations; starting salary according to age and experience; outfit allowance; candidates should have had a good general education and possess a sound knowledge of transmitters and aerials; C. and G. certificates an advantage.

APPLICATION forms and further details can be obtained on written application only from War Office (A.G.3) London, S.W.1. Closing date 21st May, 1954. [12723]

DRAWING OFFICE TRAINING, MARCONI'S WIRELESS TELEGRAPH CO. have a limited number of vacancies at their Drawing Office School as from February, 1954, onwards. A SIX months' concentrated course, with fixed salary, at the Drawing Office School, Chelmsford.

AFTER successful completion, permanent posts will be available in the Company's Drawing Offices at Chelmsford or Acton, London.

QUALIFICATIONS: age limit 28, must have workshop experience, preferably have O.N.C., must have drawing ability, write giving full details to—Dept. C.P.S., 336/7, Strand, W.C.2, quoting ref. 171B. [2514]

MURPHY RADIO, Ltd. have vacancies in the Electronics Division Laboratories for qualified engineers to design and develop the following:—

1. V.H.F. and U.H.F. communications equipment.
2. Alrborne and ground radar equipment.
3. Computing devices and servo systems.
4. Nucleonic equipment and measuring instruments.

The salary range is £600-£1,100 per annum, depending upon experience. Further posts are available to enginee rs of H.N.C. standard or equivalent having less experience, the salary range being £450 to £650 per annum. These vacancies are at Welwyn Garden City, but one or two vacancies of a similar nature are available at the Ruslip works.—Applications, giving age, full details of qualifications, experience and salary requirements should be forwarded to Personnel Department (E.D.L.), Murphy Radio, Ltd., Welwyn Garden City, Herts. [2686]

ELECTRONIC Engineers are invited to apply for the following positions with The English Electric Co. Ltd., Luton, for work on Guided Missiles.

- (a) SENIOR Electronic Engineer for field trials of a V.H.F. radio link, with previous experience of H.F. communications equipment. Applicants must be prepared to accept responsibility for equipment trials at locations in the United Kingdom other than Luton. Housing assistance may be given.
 - (b) SENIOR Radar Engineers for work on radar equipment covering a broad field. A good theoretical knowledge and sound practical experience of radar systems is essential. Assistance with housing may be given.
 - (c) SENIOR Light Current Engineers, Physicists or Mathematicians, with an engineer bias for design and development work on a range of simulators and analogue computing devices. Responsibilities will include the design and supervision of construction of complete computers.
 - (d) SENIOR Microwave Engineer for investigation of new methods of construction for miniaturisation and weight reduction, design and engineering to the production stage. Degree standard and experience essential. The successful applicant may be appointed in charge of a group. Assistance with housing may be given.
 - (e) ELECTRONIC Engineer or Physicist to develop equipment and new technique of ground testing. Applicants should be of degree or H.N.C. standard with design experience.
 - (f) SENIOR Engineer with good fundamental knowledge of Electronics and the ability to apply it to circuit development work. One vacancy exists in a group working on the application of transistors. Assistance with housing may be given.
 - (g) SENIOR Electronic Engineer for work on radio and radar equipment design. Applicants should have a good academic background and an inventive turn of mind, with extensive experience.
 - (h) JUNIOR Engineers are also required to assist all the above work.
- THESE positions are permanent and progressive and attractive salaries are offered for able and experienced men. A staff pension scheme is in operation. Applications to Dept. C.P.S., 336-7, Strand, W.C.2, quoting ref. S.A.38. [2663]

SPERRY GYROSCOPE CO. LTD.

Invite applications from Engineers holding a degree or membership of a professional Institution, for interesting research, design and development work on aircraft instrumentation, automatic controls, marine products and guided missiles. Vacancies include:

ELECTRO-MECHANICAL ENGINEERS for Brentford and Feltham; also **MECHANICAL ENGINEERS** for Gloucestershire. Additional to above qualifications desirable to have apprenticeship, knowledge of production methods, and experience in design of one or more of the following; gearing, instrument mechanisms, servos.

HYDRAULIC ENGINEERS for Brentford and Feltham. Essential to have apprenticeship and knowledge of production methods.

ELECTRONIC ENGINEERS for Brentford and Feltham. Additional to above qualifications, practical experience and knowledge of production methods, with experience in one or more of the following is desirable: control circuits, D.C. Amplifiers, Computing devices, Video circuits.

