THE AUSTRALASIAN

Radio World

PRICE, 1/-

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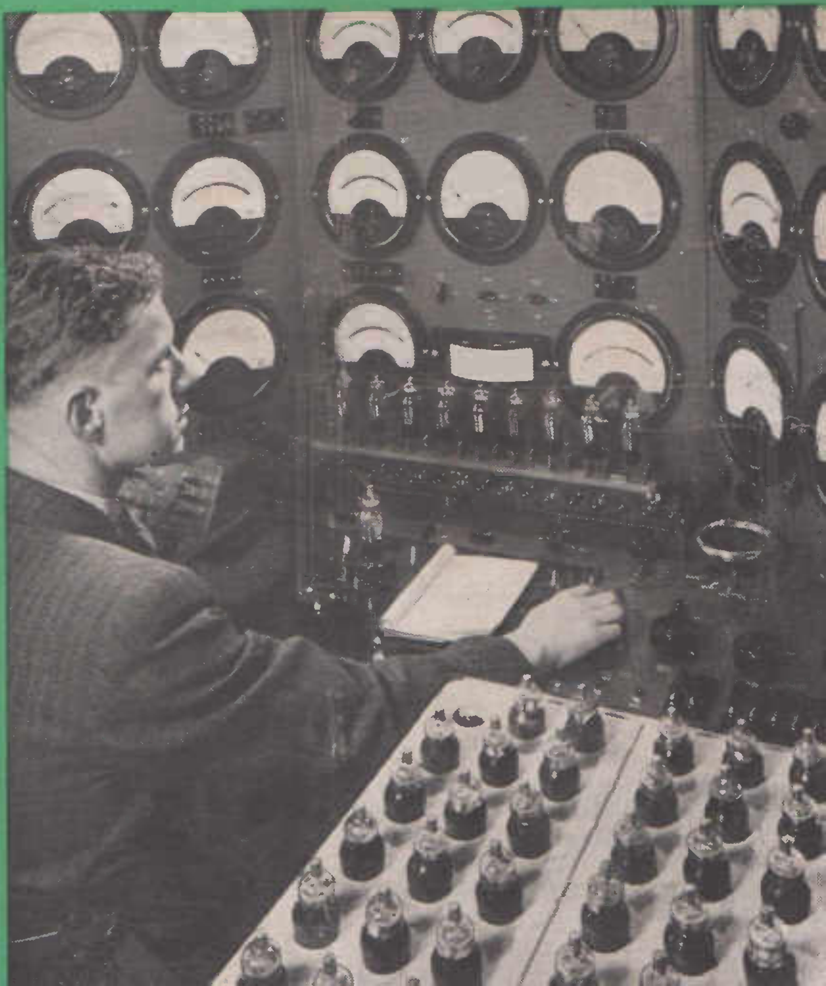
VOL. 6 . . . . . NO. 4

SEPTEMBER 15 1941

TESTING VALVES AT PHILIPS' AUSTRALIAN FACTORY

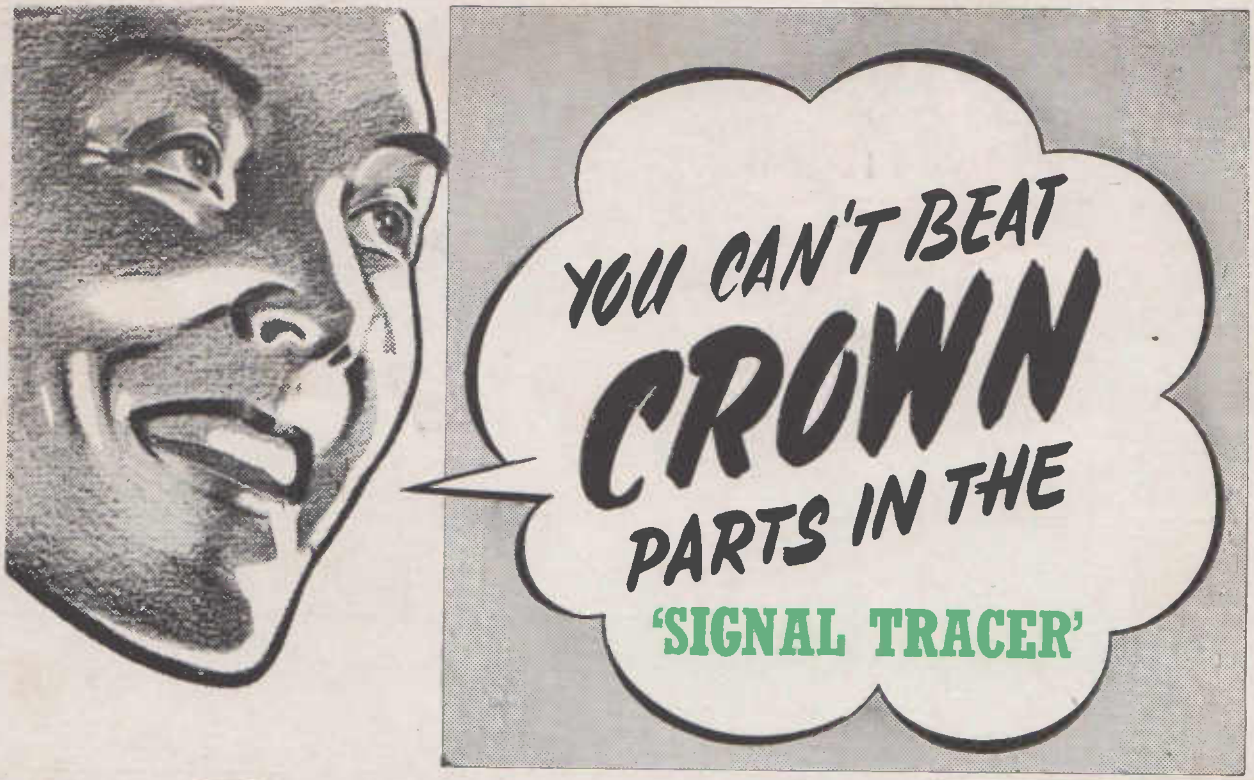


SERVICEMAN'S SIGNAL TRACER

AN ANALYSIS OF PUSH-PULL

GUIDE TO THE SHORT-WAVES

MODERN T.R.F. CIRCUIT DESIGN



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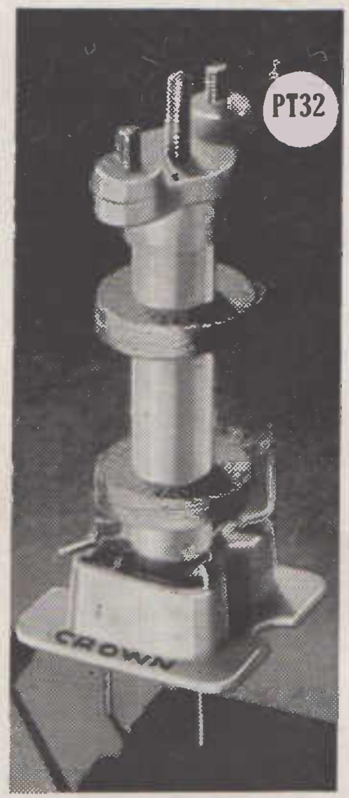

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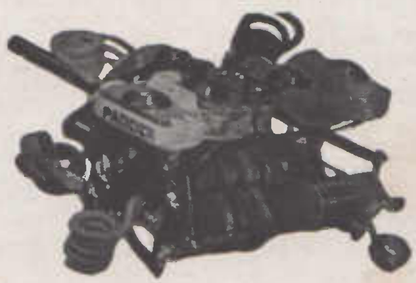

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The Australasian
RADIO WORLD
Incorporating the
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Vol. 6 SEPTEMBER, 1941 No. 4

CONTENTS:

EDITORIAL

Every now and then there is a tendency to get an impression that radio development has reached its climax, that every avenue of application has now been explored.

Just in case you feel that way we would like to tell you about a book recently received from overseas.

It deals with some new ideas about the use of ultra high-frequency radiations. It mentions such things as special valves with positive potentials on the grids and negative potentials on the plates, just to get the electrons mixed up so that the valves will oscillate without regeneration.

Like a fairy story read the chapters about radio transmission from lenses made of ebonite, instead of aerials.

Further details cannot be revealed at the moment, but you can take it for granted that when peace returns the wartime research will be found to have paved the way for radio development on a scale never before imagined.

The "Australasian Radio World" is published monthly by A. G. Hull.

Editorial Offices: 117 Reservoir St., Sydney, N.S.W. Telephone: MA 2455.

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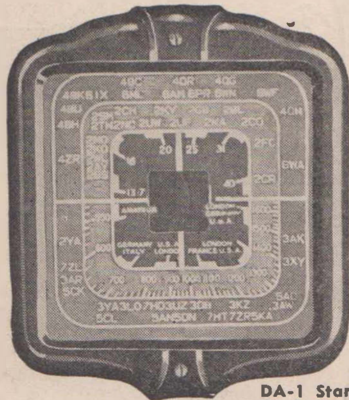

The new D.W. Kit Dial, Code DA-9, has all parts supplied ready to assemble. This is an excellent replacement dial and is suited for crystal and small T.R.F. sets. The special walnut escutcheon is easy to fit and requires an aperture 3 in. x 3 in. Available for use with "H" type Gang Condenser on 1600 and 550 k.c. and 13.7 to 40 metres S.W. bands.

Code DA-9 .... Price 9/-

DA-1	Standard D.W. Dial	22/6
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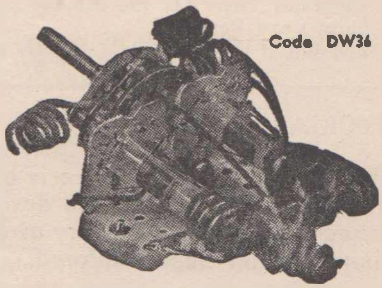
DA-7	Portable Kit Dial, D.W. "H" gang	9/-
DA-8	Same as DA-7, but ready assembled	13/6

Code DA-9
Scale 0-100

R.C.S. TROLITUL D.W. UNIT

Type DW-36, as illustrated, consists of Aerial and Oscillator Coils, Wave Change Switch, the necessary B.C. and S.W. Trimmers and Padder mounted together, wired up ready to assemble into a set utilising 465 k.c., the bands being S.W. 13.7 to 40 metres, and B.C. 1600 to 550 k.c.

Code DW-36 — Price £1/7/6



Code DW36

R.C.S. D.W. Unit, with R.F. Stage — DW-35 for "H" gang, B.C. and 13.7 to 40 metres £3/7/6

R.C.S. TUNED I.F.'s

The new R.C.S. permeability-tuned I.F.'s are wound on special Trolitul formers into which are inserted the adjustable iron cores. These R.C.S. permeability - tuned I.F.'s are the most dependable and efficient I.F.'s it is possible to produce. They should be used whenever the optimum in results is required.

465 K.C. I.F.'s
When two I.F.'s are used:

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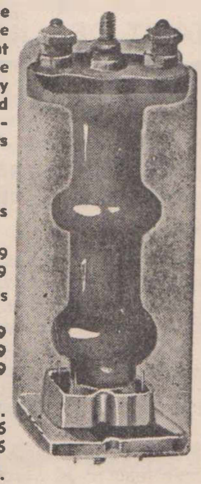
IF164 2nd .. 13/9
IF163 3rd .. 13/9

Air Core I.F.'s
Air Core 465 K.C.

IF107 1st .. 7/6
IF108 2nd .. 7/6

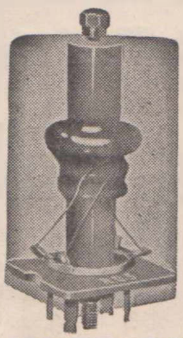
Air Core 175 K.C.

1E68 1st 7/6
1E69 2nd 7/6



IF162

R.C.S. TROLITUL BROADCAST COILS



These coils are available in both Air Core and Permeability tuned types. The latter are adjusted to ensure maximum efficiency in our laboratories.

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E342 Aerial 6/6
E343 R.F. 6/6
E344 Os. 6/6

PERM. TUNED "H" GANG

E345 Aerial 8/6
E346 R.F. 8/6
E347 Osc. 8/6

T.R.F. TYPE-AIR CORE

T88 Aerial 6/6
T89 R.F. 6/6
T87 R.F. with reaction 6/6
T81 Reinartz 3/3

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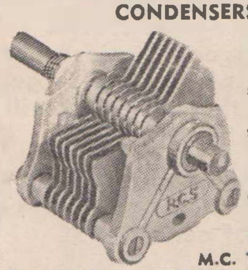

R.C.S. Midget Condensers are made in two types, using Trolitul supports, thus guaranteeing practically no loss.

M.C. Type

The 14-plate equals old style 23-plate capacity. The M.C. type may be ganged.

●

STAR AND M.C. MIDGETS

Max. Cap. mmfd.	Min. Cap. mmfd.	Plates	Star Cat. No.	Retail Price	M.C. Cat. No.	Retail Price
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15	3	3	CV35	4/3	CV42	7/9
25	3.5	4	CV36	4/6	CV43	8/4
35	4	5	CV37	4/9	CV44	9/-
50	4	7	CV38	5/3	CV45	9/6
70	5	9	CV39	5/10	CV46	10/-
100	6	14	CV40	6/5	CV47	11/3

MODERN SIGNAL TRACER

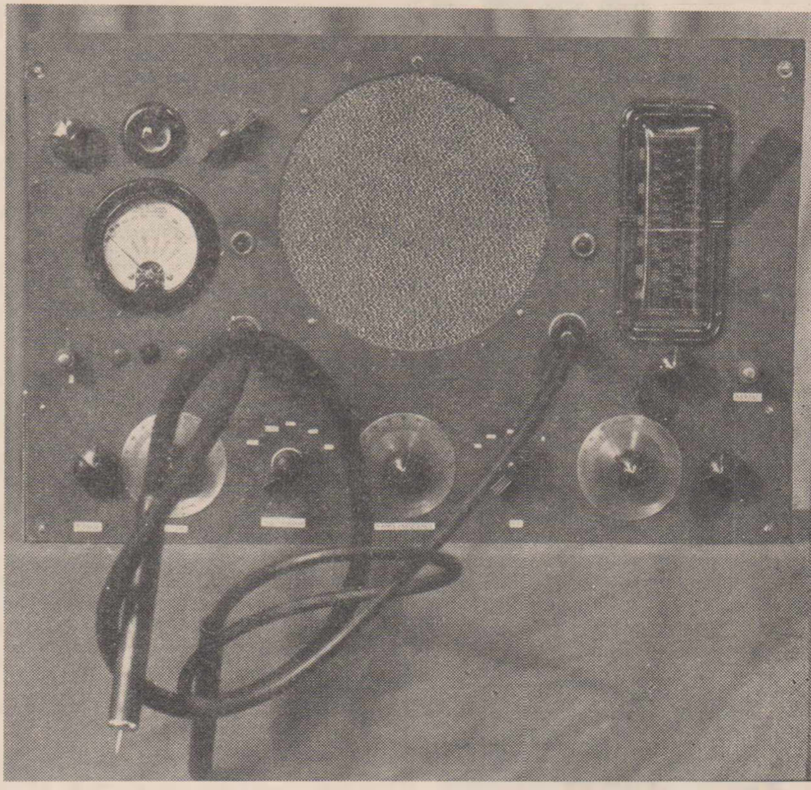
for

Servicemen

★

Designed by a radio man with plenty of experience in radio servicing, this outfit is the first practical Australian adaptation of the latest American outfit for speedy trouble tracing.

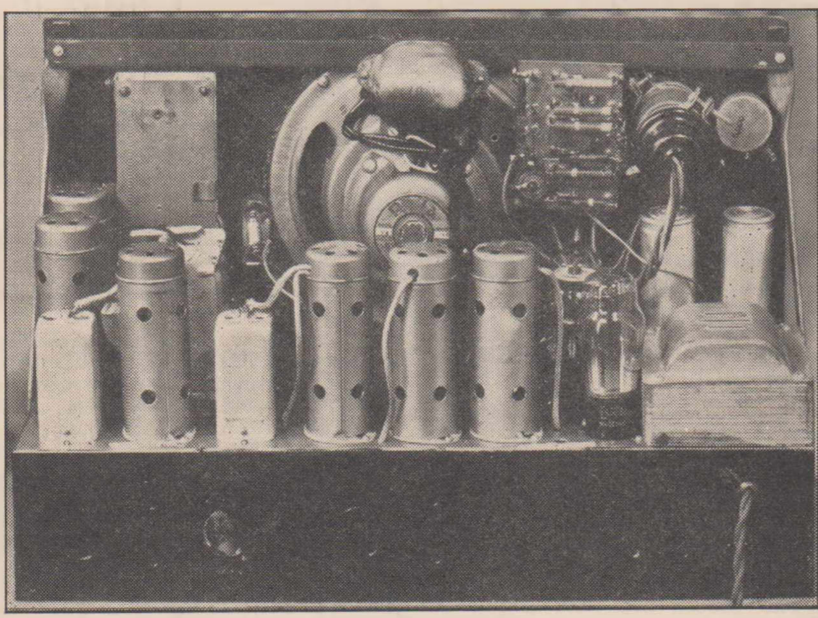
★



ABOVE: Front view of the Signal Tracer outfit, which is an invaluable addition to any radio work bench. BELOW: A rear view, showing the arrangement of components.

WITH signal tracing coming more and more into practice, many servicemen will want to build their own instrument. The servicing of any radio, new or old, can be done more easily and quickly with a Signal Tracer than with any other type of test instrument. The tracer permits you to follow the signal from the aerial terminal in the receiver, right through each succeeding stage to the speaker voice coil.

It shows instantly where the signal gets weaker, distorted or disappears entirely. Noise or hum, dry joints and faulty components, etc., are quickly located at their source; meter readings of actual gain per stage can be simultaneously indicated while audible tests are being made; a.v.c. and oscillator operation can be easily checked.



As we all know, radio servicing started with the simple circuit test and has gone through voltage, current, resistance analysis, signal substitution (with a signal generator) and, finally, signal tracing.

Without doubt, each one of these methods is not the only one to be used in servicing radio receivers. Each method has its outstanding advantages as well as its disadvantages. The man who can apply to advantage the best points of these systems can give an accurate and efficient job in the shortest time.

It will be found that with the signal tracer described below the serviceman needs only, in addition, a good oscil-

SIGNAL TRACER (Continued)

lator, which he probably already owns.

A glance at the circuit diagram shows that the first two valves comprise an ordinary oscillator and I.F. stage similar to that used in most modern radios. From then on, it differs from the conventional receiver in that it consists of resistance-coupled amplifier stages, then a diode detector followed by a usual type of audio system, with an appropriate switching system for application of the test probe to any part of the receiver being analysed.

It is not to be supposed that anyone will attempt to build or use this instrument who is not thoroughly familiar with radio servicing, as it is essential that the serviceman who would successfully employ this system be thoroughly familiar with the behaviour of the signal from the instant it enters the aerial terminal of a radio until it emerges from the loud-speaker. He must know its characteristics in every part of the set and what part the different components play as the signal passes through them. Therefore, no wiring diagrams or special layouts are included. The man who uses this instrument should be able to build it direct from the theoretical circuit supplied.

Test Probe

The cable connecting the test probe to the signal tracer is made of very low capacity, shielded cable. (I used a length of crystal microphone cable.) The lower the capacity the less detuning will occur, especially when used in radio frequency, oscillator and intermediate frequency circuits. Audio circuits are not critical.

The probe is constructed of a single length of bakelite or fibre tubing with an inside diameter just large enough to admit the low capacity cable. In one end is a small piece of wooden dowelling of a diameter just large enough to fit tightly into the tubing and through the centre of this piece of wood a thin nail is driven. Solder the end of the cable to this nail. The shield on the cable should be earthed. This completes the probe. For those who desire it, a second cable can be made, except that a low capacity midget condenser (about .00005) is placed inside the probe as close to the nail as possible, one end soldered to the nail and the other to the cable. This serves as an isolating condenser and helps to prevent detuning. However, this probe cannot be used on audio circuits, and when it is used, although it does help to prevent detuning, it lowers sensitivity.

The probes are connected to the tracer by means of a double contact automoble light plug fitted to the cable and a suitable socket fitted into the tracer. These can be purchased from any motor garage.

The chassis used is a large receiver chassis, 20" x 8" x 4." The front panel can be made of bakelite, masonite or metal, according to the builder's fancy.

The first portion is as previously mentioned, an ordinary radio tuner and I.F. valve. Connected to the plate of the first 6U7 is the primary of the second I.F. transformer, the secondary not being used. The switch coming from the .001 condenser connected to the grid of the second 6U7G is an attenuator for the probe and also switches in the radio tuner. The 5,000-ohm potentiometer connected to the cathode of this valve is an R.F. gain control. The multi-contact switch at the bottom of the diagram is the probe switch. The moving arm of this

SIGNAL TRACER — Parts List

1—Base, size 20" x 8" x 4" (Arcadian).
1—Panel, size 20" x 12."
1—Power transformer, 385v., 80 ma.
1—Dual-wave coil bracket (R.C.S., Britannic, Crown, Radiokes).
2—Intermediate transformers (R.C.S., Britannic, Crown, Radiokes).
1—2-gang condenser to suit (Stromberg-Carlson).
1—Dial to suit (R.C.S., Crown, Radiokes).

CONDENSERS:

1—.00005 mfd. mica condenser (T.C.C.).
6—.0005 mfd. mica condensers (T.C.C.).
2—.001 mfd. mica condensers (T.C.C.).
1—.006 mfd. mica condenser (T.C.C.).
3—.01 mfd. mica condensers (T.C.C.).
2—.02 mfd. tubular condensers (T.C.C.).
2—.05 mfd. tubular condensers (T.C.C.).
10—.1 mfd. tubular condensers (T.C.C.).
1—.5 mfd. tubular condenser (T.C.C.).
2—25 mfd. electrolytic condensers (T.C.C.).
4—8 mfd. electrolytic condensers (T.C.C.).

