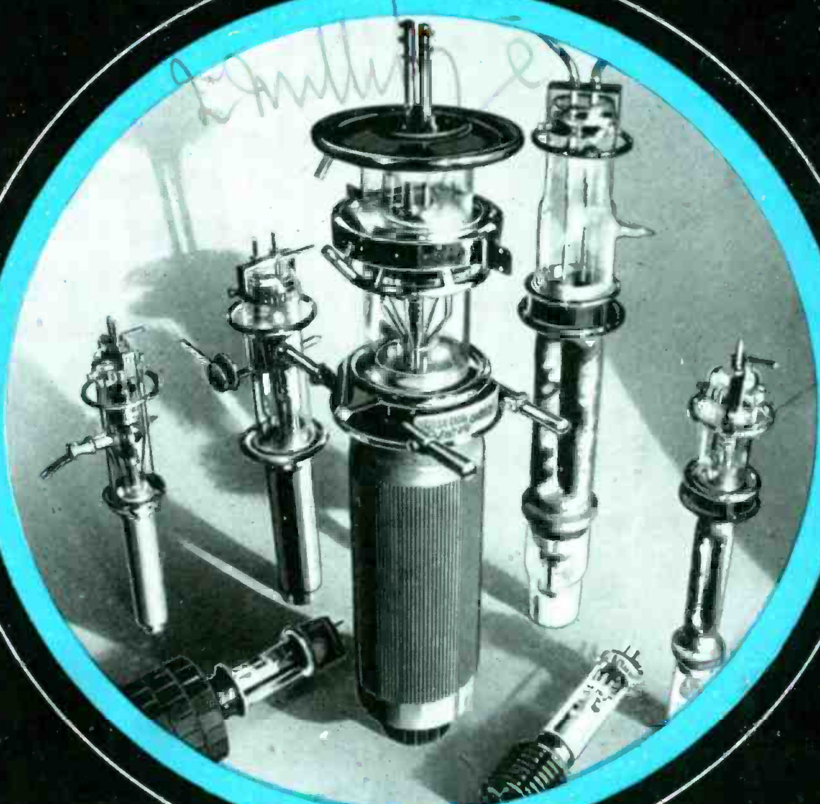
Wireless World

RADIO and ELECTRONICS



AUG. 1945

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Vol. LI. No. 8

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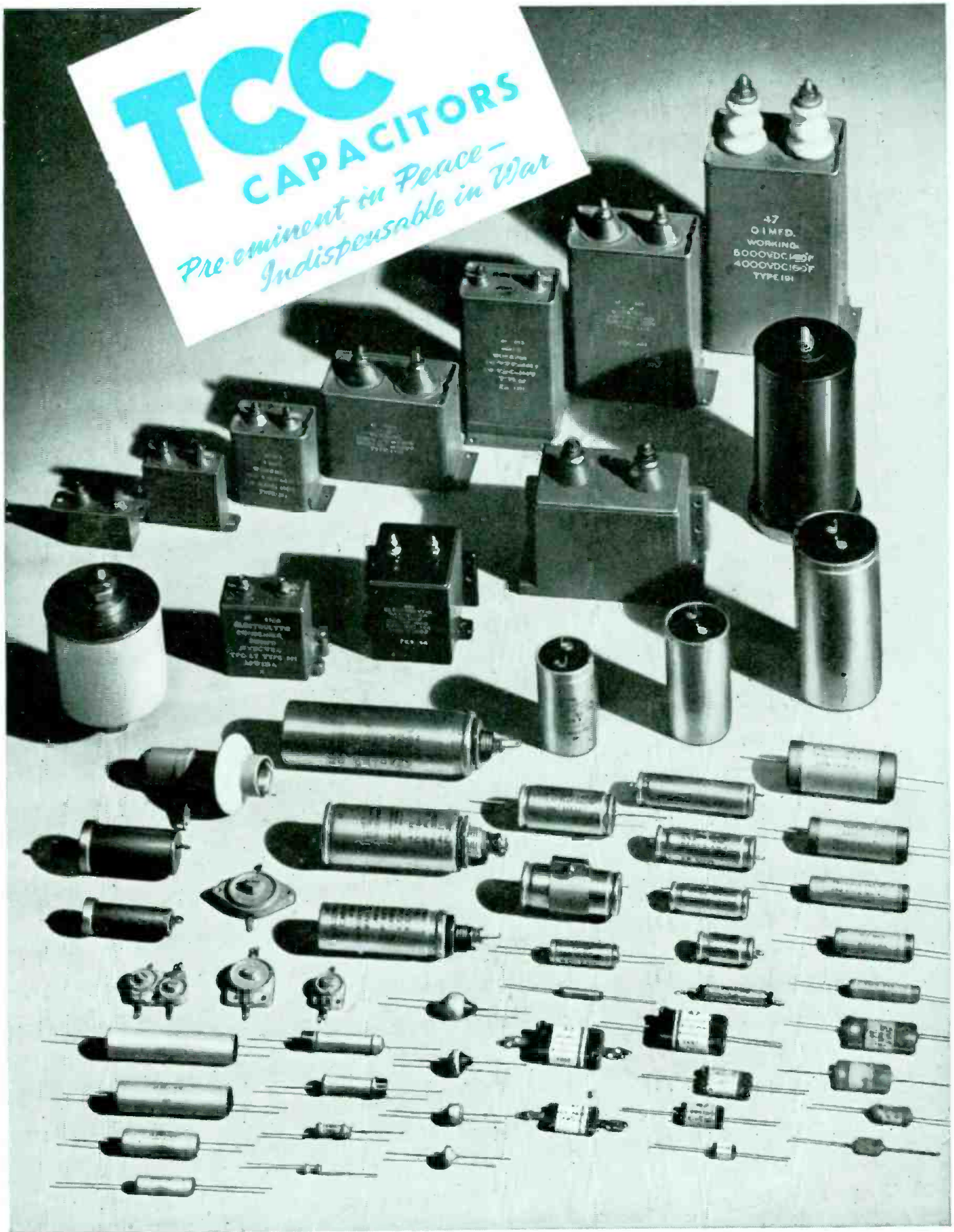


ADVERTISEMENT OF THE TELEGRAPH CONDENSER CO. LTD.

Orders bearing Government Contract Numbers and Priority Rating can now be accepted for quick delivery of the following two "AVO" Instruments:—

THE "AVO" TEST BRIDGE

A portable self-contained 50-cycles bridge of exceptional accuracy and utility for direct measurement of all normal values of condensers and resistances. Facilities also provided for condenser power factor measurements and leakage tests by the flashing neon method, resistance, capacity and large inductance measurements against external standards. May also be used as a highly efficient valve voltmeter indicator for measurement of both audio and radio frequency voltages.

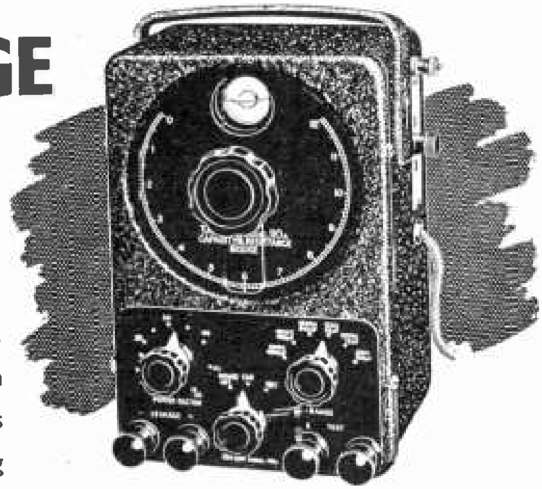
THE ALL-WAVE "AVO" OSCILLATOR

An inexpensive, accurate modulated oscillator covering a continuous fundamental frequency band from 95 Kc. to 40 Mc. A harmonic calibration extends the range to 80 Mc. A large clearly marked dial is directly calibrated throughout, accuracy being within 1%. Externally modulated, internally modulated, or R.F. signals obtainable at will. Calibrated double attenuator enables signal to be varied from a few microvolts to 50 millivolts, with a force output of 1 v. Self-contained, fully shielded.

The

TAYLOR A·C· BRIDGE

MODEL 110A



These instruments give quick and accurate measurements of Capacity and Resistance. There are six Capacity ranges covering from .00001 to 120 mfd. and the Power factor can also be measured on each range. Six Resistance ranges are available measuring from 1 ohm to 12 megohms. This bridge is A.C. mains operated and a leakage test is also available for detecting leaky paper or mica condensers. **Price £14 14s. 0d.**

Please write for technical leaflet.

6 RANGES OF CAPACITY
RANGES OF RESISTANCE

Taylor electrical instruments Ltd.

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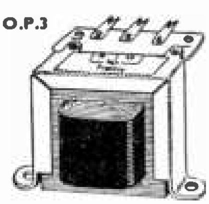
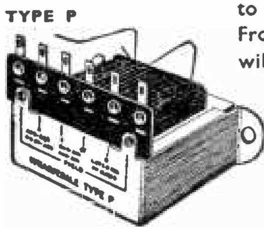
419-424 MONTROSE AVE., SLOUGH, BUCKS.
Tel: Slough 21381 (4 lines) 'Grams: "Taylins", Slough.

Wharfedale

O.P.3



TYPE P



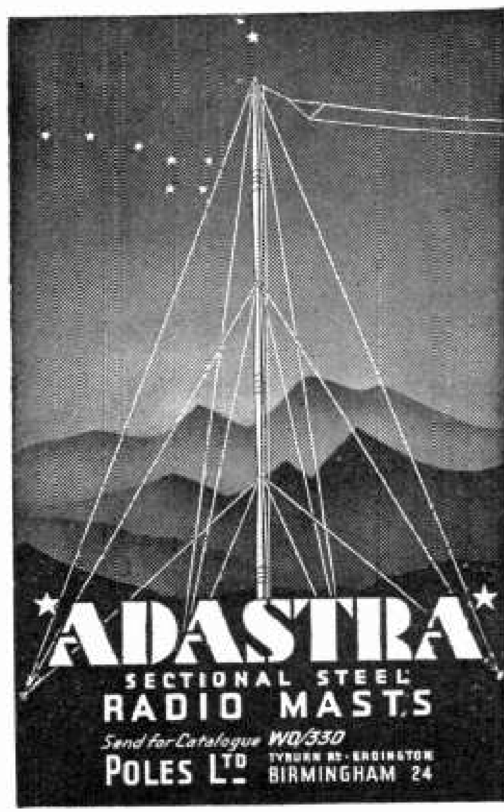
OUTPUT TRANSFORMERS

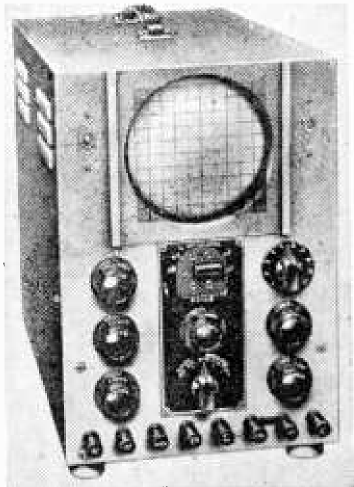
Production in recent years against Admiralty Contracts has set even higher standards to Wharfedale Components. From this both trade and public will henceforth benefit. The bulk of our production is now on Transformers for Tropical use. We regret that supplies for general sale are still very small.

PRICE LIST

O.P.3	3 ratios		5/6
Type P	4 ,,	with C.T.	6/6
G.P.8	8 ,,	,, ,,	9/6

WHARFEDALE WIRELESS WORKS
HUTCHINSON LANE, BRIGHOUSE, YORKS.
Phone : Brighouse 50 'Grams : WHARFDEL





STATIC TWO-DIMENSIONAL visual delineation of any recurrent law.

●

RELATIVE TIMING OF EVENTS and other comparative measurements with extreme accuracy.

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●

SIMULTANEOUS INDICATION of two variables on a common time axis.

INDUSTRIAL INDICATING and TESTING afford increasing scope for the Cathode Ray Tube as the only device with the above inherent features, of which the last is unique in the Cossor DOUBLE BEAM Tube.

The **Model 339 Cossor Oscillograph** thus equipped is invaluable on all problems of research, production or operational testing, when the effect examined is applied as a voltage. When recurrent the traces are studied visually and when transient are recorded photographically, using Model 427 camera.

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Cossor House, London, N.5

'Phone: CANonbury 1234 (33 lines).
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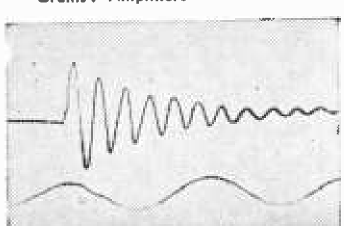

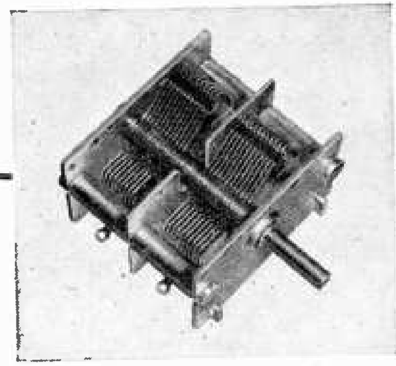

M.G. 1, 2 or 3 GANG CONDENSER

This small size condenser is of rigid construction, and is made in various capacities up to 540mmf. with tropical finish. It can be supplied with trimmers built in if required. The 2 Gang Frame is 2¼″×1 23/32″×2 9/16″ over all.

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have the following superior and brand new **RADIO and ELECTRICAL EQUIPMENT** in stock and available for immediate despatch or collection. All prices net cash.

VOLTAGE CHANGING TRANSFORMERS, 200/250 v. to 100/110 v. (and vice-versa). Fully shielded, with countersunk terminal blocks and properly rated. 75 va., **29/6**. 120 va., **37/6**. Also small supply of 550 va. (suitable for cine, electro-medical, etc.). Double-wound, 230 v. to 100 and 110 v. (and vice-versa), in cast brackets with terminal panels, **£6 10s.** (owing to heavy weight and packing difficulties we cannot despatch the 550 va. model—we have 72 only).

STEP-DOWN TRANSFORMERS, 200/250 v Prim. Secs. :—5, 12 and 17 v. at 6 amps., **49/6** (desp. 2/-). Secs. :—7, 11 and 15 v. at 2 amps., **20/-**. Sec. :—22 v. at 2 amps, **18/6**.

BATTERY CHARGERS, for 200/250 v. A.C. Metal rectified. In strong black crystalline steel cabinet, 9in. × 5in. × 4in. for wall suspension. Screw-in mains selection and radial switch for voltage selection, 2, 6 and 12 v., at full 1 amp., **£3 17s. 6d.**

S.T.C. METAL RECTIFIERS, D.C. delivery up to 12 v. at 1½ amps., **12/6**. **SLIDING RESISTANCES**, 100 watts. Fully enclosed, constantly rated. 10 ohms 3 amps., 50 ohms 1.4 amp., 200 ohms 0.7 amp. Any one, **25/-**. Also 172 ohms (graded). Max. 2 amps.; min. 0.07 amp., **32/6**. **STAGE DIMMERS**, controlling stated load from full bright to black-out at 220/240 v., fitted worm drive and handwheel, 1,000 watts, **£6 17s. 6d.** 1,500 watts, **£8 8s.** (Carr. either 7/6, plus 20/- for returnable case). **MILLIAMMETERS** by first-class makers. High-grade precision m/coil instruments, flush mtg. 0/1 m.a., 2½in., **52/6**; 3½in., **67/6**. Also same make, 0/500 microamps (for 2,000 ohms/volt combined instrument), 3½in., **75/-**. **COMBINED MEASURING INSTRUMENTS** in crash-proof black bakelite case, 6in. × 4 × 3in., with carrying handle. 1,000 ohms/volt, universal A.C./D.C. Readings:—M.A., 0/1, 0/10, 0/100, 0/500. Volts, 0/10, 0/50, 0/100, 0/500. Ohms, 0/5,000. Complete with cell, **£8 17s. 6d.** **VITAVOX HIGH FIDELITY SPEAKERS**, 12in. P.M. (Ticonal), 15 ohms coil, handling 10 watts. Very latest development and best specification. **£7** (desp. 5/-). We are obtaining maximum delivery of these, but have to advise very early application.

GOODMAN MINIATURE P.M. M/COIL UNITS, for speaker or microphone 3½in. overall, fitted high-flux P.M. latest model, **30/-**.

GRAMPIAN M/COIL MICROPHONES, suspended in square frame, with plated mounting boss, 15 ohms, **£4 4s.** Also same make, Senior model for highest quality work, all plated with local on-off sw., 15 ohms, **£7 5s.** **ROTHERMEL PIEZO-CRYSTAL MICROPHONES**, D.104, all-plated with suspension rings and 6ft. sc. cable, **£5 5s.** Also sound cell type BR.28 **£10 10s.** Also miniature deaf-aid insert type, 1¾in. dia., **29/6**. **FLOOR STANDS**, collaps. ext. to 5½ft., all chrom., **45/6**. Cradles for D.104 only, **8/-**.

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Please include sufficient for despatch, where not stated.

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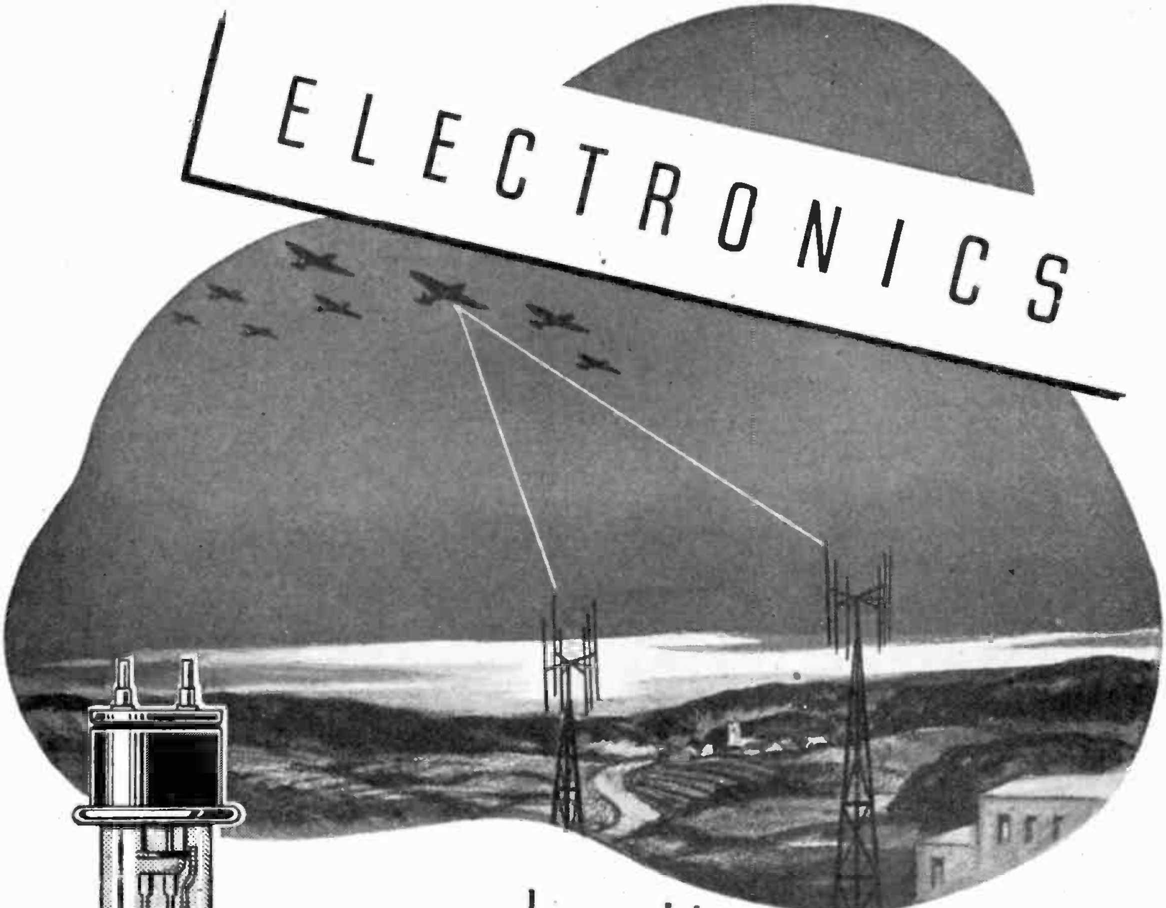
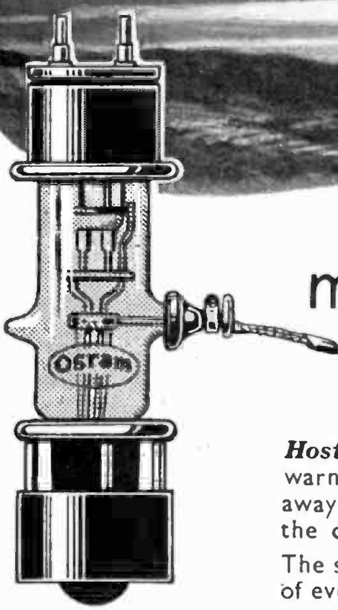
ELECTRONICS





made it possible!

Hostiles, bearing 194, height 10,000—back went the warning and fighters raced to intercept. From many miles away Radar plotted the enemy's exact position, and brought the defences hurtling into action.

The science of electronics made it possible, for at the heart of every Radar installation lies the valve.

OSRAM VALVES have been in the forefront of electronic development during the war, and will bring to the pursuits of peace many well-tried electronic devices to speed, smooth and make safer our way of life.

One of the OSRAM VALVES specially developed for Radar—an ACT 20 which will find many peace-time applications.

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In communications, wherever measurement for testing purposes is involved, empiricism can be ruled out. Of no avail without scientific instruments is anything the eye can see, the hand feel or the most observant remember. The radio engineer, therefore, must have test gear on which he can rely and, thanks to the foresight of Marconi Instruments Ltd., has a wide selection from which to choose. And he finds exemplified in these Marconi products the qualities so characteristic of British Engineering craftsmanship—rational design, precise workmanship and technical efficiency.

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Comprehensive stocks enable us to quote for EVERYTHING IN RADIO—our regular adverts. show merely a few interesting lines.