Pension Scheme

Apply giving full details, including an indication of the salary range and location preferred, to Personnel Manager, Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middx.

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QUALITY P.P.O./P. TRANS. 20w, super Silcoflams Section low leakage windings, prim. ind. 75H. leakage ind. 075H. Sec. 3 and 15 ohms Prim. to ind. requirements. Shrouded and term., wt. 5 lbs. 3 nos. Dltto 15 v., 24 nos. L.F. CHOKES, 10H, 65 ma., 4/6 15H, 100 m.A., 10/6, 20H, 150 ma., 12/6. CRT Htr. Isolation Trans., 25% sec. boost volt. 2 v., 10/6; 6.3 v., 10/6. MAINS TRANS. 0-200/250 v. tapped prim. 350-0-350 v. 80 ma. 5 v. 2 a., 6.3 v. 4 a., etc., from 21/-, 6.3 v. 14 a. Htr. Trans. 7/6. Quotations for special and rewinds. Part P. & P. 1/- 2, PAWSONS RD., W. CROYDON, THO 1665

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All the above are Three Year Courses. A Preliminary One Year Course is available for those not possessing G.C.E. in suitable subjects and levels, making a Four Year Course for the Degree.

FIRST MEDICAL EXAMINATION One Year Course

PROFESSIONAL COURSES Higher National Diplomas in Engineering Associateship of Royal Institute of Chemistry

Three Year Courses for students who have attained a suitable standard.

Fees: £28 per Academic Year (No Fee if under 18 years of age) plus £2 Union Fee. Advice and Information on Scholarships, Bursaries Entrance Standards, etc., available on request to Principal, Woolwich Polytechnic, S.E.18. (Woolwich 2856)

DE HAVILLAND ADVANCED GUIDED WEAPON PROJECTS

Staff required for research and development work. Opportunity for enthusiastic qualified men to join expanding organisation offering permanence and advancement:

ELECTRONIC CIRCUIT ENGINEERS capable of original circuit design and development. Applicants are invited from Graduates with one or two years experience or experienced Electronic Engineers. (Reference 21).

TRIALS ASSISTANTS. Excellent opportunities for keen young men with experience on electronic equipment. Duties involve short periods of working away from base. Good chance for establishing sound position in a new field of engineering. Men with experience in the services particularly welcome. (Reference 22).

ELECTRONIC ENGINEERS for technical administrative duties in Trials Division. Practical ability and experience more important than qualifications. Experience in organisation of small groups of technical personnel essential. Applicants must be between ages 28 and 35. Duties involve short periods of working away from base. Excellent prospects of promotion to senior positions in a new field of engineering for men with initiative and personality. (Reference 23).

AERODYNAMICIST with Honours degree and minimum of two years' experience in aircraft or missile aerodynamics. Work involves interest in all aspects of missile dynamics. Sound engineering background an advantage. (Reference 48).

MATHEMATICAL ASSISTANT. Inter B.Sc. or G.C.E. at advanced level with aptitude for mathematics. (Reference 47).

WRITER (Reference 28), **ILLUSTRATOR** (Reference 29), **CIRCUIT DRAUGHTSMAN**, (Reference 30), for newly established Technical Publications Section. Experience of Air Publication and/or instruction book work desirable.

PLANNING ENGINEER to examine design prior to prototype and pre-production manufacture. (Reference 36).

MECHANICAL ENGINEER to design and supervise manufacture of prototype test equipment. (Reference 37).

RUBBER TECHNOLOGIST experienced in foam rubber development, qualified to degree or H.N.C. standard in physics and chemistry. (Reference 44).

PLASTICS ENGINEER (Junior) knowledge of chemistry and structures an advantage. (Reference 45).

Please write in detail to Personnel Manager (Technical Employment), de Havilland Propellers Ltd., Hatfield, Herts., quoting reference number of position sought.

PHYSICISTS AND DEVELOPMENT ENGINEERS required for Labora- tories at Dunmow and Barkingside, Essex.

Applicants should be qualified and capable of leading teams engaged in electronic and micro-wave projects. The work is interesting, the conditions good, and the salary prospects are well in accord with those prevailing.

Details of qualifications, experience and salary required should be forwarded, in the strictest confidence, to:— The Personnel Manager, Kelvin & Hughes Limited, New North Road, Barkingside, Essex.

