THE AUSTRALASIAN

Radio World

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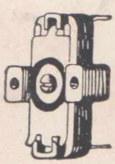
1/-

VOL. 13 ..... NO. 5

OCTOBER, 1948

CROWN
COMPONENTS



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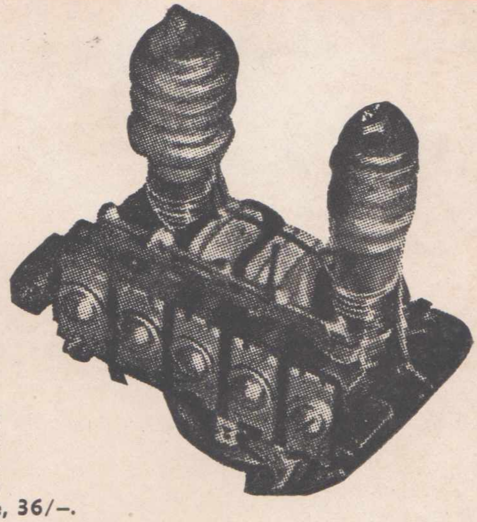
455 Kc. using Polystyrene base. For use in conjunction with H. gang condenser. Price 2/6.



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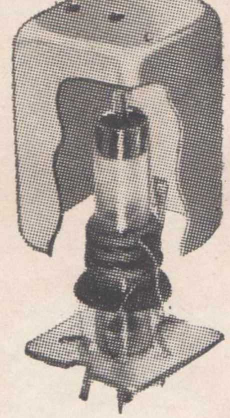

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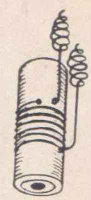

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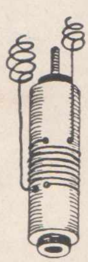

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I.C. 62 aerial,
I.C. 63 R.F.,
I.C. 64 oscillator,
13 to 42 metres, for use on standard H. gang. Price 4/9.

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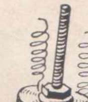
2 to 35 mmfd. on Polystyrene base. Price, 1/1.



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Reinartz Coil in aluminium can. Price, 7/6.

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THE AUSTRALASIAN RADIO WORLD

Devoted entirely to Technical Radio

and incorporating

ALL-WAVE ALL-WORLD DX NEWS

Vol. 13 **OCTOBER, 1948** **No. 5**

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EDITORIAL

In the English "Short Wave Magazine" I notice the following comment and I quote: "In the course of a recent airmail letter an Australian correspondent remarks as follows: 'In my opinion radio in Australia is a pricked balloon from the trading angle, though it is still good business for the commercial broadcasting people feeding moronic material to receptive illiterates. If you know of any Englishmen thinking of leaving home to start in radio here, tell them to think again; there are neither homes nor security to be had and to make more than average money one must be a lottery winner. One Englishman I know here (in Australia) rues the day he came——'."

A few minutes later I was reading the local newspaper about the forming of Thom and Smith's into a public company, and of their recent turnover of about half a million pounds a year. My mind went back to the days when Freddy Thom and his pal Smith left a certain radio factory and started on their own in Woolloomooloo. They had mighty little capital and everybody seemed to agree that the time was most unsuitable to start a new business. But they had guts, plus ability and faith. They didn't ask for security. They made it for themselves. They turned out sets with performance well beyond the average, secured the services of a first-class technician, Ed Fanker (whose name is now on the list of directors, I am happy to note) and away they went. They have never looked back and I for I would like to offer them my congratulations.

Australia needs immigrants, but they want to have guts, ability, faith and vision. I agree with the correspondent quoted only in so far as that anyone will be better off in England than seeking a home and security in Aussie.

A. G. HULL.

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A. G. HULL,
Balcombe St., Mornington, Vic.
Phone M'ton 344.

Technical Editor—
PAUL STEVENS
21 Fletcher's Av., Bondi, N.S.W.
Phone FW 6157.

Short-wave Editor—
L. J. KEAST
7 Fitzgerald Rd., Ermington, N.S.W.
Phone WL 1101.

Ham Notes by—
DON B. KNOCK (VK2NO)
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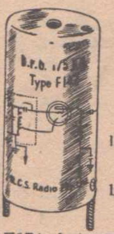
COILS

FOR MANTEL—CONSOLE—PERSONAL RADIOS

STANDARD INTERMEDIATE TRANSFORMERS



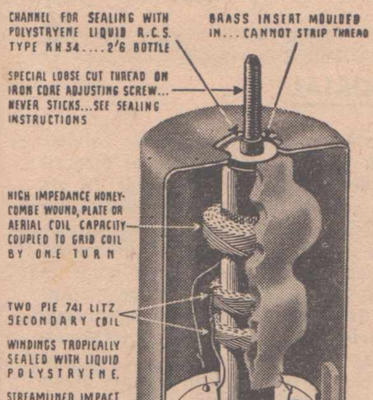
460 K.C. Intermediate Transformers

IF170 Intermediates 1st Stage Perm Iron Core	13 0
IF171 Intermediates 2nd Stage Perm Iron Core ..	13 0
IF174 Intermediates Low Gain Perm Iron Core	13 0

Shunt Condenser moulded in Base.

175 K.C. INTERMEDIATE TRANSFORMERS

E74 175 K.C. Permeability Iron Core 1st	13 9
E75 175 K.C. Permeability Iron Core 2nd . . .	13 9



NEW PERMEABILITY TUNED COILS

1. Wound on Polystryene formers.
2. Engraved with number and letters for easy identification.
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4. Extra High impedance Primary.
5. Fitted in round shield 2" high x 1⅜" dia. with 2 mounting feet ⅛" Whitworth thread.
6. The can being printed with all technical specifications, etc.
7. Polystryene sealed coils.
8. Special sealing channel for iron core screw
9. Cores adjustable from top of chassis

LOW LOSS COIL LACQUER KH34 — 2/6

A concentrated polystryene lacquer for impregnating all components against humidity climatic changes, etc. Also invaluable for holding coil turns in place and anchoring ends of coil. An excellent seal for iron core screws and other similar purposes. Every radio engineer and amateur should have a bottle standing by

WIRE WOUND RESISTORS

0 ohms to 1500 ohms, 100 M/A	1 0
1500 ohms to 2500 ohms, 50 M/A	1 2
2500 ohms to 10000 ohms, 25 M/A	1 2
1000 ohms Field Replacement	4 0

COIL FORMERS, 6 PIN PLUG IN

These transparent coil formers are moulded from polystryene powder. They are engraved for frequency and type and indented for color spotting. May also be grooved for space winding. Socket pins are heavily nickel plated

Type 124, 1¼" dia.	3 3
Type 125 1½"	3 5

5-BAND SHORT WAVE AND BROADCAST COILS

H124 10m. Aerial	4 6
H125 10m. R.F.	4 6
H126 10m Osc.	4 6
H127 20m Aerial	4 6
H128 20m R.F.	4 6
H129 20m Osc.	4 6
H130 40m. Aerial	4 6
H131 40m. R.F.	4 6
H132 40m. Osc.	4 6
H133 80m Aerial	4 6
H134 80m R.F.	4 6

R.C.S. VOLTAGE DIVIDERS

VD25 15000 ohms 2 variable clips	5 6
VD28 25000 ohms 2 variable clips	5 6

T.R.F. COILS—REINARTZ

T81 Reinartz Coils, unshielded, Air Core	5 6
T82 Reinartz Coil, Shielded Iron Core	6 6
T87 R.F. with Reaction H gang Air Core	6 6
T88 Aerial Coils, H gang Air Core	6 6
T89 R.F Coils H gang Air Core	6 0

TRIMMING CONDENSERS

CG15 2-plate	1 0

FILAMENT TRANSFORMERS

TP1 2.5 volts 2 Amps 7 Watt	11 6
TP2 4 volts 1 Amp 7 Watt	11 6
TP3 6.3 volts 3 Amps 7 Watt	11 6
TP55 6.3 volts 3 Amps 15 Watts	14 6

COIL KITS

COIL KITS, TYPE K121 — £2/3/6

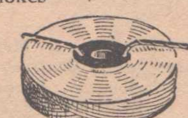
4/5 Superhet Kits—consisting of:—
1 E356 High Impedance Aerial Coil
1 E358 Oscillator Coil.
1 1F170 455 K.C. Intermediate
1 1F171 455 K.C. Intermediate
1 P21 Padder

COIL KITS. Type K122 — £2 11 0

5/6 Superhet Kits—consisting of:—
1 E356 High Impedance Aerial Coil.
1 E357 High Impedance R.F Coil.
1 E358 Oscillator Coil.
1 1F170 455 K.C. Intermediate.
1 1F171 455 K.C Intermediate.
1 P21 Padder

RADIO FREQUENCY CHOKES

RF106 Vibrator Low Tension, R.F Chokes . ..	4 3



RF81 Silk H.C. R.F Chokes ..	1 9
RF86 Cotton H C R F Chokes	1 6

RF82 3 Pie 1.7 M/H R.F Chokes	4 6
RF83 4 Pie 2.5 M/H R.F. Chokes	4 6
RF84 5 Pie 4.0 M/H R.F. Chokes	4 6
RF85 6 Pie 7.0 M/H R.F Chokes	4 6

FILTER CHOKES

TC60 100 M/A 30 Henries 250 ohms D.C. Res. . ..	13 6
TC65 50 M/A 30 Henries 400 ohms D.C. Res.	13 6
TC80 150 M/A 30 Henries	1 1 0
TC81 200 M/A 30 Henries	1 5 0
TC66 60 M/A 20 Henries 650 ohms D.C Res	10 0

AUDIO CHOKES

TA4 100 Henries 1000 ohms D.C. Res 25 M/A . .	18/6

VIBRATOR CHOKES

TC58 Low Tension 3 Amps 50 M/H .5 ohm D.C. Res.	15 0
TC70 High Tension 50 Henries 450 ohm D C Res., 75 M/4	15 0

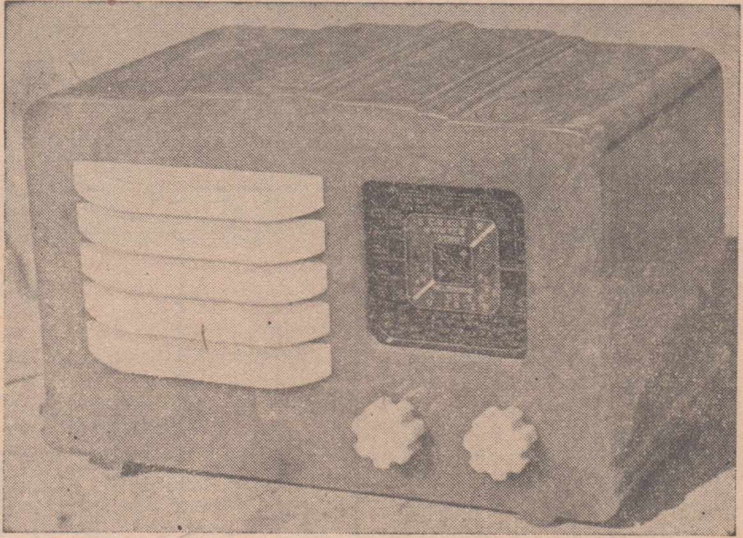
TELECONDA 4841

Pride of our new Technical Editor, Paul Stevens, this design for a mantel model has been thoroughly tested and found to give exceptional performance. The original set shown in the photographs was tested at Mornington and brought in 27 stations clearly at mid-day!