PORTABLE AMPLIFIER CASE, comprising chassis, cover and base plate. Overall size 16"×8"×9" high, chassis depth 2½", removable top cover adequately ventilated top and sides, fitted two carrying handles. Chassis drilled in front for four controls, cut for seven valves, side entries for mains cable and speaker plug. Well finished in black-crackle, this makes an ideal amplifier case £2 12 6

Packing and carriage 2/6 extra, with slight delay in despatch owing to shortage of packing. Callers from stock.

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Rothermel D104 Crystal Microphones	£5 5 0
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Magnavox Mains Energised, 2,200 ohms field, speech coil 2½ ohms, with pentode transformer :

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Permanent magnet speakers in variety from 2" miniatures to : Vitavox K12/20 high fidelity 20 watts, overall dia. 12½", baffle aperture 10½". A heavy duty speaker combining punch, high efficiency and fidelity. Flux density 17,000 lines per sq. cm. £11 0 0

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Webb's Amateur Key, similar high-grade lacquered brass, slightly lighter but perfectly balanced, front and back contacts	£1 2 6
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The day that hostilities cease may be a little late to start deciding who shall supply the Transformers and Chokes for your post-war product.

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Just at the moment we are extremely busy making hundreds of thousands of transformers for the battle front, but we are able to devote a certain amount of thought and planning for post-war.

Installed in our new actory is the very latest in Coil Winding Machines, vacuum impregnating plant, test equipment, and everything necessary for the production of the finest transformers that are made.

Drop us a line and let us show you the latest fashions. You are bound to be interested !

WODEN TRANSFORMER CO. LTD.

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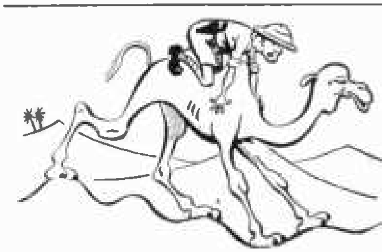

IT'S ALL UPS & DOWNS

Keeping up regular supplies these days is no easy job although we use every endeavour to schedule production evenly. Just now—whilst we are writing this advertisement—for instance, we can give very prompt delivery of that 'truly portable' Portable P.A. Equipment, the "UNIVERSAL FIFTEEN," operating efficiently on all voltages from 200-240 AC or DC. But a week... a month hence ? Who knows ? So if you are interested in equipment in which more than usual attention is paid to quality, we cannot urge you too strongly to write to us right away.

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R. S. AMPLIFIERS LTD • 3-4 HIGHFIELD ROAD • SHEPPERTON • MIDDX.
TELEPHONE WALTON-ON-THAMES 1019

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TEST METERS

Finest quality Voltmeters, 2 range pocket type, 0.25 v., 0-250 v. moving iron, **35/-**. Panel mounting moving coil Milliameters 0-100 m.a.. 2½in. dial, **57/6** ; 0-2 m.a.. 2in. dial, **45/-** ; 0-5 m.a., 2in., **45/-** ; 0-50 m.a., 2in. dial, **45/-** ; 0-150 m.a., 2in. dial, **45/-**. 0-14 amp., with shunt, **49/6** ; 0-50 m.a., 1½in. dial, **45/-**.

VARIABLE CONDENSERS. 2-gang, .0005 ceramic with trimmers, fixing feet, slow-motion drive, dial frame and pointer, **17/9.** Midget 2 gang .00035, **8/6.**

TUBULAR PAPER CONDENSERS. 350/500 v., D.C. working. .0001, 3d. ; .0025, 4d. ; .01, 9d. ; .02, 7d. ; .04, 8d. ; .08, 9d. ; .1, **10d.** ; .25, **1/-** ; .5, **1/9** .05 9d. each. Parcel of 50 assorted, **27/6.**

2-mfd. TUBULAR CONDENSERS, 350 v., **2/6.**

AERIAL AND OSCILLATOR COILS. Best D.S.C. wire wound, colour coded on bakelite formers. Short, medium and long wave, 16/50 m., 200/550 m., 1,000/2,000 m. ; with circuit diagram, **15/-** the set.

I.F. TRANSFORMERS. 465 K.C.'s Iron-cored Litz wound aluminium can. Limited quantity, **17/6** matched pair ; **9/6** each.

S.M. & L. T.R.F. COILS. Philips, best quality in screened aluminium can ; 17-51, 220-585, 725-2,000 metres. (These coils equal to performance of superhet.) Complete with circuit diagram, **9/6** the pair.

M. & L. T.R.F. AERIAL COILS. Aluminium screened Philips. 200-585, 725-2,000 metres, complete with circuit diagrams, **2/9** each.

WAVE CHANGE SWITCH, to suit all above coils, **5/9.**

SCREENED INTERLACED FLEXIBLE MICROPHONE CABLE. Twin 6 yards for **6/9** ; single, **1/-** per yard.

VOLUME CONTROLS. 1, 5, 10, 20, 25, 50 and 100 thousand ohms, ¼, ½, 1 and 2 meg., without switch, **4/3** each. As above, with switch, **6/-** each ; 100,000 ohms, ½ meg., double-pole switch, best American, **6/6** each ; 2,000 ohms only, wire wound, **2/6** each ; 1,000 ohms only, carbon, screw adjustment, **1/6** each. Midget ½ meg., with switch, **5/6** ; less switch, **2/6** each.

MAINS TRANSFORMERS. 350-0-350 4 v. 6 amp. C.T. 4 v. 2 amp., 100 m.a. ; heavy laminations ; pre-war stock. Bargain, **27/6.** 350-0-350, 6.3 v. 3 amp. C.T., 5 v. 2 amp., 100 m.a., **32/6.**

L.F. CHOKES. 20 henrys, 150 m.a., **14/-.**

SLOW-MOTION DRIVE. 8-1, complete with drum and spindle, **3/-.**

PUSH-BUTTON UNITS. Complete with escutcheon and knobs, 4-way. New, **4/6** each.

WANDER PLUGS. In 2 colours, **2/-** per dozen.

LINE CORDS. 3-way, heavy-duty, 3 amp. 360 ohms, **9/6** ; 480 ohms, **13/6** ; 600 ohms, **15/9** ; 2-way, 360 ohms, **5/6** ; 480 ohms, **7/6** ; 600 ohms, **9/3.**

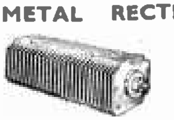
SPECIAL OFFER BATTERY CHARGERS. 1-amp type, 2, 6, or 12 volt, 200/240 volt input. Finished in black metal cabinet. Small and compact, **£3 19s. 6d.** each.

2 SPECIAL KIT OFFERS

KIT 1.—Tuning heart suitable for 6-valve superhet, comprising variable condenser and slow-motion drive, set of iron-cored I.F.'s 465 K.C.'s Litz wound, aerial coil, R.F. transformer and oscillator coil. All trimmers and padders with wave change switch for 3-wave bands, S.M. and L. Also circuit diagram for complete set, **£3 9s. 6d.**

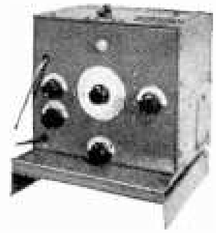
KIT 2.—Tuning heart for 5-valve superhet, comprising variable condenser and slow-motion drive, set of iron-cored I.F.'s 465 K.C.'s Litz wound, aerial coil and oscillator coil. All trimmers and padders with wave change switch for 3-wave bands, S.M. and L. Also circuit diagram for complete set, **£2 19s. 6d.**

WESTINGHOUSE METAL RECTIFIERS EX-G.P.O.



Suitable for chargers, etc., H/wave. H.T. 150/400 v., 50/200 m.a. **15/-.**

DE LUXE ALL-WAVE SERVICE SIGNAL GENERATOR



A.C. mains, 200/250 v. 50 cycles, range covers from 20 M.C. to 100 K.C., all fundamentally in 5 bands without gaps. S/M dial. Direct calibration in frequencies. Coarse and fine output attenuator. Internal modulation. 400 C/S iron-cored coils. The generator is entirely screened in heavy metal cabinet. Dim 10in. × 10in. × 12in. Each **16 gns.**

SERVICE KITS

85. 1 8-mfd. 500 v.w. Electrolytic, 12 each assorted tubular paper condensers, carbon wire end resistors, 3 yards sleeving, **9/6.**
85A. 8 × 8-mfd. 500 v.w. Electrolytic, 12 each assorted tubular paper condensers, carbon wire-end resistors, 3 yards sleeving, **10/6.**
86. 1 8-mfd. 500 v.w., 1 32-mfd. 320 v.w. Electrolytics, 25 each assorted tubular paper condensers, and carbon wire-end resistors, 1 volume control, 3 yards sleeving, **22/6.**
86A. 1 8 × 8-mfd. 500 v.w., 1 32-mfd. 320 v.w. Electrolytics, 25 assorted tubular paper condensers and carbon wire-end resistors, 1 volume control, 3 yards sleeving, **24/6.**
87. 2 8-mfd. 500 v.w., 1 4-mfd. 400/500 v.w., 1 32-mfd. 320 v.w. Electrolytics, 18 each assorted tubular paper condensers and carbon wire-end resistors, 2 volume controls, **37/6.**
87A. 2 8 × 8-mfd. 500 v.w., 1. 4-mfd. 400/500 v.w., 1 32-mfd. 320 v.w. Electrolytics, 12 each assorted tubular paper condensers, and carbon wire-end resistors, 2 volume controls, **39/6.**
88. 3 8-mfd. 500 v.w., 3 32-mfd. 320 v.w., 1 8 × 8-mfd. 500 v.w., 2 4-mfd. 400/500 v., 25 each assorted tubular paper condensers and carbon wire-end resistors, 6 yards sleeving 6 yards P.V.C. cable, 3 tone controls, 6 assorted valveholders, **£4 15s.**
88A. 3 8-mfd. 500 v.w., 3 32-mfd. 320 v.w., 3 8 × 8-mfd. 500 v.w., 2 4-mfd. 400/500 v.w., 25 each assorted tubular paper condensers, and carbon wire-end resistors, 6 yards sleeving, 6 yards P.V.C. cable, 3 tone controls, 6 assorted valveholders, **£5 5s.**
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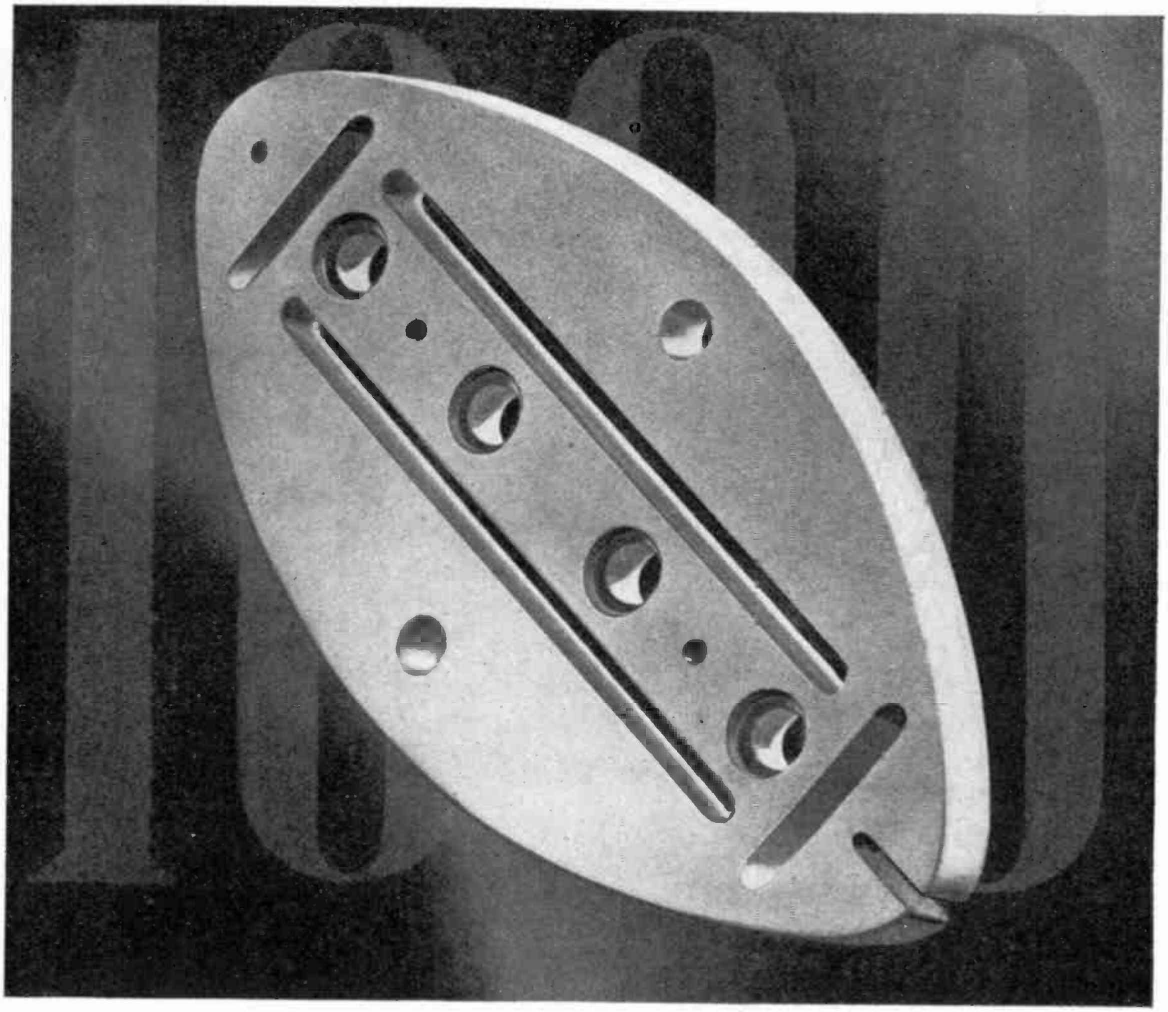

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Radio and Electronics

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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Monthly Commentary

Television: Standards of Comparison

IT is widely accepted that the cinema provides a convenient and useful standard of comparison when we come to discuss the vexed question of fixing the degree of definition desirable for our post-war television service. In the Television Commitee's Report, issued early in the year, such a comparison is constantly made, particularly with regard to big-screen television, and it is categorically stated that the pre-war 405-line system "is not adequate for the large cinema screen, which requires a definition equivalent to a standard of the order of 1,000 lines." Elsewhere in the Report, and without any proviso as to size of screen, the Committee expresses the view that the aim in developing a high-definition system for the future should be "to approach the cinema standard. We think that television definition should eventually be of the order of 1,000 lines. . . ."

Is cinema definition, in fact, equivalent to a 1,000-line television picture, and, as a secondary question, is the cinema an entirely reliable standard of comparison? An answer to the first question is offered in an article appearing elsewhere in this issue, in which the author concludes that, taking into account the conditions under which the final screen image is produced, cinema definition is unlikely to exceed a television equivalent of 400-500 lines in the centre and 300 lines at the edges of the screen.

Questions involving the optical technique of cinematography are rather outside the scope of *Wireless World*, and so we have consulted the Editor of our associated Iliffe journal, *The Amateur Photographer*. In general, he is in broad agreement with the contentions made in the article just quoted, differing only in matters of degree. For instance, he points out that the figures given for the cinema camera lens relate to minimum performance, with the lens wide open. Stopped down, as in bright light, the performance will improve to an extent almost certainly surpassing the limits set by the film. He gives this limit, for film of, say, 55 lines per mm., as about 840 lines per picture. The projection lens does not lower definition at the centre of the field, though it does so towards the edges. Thus, 840-line television is considered to be the highest standard necessary if equality with the film is the aim. It is also considered that the small angle subtended by the cinema picture as a whole might usefully be stressed. Few people realise that, to an observer situated half-way between projector and screen, the apparent picture size with a 4in. lens is only that of a photoprint 3in. × 4½in. as viewed at 10in.! With a 7in. lens, size is reduced to 1.7in. × 2.35in.

On the subsidiary question, the Editor of *The Amateur Photographer* offers a word of warning against the blind acceptance of the cinema as an entirely valid standard of comparison. He points out that the home television viewer can approach as closely as he pleases to the screen, and may thus be unwilling to accept a standard of detail-rendering that would satisfy him in the cinema, where he is anchored to his seat. To satisfy the viewer who wants to look at the screen from a distance of 10 inches, 100 lines *per inch of picture* would be needed.

* * *

Adjusting Ourselves

WE can take encouragement in facing the difficult transition period ahead in the thought that wireless men have not become slaves to conventional ideas to the same extent as practitioners in older arts. So far as receptivity to new technical ideas is concerned, that point is well brought out in a letter from a correspondent, himself an old-timer, published in this issue. But flexibility of mind in technical matters is not enough. The future wireless outlook is potentially fair, but if those potentialities are to be realised quickly and fully, we may be forced to face—or to initiate—drastic changes in the organisational set-up in the industrial and other "political" spheres. It will be the aim of *Wireless World* impartially to present any ideas bearing on these matters that seem likely to bear fruit or to direct thought along profitable channels.

THE "TELEION"

A Versatile Gas Discharge Relay Valve

By J. REISS, B.Sc. (Hons.)
(Romac Radio Corporation, Ltd.)

IN the previous issue of this journal there appeared an article on a high-speed telegraphic system in which one of the essential elements was a gas-filled relay valve of unusual design. It is proposed in this article to give some further details of this valve which has many useful applications in the electronic art.

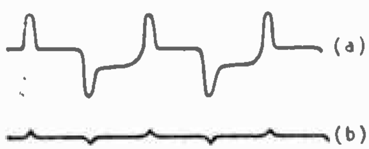


Fig. 1. Variation in voltage across input electrodes (a) without glow-up electrode; (b) with glow-up electrode.

In the early stages of development of the high-speed telegraph system in 1934 an ordinary two electrode neon valve was at first used as coupling element and later the Pressler neon relay was tried, but because of its sensitiveness to variations in the HT supply and its instability, it proved unsatisfactory. Better results were obtained by using the Pressler tuning indicator with its third electrode which was normally used for suppressing noises. This meant that for the first time it was possible to maintain the glow in the neon device over its whole working range, instead of the usual switching on and off with each impulse as was the case with the two electrode valve. Unfortunately, however, only a very small output voltage was obtainable from this three electrode device as it was not possible to polarise the voltage on the third electrode without interfering with the proper functioning of the other two electrodes.

At this stage the first improvement was made which culminated in the production of the Teleion. A screen was introduced between the first and third electrode so as to prevent the direct influence of one on the other, and so enable the third electrode to be polarised (i.e. to be held at a voltage more negative than the second electrode with respect to the first electrode).

A scientific controversy arose at the time as to whether it was at all possible to screen one part of a gas-filled valve from the other by means of a metal disc which had to have a hole in the centre to allow for the spreading of the glow along the second electrode. It was maintained that if ionisation took place in one part of the valve it could not be prevented from occurring in the other part of the valve by means of such a screen, and that at best one would still have to contend with the so-called "dark current." However, in the same year, 1934, one such valve was actually made and its effectiveness demonstrated.

In 1935 a fifth electrode was added in order to reduce the time lag normally encountered in gas-filled valves due to ionisation and de-ionisation. This again provoked a rather prolonged scientific controversy, but later on in the same year it was demonstrated on the cathode-ray tube that by the introduction of this fifth electrode—the so-called "glow-up" electrode—and by maintaining it in an over-saturated condition, the ionisation and de-ionisation times could be reduced to something negligible. In Fig. 1 are shown the type of traces seen on a cathode-ray oscilloscope of the variation of the voltage across the input electrodes of the Teleion when fed from a beat frequency oscillator (through a rectifier). Curve (*a*) was taken with a Teleion which had no saturated glow-up electrode whilst curve (*b*) shows the improvement when using an over-saturated glow-up electrode. The humps in curve (*a*) illustrate the time and energy which is required to produce ionisation and de-ionisation before the valve operates normally and stabilises its own input voltage.

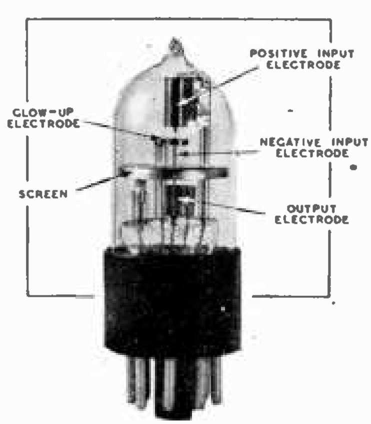


Fig. 2. Principal electrodes in the Teleion valve.

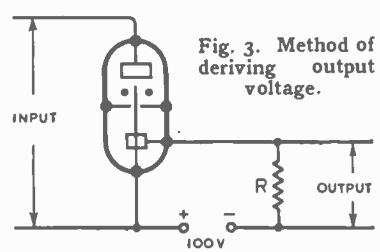


Fig. 3. Method of deriving output voltage.

The addition of this fifth electrode meant, of course, that the range of speeds for which this valve could be used had been greatly increased.

With the help of this five electrode Teleion the first successful high-speed telegraphic arrangement was produced in 1937, this being the forerunner of the arrangement which was used with such remarkable success during this present war.

The Teleion in its present form is a gas-filled valve having five basic electrodes.

1. The positive input electrode, which is a cylinder at the upper end of the valve.

2. The negative input electrode, which is a vertical thin wire in the centre of the valve.

3. The screen, which is a horizontal plate dividing the valve into two parts.

4. The output electrode which is a star-shaped cylinder surrounding the negative input electrode below the screen.

5. The glow-up electrode, which is a ring around the negative input electrode between the positive input electrode and the screen.

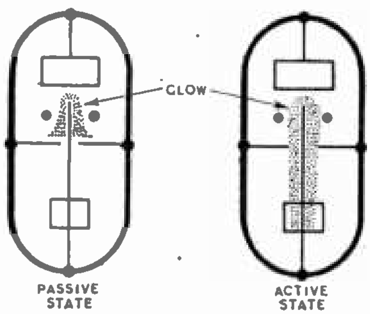


Fig. 4. Extent of glow discharge in the active and passive states.