RESISTORS:

2—200 ohm 1-watt resistors (I.R.C.).
2—250 ohm 1-watt resistors (I.R.C.).
1—350 ohm 1-watt resistor (I.R.C.).
4—5,000 ohm 1-watt resistors (I.R.C.).
1—20,000 ohm 1-watt resistor (I.R.C.).
2—25,000 ohm 1-watt resistors (I.R.C.).
3—50,000 ohm 1-watt resistors (I.R.C.).
4—.1 megohm 1-watt resistors (I.R.C.).
2—.25 meg. 1-watt resistors (I.R.C.).
3—.5 meg. 1-watt resistors (I.R.C.).
2—1 megohm 1-watt resistors (I.R.C.).
1—3 megohm 1-watt resistor (I.R.C.).
1—5,000 ohm potentiometer (R.C.S., Radiokes).
1—500,000 ohm volume control (I.R.C.).

SUNDRIES:

1—12-contact switch.
1—5-contact switch.
6—Valve cans.
Sockets, 6 octal, 1—6-pin, 2—4-pin.
Magic eye holder and bracket.
2—Test prods, knobs, scales, etc.
Solder, lugs, screws, hook-up wire, grid clips, etc.

VALVES:

1—6J8G, 3—6U7G, 1—6B6G, 1—6V6G, 1—6E5, 1—80.

SPEAKER:

8" size, 7,000 ohm load, 2,000 ohm field coil.

switch connects directly to the probe socket.

How to Use the Signal Tracer to Test R.F., Mixer, and I.F. Sections

Turn the multi-contact switch to contact A, and the attenuator switch to the blank contact. Now apply probe to the aerial terminal of receiver being tested and a signal or signals — since the amplifier is untuned — should be picked up. If the aerial is earthed, no signal will be heard. If the aerial is satisfactory a signal should be heard. In other words, the efficiency of the aerial system can easily be checked: By placing the probe on the control grid of the R.F. valve and turning the dial on the receiver we should tune in a signal. Next, by placing the probe on the plate of this valve, we should hear a definite gain in volume. Now proceed to the grid of the mixer stage. If signal is not received here, the fault is, without a doubt, in the secondary circuit of the R.F. coil. If signal is O.K., move the probe to the mixer plate. The signal should be received here with additional amplification. Proceeding to the control grid of the I.F. stage, the signal should then appear at this point. Then on to the I.F. plate, whereat the signal should be greatly amplified. Then on to the diodes of the second detector. You will observe it is merely a method of following the radio signal from the aerial through, and if the signal does not appear at any of these points the difficulty should be located quickly with the use of a simple volt ohmmeter.

Testing for Hum or Noise in the R.F. and I.F. Section

Follow the signal through as abovementioned — a broadcast or oscillator signal may be used. At the same time, we are able to check the amplification of each valve as we go along. There should be a definite gain between grid and plate of each valve.

Designed and described by
JOHN BRISTOE
Radio Manager
Denhams Pty. Ltd.
MARYBOROUGH, Q.

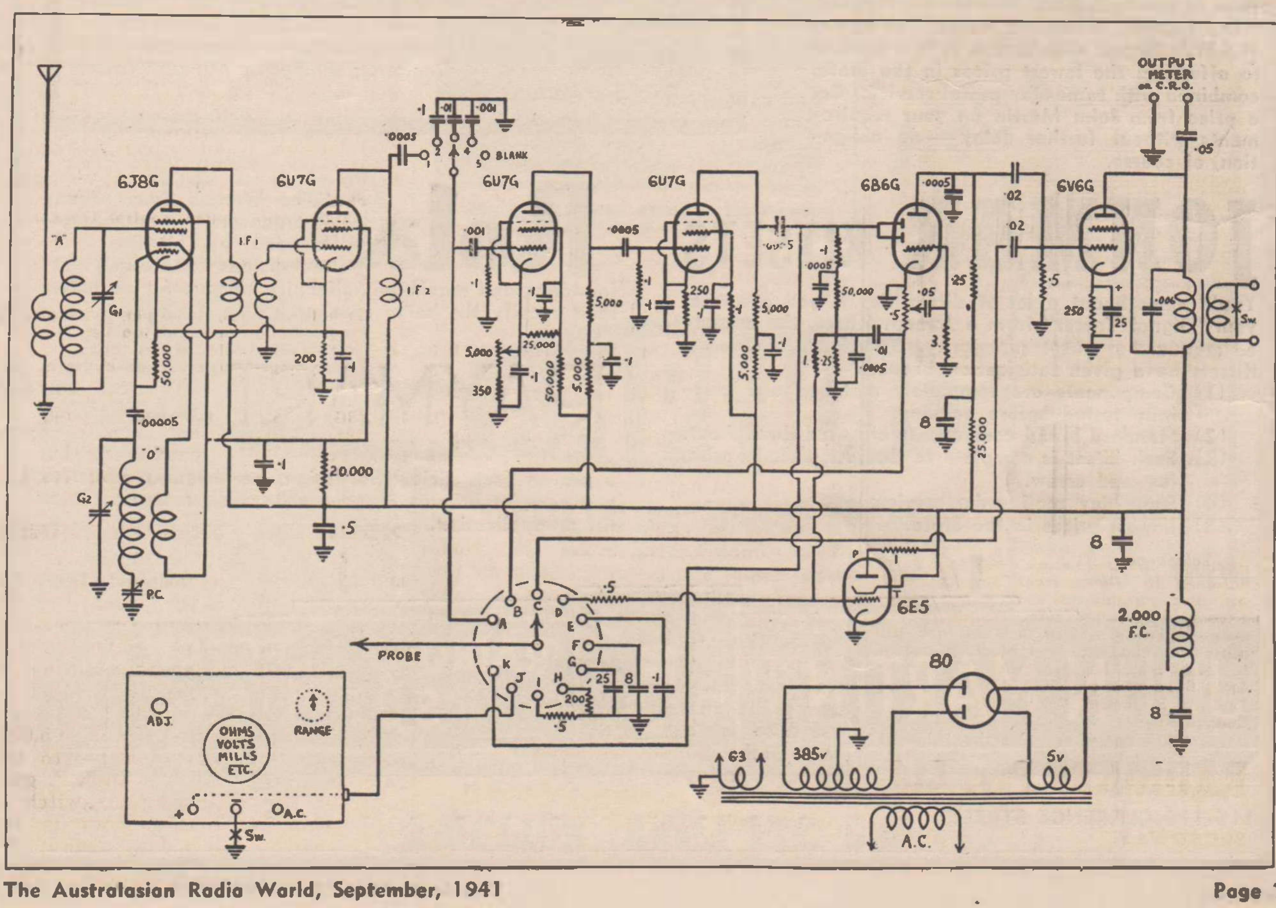
To Check the Detector and Audio Sections

Set the probe switch to position B. Place the probe on the grid of the detector, then on the plate of the detector. There should be a definite gain here. No signal, or very weak signal, at the plate of the detector usually denotes open circuit plate load resistor. From here move the probe to the grid of the output valve or driver. Distortion here usually means a short-circuited coupling condenser. Now move the probe to switch contact C. Place the probe on the grid of output valve and then to the plate. There should be a considerable amount of gain in volume here.

To Check for Noise, Hum or Motorboating in Power Supply or Audio Section

It is merely necessary to apply the probe on any part of the supply lines. Any filter condensers or H.T. chokes th^t are faulty can then be located in this way. If it appears to be an open circuit or dried-up condenser, move the probe to contact F, still holding the probe at the offending position. This contact introduces an extra filter condenser, the same as contacts H and I are merely resistors to be used in similar way. Cathode bias resistors and grid resistors may be checked with these two contacts. Open circuit or dried-up cathode condensers can be checked with contact G. Screen condensers, A.V.C. condensers, and most

Circuit diagram of the Signal Tracer.



SIGNAL TRACER (Continued)

other by-pass condensers can be checked with contact E.

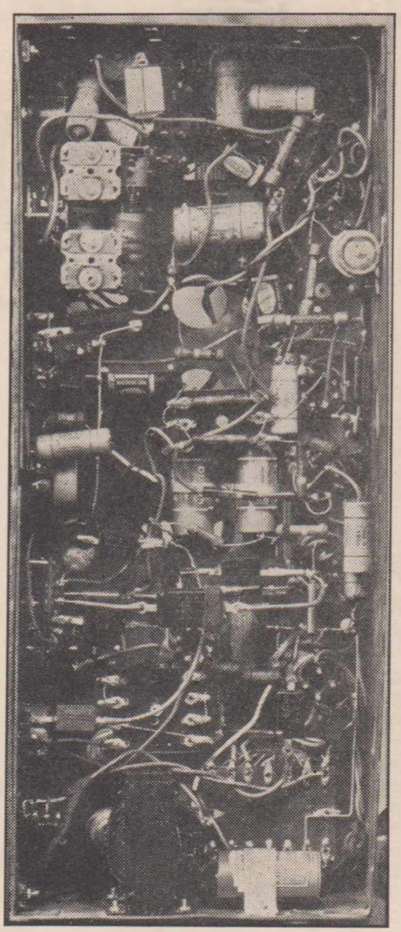
To Check the A.V.C. Circuit

Turn switch to Contact D and apply the probe anywhere on the A.V.C. line. Then, by rotating the dial of the receiver being tested, we can tell whether the A.V.C. is functioning or not. The A.V.C. voltage to each grid may be checked by watching the 6E5 in the tracer. It should perform as a normal magic eye. The 6E5 may also be used as an output indicator by applying the probe to the diodes of a receiver being aligned. The eye may be adjusted by the R.F. gain control. Maximum deflection indicates maximum signal in the 6E5.

Testing Oscillator Section

To see whether the valve is oscillating or not it is only necessary to apply the probe to the oscillator grid. If the eye of the 6E5 valve in the signal tracer closes, it is a definite indication that the oscillator is functioning; if it does not close, check the oscillator circuit and locate the cause. Also, by applying the probe to the oscillator grid of the converter or oscillator valve and rotating the tuning condenser, the efficiency of the oscillator circuit can be checked. If the eye closes, the oscillator is functioning O.K. and, by adjusting the signal tracer gain control to the point where the eye almost closes and turning the tuning dial across the whole band of the receiver, it can be noticed how efficiently the oscillator is working. Dead spots can thus be found, particularly on short waves.

Contact J connects the probe to the ohms, volts, mills, output meter, etc., which is built in as a separate unit. Probe can then be used for testing oltages on any part of the receiver.



A photograph of the wiring of the Signal Tracer.

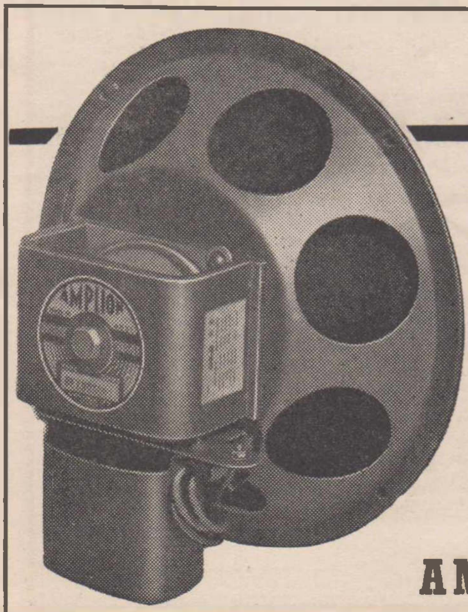
The negative lead from the meter should be connected to earth or used as required. No attempt is made to describe this volt-ohm-milliammeter as most servicemen are familiar with these instruments and how to build them. Also included is a V.T. voltmeter in conjunction with the volt ohmmeter using the same meter, although in the signal tracer itself there is a simple V.T. voltmeter in the 6E5 magic eye valve.

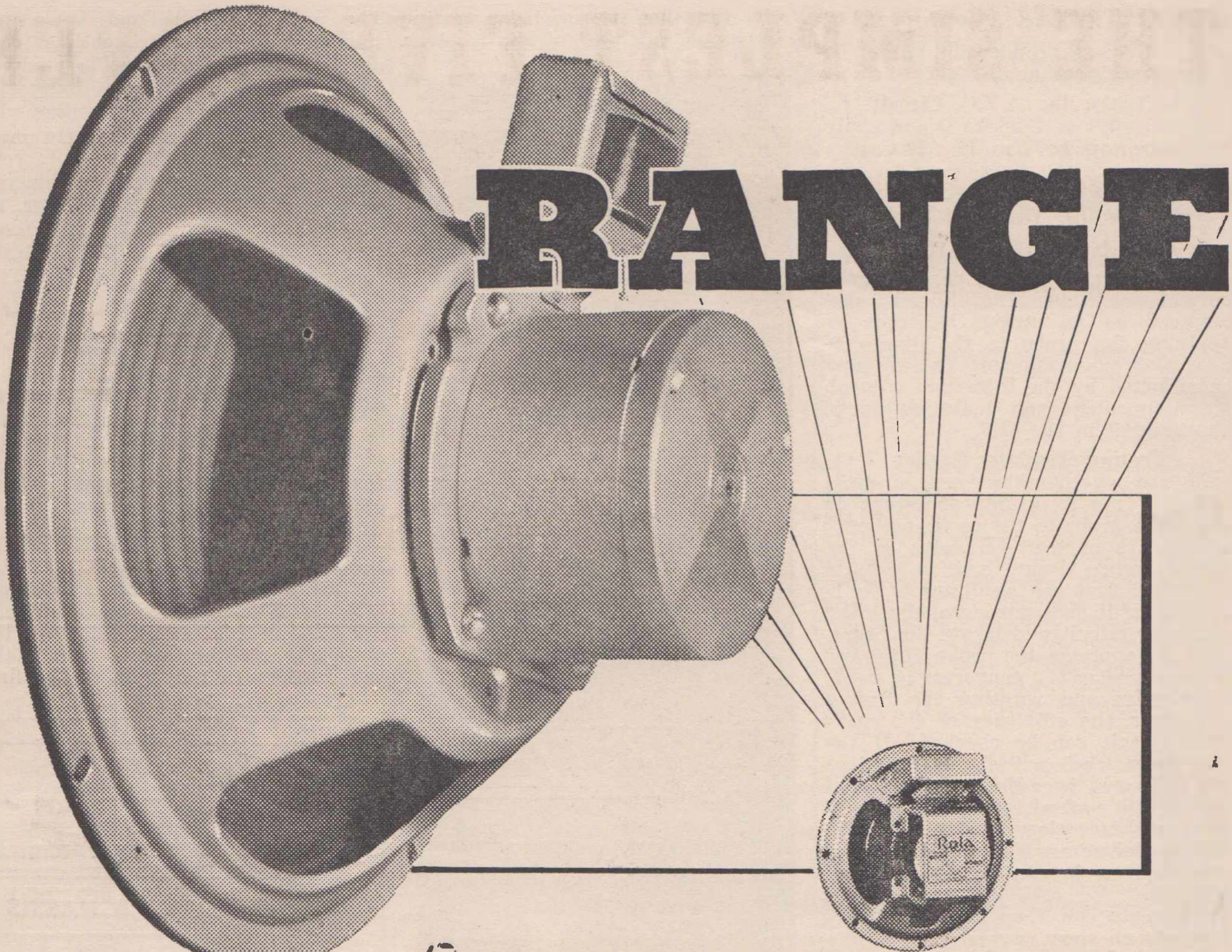
To operate the signal tracer as a radio, turn the attenuator switch to the radio contact.

If desired, this tracing system can be reversed. By this I mean instead of picking up the signal from the receiver being tested the signal is taken from the signal tracer, which is now operating as a radio receiver.

First switch off the speaker on the signal tracer. Turn switch to contact C, and there is available a satisfactory signal to apply to any audio circuit. Using this method, start at the plate of the output valve, then to the grid, and on to the plate of the first

(Continued on page 38)





FROM the High Fidelity G12.PM. above — a speaker weighing more than 22 lbs.— to the little K5, a mere handful of 18 ozs., Rola provides a complete range of the world's finest Loud Speakers.

G12.PM., the giant of all permanent magnet speakers, has a magnet which weighs 4½ lbs. (72 ozs.). This true High Fidelity speaker reproduces flawlessly from 50 to 7500 cycles, and is admirably suited to public address and home radio.

In size, K5 is the smallest of electro-dynamic speakers but it far out-performs many larger types. It is ideal for your PERSONAL radio.

ROLA

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LOUD SPEAKERS

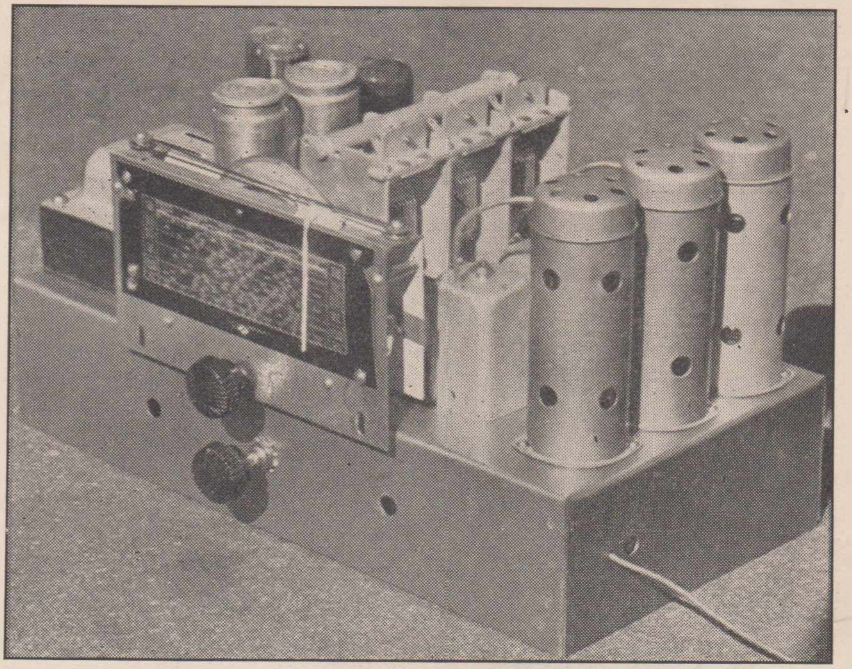
THE BEST SETS USE ROLA LOUD SPEAKERS

THE ROLA COMPANY (AUST.) PTY. LTD. THE BOULEVARD, RICHMOND, VICTORIA

THE SIMPLEST FIVE-VALVER

Designed to use the fewest components, this modern version of the old T.R.F. type of receiver offers remarkable value in performance.

★

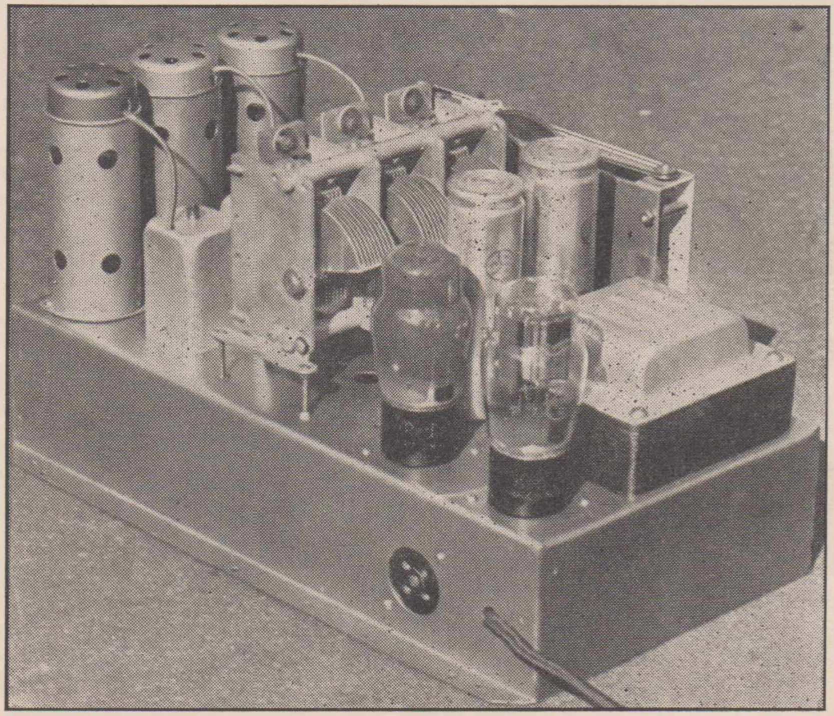


ABOVE: A front view of the completed chassis. BELOW: A rear view, showing the layout.

GOING back through the years of radio history we find that the most popular type of set in vogue from 1930 to 1933 was the design which used two stages of tuned radio frequency, a screen-grid detector and a pentode output valve.

Sets of this type gave reasonably good selectivity and sensitivity and were particularly reliable and trouble free in service. As the years went by they were forced off the market by the introduction of superhets, which, although capable of bringing in a greater number of stations, did not have anywhere near the same tone and general sweetness of operation.

Early superhets were often in disfavour on account of their hissing background and poor tone, but as these defects received attention, so the superhet won the battle.



But it should never be forgotten that the old t.r.f. sets had a charm of their own. It was brought back to us very strongly quite recently when we had occasion to service one of these old-timers. It had done eight years of running, day and night, and it was only a matter of replacing one of the electrolytic condensers and she was as good as new again. The performance was so surprisingly good in fact that the idea was born to try a similar design of set, but using the latest types of valves, the latest in high-efficiency coils and other components.

On completion this set proved to be a most attractive set in many ways, and so we offer a full description of the set and circuit for what it is worth.

Performance

It should be noted right from the outset that as regards selectivity and sensitivity this set will not hold its own with a modern superhet, but on the other hand it is capable of giving noticeably better tone than the average superhet, with quite a handy amount of general performance. Tested at Bondi, we found not the slightest difficulty in separating all the local stations and bringing in a be heard from the speaker of the set

SIMPLEST FIVE (Continued)

dozen of the interstate stations. The absence of acute selectivity makes the tuning knob much nicer to handle, and the stations seem to sneak into their places on the dial.

Looking over the finished set we find that the number of components used is remarkably small, and we have not the slightest hesitation in claiming it to be the simplest five-valve receiver that can be built.

The Circuit

The circuit design is based directly on a circuit which was extremely popular about nine years ago. In fact, a similar circuit was used by a small radio factory which started out in those days. Mainly on account of the trouble-free performance and the good tone of the sets which they made to this circuit they gained great popularity, and to-day their factory is one of the leading organisations in the radio trade. We had better not mention names.