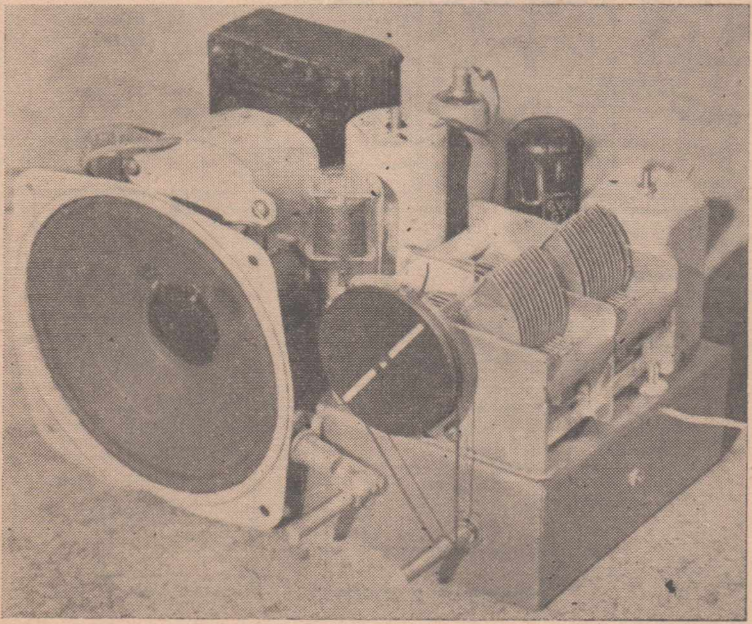
THE Teleconda R4841 differs from most other sets described in radio magazines for the benefit of home-builders by the fact that it is a commercial model, of which some hundreds have been built and sold. During this process all mechanical and electrical weaknesses have been eliminated and the R4841 is now a set which proved to be thoroughly reliable and stable in performance.

Apart from this we achieved two more desirable attributes to the commercial receiver: Durability, by electrical over-dimensioning of most components in relation to voltage and current applied; Independence of variations of valve characteristics and values of components (within reason, of course).

The set itself is a 4-valve reflex receiver very similar to the Teleconda 2, as published in A.R.W., April, 1947. It differs from it by: (a) A simplified AVC circuit, which makes the whole set almost as simple as a straight one; (b) the use of a 6SA7 converter, which was more or less forced upon me by the rather unfortunate decision of valve manufacturers to stop producing the EK2 in Australia and dropping it from the manufacturers' type list. It is now only available in very limited numbers for replacements as the more expensive, imported EK32.



Fitted in a plastic cabinet of bright blue.



Front view of the chassis.

I then had the choice between the ECH35 and 6SA7. From the radio technical point of view, the ECH35 was, of course, the natural choice; but considerations of price, availability and last, but not least, reliable stability in a production

(Continued on next page)

TELECONDA

(Continued)

set finally turned me towards the 6SA7. It was also the fact that this valve works without initial bias, which made the circuit simplification for AVC possble.

As for performance, the R4841 is about similar to a 5-valve set using 6J8, 6U7, 6B6, 6F6 valves, a still very common line-up of valves in our present-day receivers.

Now to the technical details: Fig. 1 shows the simple circuit. Starting with the aerial coil, we find a 5000 ohm resistor across the primary. This does not bring any noticeable loss of signal strength, but stabilises the set on the low frequency end of the dial, where sets often oscillate between stations, when the tuning approaches the IF frequency. With the 6SA7 converter watch out for both socket connections and cathode coupled oscillator circuit. The heavy screen current of 8 mA is supplied through two 20,000 ohm 1-watt resistors in parallel, the total load being .7-.8 watts, about .4 watts each. It is necessary here to use quality resistors and the only brand we can recommend is I.R.C. Although single-ended valves in the tuner usually present stability problems due to the proximity of plate and grid circuits, this is definitely not the case with converters, as there is too much frequency difference between RF on the grid and IF on the plate.

The reflex valve EBF35 is the really interesting part of the circuit. The IF signal, fed to the control grid, is being amplified by the valve and then, via the second IF transformer, fed to its diodes for detection; from there, via the volume control, the audio signal

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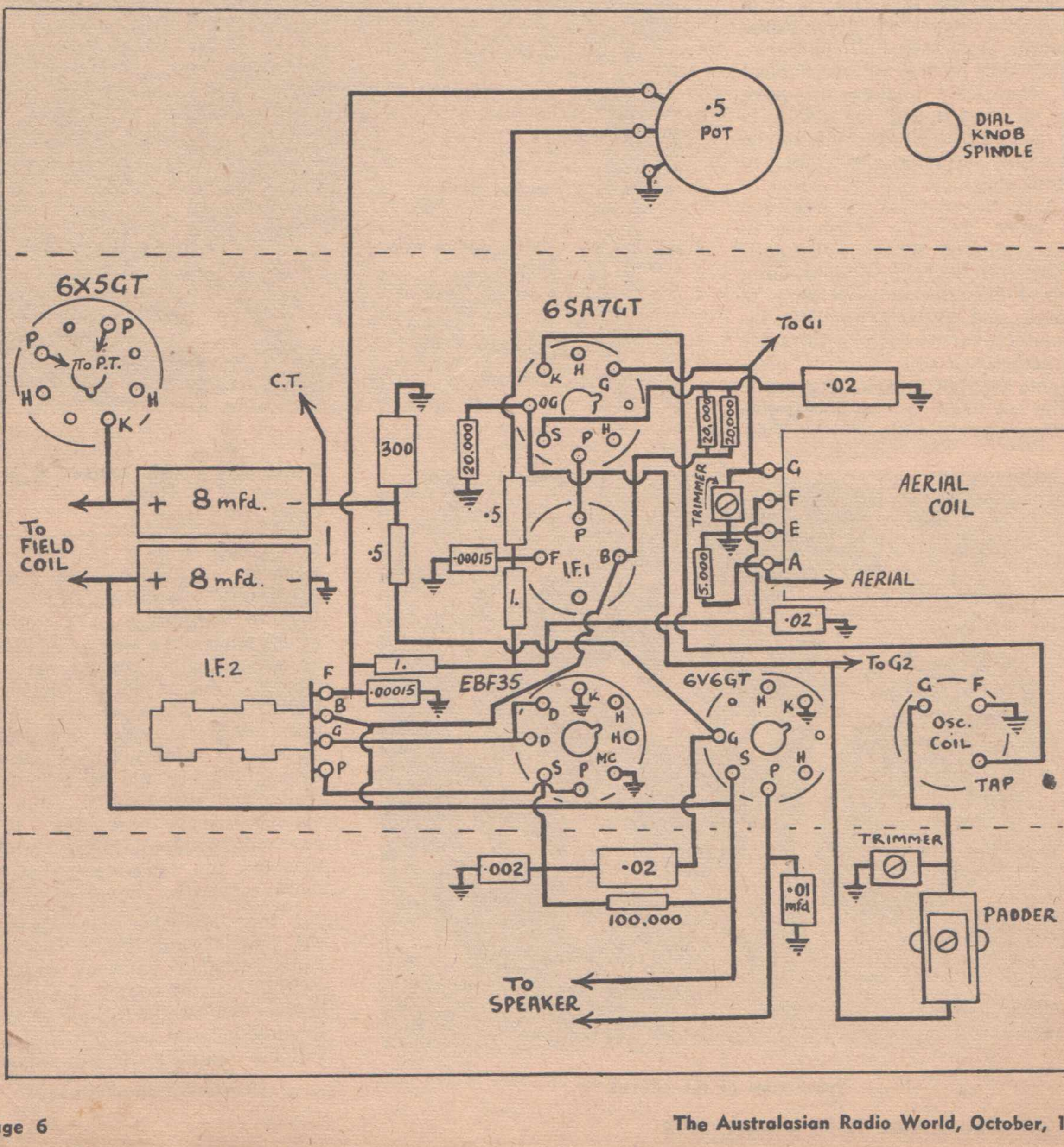

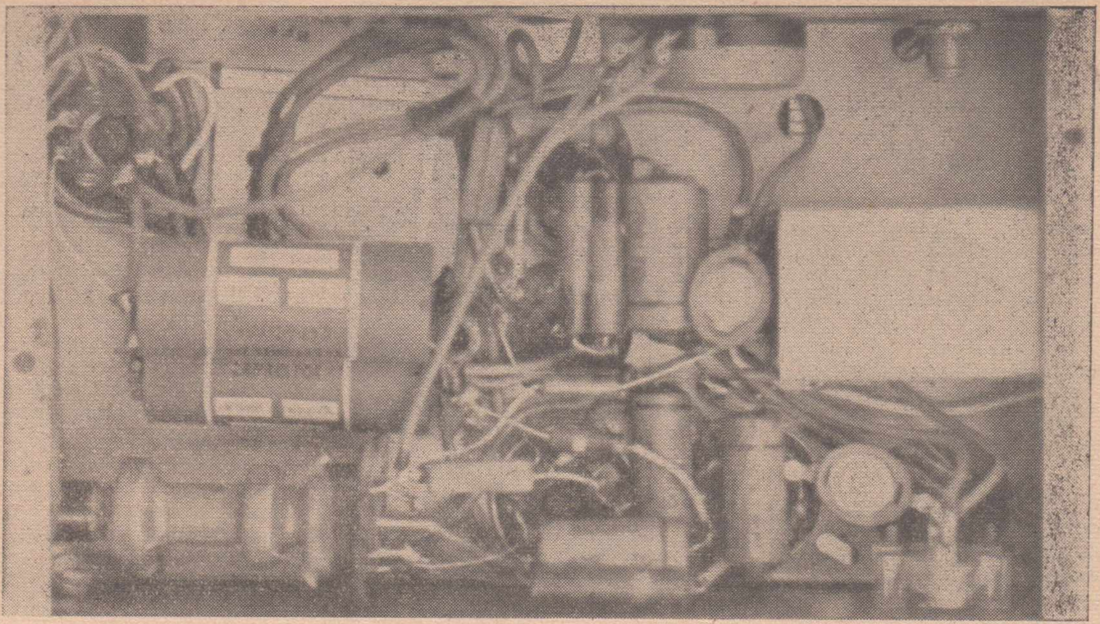

Use this photograph in conjunction with the picture diagram opposite and you can't go wrong with the layout.