The input as the name implies is formed by the positive and negative input electrodes. The output is arranged across a suitable resistance which is placed between the output electrode and a potential negative with respect to the negative input electrode. (Fig. 3).

More electrodes are added to fulfil certain requirements. There is an auxiliary positive input electrode, which is a thin wire inside the positive input electrode one end of which approaches very near to the negative input electrode; more output electrodes may be added and placed in a row below the original one.

The propagation of glow along the surface of a cathode with an increase of current in the cathode circuit, is a phenomenon in gas discharge valves. This principle has been incorporated in the Teleion, using the negative input electrode which contains the glow and the output electrode which is excited by the proximity of the glow. The glow can thus be maintained on the negative input electrode alone or by extending it downwards can be made to touch the output electrode also. This is shown in Fig. 4, where the two conditions for the glow are illustrated.

The following are the general characteristics of the Teleion. As the input current increases, there is at first practically no output current at all, then at a predetermined point the full output current is obtained with a very small additional increase in input current. Then with a further increase in input current the output current may be maintained at a constant value. It is important to add that when this process is reversed—that is to say when the input current is decreased again—the new curve obtained almost retraces the curve obtained for an increasing input current as shown in Fig. 5.

Although the change of output voltage across the output resistance is large the input voltage (i.e. the voltage between the positive and negative input electrodes) remains practically constant. This eliminates the Miller effect in the preceding valve more effectively than the screen grid tubes normally employed. The traces in Fig. 6 were taken on a two beam oscilloscope, curve (*a*) showing practically no variation across the input electrodes whilst curve (*b*) shows the output of an amplitude of 100 volts. These curves were taken at a pulsation frequency of 1,000 c/s and illustrate well why the Teleion has proved so successful in high speed telegraphy. The exponential tendencies on one side of the pulses in curve (*b*) are due to the stray capacities of the leads to the oscilloscope coupled with the one megohm across which the output was taken.

It is of interest to examine

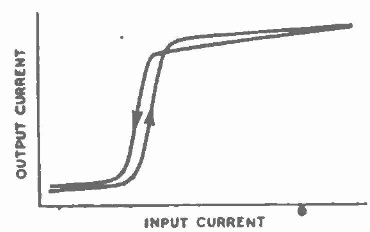


Fig. 5. Input-output characteristic of the Teleion.

more closely why the Teleion gives comparative freedom from Miller effect. One of the chief characteristics of a gas discharge tube is that the current flow may be varied without varying the voltage across the input electrodes. To control this flow of current a variable series resistance is normally employed. In the case of the Teleion, however, the preceding valve is used as the variable resistance, the control of which is maintained by means of the variation in its grid potential. In Fig. 7 is shown the basic circuit for the parallel connection

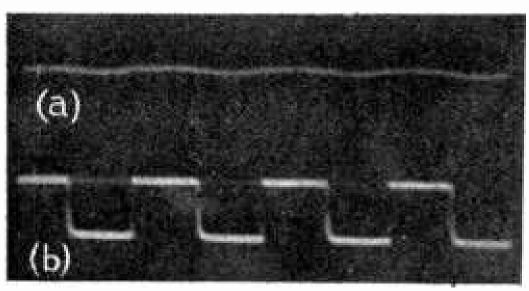


Fig. 6. Oscillograms of input voltage (a) and output voltage (b) at a pulsation frequency of 1000 c/s.

CHARACTERISTIC DATA FOR THE "TELEION"

Maximum Input Current	Input Voltage	Maximum Output Current	Glow-up Electrode Current	Screen Voltage	Minimum Input Current Variation	
3.5 mA	150–180 V	150 μA (across 1 MΩ)	3 mA	100–130V	For DC ampl. 0.6 mA	For relay 0.2 mA

The "Teleion"—
of the Teleion. It can be seen from the figure that as the supply voltage is constant—particularly as the current withdrawn through resistance R is practically constant and also as the voltage between *b* and *c* is constant—the potential

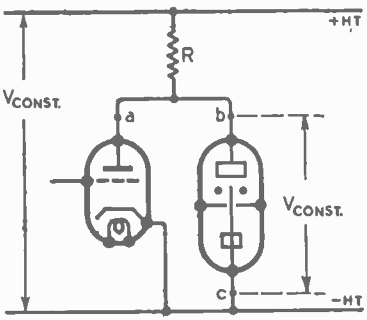


Fig. 7. Basic circuit of Teleion amplifier with parallel connection.

at point *a* must also be constant irrespective of the variation of the grid potential. This means that no contra voltage can be reflected back into the input circuit from the anode circuit by means of the inter-electrode capacities, thus eliminating the so-called Miller Effect.

From the characteristics described it will be seen that the Teleion is pre-eminently suitable for the amplification of weak DC pulses such as those derived from the photoelectric cell in a high-speed transmitter or the diode in a receiving circuit. It has also been employed in a sensitive relay circuit of simple design which provides an output of 10 watts for a change of input capacity of one micro-microfarad, and it has also been used to improve the fly-back in time base circuits.

The writer wishes to acknowledge, with thanks, the permission given by M. S. Lalewicz, the inventor of the Teleion, to use certain information incorporated in these notes.

IONOSPHERE STORMS

Direct Evidence That They are Caused by Solar Corpuscles

WHEN a solar flare is observed on the visible disc of the sun there is very often, at the same time, a sudden ionosphere disturbance, which results in a brief fade-out of short-wave radio signals. That the one is responsible for the other has been well established, the sudden ionosphere disturbance being due to the increased emission of ultra-violet light from the solar flare.

But sometimes there also occurs, about 20–26 hours after the time of the solar flare, a longer period of ionosphere disturbance of a different character from the first—of the type known as an "ionosphere storm." This is the more serious of the two disturbances; so far as its interruptive effects on short-wave communication are concerned, for it lasts a considerable time. Almost always it is accompanied by a disturbance in the earth's magnetic field, and sometimes by auroral displays.

It has for a long time been suspected that a connection exists between the solar flare and the subsequent magnetic and ionosphere storms, and that the latter may be due to the arrival in the earth's atmosphere of charged particles of matter which were emitted from the sun at the same time as the visible and ultra-violet radiations. If such particles were ejected from the sun in a direction such that they eventually encountered the earth, then, if they travelled at a speed of 1,600 km/sec. they would arrive in about 26 hours.

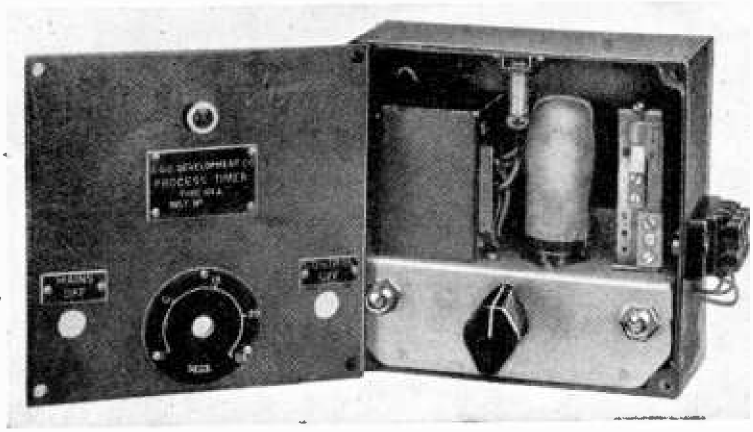
It was recently announced that spectrograms taken at Mount Wilson in 1944 during magnetic storms showed absorption bands in certain parts of the spectrum, while spectrograms taken during calm magnetic periods showed no such absorption. These absorption bands are attributed to matter travelling from the sun towards the earth, and they indicate maximum velocities of the order of 1,000 km/sec. This is the first direct evidence of the presence in space of calcium ions approaching the earth from the sun at speeds comparable with those previously suggested for the causative agent of magnetic storms.

T. W. B.

ELECTRONIC PROCESS TIMER

DESIGNED for the control of all types of industrial processes and machine tools, including rubber moulding presses, bar twisters for concrete reinforcing rods, etc., this unit makes use of a single thyratron valve and gives a range of timing intervals from 0 to 25 seconds with an accuracy of 5 per cent. It can be employed also as a time delay switch.

Contactors are fitted to handle up to 5 amps. AC at 230 volts; larger contactors can be fitted to order. The instrument requires a mains input of 200-250 volts, 50 c/s, and is contained in a case measuring 6in. x 6in. x 3in. The makers are G.G.C. Development Co., 109, Belgrave Road, London, S.W.1.



Type P.T.101A electronic process and delay timer.

RADIO PROSPECTS

Suggestions for Re-organisation

By H. A. HARTLEY

(Concluded from page 201, July issue)

THE writer has long believed that technicians should take a political interest in the work they do. This does not mean the sort of politics that the citizen practices when he goes to the poll, but that which is concerned with the way his work is done. The scientist who makes a discovery or the engineer who invents a new machine has a responsibility to society, the responsibility of seeing that the result of his work is used for the good of humanity in general, and not one restricted section of it in particular. A large proportion of the misery that has descended on civilisation has resulted from scientists and engineers taking the view that the exploitation of their work is not their concern. This attitude must be changed, even to the extent of suppressing a new discovery which might be harmful to mankind if improperly used. At the least, steps should be taken to prevent the new knowledge being turned to base ends. This is against the traditional ethic of science; but the time has come when scientific ethic must give way to more important matters, among which is the protection and advancement of civilisation. In all ways the technical worker must take the initiative in the business of developing new methods and apparatus. In our own particular case the plan to be described, if acceptable to technicians, must be sponsored primarily by technicians. It is they who devised broadcasting, and it is they who will improve it. It is their responsibility to ensure that the general public derives the greatest measure of satisfaction and service from their work, for the simple reason that no one else will. In doing so they will also protect their own interests.

In giving the outline of this plan (for considerations of space do not permit of a detailed account) certain premises have to be made. They are:

(*a*) That commodities have no excuse for existence unless they are of service or value to the consumer.

(*b*) That commodities should be designed to give the maximum service to the consumer at the lowest reasonable cost.

(*c*) That where commodities are of a complex or delicate nature, adequate servicing facilities should exist.

(*d*) That where the nature of a commodity is such that the consumer is not competent to assess its true worth, the consumer should be protected by a specification for the commodity, as to performance and reliability.

(*e*) That a manufacturer has no justification for existence as a manufacturer unless his production unit is efficiently run and produces commodities which conform to *a*, *b*, *c* and *d* above.

(*f*) That a manufacturer who produces commodities which do conform to these requirements is entitled to a reasonable profit; and so long as his production unit is efficiently managed, has a right to expect freedom from interference by outside organisations.

(*g*) That there are three parties to every industrial transaction: the employer, the employee and the consumer. The interests of the first two are safeguarded by employers' federations and trade unions. The interests of the third must be safeguarded by a new sort of organisation.

Backbone of the Industry

We may now consider how to tackle the matter of production for broadcast reception. This aspect of electronics is here considered because of its wide interest, and because it still forms the backbone of the radio industry. Judging from the work done in the U.S.A., it seems that frequency modulation solves the problem of high-fidelity transmission and reception, because it provides a system of short-wave transmission practically free from interference. The design of FM receivers and transmitters provides technicians with a good opportunity for new work, with plenty of scope for their talents. The problem of who and what is going to provide the FM broadcasting service will be deferred for the time being. For the moment we shall assume that it will exist within a few years of the end of the war.

At the present time there is a serious shortage of radio sets, and most of those now in use are obsolete or working in an unsatisfactory manner. This being so, the time is ripe for tackling the matter of providing the public with good broadcast receivers on new lines. Never, since broadcasting started, has it been so easy, from a "sales resistance" angle, to break away from stereotyped methods, and if FM also arrives, a new sort of set is wanted. It has already been pointed out that the pre-war way of designing and selling sets produced the wrong sort of equipment, so this plan is based on a new conception of how to get sound and vision broadcasting into the homes of the public.

B.B.C. "Network"

Broadcasting is as much a public utility as water or electricity supply, public transport, or garbage collection. In this country we moved ahead of the Americans in unification of the source of programmes. It has taken years of experience of the disadvantages of hundreds of irresponsible broadcasting stations, large and small, to make the Americans realise the advantages of the network system. We have had our own network, in the shape of the B.B.C., longer than any other country. We may complain very bitterly at times about the sort of programmes that are sent out, but at least the B.B.C. system was planned. The receiving of the programmes has never been planned, but it can be.

Ever since the time when the valve manufacturers, unable to

Radio Prospects—
cope with the ever-increasing variety of types of valves called for by set designers, decided to restrict the range, the circuit layout and performance of receivers has tended to become standardised. The valve makers issued to every set maker comprehensive technical reports on the circuit requirements of these standardised valves, and this relieved the set makers from the necessity of having to design receivers from scratch. Certainly, individual set manufacturers introduced novelties of their own which they thought would add refinement to the performance or provide selling points, but basically the various sets had similar sensitivity and selectivity for a given number of valves. Marked differences existed in the design of appendages like tuning scales, controls and cabinet work, but these differences did not provide alternative service to the user. Only one type of tuning scale is really needed: that which is most easily read and understood. The cabinet work is not a radio problem, and is something which does not properly belong to the radio industry at all.

Receiver Designs

The basis of this new plan is a fully standardised range of receivers of varying performance. The range might include:

- A medium-fidelity receiver for B.B.C. programmes.
- A medium-fidelity all-wave receiver.

} of about 4 watts output.

- A high-fidelity receiver for B.B.C. programmes.
- A high-fidelity receiver for AM and FM

} of about 14 watts output.

- A small-tube television receiver with medium-fidelity sound.
- A large tube television receiver with high-fidelity sound.
- Inexpensive gramophone playing desk.
- High-fidelity gramophone playing desk.

All these chassis would be designed by a central radio research and development establishment, and each type would be covered by a detailed specification of performance, quality and dimensions. This central research establishment is very much overdue. It is uneconomical in an industry like radio for each and every manufacturer to have a fully equipped laboratory and staff doing work of an almost exactly similar nature to that done elsewhere. Certain it is that without individual effort in the past many of the advances in technique that have been made would not have materialised; but that initiatory period has passed, and the technique of radio is now fairly well standardised. So much so that for years every broadcast receiver has been made under a common patent pool, and those firms that did the bulk of the original research and development have been handsomely rewarded for their time and trouble. If the industry ever agreed to produce standardised receiver chassis, then it is perfectly obvious that the technique of designing them would also be standardised. The central research institution is the answer.

The cost of maintaining this establishment would, whatever happens, have to be borne by the consumer. Every scrap of radio research must always be paid by the consumer, and it is really a side issue whether it is done by private firms or by the Government. The writer would repeat that he is not here concerned with "isms" of any kind. If Britain became socialistic, then the research centre would be run as a State establishment; if capitalism continues, then the cost would be met by the Radio Industries Council, through the individual members, and ultimately by the people who buy the sets. What is vitally important is the direction of the establishment. Radio must serve the public first, and the manufacturers afterwards. The director would, therefore, be an administrative scientist representing the public and absolutely free from dependence on the industry. He would, in fact, be a State servant.

The designs of the research centre would be made by any manufacturer who wished to make them, and no manufacturer would be allowed to design and produce other equipment unless he also undertook to produce a certain quota of the standardised sets. The standard chassis would have to conform to the specification laid down for them and they would be sold under the positive guarantee that they did so conform. By this provision the public would be protected from the effects of shoddy material and bad workmanship. It seems logical that the standard chassis should be sold at standard prices, but this system is so liable to abuse, as experience of cartels has shown, that it might be better to retain those features of private enterprise which result in the most efficiently run production unit making commodities at the lowest price, other things being equal.

Advantages

This scheme of a restricted range of standard chassis has many advantages. The cost to the consumer would be enormously reduced by the elimination of wasteful competition; also by the lowering of overhead costs per unit by the larger production of each type consequent on the reduction of number of types. The dealer who has to transfer the set from the manufacturer to the customer would have to carry a very much simpler stock, and his servicing problems would be substantially reduced by having to cater for only a few types instead of many; this would reduce the variety of component parts he has hitherto had to carry in stock. Further, standardised mass-produced test equipment could be produced at a very low figure, so enabling even small-town dealers to install the necessary facilities for carrying out all repairs on their own premises.

The manufacturers would benefit very considerably indeed, for they would at once be relieved from the anxiety of speculative production. Absolved from the necessity of trying to guess what the public will buy, they will have full opportunity for planning their production in the most effective manner; by statistical investigation, the Radio Industries Council could estimate the total number of sets required each year, how the total should be divided up into proportionate parts according to type of chassis, and allocate production of agreed percentages among its members. The factory workers would benefit by being relieved of the bugbear of seasonal unemployment, a grotesque and inexcusable result of letting things take their own course. After the war labour will have to be directed in very large numbers to such activities as the production of building materials and the erection of homes for the people; it will be necessary for factories in other industries to employ their workers in the most efficient way, and standardised radio production would remove the seasonal demand for sets which were new only in "trimmings," and so enable the factories to work at a constant rate all the year round.

And finally our technicians would benefit. Instead of a mad rush for three months in each year getting something ready for the next Radiolympia, a something which only emerged from the emotional whimsies of the managing director, the indeterminate hunches of the sales department, and such snooping into the activities of other manufacturers as could be achieved, our scientific workers and engineers would be able to evolve a properly planned scheme of broadcast transmission and reception worthy of the century in which we live. They would have security and time to do their work properly. They would not have to make do with ill-equipped laboratories, as so many have had to in the past, but, with the resources of the research and development centre behind them, could do the sort of work they have been able to do during the war, of a class quite beyond the resources of all but a very few private concerns. The semi-skilled technical men would also benefit in a way about to be described.

Radio Cabinets

Thus far we have produced a range of radio and television chassis. This is all that some people want. Architects would like to build in radio as they do central heating and air-conditioning. With these standardised units constructed to a definite specification, they would know exactly where they stand. The private householder might be glad, if he is hard up, to buy the bare chassis of a radio set; or he might wish to put it into a cabinet of his own design or construction. However, the majority of people seem to consider a radio set as an article of furniture, and in a democratic country all tastes must be considered. The difficulty is surmounted very easily. A panel of designers would be employed to produce a range of cabinet designs for each of the chassis, ranging from a simple box to a fairly elaborate radio-gramophone. These cabinets would also be standardised in construction, dimensions, materials; but they would be supplied by the cabinet-making industry direct to the dealers, thus avoiding a radio manufacturer's overhead charges. The customer would select his chassis and cabinet in the dealer's shop, and there the two would be fitted together.

The Dealer's Part

The dealer must be the essential link between factory and consumer. He must be competent to install and service the equipment, and have financial stability. He will have to employ certified service-men who are paid a salary commensurate with their qualifications. He will have premises situated to meet consumer demand and servicing. This, no doubt, sounds idealistic; but the shopkeeper has a dignified and honourable place in the community. He is not only a servant of the public, but ought also to be their adviser. By lifting the dealer outside the ordinary conception of a parasitic middleman, he acquires new dignity and self-reliance, but he must at the same time give the service which this increased prestige demands. A nation-wide network of radio dealers of this type would provide good employment for thousands of semi-skilled technical men discharged from the armed forces, whose future is otherwise not very promising.

Here, then, is a new plan for the production and marketing of broadcast sound and television receivers. Details cannot be considered here, but should be talked over by radio men in all walks of life. The plan does not depend on the adoption of any particular form of political economy by the electorate at large, for the ownership of the research centre and the means of production and distribution is a matter of indifference.

But a plan has got to be produced. So far the radio industry has produced nothing beyond a vague statement about increasing production of radio receivers over the pre-war figures, and paying a lot of attention to television. The Bristol Institution of Radio Engineers has issued a report on technical matters and the training and employment of technical workers, which is of great interest to technicians; but it does not deal with the economic and political aspects of the industry. It is not claimed that the present scheme is even approximately perfect, but it is based on a knowledge of what has been or has not been done in the industry in the past, and a shrewd suspicion that unless some positive and progressive plan is put into force, the industry will, after the first few years of meeting normal public demand, finally drift into chaos and bankruptcy.

Neither this nor any other plan will ever make progress or be adopted until organised effort by intelligent people is made. And so the matter is left for the consideration of the technical workers of the industry, who, the writer hopes, will take action on what he has put down in this contribution.

OUR COVER

A SELECTION of Osram high-power valves, ranging from 12-kW to 150-kW anode dissipation, forms the subject of this month's cover illustration. The group includes water-cooled rectifiers with binocular anodes, an air-cooled-anode transmitting triode arranged for either convection or forced air cooling, and an air-cooled-anode mercury rectifier for an output up to 12 amps.

POSTAL TUITION

A SERIES of postal courses has been instituted by the Dundee Wireless College, 7, Airlie Place, Dundee. The courses are planned for those proposing to sit for the P.M.G. 1st and 2nd Class Certificates and for the Civil Air Licence; there is also a course in radio engineering and servicing.

VALVES IN THE SERVICES

Type Designations and Their Commercial Equivalents

(Information supplied by The Inter-Service Technical Valve Committee)

Many readers, both inside and outside the Services, who are concerned with the use of valves marked with Service names, would like to know the commercial types on which the Service types were based. The following tables give this information. The first column shows the Service names, A . . . being an Army type, N . . . a Naval type, V . . . an Air Force type, and CV . . . a common Service type. Since 1941 all valves adopted by the Services have been given "CV" titles, and later all the old A . . ., N . . ., and V . . . valves were brought into this system to eliminate overlapping. However, as large stocks of valves marked with the old Service type designations still exist and numerous equipments are marked with those names, they are made the basis of the arrangement in the first column.

A warning should be given that strict equivalence between the Service type and the given commercial type must not be assumed, as the specification for the Service valve may require selection either for electrical or mechanical requirements or both.