SITUATIONS VACANT

FERRANTI, Ltd., Edinburgh, have vacancies for Electronic Engineers in their Test Equipment Laboratory for the following duties: (1) DESIGN of precision test equipment for radar and specialized valves. (2) TESTING of prototype products. APPLICANTS should preferably have some radar experience and be of degree or equivalent standard, though experienced applicants with lower qualifications will be considered. Good prospects in a expanding organization. Staff Pension Scheme.—Apply quoting "EE/TEL" and giving full details of training, qualifications and experience. to the Personnel Officer, Ferranti, Ltd., Ferry Rd., Edinburgh, 5. [2741]

ELECTRONIC engineers required by The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry, in their development laboratories, for work on the following items:—

- (a) DESIGN of R.F. modulators.
- (b) INVESTIGATION into valve parameters.
- (c) DESIGN of valve test apparatus associated with (b) above.
- (d) TRIALS team in connection with guided weapons.
- (e) DEVELOPMENT of pulse circuitry techniques for guided weapons.
- (f) SERVO-MECHANISMS.
- (g) MICROWAVE development.
- (h) TEST equipment.
- (i) GENERAL radar circuit development.
- (j) POWER units including electronic stabilizers and rectifier systems.
- (k) Magnetic amplifiers.

APPLICANTS, preferably with a degree or an equivalent qualification, should have had at least two years' experience in the development and engineering of Service equipment as well as experience in one of the above.—Reply stating age, qualifications and experience, to The Personnel Manager, Ref. R.G. [2714]

TELEVISION offers careers for young men; previous experience not necessary as training is given.—Apply in writing to Personnel Manager, Pye, Ltd., St. Andrew's Rd., Cambridge. [2689]

FIRST-CLASS openings for young men with service or amateur radio experience, on work which introduces them to television technique.—Apply in writing to Personnel Manager, Pye, Ltd., St. Andrew's Rd., Cambridge. [2690]

FIRST-CLASS public address engineers required by leading company, for London; good remuneration to right men; own car an advantage but not essential.—Apply Tannoy Products, Ltd., West Norwood, Gipsy Hill 1131. [2697]

TELEGRAPH CONSTRUCTION & MAINTENANCE CO. Ltd., cable manufacturers, have the following male technical vacancies for work on the inspection and carrier frequency testing of submarine cables:—

1. SENIOR Technical Assistant, B.Sc. Electrical Engineering, H.N.C., or equivalent professional qualifications. Salary £520 upwards according to qualifications.
2. TECHNICAL Assistants. City and Guilds Telecommunication Course Parts 3 and 4. Commencing salary £8/10 p.w.k. upwards according to qualifications.
3. JUNIOR Technical Assistants. City and Guilds Telecommunication Course Part 2. Commencing salary £7/10 p.w.k. upwards according to qualifications.

FOR all these posts closely related experience would be advantageous, but adequate training will be given. Pension scheme, five-day week. Must have completed National Service.—Apply in writing to: Staff Officer, Telcon Works, Greenwich, S.E.10. [2701]

RADIO and television engineers wanted, for Merseyside district. Good job for good men. Staff rate, payment for overtime, Sick Pay and Pension Scheme after qualifying period.

APPLICANTS should give full details of age, training, qualifications and experience. If required for interview expenses will be paid.—Apply Box 4305. [2699]

KEEN sheet metal workers required for radio and instrument case manufacture; improvers also considered.—Apply Philpot's Metalworks, Ltd., Chapman St., Loughborough, Leics. [2742]

FULLY experienced television/radio engineer required by main dealer handling leading makes only; excellent conditions and a permanent well-paid position offered.—Edwin P. Fox, East Molesey, Molesey 2721. [0442]

AIRCRAFT radio mechanics, skilled in workshop practice, required by Skyways, Stansted Airport, Essex.—Apply in writing to the Personnel Manager, Skyways, Ltd., 7, Berkeley St., W.1. [2732]

TELEVISION & radio engineers required; permanent progressive positions for the right men.—Apply to A. S. White & Sons, Ltd., 132, High Rd., South Tottenham, N.15. Stamford Hill 7861. [2644]

SAUNDERS-ROE, Ltd. have a vacancy for a Draughtsman in their electronics division.—Apply, stating age, experience, salary required and quoting ref. W/4, to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.O.W. [2721]

RADIO and television planning and designs engineer wanted, man with experience and ideas able to plan new season's models to pre-production stage; write giving full details and salary required.—Box 4510. [2757]

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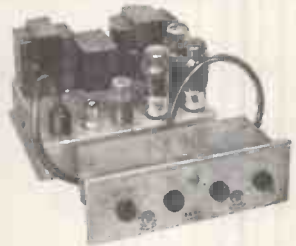
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New LEAK TL 10 AMPLIFIER WITH POINT
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Complete 27 gns.