TELECONDA

(Continued)

gets back to the grid of the EBF35 and is amplified, this time only by a triode consisting of cathode, control grid and, as plate, the screen grid of the pentode valve. The screen dropping resistor serves as load; the bypass is reduced to .002 so as to bypass only IF, but block audio frequencies, which are passed on to the grid of the output valve by the usual coupling condenser of .02 mf.

The EBF35 thus acts as a fully-powered pentode for IF signals, as a triode for audio signals. This somewhat unorthodox arrangement has big advantages over the usual system of putting the audio load resistor into the plate circuit of the reflex valve, which gives higher audio but less IF gain, and also increased distortion due to reduced plate voltage, especially at great signal strength. With this type of set it was therefore nearly always necessary to fit a local-distance switch, which decreased the signal input on local stations.

Another feature of reflex receivers is the "minimum volume

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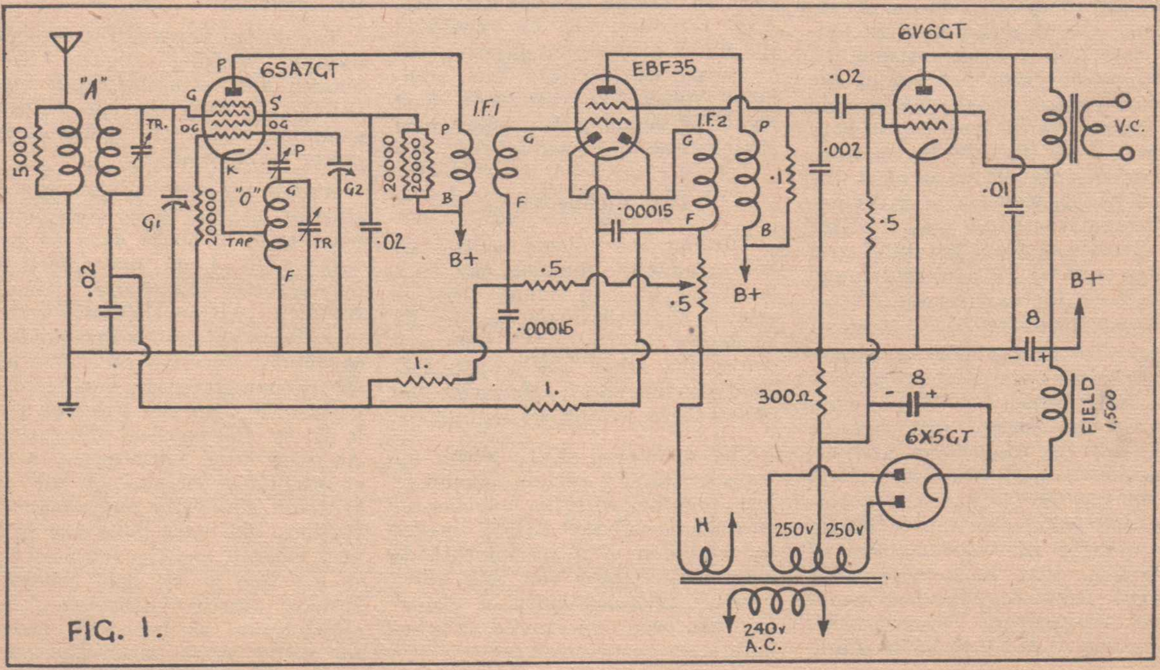


FIG. 1.

effect," which means, that the volume cannot be turned right off at the control. This is caused by the valve acting as anode bend detector, feeding a weak, detected signal straight from the first IF transformer to the output valve. The disagreeable thing about it is not so much that the volume cannot be turned right down to zero (for who will use his radio with the volume turned off?) but rather the harsh and high-pitched quality of the minimum signal, which, on strong locals, is, with normal reflex circuits, of soft room volume strength.

As the R4841 circuit uses only a triode for the audio section of the reflex valve, the minimum volume effect is naturally reduced. At the same time it gets a strong bass boost thanks to a peculiarity of the AVC circuit, which we are going to discuss now.

No Bias

Fig. 2 shows the AVC circuit only, taken out of the diagram in Fig. 1. First, we notice that the EFB35 has no bias arrangement whatsoever, the diode being directly connected to chassis. The diode load is presented by the .5 volume control, from which the EBF grid is fed directly, without blocking condenser, via a .5 resistor. AVC for the 6SA7 is provided by the 1 meg. resistor R1, which feeds from the top of the volume control to the 6SA7 grid (of course via the grid coil in both cases). Note that the bypass condenser is only .02 as against the standard .05, which is of great importance. Another 1 meg. resistor R2 feeds back from the 6SA7 grid return to the EBF grid return and that is all there is to our AVC—volume control circuit.

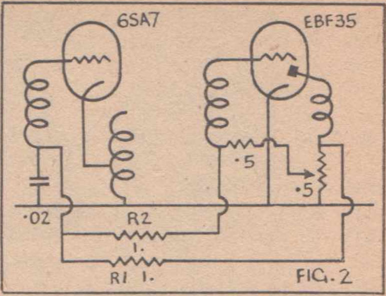
Now let us see how it works: First we take the case of the volume fully turned on. The moving arm of the control will then be right on the "hot" end and—oh horrors!—both EBF and 6SA7 will be on full AVC, the former getting full volume on top of it! By the thought of the quagmire of distortion, that must necessarily emerge from the speaker under these conditions, every self-respecting A.M.I.R.E. must faint, his slide rule curl up and the screen of his oscilloscope crack with dismay. But nothing of the sort; to the human ear there is no noticeable distortion, the tone emerges as clear as a bell at loud room volume; and loud room volume is the maximum volume our AVC allows and is all a small mantel set should ever be used with unless you want it to rattle itself to bits. But at this volume level most stations will come in, no matter whether local or distant, as long as they are within the sensitivity limit of the set. Here in Sydney I get 2BL, our strong national local, and 2KA, Katoomba, about 60 miles away, in day time at about the same volume. The 100 per cent. efficient AVC is due to the fact that it acts on audio frequencies as well as RF and IF.

Now let us have a look at the other extreme, the volume turned off at the control, the wiper arm right at the "cold," earthed end. AVC will still reach the 6SA7 through the 1 meg. resistor from the top of the potentiometer, from there it will feed to the EBF35 via the second 1 meg. but the .5 meg. decoupling resistor, which is now on earth, will cut the control voltage down considerably. "Minimum volume" will reach the speaker, but it will not be harsh and tinny. The high notes will be counterbalanced by strong bass, which is fed in through the two 1 meg. AVC resistors, the .02 bypass in the 6SA7 grid circuit filtering out all other frequencies. The minimum volume is very soft, just right for listening in a quiet room sitting close to the set.

Tone Compensation

Turning the volume control up will gradually diminish the bass boost, till at loud volume there is even a slight bass cut, as the .02 condenser in the AVC line now works the other way round, this time on the 6SA7. However, the effect there is almost negligible.

The undelayed AVC, which always produces a certain amount of bias, together with the low bias requirements of the EBF35 makes the omission of a special cathode bias arrangement for this valve possible. No instability or distortion has been experienced as a result.

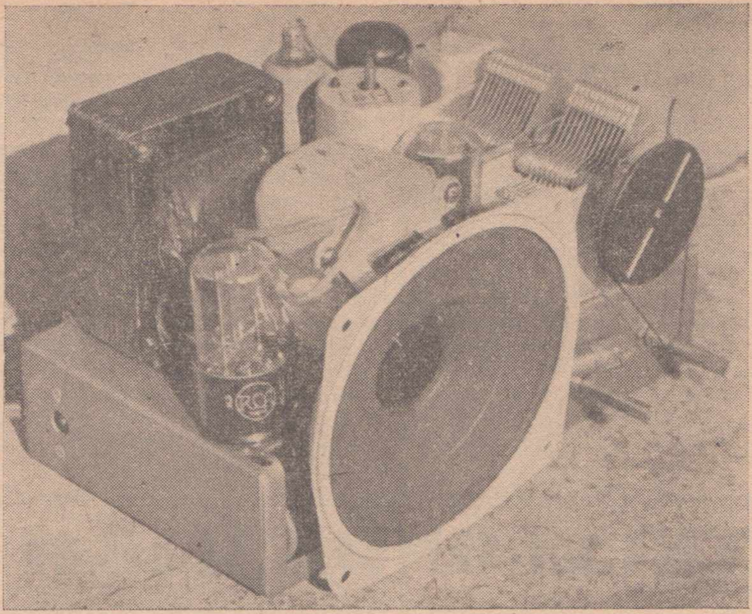


A.V.C. Circuit

Fig. 3 shows an alternative AVC-volume control circuit, which is also well tested and it is hard to say which is the better. In this case the volume control replaces the grid resistor of the output valve, while the diode load is a fixed .5 resistor. Another .5 leads to the grid return of the EBF and from there a 1 meg. to the 6SA7. The second 1 meg. in the original AVC circuit is now unnecessary and therefore omitted. But a 10 MF. electrolytic across the back bias resistor for the 6V6 becomes essential to keep the hum level down on low volume control settings. Thea dvantage of this arrangement is the complete absence of "minimum volume," the disadvantage the lack of bass boost on music. As it is easy to change from one system to the other, you can try both and stick to the one you like best.

The output valve is the standard 6V6GT, working slightly over-biassed and with decreased plate voltage to keep the current consumption within the limits of the power transformer.