SIMPLEST FIVE-VALVER — Parts List

1—Base, size 14" x 7" x 3" (Arcadian).
1—Power transformer (8 ma.).
3—Coils (Crown, Radiokes, R.C.S., Britannic).
1—3-gang tuning condenser (Stromberg-Carlson).
1—Dial to suit (Radiokes, R.C.S., Crown).

CONDENSERS:
1—25 mfd. 25v. electrolytic (T.C.C.).
2—8 mfd. 500v. electrolytics (T.C.C.).
3—.5 mfd. tubular paper condensers (T.C.C.).
1—.1 mfd. tubular paper condenser (T.C.C.).
1—.001 mfd. mica condenser (T.C.C.).

RESISTORS:
1—200 ohm wire-wound to carry 100 ma. (I.R.C.).
2—10,000 ohm 1-watt type (I.R.C.).
1—.1 megohm 1-watt (I.R.C.).
1—.25 meg. 1-watt (I.R.C.).
1—.5 meg. 1-watt (I.R.C.).
1—15,000 ohm potentiometer (R.C.S.).

VALVES:
1—6J7G, 2—6U7G, 1—6V6G, 1—5Y3G.
Sockets: 5—octal, 1—UX, 3—cans.

SPEAKER:
To suit 6V6G, with 2,000 ohm field (Rola, Amplion).

SUNDRIES:
Knobs, screws, hook-up wire, flex, solder lugs, dial lights, cap clips, etc.

The Components

The coils used are of the same type as designed for superhet operation, but of course the kit is made up differently, consisting of one aerial coil and two radio frequency transformers.

These coils are fairly closely coupled, compared to the coils used in the sets of years ago, giving much greater gain. This increased gain tends to make the set a trifle unstable unless fairly large by-pass condensers are used, and we found a tendency to a peculiar form of motor-boating when we first put the set together with conventional by-pass condensers of .1 mfd. capacity. Replacing with condensers of a slightly larger capacity, we found that the stability was obtained, without impairing the gain.

Assembly

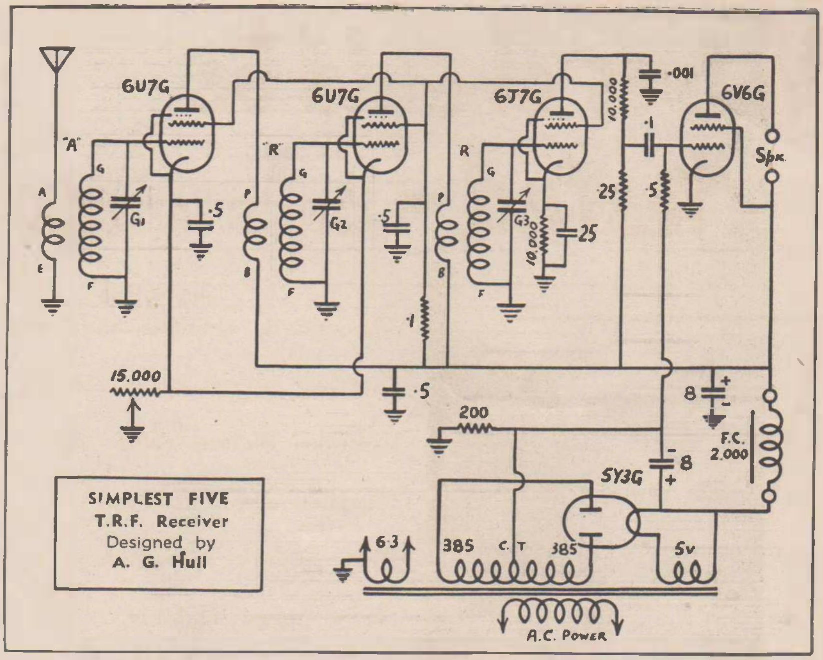
Generally speaking, the construction of this set is also in keeping with the title of "Simplest," but there is one point worth noting. This is in regard to the mounting of the first electrolytic condenser. Owing to the use of back biassing for the output valve, it becomes necessary for the negative side of this condenser, which is the can, to be insulated from earth. This is arranged by using the insulating washers which will be supplied free of charge with the condenser on request. With some kinds of condensers there are two leads coming from the condenser, one black and the other red. With condensers of this type the matter of insulating is simple, as the black lead is the negative.

Wiring

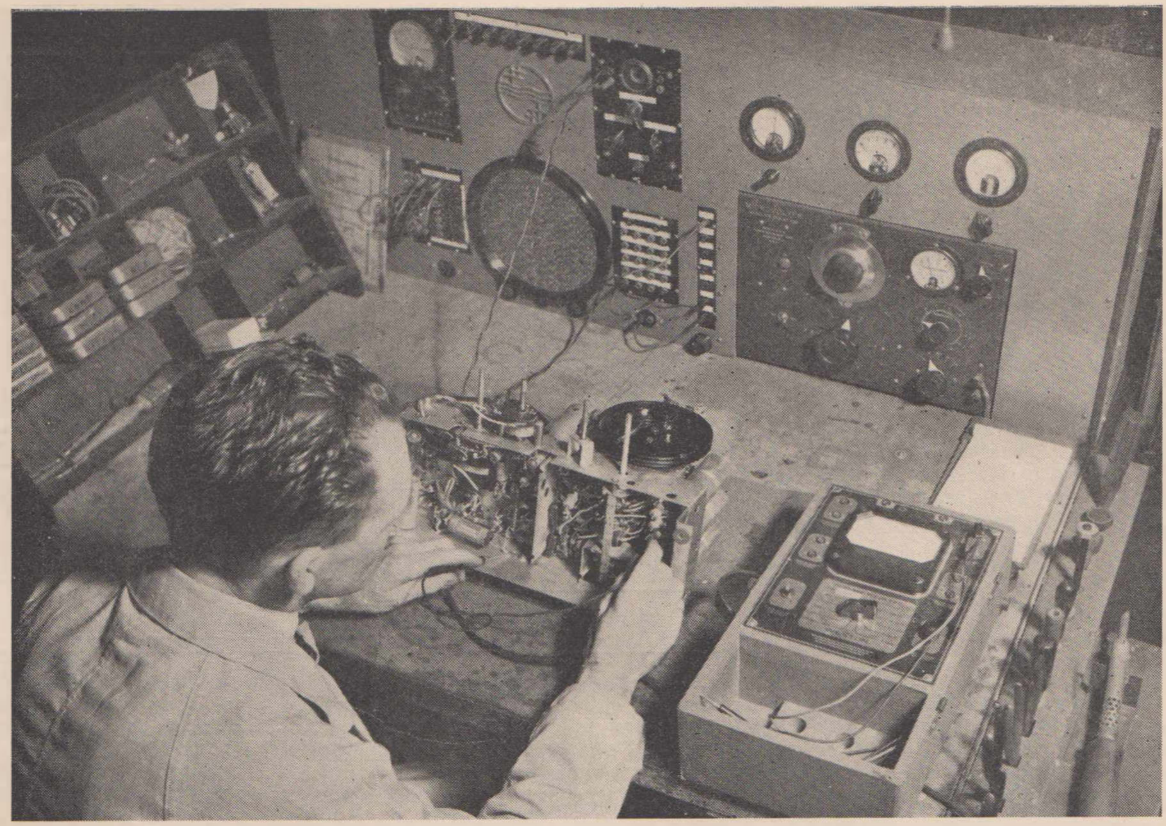
Having assembled the main components on to the base, the first step in the wiring is to connect up the heaters to the 6.3-volt winding. All the valves, except the rectifier, of course, can be wired to the one 6.3-volt supply, one side of the wiring being earthed at the socket of the first r.f. valve, or at one of the valve sockets up at that end of the set.

The filaments of the rectifier are wired to the 5-volt supply, and care is taken to note that the same side is used to connect up to the first electrolytic condenser as is used to connect up the high tension supply to the speaker field socket pin.

All the main wiring can be done by



SIMPLEST FIVE
T.R.F. Receiver
Designed by
A. G. Hull



SIMPLEST FIVE (Continued)

paying attention to the picture diagram which shows it all in detail.

Alignment

Unlike the superhet, the alignment procedure of a tuned radio frequency type of receiver is remarkably simple, and consists merely of tuning in a station about the middle of the dial and setting the gang trimmer screws to give maximum volume for any given setting of the volume control. During the process the volume control should be retarded to keep the volume level at a whisper as it is easier to detect changes in volume level when it is at low strength.

Actually this does not give us perfect alignment at all settings of the dial, and in cases it may be found worthwhile to fit a small midget condenser across the aerial tuning section, so that it can be adjusted as part of the tuning-in process. This will then allow the loading effect of the aerial to be compensated by manual trimming. With a fairly short aerial, however, the loading effect is not considerable, and the general broadness of the set's tuning makes it hardly noticeable.

Inverse Feedback

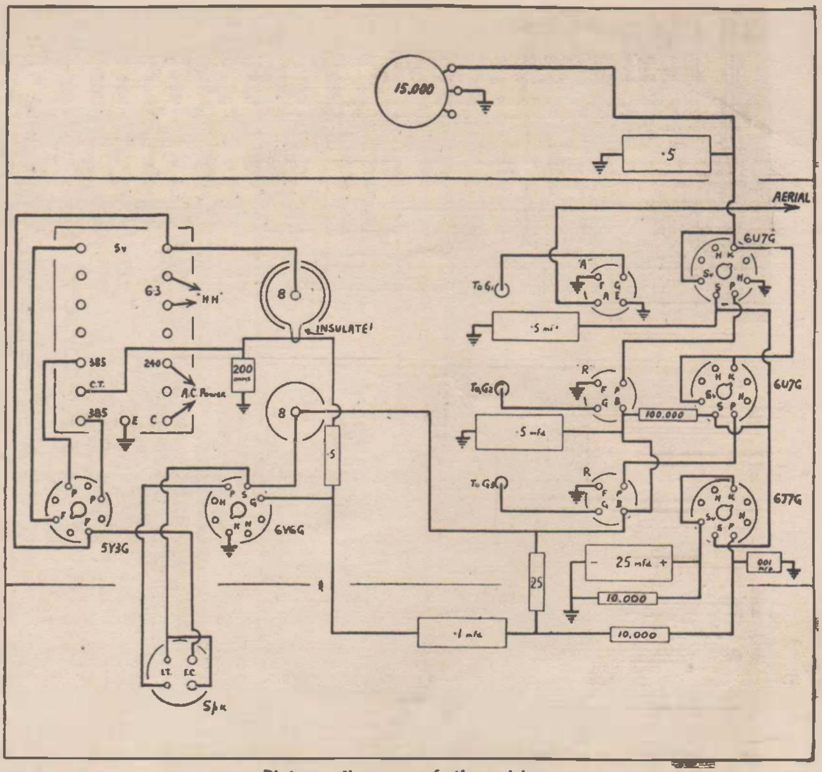
No inverse feedback is shown in our design and the tone is quite good without it in this particular rig. Those who desire to incorporate feedback, however, can do so quite easily by running a 1-megohm resistor from the plate of the output valve 6V6G to the plate of the detector valve 6J7G. This provides a simple form of inverse feedback which is quite effective.

The Volume Control

One of the minor difficulties with all t.r.f. sets is the matter of obtaining effective volume control. It is not easy to arrange automatic volume control on the r.f. end of the set and use a manual control on the audio end, as is standard practice with modern superhets.

The manual control on the r.f. end is O.K. as far as it goes, but not in one or two difficult locations, where trouble may be experienced in stopping the power from a nearby transmitter. This is especially noticeable when a large outdoor aerial is used.

In our circuit we use a simple series resistor for the screen feed and a 15,000 ohm wire-wound potentiometer to operate as a volume control by varying the bias on the r.f. valves. This is reasonably effective for all normal uses, and is the simplest arrangement. In cases where trouble is experienced it may be found desirable to feed the screens from a voltage divider formed by running two 25,000 ohm resistors in series from the high tension to the cathodes, taking the screen current from the junction of these two resistors. This arrangement, although a little more complicated, provides a bleed current for the volume control potentiometer, thereby making it more effective in action.

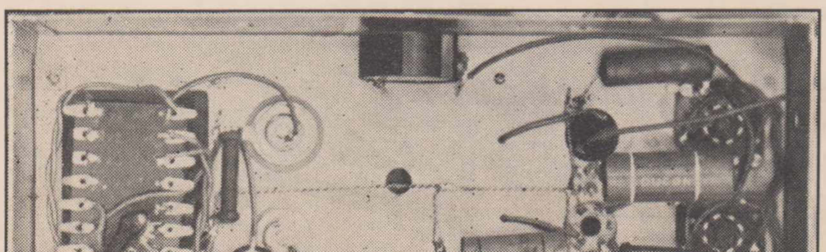


Picture diagram of the wiring.

Designed and described by A. G. HULL

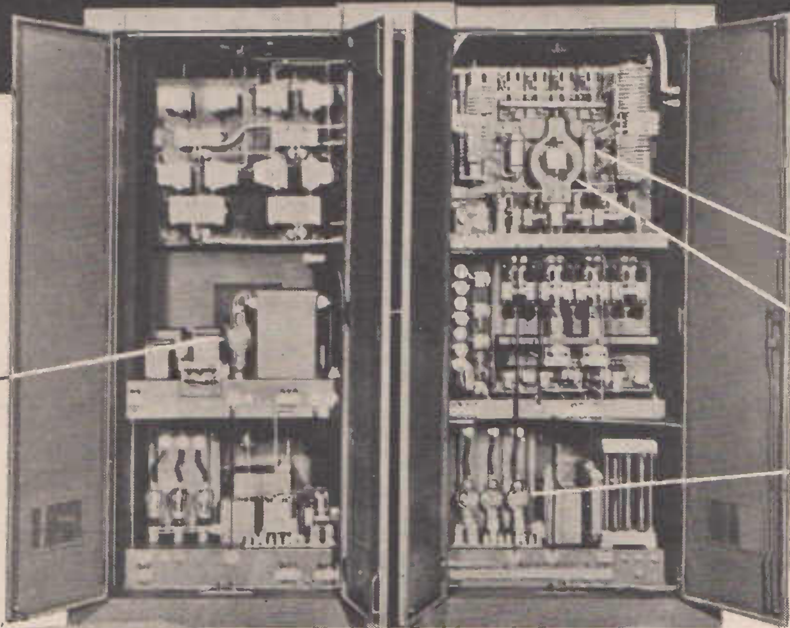
Tone Control

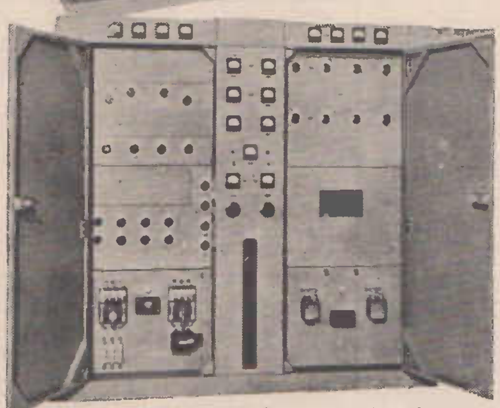
Due to the wide band of frequencies passed by the comparatively broad tuning circuits the tone of the t.r.f. set tends to appear a little high-pitched, especially after the ear has become accustomed to the tone of ordinary commercial receivers. To some people this improved high note response will be welcomed as giving improved realism and making speech much clearer and easier to follow. On the other hand there may be those who will prefer to tone it down a bit. This is easily accomplished by fitting a .01 mfd. condenser across the speaker terminals. If this is a little too severe, a capacity of .005 mfd. may be found to be more to taste.



Photograph of the wiring.

EIMAC EQUIPPED BRAZILIAN ARMY STATION





Photos from top to bottom show a rear view of transmitter, the remote control and a front view of the transmitter constructed by Maya Rebello & Comp. of Rio de Janeiro for the Brazilian army

With a single 750T in the final stage and a pair of 250T's as modulators this station puts 1200 watts on the antenna. Operated by remote control on four frequencies using phone, CW and ICW.

The transmitter was constructed by Maya Rebello & Comp. of Rio de Janeiro and employs Eimac RX 21 rectifier tubes as well as Eimac vacuum tank condensers in the final circuit. The design and construction does credit to its makers and the use of Eimac Tubes in the most important sockets is convincing evidence of their superiority and position in the world of radio.

Follow the Leaders to **Eimac TUBES**

• Export Agents:

FRAZAR & CO., LTD.
301 Clay St., San Francisco, California, U.S.A. • Cable "Frazar"

Export Agents: Frazar & Co., Ltd., 301 Clay Street, San Francisco, California, U. S. A.

WHAT S.W. LISTENERS ASK THE B.B.C.

By every overseas mail the B.B.C. Engineering Division receives requests for information and advice from listeners to the British short-wave broadcasts. In this article, specially prepared for the use of the overseas Press, the Engineering Division answers some of the questions most commonly asked.

What is the difference between frequency and wavelength?

Wireless waves have frequently been compared with the waves set up in a pond when a stone is thrown into it. If the listener imagines he is stationed somewhere in the pond these waves will pass him with a certain regularity. This regularity is determined first by the speed with which the waves travel outwards and, secondly, on the separation between the successive wave crests.

So it is with wireless waves. They occur in the abstract substance known as the ether, which permeates solid objects as well as the atmosphere, and travel outwards from the transmitting station just as do the waves in the pond. The speed with which they travel is the same as the speed of light—186,000 miles a second.

It will be seen, then, that there is a fixed relationship between the frequency of the waves—that is, the number of wave crests passing a fixed point every second—and the wavelength—that is, the distance between the wave crests. The frequency of short-waves is usually referred to in units of a million cycles per second, expressed "Mc/s," and the wavelength is usually measured in metres. The wavelength in metres is equal to the figure 300 divided by the frequency in Mc/s. Thus a wavelength of 30 metres is equivalent to a frequency of 10 Mc/s. It is immaterial, therefore, whether a transmission is referred to in metres or Mc/s, since they both mean the same thing.

Why are the wavelengths used in the overseas transmissions constantly altered?

No doubt at some time or other every overseas listener to B.B.C. programmes has wondered why the transmissions he receives are sometimes on one wavelength and sometimes on another. For example, a listener in South Africa, according to the B.B.C.'s current schedule, will receive a service on the 31m. band between 0457 and 0700 G.M.T., on the 19m. band between 0630 and 1000, on the 13m. band between 1055 and 1330, and on the 16m. band between 1345 and 1630, and so on. Surely, it is argued, it would be much more convenient if one of these bands were chosen to cover the whole period?

Probably every questioner realises that long-distance transmission is made possible only by the reflection of the waves in a region of the upper atmosphere known as the ionosphere. Unfortunately, however, the ionosphere is not very accommodating in the manner in which it deals with the waves. At some times of the day it will allow certain waves to pass right through it, while at other times these very same waves will be so badly absorbed that they will never reach their destination. Therefore, there is a certain optimum wavelength that can be used at any time. This optimum wavelength varies in a most complex manner, being much lower, for example, at night than it is in the day, altering with the seasons of the year, and generally reacting to various other conditions.

Hence, if the B.B.C. were to transmit their programmes on one wavelength, only at certain times of the day could they be received at any one place. By altering the wavelength as the day advances, there is a much greater chance of maintaining a reliable service.

How does the broadcaster know when to change his wavelength?

As has been explained, the optimum wavelength depends on conditions in the ionosphere. It also depends on the distance that the receiver is from the transmitter — so the waves may reach the receiver in a single "hop," that is, after being reflected by the ionosphere only once or they may go round the world in a series of "hops," that is, with successive reflections from the ionosphere to the earth and back again.

As the result of recent investigations of the ionosphere, it is now known with some accuracy what the state of the ionosphere is at various times of the day in various seasons of the year and at various latitudes. In general, where there is sunlight, the ionosphere is capable of reflecting shorter waves than where there is darkness. By knowing where we want to direct our transmissions, therefore, and by determining the number of "hops" required to get there, we can fix the places where the waves will be reflected from the ionosphere. By consulting various graphs, we can then obtain a very good idea of what the optimum wavelength will be.

This optimum wavelength is only a guess at what the average should be, and on some days will give better transmission conditions than on others. These variations are caused by random effects that cannot be predicted as yet, and so there are occasions when the B.B.C. transmissions are imperfectly received. It is hoped that as our knowledge of the behaviour increases, the frequency of the "bad days" will get less and less.

Why not increase power to give a better service?

Theoretically, of course, there is no reason why the power of a transmitter should not be put up indefinitely, but it will be remembered that, in order to double the signal the listener receives, it is necessary to increase the power at the transmitter four times. Such a power-increase makes little difference in the cost of operating the transmitting station when the total power is small, but increases it a great deal when the region of high powers is reached. Which, incidentally, explains why this method of increasing the signal strength at the receiver is sometimes referred to as "gilt-edged."

A much cheaper method of giving a good signal at a particular place is to design the transmitter's signal so that the available energy can be directed in the best direction. This, of course, gives an increase of signal in one place at the expense of the signal at another, but it is usually found that this causes little difficulty owing to the fact that one area will require a programme either at a different time or in a different language, or on a different wavelength in any event. The listener himself can achieve quite a considerable improvement by putting up a similar — though necessarily simpler — aerial, which will receive best from the direction in which the transmitter lies. Information on this subject is contained in a booklet entitled "Receiving the B.B.C. Overseas Services" available from the B.B.C.

How are the directions for transmission chosen?

The problem of choosing the direction for the shortest route between two places in the world is not so simple as it might appear. If the reader considers a map of the world of the familiar type — that is, Mercator's Projection — and makes a casual estimate of the shortest path between London and, say, North Island, New New Zealand, he will probably conclude that the path would go over Arabia, India and Australia. Actually, however, the shortest path goes from London over Norway and nearly over the North Pole!

A special map has been prepared that shows the direction of this shortest path — or, as it is called, Great Circle Path — from London to anywhere in the world. The map takes the form of a circle centred upon London, the circumference of the circle really representing the Antipodes. A straight line drawn on this map is then the Great Circle route and the route which the wireless waves will take, and it gives at once the bearing from north on which the aerial must be erected.