Original Service Name	Current Title	Other Service Names	Commercial Type
AD1	CV1314		DLS10
ARDD1	CV1300		10D1
ARDD3	CV1301		D63, 6H6G
ARDD5	CV1054	VR54	EB34
ARD2	CV1078	VR78	D1
ARD4	CV1302		D42
ARH1	CV1280	NR67	X64
ARP1	CV1118	NR39, VR118	PT2, KT2
ARP2	CV1320		SP2
ARP3	CV1321		9D2
ARP4	CV1322		SP210
ARP5	CV1323		VP2
ARP6	CV1324		SP4
ARP7	CV1325		42MPT
ARP8	CV1326		AC4/Pen
ARP9	CV1327		Pen1340
ARP9A	CV1328		7D8S
ARP10	CV1329		APP4G*
ARP11	CV1330		TSP4
ARP12	CV1331		VP23
ARP13	CV1332		210VPT, VP21
ARP14	CV1333		220HPT
ARP15	CV1195	NR86	KTW63
ARP16	CV1074	NR83, VT74	KTZ63
ARP17	CV1186	NR85	KT63, 6F6G
ARP18	CV1334		KT24
ARP19	CV1335		SP41
ARP20	CV1336		SP42
ARP21	CV1192	NR79	Z62
ARP22	CV1337		116Pen
ARP23	CV1124	NR70, VR124	MS/Pen
ARP24	CV1338		220VPT
ARP25	CV1181	NR59	KT41
ARP26	CV1340		KT44 (mod)
ARP33	CV1341		MSP4
ARP34	CV1053	VR53	EF39
ARP35	CV1091	VR91	EF50
ARP36	CV1065	VR65	SP41 (mod)
ARP37	CV1342		QP25
ARP38	CV1343		KTZ73 (mod)
ARS6	CV1317		S625
ARS7	CV1318		VS24, PM12M, S215VM
ARS8	CV1319		VS2
ARTH2	CV1347		ECH35

Original Service Name	Current Title	Other Service Names	Commercial Type
ARTP1	CV1344		TP22
ARTP2	CV1345		TP25
AR4	CV1303		HL210A
AR5	CV1166	NR42	LP2
AR6	CV1304		LP2
AR7	CV1109	NR55, VR109 and A	4D1
AR8	CV1306		HL23DD
AR9	CV1307		210LF
AR10	CV1308		L21DD
AR11	CV1309		4019B
AR12	CV1310		4020A
AR13	CV1311		4022AR
AR14	CV1312		220RC
AR15	CV1313		220LF
AR16	CV1032	VR32	220B
AR17	CV1037	NR31, VR37	MH4
AR20	CV1316		4021B
AR21	CV1055	NR48, VR55	EBC33
ATP4	CV1366		V248A
ATP5	CV1367		V245
ATP7	CV1368		V226
ATP10	CV1369		4061A
ATP35	CV1370		PV1-35
ATP75	CV1371		PZ1-75, SW75Pen
ATP100	CV1372		4069A
ATP600	CV1373		PY3-600
ATS25	CV1374		807
ATS70	CV1365		4282BZ
ATS250	CV1357		SG250
AT15	CV2845		LS5
AT16	CV2846		LS5B
AT20	CV1361		MZ05-20
AT35	CV1025	VT25	DET25
AT75	CV1222	NT39	ACT6
AT200B	CV1363		DET16
AU1	CV1264	NU12	FW4-500
AU2	CV1349		RG5-500, 4064A
AU3A	CV1039	NU17, VU39	MU12/14, UU5, IW4, 44IU
AU4	CV1113	NU18, VU113	U17
AU5	CV1111	VU111	V1907
AU6	CV1072	VU72	GU50, MU4250, RG1/240

Original Service Name	Current Title	Other Service Names	Commercial Type
AU7	CV1355		ESU300
AU8	CV1356		U22
AU12	CV2853		U15, RZ1-250
AW2	CV1070	VS70	7475
AW3	CV1110	VS110	S130
AW4	CV1068	VS68	STV280/40
AW5	CV1359		ME41
AW6	CV1077	VI77	EM31
CV5	CV5		GU21 (special)
CV9	CV9		AL60
CV18	CV18		RK34
CV19	CV19		EHT1
CV24	CV24		HL41
CV25	CV25		4242A
CV26	CV26		813
CV27	CV27		4357A
CV28	CV28		ACT9
CV30	CV30		4270A
CV31	CV31		U20
CV33	CV33		4077A
CV34	CV34		MR10
CV45	CV45		S130 (mod)
CV49	CV49		3B/501A
CV65	CV65		Pen25
CV66	CV66		RL37
CV71	CV71		" Osglim "
CV75	CV75		4313C
CV84	CV84		3B/102B
CV93	CV93		V625
CV152	CV152		GU21
CV173	CV173		DDR2
CV181	CV181		ECC32
CV185	CV185		PM202
CV187	CV187		U19
CV190	CV190		DLS10
CV207	CV207		AC/P4
CV216	CV216		VR150/30
CV225	CV225		ACT17
CV235	CV235		U23
CV242	CV242		GS18, CMG25
CV243	CV243		4045A
CV244	CV244		4046A
CV245	CV245		4328D
CV285	CV285		VA35
NGT1	CV1141		GDT4C
NGT2	CV1128	VGT128	GT1C
NGT3	CV1142		MR75
NGT4	CV1143		GT1A
NGT5	CV1144		BT19
NGT6	CV1145		BT9A
NGT7	CV1147		BT35
NGT9	CV1149		BT41
NR15	CV1151		I410, PM4DX
NR16	CV1153		PM254
NR16A	CV1154		PM254
NR18	CV1156		DEQ
NR22	CV1158		S410, PM14
NR23	CV1159		S410, PM14
NR26	CV1038	VR38	MHL4
NR27	CV1160		104V
NR28	CV1019	VR19	215P
NR31	CV1037	AR17, VR37	MH4
NR35	CV1163		PM2BA
NR37	CV1164		MS4, MSPen (mod)
NR38	CV1165		VMS4, MVSPen (mod)
NR39	CV1118	ARP1, VR118	PT2, KT2
NR41	CV1083	VR83	210VPT, VP21
NR42	CV1166	AR5	LP2
NR43	CV1167		PM24A
NR44	CV1168		ACO44, PX4
NR45	CV1169		VMP4G
NR46	CV1170		D41
NR47	CV1040	VR40	PX25, DO24, PP5/400
NR48	CV1055	AR21, VR55	EBC33
NR49	CV1056	VR56	EF36
NR50	CV1171		HA1, AT4, A40
NR51	CV1172		VP4A
NR52	CV1173		354V
NR53	CV1174		KT42, MP/Pen, Pen4VA, AC/Pen
NR54	CV1175		ZA1, AP4
NR55	CV1109	AR7, VR109 and A	4D1
NR56	CV1178		DA30, DO30
NR57	CV1179		TT4
NR58	CV1180		V312
NR59	CV1181		KT41
NR60	CV1182		H42
NR61	CV1183		W42
NR62	CV1184		A373
NR64	CV1281		KTW61
NR65	CV1282		AC/S2Pen, MSP4
NR66	CV1187		D41
NR67	CV1280	ARH1	X64
NR68	CV587		DH63, 6Q7G
NR69	CV1103	VI103	Y63
NR70	CV1124	ARP23, VR124	MS/Pen
NR71	CV1129	VR129	MS/PenT
NR72	CV1188		N43
NR73	CV1285		ECC31
NR74	CV1189		AC6Pen
NR75	CV1190		AC/P4
NR76	CV1191		KTZ41
NR77	CV1286		EL35
NR78	CV581	6C5G	6C5G
NR79	CV1192	ARP21	Z62
NR81	CV1941	6K7G	6K7G
NR82	CV1193		X65
NR83	CV1074	ARP16, VT74	KTZ63
NR84	CV1194		X41
NR85	CV1186	ARP17	KT63, 6F6G
NR86	CV1195	ARP15	KTW63
NR87	CV1196		AC5PenDD
NR88	CV1197		RL18
NR94	CV1198		AC/P4
NR95	CV1502	VR502	KT32
NS1	CV1069	VS69	STV280/80
NS3	CV1200		202
NS4	CV1201		4317
NS5	CV1202		304
NT13	CV2788		P610
NT18	CV1206		DO60, DA60
NT20	CV1208		P625, PM256
NT36	CV1219		DA100, MZ1-100
NT37	CV1220		4033A
NT38	CV1293		SW75Pen, PZ1-75, PT6
NT39	CV1222	AT75	ACT6
NT40	CV1223		DET5
NT58	CV1288		DET12, TY1-50
NT62	CV1237		PM24D
NT65A	CV1240		PZ1-35

Original Service Name	Current Title	Other Service Names	Commercial Type
NT82	CV1246		P2
NT87	CV1250		4279A
NT92	CV1252		4212E
NU5	CV1261		RX3–120
NU12	CV1264	AU1	FW4–500
NU13	CV1265		U15, RZ1–250
NU15	CV1267		U4020
NU17	CV1039	AU3A, VU39	MU12/14, UU5, 1W4, 441U
NU18	CV1113	AU4, VU113	U17
NU20	CV1268		U50
NU31	CV1279		MU2
NU33	CV1290		SU2150A
NU34	CV1134		HVR2
VGT121	CV1121		T41
VGT128	CV1128	NGT2	GT1C
V177	CV1077	AW6	EM31
V1103	CV1103	NR69	Y63
VR18	CV1018		215SG
VR19	CV1019	NR28	215P
VR22	CV1022		220PA
VR28	CV1028		220VSG
VR32	CV1032	AR16	220B
VR35	CV1035		QP21
VR37	CV1037	NP31, AR17	MH4
VR38	CV1038	NR26	MHL4
VR40	CV1040	NR47	PX25, DO24, PP5/400
VR41	CV1041		PM12M
VR43	CV1043		210PG
VR44	CV1044		210DDT
VR49	CV1049		210SPT
VR53	CV1053	ARP34	EF39
VR54	CV1054	ARDD5	EB34
VR55	CV1055	NR48, AR21	EBC33
VR56	CV1056	NR49	EF36
VR57	CV1057		EK32
VR59	CV1059		HA2, 955, 4671
VR65	CV1065	ARP36	SP41 (mod)
VR65A	CV1574		SP41
VR66	CV1066		P41 (mod)
VR67	CV1067		L63
VR78	CV1078	ARD2	D1
VR82	CV1082		220TH
VR83	CV1083	NR41	220VPT, VP21
VR91	CV1091	ARP35	EF50
VR92	CV1092		EA50
VR95	CV1095		ZA2, 954, 4672
VR99	CV1099		X66
VR99A	CV1581		ECH35, E1341
VR100	CV1100		KTW62
VR101	CV1101		MHLD6
VR102	CV1102		BL63
VR106	CV1106		9D2
VR107	CV1107		15D2
VR108	CV1108		8D2
VR109	CV1109	NR55, AR7	4D1
VR116	CV1116		V872
VR117	CV1117		41MTL
VR118	CV1118	NR39, ARP1	PT2, KT2
VR119	CV1119		DDL4
VR122	CV1122		41MXP
VR124	CV1124	NR70, ARP23	MS/Pen
VR125	CV1125		MS/PenB
VR126	CV1126		4SH
VR129	CV1129	NR71	MS/PenT
VR130	CV1130		HL23
VR135	CV1135		E1148
VR136	CV1136		RL7

Original Service Name	Current Title	Other Service Names	Commercial Type
VR137	CV1137		RL16
VR502	CV1502	NR95	KT32
VR503	CV1503		KT33C
VR505	CV1505		MH41
VS68	CV1068	AW4	STV280/40
VS69	CV1069	NS1	STV280/80
VS70	CV1070	AW2	7475
VS110	CV1110	AW3	S130
VT20	CV1020		220P
VT23	CV1023		230XP
VT25	CV1025	AT35	DET25
VT31	CV1031		SG250
VT34	CV1034		DET3
VT45	CV1045		X56
VT46	CV1046		PT25H
VT47	CV1047		TZ05–20, VLS417
VT50	CV1050		HL2K
VT51	CV1051		Pen220A
VT52	CV1052		EL32
VT58	CV1058		E960
VT60	CV1060		807
VT61	CV1061		4074A, DET19, RK34
VT61A	CV1573		TVO3–10 (mod)
VT62	CV1062		DET12, TY1–50
VT73	CV1073		H63
VT74	CV1074	NR83, ARP16	KTZ63
VT75	CV1075		KT66
VT75A	CV1576		KT44T
VT75B	CV1577		KT44
VT76	CV1076		DA41, TZ40
VT79	CV1079		KT8
VT80	CV1080		4307A
VT81	CV1081		4052A
VT88	CV1088		832
VT96	CV1096		5B/502A
VT104	CV1104		PT15
VT105	CV1105		ML6
VT114	CV1114		E1024
VT127	CV1127		Pen46
VT506	CV1506		5C/450A
VU39	CV1039	NU17, AU3A	MU12/14, UU5, 1W4, 441U
VU71	CV1071		U52
VU72	CV1072	AU6	GU50, RG1–240, MU4250
VU111	CV1111	AU5	V1907
VU113	CV1113	NU18, AU4	U17
VU134	CV1134	NU34	HVR2
VU504	CV1504		V1901
VU508	CV1508		V1913

CULTIVATED CRYSTALS

DUE to the present difficulty in obtaining natural quartz in Switzerland, the firm of Brown-Boveri, of Baden, are "growing" artificial piezo-electric crystals. The manufacturing process used was developed by Prof. Scherrer, of the Swiss Federal Institute of Technology. It is stated that the artificial crystals differ only slightly in their properties from those of natural quartz.

Another development of the Swiss firm, described in the *Brown-Boveri Review*, relates to the "Turbator" valve, designed for the generation of centimetre wavelengths. Formerly, the output frequency was fixed solely by the internal valve characteristics, but means have now been devised for introducing variable external tuning by a Lecher wire system.

ARMY SET —Type R107

Communications Receiver, Embodying Variable Selectivity, High Sensitivity and Covering a Wave-band of 1.2 Mc/s to 17.5 Mc/s

ALTHOUGH much Army wireless equipment is of a highly specialised kind, some of the apparatus represents an obvious development from civilian prototypes, and so is of much more general interest. A good example in this category is the Type R107, one of the Army's best communications receivers.

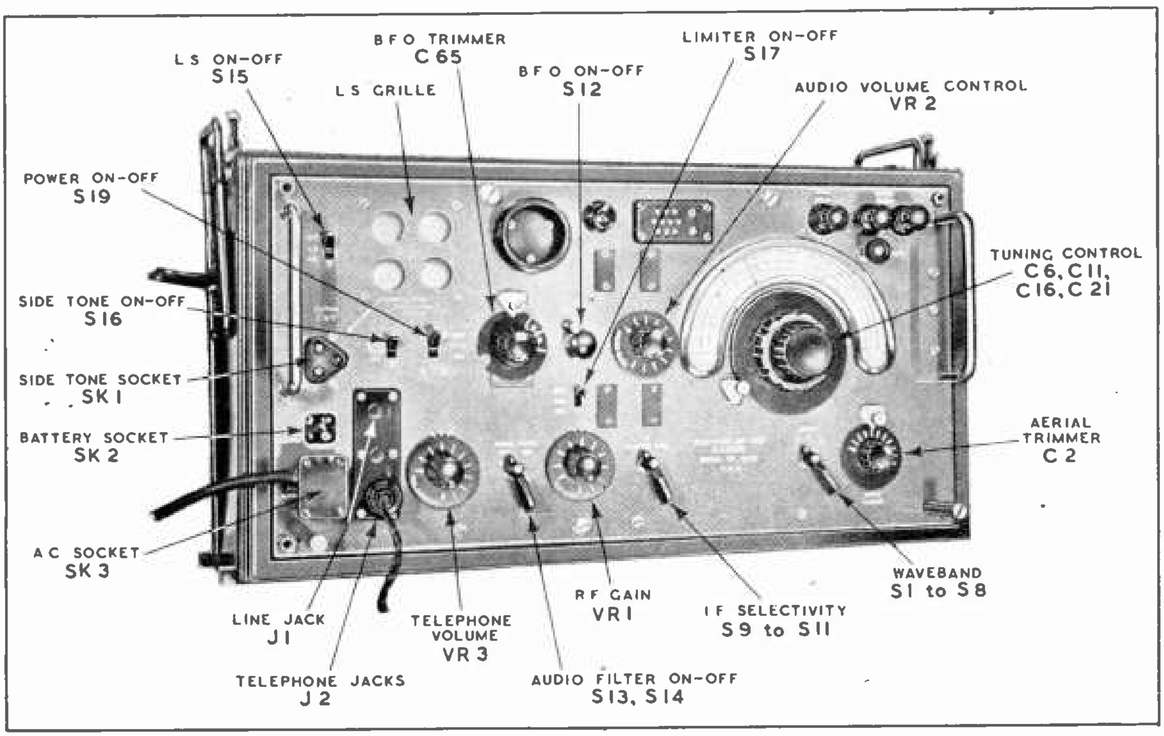
Referring to its circuit diagram reproduced here it will be seen that eight valves are used, they perform the following functions. V1 is a signal-frequency RF amplifier which is coupled to a frequency changing valve V2 by a pair of link-coupled tuned circuits. There is a separate local oscillator valve V3 and then come two IF amplifiers V4 and V5. These are followed by a duo-diode-triode V7, one diode of which functions as a detector with its companion diode providing delayed AVC and the triode section giving a stage of AF amplification. The valve V6 is a beat-frequency oscillator for CW reception and, finally, there is a low-power triode output stage in the form of the triode section of another duo-diode-triode valve V8. Outside this receiving chain is one other valve V9, a full-wave rectifier for HT supply, which will be found in the power unit.

The first interesting feature one notices is the pair of link coupled tuned RF circuits, which form the coupling between the RF amplifier V1 and the frequency changer V2. Their function is to give good second-channel discriminatory powers to the circuit as at the higher signal frequencies a total of two tuned circuits only ahead of the frequency changer does not provide a very high ratio of signal to second channel interference, even with an IF of 465 kc/s.

The IF amplifier next claims attention if only for the imposing array of the eight tuned circuits it contains. A single pair couples the frequency changer to the first IF amplifier V4, but two pairs in tandem couple V4 to V5, the second IF amplifier. Coupling between the secondary circuit of one and the primary circuit of the next is, in this case, by means of a 2.2 $\mu\mu$F capacitor C44.

The selectivity provided by this chain of circuits is such that at 3 kc/s off resonance the signal attenuation is about 6 db. This is quite satisfactory for modulated CW morse transmissions and tolerable for R/T where inter-

The front panel of the R107 receiver carries no fewer than fourteen controls. The annotation is the same as used on the circuit diagram.



Army Set—Type R107—

ference is very bad, but under less stringent conditions a broadening of the IF response will have its advantages. This also can be done, provision being made for opening out the IF response to a bandwidth of ±7.5 kc/s.

This variable selectivity feature is obtained by augmenting the normal inductive coupling in the IF transformers by inserting capacity coupling in the low-potential ends of the first three transformers. The capacitors used for this purpose are C31, C42 and C50, each of 0.05 μF capacity and the necessary circuit rearrangement is effected by the three ganged-switches S9, S10 and S11.

When interference is really bad and still higher selectivity is needed (it can be utilised only for CW transmissions) an audio filter tuned to 900 c/s and having a bandwidth of ±150 c/s can be inserted between the penultimate and output valves, V7 and V8, by the linked switches S13 and S14.

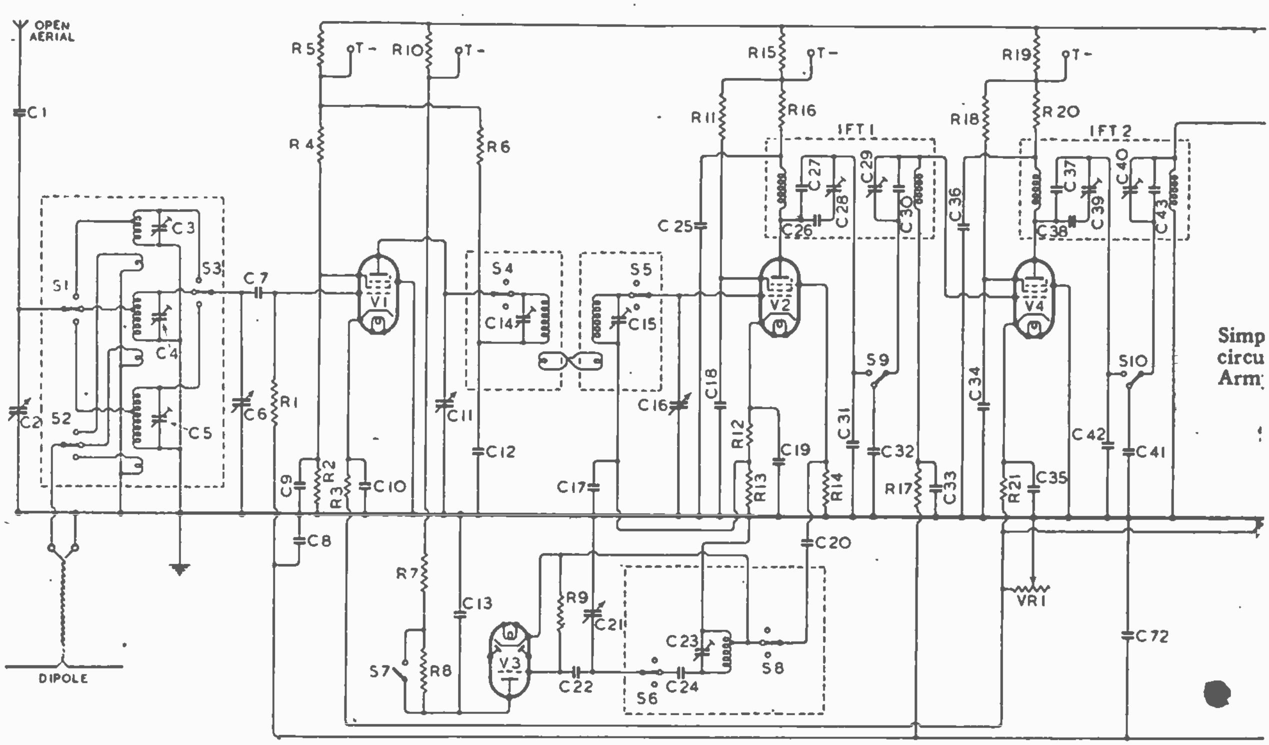
Reverting now to the input end of the receiver we see that there are three tuning ranges giving a frequency coverage of 1.2 Mc/s to 17.5 Mc/s, which in wavelength is 250 metres to 17 metres approximately. The individual coverages of these ranges are 1.2 to 3 Mc/s, 2.9 to 7.25 Mc/s and 7 to 17.5 Mc/s respectively. Tuning is by a four-gang variable condenser, each section of which has a capacity of 300 μμF. these being marked C6, C11, C16 and C21 in the circuit. The latter is the oscillator tuning section.