As for the speaker you may be startled to find it a electromagnetic type in these days of permags., but I do not intend to apologise for this choice. It is the Amplion AB18 speaker, which, measured by its power-handling capability, effective cone size and other characteristics, equals more a six-inch than the five-inch type it is by its physical dimensions. As there is no sub-filter for audio or oscillator sections in our set, for both simplicity and cheapness reasons, the main filter has to be very efficient and the simplest way to get this is the field coil of a speaker together with two 8 mf. electrolytics, as has been proved for many years past. The other alternative is a permag. speaker in conjunction with a choke. The 6 Hy choke as supplied by the Rola Company with 2 16 mf. electrolytics gives about the same filtering, the total cost of this arrangement being only little in excess of the former, as the Rola five-inch speaker is much cheaper. There is also a 14 Hy choke marketed by Rola, which is, however, too big to fit anywhere in our receiver. The DC resistance of the choke is only about 350 ohms, against 1500 for the speaker field, the plate voltage will therefore be lower in the latter case. It will be within 175 and 190 volts, which does not mean any noticeable loss in amplification against the 220 to 230 volts obtained when a choke is used. Higher B voltage also means increased current drain and consequently bigger strain on the 50 mA power tranformer; if we try to offset this by increasing the back bias resistor, filtering suffers. As against this argument stands the fact that the electromag. speaker supplies a little bit of extra heat, about 25 watts to be exact, through its field coil, but as the total B-current is lower so will be total heat dissipation inside our receiver.



Speaker

From the practical point of view there is actually little to choose between the electromag. and permag. speaker. Each has its advantages and disadvantages, which are however not big enough to decisively swing opinions behind one or the other. The largest single factors which made me decide for the Amplion Electromag. was the question of cost and availability. Here I got in at the ground floor with my order at a time when speakers were worth their weight in gold and also got away a few shillings cheaper, as mentioned before. Both 16 mf electrolytics (525 P.V.) and chokes were just as unobtainable as Rola permags at that time and so I decided for and stuck to the AB18 and never regretted my decision.

The power supply consists of a 50 mA, 2 x 250 volt sec. transformer with only one heater winding, 6.3V, a 6X5G7 rectifier and two 8 mf electrolytics.

Rectifier

The transformer, which is of the normal 40 mA size of higher B voltage, works into the 6X5 rectifier, which is an indirectly heated 6.3 volt type, and is supplied by the same heater winding as the other valves. At first I was horrified at the suggestion to do this. There is actually 250 volts between filament and cathode and, although the insulation there is supposed to stand up to over 400 volts, I did not trust that scheme at all. However, a look through the Service Manual showed me that quite a few large radio manufacturers connect their 6X5's to the common heater winding, which is on chassis one side, and so, after further assurances from the valve manufacturers, I decided to take the risk. It turned out quite satisfactory and we had only one case of cathode heater break down out of several hundred sets.

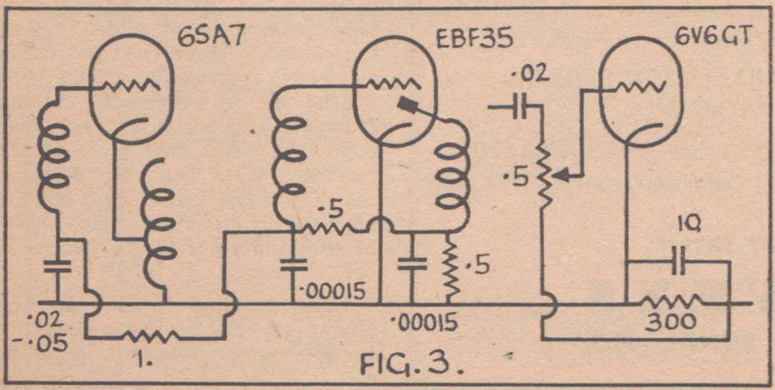


FIG. 3.

Heat

The reason why I chose the 6X5 in preference to the cheaper 5Y3 was the question of heat. While the former develops about 4 watts the latter heats up on a 10 watt filament consumption, which is hardly permissible in a receiver as small as ours, where the problem of getting rid of the heat becomes of major importance. With this in mind, just stop and think how nice and warm the components of the "modern" all-enclosed mantel radios must feel, which have only a comparatively small and usually speaker silk-covered hole for ventilation.

The voltage drop through the 1500 speaker field is about 60 to

(Continued on page 10)

65 volts, giving a field excitation of 2.5 watts, which is just right for the AB18. The plate voltage averages 180 volts, which gives an excellent safety margin for condensers and electrolytics, which are of 600, resp. 525 working voltage type. Due to these precautions no breakdown of these components has occurred up to now, being of utmost importance in a commercial receiver, which, to the advantage of both customer and manufacturer, has to be made to last.

Constructional Details

Like any other circuit, the R481 can be built on any chassis and into any cabinet you can get hold of. The trade is going to be informed and the chassis template of our own job made available to them, so that any wholesaler or retailer who wants to stock it can do so. The same applies to the dial assembly, which is of the simplest possible nature, and the cabinet dimensions. All the other components are 100 per cent. standard, although due to the top mounting of the second IF transformer and the aerial coil, only certain types of those can be used.

I myself can supply any reader with complete or foundation kits (see advert.) but not with single chasses and other parts, as I have not got any superfluous ones to spare.

The component arrangement of our set is based on a centralised design, which enables shortest possible leads, good stability and easy point-to-point wiring. Looking at the under chassis view, you notice that nearly all the wiring and small components are concenttrated in a strip running through the centre of the chassis between back and front. Valves, IF transformers, aerial coil, electrolytics, etc., have their terminal ends in this "business centre," the only "outsider" being the oscillator coil and rectifier valve. There is plenty of room for all resistors, condensers and parts are not crammed together. The second I.F. transformer has no can, which increases its Q without causing instability, as it is well out of the way of critical sections. However, if you do not like the idea, just leave the can on.

If you stick to the chassis layout and keep wiring and components in the indicated places, we can guarantee stability. If you follow your own ideas, it will probably work just as well, but if it does not, don't blame us. A special point to watch, for instance, is the connection between EBF35 plate and 2nd IF. It should run around the valve socket the back way. One of my chaps once wired a number of chasses with that connection wire passing around the front of the socket, near the first IF, and every one of them was hopelessly unstable. So don't take chances; you may get away with it, or you may not.

Watch out for proper earthing; note the position of solder lugs on the chassis. All earthed points are connected together by a bare wire, which runs all around the chassis, from 6SA7 to aerial coil, oscillator coil, 6V6, EBF, ending up at the rectifier. Note that the rivet at the side of the aerial coil, holding an unused mounting bolt, serves as earthing point for it, just to be sure.

When building the set up first mount all the big components on to the chassis, except the aerial coil. Then do the transformer, earth and other wiring, after which you mount the aerial coil and earth it. Next follow the electrolytics with the back bias resistor, then resistors around the converter, EBF and 6V6. Finally the trimmers. To facilitate the adjustment of the second IF, mount it slanting outwards, which is achieved by putting a 5/32 nut as washer between IF and chassis on the inner mounting screw (Fig. 4).

Gang Mounting

The tuning condenser is a Stromberg or Myba H type, resting flat on its back. One of the lugs of its back foot has to be chopped off to make room for the oscillator coil, which stands hard up against it. The dial is a modified EFCO kit, with an RCS spindle. It uses an escutcheon less dial glass of standard size, which is either stuck or fastened with screws and clips behind the dial opening of the cabinet.

It is noteworthy that, although this set is one of the smallest on the market, not a single midget component is used in it, which means increased efficiency and durability.

Speaker Mounting

An interesting point is the speaker mounting. In practically every set of today the speaker is fitted to the chassis itself for convenience sake. Rarely does it make proper all round contact with the baffle opening in the cabinet, which is very important for the better reproduction of bass notes. So we decided to be again old fashioned and screw our old-fashioned electro-dynamic against the front of the cabinet, leaving leads long enough for the chassis to be pulled out, and folding them up beneath the speaker, when the set was in place.

On a wooden cabinet mounting is a simple matter, but with our plastic cabinet this was a bit of a problem. We solved in the way shown in Fig. 5. The top of the cabinet carries two undercut blocks on the inside, into which the top rim of the speaker fits. A ⅛-inch screw with lock nut coming up through the bottom of the cabinet presses the speaker firmly into the grooves and at the same time holds it tight at the bottom rim. The screw need not and must not be more than finger tight, as otherwise the speaker frame will be pressed out of shape and cone trouble may result. The lock nut is then tightened up properly and the superfluous part of the screw sticking out at the bottom, including the head, cut off short, so that it cannot scratch the table. This mounting method proved 100% successful; we never had the slightest trouble with it.

The dial glass in our plastic cabinet is stuck against the front with Bostik rubber cement, which makes a very tough bondage.

The latest cabinets are fitted with a slide-in bottom of thick cardboard, wood or masonite, which makes inspection, servicing and alterations possible without taking the set out of the cabinet. But there is some trouble with the die and they are very slow coming from the plastic factory.

Alignment

The alignment procedure is as usual. After the set is switched on and the voltages checked (B, round 180V; 6SA7 screen, 80V; EBF screen, no signal, 60V), the IF is aligned. If no oscillator is available, the aerial is taken off and the set tuned, with volume control full on, to a very weak but steady signal. This will be accompanied by loud valve hiss and by it we adjust the IF's. The second IF top screw, sticking out the side of the chassis, is adjusted to the "inner setting," whereby the slug is screwed right through the coil. This not only increases gain, but also gets rid of the screw at the side of the chassis, which otherwise would have to be cut off after alignment. With an oscillator aligning is simpler and more accurate. After putting the tuning condenser full in mesh, clip the active lead from the oscillator on to the insulated part of the short piece of aerial wire dangling out the back of the chassis. The earth lead of the oscillator can stay disconnected. The alignment frequency can be anywhere between 450 and 465 kC. (IF frequencies of some commercial sets are given as 452 or 456.5 in the service sheets. This is all hooey; they work just as good on 460 kC.) To get the right peak in spite of AVC is easy with a modulated oscillator, even without output meter. It is a queer fact that the pitch of the modulating note seems to change distinctly when crossing the resonance spot, although its strength appears to remain the same (due to AVC), to within

(Continued on page 32)

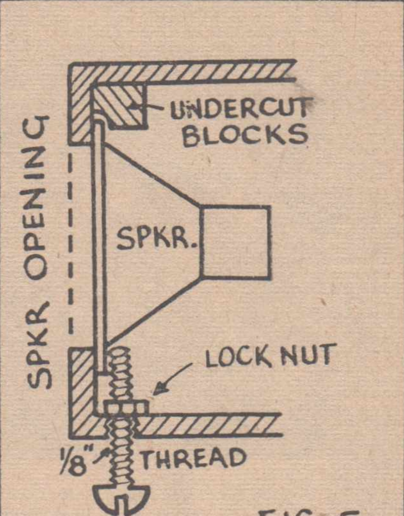


FIG. 5.