The aerials actually used for the B.B.C. Overseas Service are designed to transmit over a fairly wide beam so that the area covered is not too restricted, while at the same time giving an improvement over an omnidirectional aerial in the matter of signal strength. The centre line of the beam is chosen to fall on any important areas lying in the area concerned.

Why are the Empire programmes not continuous?

The reason for the gaps that divide the four transmission-periods in the B.B.C. Empire Service is to enable the engineers to adjust the transmitters and other apparatus to the various wavelengths which are required to take the service to the various parts of the globe. In a wireless set a change of wavelength is achieved merely by turning a switch or adjusting a knob, but in a short-wave transmitter, where much power is being handled, such simple switching devices are quite out of the question — the various functions must be carried out separately, and may involve quite considerable manual labour. As an example, a simple tuned-circuit in a wireless receiver may occupy a space about the size of a jam jar, whereas in a transmitter the same circuit would have to be housed on a truck about the size of a bath chair.

Not only must the circuits in the transmitter be altered every time the wavelength is changed, but the aerials themselves must be switched over. This often involves switching processes some distance from the transmitter itself — as much as a quarter of a mile perhaps — and the engineer on duty must travel this distance to perform the operation. In addition, switching arrangements and marshalling of artists and so on must take place at the programme source, and the co-ordinating of all these functions makes short breaks in the programme inevitable.

Why does the wavelength wander?

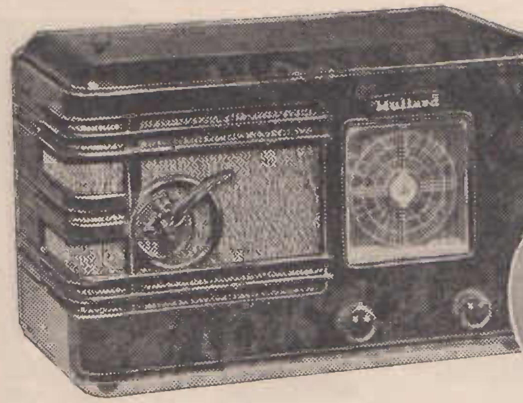
Sometimes listeners tell the B.B.C. that a wavelength on which its overseas transmitters are working is apt to wander. They say that when the set has been accurately tuned, the wanted station fades out and a neighbouring station comes in.

The accuracy of the observation is not challenged, but its cause is certainly not the fault of the transmitter. The signal a listener tunes in is the result of the combination of the waves received from the distant transmitter and similar waves generated in his own receiver.

Mullard MANTEL R

42.. "HAS AMAZING PUNCH"

Says A. E. READ, B.Sc., in a test report on the Mullardette Model 42 4-valve A.C. Broadcast midget mantel shown below. He writes: **". . . to pack a 4-valve receiver into a tiny bakelite cabinet measuring only 10" x 6½" x 5" is in itself a fine achievement. But it becomes nothing short of remarkable when the resulting receiver has the amazing punch and good tone given by the 42 . . ."**

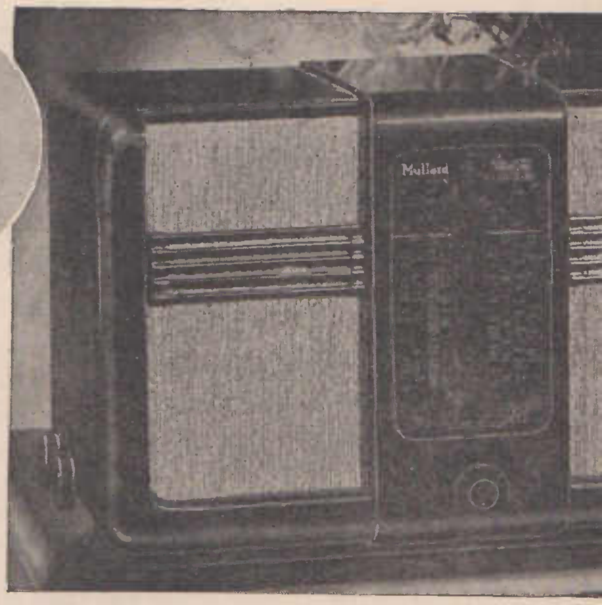


Inset left: A. E. READ, B.Sc., whose test reports on the Mullard Mantel Models 42 and 63 are quoted below, was Editor for three years of the "N.Z. Radio Times" and other technical publications (1933-36), then Managing Editor of "The Australasian Radio World" for four years.

Inset ports quote Edito and Austr

63..."A MAGNIFICENT PERFORMER"

Says Mull Wave Receiver illustrated below. He writes: **"Both excellent, while tone is particularly good . . . can be to anyone wanting the best possible radio value for**



MULLARD PRICE LIST

MANTEL AND TABLE MODELS

42—4V. A.C. Broadcast (Walnut)	£12	19	6
(Extra for Ivory or Green)	1	1	6
61—5V. Dual-wave	22	19	6
63—5V. A.C. Dual-wave	19	13	0
64—5V. A.C./D.C. Dual-wave	24	1	0
65—4V. A.C. Dual-wave	17	19	6
66—4V. Battery Dual-wave	25	17	6
66—4V. Vibrator Dual-wave	31	3	0
67—5V. Battery Dual-wave	32	10	0
67—5V. Vibrator Dual-wave	37	15	6

(Subject to alteration without notice)

CONSOLE MODELS ALSO AVAILABLE

Mullard

RADIO AND RADIO VALVES

"For the Empire's Millions"

MULLARD-AUSTRALIA PTY. LTD., 367-371 Kent Street, Sydney.

65.."MORE STATIONS P OUTLAY"

Says A. 65 4-valve illustrated above. He writes: **"Once over the di opinion that this little set has the most remarkab stations with ease. On the broadcast band, the gener and man-made static was the only limitation to d the weaker overseas stations came through with a classed as uncanny. . . . This Mullard job can ha receiver using an extra valve. . . . The nett result is stations per pound outlay than any other receive these columns."**

(NOTE: Other Mullard Models available in the cabinet Model 66 — 4-valve dual-waver for both 2-volt battery oper

RADIOS

Acclaimed by leading radio experts

nset right: A. G. HULL, whose test re-
orts on the Mullard models 65 and 67 are
uoted below, was for ten years Technical
ditor and Editor of "Wireless Weekly"
nd is at present the publisher of "The
ustralasian Radio World."

T ALL-ROUND

. E. READ, B.Sc., regarding the
d Model 63 a.c. 5-valve Dual-
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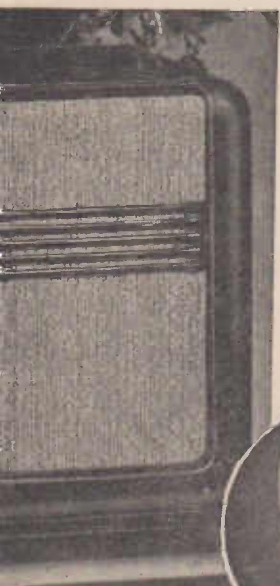
be recommended without reserve
or their money."



PER POUND

. HULL of the Mullard Model
e a.c. Dual-wave table model
was enough to confirm the
e knack of bringing in distant
eneral noise level of atmospherics
distance. On the short-waves
a clarity which could only be
hold its own with the average
t is a receiver which gives more
iver we have ever reviewed in

inet illustrated above comprise the
operation and 6-volt vibrator power.)

61..."AN EXCEPTIONALLY FINE RECEIVER"

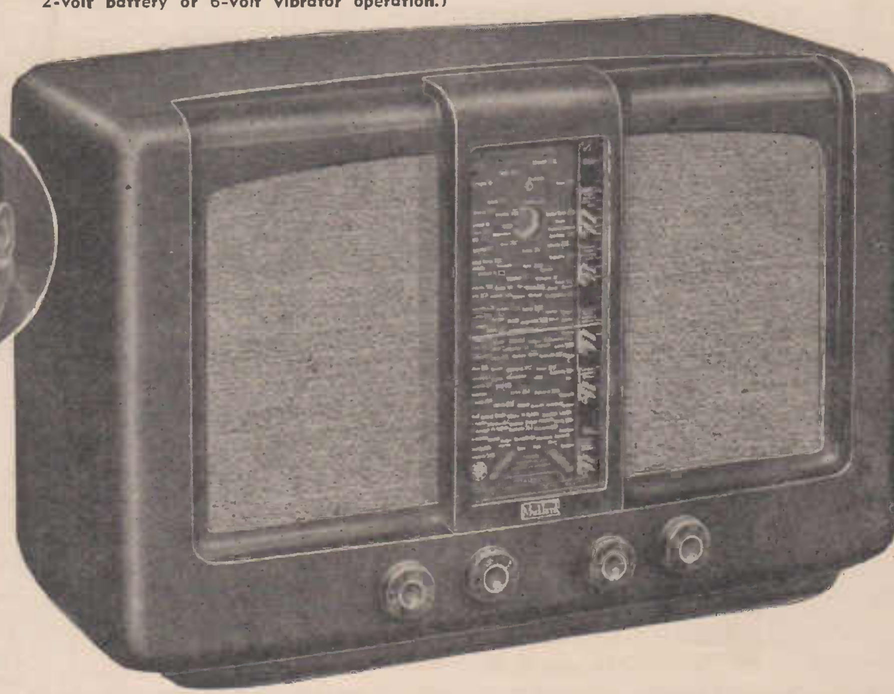
Says ALAN H. GRAHAM, for years Short-wave Editor of "Radio World," and a leading Australian authority on short-wave reception. He writes: **"During a period of approximately one month one of the latest Mullard receivers — the CONSOLETTE Model 61 — has been subjected to a series of exhaustive tests on both short-wave and broadcast bands, and at the end of this period the writer has not the slightest hesitation in recommending the Mullard 61 as an exceptionally fine receiver — thoroughly efficient from the point of view of DX, of handsome appearance and possessing tonal qualities not often found in table model receivers.**

"In all tests on the short-waves, the Mullard 61 proved outstandingly satisfactory in sensitivity and selectivity on all bands .. . . On the broadcast band, the Mullard 61 more than measures up to any dual-wave receiver we have heard, giving remarkable reception results. Practically all the Australian and New Zealand stations were logged nightly, and in addition numerous overseas stations in the East and in Europe."

67..."ONE IN A MILLION"

Says A. G. HULL, referring to the Mullard 5-valve Dual-wave de luxe table model type 67 (for battery and vibrator operation). He writes: **"The Mullard model 67 is a battery set in a million. It gives extreme sensitivity and selectivity, yet is not at all extravagant, either in initial cost or upkeep."**

(NOTE: Other Mullard model available in the de luxe cabinet shown below is the Model 64 5-valve Dual-wave a.c./d.c. Receiver. Also the 67 reviewed above is available both for 2-volt battery or 6-volt vibrator operation.)



Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY

I am very grateful to all those who sent me telegrams, letters and 'phone messages re **XCDN** or **XVDM**. Pressure of work, combined with three days in bed with laryngitis — to cap all — a move into another flat, have made it impossible for me to answer all letters.

It is pleasing that so many are on the alert and notice quickly a new station, but what appeals to me most is the desire to make their discovery known. This is the co-operative spirit these pages have always fostered.

Don't forget the station will be pleased to receive your report. They are most anxious to know how far and in what direction their signals are going and the strength at which they are heard. If you want a verification, get in early, as often when a station becomes established (instant reports having assisted them in making necessary adjustments), further reports are not so eagerly awaited, and verifications can only be expected after a fairly long period and then in most instances only if you have taken the precaution of enclosing an Empire or International Reply Coupon. (Further reference to XCDN will be found under "New Stations").

Well, it looks as though we can now feel reasonably sure that the 19-metre band will behave from now onwards of an evening and also the 16 shortly. At my location 31 metres are getting very wobbly in the forenoon, 25 being fairly reliable, while some of the 19 laddies are good.

Heard the male announcer from **Radio Saigon** (25.47m) the other night say, "I am afraid there will not be much news to-night, not that there is no news from the world, but —— is absent, and I will have to read the news, and I must ask you to pardon my poor English." He, however, made a jolly good job of it.

KGEI, 'Frisco, 31.02m, gives extracts from "Time" magazine from 12.30 a.m. to 1 a.m. on Saturdays. But if you find this hour inconvenient, one of the Sydney Sunday papers may oblige.

One of the surprises of the week was the fine signal from **FFZ**, Shanghai, particularly round about 10 o'clock.

Another note I see is that **WNBI**, 25.23m, with plenty of foreign announcements, was going great guns at 9.30 a.m.

WRUW, 11,730kc, 25.58m, is putting in a good signal at 8 a.m., but on 6040kc, 49.65m, is not so good.

"The Broadcaster," Perth, quotes a new Chinese station on the top end of the 25-metre band — **XOGY**, which is not to be confused with **XGOY**. Using mostly Chinese, they give call-sign in English when closing at 12.30 a.m.

On Sunday, August 24, found **RW-96**, 19.76m, giving a good talk at 9 a.m. At conclusion of talk, excerpts from **Moscow** newspapers were given at 9.15.

Here is a list of wave-lengths given out by **Radio Frunze**, Khabarovsk, the other night: 19.43, 19.47, 19.76, 19.78, 20.11, 22.71, 24.61, 31.36, 31.43, 31.51, 31.82, 40.65, 60.93, 67.31, 70.20.

The French station on 25.35m which we once knew as **TPC-2** is now heard announcing as **Radio National**, Vichy, France, while at other times "Ici la voix de la France." Best time is between 2.15 and 5.15 p.m.

Another station heard in the afternoons, between 3 and 4 p.m., is **CR7BD**, Lourenco Marques. Man talks in Portuguese, while a woman gives News in English at 3.45.

Russian Heard Every Night

Moscow, evidently tired of the interference on 25 metres, does not seem to use this frequency as often as previously. Khabarovsk transmitter can be heard every night on 24.61m with a very good signal.

CBFY, Montreal, 25.63m, can be heard well from 9.30 p.m. Excellent news service at 10. Those of us who moan at the petrol restrictions will be consoled when they hear Canadians requested to "Conserve petrol. Help the man in the air."

Listeners doubtless noticed London reverted to ordinary Summer time on Sunday, August 10, making us now nine hours ahead.

The Jap on 25.55m opening at 11 p.m. gives a good news session at 11.25. Doubtless the B.B.C. get a kick out of hearing "That concludes the news from Radio Tokyo. Your readers were ——, ——. We would ask you to listen to the rest of the programme. Here is 'In a Little Gypsy Garden,' played by Russ Morgan and his orchestra."

My old friend the French on 30.77m, whom we have labelled Radio Unconnu, is heard of an afternoon between 4 and 4.45 and calls himself **Radio Antoine**.

Herewith is a translation of a morning talk taken from "The Broadcaster," Perth: "Everywhere the Knights of the Broom are active. Everywhere we have little groups and everywhere little gatherings collect to listen to us. Darlan no longer goes out

---

ALL-WAVE ALL-WORLD DX CLUB

Application for Membership

The Secretary,
All-Wave All-World DX Club,
117 Reservoir Street, Sydney, N.S.W.
Dear Sir,

I am very interested in dxing, and am keen to join your Club.

Name ....

Address ....
(Please print both plainly) ....
....

My set is a ....

I enclose herewith the Life Membership fee of 3/6 (Postal Notes or Money Order), for which I will receive, post free, a Club Badge and a Membership Certificate showing my Official Club Number.

(Signed) ....

(Readers who do not want to mutilate their copies can write out the details required.)

except in a reinforced steel car. He is wise. On railways the rails are unbolted and sleepers placed across the track. Trains are held up for several days. At level crossings lights disappear.

"Boche cars in garage for minor repairs are run over by mysterious hands that do mysterious things. Water is drained from radiators. The honeycomb of the radiator is given a small fracture which increases with the water pressure, and then the cylinders seize. Another little trick is to doctor the petrol.

"Go ahead, tickle up the Boche communications and transport. Let each one of us be a little grain of sand to hold up the Boche machine. Go ahead, mechanics, and you railway workers, and do even better and hold up transport for days. Let our brooms sweep clean!"

Mr. Arthur Cushen, Invercargill, N.Z., sends a nice lot of notes, and inter-alia, says: "Have received verification from Radio Brazzaville for report sent last November. (This is good news, and augers well for the Australians who sent reports.—Ed.) Have a card from YDH-4, 3.32mc, 90.36m, saying they are off the air. Radio Pacifique, 46.30m, say they will only broadcast on special occasions, but have a broadcast outlet on 590kc, with a power of 1 kilowatt.

"My mystery station on 11.54mc is still excellent, closing at 10.14 a.m. after news session. Closes with march."

Mr. Sam Nelson, of Cairns, says he heard KZRM, Manila, on 30.3m one night. (Perhaps they are trying to find a new channel, as sandwiched in between the two Khabarovsk stations, I guess a great number find it hard to bring KZRM in clearly.—Ed.)

Mr. Nelson is hearing ZHP-1, Singapore, on 32.92m, with an R8 signal in their "early morning session" at 9.45.

Another heard in North Queensland is XPSA, 35.36m, at R8 when giving Chinese programme around 7 a.m.

Mr. Nelson asks can we identify a European on approximately 30.5m, closing at 10 p.m. (Can't say, but a rough guess would be IRF, Rome, 9835kc, 30.52m.—Ed.)

Mr. Nelson concludes with something to make us envious. He refers to a broadcast station, KFBK, on 1530kc, with a power of 10,000 watts. At 5.45 p.m. at good strength he hears news just before they close. (KFBK is in Sacramento, California.—Ed.)

Received a long and informative letter from Mr. Allan Beattie just after Loggings had been printed. Here are some of his comments:

"WLWO is now using 25.63m till 3 p.m. and reaches good strength by closing time. WRCA, on 31.02m, has improved somewhat, but I cannot hear WNBI (25.23m), which was previously much louder. Morning signals are improving somewhat. The Berlin transmitter, DXC-2 puts in a good signal, as does MTCY (19.58), 2RO-3, GSF and most of the others. WRUW (25.58m) is quite good in the mornings and is the best of the WRUL/W stations.

"XCDM, or is it XCDN (25.51m) gives the loudest signals and most enjoyable programmes of the Shanghai stations."

Mr. Roy Hallett, Enfield, sends some useful notes too late for classification:

"XGOK, Canton, 25.75m, after giving news at 10 p.m., announced they give news in English also at 1 p.m., 3.50 and 10 p.m.

"The Vichy station, 25.33m, is heard well every afternoon from 4 to 4.30, but I have not heard any English.

"Have received a report from Stockholm, together with some fine photographs of Sweden. This is in reply to a report sent to the Swedish-American News Exchange, 630 Fifth Avenue, New York.

"MTCY, Hsinking, is now using 25.48m, opening at 11 p.m. (They use 15.38mc, 19.58m, now at 7 a.m.—Ed.)

"WNBI opens on 25.23m at 11 p.m. with great signal." (In this I concur.—Ed.)

Mr. Hallett refers to WRUL and the "Dit and Dah" session, but says 2YC, Wellington, N.Z., on 840kc, give a much better lesson. (Mr. Cushen, take a bow.—Ed.)

Mr. E. Miles Samuel, of Wellington, sends particulars of French station on 25.33m. He says: "Radio Difusion Nationale, Vichy, France, on about 11.84 mc, QSA-5, R7, at 3.30 p.m. Opens at 3.30 and closes at 4.14 p.m. Opens with news, followed by talks, songs and musical items destined for French people in Africa. Also announces as 'La voix de France.' Reports to be addressed to Radio Difusion Nationale, Vichy, France."

And some last-minute notes from Dr. Gaden, Wallumbilla:

"CBFY, 11,705kc, 25.63m, relaying CBM. Excellent most nights at 9.30. 2RO-4, 11,840kc, 25.40m, and DXC-2, 11,740kc, 25.55m, the best of the morning stations, at 6.45, with GSD next. Some nights I am hearing DJH and DJE at 7.45 and DJR and DJQ by 9 p.m. DJP, 25.31m, is or would be good if that swirling noise were only absent.

"GSV in its weekly service to China in Cantonese was excellent last Wednesday and is often O.K. in French at 8.45 p.m. GSV at 9 p.m. is at times A1 and full speaker strength. (At Randwick is still erratic.—Ed.). GSF at 9 p.m. not as good as V usually. (Here, it is improving rapidly.—Ed.). GSD on August 25 at 9 p.m. was best of the Daventrys. Looks as though Summer is on us.

"Found an extra Chow or Jap between JVW-3 and CBFY last night. (This may be XOGY mentioned elsewhere. I have heard them weakly for a few nights, but cannot identify.—Ed.)

"DZD, 28.45m, is splendid at lunchtime. DZC, 29.25m, is in good form at this time, but gives no English. The Americans are going off a lot. After breakfast WNBI (25.23m) easily the best, while WRUL/W next, but not up to form. KGEI, 19.57, not much good till after 1 p.m."

And here are some observations of my own made just before rushing to catch printer:

American news commentators can be heard at 10 p.m. through RW-96, 19.76m, at excellent strength.

There is another Russian being heard at midnight on 31.17m, and in the afternoons they can be noticed giving talks and news in foreign languages. (This is the one reported by Mr. Muller last June; used to be on every morning at 7.)

(Continued on page 28)

NEW STATIONS

XCDN, Shanghai, 11,755kc, 25.52m: Announcing as "The Voice of Democracy," is heard from 6.30 p.m. till 1 a.m. Opening session, till 8 p.m., is in Chinese, then Russian on occasions. Sometimes a break follows, but B.B.C. News is relayed at 9. After the News the B.B.C. talk is generally given and then announcements, which often include the B.B.C. programme for the following evening. At 10 p.m. David Conway gives local news. Cabaret items follow. Station announcer says, "You are listening to **XCDN**, Shanghai, "The Voice of Democracy," broadcasting on 1440 kilocycles or a wavelength of 208 metres. No mention is made of the short-wave frequency. Station is definitely pro-British and is a welcome reply to the German-owned **XGRS** and the Italian **XIRS**. There appears to be doubt as to the call-sign, quite a number suggesting it is **XCDM**, advancing the argument that DM might be the symbol for Democracy, but, after intensive listening, I'm sticking to my original claim it is **XCDN**, and my report went forward to Shanghai addressed to Station **XCDN**. It is just a coincidence that Shanghai once before gave us a little worry when the German Club station, **XGRS**, first came on the air. For a long while it was known as **XGRX**, and it was not till the station announcer mentioned "S for snake" that the matter was cleared up. I think the reference to snake particularly apt.