KORTING Electrostatic Treble	£1 12 6
Speaker Unit, High Impedance.....	£1 16 0
Low Impedance.....	£2 0 0
G.U.A.D. Mk. II Amplifier with tone control unit.....	£42 0 0
LOWTHER A.M./F.M. Radio Tuner....	£22 0 0
CHAPMAN A.M./F.M. Tuner, type FM 81.....	£15 0 0
CHAPMAN Standard S4 Tuner.....	£16 0 0
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GOODMANS Axiom 150 Mk. II.....	£10 5 6
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TANNOY 15in. Dual Concentric.....	£23 10 0
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STENTORIAN H.F. Units from.....	£2 10 6
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WHARFEDALE W.15 C/S.....	£17 10 0
WHARFEDALE Golden 10.....	£7 13 3
GOODMANS 101 and 102 from.....	£6 12 1

PICK-UPS AND AUTOCHANGERS

DECCA X.M.S. with new type H head	£6 9 3
CONNOISSEUR P/U. with head...	£5 19 3
ACOS HGP 39 Pick-up Head.....	£2 2 3
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COLLARO Transcription Motors.	

CABINETS TO HOUSE ALL TYPES OF HI-FI EQUIPMENT. Send S.A.E. for photos and prices.

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GRUNDIG "Reporter".....	£78 15 0
GRUNDIG Console.....	£99 15 0
WEARIE Tape Decks.....	£35 0 0
TRUVOX Tape Decks.....	£23 2 0
LANE Mark IV Deck.....	£17 10 0
LANE 2-speed Complete Recorder...	£17 5 0
EKOVISION and other leading makes of TELEVISION. Prices from 49 gns.	

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LONDON CENTRAL RADIO STORES

MINIATURE 2in. SPEAKERS. Fitted in circular wood wall plaque 5 1/2in. diameter, 12/6. P. & P. 1/-.

TRANSMITTING UNIT. Type 22. 3 valves, V801, V162, VT501 (less Crystal), 17/6. P. & P. 2/6.

CARBON MIKE INSERTS. New condition, 2/9.

MOVING COIL MICROPHONE OR RECEIVING INSERTS. 30 ohms., 3/-, P. & P. 6d.

5-WAY CABLE. Suitable for all purposes, 12 yds., 6/-, P. & P. 1/6.

5in. P.M. SPEAKER UNITS. In good condition, 6/6. P. & P. 1/6.

TELEPHONE HANDSETS, 9/6. P. & P. 1/-.

SELENIUM FULL-WAVE RECTIFIERS. 80 v. 20 a. Approx. 1 1/2 x 6 x 1/2 in. Used, but perfect. Weight 14lb. £3/10/-.

GROOVE LOCATING UNITS enabling operator to preselect any point on 10, 12 or 16in. discs for playback purposes.

Consists of substantial machined casting with adjustable counterpoise pick-up arm fitted with high-fidelity pick-up, and instantaneous calibrated groove selector with micrometer adjustment and 'velvet touch' lever for dropping pick-up. £2/10/-, carr. paid.

See previous issues for other bargains.

N.B.—Carriage charges relate to British Isles only.

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all occasions*



WEST NORWOOD, S.E.27. - Gipsy Hill 1131 (7 lines)

THE EDISON SWAN ELECTRIC CO., LTD., PONDER'S END WORKS, REQUIRE THE FOLLOWING:

Electronic Development Engineer with knowledge of Physics and experience of government contract work desirable. Higher National Certificate. B.Sc. or A.M.I.E.E. Opportunity for original development work in radiation monitors (ion chamber type). Age 27-40 years.

Two Electronic Development Engineers, B.Sc. or graduate I.E.E. Experience of low frequency and measuring equipment particularly valuable. Age 25-40 years.

Please apply to the Personnel Officer.