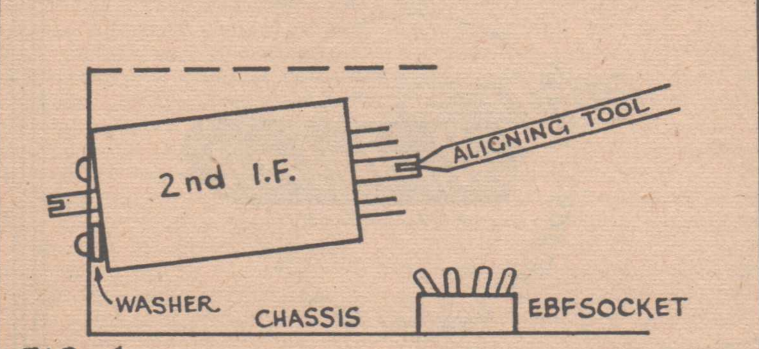


FIG. 4


Sealing and exhausting glass bulbs
Overload test run under operating conditions
Assembling parts and welding to stems.
ASSEMBLING
Design for quality
The intricate detail of a Radiotron valve calls for deft fingers and precision workmanship. Constant scrutiny throughout every process in construction ensures dependable performance . . . New Radiotrons mean better radio entertainment
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VALVES
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THE VIBRATOR

Here is a splendid feature article of engineering data on vibrators, prepared by the staff of Ferrocart (A/sia) Pty. Ltd., a division of Electronic Industries Ltd., South Melbourne. You'll agree that it covers the subject most fully and deals with every angle, including practical circuits, the construction of special chokes and other invaluable information.

ALTHOUGH vibrators of one form or another have been in use for many years in telephone exchanges, and other similar environments, it was not until the development of automobile radio receiving sets that compact and relatively inexpensive vibrators were produced capable of withstanding the wide fluctuations of battery voltage and mechanical jarring found in a modern automobile. Not only do modern vibrators operate in any physical position, function over a wide range of conditions and give long life, but they are quiet both mechanically and electrically.

All of the synchronous and all of the non-synchronous vibrators are identical in construction except that a different driving coil is used for each voltage, and different numbers and arrangements of prong bases are used.

Non-synchronous Vibrators

This type of vibrator is also called "Single" or "Valve Type" since it has a reed vibrating so as to make alternate contact with a single contact on either side, and hence requires a separate rectifier to produce direct current for high potential supplies used in battery operated radio receivers. They are intended for use with a full-wave or centre tapped primary winding of a step-up transformer. The reed is energised by means of a small electromagnetic coil which acts on a magnetic armature mounted on the free end of the reed. The coil is connected electrically between the red and the fixed contact which closes when the reed is attracted by the coil. Thus when the starting switch is closed, the vibrator coil is in series with one half of the transformer primary winding. The resistance of the vibrator coil is high compared to that of the primary winding, so that no appreciable effect is produced at this instant in the primary winding. However, the vibrator coil attracts the reed armature, closing the initial or "starting" contact thereby short-circuiting the coil. This creates a direct path for battery current to flow through the primary winding. The momentum of the reed keeps the initial contact closed for a time, and then the elasticity of the reed causes it to swing back, open the initial contact and close the second or "rebound" contact.

Wave-form

When the primary winding of the transformer is connected directly to the battery, a counter electromotive force is induced in all of the transformer windings, which is in opposition to the battery potential, in the primary winding. The induced potential remains practically constant as long as the contacts remain closed. When the contacts open, the induced potential in the transformer windings starts to reverse. However, the rate of reversal is controlled by a condenser usually connected in shunt to the high potential secondary winding, sometimes called a "buffer" condenser. This condenser usually is given such a value that the induced potential in the primary winding has reversed but has not yet equalled the battery potential by the time the alternate contacts close. Since the direction of current flow around the transformer core is reversed when the alternate contacts close, the counter electromotive force during the second half-cycle will have a polarity opposite to the first. The result is that the wave-form of potential in all windings consists of a series of flat-topped half-cycles of alternate polarity. Each flat-topped wave is connected to the following one by a sloping line terminating in an abrupt voltage change just as the contacts close. The slope of the wave between flat-tops, that is, while both sets of contacts are open, is controlled by the size of the buffer condenser.

Rectification

When current of this wave-form is rectified by a full-wave rectifier of any type, a series of current impulses is obtained, each having the characteristic flat-topped wave shape, but all of the same polarity. This is passed through a smoothing filter consisting of an iron-cored reactor or "choke," with a filter condenser, usually electrolytic, connected across the circuit at both input and output ends of the filter reactor. The output current and voltage from the smoothing filter is quite steady and contains negligible ripple if the reactor and condensers are of proper values.

In the case of automobile radio receivers, the ground or common

(Continued on page 15)

Presenting . . . .

THE EVER GROWING 'Q PLUS'

COIL RANGE

THE FAMOUS IR5 MIDGET OSCILLATOR COIL

Thousands upon thousands have now been sold—tested and tried by all—it's good value too. For each one is wound on a 100,000 W. ½ Watt IRC Resistor. Only for use with the IR5 .... **4/9**

PERMEABILITY TUNED OSCILLATOR COILS

Illustrated you see ½ actual size of the new iron tuned series. Available for IR5, 6J8GA and 6SA7 converter valves at the special low price of **6/11**

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MIDGET AERIAL AND RF COILS

Well tried now and all reports are that large size coils will soon be obsolete. Litz wound with full primary inductance. All coils of this series are treated with the amazing "Ferropreg" process. The cheapest iron clad coil at **6/11**

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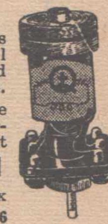
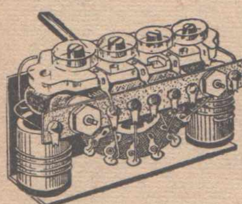




MIDGET DUAL-WAVE BRACKETS

Country Enthusiasts N.B.

The IR5 bracket has been specially designed for **YOU,** using a special neutralising condenser to ensure high performance on all bands. Available also for 6J8GA Converter.

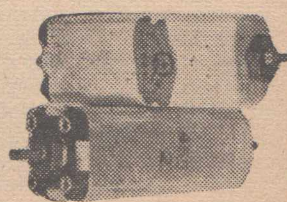
Retail **44/-**

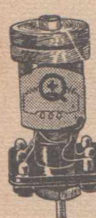
Q "PLUS" MIDGET IF's

(Permeability Tuned)

Absolutely the smallest I.F. in production in Australia—but it still has full I.F. performance. Practical one hole mounting, litz wound, Ferro-pregnated, ceramicon condensers, No. 1 for ordinary stages, No. 2 for diode detectors.

Each **13/9**





AND NOW THE Q PLUS MIDGET IRON CORED REINARTZ COIL

With apologies to those who have waited so long. Now through its trials with amazing success.

Litz wound, Ferro-pregnated, etc.

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Q Plus recessed flush fitting. They prevent detuning by knocks, etc. Available in the following attractive shades. Peach blossom, Sky blue, apple green, grey, walnut, black, yellow, ivory, wine. Push fitting.

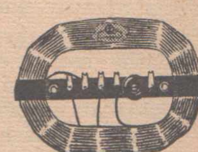
Each **1/3**

STANDARD SIZE COILS & IF's

Don't forget, Mr. Serviceman, that "Q Plus" Coils and IF's will save money for you. Try them and see.

As we still can't make enough of these High Efficiency Midget Loops—we'll say no more.

Retail price **6/11**



CAR-RADIO COIL KIT

First we must apologise to those who have waited so long, but we can say with confidence that supplies will be released this month. Kit comprises midget shielded special aerial, R.F. and oscillator coil to suit 6SA7 converter valve, ignition hash filter choke and 1 pair of midget I.F. transformers.

Comes complete with circuit and notes on manufacture **£2/17/6**

RADIO FREQUENCY CHOKES

To complete our range of R.F. products "Q Plus" are now releasing a full range of R.F. Chokes for both the set-builder and the "ham." Polystyrene coated on high quality ceramic formers, they are the best value obtainable.

First release—2½ MH single pi unit **1/3**

COMING SOON—THE "Q PLUS" "IN-BETWEEN" PORTABLE KIT

A 5-valve superhet using midget components throughout but with full-size 45V Minimax Batteries—this will cheapen your running costs. Limited quantities will be available late October.

R. W. STEANE & CO. PTY. LTD. AUBURN, VIC.

STOCKED BY ALL LEADING DISTRIBUTORS

VIBRATORS

(Continued)

electrical point of the receiver is connected to the low potential battery, and is negative with respect to the high potential required for the anodes. If a hot cathode rectifier is to be used, the cathode must be at a potential several hundred volts positive with respect to the battery, which is the best available source for cathode heating current. To meet this problem, overseas engineers introduced the first indirectly heated cathode rectifier for automotive use, in which there was sufficient insulation between heater and cathode to permit a potential difference of several hundred volts between them. Thus the heater is operated from the battery, but the cathode operates at full positive "B" potential. From this original rectifier developed the present 84 or 6Z4 type.

Synchronous Vibrators

Another method of rectifying the output of the vibrator transformer is to add a second set of contact points on the reed to engage with a second set of fixed contacts. Such vibrators are called "synchronous" since primary and secondary contacts operate in synchronism, also "double" since there are two complete sets of full wave contacts, and "tubeless" since no rectifier tube is required. The secondary contacts are adjusted to close after and open before the corresponding primary contacts, to prevent destructive arcing. This results in an advantage over the non-synchronous type of vibrator, in that the primary contacts open and close at times when the transformer is disconnected from its load. The transformer in a no-load or idle condition draws the relatively small exciting or magnetising current from the battery, so that the primary contacts operate at moments when they are carrying very little current. This prevents appreciable arcing at the primary contacts.

On the other hand, the secondary contacts are not required to open or close with a large difference of potential across them, since the input condenser of the smoothing filter retains nearly its full charge during the interval that it is disconnected from the transformer secondary winding, and the prior closing of the primary contacts produces the full no-load potential of the secondary winding before the secondary contacts are brought together. As soon as the secondary contacts close, the secondary voltage drops from the no-load to the full-load value, which is not much lower if the transformer is designed to have good voltage regulation. When the secondary contacts reopen, the secondary voltage rises again to its no-load value. Thus the secondary contacts operate at times when very little difference of potential across them exists. By the time the primary contacts open the secondary contacts have separated far enough to prevent a spark from occurring.