PLS, Bandoeng, 10,365kc, 28.94m: This N.I.R.O.M. station appears to have replaced **PMN**, 29.24m, which for a long time has been badly interfered with. **PLS** is in the clear and gives a fine strong signal.

CR7BD, Lourenco Marques, 15,250kc, 19.66m: This Mozambique station is heard between 3 and 4 p.m. at fair strength. Both Portuguese and English is used, the former by a man, while News in English is given by a woman at 3.45. Is easily identified by chimes between items.

The MONTH'S LOGGINGS

ALL TIMES ARE AUSTRALIAN EASTERN STANDARD

AUSTRALIA AND OCEANIA

VLG-6, Melbourne 15,230kc, 19.69m
Schedule: 6.30 a.m. to 6.15 p.m.: Relays national programme. 3.55 p.m. to 4.40 p.m.: To North America (West).
Excellent at 4 p.m. (Cushen).

VLR-3, Melbourne 11,880kc, 25.25m
Schedule: Noon to 6.15 p.m. Relays national programme.

VLG-5, Melbourne 11,880kc, 25.25m
Schedule: 6.30 p.m. to 11 p.m. Relays national programme. (From 6.25 p.m. to 7.25 p.m. to New Caledonia and French Oceania.) 9.20 p.m. to 10.05 p.m.: To North America (East). 11.10 p.m. to 1 a.m.: To South-east Asia.
R9 when opening at 6.30 p.m. (Perkins). Fair to middling at 9.30 p.m. (Gaden).

VLQ-7, Sydney 11,880kc, 25.25m
Schedule: 1.25 a.m. to 2.10 a.m.: To Central America.

VLQ-2, Sydney 11,870kc, 25.27m
Schedule: 3 p.m. to 3.30 p.m.: To A.I.F. in Palestine. 3.55 p.m. to 4.40 p.m.: To North America (West). 9.40 p.m. to 10.15 p.m.: To North-east Asia.

VLW-3, Perth 11,830kc, 25.36m
Schedule: Daily, 8.30 a.m. to 11.45 a.m.; 1.30 p.m. to 8.45 p.m.: Relays W.A. national programmes. Sundays, 9 a.m. to 8.45 p.m.

VLR-8, Melbourne 11,760kc, 25.51m
Schedule: 6.30 a.m. to 10.15 a.m.: Relays national programme.

VLQ-5, Sydney 9680kc, 30.99m
Schedule: 9.20 p.m. to 10.05 p.m.: To North America (East).

VLQ, Sydney 9615kc, 31.2m
Schedule: 6.25 p.m. to 7.25 p.m.: To New Caledonia and French Oceania. 11.10 p.m. to 1 a.m.: To South-east Asia.

VLR, Melbourne 9580kc, 31.32m
Schedule: 6.30 p.m. to 11.35 p.m.: Relays national programme.

VLW-2, Perth 9560kc, 31.38m
Schedule: 9 p.m. to 1.30 a.m.: Relays W.A. national programme. 11.10 p.m. to 1 a.m.: To South-east Asia. Sundays: 9 p.m. to 1 a.m.

VLG, Melbourne 9580kc, 31.32m
Schedule: 1.25 a.m. to 2.10 a.m.: To Central America. 2.25 a.m. to 2.55 a.m.: To North America (West).

Fiji:

VPD-2, Suva 9535kc. 31.46m
Schedule: 7-8 p.m. except Sunday.
French session 3 to 3.30 p.m. Poor signal (Schodel).

New Caledonia:

FK8AA, Noumea 6130kc, 48.94m
Schedule: 5.30 to 6.25 p.m., except Sundays. On opening and closing plays "Marseillaise," "God Save the King" and "The Star-Spangled Banner."

Tahiti:

FO8AA, Papeete 7100kc, 42.25m
Monday and Thursday afternoons around 3.30 p.m.

AFRICA

Algeria:

TPZ, Algiers 12,120kc, 24.76m
Schedule: 5 a.m. to 9 a.m.
Very weak. Lately mostly drowned by noise (Schodel).

TPZ-2, Algiers 8960kc, 33.48m
Schedule: 5 a.m. to 9 a.m.
Louder than **TPZ**, but fades after 7 a.m.

Belgian Congo:

OPM, Leopoldville 10,140kc, 29.59m
Schedule: 4.55 a.m. to 5.45 a.m.

Egypt:

SUV, Cairo 10,055kc, 29.84m
Some mornings, round about 5.30. Fair signal.

SUX, Cairo 7865kc, 38.15m
Schedule: 4.30 a.m. to 6.30 a.m.

French Equatorial Africa:

FZI, Brazzaville 11,965kc, 25.06m
From 1.45 to 2 p.m., News in English for U.S.A. (Cushen). Fair at 4 p.m.

Gold Coast:

British West Africa:

ZOY, Accra 6000kc, 50.00m
Relays B.B.C. at 4 a.m.
R4 at 5.30 a.m. (Perkins).

South Africa:

Rhodesia:

THE POST OFFICE STATION, Salisbury 7317kc, 41m
Schedule: 2 a.m. to 6 a.m. Relays Daventry at 4 a.m. Closes with "God Save the King." Fair signal just before closing.

Portuguese East Africa:

Mozambique:

CR7BE, Lourenco Marques 9710kc, 30.9m
Schedule: 5 to 7 a.m. except Mondays. News 5.55.
Only fair now.

CR7BD, Lourenco Marques 15,250kc, 19.66m
Heard at fair strength in English by a woman, in Portuguese by a man, between 3 and 4 p.m. News in English at 3.45 p.m. Chimes are given between various items.

AMERICA

Central:

Costa Rica:

TIPG, San Jose 9620kc, 31.19m
Schedule: 10 p.m. to midnight.
Loudest of the Central Americans and sometimes heard from 2 p.m. to 4.45 p.m. R8 at 10.15 p.m. (Nelson).

TILS, San Jose 6165kc, 48.66m
Opens at 10 p.m. with "Stars and Stripes."

TIGPH, San Jose 5910kc, 50.76m
Good around 10.15 p.m.; also heard at 2.30 p.m. (Cushen).

El Salvador:

YSPB, San Salvador 6575kc, 45.63m
Best Central American closing a few moments before 3 p.m. (Cushen).

Guatemala:

TGWA, Guatemala 9685kc, 30.98m
R5 at 2.30 p.m. Sundays (Nelson).

Panama:

HP5A, Panama City 11,700kc, 25.64m
Schedule: 2 p.m. to 3 p.m., 10 p.m. to midnight.

HP5J, Panama City 9607kc, 31.22m
Schedule: 10 p.m. till midnight.
Weak at 10 p.m. (Nelson).

HP5B, Panama City 6030kc, 49.75m
"Radio Estation Miramar." Heard on Sunday, July 13, at noon. Cabaret relay. R6 (Cushen).

HP5K, Colon 6005kc, 49.96m
Heard occasionally from 10 p.m. English announcements.

North:

KGEI, 'Frisco 15,330kc, 19.56m
Schedule: 10 a.m. to 3 p.m. News, 10.45 a.m. 2.55 p.m.
R9 at 3 p.m. (Cushen). R5 closing at 3 p.m. (Nelson). (R7 at Randwick.—Ed.)

WCBX, New York 15,270kc, 19.65m
Improving in strength from 10 p.m. onwards. News at 10.30.

KKQ, Bolinas 11,950kc, 25.11m
Good Sunday afternoons (Cushen, Nelson).

WNBI, Boundbrook 11,890kc, 25.23m
R8 at 12.30 p.m. (Cushen). R4-5 at 3 p.m. (Nelson). (Think they close now at 9.45 a.m.—Ed.)

WBOS, Boston 11,870kc, 25.26m
Schedule: 7 a.m. to 2 p.m. News, 9 a.m. and 1 p.m.
R7 at 8.30 a.m. (Nelson).

WRUL, Boston 11,790kc, 25.45m
Schedule: 4 a.m. to 7.30 a.m. (News 6.30 a.m.)

WRUW, Boston 11,730kc, 25.58m
Schedule: 8 a.m. to 12.30 p.m. (News 8.30 a.m. and 10.15 a.m.).
R5 at 8.30 a.m. (Nelson).

WLWO, Cincinnati 11,710kc, 25.62m
Schedule: 8 a.m. to 10.45 a.m. News, 10.30 am.
Not a consistent signal (Gaden). R8 at 8.30 a.m. (Nelson). (Not one two six with last year.—Ed.)

KGEI, 'Frisco 9670kc, 31.02m
Schedule: 3.30 to 7 p.m. (News 4 p.m. and 5.55 p.m.). From 6 to 7 p.m. session is "Good Neighbour Hour" in Chinese from Chinatown, San Francisco. 10 p.m. to 3.10 (News 10.30 p.m., 12.30 a.m., 1.30 a.m., 3 a.m.).
R9 at 4 p.m. (Cushen). R8 at 6 p.m. (Schodel). R6 at 10 p.m. (Nelson).

WRCA, Boundbrook 9670kc, 31.02m
Schedule: 6 a.m. to 3 p.m.

WLWO, Cincinnati 9590kc, 31.28m
Schedule: 11 a.m. to 3 p.m.

WGEA, Schenectady 9550kc, 31.41m
Schedule: 8.15 a.m. to 11.15 a.m.

WGEO, Schenectady 9530kc, 31.48m
Schedule: 5 a.m. to 7.45 a.m., 8 a.m. to —2 p.m. (News 6.55 and 8.25 a.m.).
Fair to good at 7.15 a.m. (Schodel).

NOTICE TO DX CLUB MEMBERS

Members of the All-Wave All-World DX Club are advised that they should make a point of replenishing their stock of stationery immediately, as all paper prices have risen, and we expect that it will be necessary to increase prices by at least 25%.

Already it has been found necessary to abandon the log-sheets and club stickers. However, while stacks last, the following stationery is available at the old prices, as shown.

REPORT FORMS.—Save time and make sure of supplying all the information required by using these official forms, which identify you with an established DX organisation.
Price .... 1/6 for 50, post free

NOTEPAPER.—Headed Club notepaper for members' correspondence is also available.
Price .... 1/6 for 50 sheets, post free

ALL-WAVE ALL-WORLD DX CLUB, 119 Reservoir Street, Sydney

KEI, Bolinas 9490kc, 31.61m
R7 at 2.15 p.m. (Cushen).

Mexico:

XEQQ, Mexico City 9680kc, 30.99m
Heard between 2 and 4 p.m.

XEWW, Mexico City 9503kc, 31.57m
Between 2 and 4 p.m.
Excellent at 3 p.m. (Cushen).

XEUZ, Vera Cruz 6120kc, 49.02m
Good at 3 p.m. (Cushen).

XEUW, Vera Cruz 6023kc, 49.78m
Good on closing at 4 p.m. (Cushen). Opens at 10 p.m. Very weak signal.—Ed.

South:

Argentine:

LSX, Buenos Aires 10,350kc, 28.98m
Appears to be only audible on Sunday mornings.

LRX, Buenos Aires 9660kc, 31.06m
Fair signal in mornings around 9.

Bolivia:

CP-5, La Paz 6200kc, 48.39m
Heard at 10 p.m. with female announcer. Good signal when closing at 2 p.m. (Cushen).

CP-2, La Paz 6110kc, 49.10m
R5 at 2.30 p.m. (Cushen).

Brazil:

PRA-8, Pernambuco 6010kc, 49.92m
Good strength at 6.45 a.m. (Cushen).

PSF, Rio de Janiero 14,690kc, 20.42m
Heard in same programme as **PSH** between 9 and 10 a.m.

PSH, Rio de Janiero 10,220kc, 29.35m
Opens at 8.30 a.m. Very fair signal.

British Guiana:

VP3BG, Georgetown 6130kc, 48.94m
Heard weakly at 7 a.m. (Gaden).

Chile:

CB960, Santiago 9600kc, 31.25m
Reported heard at 3 p.m. and again at 10 p.m.

Ecuador:

HCJB, Quito 12,460kc, 24.08m
Noon to 12.40 p.m.; 9.55 p.m. to 11 p.m. (Often heard at 9.30 a.m.—Ed.)

HCJK, Guayaquil 9420kc, 31.85m
Very good on Sunday afternoons.

HCETC, Quito 9355kc, 32.05m
R7 at 1 p.m. (Cushen).

HCQRX, Quito 5975kc, 50.21m
"Radio Quito" opens at 9.45 p.m. with march.

Colombia:

HJCT, Bogota 9630kc, 31.15m
Closes weakly at 2.30 p.m. Suffers interference from **2RO-3.**

HJFB, Manizales 6110kc, 49.10m
R6 when closing at 1 p.m. (Cushen).

HJFK, Pereira 6090kc, 49.20m
Heard in afternoons and sometimes till 5 p.m. on Sundays.

HJCX, Bogota 6018kc, 49.85m
Excellent at 4 p.m. Specialises in dance items Sunday afternoons.

Paraguay:

ZP-14, Villarica 11,720kc, 25.60m
Heard at R6 when closing at 11 a.m. (Cushen).

Peru:

OAX5C, Ica 9810kc, 30.58m
Only fair till closing at 2.30 p.m.

OAX4J, Lima 9340kc, 32.12m
Heard closing at 4 p.m. and opening at 11 p.m. (Rogers).

OAX6D, Arequipa 9455kc, 31.73m
R7 till **GRU** opens at 2.55 p.m. (Cushen).

OAX4G, Lima 6190kc, 48.47m
Fair on Sundays till 5 p.m. (Rogers).

Venezuela:

YV5RM, Caracas 4890kc, 61.35m
Note slight change in frequency (Cushen).

THE EAST

Burma:

XYZ, Rangoon 6007kc, 49.94m
Schedule: 9.45 p.m. to 1 a.m. News at 12.30 a.m.

China:

FFZ, Shanghai 12,090kc, 24.83m
Schedule: 7 p.m. to 1 a.m. News 10 p.m. Good when free of interference (Rogers, Schodel).

LOGGINGS (Continued)

XGRS, Shanghai 12,015kc, 24.97m
Schedule: 6.30 p.m. to 1 a.m. "The Voice of Europe." News 8.45 p.m., 9.30 p.m., 11.15 p.m. and 12.15 a.m.

XIRS, Shanghai 11,980kc, 25.02m
Schedule: 7.30 p.m. to 11.30 p.m.
News in English at 9.15 p.m. (Perkins).

XMHA, Shanghai 11,853kc, 25.31m
Schedule: 6.30 p.m. to 1 a.m. News, 9 p.m. and 11.15 p.m.
Excellent nightly (Gaden). (Splendid News service by Carol Alcott.—Ed.)

XCDN, Shanghai 11,755kc, 25.51m
Schedule: 6.30 p.m. to 1 a.m.
Terrific strength from 9 p.m. (Gaden, Perkins, Rogers). Relays B.B.C. at 9 p.m. Local news 10 p.m. and midnight. (See article under "New Stations."—Ed.)

XGOA, Chungking 9720kc, 30.85m
Good at 9 p.m. News at midnight

XGOY, Chungking 9620kc, 31.17m
Schedule: Midnight to 2 a.m. News at midnight and 1 a.m.

XPSA, Kweiyang 8484kc, 35.36m
Schedule: 9 p.m. to 1 a.m.
Being heard with R8 Q5 signal at 7 a.m. in Chinese (Nelson).

XOZS 29.88m
Good nightly (Rickard).

XGOY, Chungking 5950kc, 50.42m
10.30 p.m. to 11.55 p.m. News 10.30 p.m. R4 at 10.30 p.m. (Perkins).

Thai:

HSP5, Bangkok 11,715kc, 25.61m
Schedule: 10.50 p.m. to 1 a.m. except Mondays. News, 11.45 p.m.
Is anyone hearing this station?

Dutch East Indies:

PLG, Bandoeng 15,950kc. 18.81m
Heard at good strength calling Singapore at 7.20 p.m. (Perkins).

YDC, Bandoeng 15,150kc, 19.81m
Improved tremendously. Best from 8.30 to 10.30 a.m. and 1.30 to 5 p.m., but night session is now good from 8.30.

PLJ, Bandoeng 14,630kc, 20.51m
Heard from 7.30 p.m. to 3 a.m. in Malay programme.

PLP, Bandoeng 11,000kc, 27.27m
Very good at night.

PMN, Bandoeng 10,260kc, 29.24m
7.30 p.m. to 1.30 a.m.

YDB, Bandoeng 9550kc, 31.41m
Requires a little sorting out, but is on from 7.30 p.m. to 1.30 a.m.

YDX, Medan (Sumatra) 7210kc, 41.55m
Schedule: 8 p.m. to 3 a.m.

PMY, Bandoeng 5145kc, 58.31m
7.30 p.m. to 1.30 a.m.

YDH-4, Bandoeng 3320kc, 90.36m
Mr. Cushen advises he has card saying they are now off the air.

YDA, Bandoeng 3040kc, 98.68m
Heard from about 9 p.m.

French Indo-China:

Radio Saigon, Saigon 11,780kc, 25.47m
Schedule: 8.40 p.m. to 2 a.m. News, 9.15 p.m., 1.45 a.m.
Heard with R5-6 signal at 3.15 p.m. in French (Nelson).

Radio Saigon, Saigon 6180kc, 48.54m
Scredule: 8.15 p.m. to 2 a.m. News at 9.15 p.m. and 1.45 a.m.
Very loud **signal.**

Hong Kong:

ZBW-3 .... 9525kc, 31.49m
Schedule: 7 p.m. to 12.15 a.m. Relays B.B.C News at 11 p.m.

India:

VUD-3, Delhi 15,290kc, 19.62m
Schedule: 12.05 p.m. to 3.05 p.m.
News in English at 1.20 p.m.

VUD-4, Delhi 11,830kc, 25.36m
Schedule: 9.30 p.m. to 3.20 a.m.
News, 10.30 p.m., 1.50 a.m., 3.15 a.m

VUD-2, Delhi 9590kc, 31.28m
Schedule: 9.30 to 2 a.m. News, 10.30 p.m., 1.50 a.m.

VUD-2, Delhi 7290kc, 41.15m
Schedule: 9.30 p.m. to 2 a.m. News 10.30

VUB-2, Bombay 7240kc, 41.44m
News at 10.30 p.m. English at 1 a.m. Closes at 1.15 a.m. (Cushen).

VUC-2, Calcutta 7210kc, 41.61m
Fair about 10.30 p.m.

VUD-8, Delhi .... 4920kc, 60.98m.
Schedule: 10.30 p.m. to 2 a.m.

VUB-2, Bombay 4880kc, 61.48m
Good at 3 a.m. (Cushen).

Japan:

(Tokyo considered source of supply unless otherwise mentioned)

Pressure on space does not permit of full schedules.

JLU-4 .... 17,795kc, 16.86m
11 a.m. to 1 p.m. News 11.05 a.m. 4.30 p.m. to 6.30 p.m. News 4.30 p.m.
Only fair at 11.15 a.m. (Cushen). Talk in English at 5 p.m.—Ed.

MTCY, Hsinking 15,340kc, 19.56m
Schedule: 7 a.m. to 8 a.m.
News at 7 a.m., good strength (Cushen).

JZK, Tokyo 15,160kc, 19.79m
Schedule: 1 a.m. to 2.55 a.m. News 1.45 a.m. 3 a.m. to 4.30 a.m. News 4 a.m. 7 p.m. to 12.30 a.m. News 11.30 p.m.

JLG-4, —— 15,105kc, 19.86m
5 a.m. to 8.30 a.m. (News 7.30 a.m.). 11 a.m. to 1 p.m. (News 11.05 a.m.).
Good with news at 7.30 a.m. (Cushen).

JZJ 11,800kc, 25.42m
Schedule: 1 a.m. to 2.55 a.m. News 1.45 a.m. 3 a.m. to 4.30 a.m. News 4 a.m. 5 a.m. to 8.30 a.m. 7 p.m. to 12.30 a.m. News 8.30 p.m.

—— 11,740kc, 25.55m
Opens at 11 p.m. News in English at 11.25. No call-sign heard, although he refers to **JZK.**

JVW-3 .... 11,720kc, 25.6m
Schedule: 6.45 a.m. to 8.30 a.m. (Exercises 7.7 a.m.). 6.45 p.m. to 12.30 a.m.

——, ... 10,274kc, 29.20m
Opens with Japanese national anthem at 9 p.m.

Malaya:

ZHP-1, Singapore 9700kc, 30.92m
Very poor signal from 9 to 10 a.m. (Gaden). "Early morning programme" R8 at 9.45 a.m. (Nelson). (Note how a.m. signal varies according to location. Night signal splendid.—Ed.)

ZHP-3, Singapore 7250kc, 41.38m
R6 at 10.30 p.m. (Byard).

ZHP-2, Singapore 6175kc, 48.58m
Schedule: 7.40 p.m. to 1.25 a.m.

ZHJ, Penang 6095kc, 49.23m
Schedule: 8.35 p.m. to 11.45 p.m. News 9 p.m. and 11 p.m.

Philippines:

(Manila, unless otherwise stated)

KZRH 9640kc, 31.12m
Schedule: 7.30 a.m. to 9.30 a.m. (**News** 8.15 a.m.). 6 p.m. to 2 a.m. (News 6 p.m., 10.30 p.m. and midnight).

KZRM 9570kc, 31.35m
Schedule: 6.45 p.m. to 1.30 a.m. News, 8.35, 10.45 and 11.45 p.m., also 12.45 a.m.

KZND, Manila 8790kc, 34.13m
Schedule: 9.25 p.m. to 10.30 p.m.
Fair 9.20 p.m. (Schodel).
Bad interference from 9.30 to 10.30 p.m. (Cushen, Nelson).

KZRF, Manila 6140kc, 48.86m
Schedule: 7 p.m. to 2 a.m.
Signal improving.

GREAT BRITAIN

"This Is London Calling"

GSV 17,810kc, 16.84m
E.T., 8.55 p.m. to 2.30 a.m. News 9 p.m., 11 p.m. and 2 a.m.
Reception some nights quite good and will improve.