Unit Construction

It might be advisable to explain that the circuit diagram given here has been much simplified. In actual fact the receiver is an assembly of three independent units interconnected by twelve-way tag boards and the medley of leads so produced is most confusing when endeavouring to follow a circuit. These interconnections were accordingly omitted, as were two of the three sets of signal frequency coils in the RF intervalve coupling and in the oscillator circuit. All three coils are included, however, in the input circuit in order to emphasise their existence. The appropriate ones are brought into circuit by a three-way waveband-switch which in reality is a ganged assembly consisting of the separate switches S1 to S8 inclusive, plus those for shorting out the idle coils and not included in the diagram.

In the general outline of the function of the various stages in the set V2 was described as the frequency changer. Actually this function is shared by V2 and V3, the former being the mixer, which in the early days of the superheterodyne was often, and with some justification, described as the first detector, while the latter is the local oscillator.

The locally generated oscillations are injected into the suppressor grid of V2 via C20. This grid, being joined to the earth line via the resistor R14, receives a negative bias derived from the flow of cathode current through R12 and R13 in series, whereas the control grid gets its negative bias from the voltage drop across R12 only. In this case the bias on the suppressor grid is about ten times the control grid bias. Switch S7, which is embodied



Simp
circu
Arm

in the waveband switch, is used to bring an extra anode resistance R8 into circuit, for limiting the amplitude of oscillations on the lowest frequency range.

Although there is a small loudspeaker built into the set its use is generally limited to stand-by occasions, normal traffic working being carried out with headphones. These are plugged into the jack J2—which, incidentally, is in duplicate in the actual receiver.

As the set is primarily designed for headphone reception a signal strength limiter, described as a "crash" limiter, and comprising the two metal rectifiers D1 and D2, is included. Switch S17 brings it into use when needed.

Provision for remote control via the socket SK1 tends to complicate the output end of the receiver, particularly as it also brings "side tone" from the transmitter into the receiver's telephone circuit for the purpose of monitoring the transmission.

COMPONENT VALUES

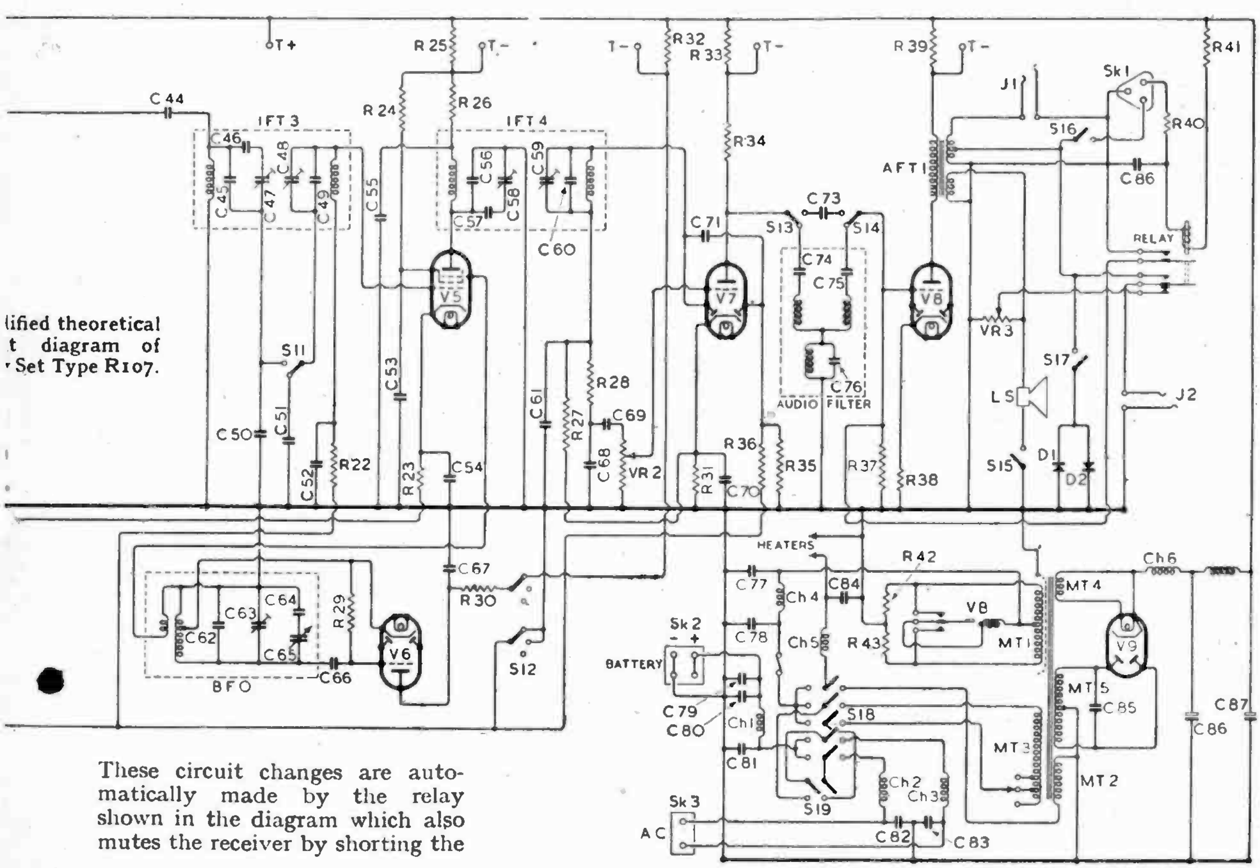
Value	Circuit Positions
2.2 μμF	C44
20 ,,	C1
25 ,,	(Pre-set) C3, C4, C5, C14, C15, C23
50 ,,	(Variable) C2
80 ,,	C22
100 ,,	C64, C66, C70
200 ,,	C7, C20, C61, C62
300 ,,	(Variable ganged) C6, C11, C16, C21
750 ,,	C24
0.001 μF	C26, C38, C46, C57, C80, C81
0.005 ,,	C72, C73
0.01 ,,	C13, C63, C71, C75, C76, C77, C85
0.05 ,,	C8, C9, C10, C12, C17, C18, C19, C31, C32, C41, C42, C50, C51
0.1 ,,	C25, C33, C34, C35, C36, C52, C53, C54, C55, C67, C68, C69, C74
1.0 ,,	C78, C79, C82
4.0 ,,	C86
8.0 ,,	C83, C84
100 ohms	R40
150 ,,	R42, R43
300 ,,	R3
400 ,,	R12
500 ,,	R21, R23, R38
1,000 ,,	R31
3,000 ,,	R5, R10, R15, R19, R25, R32, R33, R39
5,000 ,,	R6, R13, R20, R26
15,000 ,,	R41
20,000 ,,	R2, R34
25,000 ,,	R4, R7, R16
30,000 ,,	R30
50,000 ,,	R9, R14, R29
80,000 ,,	R8, R11
100,000 ,,	R18, R24, R37
250,000 ,,	R1, R17, R22, R28, R36
500,000 ,,	R27, R35
500 ,,	VR3
4,000 ,,	VR1
500,000 ,,	VR2

output valve grid leak, R37, to earth.

A combined AC/DC power unit embodied in the set supplies all working voltages. DC is derived from a 12-volt accumulator battery and either AC or DC operation is obtainable simply by throwing over the switch S18 to the appropriate position and, of course, connecting up to the right form of supply. No harm can befall the set if the switch is thrown to DC with an AC input and *vice versa*.

Vibrator HT Supply

Whether battery or AC operated HT for the valves is obtained from an orthodox rectifier circuit fitted with a 6X5G full-wave rectifying valve V9 and the associated transformer windings MT4 and MT5. When battery operated the transformer gets its input via the primary winding MT1 which is energised by the vibrator unit VB. The valves (with the exception of V9) being



lified theoretical t diagram of Set Type R107.

These circuit changes are automatically made by the relay shown in the diagram which also mutes the receiver by shorting the

Army Set—Type R107—
connected in a combination of series and parallel, then draw their filament supply from the battery via a "mush" filter consisting of the choke Ch5 and capacitor C84.

With AC operation the filament supply comes from a 12-volt AC winding, MT2, on the transformer, while another winding, namely MT3, now becomes the primary. Under both conditions of operation V9 gets its filament supply from winding the MT4 on the transformer.

The arrangement of the vibrator circuit is of interest as its contacts do not make and break the DC supply, but they merely serve to short-circuit first one then the other half of the primary winding, both of which are in parallel so far as the DC supply is concerned. As there is no abrupt interruption of relatively heavy currents, which in vibrator circuits produce very high peak voltages in the secondary circuit of the transformer, very simple filtering suffices in this case. The small current needed to energise the operating coil of the vibrator is, of course, rhythmically interrupted, but its magnitude is too small to produce any troublesome surges.

The only filtering required for this unit is provided by the choke Ch4, capacitors C77 and C78 assisted by the suppressors R42 and R43. Any residue that might get into the rectifier circuit is taken care of by Ch6 and C85.

Provision is made for monitoring the various stages in the set by measuring the voltages dropped across resistors R5, R10, R15, etc., to R39, which carry the HT feed currents of the various valves. All these test points, which are marked T in the circuit, are brought out to a small test panel on the front of the set.

As the annotated photograph of the set shows an extraordinary number of controls are assembled on the panel. These include controls for RF and for AF gain, as well as all the switches except S18.

DEFINITION IN THE CINEMA

Assessment of Optical Standards for Television

By H. W. LEE, B.A., F.Inst.P.
(Scophony Limited)

SINCE the question has recently been raised as to the number of scanning lines required in television to produce a picture having the same standard of definition as the picture projected on the cinema screen it is worth while first to try to assess that standard and express it in terms of lines per picture.

For the purpose of calculation the dimensions of the film picture are taken as 0.600in. × 0.825in. We have to decide how far definition is affected by (1) the film, (2) the camera, (3) photographic technique, (4) the taking lens, (5) processing, (6) the projector and (7) the projection lens.

(1) The Film.—Three films are mentioned in the Kodak Data Book as suitable for cinematography, viz., a normal very high speed emulsion with a resolving power of 30 lines per mm.; i.e., 450 horizontal lines to the picture; a new very high speed emulsion of moderate contrast with a resolution of 45 lines per mm.; i.e., 675 lines per picture; and the normal high-speed emulsion of fairly high contrast which resolves 50 lines per mm., or 750 lines per picture.

(2) The Camera.—No data are available as to the standard of workmanship. Perforations have a tolerance of 0.0004in. in size and 0.0005in. in pitch. It would thus seem that about 0.001in. error is considered allowable in all, and probably a similar standard is aimed at in manufacture. This demands a precision of a few ten-thousandths of an inch in the individual parts of the film transport mechanism and is attainable in precision engineering. This gives 600 lines per picture.

(3) Photographic Technique.—This includes possible blurring of the image through variations in focusing and the requirements of field depth. It will be supposed that a 2in. f/2 lens is used in the camera. Experience shows that it is impossible to be sure of focus closer than 0.002in. even with the refined tools of the opticians testing room. It is unlikely that precision in the studio will be high. An error in focus of 0.002in. is thus possible. At f/2 this produces a blur of 0.001in., which is 1/600 picture height.

A guide to the limit set by depth of focus can be obtained by considering a close-up of a head nearly filling the screen. The reduction will be about 1/20. Now a depth of ±1in. on either side of the part upon which attention is focused (usually the eyes) must be allowed without the image becoming perceptibly blurred. Therefore the depth of focus will be ±1/400in. at the film; at f/2 a blurr of 1/800in. is produced. If this is tolerable, so is a standard of 480 lines.

(4) The Taking Lens.—No lens is perfect and generally accepted figures for the usual errors will be quoted for high quality cinema lenses.

(*a*) *Axial.* The definition can be spoiled by axial chromatic and spherical aberrations; even though these are said to be "corrected" there are always residuals which cannot be entirely removed with the glasses at present available. In a lens for spherical aberration it will be found that if zones are isolated they will each give a slightly different focus. This variation will in a good lens amount to 0.004in. per inch focal length; i.e., it will be 0.008in. in a 2in. lens f/2 and will occur at a zone having a diameter of about f/3, so that a point is rendered by this zone as a ring of diameter 0.0027in. if observation is made at the focus for central rays. Now this is the worst zone and the eye in focusing is conscious of the effect of all zones and, so to speak, integrates the effect and chooses not the focus for central rays but one where the total blurring is least. The consequence is that the resulting blur is only half that computed for the worst zone; i.e., will amount to 0.0013in. This divided into 0.6in. gives 450-line definition.

Chromatic aberration is smaller but will add to the size of the blur and so lower the definition slightly from this figure.

(*b*) *Extra-axial.*—Lenses have likewise residuals of astigmatism and field curvature by which the foci for points off the axis fall outside the plane through the axial focus. A 2in. lens has a field of ±15 deg. on the film area, and within this angle departure from the focal plane may amount to 0.5 per cent. of the focal length; i.e., to 0.01in. with a 2in. lens. The aperture for oblique pencils is substantially less than for axial pencils, owing to cut off by the rims of the lenses, so that the aperture will be about f/3 at the edge of the field; consequently the image of a point will amount to 0.003in. This is 200-line definition, but again it is possible to choose the focal plane so as to give the best results throughout the field and an overall definition of perhaps 400 lines may be looked for.

It may be argued that the focal plane has already been chosen to get the best axial definition and that it is not legitimate to postulate a fresh choice dictated by extra-axial imagery. The answer to this is that the best lenses are so designed that the requirements for best axial and oblique image points are met by the same choice of focus.

(5) **Processing.**—Film shrinkage and the effect of processing have been investigated and certainly may lead to impairment of definition, but these defects can be largely guarded against by careful treatment and storage.

(6) **The Projector.**—What was said about the camera applies equally to the projector, and it is probable that the standard of workmanship aims at a possible 600-line definition.

(7) **The Projection Lens.**—This is of an entirely different type from that of the taking lens and is of greater focal length. A 4in. f/2 may be considered typical. Usually the axial definition is better and the oblique definition worse than that of the camera lens. The definition of axial points will therefore not suffer much on projection; the field of this type of lens is, however, far from flat and may have a divergence from flatness of as much as 0.01in. in a good lens, giving an out-of-focus blur which is equivalent to 0.005in. on the film. This is only 120-line definition. Even if central definition is sacrificed somewhat, that at the corners can hardly exceed a 200-line standard. At the side of the picture it may be 50 per cent. better; i.e., 300 line. With a longer focus lens definition will, of course, be somewhat better.

General Considerations.—These standards may seem low, but need not cause surprise. It is generally considered that the eye accepts an image as sharp if the blur does not exceed one minute of arc at the eye. The front of the balcony may be taken as being the best point of view in the cinema and this may be half way between the projector and screen, consequently the latter subtends twice the angle at the spectator that the film does at the projector. The standard of definition for the projection lens then should be that blur on the film does not exceed half a minute of arc (an angle of 1 in 7,000) and with a 4in. lens blur should then be restricted to 4/7,000in. The "line" standard is thus $0.6 \div 4/7{,}000$; i.e., about 1,000. With a 7in. projection lens a blur of 1/1,000 could be tolerated, which is 600 lines definition. This physiological tolerance is based on laboratory experiments with a stationary test object of black and white lines. In the cinema the objects on the screen are usually moving, are not geometric in shape and rarely have black and white contrast. Thus a lower standard could be tolerated in the cinema.

Conclusions.—A definition represented by 600 lines is probably the highest the eye could appreciate under the most exacting conditions, and this is probably within the range of resolution of the finest grain film that is used. The conditions under which the final image is produced on the screen do not suggest that definition there ever exceeds a 400- to 500-line standard in the centre and 300 at the edges, and it may at times be lower.

NIGERIAN SERVICE.—The maintenance of the receivers in public buildings and administrative offices in Nigeria is undertaken by the Radio Section of the Public Relations Office. C. A. Huber, a Swiss engineer, who is in charge of the Section, is seen in the workshop in Lagos.

SOLAR ECLIPSE OBSERVATIONS

Effects on the Ionisation of the E and F Layers

DURING the eclipse of the sun on Monday, July 9th last, a series of radio observations that had been in progress for several days reached their zenith. These observations were undertaken by civil and military radio research organisations throughout the British Isles under the direction of the Department of Scientific and Industrial Research.

When the results have been carefully studied and correlated it is hopefully expected that much new knowledge will emerge regarding the composition and characteristics of the E and F ionised layers in the upper atmosphere, which play such a vital part in long-distance radio communication.

Both ordinary transmissions and reflecting systems were employed, the former to study the effects produced at a distance by changes in ionisation and the latter to record and measure changes in density, height and absorption of the respective layers, before, during and after the actual period of the eclipse.

Previous observations had shown that the lower E layer is caused by ultra-violet light emanations, and during previous eclipse observations radio fadeouts have invariably coincided with the optical eclipse.

A definite pronouncement on the composition of the F layer may be forthcoming when the results of the observations carried out by the ionosphere research section of the Radio Research Board at their Datchet experimental station are analysed and correlated. This entails the careful study of many thousands of measurements and examination of hundreds of feet of photographic record, much of which was taken during the eclipse period.

Investigations of the E layer ionisation were made by one subsection using two pulse transmitters and by observing the nature of the reflected echoes. One transmitter operated on 2 Mc/s, while the other was varied over the range 1.6 to 3.5 Mc/s. These were manually controlled and visual observations made with a large cathode-ray tube. The work was mainly concerned with the absorption effects of the lower strata of this layer.

Investigations of the behaviour of the F layer were made by means of another pulse transmitter automatically sweeping over a frequency range of 0.5 Mc/s to 8 Mc/s and recording on a moving photographic film the echoes reflected from the E and F layers as well as from any patches of high ionisation in or outside the confines of the layers. It is interesting that the paths of meteorites through the ionised layers are clearly discernible.

Elsewhere a continuous record was made on a short-wave signal transmitted from the north of England. The recordings showed a gradual falling-off in signal strength as the eclipse progressed and during the maximum period it was almost inaudible, only to return slowly as the shadow of the moon receded. The radio eclipse did not coincide exactly in time with the optical eclipse, and indeed this was not expected, but the radio fade-out did occur at the anticipated time.

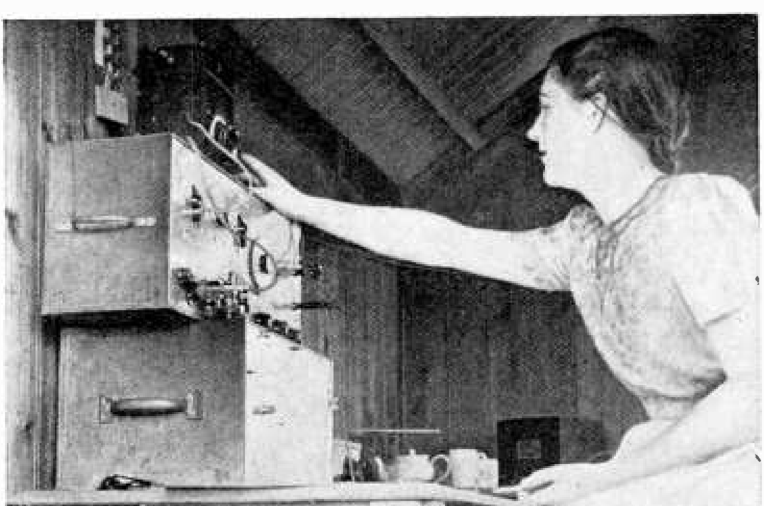
Sun-spot Disturbance

Observations were also made on signals from Canada and other distant countries on, or close to, the path of totality. Direction-finding technique was employed in order to trace the actual path of the signals.

At one period it was feared that sunspot eruptions, which caused some disturbance in the ionised layers, might obscure the effects of the eclipse. Fortunately these fears were not substantiated.

Observations on the F layer are so far not very conclusive as although the critical frequency for the layer fell to a low one and then slowly increased to normal for the time of day and season there was also a change in the critical frequency some little time before the optical eclipse. This could conceivably have been due to a change in the layer's ionisation on the assumption that its composition was due to corpuscular emanations from the sun.

Possibly when all the observations from the many radio bodies engaged have been studied a definite pronouncement might be forthcoming on the actual composition of the F layer.



Visual observations on propagation of radio signals on 100 Mc/s were made during the eclipse with this equipment.

CHEAPER HEARING AIDS

Should They be Sold by Wireless Dealers ?

By C. M. R. BALBI, M.I.E.E.

THERE are indications that before long better and less expensive hearing aids will become available through the radio industry; the problems involved in distributing these instruments to the public are of interest to all concerned.

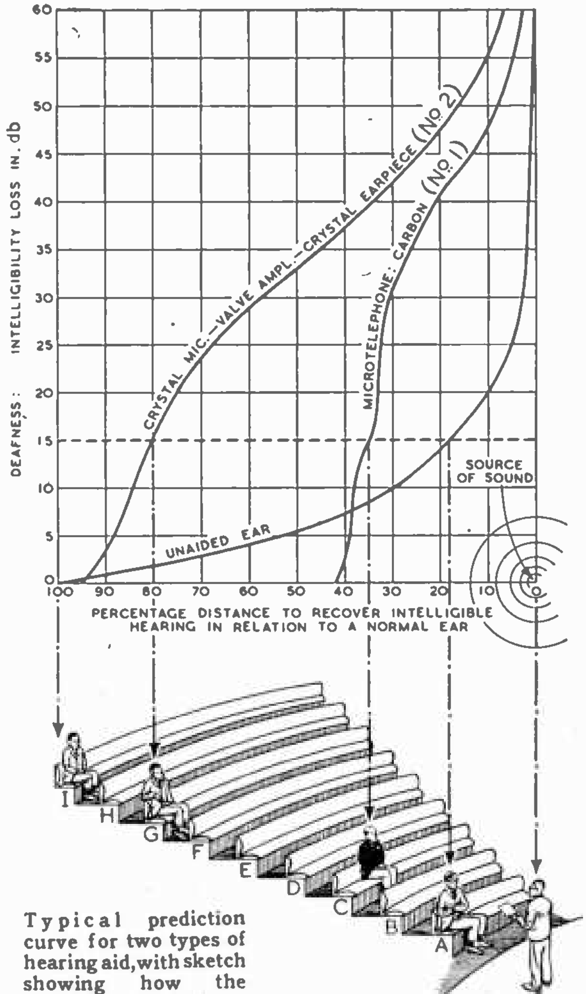
The question arises whether the wireless retailer should or should not handle these devices. It is obvious that widest scope for distribution is through the radio retail market. This will mean that at last the public will get their instruments and service at rock-bottom prices, but the first thing the public will want to know is, if any harm can come to them by purchasing their instrument from an inexperienced person (I use this term deliberately to distinguish a radio dealer from a hearing aid salesman in a white coat practised in the art of mumbo-jumbo). The answer is given by the National Institute for the Deaf in a statement approved by the Medical Research Council which reads as follows:—

"There appears to be no clinical or experimental evidence that the continued use of a hearing aid causes any increase in existing deafness; nor, except in a few rare cases, does it improve or restore hearing. Nevertheless, the benefits from a satisfactory and appropriate instrument are very definite both to the patient and his friends."