Synchronous vibrators therefore have several advantages over non-synchronous vibrators: They eliminate separate rectifiers while costing no more than non-synchronous vibrators which they equal in external dimensions; they are more efficient, since they eliminate the

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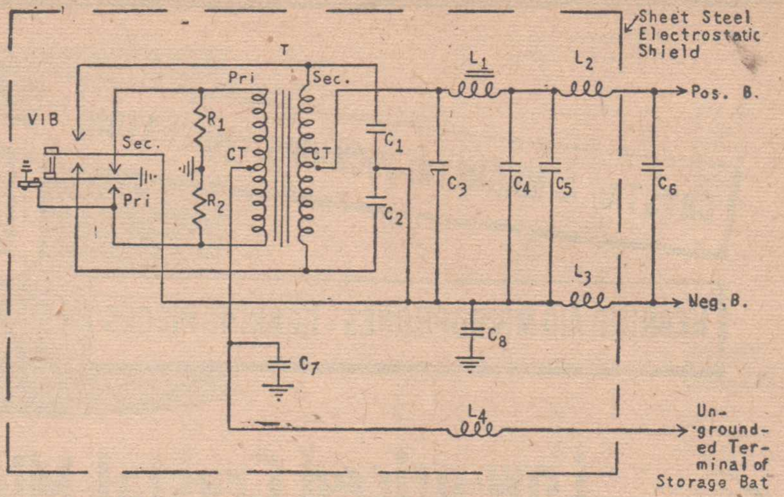


SPLIT-REED SYNCHRONOUS CIRCUIT

For use with Receivers having Filament Type, Directly Heated Tubes.

COMPONENTS

VIB—Split-Reed Synchronous Vibrator.
T—Vibrator Transformer.
R1, R2—100-ohm 1/3-watt resistors.
C1, C2—Secondary condensers, equal, as required by transformer.
C3—4 to 8 M.F. electrolytic condenser.
C4—6 to 12 M.F. electrolytic condenser.
C5—0.05 to 0.25 M.F. r.f. by-pass condenser.
C6—0.01 to 0.05 M.F. r.f. by-pass condenser.
C7, C8—0.1 to 0.5 M.F. 120-volt low r.f. power factor paper condensers.
L1—200 to 400-ohm d.c. 5 to 30 henry choke reactor, iron cored.
L2, L3—Dual radio frequency choke reactor, 0.5 to 5-milhenry, each.
L4—30 to 100 turns No. 16 to No. 20 A.W. Gauge enamelled copper wire, air cored, single or double layer.

NOTES

Condensers C1 and C2 may require resistors in series with them, or better results in elimination of interference may be obtained by substituting a single secondary condenser, with or without series resistance. Primary resistors R1 and R2 may not be required.

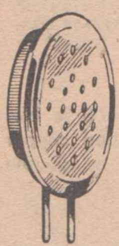
Negative B lead connected to ground through bias resistors, with suitable by-pass condensers, thereby obtaining grid bias for directly heated, filament type cathode tubes.

Where greatest power efficiency is required, as for battery operated receivers in remote locations with limited charging means, filament type tubes with split-reed vibrator power supply is recommended.

CRYSTAL & MAGNETIC PICK-UPS. "HUSHATONE"

HEARING AID MICROPHONES - HEARING PIECES

The acos Range!



Low-priced Crystal Microphone Inserts

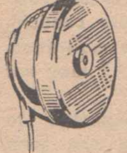
FOR HAMS, PUBLIC ADDRESS, HEARING AIDS, ETC.

Crisp, clear cut reproduction plus a host of technical features makes Acos Crystal Microphone Inserts the ideal choice for:
HAMS: "DX" reproduction cuts through QRM. High frequencies peaked. Built-in load resistor.
PUBLIC ADDRESS: High output. Light and rugged. May be adapted as lapel mike.
HOME BROADCASTING: Exceptionally high gain allows direct use on pick-up terminals of good receivers. No preamplifiers or transformers required. Because of their accentuated speech range and sensitivity they may also be used for OFFICE and FACTORY CALL SYSTEMS and are incorporated in leading British DEAF AID equipment.

Size: Only 1 11/16" x 5/16"

LIST PRICE

28/2



MINIATURE CRYSTAL EARPIECES

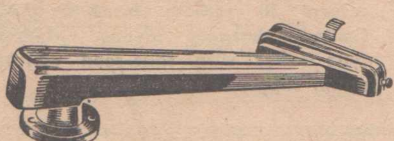
Ultra sensitive, light, and rugged! Acos Crystal Ear Pieces may be used in Personal Radios, Hearing Aids, by Convalescent Hospital Patients, and in Silent Radios for Hospitals and Hotels. They're smaller than the smallest speaker-obtainable in moulded, flesh coloured plastic—light and comfortable to wear. There's perfect tone for speech or music.

Prices on Application

THE "HUSHATONE" PERSONAL SPEAKER

Here is a personal speaker that fits snugly under your pillow; provides personal listening to your favourite programme—without disturbing others. Tone quality compares favourably with cone-type speakers. Light-weight BIMORPH crystal drive ensures uniform response—high sensitivity. Attractively styled in plastic case with chrome finish. For use with radio or sound system.

List price **£3/16/4**



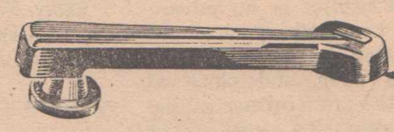
GP10

CRYSTAL PICK-UP

A modern, high fidelity, crystal pick-up housing the G.P.9 unbreakable cartridge in a smart, moulded bakelite arm. Needle pressure can be adjusted from novel beryllium copper spring in the base and bracket assembly to user's preference. Normal pressure is only 1¼ oz. Other features include 95 degree lift back for needle changing. Vibration-free arm movement.

LIST PRICE **£2/8/6**

ACOS G.P.9 CRYSTAL CARTRIDGE WITH UNBREAKABLE CRYSTAL 22/1



GP6

MAGNETIC PICK-UP

Designed to conform with modern standards the G.P.6 is an attractive moving iron magnetic pick-up. Moving parts are small—reducing needle impedance, improving fidelity, reducing record wear. Other features include: Adjustable needle pressure—normally 2 oz. High permeability Ticonal magnet.

Price **£2/4/1**

OBTAINABLE AT ALL GOOD RADIO & ELECTRICAL STORES—WRITE FOR PUBLICATION C.1.

AMPLION

36-40 PARRAMATTA RD., CAMPERDOWN, SYDNEY, N.S.W.

power required to heat rectifier cathodes, and also the space potential drop inside the electronic rectifier; and they will handle relatively large amounts of output power with less deterioration than non-synchronous vibrators.

Split Reed Synchronous Vibrators

Radio receivers with output tubes having directly heated filaments present a special problem in connection with the grid bias for the output stage. Unless a bias battery is used there is no way to obtain a potential more negative than the negative end of the filaments using an ordinary synchronous vibrator, since the moving contacts of the secondary circuit are electrically common with the primary reed contacts, which in turn are connected to one side of the battery. To meet this difficulty, the split-reed synchronous vibrator was developed. It differs from the normal synchronous vibrator in that the reed is divided longitudinally, each section carrying a set of contacts electrically insulated from those of the other section. The armature is mounted on the free ends of the two reed sections by means of small insulators, while the fixed ends of both reeds are insulated from one another and from the frame. The circuit is arranged so that the secondary reed is negative, and is returned to common or ground through a resistor which is bypassed by a condenser. The potential created across this resistor by the "B" current flowing through it is then used for grid bias. The design and operation of split-reed vibrators is otherwise the same as ordinary synchronous vibrators.

Elimination of Vibrator Interference

The introduction of a vibrator into a radio receiving set for the purpose of obtaining a high voltage B supply from a lower direct current supply such as a storage battery, at once raises problems concerning the interference such a vibrator causes due to interrupting a direct current at a constant rate. These problems are entirely apart from such questions as mechanical vibration transmitted directly from the moving elements of the vibrator to the radio set. The mechanical cushioning of present-day vibrators is such that this is not an important factor.

Electrical interference from the vibrator may occur due to the following kinds of action:

(1) **Direct pick-up** from the vibrator circuit by unshielded coils, exposed grid leads or the antenna lead itself.

(2) **Anode modulation** of any of the high frequency amplifier or detector tubes, due to improper filtering of the anode supply voltage.

(3) **Heater modulation** of any of the high frequency amplifier or detector tubes, due to improper filtering of the direct current connections to the heaters.

(4) **Chassis - coupled voltage pick-up** in any of the high frequency circuits, usually grid circuits, due to the chassis base acting as a common path for currents of signal frequencies, and the

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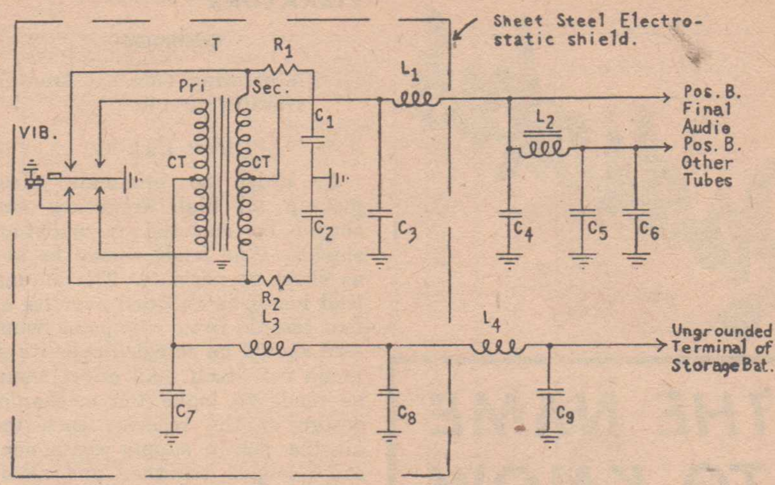


SYNCHRONOUS CIRCUIT

For use with Indirectly-heated Cathode-type Valves.

VIB—Synchronous (tubeless) vibrator, self-rectifying type.
T—Vibrator transformer.
R1, R2—50 to 250 ohm resistors, ½ watt.
C1, C2—Secondary condensers, equal, capacity according to transformer used.
C3—.0005 to .001 mfd. r.f. by-pass condenser.
C4—4 to 8 mfd. electrolytic condenser.
C5—6 to 12 mfd. electrolytic condenser.
C6—.05 to .5 mfd. r.f. by-pass condenser.
C7—.5 mfd. 160-volt condenser with low r.f. power factor.
C8—20 to 200 mmfd. spark plate condenser, steel plates and fish paper.
C9—.02 to .25 mfd. by-pass condenser.
L1—.5 to 5 mh. r.f. choke reactor, air cored.
L2—200 to 400 ohms d.c. 5 to 30 hy. choke, iron cored.
L3, L4—30 to 100 turns No. 16 to No. 20 A.W. gauge enamelled copper wire, air cored.