GSP 15,310kc, 19.60m
P.T., 5.30 p.m. to 6.15 p.m.; Af.T., 5.30 a.m. to 7.45 a.m.

GSI 15,260kc, 19.66m
P.T., 2.57 to 6.15 p.m.

GSF 15,140kc, 19.82m
P.T., 3 p.m. to 6.15 p.m.; E.T., 8.55 p.m. to 2.30 a.m.; Af.T., 2.55 a.m. to 5.15 a.m., 6.45 a.m. to 7.45 a.m.
GSF is improving nightly and is good from opening of Eastern transmission.—Ed.

GRV 12,040kc, 24.92m
Eur., 2.55 a.m. to 4.15 a.m. (News at 4 a.m.).
Heard in French at 7 a.m. Spanish at 7.30 a.m.

GSN 11,820kc, 25.38m
Eur., 11 p.m. to 1.30 a.m. (News 11.30 p.m.). 8.40 a.m. to 12.30 p.m. (Spanish and Portuguese).
Intended for Latin America.

GSD 11,750kc, 25.53m
2.57 p.m. to 6.15 p.m.; E.T., 8.55 p.m. p.m. to 2.30 a.m.; Af.T., 2.55 a.m. to 7.45 a.m.; Am.T., 8.20 a.m. to 2.45 p.m. Radio Newsreel at 1.30 p.m.

GRX 9690kc, 30.96m
Eur., 2.55 a.m. to 8.30 a.m., 8.40 a.m. to 12.30 p.m. (Spanish and Portuguese), 6.30 p.m. to 8 p.m. News, 8 a.m. and 6 p.m.

GRY 9600kc, 31.25m
P.T., 3 p.m. to 5 p.m. (News 4.15 p.m.). E.S., 3 a.m. to 7.45 a.m. (News 4 a.m. and 6.45 a.m.). N.A.S., 8.15 a.m. to 2.45 p.m. (News 8.45 a.m., .10 a.m., 11 a.m., 2.30 p.m. (Radio Newsreel 1.30 p.m.).

GSC 9580kc, 31.32m
Am.T., 8.10 a.m. to 2.45 p.m. Radio Newsreel 1.30 p.m. News 2.30 p.m.

GSB 9510kc, 31.55m
P.T., 2.57 p.m. to 6.15 p.m. (News 4.15 p.m.). 8.40 a.m. to 12.30 p.m. (Spanish and Portuguese).

GRU 9450kc, 31.75m
E.T., 11.45 p.m. to 2.30 a.m.

GSW 7230kc, 41.49m
1.55 p.m. to 6 p.m. in European service.

GRS 7065kc, 42.49m
Excellent from opening at 2.57 p.m. till closing at 3.45 p.m.

GRW 6145kc, 48.82m
Home Service, 2.30 p.m. to 6 p.m. (News 3 p.m. and 4 p.m.). 2 a.m. to 7.15 a.m. (News 2 and 5 a.m.).

GRR 6075kc, 49.38m
3.30 p.m. to 6.30 p.m. (News 4 p.m. and 5 p.m.). 2 a.m. to 8.30 a.m. (News 3 a.m., 6 a.m. and 8 a.m.)

GSA 6050kc, 49.59m
Eur., 1.55 p.m. to 8 p.m., 2.55 a.m. to 8.30 a.m. (News 6 p.m. and 8 a.m.).

EUROPE

France:

(Of course, Nazi controlled)

Paris Mondial 15,240kc, 19.68m
Between 3 p.m. and midnight.

—— 11,840kc, 25.33m
Announces as "Ici la voix de la France" ("Here is the voice of France"). Heard fairly regularly between 3.15 and 5.15 p.m. and sometimes in the mornings around 7 o'clock.

"Y" 9520kc, 31.51m
Schedule: 7.50 a.m. to 2 p.m. (News 1.30 p.m.).

Germany:

"Station Ananias," Berlin

DJH 17,840kc, 16.81m
5.30 p.m. to 2 a.m. News 7.30 p.m. and 10 p.m.

DZG 15,360kc, 19.53m
Reported being heard in late afternoons.

DJR 15,340kc, 19.56m
Schedule: 3 p.m. to 2 a.m. News 5 p.m. and 10 p.m.
Reception between 6 p.m. and midnight is erratic, but every indication of rapidly improving.—Ed.

DJQ 15,280kc, 19.63m
3 p.m. to 2 a.m. News 5 p.m., 10 p.m. and midnight.

DJB 15,200kc, 19.74m
7.50 a.m. to 2.05 p.m. News 9 a.m., 11.15 a.m. and 1.30 p.m.

DJL 15,100kc, 19.85m
1.40 a.m. to 3.15 a.m. News at 2.15 a.m.

DZE 12,130kc, 24.73m
Fair signal, but noisy at 7.25 a.m. (Schodel).

DJP 11,855kc, 25.31m
8 p.m. to 2 a.m. News at 10 p.m.

DXC-2 .... 11,740kc, 25.55m
Schedule: 3.40 a.m. to 7.25 a.m. News 6.15 and 7.15 a.m.
R6 at 7 a.m. (Perkins, Schodel).

DZD 10,530kc, 28.45m
7.50 a.m. to 4 p.m. News 1.30 p.m. and 3 p.m.

DZC 10,290kc, 29.25m
Very loud before mid-day.

DJD 11,770kc, 25.49m
Schedule: 1.40 to 7.25 a.m. News, 2.15, 5.15 and 7.15 a.m. Talk at 3.30 a.m.
7.50 a.m. to 2.05 p.m. (News 9 a.m., 11.15 a.m. and 1.30 p.m.

DJX 9670kc, 31.01m
1.40 a.m. to 7.25 a.m. News 2.15 a.m. and 7.15 a.m.

DJW 9650kc, 31.09m
3 p.m. to 8 p.m. News at 8 p.m.

DJA 9560kc, 31.38m
Schedule: 3.30 a.m. to 6 a.m. News 3.30 and 4.30 a.m., and 5.30 "Lord Haw-Haw."

DXM 7270kc, 41.27m
Schedule: 6 to 8 a.m. "Lord Haw-Haw" 6.30 and 7.30 a.m.

DJC 6020kc, 49.83m
3.40 a.m. to 7.25 a.m. News at 6.15 and 7.15.

Hungary:

HAT-4, Budapest 9123kc, 32.88m
R9 at 10.30 a.m. News at 11.15 a.m. (Cushen).

Italy:

"This is Radio Roma"

2RO-6 .... 15,300kc, 19.61m
12.30 a.m. to 8.55 a.m.; 11 a.m. to 3.20 p.m.; 5 p.m. to 5.30 p.m.; 6.10 p.m. to 6.20 p.m. News: 1.40 a.m., 7.12 a.m., 8.20 a.m., noon, 1.30 p.m., 3 p.m., 5.20 p.m., 6.10 p.m.

2RO-4 .... 11,810kc, 25.4m
12.30 a.m. to 8.55 a.m., 11 a.m. to 2.20 p.m., 2.30 p.m. to 3.30 p.m., 6.10 p.m. to 6.20 p.m.

2RO-15 .... 11,760kc, 25.51m
2.30 a.m. to 8.55 a.m.

2RO-18 .... 9765kc, 30.74m
11 a.m. to 2.20 p.m.

2RO-9 .... 9670kc, 31.03m
2.30 a.m. to 8.55 a.m.

2RO-3 .... 9630kc, 31.15m
2.30 a.m. to 8.55 a.m.; 11 a.m. to 2.20 p.m.; 2.30 p.m. to 3.30 p.m.; 5 p.m. to 5.30 p.m.

2RO-11 .... 7220kc, 41.55m
2.30 a.m. to 8.55 a.m.

HVJ, Vatican City 11,740kc, 25.55m
Heard between 4 and 6 p.m. Wednesdays and Fridays, giving names of prisoners of war.
R6 at 4.25 p.m. (Perkins).

HVJ, Vatican City 48.47m
5.15 a.m. to 5.30 a.m. Talks.

Portugal:

CSW-6, Lisbon 11,040kc, 27.17m
Schedule: 3 a.m. to 6.35 a.m., except Sundays.
Splendid signal.

CSW-7, Lisbon 9740kc, 30.8m
Schedule: 6.45 to 9 a.m. Talks: On Wednesday, Friday and Sunday from 6.50 a.m. to 7.15 a.m.
Good signal at 7 a.m. (Nelson, Schodel).

CS2WD, Portugal 6200kc, 48.38m
Schedule: 6 to 9 a.m.
Very faint and fades out by 6 o'clock.

LOGGINGS (Continued)

Rumania:

Radio Bucharesti, Bucharest . 9234kc, 32.44m
Heard at great strength at 2 p.m. (Cushen).

Russia:

("This is Radio Centre, Moscow, calling")

RW-96, Moscow 15,410kc, 19.47m
Schedule: 7 p.m. to 11.50 p.m.

RW-96, Moscow 15,180kc, 19.76m
9 a.m. to 10 a.m. News 9 a.m. Noon to 5.30 p.m. News 12.30 p.m. 6.05 p.m. to 6.50 p.m. News 6.5 p.m. 10.05 p.m. to 10.30 p.m. News 10.05 p.m. Midnight to 3.30 a.m. News 1.10 a.m.
Splendid in News at 12.30 p.m. (Collins).

——, Moscow or Khabarovsk 24.61m
Heard at great strength at 8.30 p.m. on August 24.—Ed.

RW-15, Khabarovsk 9566kc, 31.36m
Schedule: 5 p.m. to midnight; 5.50 a.m. to 7.30 a.m.

RW-15, Khabarovsk 9546kc, 31.43m
5 p.m. to midnight.
News at 10 a.m. (Rogers).

RW-96, Moscow 9520kc, 31.51m
10.30 p.m. to 11.50 p.m.; 3.45 a.m. to 8.45 a.m. News at 4 a.m., 5.30 a.m., 7.15 a.m.

RV-15, Khabarovsk 4457kc, 67.31m
R6 at 9.35 p.m. (Perkins).

RW-15, Khabarovsk 4273kc, 70.2m
5 p.m. to midnight.

Spain:

Radio Malaga, Malaga 7210kc, 41.61m
Fairly good strength at 6.30 a.m.

——, Malaga 6993kc, 42.9m
Between 6 and 7 a.m., good signal.

Switzerland:

HBH, Geneva 18,480kc, 16.23m
Schedule: 11.45 p.m. Fridays to 1.10 a.m. Saturdays. Mostly English, little French. News 12.5 a.m., 11.45 p.m. Mondays to 1.10 a.m. Tuesdays, Italian. German and French.

HBJ, Geneva 14,535kc, 20.65m
First Sunday in the month. 3.45 p.m. to 5.10 p.m.
R5 at 3.45 p.m. on August 3 (Perkins).

HBO, Geneva 11,420kc, 26.31m
Same remarks as **HBJ**.
Weak at 3.45 p.m. on August 3 (Perkins, Nelson). (Not always audible at Randwick. —Ed.)

HER-3, Schwarzenburg 6165kc, 48.66m
Schedule: 2.40 p.m. to 3.37 p.m.
Good signal. 3 a.m. to 7.05 a.m. Splendid signal when closing at 7.05 a.m. (Perkins).

SCANDINAVIA

Denmark:

RADIO DENMARK, Copenhagen
9710kc, 30.9m
Heard at good strength in afternoon.

Finland:

OIE, Lahti 15,190kc, 19.75m
1.30 a.m. to 8 a.m. News 4.15 a.m. and 7.15 a.m.
Heard giving News in English at 10.30 p.m. Very noisy. Said they were also on 25 and 31 metre bands.—Ed.

——, Helsinki 11,966kc, 25.07m
Said to be on air from 5.20 to 6.50 a.m.—Ed.

OFE, Lahti 11,708kc, 25.47m
Schedule: 1.30 a.m. to 8 a.m. (News, 4.15 and 7.15 a.m.); 3.30 p.m. to 6 p.m.
R6 with News in English at 7.15 a.m.. (Nelson).

OFD, Lahti 9500kc, 31.58m
Schedule: 1.30 a.m. to 8 a.m. News, 4.15 and 7.15 a.m.
R8 at 7.15 a.m. (Byard).

——, Helsinki 8586kc, 34.94m
Said to be on air from 5.20 to 6.50 a.m.—Ed.

S.W. REVIEW

(Continued from page 23)

The Asiatic station right next to PMY is, I am told, XUD. No English spoken, but call-sign is given at 9 p.m.

And here is what I think is a new one: The station on approximately 9.24mc, 32.46m, which a number have taken to be Bucharesti at 10.30 p.m., is, I am told, XLMA. The address I do not know, but they give the call-sign at 12.40 a.m. The prefix X, of course, denotes somewhere in China.

This must be of interest to listeners. On Sunday, August 24, the Rev. Loveday, giving the B.B.C. church service from St. Martins in the Field, asked for special prayers for all journalists and broadcasters that "they might be guided in their task of enlightenment."

We welcome a new member to the All Wave-All World DX Club, Mr. Ronald Collins, Glanville, South Australia. Well, Mr. Collins, you have started off with a very good list and very nicely set out. Will be particularly interested in your further reports, as I am South Australian born.

Dr. Gaden reminds me that some good listening is to be had on and around 51m. Here will be found quite a number of U.S.A. airports. Don't send reports, as you are not permitted to do so. Around 63 metres you might find the same class of listening, but the location, Canada.

Vibra 4 is Battery "Trade Builder"

FOLLOWING on our article in last month's issue in which we described a receiver called the "Trade Builder," designed for use as a proposition by dealers wanting a handy mantel model for business purposes, we have had a number of requests for a similar type of receiver, but designed for battery use.

Whilst we would like to oblige, we feel that it would be most difficult to produce a design which would in any way improve upon the "Vibra Four," which was detailed in our July issue.

The "Vibra Four" has proved to be a completely satisfactory receiver in every way, and the only complaints that have been received to date are in regard to the modesty of our claims for its performance. A couple of country dealers have taken us to task for the remarks we made about the difficulty of obtaining noise-free operation from such a set when operating on short-waves. We did not extend our recommendation to cover the operation of the set when used with a dual-wave tuning unit, but these dealers have given us a most definite assurance that with any of the vibrator units at present on the market there will be no trouble at all and maximum sensitivity can be used without fear of the noise level being excessive.

As a Dual-waver

There are no modifications necessary to the actual circuit for the use of a dual-wave unit, but naturally there is a certain amount of alteration in regard to the chassis design, as the coil bracket will fit in to the underside of the base amongst the wiring.

According to one report the original base can be used, plates being put over the unused holes, which were originally provided for the aerial and oscillator coil units. The dual-wave unit is then mounted in the hole originally intended for the volume control, this item being placed over at the other side of the base, with the switch built into the actual volume control potentiometer. Potentiometers of this type are readily available at only a slightly increased cost.

CASH PRIZES

Watch out for the announcement of our

BATTERY CIRCUIT CONTEST

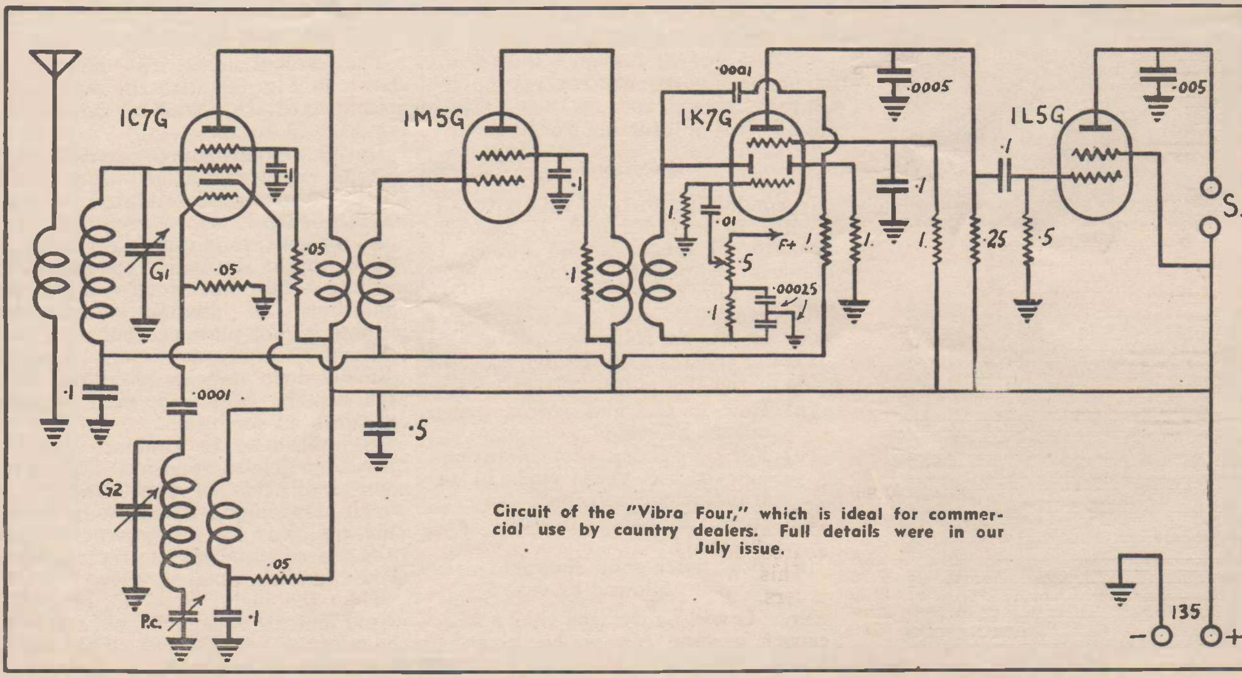
next month

As a Straight Battery Set

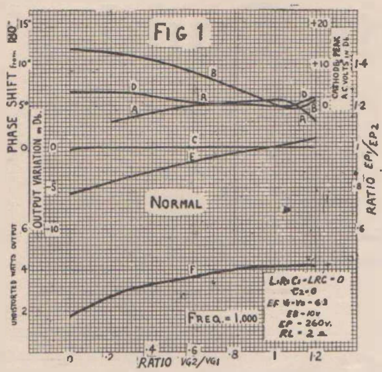
For those who want a straight battery set and not one to operate from a vibrator, this circuit still holds good, as mentioned in the original article. By following out the original circuit design for the filament network it becomes possible to use the ordinary two-volt valves, but with the six-volt accumulator. The current drain is cut down to about one-third of the normal current for a battery set, making it possible to operate the receiver for months at a time between re-charging. In many cases this is indeed an attraction and well worth the extra cost of the six-volt accumulator, compared to the single-cell type. For the high-tension supply a set of three 45-volt "B" batteries is required, and the high tension current drain is well within the capacity of batteries of this type.

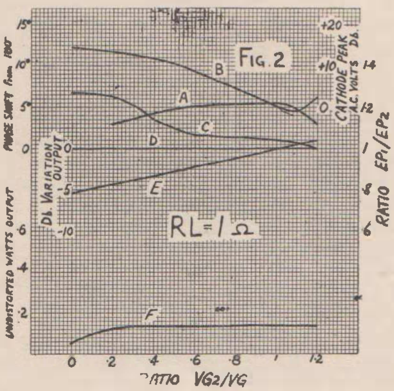
Gang Condensers

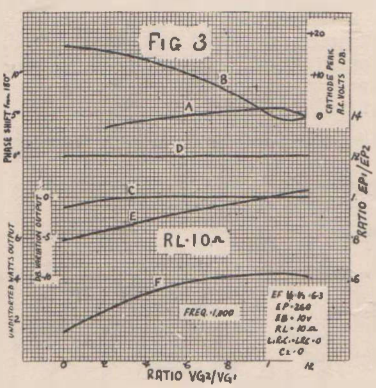
With the "Vibra Four," as with most other receivers. the matter of the selection of a gang condenser calls for some comment. Unfortunately, there is a certain amount of shortage of modern-type gangs, and in many cases the wholesalers have plenty of the earlier type gangs on hand, but are unable to supply the type "H." This is not really such a problem as it might seem, for the "F" type gang is equally suitable, provided that the coil unit or coils are of suitable type, and the dial is calibrated to suit the gang and coils. In cases where wholesalers are in a position to supply matched coils, gang and dial we have no hesitation in saying that there is no need to worry about which type of gang is supplied.

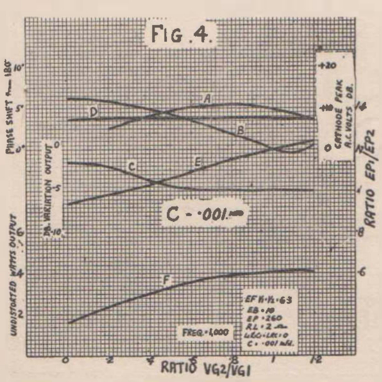


Circuit of the "Vibra Four," which is ideal for commercial use by country dealers. Full details were in our July issue.









BALANCE CONDITIONS IN PUSH-PULL OUTPUT

By C. PARRY

PUSH-PULL operation is extremely popular amongst set-builders to-day, and probably there is no more popular combination at present than a pair of 6V6G's driven by some suitable means.

Experiments were begun recently to try and determine the constants of such a combination on considerably simplified lines. As might be expected, the trend of these experiments again and again led to some form of paraphase operation.

At this stage it was observed that the matter of a balanced drive was not of great importance — at least not as great as might be ordinarily expected. Further experiment brought to light quite a number of interesting points.

Accordingly, all the data available on push-pull was once more scanned. The matter of actual drive ratio was still obscure. It seemed, however, that given a perfect pair of valves, a perfect transformer and a certain amount of luck, satisfactory calculations on performance could be made.

As is well known, unpredictable things happen in practice once the ideal is departed from.

It was decided, accordingly, to settle the matter for once and for all. Remembering the controversy on the "Barnes" circuit seemed to indicate it might yield interesting results.

Questions

In conducting tests of this nature it is vital to consider and, if possible, measure all those factors known to influence amplifier performance or likely to affect those factors.

The most pertinent questions raised seem to be as follows:

Should the ratio of the drive on the grids of the two output valves vary —

(a) How is the undistorted power output affected?
(b) For feedback considerations, how is the phase shift in the transformer affected?
(c) How is the overall gain affected?
(d) How much may this grid drive ratio be allowed to vary?