CABLES AND FLEXES CHEAPER IN ODD LENGTH COILS

No coil under 20 yds. All Prices per 100 yd. lot. Everything tested and guaranteed.

	Do.	7/029	W/E	W/E	7/044	W/E
TWIN FLAT	1/044	3/029	W/E	W/E	7/044	W/E
RUBBER	39/-	49/-	59/-	101/-	156/-	198/-
PLASTIC	38/-	49/-	57/-	99/-	156/-	198/-
Single V.I.R.	17/-	21/-	—	34/-	66/-	—
Single Plastic	13/-	22/-	—	38/-	72/-	—

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23/36 40/36

	Do.	14/36	23/36	40/36	23/36	40/36
CIRCULAR	Twin	14/36	23/36	40/36	23/36	40/36
RUBBER		54/-	61/-	76/-	75/-	100/-
PLASTIC		41/-	54/-	76/-	63/-	89/-
Padd. / Braided		35/-	42/-	53/-	53/-	68/-

FLEX. Plastic T.T. or flat, 13/9. Maroon 24/- (in 10/20 yd coils 20/-).

100 yd. Coils Transparent Plastic, T.T. or flat, 15/-; 100 yd. Coils Maroon T.T. D.V., 27/8. Less than 100 yd. lot of anything supplied. Just add 5% 7/044 and heavier supplies in as little as one yard at a time. Send for lists, every type ever made is available. Add part carriage to small orders please. British Distributing (W.W.), 591 Green Lanes, London, N.8. MOU. 0055/6.

SITUATIONS VACANT

PYE TELECOMMUNICATIONS, Ltd., Ditton Works, Cambridge, will shortly have a limited number of vacancies for junior engineers experienced in VHF design and engineering is essential.

SALARY according to qualifications and experience; modern factory, sports, social and canteen facilities; single board available.

PLEASE apply stating age, qualifications and experience to the Personnel Manager [2342]

VACANCIES exist for junior engineers and laboratory assistants on work connected with expanding programme involving radar and associated devices. Qualifications required are as follows:—

JUNIOR Engineers—Should be of Graduate standard with preferably some Services or laboratory experience of radar.

LABORATORY Assistants—Should be of matriculation standard in mathematics and physics and familiar with the use of normal test equipment; a student member would be suitable.

SALARIES according to age and experience. Applications should be made in writing in the first instance to the Chief Development Engineer, Decca Radar, Ltd., 9, Davis Rd., Tolworth, Surbiton, Surrey. [2727]

BERRY'S (SHORT WAVE), Ltd., have a vacancy for counter sales; must have good knowledge of quality amplifiers, tape recorders, etc.—Write giving full details of past experience, etc., to 25, High Holborn, W.C.1. [2573]

WANTED, laboratory assistant, H.N.C. standard, for television and radio coil factory, 44-hour, 5-day week, salary in accordance with experience.—Apply to Miss K. S. Cowan, Personnel Officer, Mitcham Works, Ltd., Winchelsea Rd., Harlesden, N.W.10. [0106]

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus, also instrument makers, wiremen and assemblers, for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekeo Works, Malmesbury Wilts. [0238]

SERVICE engineer (resident Manchester district) required by manufacturer of electrical equipment to cover several counties in the N.W. Please give details of radio servicing experience, auto-electrical knowledge and any commercial experience.—Box 4404. [2707]

SUB-EDITOR for technical books; should have experience of book or magazine production as well as technical and scientific knowledge (particularly electricity and electronics); applicants must be members of the N.U.J.—Box 4505. [2753]

TELEVISION engineers required for demonstration installation unit (T.V. transmission equipment); must be willing to travel overseas.—Apply by letter in first instance to: Engineer-in-Charge, Demonstration and Installation Section, Pye, Ltd., Cambridge. [2761]

A FEW vacancies occur for superior field television engineers in various parts of the country; opportunity to join a large, well-established firm offering permanent engagement and good salary.—Give full particulars and state areas preferred to Box 4495. [2739]

A LARGE engineering organization in S.W. Lancs in the light electrical field has several vacancies for development engineers for work on circuit design in telecommunications utilizing the properties and potentialities of semi-conducting materials.

APPLICANTS are invited to write to Box No. 606, Dorland Advertising, Ltd., 18/20, Regent St., London, S.W.1, giving details of age, qualifications, experience and approximate salary sought; experience in these fields is desirable, but consideration will be given to applicants who are interested in the scope offered by such materials.