NOTE

In some cases a single secondary condenser, with or without resistance in series with it, gives less r.f. interference. In some cases better results will be obtained if C3 and C4 are inter-changed.

VIBRATORS

(Continued)

interfering currents from the vibrator circuit.

Direct Pick-up

In order to eliminate direct pick-up all high frequency coils should be enclosed in individual shields. Grid leads should be kept as short as possible. The antenna lead hould be shielded over its entire length from the point where lead should be shielded over its entenna coil itself. An effort should be made to make the mechanical design of the receiver such that all the power supply components are grouped together and should be kept as far away from the high frequency input of the receiver as possible.

Anode Modulation

Anode modulation is easy to detect and comparatively simple to cure. The simplest method of detecting this form of interference is to connect a resistance load of such a value that the power supply is operating under normal load, then supply the anode voltages to the receiver from batteries; if there is still interference, with the power supply operating under these conditions, it is evident that interference is occurring in another portion of the circuit. However, if the interference is reduced when the receiver is operating from batteries, then the high frequency choke reactor in the B output circuit, if used, is either too small, it has too high distributed capacitance, or the associated radio-frequency by-pass condenser is too small. Generally it need not be larger than 0.05 to 0.1 M.F. The axis of the high-frequency reactor should be changed to make sure it is not coupling to either the iron-cored choke reactor or the vibrator transformer. On tube type circuits the r.f. by-pass condenser is seldom required.

Heater Modulation

Heater modulation is usually detected by operating the power supply from a separate battery. When the power supply is obtained from a separate battery, a shielded cable should be used, grounded to the chassis, to prevent radiation of interference from this cable which might entirely mask the heater modulation interference.

It must be kept in mind that if any change is made which reduces the power of an interfering noise or signal by one-half the apparent reduction will be slightly more than detectible by the ear. This corresponds to a change of 3 decibels in loudness, while an actual change of approximately 10 decibels is necessary to give the impression of a 50 per cent. reduction in loudness. Thus if the interference is coming equally from two sources, elimination of either one will not seem to help much, but if both sources are eliminated simultaneously, the interference ceases entirely. The use of an output meter on the audio output is suggested, as changes of noise of much less than one half are easily detected, especially if the interference is relatively steady.

It has been found that receivers having high sensitivity may require two h.f. reactors between the battery or d.c. power supply, and the heaters. The use of the chassis as a common connection for all of the heaters is not recommended due to the chance of voltage pick-up in the chassis. This may not show up on model receivers, but in production, the resistance of the grounding may vary slightly, and cause large changes in the amount of interference caused. The heater circuit should be grounded to the chassis at only one point. The usual method is to wire all heaters together, grounding one of them to the chassis. The heater to be grounded should be found by experimenting to find the best point, as this will vary with different designs. Care should be taken that there are no radiating loops formed by the heater circuit which might couple to some portion of the high frequency amplifier.

Chassis-coupled Voltage Pick-up

Voltage pick-up due to improper grounding of the power supply and high-frequency amplifier elements is the most common source of interference and also the most difficult to locate. The simplest method of locating the source of interference is to short the grids

VIBRATORS.

Part No.	Ferrocart Type No.	Type	Voltage	No. pins base	Bobbin ohms.	Output Voltage	Sec. current each side	Freq. Reed	Base Chart	No. of Test Transformer
PM 104	18978	Synch.	6	5	55	150	10 mils.	100	G	PT 455
PM 126	18178	Sp. Reed	6	6	55	90	10 "	100	N	PT 194
PM 131	18938	Non Syn.	6	6	55	230	20 "	100	D	PT 232
PM 132	18938	Non Syn.	12	6	260	230	20 "	100	D	PT 182
PM 237	18938	Non Syn.	6	6	33	230	20 "	150	D	PT 232
PM 238	18938	Non Syn.	12	6	144	230	20 "	150	D	PT 182
PM 410	18978	Syn.	2	5	5.7	90	10 "	100	G	TP -152
PM 411	D18978	Syn.	4	6	26	150	10 "	100	O	TP-97 Delco
PM 412	18978	Syn.	4	5	26	150	10 "	100	G	TP-97
PM 413	18978	Syn.	6	6	55	150	10 "	100	I	PT 455
PM 414	D18978	Syn.	6	6	55	150	10 "	100	O	PT 455 Delco
PM 415	18978	Syn.	12	6	260	150	10 "	100	I	TP-75
PM 415A	The same as PM 415; except that the can is not soldered, and the earth lead is omitted.								G	Transmission
PM 416	18978	Syn.	12	5	260	150	10 "	100	G	TP-75
PM 417	18978	Syn.	32	5	1,000	150	10 "	100	A	TP-45
PM 418	18938	Non Syn.	6	4	33.	230	20 "	150	A	PT 232
PM 419	18938	Non Syn.	12	4	144	230	20 "	150	N	PT 182
PM 420	18178	Sp. Reed	12	6	260	250	20 "	100	H	PT 421
PM 433	18978	Syn.	6	5 UY	55	150	10 "	100	I	PT 455
PM 469	18978	Syn.	24	6	750	200	10 "	100	C	TP 1208
PM 471	18938	Non Syn.	6	5 UY	33	230	20 "	150	I	PT 232
PM 472	18978	Syn.	4	6	26	150	10 "	100	I	TP-97
PM 525	18978	Syn.	32	6	1,000	150	10 "	100	H	TP-45
PM 526	18978	Syn.	4	5 UY	26	150	10 "	100	N	TP-97
PM 529	18178	Sp. Reed	2	6	5.7	90	10 "	100	N	PT 413
PM 530	18178	Sp. Reed	4	6	26	150	10 "	100	I	TP-97
PM 535	18978	Syn.	12	6	260	150	10 "	100	J	TP 75 Kingsley
PM 535A	The same as PM 535; except for Base connections									"
PM 541	18978	Syn.	2	6	5.7	150	10 "	100	I	TP-152
PM 570	18978	Syn.	32	5 UY	1,000	150	10 "	100	H	TP-45
PM 582	18978	Syn.	12	5 UY	260	150	10 "	100	H	TP-75
PM 598	18938	Non Syn.	32	6	1,000	150	10 "	100	D	TP-45
PM 807	18978	Syn.	14.5	6	260	150	10 "	100	I	TP-75 R.A.A.F.
Is the same as PM 415A, but is adjusted to suit 14.5V; and can is soldered.										
PM 402	18978	Syn.	6	6	55	230	20 "	100	D	PT 232 Homecrafts
(is wired as a Non Syn.)										valve testers
PM 593	—	Syn.	12	6	260	230	20 "	100	D	PT 182 Ferrocart
(is wired as a Non Syn.)										
PM 640	—	Syn.	6	6	55	150	10 "	100	J	PT 455 Ferrocart
*PM 652	—	Sp. Reed	6	6	55	250	10 "	100	N	PT 667
*PM 357	—	Sp. Reed	12	6	260	250	20 "	100	N	PT 421

NOTE:
* = PM 652 — Designed for Tropical conditions.
* = PM 357 — Designed for Tropical conditions.
PT type — Transformers made by Radio Corporation.
TP type — Transformers made by Trimax Transformers Ltd.
Base connections "J" correspond to Oak type V5124.

of the tubes, starting with the output tube and determine in which stage of the amplifier the noise is originating. A common source of trouble is found in receivers using automatic volume control. In such receivers the tuned circuits are completed through condensers by-passing the grid return to ground. When these condensers are grounded directly to the chassis, a voltage which is developed across the common impedance between the point where the condenser is grounded and the wiping contact of the variable condenser is picked up and applied to the grid of the tube. In order to eliminate this interference the bypass condenser should return directly to the wiper of the section of the variable condenser tuning that particular coil. The condenser wiper should be bonded to the chassis through a piece of heavy flexible copper braiding. As a rule, it is desirable to ground the variablé condenser at only one point on the chassis.

Locating Interference

In order to check for interference on a completed receiver, the antenna lead-in should be grounded through a .0002 M.F. condenser. If the interference appears with the lead-in short-circuited in this manner, but does not appear with it open, it indicates improper grounding of the primary circuit of the antenna coil. In some cases, this type of interference can be eliminated by returning the ground end of the antenna coil primary to the condenser wiper. Sometimes it will be found that there is less interference when the Automatic Volume Control condenser or the primary of the antenna coil is grounded to some point on the chassis rather than on the condenser wiper. This is due to an out-of-phase voltage being picked up and balancing out the interference leads to erratic receivers in production, as small changes in the impedance of the current paths will change the balancing-out effect a great deal.

In some cases, intrference has been located in the grid circuit of the first audio frequency tube, due to the ground return of the volume control being at a point remote

(Continued on next page)

VIBRATORS

(Continued)

from the tube's cathode circuit. Where diode detection is used, it has been found that often a hum voltage is induced in the last high-frequency transformer through coupling with the power transformer. The grid lead of the first audio tube will pick up considerable interference if it is long and unshielded, or if it runs close to the power supply or heater wiring.

Components

Although the general construction of vibrator operated receivers follows the lines of a.c. sets, there are certain additional considerations with regard to some of the components having to do with the vibrator circuit.

Practically all vibrators now supplied have their own individual shields or metal housings. The shielding housing is not essential where the entire vibrator is enclosed within a shield together with the transformer and other components recommended to be so shielded. The vibrator housing will nearly always require grounding, however, especially if the housing projects into the unshielded space of the receiver.

There are several ways in which the housing may be grounded. One most common way is to make a connection inside the vibrator, between the housing and the prong connected to the reed, which in turn is generally connected to the grounded side of the storage battery or d.c. source. Another method is to omit the internal strap, and ground the housing by means of a clamp surrounding the vibrator socket, having 6 or 8 spring fingers which grip the lower part of the housing firmly. Such vibrator ground clamps can also be obtained with bent or "formed" ears which fit into an annular groove at the lower edge of the housing, thereby preventing the vibrator from working loose from the socket, even if mounted in a position other than vertical. Another method less often used is to connect the housing to an otherwise insulated prong of the vibrator base plug, grounding the corresponding socket jack as desired for best results.

Primary Resistors

For 6-volt operation, it is generally found that improved operation is obtained if a resistor of from 50 to 100 ohms is connected from the reed of the vibrator to each stationary contact, the leads being as short as possible. The rating should be from ½ to 1 watt. For operation on other voltages, the resistance will vary approximately as the square of the voltage.