Now, it will be realised that a satisfactory answer cannot be given to most of these questions.

Method of Examination

In order to get answers, a circuit set-up as in Fig. 19 was used. This shows simply the layout and equipment.

It will be noted that six oscillographs are shown. As only two were available, one was left permanently in position A to check grid phase shift, and the other used for observation in the other five positions.

The attenuator was carefully arranged so that the ratio of the drive on V_2 to that on V_1 could be altered in steps from 0 to 1.2 times. This was rechecked from time to time and whenever it seemed circuit conditions might alter it.

At each step of this control, it is therefore possible to determine —

(a) Phase shift in the grid circuit from true 180° push-pull;
(b) Similar shift in the plate circuit;
(c) Ratio of alternating plate voltages on V_1 (EP_1) and V_2 (EP_2);
(d) Power output and overall gain;
(e) A.c. voltage appearing across the cathode circuit.

The actual electrical circuit is shown in Fig. 20, with the equipment disconnected. This must be referred to for Figs. 1 to 18.

Initial experiments carried out showed small variations which could not be accurately formulated for conclusive deductions.

As a result, conditions were selected which might be said to represent medium — but not good — operating conditions. A slightly lower bias allowed higher plate current than normal. A transformer was selected which had poorer characteristics than standard in order to give slightly exaggerated conditions.

In order also to simulate possible operating characteristics and give some indication of the direction in which care should be taken in actual push-pull, various changes were made to the circuit and all the factors mentioned again measured.

Thus the inclusion of C_1 (Fig. 20) would indicate a capacity unbalance in the transformer. A resistive unbalance was produced by placing L_1 R_1 (or LR)

IN A very practical way the effects of the various unbalances and load changes likely to occur in push-pull output stages have been graphically tabulated from nearly one thousand observations on a very conventional and popular amplifier, and an excellent analysis made of the results.

This will be of great interest to technicians and experimenters alike since, for the first time, the effects of various circuit changes is made available in a reference form. These observations, too, should serve to settle many controversial points and dispel many existing fallacies.

in parallel, consisting of approximately 10 henries and 2000 ohms. L_1R_1 and LR are, of course, equal, but merely in different parts of the circuit.

All these results have been put into graphical form in Figures 1 to 16, so that ready comparison can be made. In each of these figures the operating conditions are shown, while in large figures is indicated the particular circuit change which was made for that particular set of graphs. Normally, no cathode by-pass condenser was used, but Fig. 9 shows the results obtained when a 10 mfd. by-pass was used.

Observational Difficulties

As might be expected, there were certain difficulties attendant on these observations. Some of the graphs, therefore, are the result of averaging several sets of figures. Some of the values can only be approximate or comparative but, nevertheless, just as useful.

It is a fact that when any "observational error" occurs, the probable effect of this and its magnitude may be predicted by a careful analysis of all the factors pertaining to it. This has been done in several cases to overcome most obvious errors.

Some of the difficulties are worth discussing. Firstly, the small phase angles measured can only be approximate because the thickness of the trace of the CRO sets a limit.

In the plate circuit accurate figures are impossible since a true elipse does not occur, as the valves work on different characteristics and with eliptical load variations. What could be observed, however, was any change in phase. In most cases where the graphs indicate zero phase shift, this was so small it was incapable of accurate observation.

The gain variations shown represent the actual change in amplification of the system taken by observing the output voltage for each grid ratio. They are therefore no indication of power, max. voltage and so on, and are quite accurate.

The Peak A.C. Cathode Volts

The peak cathode A.C. volts is rather a complex factor. It was noticed that, at the minimum point, the fundamental input signal balanced out, leaving a second harmonic.

The phase of this depended on just which grid had slightly greater drive. It was not due to grid current and could only be explained by actual operating differences in the valve characteristics although this was the point of perfect "balance."

This is important to consider should the cathode be tapped for inverse feedback purposes, since it would be possible to obtain a condition of negative feedback at fundamental and **positive at the second harmonic.**

It is important to remember that this harmonic voltage observed occurs, although the valves are perfectly balanced for drive. The actual amount varies with the secondary transformer load and was noted to be considerably less in triode than in pentode operation. Since it occurs (with varying amplitude) over a large range of signal into the grids, it means that harmonic distortion must occur due to differences, as well as the type of valve characteristics, even though the valves are in push-pull and that this must be worse in pentode than in triode operation for the same grid cathode voltages.

At high extremes of load this distortion voltage comprised also additional harmonic components to second.

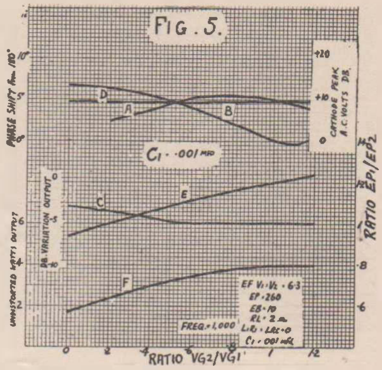
The peak value of this A.C. voltage was therefore measured and includes fundamental and second harmonic components. As would be expected, this prevents the graph of this record (curve B) from being properly linear.

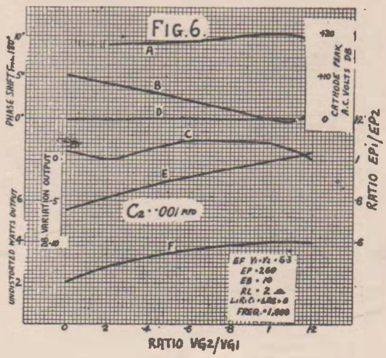
However, beyond a grid ratio (VG_2/VG_1) of .8 the harmonic content is sufficiently low to regard the peak A.C. voltage as only fundamental.

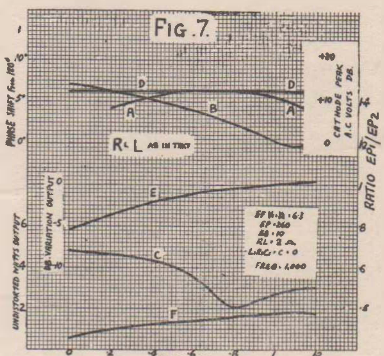
As would be expected, the phase of this voltage at large grid ratios is such that it is in phase with the signal on the grid having the greatest swing.

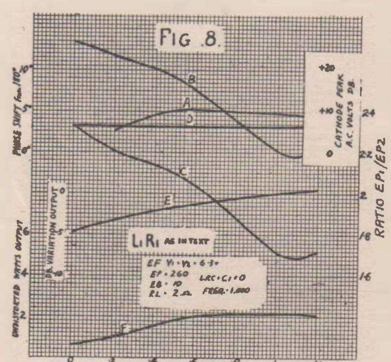
Maximum Grid Drive Ratio

At this point it will be observed that the maximum figure for this grid ratio is 1.2. This was sufficient to go over true balance. Since, once signals



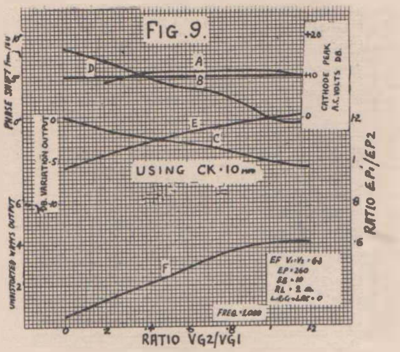






PUSH-PULL (Continued)

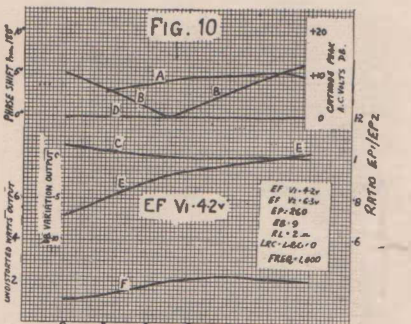
are on each grid, the valve characterics change, it was not considered necessary to go very high in the other direction. The most important and interesting results are observed as the ratio varies from 0 to true balance; beyond this we merely have the same conditions, as it were, reversed. It is also interesting to note (as will be later shown) that valve conditions will depend upon the actual signal upon each grid as well as their ratio — important to keep in mind when considering low volume distortion.



Undistorted Power Output

The undistorted power output was quite difficult to arrive at. This was because the type of distortion altered with each grid ratio. As a result, the wave-form was kept very pure in each case, resulting in lower figures than would be normally reached.

This point about distortion is itself very interesting. At low grid ratios and in "Barnes" operation [I use the word for want of a simpler term] the distortion is predominantly second harmonic. Fairly large power outputs may be maintained, if you are prepared to accept the accompanying distortions.

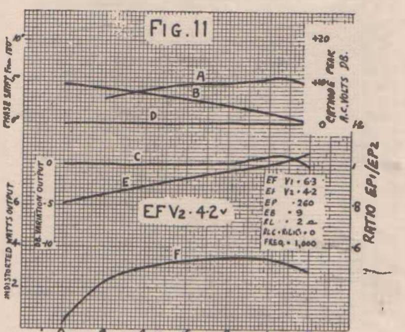


In the case of a high load good transformer (Fig. 15) the distortion changed very rapidly from second to third as the drive ratio increased.

Observations were taken on both plates (CRO in positions E and F, Fig. 19) and it was noticed that the amount and type of distortion in each plate varied, depending on this ratio. When this was low the plate of V_1 showed excess second harmonic.

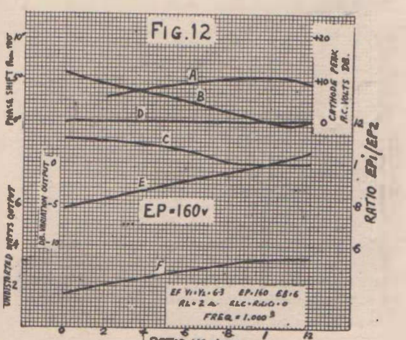
The power curves shown are fairly indicative of the power performance of the valves under the conditions shown.

Despite the large amount of equipment, no trouble occurred due to spurious oscillation and the like, although at first a little difficulty was experienced due to leakage on the grids of V_1 and V_2 from the harmonics of the sweep of oscillograph A (Fig. 19).



In addition to these ratio tests, a series of frequency runs were made to see what might happen under varying signal conditions. To get satisfactory variations a low load RL (Fig. 20) of one ohm was used. The power output here does not agree with the figures of Fig. 2 since it was possible to allow somewhat higher distortion on the frequency runs. These will be referred to later.

It will be realised how much tabulation is necessary to accumulate these graphs and how practically every possible variation likely to occur in practice has been simulated and data recorded for it.



For instance, Figs. 10 and 11 show the effect of lowered filament voltage on each valve — equivalent to using one good and one poor valve.

It might be thought that much better results would be obtained by using good transformers. Figs. 13, 14 and 15, however, show that the general form of the curves is the same as Fig. 1. We might expect less transformer loss, better coupling and frequency response, but in general the same conditions apply whether the transformer is good or medium. Circuit unbalances as evidenced by other graphs will produce graphical changes purely in keeping with those already shown. So, too, using the valves as triodes (Fig. 16) provides very little departure from the general form of the curves in Fig. 1. If anything, the grid drive ratio is even less critical. As a result, it was not considered necessary to duplicate all the other circuit conditions for the valves used in this manner.

Example of Graphical Interpretation

As an example of how to read Figs. 1 to 16, take the following example (referring to Fig. 1):

Balance occurs (minimum cathode voltage) at a grid drive ratio of 1.1. The phase angle departure from true push-pull in the plates (and the grids) is about 5° at this point. That is, almost perfect anti-phase conditions exist. The A.C. plate voltages are equal, power output is 4 watts, and the gain has risen 6 d.b. from the "Barnes" conditions.

So much for the testing methods and initial observations.

The A.C. Plate Voltage Ratio EP_1/EP_2

The first point of discussion is the A.C. plate voltage ratio, EP_1/EP_2 (curves C).

It will be realised from these that this ratio gives no indication of balance, power, output phase shift, or, in fact, anything about the operation at all.

It is supposed to be theoretically equal to unity. The greatest variations under any circuit conditions occur when there is a large VG_1/VG_2 ratio — and it may therefore be said to depend on this. (Refer to Figs. 7, 8, 9, 10.)

Obviously, too, it depends on the quality of the transformer as well as the reflected load condition (Figs. 1 and 2). Again, as might be expected, from Figs. 10 and 11, we see that valve quality will affect it. Figs. 1, 4, 5, and 6 show that a capacity unbalance or phase shift in the grid affects the ratio. In fact, from this it appears that any condition tending to produce a phase shift between the plates will affect this ratio.

It may not, therefore, be used for

determining points of optimum operation.

Also, as mentioned, since different amounts of harmonics are in each plate, voltage feedback off either (when grid drive ratios are large) may not produce the requisite effect and should then be taken from the voice coil.

However, where fairly satisfactory transformers are used, it is important to realise (Figs. 13, 14 and 15) that this ratio does not alter much with change in grid drive ratio so that this should be considered when applying paraphase circuits. Also, when considering paraphase, the point of distortion should not be overlooked. It may be generally taken that the plate whose grid has maximum drive also has maximum distortion.

Since a levelling-off appears to occur in all general cases when VG_1/VG_2 is about .8, this should be the limit for push-pull conditions unless feedback is applied. As balance in all these cases occurs at $VG_2/VG_1 = 1.1$,

In figs. 1-16, the following curves are tabulated:

- **A = Phase shift from true 180° between V_1V_2 grids.**
- **B = Cathode peak A.C. volts.**
- **C = Ratio EP_1/EP_2.**
- **D = Phase shift between V_1V_2 plates.**
- **E = DB variation in output.**
- **F = Undistorted power output.**

this actually means that the drives on the grids may vary by 1.1/.8 or 1.37 times. Also at this point the apparent loss of power is negligible. Under any considerations, should the ratio vary between this and 2 times as much, feedback should be used.

Considering an average case of Fig. 13: The power has dropped at this grid ratio by approximately 25%. If we consider the power roughly proportional to the load, and the harmonic distortion as roughly inversely proportional to this, then the distortion is about 1.3 times as great. This will not be strictly true as the action is rather more complex, but this may be used as a rough yardstick.

Then, to cut back the distortion to the same point as before, the reduction factor is 1.3. Or, if you must use per cent., allowing a gain of 20 to the 6V6 stage, this is about 1.5%. Since this is a conservative minimum, it will be best to double the figure—giving a gain reduction of 2.6 and a feedback of 8%.

Fig. 8 shows the extreme variations which can occur in the plate ratio yet still show no relation to the power output. It is interesting to observe in Fig. 7 that under certain conditions it is possible for the undriven valve **to have the greatest alternating plate voltage.**

The frequency responses of Figs. 17 and 18 only further show that this ratio cannot be used for very useful observations since wide variations occur irrespective of phase shifts and the power output does not vary accordingly. Obviously, this is determined by the absolute valve of one of the voltages, not their ratio. In general, the plate ratio may be said to depend upon **the grid drive ratio to the valves, the phase angle between grid voltages, the output transformer and the balance of the same, and the valve quality.**

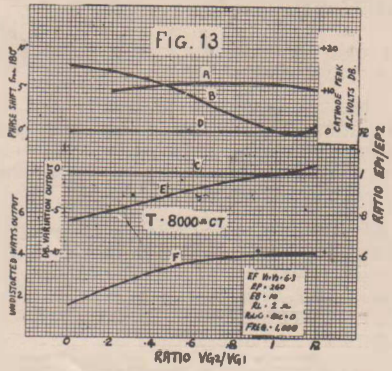
Plate Phase Changes

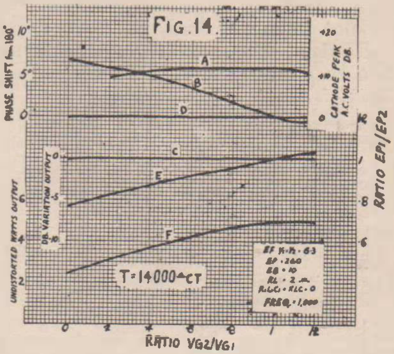
It is important to realise that the various circuit conditions shown do not greatly alter the phase shift across the transformer, so that any feedback circuits used will not have a changed frequency characteristic for different plate or A.C. voltage grid ratios. The departure from true push-pull depends, as would be expected, on the frequency (Fig. 18) and might become quite serious as is often the case in practice at frequencies over about 8,000 to 9,000 c.p.s.

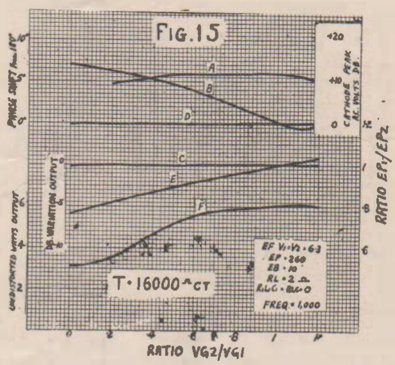
Point of True Balance

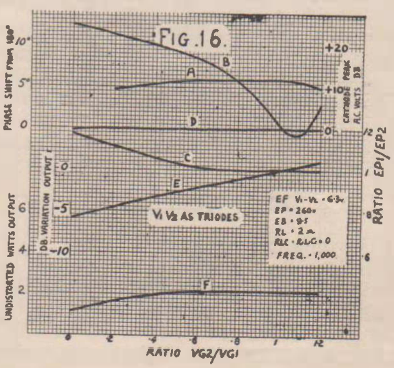
The point of balance has been mentioned several times. It will be seen that in all normal cases the minimum A.C. cathode volts occur with a VG_2/VG_1 ratio of 1.1. At this point, only second harmonic remains, and in each case coincides with maximum power output and, by observation, with equal distortion in each plate for a small overload. It is obvious that this voltage may be taken as a very satisfactory indication of true balance if such is required. While the amount of voltage tends to indicate the state of unbalance.

Since the plates are practically in true antiphase, the current in the common cathode arm may be taken as the difference between them. The cathode voltage then is an indication of the difference in A.C. plate currents in the two valves. The valve with the greatest drive has the greatest current, as would be logically expected, irrespective of the individual alternating plate voltages, for, as we have already seen, these may vary considerably, but in every case the curve B takes approximately the same shape. Thus, the curve B serves to









PUSH-PULL (Continued)

indicate the excess of plate current in the valve with greatest drive.

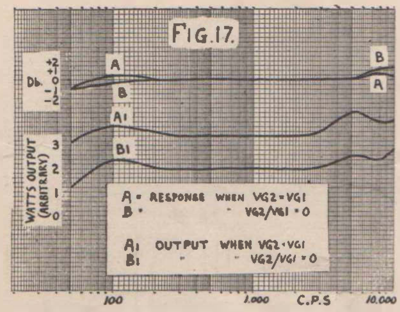
The curve must therefore take a minimum, as first one valve then the other receives greatest drive, the midway condition depending on the actual valve characteristics.

To further substantiate this, take Figs. 1, 10 and 11 for cases of practically equal valves, then Fig. 10, V_1 weak, and Fig. 11, V_2 weak. In Fig. 10, as would be expected, balance occurs at a smaller VG_2/VG_1 ratio since the operating current of V_2 is much greater than V_1. In this case, then, the right-hand slope of curve B indicates excess current due to V_2, while in the case of Fig. 11, balance has still not been reached, as more drive is required to make V_2 alternating plate current equal to that of V_1.

It is to be remembered that A.C. plate current is given by $I = GMVg$, where GM is the dynamic mutual conductance, which depends on valve quality, and Vg is the grid voltage.

This will again be considered in our final analysis.

Since this cathode voltage is in phase with the input voltage, it exerts a "degenerating" effect which it might well be argued would give the gradually increasing gain curve of E in these graphs. Fig. 9, however,



shows the effect of by-passing the cathode and the gain still increases with the VG_2/VG_1 ratio. In this case the cathode A.C. voltage is smaller but only comparative. No actual values are shown, so that this again indicates an excessive V_1 A.C. plate current. In this case the overall gain is somewhat greater, but this does not give us much indication of events — it is the change of gain with VG_2/VG_1 that, as we shall later see, is most important.

Gain Variations

The change of gain (curves E) is therefore an indication of amplification taking place within the valves themselves and shows that varying the grid drive ratio must be in some way affecting the valve operating characteristics, otherwise curve E would be greatly affected by the presence of CK in Fig. 20.

Several mentions have been made of normal cases. This refers to conditions most likely to be met in practice with good transformers delivering evenly balanced loads, and all, except Figs. 7, 8, 10 and 11 may be regarded as such.

It will be noticed that much more rapid balance occurs with the valves as triodes (Fig. 16) than in any other case. Whatever causes the effect must therefore also be in keeping with this observation. It will be apparent from this that the change in grid drive ratio must have the effect of changing the individual plate currents. This will be further considered later.

It is important, before passing on to the power output, to consider the loss of gain which actually results due to zero drive on one push-pull grid. Since this is an average of 6 D.B., it means quite a substantial amount, and for a constant input means **that only one-quarter the power will be delivered.** To raise the power it will be necessary to double the input voltage which will obviously **extend into the region of grid current of the driven tube and so only aggravate the distortion which, as already mentioned, is quite severe at relatively low levels of power.**

Power Output

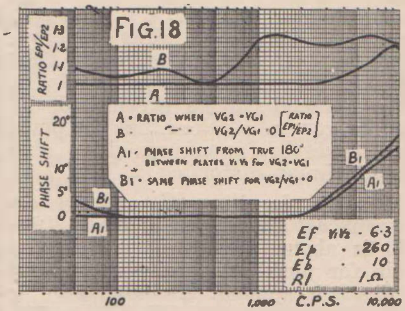
The power output (curves F) seem to be low, but this is understandable in the light of previous remarks.

It will be observed that once a drive ratio of about .8 is reached this curve starts to flatten out and for all practical purposes may be regarded as satisfactory from this point of view. There is thus little power loss or increase of distortion from true balance to a drive ratio of about 1.37 on the grids. That is, the **grid drive ratio need not be critical** and may vary about $\pm 30\%$ from true balance without the effect being serious from a quality point of view. At this juncture it must be realised that we are considering the operation of push-pull **from the point of what can be regarded to-day as good reproduction.**

For poor tonal response, or only "speech" consideration, it is possible that the above ratio might be greatly exceeded.