POSITIONS will be on established staff status with contributory pension fund and usual staff conditions. [2585]

DRAUGHTSMEN required; electronic instrument or radio experience; salary according to qualifications; Saturday interview needed; opportunity to broaden experience with reputable firm; near city centre and all amenities.—Apply Marconi Instruments, Ltd., Longcross, Hatfield Rd., St. Albans. [2765]

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MINIMUM qualifications: Development engineers, University degree or equivalent; technical assistants, H.N.C. & sal. Finalist; good salaries and prospects for men with initiative; pension scheme; assistance with housing.

SEND full particulars of age, qualifications and experience, with salary required, to Short Brothers & Harland, Ltd. Castlereagh Factory, Belfast, quoting Ref. No. E.4.

DRAUGHTSMEN; vacancies will be available shortly in West London area for senior and intermediate draughtsmen with good experience in radio or telecommunications equipment; interesting work associated with tooling, test gear, and quantity production of latest design airborne transmitter and receiver equipments; posts provide scope for initiative and extending experience in this field.—Reply in confidence, stating age, technical training, experience and present salary, Box 4500. [2749]

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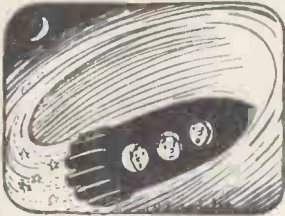
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OPPORTUNITY offered to an electronic engineer capable of holding a responsible post as an instrument designer; an engineering degree and experience covering a wide range of frequencies are advantages which will be reflected in the salary offered.—Apply Box 3284. [2484]

RESEARCH company at Feltham has a vacancy for an electronics technician, able to use engine indicating equipment and service same; ample scope for design; good wages; permanent post.—Apply in writing to **Alan Mintz & Co., Ltd.,** Browells Lane, Feltham, Middlesex. [2750]

TRANSFORMER Designer required for development projects involving audio-frequency power transformers, pulse transformers, oil-filled units, etc.—Apply stating age, qualifications and experience. to The Personnel Manager (Ref. R.G.), The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry. [0260]

DEVELOPMENT Engineers with experience required to work on the application of electronic methods to the solution of aeronautical and/or training problems. University degree or equivalent standard. Accommodation available to suitable applicants.—Apply in writing to—**REDIFON, Ltd.,** Kelvin Way, Crawley, Sussex. [2790]

RADIO and radar testers; first-class men required for work on V.H.F. communication gear and Government contracts for radio and radar equipment by Midland manufacturers.—Men with wide experience of fault finding in any of the fields mentioned should write, giving full details, to Box 4508. [2755]

EXPERIENCED fault-finders wanted by Midland manufacturers of radio equipment; permanent posts located in the Midlands are offered to men with experience of radar, radio control, V.H.F. equipment.—Write, stating fully experience and salary required, to Personnel Manager, Box 4509. [2756]

WANTED, car radio technician; must be fully skilled in installations, suppression, fault-finding, etc.; applicant should be a competent driver, able to deal with customers and take sole charge of the car radio department; London suburban locality.—Write fully to Box 4149. [2757]

TECHNICAL representative required by E. K. Cole Ltd., for Car Radio Division; should be experienced in servicing, maintenance and installation of car radio receivers; resident in the Birmingham/Rugby/Coventry area.—Submit details of experience, age, and salary required to Ekco Works, Southend-on-Sea. [2702]

PARTRIDGE TRANSFORMERS, Ltd. have a vacancy for a senior transformer designer, applicants must have considerable experience in the design and development of all types of audio and power transformers, interesting and permanent position.—Written applications to Managing Director, Partridge Transformers, Ltd., Tolworth, Surrey. [2720]

APPLICATIONS are invited by large electrical manufacturers for engineers to design, develop domestic broadcast radio receivers; permanent pensionable posts will be offered to men who have sufficient technical background and experience to work with a minimum of supervision.—Write, stating age, experience and salary required, to Box 4502. [2751]

REQUIRED in Buckinghamshire, experienced assistant (male) for maintenance of electrical (including electronic and photo-electronic) laboratory equipment; skilled R.A.F. tradesman considered; salary £8 to £11, according to age and qualifications; full working conditions.—Reply, giving age, particulars of education and experience, to Box 4507. [2754]