That is hardly surprising; indeed, if the contrary were true, no person afflicted with deafness should use a telephone or listen to broadcasting without the consent of his medical adviser.

If matters are as simple as this, then why has the retailer not added such a profitable line to his business before? The reason is that the deaf quite naturally want to know what benefit an instrument will give them before purchase. If the retailer was not prepared to give vague promises it meant that the intending purchaser had to be given a week or more home trial. This is expensive because an instrument after a home trial often looks second - hand and the margin of profit does not allow of such a costly procedure.

If, on the other hand, the manufacturers could guarantee that a particular type of instrument would benefit a deaf person to a precisely stated degree, then the cost of selling a hearing aid would immediately be reduced to a level comparable with that of a radio receiver.



Typical prediction curve for two types of hearing aid, with sketch showing how the benefit derived from them may be simply assessed.

To make this possible an instrument has been designed which has been termed a "hearing aid predictor." The device is a very simple one and consists of a microphone, amplifier (battery or mains driven) and an earpiece so calibrated in db. that it will assess a patient's intelligibility loss.

The technical aspects involved in the calibration of the predictor can be obtained by reference to the *I.E.E. Journal*, vol. 91, part 3. page 67. In brief, the reproduced sound in the earpiece is such that when the instrument is spoken to at a distance of about three feet with the pointer at zero the amplification is unity, so that to a person with normal hearing the loudness of reception would appear to be at the same level as if hearing the operator direct.

When a deaf person is being tested the operator would increase the amplification until the patient (also 3ft. from the operator) indicated that the reception was at a comfortable level and appeared normal for the distance which separated them. A tone control is provided with base and top cut which is adjusted to suit the patient.

A short conversation between the operator and the patient quickly determines the degree of deafness concerned, and then the retailer can, by referring to the prediction curves provided and

Cheaper Hearing Aids—

guaranteed by the manufacturer, inform the patient what benefit he can expect from the use of the instrument he intends to purchase.

A typical prediction curve relating to two types of instrument is shown in the figure. If, for example, it was found that the patient's hearing loss was 15 db. then the retailer would be able to assert that he would benefit to the extent of 17 per cent. with instrument No. 1, and 62 per cent. with instrument No. 2. In actual practice it is easier to explain the results by the diagram of an auditorium given below the curves. If the speaker can just be heard intelligibly at the back of the hall by a listener whose hearing is normal, then a deaf person with a 15-db. intelligibility loss can only hear intelligibly with his unaided ear in row A, but with instrument No. 1 he then has the choice of rows A to C, and with instrument No. 2 his choice is extended to rows A to G.

If, on the other hand, a patient was only 5-db. deaf, it can be seen that instrument No. 1 would be of no benefit at all; in fact he would be worse off.

"Difficult" Patients

It is well known that there are certain people, generally of advanced age, who although they can hear sounds easily, cannot distinguish words whatever the intensity level. The predictor, which is founded on an intelligibility basis, would immediately indicate that the patient was unsuitable for any form of hearing aid and thus avoid needless disappointment to the patient and waste of time and expense to the vendor. The operator and the patient therefore know where they stand and the purchase can be made in the confidence that the associated prediction curve provided by the maker will be correct. The integrity or judgment of the vendor is therefore not involved and the system is likely to encourage the manufacturer to improve the performance of his instruments and not let this take second place to appearance, which has generally been regarded as the factor chiefly affecting its commercial success.

BOOK REVIEWS

Radio Service Test Gear. By W. H. Cazaly. Pp. 89; 46 diagrams. Published by Sir Isaac Pitman & Sons, Pitman House, Parker Street, Kingsway, London, W.C.2. Price 6s.

THIS book is mainly a reprint of the eight articles published as a series during 1942 in *Wireless World* under the heading "Instruments." Each of the eight articles in that series constitutes a chapter in the book and they are preceded by an introductory chapter explaining the necessity for more precise information on the performance of a radio receiver than has been customary in the past.

It is quite rightly pointed out that such indefinite expressions as "loud," "powerful," and "mellow tone" possess no real meaning and any interpretation including, or excluding, the right one could be applied to them. But in order to obtain this precise information scientific measurements of performance must be made and to make them suitable apparatus is required. It is a description of this apparatus that fills the remaining eight chapters. The description is theoretical and not the constructional kind, for as the author says in his preface—"Construction involves not only buying and assembling the right components, but adjustment and calibration of the instrument as a whole—and this is usually much more difficult than mere assembly and requires skill and knowledge that cannot be imparted either in a book of this nature or in correspondence." Thus the reader is fully forewarned and in the many circuits of test and measuring apparatus that follow there are few cases where values have been assigned to the components. But construction of the apparatus would not be unduly difficult, as adequate references are given; moreover, calculating component values for any desired set of operating conditions is always valuable experience.

The book is a guide to the understanding of the basic principles of the design and operation of test gear, and having mastered these facts the reader will be in a far better position to use measuring apparatus intelligently, since knowing its limitations the impossible will not be expected. Moreover, this knowledge will prove invaluable in adapting apparatus for unusual test work, while familiarity with the circuit arrangement enables repairs to be carried out with greater confidence. H. B. D.

Elektrische Schwingtöpfe und ihre Anwerdung in der Ultrakurzwellen-Verstärkertechnik (Klystrons and their use in ultra-short-waye amplification.) By Alfred de Quervain; pp. 88 with 47 figures. A.-G. Gebr. Leemann & Co., Zürich. Price 6 Fr. (Swiss).

This is the result of two years' research at the Zürich Technical College. It goes very fully into the calculation of the losses and thus of the Q-factor of klystrons, also into the temperature coefficient and its compensation in order to keep the resonant frequency constant. The methods of coupling klystrons and matching them to one another and to valves is discussed very fully. The wavelengths considered are usually from 1 to 2 metres. The thesis is well prepared and should appeal to anyone interested in klystrons. G. W. O. H.

WHAT IS QUALITY CONTROL?

Background for Wireless Technicians

By THOMAS RODDAM

WHAT A. P. Herbert calls "witch words" are popular because they relieve both the reader and the writer of the tedious task of trying to understand what is being talked about. In most of the shorter texts on "Quality Control" it is assumed that the reader has some basic knowledge of the subject and merely wants to know the rules and formulæ. In the remainder it is assumed that the reader does not want to know anything about quality control, but needs a sort of drill book which he can use blindly. This article is an attempt to give a background against which the detailed instructions will fall into an ordered scheme. It does not give instructions on how to apply quality control: for those, references 1 and 3 should be consulted. Reference 2, unfortunately, uses a different notation, and may confuse the student. One difficulty which the reader may find troublesome is the fact that almost all the literature is based on machine-shop practice and the application to radio problems is not immediately obvious. This is because the use in machine shops is much easier. There is, however, considerable scope for quality control in radio production, and some uses will be mentioned later.

Modern industry is based on the large-scale production of nominally identical articles. The guiding principle is that a product is not the work of one man, but is an assembly of parts each made by separate men or machines whose sole function is part-making. Indeed, even a single part may be the result of several processes each carried out in separate stages. For this procedure to be successful it is necessary that the parts should be accurately made, so that sets of parts drawn at random from a store should be capable of being assembled without much fitting work.

If parts are to be interchangeable, they must be made to close tolerances. This means that careful inspection is necessary, and it is when inspection costs start to become a serious part of the whole cost of a part that quality control becomes important. Close tolerances may also mean the risk of a high proportion of scrapped parts, and the inspection process must be quick and efficient so that a machine which is making defective parts is spotted before it has made very many. The most elementary form of inspection involves the checking of every item. Checking may mean merely the use of gauges, or it may involve the measurement of a dimension with a micrometer or some other device which actually determines a value, rather than finding whether the value is within limits or not.

The first step taken by the statistician in simplifying testing procedure is to abandon 100 per cent. inspection and rely on samples.* If we want to know what electrical engineers think about the B.B.C. programmes we do not ask every engineer in the country: we seek out a sample, chosen at random. We might take all members of the I.E.E. whose names begin with the letter R. As their names do not affect their listening habits, this would give us a reasonable number of views from engineers of all shapes and sizes, and we could predict the general engineer's view from this. Systems of this sort are well known, and their only defect is that the sampling may not be truly random. A poll on the merits of fox hunting taken at a point-to-point race meeting would give very different results from one taken at a performance of "Wozzeck." In sampling parts from a machine we must adopt a lucky-dip procedure. Tables have been published (reference 5) showing the number of items in a sample required to give the information needed about the whole batch. These samples may be quite large and the testing of the samples may still be expensive. Sampling is, however, the only way of dealing with parts which have been shuffled, such as parts made in another factory and delivered as a large batch. Sampling is less efficient than quality control, because one piece of information, the order in which things were made, has been thrown away. The taking of samples for quality control, where the process is being watched in time, should not be random and a sample of successive parts must be taken straight from the machines, to give the latest news. The engineering problem is, as always, that of getting a result which is just good enough with a minimum of effort. To do this in inspection it is imperative that all the information should be obtained from the smallest number of tests. Quality control is a method of squeezing the maximum amount of information out of test results with a minimum of delay.

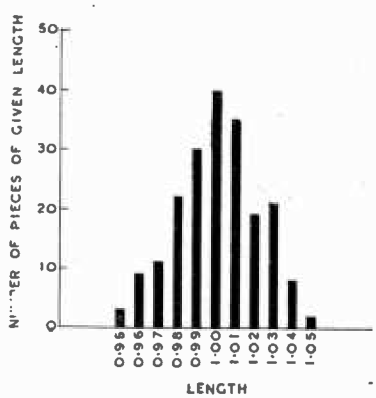


Fig. 1. A typical histogram.

Let us assume that we are concerned with the problem of parting-off a length of rod on an automatic machine. Ideally our

* "Sample," as used here, is a technical term. It is defined in BS600R : 1942, as "A portion of material or a group of individuals or specimens taken from a large mass or bulk ..... which is used to give information as to the quality of the larger quantity."

machine will cut off standard one-inch lengths, but in practice, when we measure the pieces, we find that some are 1.00in. long, some 1.01in., some 0.99in., and

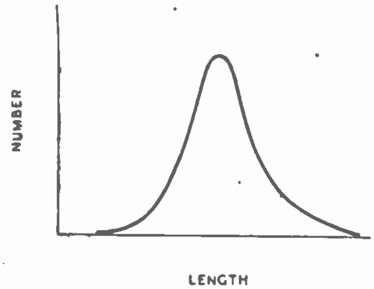


Fig. 2. Example of Gaussian distribution.

so on. If we take a number of pieces and measure them, we can plot the diagram of Fig. 1, which shows how many pieces of each length there are. Note that we only worry about the measurement to 1/100th of an inch. From this we can see that the machine is turning out pieces of length 1 ± 0.05in., and that of the 200 pieces studied only 25 per cent. lie outside the limits 1.00 ± 0.02in. This plot is called a "histogram." If more pieces were measured more accurately, the histogram would tend towards the smooth curve of Fig. 2, which is a Gaussian or "normal" curve. This "normal" curve is very important in statistical work, and its properties have been closely studied.

If our machine was not parting off one-inch lengths, but grinding to one-inch diameter from a 1.01-in. bar, we might get the histogram of Fig. 3. This is known as a skew distribution. As this is rather inconvenient, as it does not obey the same laws as a "normal" distribution, something must be done. In Fig. 4, which is taken from BS600R:1942, we see that by plotting the average values of samples of 5 or 10 items we can get our results to "normalise" themselves. A histogram made up from a set of averages is always nearly Gaussian. The engineer making use of general rules for Gaussian distributions should always take the average of a sample of four or more pieces. The original distribution is not then important.

We have now got some idea of what we are dealing with in our statistics. If our machine is behaving itself, it will go on churning out parts which if measured will simply magnify the histogram without altering its shape or position. We may get different numbers, but the next 200 in Fig. 1 will still have more parts at 1.00in. than anywhere else, and will still have only 2 or 3 per cent.

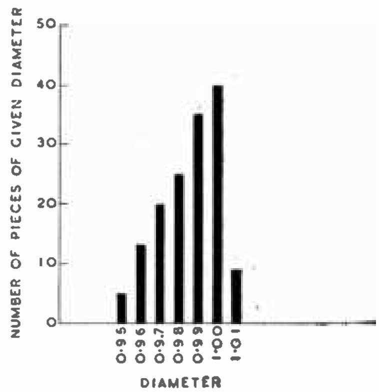


Fig. 3. Histogram showing skew distribution.

as far out as 0.95in. or 1.05in. When a system is behaving like this, it is said to be in "statistical control." Our object is to keep the system in "control." Of course, this is no good if the length should have a tolerance of ±0.01in. The controlled level must be good enough for the func-

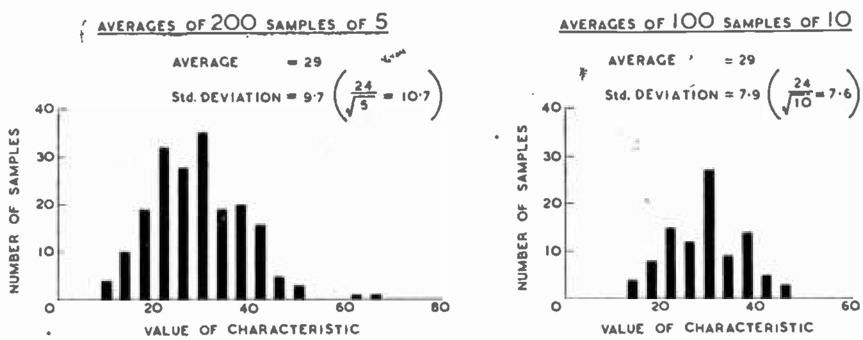


Fig. 4. Sampling from a skew distribution. (*From BS600R : 1942.*)

tion, but our data would be suitable for a spacer designed to have a tolerance of 0.07in. Indeed, our machine is slightly too good!

Suppose now that for some reason the machine changes to producing at a controlled average of 0.98in. We shall start to get pieces as short as 0.93in. The appearance of these is an indication that something has gone wrong. If a histogram is drawn it may be found that the shape of the bell-like smooth curve to which it tends is unaltered but that the whole thing has been shifted bodily sideways. The machine is still working as accurately as before, but it is now making the wrong thing and requires to be adjusted to bring the mean length back to its target value. Sometimes the centre of the histogram will not be shifted, but the flare of the bell will be wider. The machine is not working as accurately as it was before. The cure for this condition must be sought. In quality control charts, the first effect is indicated by the "chart for averages" showing loss of control; the second condition is shown by the "chart for range" showing loss of control. The charts give a clue to how the machine has gone wrong.

The detection of a loss of control by the charts and detailed instructions on how to prepare charts are given in references 1 and 3. The procedure is to plot the average value and range of the "quality" of a sample at intervals, and to investigate whenever either of these quantities falls outside lines marked as "Action Limits" on the charts. Just as a modulation control system can be arranged to flash a red light if the signal level sent to a transmitter exceeds the prescribed value, so a point beyond the action limits on the control chart is a warning that the machine *may* be going wrong. The choice

What is Quality Control?—

of action limits requires care: I shall attempt an analogy.

If the reader will look at only the left-hand section of the curve of Fig. 2, he will see that this is very similar to I_a-E_g curve for a valve. If we examine what happens at a given distance from the centre, we are doing something rather like noting the anode current for a given bias.

The action limit on this side of the curve defines the working point and the number of measurements beyond the action limit on the left corresponds to the "red lamp current." Moving the curve means that the working point is altered, and it is known that the greatest sensitivity of anode current to bias will be on the straight part of the slope. In statistical control we usually work near cut-off and the problem is rather like that of detecting a carrier in the presence of noise. The reason why the less sensitive position is chosen is that if we work at the cut-off, we shall not often get any false alarms.

In setting up a quality control system, therefore, we first of all determine the "control characteristic." Then we choose a "cut-off" level, which in the language used is called the 2σ level because it is the (average value) $\pm 2\sigma$ where σ is the "standard deviation," a term which is the measure of the width of the bell.

We plot the average value of our sample of 4, 5 or 10 parts on a chart, taking samples once every 20 minutes, once an hour or once a day depending on the process. Theoretically 1 reading in 40 should be above the upper cut-off and 1 in 40 below the lower cut-off. In practice the extremes of the Gaussian curve do not appear, for obviously there is no chance of our machine making 2-in. pieces or ½-in. pieces unless it is hopelessly out of order. We can therefore safely regard any point outside the limits quoted as indications that the machine should receive a closer inspection as it is starting to go wrong. Sometimes 3σ limits are used as well. The chance of being outside these is only 1 in 1000, so that a point outside means there is almost certainty that something is wrong.

The detailed procedure is laid down in reference 1 and 2, and a number of other descriptions have been published. It is not intended to go further into the detail here. The sort of record obtained is shown in Fig. 5.

The bell-like normal curve appears in other connections. In reference 4, the results of measurements on radio programme material are discussed. It is found that the instantaneous sound level follows the Gaussian law, so that it would be possible to use the principles of our statistical control to monitor transmission levels.

More closely to the point in radio work, however, is the inspection and testing of receivers and amplifiers. The gain of an amplifier, or the sensitivity of a receiver, is the average effect of a number of causes. Resistances and valve slopes deviate from their nominal values. In testing an amplifier we require to know whether this deviation is due only to these random causes, or whether there is in addition a true defect. If a control chart is constructed, we can tell whether we should be worried, or whether we are about to go shooting imaginary troubles. Almost all the tests carried out on mass-produced radio equipment could be monitored by quality control methods and there are also possibilities in fields other than production.

Quality control is a method of analysing data which has very wide applications. It is hoped that this article will help to encourage radio men to apply the method to the many radio problems which can be treated by it.

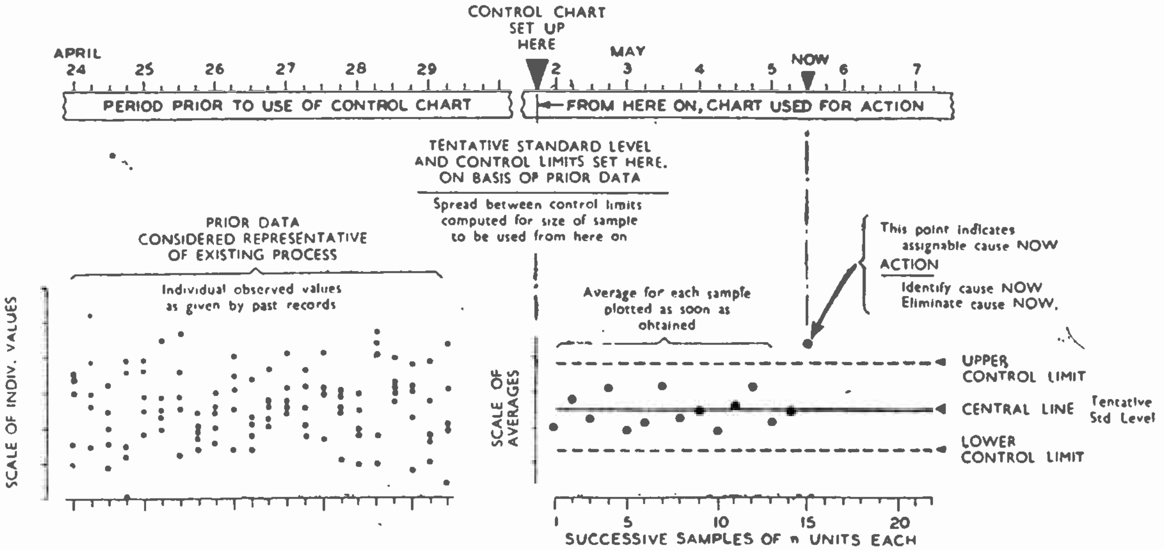


Fig. 5. Features of a control chart for controlling quality during production. (*From BS*1008: 1942.)

References

1. Quality Control Charts. BS600R: 1942.
2. Quality Control. BS1008: 1942. (Contains good bibliography.)
3. First Guide on Quality Control for Engineers. Ministry of Supply.
4. Le Contrôle des Phénomènes Transitoires dans les Transmissions Radiophonique. E. Divoire. *L'Onde Electrique*. Jan., 1936. pp. 40-58.
5. Single Sampling and Double Sampling Inspection Tables. Dodge and Romig. *Bell System Technical Journal*, Jan., 1941; pp. 1-61.

OPTIMUM VALVE LOAD

Unified Treatment for Different Operating Conditions

By EDWARD HUGHES, D.Sc., M.I.E.E.

IT is with some diffidence that one takes up this somewhat hackneyed subject, but the treatments of this problem given in textbooks and some recently-published articles are so involved, and in some cases misleading, that the writer would like to suggest that the various conclusions as to the value of the optimum load resistance can be derived, for different conditions governing the anode voltage, by a *single* method of solution.

The following treatment utilises the I_a/V_a characteristics together with the load line drawn in the position giving maximum output for zero distortion; and, for simplicity, idealised characteristics are assumed. With the equivalent circuit method, it is impossible to appreciate fully the assumptions involved.

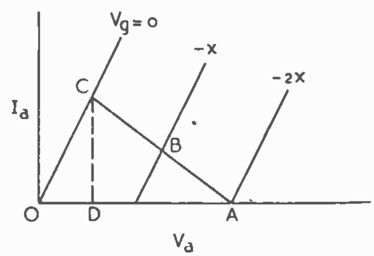


Fig. 1. Idealised valve characteristics for the condition where the HT voltage is fixed and the load resistance is connected directly in the anode circuit.