It will be observed from Figs. 1, 2, 3, 13, 14 and 15 that the actual secondary load may vary over wide ranges without affecting greatly the point of balance or relative losses at given grid drive ratios. Since the secondary load is fixed in each case, some difficulty would result if a change in load also greatly affected the grid drive ratio, due to some particular circuit condition departing from conventional arrangements. The load obviously affects power output, but should the grid drive ratio be altered simultaneously severe distortion could result. Otherwise, we may say that the condition of grid drive is quite unaffected by the loading.

The loss of gain from true balance at the above ratio of .8 is, in general, only about 1 d.b. and therefore not serious. It might be thought, too, that this gain curve should reach a maximum. However, this cannot be so un-



til the valves are quite blocked, for, as balance is passed, it merely means a reversal of drive condition and the gain must therefore increase.

Grid Drive Ratios VG_2/VG_1

It will be noted that the grid balance ratio is even more broad when the load is low (Figs. 2 and 13). Generally, however, the slope of this curve may be taken as an indication of the distortion occurring at that particular drive ratio. Thus, in Fig. 1, at a ratio of .5, the power has dropped appreciably, so we may consider distortion to start rising. This statement is merely in keeping with previous observations.

From the normal cases we see that, even with feedback, the grid ratio should not fall below 2 (.5), since there is not only an increase of distortion but the loss of gain and power is too great to be satisfactorily overcome, while **feedback, of course, can only further lower a gain already dropping.** There is little advantage from a reproduction point of view to balance exactly, and in any case this would **require readjustment every time a valve was replaced.**

It might be wondered how balance occurs in these experiments at $VG_2/VG_1 = 1.1$, instead of 1. This was due to different valve characteristics which might reach a difference of as much as 20%, even in new valves. The valves were reversed in position in the test set-up of Fig. 20, and balance then occurred at a ratio of .9, showing this to be true.

It was decided, however, to choose "poor" conditions, and the weaker valve was therefore put in the position which would receive no drive at one end of the attenuator setting.

Initial Analyses — Plate Loading

There now comes the very important part of analysing all these graphs into some workable and useful conclusions. One thousand experiments or so are not much use if all we can say is that one thousand ways won't work.

It seems at first difficult to obtain a correlating factor for all the varying data, but a little study soon clears the situation. Considering first the normal circuits: Since the A.C. plate voltage is unity, and from curve B the A.C. plate current in V_1 is greater than in V_2, then the effective load —

$$\frac{EP_1}{I\ A.C.} \quad \text{of } V_1$$

must be much lower than V_2. Because the drive voltage on the grid of V_1 is fixed, then at balance the A.C. plate current equals that of V_2. The change of plate current must then occur, due to the dynamic mutual conductance, which means that the load must decrease from its optimum value at balance to a very low value when the drive on the other valve is dropped. Under these conditions we would expect a large second harmonic component to be developed and, of course, a decreased power output. Although the "effective" load of V_2 must increase, it cannot make up for the drop in grid drive, otherwise the A.C. plate currents would remain equal and curve B would be a straight line.

Broadness of this grid ratio could then be expected, because as V_2's load became equal to V_1, so the second harmonics would tend to balance — but broadly so — since the amount of second in V_2 would rapidly rise as V_1 dropped, so tending to keep the value constant over an appreciable range, until V_2, due to low grid drive, had very little second, so that the overall, due to V_1, would be quite appreciable. This change in load is depicted in Fig. 21.

Under these conditions, too, it is apparent that as the effective load of V_1 (Fig. 19) gradually rose there would be a gradual rise in overall amplification

$$\frac{URL}{RP + RL}$$

which would be independent of cathode by-pass.

Also, since the loads on each plate would vary as the drive ratio varied, then it is apparent that different types and amounts of distortion would be observed on each plate. Should the valves be arranged as triodes, the rising of V_2 (undriven) plate load would very rapidly drop its A.C. plate current, so making a very perceptible minimum point and, at extremes, a very large observed cathode voltage. In fact, if the reader accepts this solution, it may be satisfactorily applied to the observations recorded and will certainly assist in understanding push-pull more clearly.

I wish to express my thanks to the Rola Speaker Company for their co-operation in preparing samples for these experiments.

— C. PARRY.

This observation is borne out by the calculation of the effective plate load (given in Radiotronics 79) of each valve.

This is —

$$\frac{1}{4}\,RL \left\{ \frac{1 + RPV_1}{RPV_2} \right\}$$

RL is the normal plate to plate load, RPV_1 is the plate resistance of the valve whose load we are considering, and RPV_2 the plate resistance of V_2.

The plate resistance varies considerably with the grid drive and in the extreme case, with no drive on V_2, may be considered infinite. This must be so, for we have the same A.C. plate voltage on each valve yet zero grid drive on V_2.

Its dynamic amplification is then infinity, giving it an effective infinite impedance. Under these conditions, the load on V_1 is a maximum of ¼ RL or half normal load, while, since it must also supply power to the other valve and the other half of the transformer, it is probably less.

At the point of balance, of course, each valve has a load of ½RL since $RPV_1 = RPV_2$, and in this case the transformer serves only as a coupling and could, if required, be made in two separate units. However, by making a centre-tapped unit, the effective D.C. through the windings magnetising the core is greatly reduced and the low frequency response can therefore be extended.

It will be realised at this stage that at low signal levels the effective plate impedances must also change.

As a result, the distortion factor will depend on the amplitude of signal for large grid ratios, because under these conditions the ratio

PUSH-PULL (Continued)

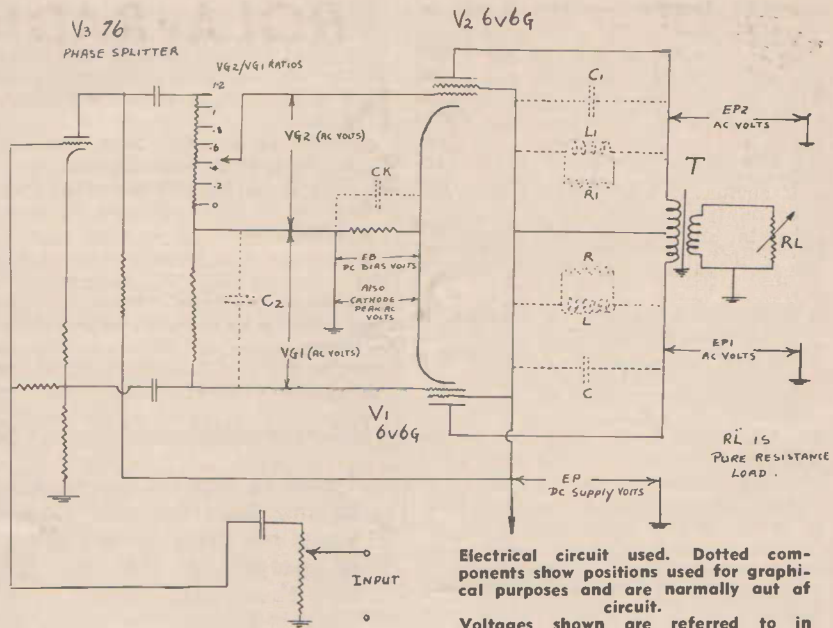
Thus increasing the signal in these experiments, at low grid ratios beyond the point where distortion starts, does not greatly increase the distortion, unless, of course, the region of grid current is entered, because the changing V_2 plate impedance (due to increasing signal) tends to raise the effective load of V_1.

This effect will obviously be most serious at grid ratios of less than .8 (on our graphs) as can be judged from the shape of the curves F.

We may say, in fact, that beyond this the plate impedances vary too rapidly to allow much automatic compensation to take place. Thus low grid ratios will give complex distortion effects for varying signal inputs and on this score alone should be avoided. Under these circumstances the plate load will depend in a very complex way upon the **actual signal on the grid of the main driven valve, the grid voltage ratio and the reflected load from the secondary of the output transformer.**

Sliding Reflected Load

For a clearer understanding of what goes on we may regard Fig. 21. R_2 and R_3 represent resistors which vary so that they decrease as the signal on their corresponding grid increases. The minimum value of each will be slightly less than half the normal rated load for the valve as a class A amplifier. The maximum value will be at least 10 times this value (since infinity is rather a hard conception to put into resistors). These resistors represent the effective plate loads of the valves as presented to them through the action of the transformer.



Electrical circuit used. Dotted components show positions used for graphical purposes and are normally out of circuit.
Voltages shown are referred to in graphs and text.

We may then quite conveniently assume that the load reflected by the transformer is of a varying nature, **its centre tap sliding up and down depending on which valve has the greatest drive.**

The minimum load reflected will be the rated plate-to-plate load, and the maximum infinity. Or better, a maximum variation takes place at which the load on one half the secondary is, at most, half its correct value, and on the other half is infinity, the one increasing and the other rapidly decreasing until the reflection is the correct plate-to-plate load, while beyond this the process is the same but on different halves of the transformer.

By observing Fig. 21 and keeping the above in mind, the broadness of grid drive ratio will be more readily apparent, and the excessive distortion and loss of power will become more understandable. Other factors, too, will fit more easily into the picture.

Summary of Data

It is now fairly simple to summarise the important conclusions which have been made and put them into workable form. These will apply in general to any class A stage push-pull.

(a) Observation of the A.C. plate voltage ratio is indicative of nothing.

(b) Where exact balance is required, this can only (and very satisfactorily) be checked by obtaining a point of operation such that minimum A.C. cathode voltage results.

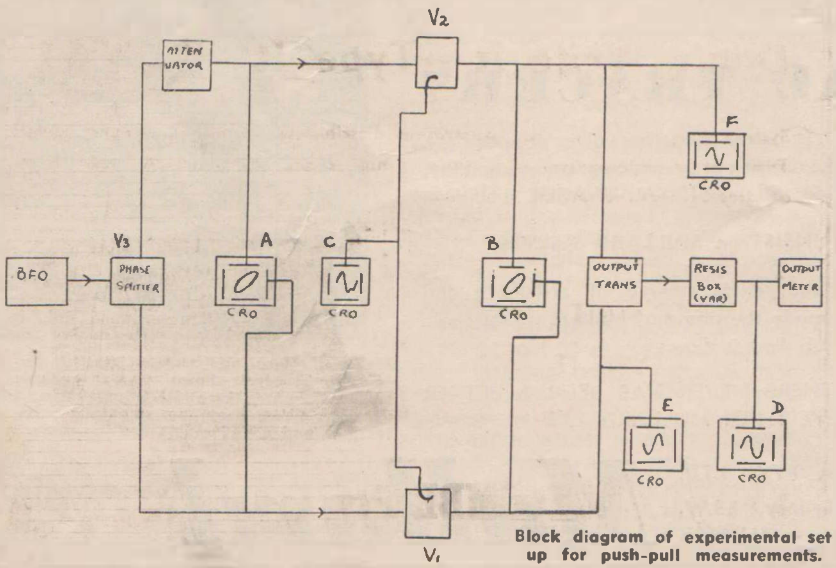
(c) There is no point to be gained in using a cathode by-pass condenser.

(d) Any feedback taken from the cathode must be very carefully considered, owing to possible second harmonic regeneration.

(e) Inverse feedback to previous amplifier stages should not be taken from either plate but from the voice coil unless a grid drive ratio of less than .8 : 1.1 (1.37 times) is used.

(f) Circuit conditions popularly known as "Barnes" should not be tolerated unless lowered gain and power, plus increased distortion, can be allowed.

(g) The ratio of grid voltages is not critical and may vary from true balance at least ±30% without serious results. Beyond this, and to a range of two times, inverse feedback should be used, giving a gain reduction of at least 1.3 times, and preferably twice



Block diagram of experimental set up for push-pull measurements.

as much. Beyond this should not be tolerated under any conditions.

(h) Phase shifts will not be serious for conditions of unbalance in the grid drive, so that in cases of unbalance no fear need be felt that such shifts might affect the frequence response, i.e., the response with feedback (applied to previous stages) will not alter if the grid ratio changes.

(i) There is no point to be gained (outside of laboratory considerations) in exact balance, and this is further evidenced by the fact that it must be adjusted with each new change in existing circuit conditions.

(j) The transformer, provided it is

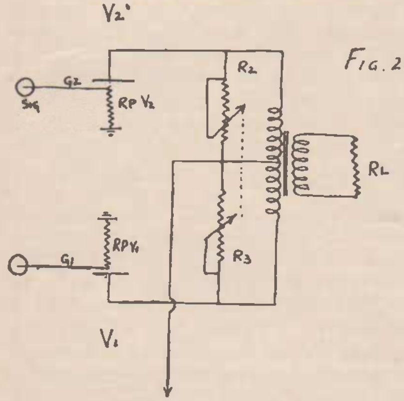


Fig. 21.

of a standard and satisfactory make, will not upset normal operation even for comparatively large unbalances, within itself, over the grid ratio range discussed. That is, the circuit conditions are not greatly critical on the transformer balance, provided the grid ratio does not depart more than indicated from true balance.

(k) These conditions hold for both triodes and pentodes.

(l) The secondary load may vary over a wide range without these conditions changing appreciably.

(m) The plate load into which each valve works is dependent upon the grid drive ratios as much as it is on the output transformer.

(n) Even perfect balance does not necessarily mean even harmonic distortion is completely eliminated.

Conclusion

It will be observed that many fairly popular fallacies are somewhat exploded by these observations. However, this is quite possible, because many fallacies have a very insecure background. The observations made were done very thoroughly and may quite readily be used for reference purposes.

Space does not permit of a detailed discussion of all the graphs shown, but the information given so far will enable the reader to analyse those graphs which might appear to apply to some particular problem with which he is associated.

Measurements were taken at 1000 c.p.s., since this appeared to be the most satisfactory standard from which unbalances might be calculated. The valves were not individually balanced for mutual conductance as this is not normal in practice. The frequency run made shows only a slight departure between curves for two extreme conditions, so that, whether feedback is used or not, no fear need be entertained that the response will be affected by changing grid drive ratios.

Finally, it is to be hoped that the data made available by all these observations will prove of use in both the understanding and design of this very popular circuit arrangement.

ROLA RADIO NEWSREEL

NO RADIO programme has been more in the news in the last twelve months than has Rola Radio Newsreel, inaugurated by the Rt. Hon. R. G. Menies on September 8, 1940.

For the first six months the programme originated in either 2UE or 3XY studios and was broadcast by both these stations. Recently, however, the programme direction has been centralised in Melbourne and relayed to the popular South Australian stations, 5AD-PI-MU-SE.

The programme follows a fairly definite form in that it opens with a brief summary of the news (akin to the B.B.C. headline news), followed by a commentary on the news by Rola's expert commentator (Mr. G. Sawer). This has been a feature which listeners have been quick to appreciate owing to the unusual material and method of presentation. Incidentally it is interesting to note that this commentary is regarded by the Rola Company as an editorial.

Another feature and it is this on which the programme usually ends is a musical item, "The Story Behind the Song." While not necessarily topical, this item is frequently connected with the news as was the "scripts" on Kriesler, Paderewski and there was the notable occasion when Yugo-slavia flared up into the news, when the orchestra of the Yugo-slavs Club was brought into the Sydney studios.

The most notable strip was the V for Victory song, which was hailed throughout the country as one of the greatest scoops of its type in the radio broadcasting. Rola Radio Newsreel presented the first full performance of Wing-Commander Goodman's sensational song, "V for Victory." On this memorable occasion, Rola Radio Newsreel made headlines in the newspapers.

In its forecast of the news Rola Newsreel has been remarkably accurate, and within the last month skilfully connected the Syrian campaign with a likely move into Iran. Events show the newsreel to be correct.

This highly entertaining programme is broadcast by Rola Company (Aust.) Pty. Ltd., manufacturers of loudspeakers, magnet winding wire and magnet alloys. It is broadcast at 7 p.m. every Sunday evening from the previously-mentioned stations.

SPEEDY QUERY SERVICE

Conducted under the personal supervision of A. G. HULL

V.L. (Granville) is in trouble with a coil kit.

A.—From what you say we would think that you have been supplied with an unmatched set of coils. So far as we known, all "Crown" coils and components are supplied in boxes which are clearly branded and with the correct converter valve and type of gang condenser shown on the label. With the correct type of coil bracket the padding condenser is built into the unit and is not supplied separately at all. We can only suggest that you go back and have a chat to the dealer who supplied the components.

* * *

P.L. (Corowa) wants a design for a battery set with ocoustic compensation.

A.—So do we! We have had many requests for circuits of this kind, and have referred the matter to Mr. Parry. He has done considerable work in this direction, but has been unable to evolve a circuit which is completely satisfactory. We have the matter well in mind, however, and if any solution to the present problem come to light we won't hesitate to let our readers know all about it.

* * *

W.L.K. (Paddington) raises some interesting paints about amplifier design.

A.—There seem to be three different schools of thought on this subject at the moment: 1) Those who prefer the old-style triodes in push-pull; (2) those who like beam power valves in push-pull with inverse feedback, and (3) those who can produce theoretical argument to prove that the ideal is a single beam power valve with suitable feedback. In practice there is still little doubt about the popularity of the old triodes. We suspect that this is due to the fact that many examples built up to latest circuits for beam power valves fail to give perfect performance on account of the presence of parisitic oscillation, which is so easy to run into when using high-gain valves and intricate feedback circuits. Precautions, such as a mica .005 condenser from screen to cathode at each output valve

socket, grid stoppers and plate stoppers, can be helpful in some cases, but often enough the trouble is only in evidence as a type of distortion which makes the reproduction irritating without being sufficiently noticeable to be readily identified as such. With some amplifiers it only creeps in at low volume levels, in others only at high. With beam power valves the matter of correct loading is more critical than with triodes, in fact, in every way the triodes are easier to get into proper operating condition. In a correctly designed amplifier they can give reproduction which is highly satisfactory.

* * *

G.K. (Bowrol) draws our attention to a little act of piracy in regard to the simple inverse feedback circuit which we have used several times since it was first published in "Radio World" in 1939.

A.—Yes, we noticed, but it really doesn't concern us and we don't worry a bit about other technical journalists using our ideas when they run short of inspiration. The circuit is a most effective one and so simple that it is rather a wonder to us that they didn't wake up to its advantages long ago.

Incidentally, we notice that two of the American journals have taken up the same circuit, one of them giving us due acknowledgment, but the other making a grab without apology. The question of copyright doesn't arise. We publish our magazine with a view to helping technicians far and wide and if we also help our contemporaries, well, that is all in the game.

Many thanks for the good wishes.

SIGNAL TRACER

(Continued from page 9)

audio or detector. The signals should being tested and increase going along. This being the end of the audio sections, turn the switch to contact K. There is now a suitable signal ready to apply to any part of the I.F.-R.F. sections, commencing from the diodes of the detector and working from plate to grid until the aerial terminal is reached. The fault will be located when the signal stops.

Important

The signal tracer earth terminal should always be connected to the H.T. negative or earth terminal on the receiver being tested.

Controls

Taking the signal tracer illustrated, front panel. The controls, commencing with the bottom row and reading from left to right, are as follows:

First on left: A.C. power main switch.
Second on left: Audio volume control.
Third on left: Probe switch.
Fourth on left: R.F. gain control.
Fifth on left: Attenuator.
Sixth on left: Switch on dual-wave coil box.
Seventh on left: Speaker switch.

Second row:
First: Earth terminal.
Second: Meter sockets.
Third: Probe socket.
Fourth: Probe socket.
Fifth: Tuning dial.
Sixth: Aerial terminal.

Immediately above these are a pair of indicator lights. The speaker is in the centre. The top row of controls above the meter (left to right) are:

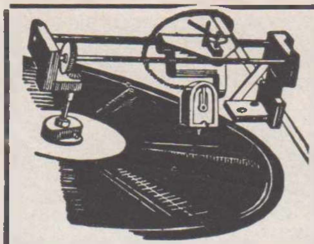
1: Ohm adjustment.
2: 6E5.
3: Meter range switch.

On the underneath view it will be noticed that some condensers and resistors are marked which cannot be seen in the circuit diagram. This is due to substitution. That is, in some places we had no 5,000, so 10,000 in parallel were used. Some of the condenser capacities were made up in the same way.

The output meter terminals and the switch from the negative side of the meter to earth were put on after the photographs were taken.

The instructions given above give the main outline of the uses of the signal tracer. When familiar with its operation, the serviceman will find that it can be employed in innumerable ways, and he will never be without a signal tracer in his workshop.

The writer of this article has built and experimented with a number of different type signal tracers and will be pleased to give anyone further advice on this instrument or signal tracing in general.



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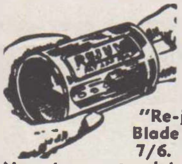

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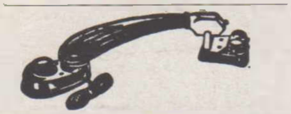

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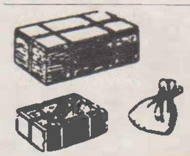

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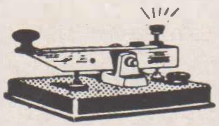

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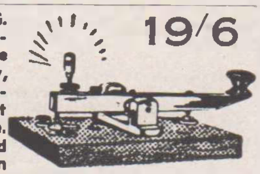

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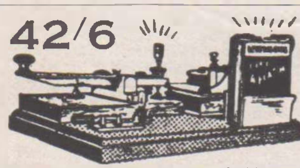

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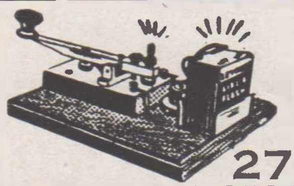

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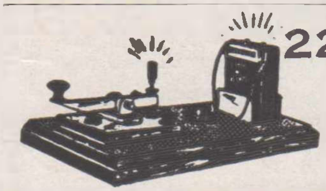

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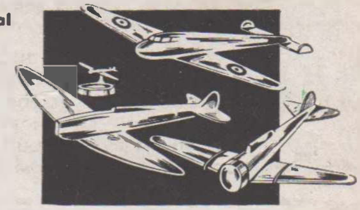

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