SENIOR development engineer with several years' experience in electronics for work on sub-miniaturization techniques in the V.H.F. and U.H.F. bands; A.M.I.E.E. or equivalent qualification desirable; West London district.—Please write in the first instance, giving details of past experience, qualifications, age and salary expected, to Box 4497. [2746]

THE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Coventry, requires senior and junior electronic development engineers for work on guided weapons and like projects, particularly in the field of microwave and pulse applications; mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments, also required for the above projects; salary according to age, qualifications and experience.—Apply by letter, stating age and experience, to the Personnel Manager (ref. R.G.). [0259]

BRITISH OVERSEAS AIRWAYS CORPORATION require engineers for the overhaul and maintenance of flight simulators in Central Training Unit, near London Airport; applicants should have a thorough knowledge of electronic techniques; practical experience in the maintenance of analog computers, aircraft radio equipment and remote indicating system an advantage; duties: 3-shift system covering 24 hours per day; salary according to qualifications £608 to £725 p.ann. plus approximately £78 p.ann shift pay.—Applications to be addressed to Staff Supt. (Recruitment), B.O.A.C., London Airport, Bounslow, Middx. [2655]

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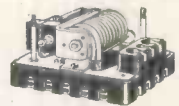
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PHYSICISTS and electronic engineers reqd. for research work on electronic tubes and circuit development; applicants should have a good degree in physics or electrical engineering; vacancies offer good prospects and comm. and are superannuated.—Apply to Personnel Dept. (R./JDM), E.M.I. Research Laboratories, Ltd., Hayes, Middx. [2768]

PHILIPS BALHAM WORKS, Ltd., 45, Nightingale Lane, Balham, S.W.12, require Graduate in Electrical Engineering or Physics, preferably with experience in electronics for development of nuclear and radiation instruments; permanent appointment with excellent prospects.—Write, giving full details of age, experience, etc. [2687]

FIRST-CLASS television/radio service engineer, to take position of chief engineer in up-to-date and well-equipped Murphy Radio Dealer's Service, Dept. 7 engineers employed; only man of proved experience willing to work on the bench and capable of giving guidance to others need apply; wages £14 plus; S.W. London area.—Apply Box 4294. [2694]

PAPER capacitor development engineer required by a large progressive company for work on impregnated paper dielectrics; applicants should have considerable practical experience, ability to originate prototypes and assess their market potentialities.—Reply in confidence, stating age, qualifications, summary of experience and salary required, to Box 4058. [2667]

DEVELOPMENT engineers, senior and junior, required for interesting work on new radio and television projects by leading manufacturers in W. London; applicants should have suitable academic qualifications and, for the senior posts, some previous experience.—Please write, in confidence, stating age, experience, qualifications and salary desired, to Box 4496. [2745]

DRAUGHTSMAN required with experience in layout of automatic moulding press electrical equipment, involving mechanical drawings, sub-assemblies, circuits, and parts schedules; suitable for prototype and batch production; apply, in writing, to—Works Supt., The Streetly Mfg. Co., Ltd., Aldridge Rd., Streetly, stating age, experience and salary required. [2521]

ELECTRONIC Engineers required to inspect and service A.A. radar equipments in Waltham Abbey, Gillingham and Sittingbourne areas; ONC or equivalent; experience on service radar an advantage; salary, age 28 or over, £550-£640 p.a.—Application forms from O.C. 1 A.A. Maintenance Unit, R.A. Veterinary Lines, Shrapnel Barracks, Woolwich, S.E.18. [2725]

ELECTRONIC engineer aged 20-35 with Ordinary National Certificate required by The Morgan Crucible Co., Ltd.; applicants should have had experience in building and servicing factory test equipment and some knowledge of proprietary electronic equipment.—Write, giving full details and quoting reference U.2, to the Staff Manager, Battersea Church Rd., S.W.11. [2740]

DEVELOPMENT engineer required to head up section on light electro mechanical devices; projects include both armament and commercial items and will give exceptional scope to man with ideas; science degree, suitable experience and ability to organize development programme required; located in Home Counties; housing available.—Write details and salary required to Box 457. [2749]

ENGINEER required to undertake the design of electronic instruments; the successful candidate will be required to accept responsibility for development to the production stage; degree or equivalent preferred; the salary will be commensurate with qualifications and experience.—Apply in writing to Advance Components, Ltd., Back Rd., Shernhall St., London, E.17. [2485]