There are three distinct and clear-cut cases to be considered, namely:

(1) Where the HT voltage is fixed and the load resistance is in the anode circuit.

(2) Where the HT voltage is fixed and the load resistance is supplied through a transformer.

(3) Where the HT voltage is unlimited but where the output power is limited by anode dissipation. In this case, the load resistance may be either in the anode circuit or supplied through a transformer.

Case 1. Suppose the load resistance R to be in the anode circuit of a triode having a slope resistance R_a and the idealised I_a/V_a characteristics to be as in Fig. 1. Let OA be the HT voltage available; then the maximum grid swing with zero distortion is obtained with a grid bias of $-x$ of such a value that a grid voltage of $-2x$ reduces the anode current to zero.

Let ABC be the load line corresponding to resistance R; then output power due to the AC components of anode voltage and current is given by

$$\frac{CD \times AD}{8} = \frac{(CD)^2R}{8}$$

But

$$OA = OD + AD = (CD \times R_a) + (CD \times R) = CD\,(R_a + R)$$

Hence, AC output power

$$= \left(\frac{OA}{R_a + R}\right)^2 \times \frac{R}{8}$$

$$= \frac{OA^2 \times R}{8(R_a^2 + 2RR_a + R^2)}$$

To find the value of R that gives the maximum AC power, the simplest procedure is to divide the numerator and denominator of the above expression by R, i.e., AC power

$$= \frac{OA^2}{8(R_a^2/R + 2R_a + R)}$$

This power is a maximum when the denominator is a minimum, namely when

$$\frac{d}{dR}(R_a^2/R + 2R_a + R) = 0$$

$$\text{i.e., } -R_a^2/R^2 + 0 + 1 = 0$$

$$\therefore R = R_a$$

Hence the AC output power is a maximum when $R = R_a$.

Case 2. Let OA in Fig. 2 represent the HT voltage available and assume the resistance of the primary of the transformer to be negligible. Draw a line XY such that its slope corresponds to the load resistance R referred to the primary winding, this equivalent resistance being n^2R, where

n = primary turns/secondary turns.

By trial, draw a line EF parallel to XY such that the mid-point H of EF lies on the vertical line drawn at A. If $-y$ be the grid bias corresponding to the I_a/V_a characteristic through H, then y represents the peak value of the maximum alternating grid voltage for zero distortion.

From Fig. 2, AC power

$$= \frac{GF \times GE}{8}$$

But $GE/GF = n^2R$ and $OA = OG + \tfrac{1}{2}GE = (GF \times R_a) + (\tfrac{1}{2}GF \times n^2R) = \tfrac{1}{2}GF\,(2R_a + n^2R)$

$$\therefore \text{AC power} = \frac{GF^2 \times n^2R}{8}$$

$$= \left(\frac{2\,OA}{2R_a + n^2R}\right)^2 \times \frac{n^2R}{8}$$

$$= \frac{OA^2 \times n^2R}{8R_a^2 + 8n^2RR_a + 2n^4R^2} \quad \ldots (1)$$

If n be the variable quantity, the condition for maximum AC

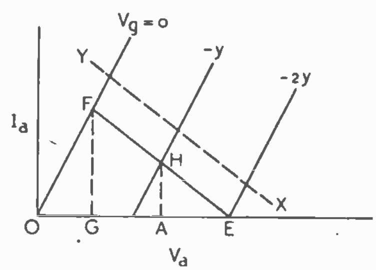


Fig. 2. Fixed HT voltage and load applied through a transformer.

power can be found by first dividing the numerator and denominator of expression (1) by n^2, giving

AC power

$$= \frac{OA^2 \times R}{8R_a^2/n^2 + 8RR_a + 2n^2R^2}$$

This power is a maximum when the denominator is a minimum, namely when

$$\frac{d}{dn}(8R_a^2/n^2 + 8RR_a + 2n^2R^2) = 0$$

$$\text{i.e., } -16R_a^2/n^3 + 0 + 4nR^2 = 0$$

$$\therefore 4n^4R^2 = 16R_a^2$$

$$\text{and } n^2R = 2R_a$$

Similarly, if R be the variable

quantity, divide the numerator and denominator of expression (1) by R, giving

AC power

$$= \frac{OA^2 \times n^2}{8R_a^2/R + 8n^2R_a + 2n^4R}$$

This power is a maximum when

$$\frac{d}{dR}(8R_a^2/R + 8n^2R_a + 2n^4R) = 0$$

i.e., $-8R_a^2/R^2 + 2n^4 = 0$

$$\therefore n^2R = 2R_a$$

Hence, in each case, the AC power is a maximum when the equivalent resistance of the load referred to the primary circuit is *twice* the slope resistance of the triode.

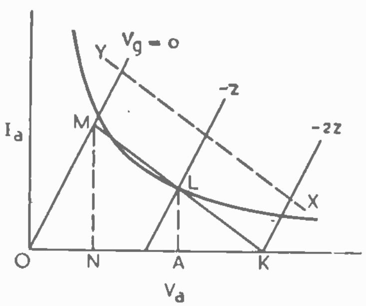


Fig. 3. Unlimited HT voltage, but output power limited by anode dissipation. Load connected direct or through a transformer.

Case 3. Suppose the rectangular hyperbola in Fig. 3 to represent the permissible anode dissipation. Again, draw XY so that its slope represents the load resistance when the latter is in the anode circuit or the equivalent resistance when the load is fed through a transformer.

By trial, draw a line KM parallel to XY such that the point of intersection with the hyperbola at L is midway between K and M. If the I_a/V_a characteristic passing through L corresponds to a grid bias of $-z$, then z represents the peak value of the maximum alternating grid voltage for zero distortion.

With no alternating voltage applied to the grid, the anode dissipation is given by OA × AL. With an alternating voltage applied to the grid and no distortion, the average power from the HT source remains unaltered, and the AC output is equal to the reduction of power dissipated at the anode. A graphical explanation of this was given by the writer in *Wireless World*, October, 1942. Consequently, so long as the frequency is sufficiently high to prevent appreciable variation of the anode temperature, it is immaterial that any part of the load line is above the hyperbola in Fig. 3, i.e., the instantaneous power over a part of the cycle may be allowed to exceed the permissible anode dissipation.

From Fig. 3, AC output power

$$= \frac{MN \times NK}{8} = \frac{LA \times AK}{2}$$

But LA × OA = a constant, (say, k) for a given triode.

Also,

AK/MN = R/2, and OA/MN = ON/MN + NA/MN = R_a + R/2

$$\therefore \frac{OA}{AK} = \frac{OA}{MN} \times \frac{MN}{AK} = \frac{R_a + R/2}{R/2}$$

$$= 2R_a/R + 1$$

and AC output power

$$= \frac{LA \times OA}{2} \times \frac{AK}{OA}$$

$$= \tfrac{1}{2}\,\frac{k}{1 + 2R_a/R}$$

Hence the AC power is a maximum when the denominator is a minimum, namely when R is infinity. Even with $R = 4R_a$, the maximum output is 100 per cent. greater than with $R = R_a$ and 33 per cent. greater than with $R = 2R_a$. Actually, the maximum power is limited partly by the curvature at the lower end of the I_a/V_a characteristics and partly by the highest HT voltage practicable; with the result that in practice R may have to be limited to about 3 or 4 times R_a.

CATALOGUES RECEIVED

BOOKLET describing the "Mastatic" noise-free aerial system and a technical guide on television receiving aerials from Aerialite, Ltd., Castle Works, Stalybridge, Cheshire.

Illustrated leaflet showing typical applications of Oddie fasteners and quick-release pins for instrument panels, from Oddie, Bradbury and Cull, Ltd., Portswood Road, Southampton.

Leaflet describing the "Lens Lite" unit for illuminating and magnifying small instrument parts during manufacture or assembly, from the Electric Depot, Ltd., Pritchett Street, Aston, Birmingham, 6.

WORLD OF WIRELESS

U.S. FREQUENCY PROPOSALS

FOLLOWING the recent proposals put forward by the U.S. Federal Communications Commission for the allocation of frequencies above 25 Mc/s, recommendations have now been made for the lower frequencies.

In view of the rumours current some months ago it is interesting to find that some 120 channels have been allocated for international broadcasting. In its finding the F.C.C. states: "Other means of international communication, including the transmission of U.S. broadcasts via point - to - point facilities to foreign countries for rebroadcast there over domestic stations, have a rôle to play; but no such technique can take the place of direct broadcasting from the United States to listeners abroad."

The only changes in the proposed allocations for international broadcasting in this section of the spectrum are: the 15 Mc/s band has been narrowed by 50 kc/s, 100 kc/s have been added to the 17 Mc/s band, and 100 kc/s deleted from the 21 Mc/s band, making each 200 kc/s wide. It will be remembered that the present allocation of 25.6-26.6 Mc/s was omitted from the proposals relating to the higher frequencies as it is useful only during maximum sunspot activity.

Amateur frequencies below 25 Mc/s remain unaltered in the 3.5, 7 and 14 Mc/s bands, but it is proposed to delete the 300 kc/s band of from 1.75-2.05 Mc/s. In lieu of this the Commission is making provision for an amateur "disaster" network in the 1605-1800 kc/s band. In addition, the 21-21.5 Mc/s band is allocated to amateurs.

The extension of the present broadcast band of 550-1600 kc/s to 535-1605 kc/s is recommended.

There is still considerable controversy on the relative positions of FM and television in the higher frequencies. So much so that in the final allocations between 25-30,000 Mc/s, the 44-108 Mc/s band is not being assigned until the results of FM tests being undertaken during the summer, when sporadic E transmissions are at their maximum, are known. F.C.C. states that space will ultimately be allocated as follows: 36 Mc/s to television, 18 Mc/s to FM, 4 Mc/s to amateurs, 4 Mc/s to non-government fixed and mobile services, and 2 Mc/s to facsimile. The FM alternatives are 50-68, 68-86, or 84-102 Mc/s.

The proposals will be passed to the Federal government preparatory to the holding of an international conference on frequency allocations.

INDIAN SIGNALS. The general-purpose low-power No. 22 transceiver, which has facilities for both 'phone (5W) and CW (15W), in use in the Burma campaign. Men of the Fifth Indian Division are operating the set which has a frequency coverage of from 2-8 Mc/s.

B.B.C. CHANGEOVER

THE first of the B.B.C.'s post-war plans for home listeners is due to come into operation on July 29th, when two programmes, which will be known as the Home Service and the Light Programme, are introduced. They will be followed later by a third programme.

The Home Service will be radiated from 6.30 a.m. until midnight on medium wavelengths by Regional transmitters, which will in most cases operate on the wavelengths used before the war.

The provisional list of the Home Service wavelengths are:—

London Region	342.1	(877 kc/s)
Midland Region	296.2	(1,013 kc/s)
North Region	449.1	(668 kc/s)
	285.7	(1,050 kc/s)
West Region	514.6	(583 kc/s)
	203.5	(1,474 kc/s)
Scotland	391.1	(767 kc/s)
Wales	373.1	(804 kc/s)
Northern Ireland	285.7	(1,050 kc/s)

The Light Programme will be radiated from 9 a.m. until midnight on 1500 metres (200 kc/s), and on 261.1 metres (1145 kc/s) for urban areas where the long-wave transmission is not well received.

U.S.S.R. MORSE BULLETINS

IN response to enquiries from readers we have secured details of the transmission of news in morse from Moscow.

Transmissions are continuous from 0830 to 0430 GMT, but it is impossible to give the exact times for the English transmissions owing to the procedure employed. It is as follows:—Several news items are first transmitted in English and then in French on the Hellschreiber radio-printer; these items are then repeated in the same sequence in English and French morse. After a short interval new items are transmitted in the same order.

The following schedule gives the wavelengths employed throughout the period of transmission:—

0830-1100	25.95, 30.03
1100-1600	20.07, 25.95
1600-1900	36.92, 39.89
1900-2100	54,95
2100-0100	39.89, 54.95
0100-0430	54.95, 65.08

SETS IN THE U.S.

AS a result of a survey of American broadcast receiver manufacturers it is predicted that the industry will require only 83 days after Government restrictions are removed before it starts civilian production. Some five million receivers are expected to come off the production lines in the first six months and a further eight million in the second.

In addition to the broadcast sets some 96,000 television sets are promised.

The majority of the broadcast receivers (65 per cent.) are expected to have seven valves or less.

EDUCATIONAL OPPORTUNITY

WE are informed by the Head of the Department of Electrical Engineering and Physics at the Borough Polytechnic that another intensive full-time course in radio engineering under the Hankey Scheme will commence on October 2nd.

The conditions for entry, which include free tuition and a maintenance grant, are obtainable from the Borough Polytechnic, Borough Road, London, S.E.1.

ABSIE

THE activities of ABSIE (American Broadcasting Station in Europe) ceased on July 4th. With its cessation the two transmitters placed at the disposal of the American Office of War Information by the B.B.C. have been returned.

In addition to being radiated by these two transmitters on 307.1 and 267.4 metres the programmes originating from the London studio of ABSIE have been broadcast on short-waves by American and British stations.

WHAT THEY SAY

A FAULTLESS MONSTER.—Many who attach importance to the fair representation of public opinion regard the B.B.C. as a Frankenstein's monster which is getting out of control. . . . The influence over public opinion of the B.B.C. is already as great as that of all the newspapers put together.—*Somerset de Chair, M.P., writing in "The Times."*

LIBERATION PLEASURES.—I must write to tell you that receiving *Wireless World* was one of the greatest pleasures for me since being liberated. I have already read it completely, but shall go through it several times again.—*A Channel Islands reader.*

SOVEREIGNTY.—One might almost define sovereignty to-day as the possession of a radio station of one's own.—*Walter Elliot in the House of Commons.*

PERSONALITIES

Sir Robert Watson-Watt was present at the opening session of the British Commonwealth Air Transport Council, as advisor on radio and radar.

E. Lloyd Thomas, a contributor to *Wireless World*, has left The Plessey Co., and is now in charge of the electronics section of the Sperry Gyroscope Company.

IN BRIEF

Palestine Broadcasting.—The administration of the Palestine Broadcasting Service has been separated from the General Post Office and a new department of broadcasting has been formed in Jerusalem. The new department has appointed an assistant controller of the English programmes and separate controllers of the Arabic and Hebrew transmissions.

American Radio Conference.—U.S. Government officials, in conjunction with representatives of the American radio industry, are meeting under the chairmanship of Dr. Dellinger preparing for the Third Inter-American Radio Conference, which opens at Rio de Janeiro on September 3rd.

Running Repairs.—The maintenance of the broadcast receivers issued to the Forces presents something of a problem when, as often happens, nobody in the unit knows sufficient about radio to tackle the job of repairing or overhauling a defective set. Middle East Command has now arranged for five radio repair trucks, jointly organised by the Forces Broadcasting Service and R.E.M.E., to tour the Command.

Re-issued.—We have received a copy of the re-issued Bulletin of the British Sound Recording Association. This four-page news sheet gives information on recent developments, equipment and people in the sound recording sphere. Information about the Association's activities is obtainable from the General Secretary, D. W. Aldous, "Strathdee," Studley Road, Torquay, Devon.

Radio v. Cancer.—According to *The Petroleum Times*, radio-frequency energy is being used by Soviet scientists in preparing mineral oil in a finely emulsified state for the treatment of cancer. The emulsion, of which the oil particles must be small enough to pass through very fine capillary vessels, has been successfully used for intravenous injections.

B.L.A.1.—Operated by men of the British Liberation Army, the former German transmitter at Cologne is now broadcasting on 455 metres and is announced as B.L.A.1.

Export Interest.—Industry generally is taking a lively interest in the recently formed British Export Trade Research Organisation (BETRO). The following radio firms are among the ordinary members: The British Thomson-Houston Co., Ltd.; Ultra Electric, Ltd.; PortOgram Radio Electrical Industries, Ltd.

New Address.—The address of the Technical and Commercial Radio College, formerly of Ealing, is now North Road, Parkstone, Dorset.

Peacetime Radio.—A Government factory at South Shields has been allocated to Wright and Weaire for civilian radio production.

Cable Merger.—British Insulated Cables, Ltd., and Callender's Cable and Construction Co., Ltd., have amalgamated and will in future be known as British Insulated Callender's Cables, Ltd.

RECORDING LABORATORY

Installation in the Library of Congress, U.S.A.

By DONALD W. ALDOUS

IT does not appear to be generally known that one of the most modern and elaborate sound recording laboratories in the U.S.A. is installed in the Library of Congress, Music Division, at Washington, D.C., under the direction of the Librarian, Archibald MacLeish.

The need for such a laboratory first expressed itself through the popular demand for duplicates of the recordings in the Library's Archive of American Folk Song. For many years the Library of Congress has sponsored a scheme for recording American folk music in the field from the mouths of contemporary singers. A collection of 10,000 songs on discs, cylinders, etc., has been accumulated under the direction of John A. Lomax, Honorary Curator, to form one of the largest collections of its kind in the world. However, only students who were free to come to the library or enthusiasts who could afford to have expensive copies made were able to use the library's vast collection.

The Carnegie Corporation, in 1940, made a grant of over 41,000 dollars for the installation of a complete laboratory for duplicating gramophone recordings of all types, for making master recordings that can be pressed and distributed, for originating broadcasts and for making transcriptions (16-in. 33⅓ r.p.m. discs) for radio transmissions. In addition, a mobile sound unit and a number of portable recorders were purchased for use in the gathering of "on-the-spot" material and other field recording work.

Through the facilities of the laboratory it is now possible for schools, libraries and individuals to obtain recordings for home study of rare American folk music, poetry, etc., and contemporary U.S. history and culture can be recorded for future generations.

Equipment

The technical equipment of the laboratory includes RCA 88A and MI-3044 microphones, used in the main studio, and in the recording room a large four-panelled rack houses: (1) Hallicrafters SX-28 receiver and Hallicrafters S-31 FM-AM high-fidelity RF tuner (specially chosen for recording radio transmissions with optimum quality and low background noise); (2) 3-channel RCA 85B pre-amplifier, dual-channel line equaliser, patch panel, 40-D amplifier and 94-D monitor; (3) 3-channel pre-amplifier meter panel, patch panel, duplicate RCA 40-D amplifier and 94-D monitor; (4) Presto 55-watt recording amplifier and cutting-head bridging-monitor amplifier. The patching panels permit various possible interconnections of apparatus to be made and allow monitoring at almost any point of the circuits.

Two Scully recording lathes, fitted with RCA MI-4887 heads, with a pair of Presto 6N recording units, comprise the actual cutting apparatus. These precision Scully machines have an automatic run-out spiralling device and many other useful features, including a special relay-operated change-over circuit to switch the modulation from one cutting-head to the other instantaneously by push-button control.

"Dubbing" Apparatus

As the production of duplicate recordings, up to as many as 200 in one week, from the collection on the shelves of the library is an important part of the work of the laboratory, considerable attention has been paid to the re-recording or "dubbing" apparatus. The main dubbing-table has several pick-ups, including Brush PL-20 and RCA models, each adapted to give the best results with certain types of records. Various cut-off, taper filters and equalisers, mostly used in transcription work, are located on this dubbing-table, to

Interior view of the recording laboratory's sound truck, showing one of the 16-in. recorders, control panels, telephone intercommunication link, recording amplifier, etc.

which also is connected a variable frequency generator that enables old records, originally recorded at speeds other than the normal, to be copied, as the speed of the turntable can be adjusted until the best quality of reproduction is obtained.

Restoring Old Records

An interesting aspect of the work undertaken in this laboratory has been the repair and restoration of old cylinder and disc recordings, of which some specimens are of unique historical value. Many of the cylinders reach the laboratory in dirty and cracked condition covered with mould, and have to be cleaned before being transcribed on to "cellulose" direct playback discs, but the minimum of treatment is applied as the grooves are sometimes damaged by this operation. Another difficult problem is cracked cylinders and discs, but the laboratory technicians are experimenting with a machine to eliminate the worst effects of such cracks and scratches.

The cylinders are copied on a simple rebuilt "Dictaphone" machine with which can be used several specially designed vertical pick-ups, i.e., a photo-electric model made by the Philco company, a lightweight electro-magnetic model, or a special crystal unit. Four feeds, namely, 100, 150, 160 and 200 tracks per inch, have enabled the machine to handle all the cylinders so far encountered, but the transcription turntable has been made continuously variable to cope with rotational speeds varying between 50 and 225 r.p.m.

The sound level on most of the acoustically-recorded cylinders is very low, and the useful frequency range recorded was usually between about 250 and 3,500 c/s, with most of the rumble occurring below 250 c/s and most of the surface noise above 3,500 c/s; hence careful application of equalisers is needed to allow a disc transcription of tolerable quality to be made.

The portable or field recording equipment of the laboratory consists of nine complete portable recorders and a fully-equipped mobile sound truck. All the portable units, comprising small 12-in. and 16-in. slow-speed models, have self-contained power supplies, operated from storage batteries, as well as several with petrol chargers for recharging batteries when commercial power is not available. The sound truck is equipped with two 16-in. Presto turntables, of which one can be seen in the illustration. Telephonic communication is provided between the recording location and the engineers in the truck, and a portable four-channel mixer is available. The apparatus is energised from a self-contained 110-volt 60-c/s. supply, which operates from a 32-volt storage battery system. The batteries can be recharged by a generator driven by the truck engine, or from commercial mains. The frequency of the power supply is regulated by a field control connected to the convertor, and the former, with a frequency-indicating meter, is visible on the control panel next to the turntable in the illustration on the preceding page.

Preserving Recordings

Completed reference transcriptions, recorded on conventional nitro-cellulose direct discs, are stored on racks in closed metal boxes in air-conditioned vaults, as such discs are not stable. Solid-stock pressings are durable, but this process is too slow and costly for most of the records stored in the library's collection, and so research has been commenced to determine the life expectancy and shelf-life, and the best method of preservation, of direct recordings.

In closing this brief survey of the work and equipment of the Library of Congress recording laboratory it should be mentioned that, since 1941, when the United States of America entered the war, the laboratory has been actively engaged in war work, and has devoted a major portion of its time to the Armed Services in the production of master recordings for processing purposes and the rendering of a technical reference service.

The author wishes to express his thanks to Dr. Arthur D. Semmig, Chief Engineer of the laboratory, for information and for permission to reproduce the accompanying illustration.

Letters to the Editor

Textbook Authors • Students' Troubles • Antiquity of UHF • Tone Control

Radio Textbooks

I READ Thomas Roddam's article in your June issue with interest, as I am the author of an elementary textbook which was reviewed in October, 1944, in *Wireless World*, *Wireless Engineer* (by G. W. O. H.), and in the *Proceedings of the Physical Society*.

Mr. Roddam's suggestions for obtaining authors of good textbooks on radio, presumably those of an advanced nature, are based on the following theme: "There is no time in which the full-time lecturer in radio can keep up to date . . . we cannot see books we want coming from this source. . . . In industry there are potentially better-equipped authors."

Now in my view a good textbook should exhibit these qualities: (i) An ordered assembly of accurate subject-matter to the standard concerned, (ii) clarity of exposition, (iii) a knowledge of the special difficulties of the students for which the book is written.

The possession of a fund of accurate and detailed knowledge of a subject does not automatically carry with it the ability to impart information in a clear and orderly manner by the written (or the spoken) word, and although quality (i) above appears to be well within the powers of men in industry, qualities (ii) and (iii) can only be achieved after experience of active teaching of the subject. Consequently if research workers and others in industry wish to write a good textbook on radio (with the emphasis on the word "good"), they should spend some time in teaching.

On the other hand, as Mr. Roddam has no doubt in mind, there are teachers in the universities, the polytechnics and technical colleges, and the schools who do not take the trouble to keep up with modern developments in their subject. Macaulay wrote: "I hold every man a debtor to his profession," and many teachers, the true *élite* of the profession, do find time to read regularly journals such as the *Proc. I.E.E.*, *Proc. I.R.E.*, *Wireless Engineer*, *Wireless World*, *Nature*, to quote only a few examples. My suggestions for authors of good advanced textbooks on radio are: Professor G. W. O. Howe of Glasgow University, and J. A. Ratcliffe, C. W. Oatley of Cambridge University.

M. NELKON.
Northampton Polytechnic,
London, E.C.

WITH reference to Thomas Roddam's article, may I suggest that the trouble is in part due to our authors being undecided upon the type of reader to cater for?

This indecision is quite understandable, as the readers of radio textbooks vary between the trained electrical engineer who wishes to specialise in radio and the draper's assistant who is fed up and wishes to "take up something more interesting."

The author, vaguely conscious of this diversity in type of reader, makes an attempt at satisfying all concerned, and inevitably falls between two stools by producing a book which bores to tears the trained engineer, and completely baffles the lay reader who obviously needs a preliminary electrical training before attempting such a highly specialised subject.

So let us take an adequate background knowledge for granted when we write our radio textbooks, and not try to compensate for the lack of such training by using up half or three-quarters of each book with matters which should have been covered by the reader long before he aspired to the study of radio communication.

C. M. LLOYD.
London, N.W.3.

"Valve Vectors"

MAY a student chip in to the "Valve Vector" scrimmage? Many of us have dabbled in wireless for years; we haven't got cathode-ray tubes or valve voltmeters or standard sine-wave sources, so we are not able to check experimentally the dictum of the expert. We have accepted such textbook statements as the "anode current is in phase with the grid input voltage, when the anode load is resistive." We welcomed the appearance of Dr. Sturley's article and spent many hours reading and re-reading it, but we are afraid we must agree with Dr. Parnum at least to this extent, that we were never quite clear what Dr. Sturley meant by "the current I_a produced by the generated voltage μE_g." Not that Dr. Parnum has cleared matters up; indeed, his criticism and Dr. Sturley's reply have made confusion worse confounded!

Now, Sir, what is the poor student to do? We welcome articles by experts who take pains and trouble to make things clear to avid amateurs, but we like to feel our authority is inviolable. Personally, we confess we are often confronted with an inability to follow an experts' exposition and admit to the human weakness of preferring to remain in happy ignorance rather than lose face by admitting our mental weakness.

But Dr. Sturley will not let us remain in happy ignorance. He has made us so unhappy over this question of anode and grid phase relationship that we hope he will take pity on us and explain a little more fully the problem that disturbs our sleep. The problem is this: does the connection of a reactance in parallel with the resistive anode load affect the phase of the anode voltage, E_o? So far as our memory serves, we have never seen in any textbook a reference to the effect, if any, of reactance on the anode voltage phase—all references confining themselves to the special case of a resistive load. One infers, of course, that a reactive load will change the phase, but when we, ourselves, put the question to several of our expert friends their explanations were, to say the least, unsatisfactory.

We applied ourselves vigorously to Dr. Sturley's article feeling that herein lay the solution, but we were not able to expose it—somewhere it lies hidden in E_g, I_a, I_c, I'_a, I_L and μE_g. His statement that "the grid input AC voltage and the voltage generated by the generator imagined to exist inside the valve are 180 deg. out of phase; this is true whether the anode load is resistive or reactive," seems incompatible with his conclusion that "E_a lags behind μE_g" in his analysis of the tuned anode oscillator. Our bewilderment is due to our inability to decide which is the source of the AC output, the HT battery or the generator inside the valve? If the valve is an impedance varying inversely with the grid voltage and the anode load is in series with it, then the phase of the voltage at the junction of these two impedances will be determined by their reactances. On the other hand, if the valve is a generator with the anode load strapped across it the reactance of the load will not shift the voltage phase of the generator, but will only affect the phase of the current flowing through it relative to the voltage.

Please, Dr. Sturley, we are grateful for your article; that we do not fully understand it is our lack. Will you help us out?

"STUDENT."

Were Old-timers "Dumb"?

ALTHOUGH I have little fault to find with your contributor "Diallist," I think it is a little unkind to suggest that we old-timers of twenty-five (and more) years ago were "dumb" or conservative enough to scoff at the idea of working on frequencies as high as 25 Mc/s.

In 1917 experiments were being carried out with *spark* transmitters by the Marconi Company on frequencies lying between 60 and 70 Mc/s., and surely "Diallist" has not forgotten the Inchkeith rotating beam, installed in 1920, operating at 50 Mc/s.

It is doubtful whether the "astonishing developments in wireless technique" seen during the last 25 years would have materialised had not most of those associated with its development been singularly free from the hide-bound limited outlook that one normally associates with followers or practitioners of other professions.

After nearly 30 years' work on frequencies from below 20 kc/s, to something over 6,000 Mc/s., I cannot recall one colleague who ever expressed a doubt regarding the value to the world of development work on frequencies extending in both directions.

I am hoping to live long enough to see the modern physicists turn their attention to the frequencies below 15 kc/s.—possibly for the purpose of erecting a real central heating plant. Then I shall die technically happy.

CHAS. H. WHITE.

Staines, Middx.

"New Versatile Tone Control Circuit"

WITH reference to the letter by D. Winget published in the June *Wireless World*, I should like to make two comments.

His suggestion regarding the alteration of the position of the resistance R3 (reference his figure) is good, although it cannot be applied to my tone control circuit.

Concerning Mr. Winget's second remarks I entirely disagree. If one takes the meaning of "normal" as being the amplifier without bass boost, then obviously, if one increases the bass, one must also increase the output at the bass compared with normal. Why Mr. Winget refers to correcting the loudspeaker deficiencies as "cooking" and yet does not use this term when it is applied to the correction of deficiencies in other components I cannot see. Surely it is no more cooking to correct for the loss of the low frequencies in the loudspeaker than for the loss of the low frequencies in the pick-up. Usually the loudspeaker is the weakest link in the chain, so why not correct for it? There is another point; assuming the loudspeaker to be perfect, there is greater power associated with the low frequencies than with the higher frequencies, and therefore, if you now put in the low frequencies which were not there in the "normal" amplifier, the output must go up.

G. N. PATCHETT.

Bradford.

RANDOM RADIATIONS

By "DIALLIST"

Jointing Litzendraht

A BLACKPOOL reader asks if I know any way of making satisfactory soldered joints in "Litz" wire. The ideal method would, I suppose, be to solder and re-insulate each strand separately, but I can hardly imagine any normal human being going to those lengths with, say, 27/44! What I have always done is simply to bare all the strands of both ends, to twist them together, to run in resin-cored solder, and to insulate with a silk binding. It does not take long to do and it seems to work well enough. When making a tapping in a Litz-wound coil, I bare about three-quarters of an inch at the appropriate place in the main wire and about the same amount at the end of the piece that is to form the tap. A standard flex T-joint is then made, soldered and wrapped. The chief snag lies in stripping the insulation from such fine stuff as No. 44 SWG. Scraping is a tedious job and if you attempt to do it you are almost certain to cut or break some of the strands. I have seen it recommended that the insulation should be burnt off with the flame of a match. I wonder if the maker of that suggestion has ever tried it out! Hardly, I think, for if he had he'd have found that the flame burns out not only the insulation, but the wire as well. My own way is to *char* the wrapping by waving a match flame to and fro under it, taking care not to let the silk catch fire. When the insulation has been charred it is easily rubbed off with the fingers. Readers are very likely to know of better methods of dealing with Litz. If they do I should be very glad to have particulars and to publish them for the common good if they will be so kind as to send them along.

□ □ □

Small Tools

ON my return to civil life I was horrified to find how difficult small tools, such as one needs for wireless work, were to obtain and to what prices some of them had risen. My drill canister, when I came to check over its contents, was found to be in need of replenishment. Well, mine proved to have fifteen drills missing or unserviceable (friends and evacuees had done some borrowing in my absence, I suspect) and it wasn't too easy to obtain them. They would have cost about fourpence or fivepence apiece in pre-war days, but I had to pay an average of just over a shilling a time for them. And such pliers! Can anyone tell me where to buy a good pair of little four-inch bottle-nosed pliers? Mine have mysteriously disappeared, so have flat-nosed pliers of the same size and a much-valued pair of small toggle-action end-cutters.

□ □ □

Good News—If True

KNOWING (a) how many and how strange are the vested interests concerned and (b) our national love of compromise, I've always taken rather a gloomy view of the possibility of our getting rid, in any reasonable time, of interference with wireless reception due to man-made causes. I have just heard that a committee is considering the question at the moment and that it is likely to recommend in its report that strong and immediate action should be taken. I hope that this is so and that, when made, its recommendations will be accepted and acted upon at once. What too often occurs is that when a committee of highly qualified and experienced men is constituted to consider this question or that its labours eventually go for little or nothing. Government officials, who must know far less about the subject than they, water down the recommendations until they become more or less ineffective. That's what I'm so afraid of in the case of interference. We are on the verge of producing masses of new motor cars and vast quantities of domestic electrical appliances. Will any Government take the strong line of bringing in immediately legislation making it an offence to sell or use any kind of apparatus which can cause interference with wireless reception? I wish I could think so.

□ □ □

Queer Ideas

A CORRESPONDENT, who endorses my remarks in a recent issue on the folly of leading the man-in-the-street to believe that post-war receiving sets are going to be cheaper, points out also that the lay Press has been guilty—in part at any rate—of starting and fostering some strange ideas. One of these is that radiolocation has led to vast advances in television technique. Quite a lot of people seem to believe that one. Actually it hasn't, for almost the only similarities between the television and radiolocation receivers are that both use cathode-ray tubes and work on the ultra-short waves. We have probably learnt a good deal about the design and mass production of CRTs, though so far there haven't been many signs that mass production is going to result in any sensational lowering of prices. There have been advances, too, in ultra-short-wave technique in radiolocation and in other branches as well: much work, for instance, has been done on aerial systems and the development of Polythene has solved certain problems. But I don't fancy that any of these things is going to revolutionise television. One weird piece of confused thinking that one comes across is that television and radiolocation are much the same thing. I've heard railway-carriage experts explaining (!) that post-war television will enable those who use it to see distant objects in the dark or even through brick walls. And I wish the lay press would keep radiolocation and ionosphere "sounding" separate.

□ □ □

Make It Plain

IT would be no bad idea if radio manufacturers who turn out broadcast sets with magic eyes explained rather more clearly in their books of words how necessary it is to tune correctly if a set is to do itself justice. And would it not be better if the directions told the layman to tune for the smallest spaces between the limbs of the cross rather than for the biggest cross? That is a point that designers of magic-eye tubes might also bear in mind. If the set has no tuning indicator, the handbook should certainly give very plain instructions for finding the optimum setting by ear. With either an indicator-less superhet or a straight receiver I don't think you can beat the bracketing method. Having found the approximate setting, turn clockwise until obvious distortion occurs; then turn anticlockwise until the same thing happens. Make a smaller bracket if need be. The right setting will then be easy to find.

□ □ □

Loudsquawker

SOMETHING has been said recently in *Wireless World* about the fine selection of weird noises that a loudspeaker can emit when there is an electric lamp in the house with a broken filament whose free ends are vibrating and making intermittent contact. I had a similar experience, but on a grander scale, a few evenings before writing these notes. The loudspeaker began to moan quietly. But the doleful noise didn't remain *piano*; it grew rapidly in volume and ere I could switch off it had become an ear-splitting shriek. When I'd silenced the set I found that the noise was still faintly audible. At first I thought that my ears were still singing, but the sound persisted and I traced its origin to an electric bowl fire, which had been turned on to make flaming June seem a little less like chill December. Switching that off, too, and blessing the ensuing peace and quiet, I waited for it to cool down before making an examination. This bowl fire has a heater element with a screw-in fixing. The screw had worked loose—one of life's deep mysteries is the apparent possession by inanimate screws and nuts of sufficient power of movement to loosen themselves, no matter how firmly they may have been tightened down—and a respectable arc had been taking place between the contacts within the holder. I can assure you that the performance of the wireless set under its stimulus had to be heard to be believed.

Arc Royal

Speaking of arcs reminds me of a spot of bother that we used to have occasionally with what for security reasons I had perhaps better still call radiolocation equipment. The load when one type of transmitter is working is about 16 amps at 230 volts, 50 cycles. The power cable of the transmitter is connected to the generator by means of a hefty plug with good fat pins. Having pushed the plug in you fix it well and truly home by means of a screw-down locking ring. More than once I've known those plugs to be welded solid into the sockets and on one occasion the heat became so intense that the whole lot melted, causing a magnificent short. You might hardly expect arcs to occur in plugs and sockets such as these, or the results to be so devastating with a 16-amp. current. The trouble was invariably due to the carelessness of one "number," who had scamped the work of cleaning the plug points during "care and maintenance." A little dirt on the points was quite sufficient to cause arcing—and there you were. And yet I never remember hearing of similar trouble with 2-kilowatt domestic electric fires, where the load is some 10 amps and the plugs, besides never being cleaned, are often none too good a fit in their sockets.

RECENT INVENTIONS

A Selection of the More Interesting Radio Developments

TELEVISION STUDIOS

TO avoid the unpleasant heating effect of the usual high-powered incandescent lamps, the studio is flood-lit by the fluorescent type of lamp.

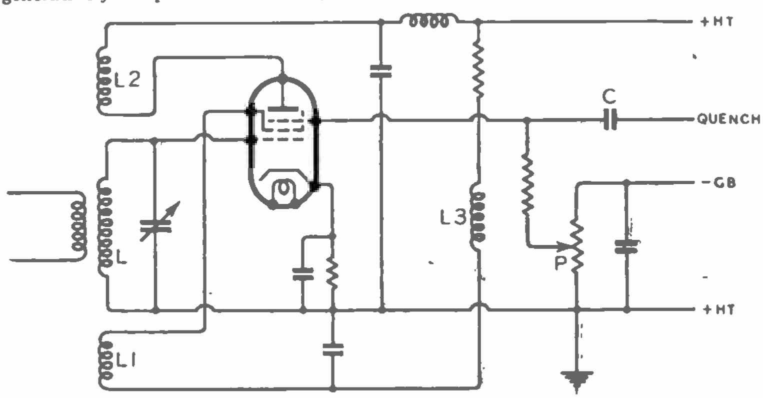
The increased tendency to "flicker" is offset by enclosing the Iconoscope camera in a light-tight casing, which is fitted with a number of incandescent lamps to provide an adjustable "bias" illumination for the mosaic screen. In addition, an adjustable shutter admits a ray from the studio lamps, which is directed against a photo-sensitive layer on the wall of the tube facing the screen. As the current from the AC lighting mains passes through its zero, the flicker from the biasing lamps will tend to produce a "black" pulse, whilst the ray of light coming from the studio through the shutter simultaneously tends to produce a "white" pulse, due to the electrons released from the sensitised wall of the tube. The two effects are cancelled out in the transmitted picture.

Marconi's Wireless Telegraph Co., Ltd. (assignees of O. H. Schade). Convention date (U.S.A.) July 27th, 1942. No. 566429.

SUPER-REGENERATIVE RECEIVERS

THE theoretical advantage of using a high quenching frequency is partly offset by the fact that the "decay" period becomes too short to allow the amplified signal to fall to its input level before the onset of the next "build-up." To avoid distortion from this cause, it is proposed to accelerate the rate of decay by the periodical application of an out-of-phase voltage.

As shown, incoming signals are applied to the first grid of a pentode through a coil L, which is regeneratively coupled to a coil L_1 and degeneratively coupled to a coil L_2, the two latter coils being connected to the second grid and anode respectively. Quenching oscillations are fed from a source (not shown) through a condenser C to the third grid, which also takes a variable bias from a potentiometer P.



Circuit for high quenching frequencies.

In operation, the bias on the third grid is adjusted so that at the point of the "quench" when the signal amplification starts to decay, the anode of the valve begins to take current and so feeds back to the first grid an out-of-phase voltage which ceases when that grid regains the level of the input signal. During the ensuing build-up, the anode is again cut off, and the signal is taken wholly by the second grid, the circuit of which includes the positive reaction coil L_1 and the output coil L_3.

Ferranti, Ltd.; M. K. Taylor; and I. N. Vaughan-Jones. Application date June 1st, 1943. No. 566209.

TUNING INDUCTANCES

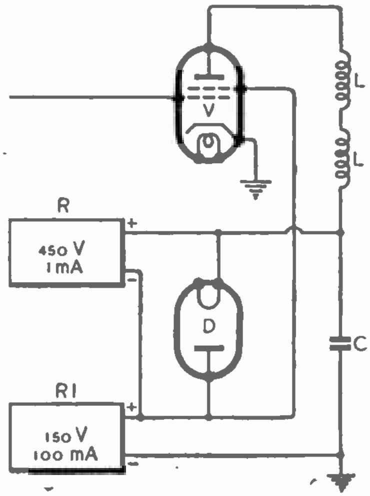
A VARIABLE inductance is coiled on a rotatable drum and is engaged by a grooved roller contact, which is spring-pressed on to the wire of the coil and is so moved laterally along it when the coil drum is rotated by the tuning control.

According to the invention, the grooved roller is also constrained to rotate at a speed which is different from that due to a simple rolling movement, in order to ensure a good wiping contact. For this purpose, the contact roller is keyed to a squared shaft which is driven through cord-and-pulley gear from the main tuning shaft, so as to rotate at a lower peripheral speed than the wire of the inductance coil.

Radio Transmission Equipment, Ltd., and C. E. Payne. Application date June 22nd, 1943. No. 567080.

CATHODE-RAY TUBES

A HIGHER voltage must be applied to the deflecting coils to generate a high-speed scanning sweep lasting, say, for 10 microseconds, and repeated every 1,000 microseconds than is required to give a low-speed sweep lasting for 1,000 microseconds at the same repetition frequency, though the average current taken is larger in the second case. If the supply is taken from a constant-voltage source, it can be shown that a large part of the energy consumed is lost as heat in the power tube. On the other hand, if the anode voltage is made to vary with the velocity of the sweep, much of this waste can be avoided, with a corresponding saving in the size and cost of the equipment.



Two-speed sweep circuit.

As shown in the drawing, the power tube V supplying the deflecting coils L is fed from two separate main supply units, arranged in series with a condenser C, one unit being shunted by a diode D. The unit R is a single-diode rectifier in series with a high limiting resistance, and is rated to deliver, say, 1mA at 450 volts. The other unit R_1 may be a full-wave rectifier giving an output of 150 mA at 150 volts. For high-speed operation the slope of the saw-toothed oscillation is steep, and the voltage-drop across the coils L will reverse the polarity of the diode D, so that during the idle part of the repetition cycle the applied voltage is reduced to that of the unit R_1, with a corresponding saving of energy. For low-speed working the unit R_1 supplies the larger current required.

Marconi's Wireless Telegraph Co., Ltd. (assignees of O. H. Schade). Convention date (U.S.A.) May 30th, 1942. No. 566877.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.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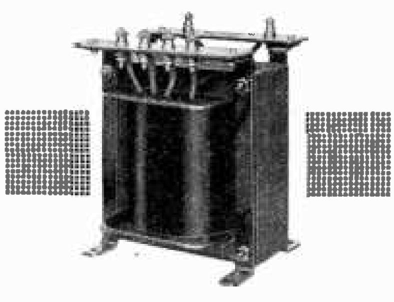

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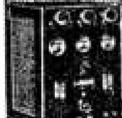

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No. 11. Battery 2¼ watt Amplifier, 3 valves, Push-Pull.
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Toggle Switches. Miniature, on-off, single pole, 2/6. D.P., D.T., 4/3.

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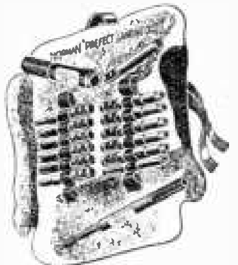

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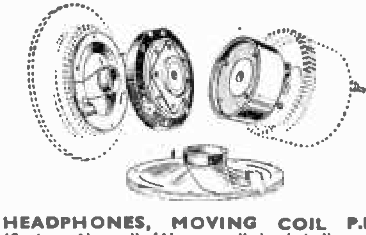

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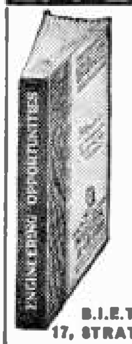

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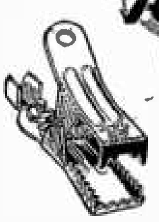

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