DRAUGHTSMEN, senior and intermediate, are required at Chelmsford and Acton by Marconi's Wireless Telegraph Co., Ltd., experience in the design of radar, radio or similar apparatus preferred; these are permanent positions in expanding development department; applicants should write, giving full details and quoting ref. 142J, to—Dept. C.P.S., 336/7, Strand, W.C.2. [2513]

MICROWAVE inspection: Engineer required to take charge of Microwave Inspection Department, must have both electrical and mechanical knowledge of testing aerials, waveguide sections, attenuators, wave-meters, oscillators, mixers, etc. opportunity for advancement with progressive company in S.W. London area; application in writing stating experience and salary required to—Box 4303, 15, Hill St., London, W.1. [2737]

QUALIFIED electrical engineer required to participate in development and testing work on cables, some experience on cable test at audio and carrier frequencies desirable but not essential; this post is pensionable and carries a salary of £550 upwards in accordance with qualifications and experience.—Details to Staff Officer, The Telegraph Construction and Maintenance Co., Ltd., Telcon Works, Greenwich, S.E.10. [2760]

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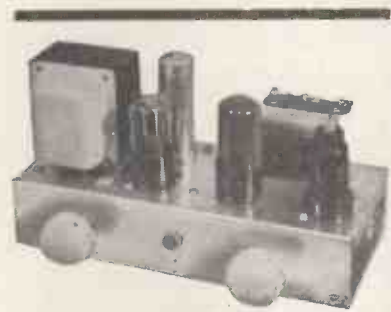
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ENGINEER required to undertake the development of transformers and iron-cored components; a degree, or equivalent, and some experience of this type of work are desirable.—Apply in writing to **Advance Components, Ltd., Back Rd., Sherrinall St., London, E.17.** [2674]

ELECTRONIC Engineers required to inspect and service electronic fire control equipment in London, W. and Southend areas; O.N.C. or equivalent; experience on fire control equipments and/or servo mechanisms desirable but not essential; salary, age 28 or over, £550-£670 p.a., starting rate dependent on location—44-hour week.—Application forms from **OC 1 AA Maintenance Unit, R.A., Veterinary Lines, Shrappell Barracks, Woolwich, S.E.18.** [2728]

PRODUCTION Manager, who possesses considerable experience in the production of all types of Paper Dielectric Capacitors is required by a large manufacturing company. The position carries high remuneration and only men of proved ability in this field of electronics need apply. Applications, stating age, qualifications, experience and salary requirements, should be addressed in confidence, to Box 4057. [2666]

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MECHANICAL designer for television and radio domestic equipment required, candidates should be at least of H.N.C. or similar educational standard, with a workshop apprenticeship and have 3 years' experience as a mechanical designer; salary according to experience and qualifications but not less than £600 p.a.—Apply in confidence to the Personnel Officer, Mitcham Works, Ltd., New Rd., Mitcham Junction, Surrey, quoting reference R.2A. [2733]

McMICHAEL RADIO, Ltd. require senior and junior engineers in their equipment division laboratory at Slough; training and experience in the field of applied electronics (including communications) and experience of working with Government Departments are the chief qualifications required.—Write, stating age and full details of training, qualifications and experience, to the Chief Engineer, Equipment Division, McMichael Radio, Ltd., Slough, Bucks. [0198]

DECCA RADAR, Ltd. invite applications from engineers and technicians with experience of installation or maintenance of radar, for field duties with the Company's Heavy Installations Division on the installation of high-power radar equipments; the appointments will be permanent and pensionable; applications giving details of experience and stating salary required should be addressed to the Personnel Officer, Decca Radar, Ltd., Shannon Corner, New Malden, Surrey, quoting reference HID.3. [2736]

MATERIAL and Stock Controller.—Vacancy occurs with a leading firm of electrical manufacturing company in their radio electronic division, for a man well versed in material control capable of taking charge of the department covering ordering, scheduling and control generally. The post is a senior appointment and will carry contributory superannuation after a probationary period. Replies will be treated in confidence, and should give full details of education, experience and salary required to the Personnel Manager, Box 4178. [2682]

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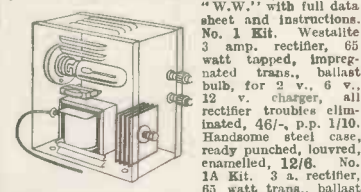


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