High-Frequency Filter

In stationary radio receivers containing vibrators, it is necessary to place a filter between the d.c. supply and the vibrator circuits to prevent interference from coupling to the signal circuits via the d.c. supply. In automobile receivers it is also necessary to prevent interference from the ignition system of the car from entering the radio receiver. It has been found that it is seldom necessary to use suppressor devices on the spark system of an automobile, if certain filter elements are added to the receiver, which are designed to operate at very high frequencies.

From one to three **air cored choke reactors** are used in the battery lead to the vibrator circuit, having from 30 to 100 turns of sufficiently heavy wire to carry the current. One form of choke which has been used satisfactorily in many sets consists of 74 turns of No. 16 A.W. Gauge wire (0.05 inch, 1.29 mm. diameter) wound with 4 layers insulated with paper, on a mandrel having a diameter of 5/16 inch (7.94 mm.). Single layer chokes are also used. When multilayer chokes are used, it is usually best to connect the inner end toward the d.c. supply; the outer end, toward the vibrator.

To prevent interference from the vibrator, **condensers** of approximately 0.5 M.F. are connected to ground from both sides of the choke nearest the vibrator, if more than one is used. These must have very low power factor at high radio frequencies, and must have short leads, of low resistance material. The ground return of these condensers should be as short as possible and soldered directly to the chassis. The ground connection to the vibrator reed should be soldered to the same point as these condensers.

To prevent spark interference from the automobile motor, low-capacity condensers called **spark plates** are used, generally connected between ground and the ends of the air-cored choke nearest the battery, if more than one is used. These condensers have a capacitance of from 10 to 100 mmf., usually between 20 and 50 50 mmf. One type of spark plate consists of a steel plate having an area of several square inches riveted to the radio case by insulated rivets, and insulated from the case by either mica or a good grade of insulating or fish paper, to give the desired capacitance. Spark plates are not required on non-automatic sets.

Filter in Output Circuit

To keep vibrator interference from reaching the anode supply circuit an air-cored high-frequency choke reactor is placed between the iron-cored choke reactor and the cathode of the rectifier tube, or centre tap of the secondary winding of the transformer in synchronous vibrator circuits. It has an inductance of from 0.5 to 5 milhenrys, and should be of "universal" or self-supporting construction, having low distributed capacitance. It should be physically small to restrict its external field.

A by-pass condenser of from 0.0005 to 0.1 M.F. capacitance may be required connected between ground and the side of the air-cored choke nearer the interference. In tube type circuits, this condenser is seldom required.

In some cases, the high-frequency filter is placed on the other side of the smoothing filter, that is, between the iron-cored choke and the tube anodes.

Smoothing Filter

The rectified high-voltage direct current is smoothed out by means of an **iron-cored choke reactor** shunted by electrolytic condensers much as in a.c. radio receivers. The **input filter condenser** may be from 4 M.F. up, and the **output filter condenser** from 6 M.F. up to as high as 30 M.F. if exceptionally good filtering is required. The choke usually has a resistance (d.c.) of from 200 to 500 ohms, with an inductance of from 5 to 30 henrys.

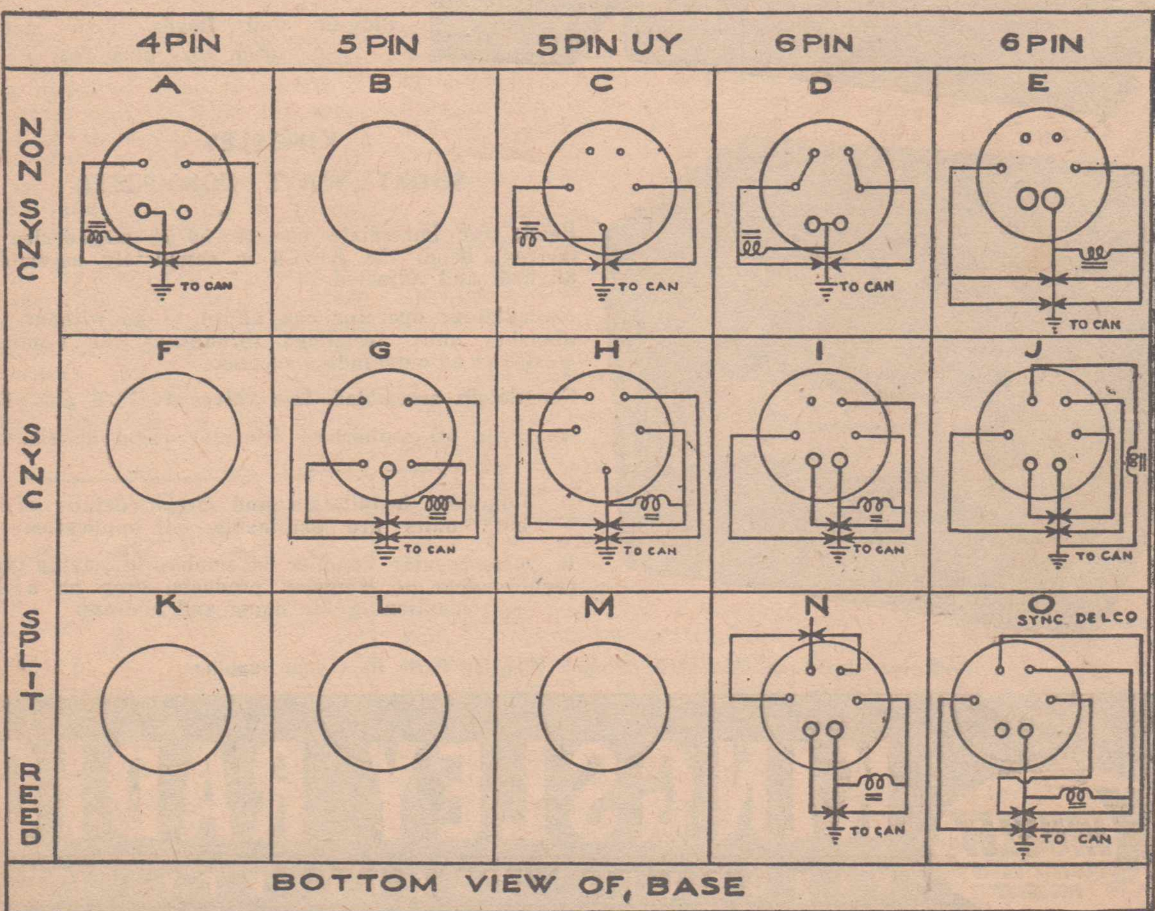
Spark Filters

Besides the spark plates and high-frequency chokes in the battery leads, interference filters or condensers are required on all other leads from or to the receiver.

In the antenna lead-in, a small high-frequency reactor as small as 20 to 40 turns, ¼ to ½ inch in diameter (6 to 12 mm.) is used, with by-pass condensers. In many cases, the lead-in is of shielded wire, which acts as a by-pass condenser. The other side of the antenna choke is by-passed by a small spark plate of from 5 to 20 mmf., usually with mica insulation. Any other leads, such as to dial lamps, external controls, etc., usually require spark plates to prevent bringing in interference from the spark system.

JAW-BREAKER

My copy of the Belgian technical monthly "Radio Revue" used to arrive in the French language and with some difficulty I could manage to understand the text. Now the issues are being received in the Dutch edition and the going is much harder. For example, in the parts list for one circuit I notice that there is an item called a "schermroostervoorschakelweerstand"; yes, all one word and only 33 letters in it! The reference to the rooster in it might make you think it has to do with a loudspeaker which crows.



Socket connections for vibrators as listed on page 19.

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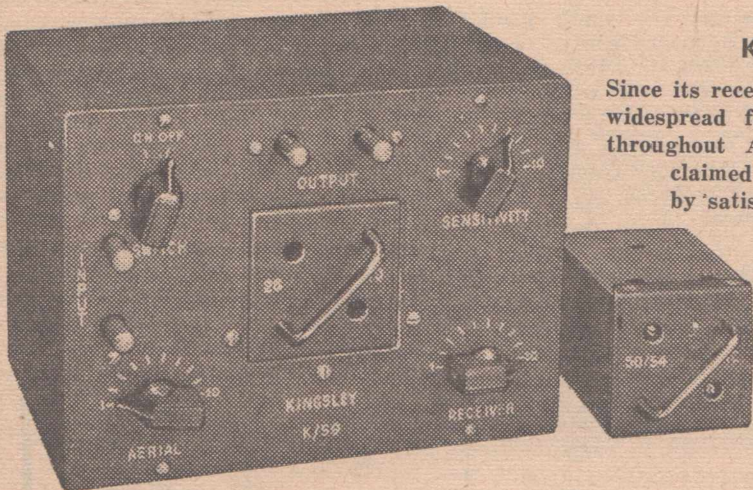

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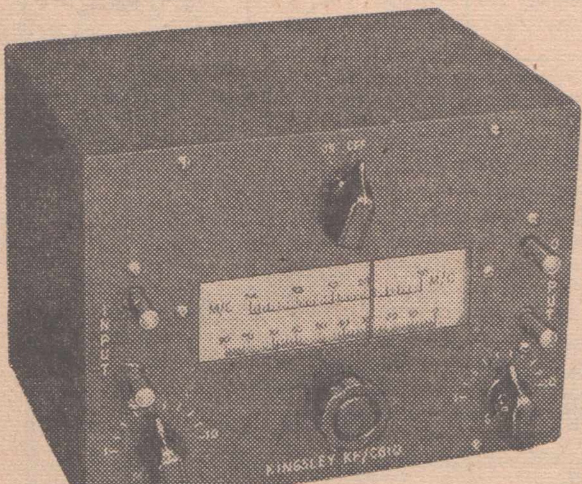

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EXTENSION SPEAKER

AND HEADPHONE CONNECTIONS

Extension speakers, including the new Amplion "Hushatones" and the Kingsley "Pillophones" are now available and offer a wide scope of application. Their proper connection, control of volume and general set-up is quite simple, if you know how. This article tells just what you want to know.

IT is surprising that the extension speaker, with all its tremendous advantages, has not gained much favour with the public up to now. One would actually think that practically every cottage or large flat, equipped with only one radio in the lounge room, would have one or even more of these devices in kitchen, verandah or bedroom. Instead, people keep their sets blaring away to listen to serials or musical sessions from the other end of their flat, or else force themselves to stay in one certain room whenever they feel a longing for Franky's moaning or Tommy Dorsey's hoarse screeches.

As for earphones, especially the rubber-cushioned army type, which does not press against the ears and keeps noise out, they make an excellent device for "personal listening," without disturbing and being disturbed. A flick of the switch can silence the speaker and you are all for yourself with your favourite programme in spite of half a dozen women cackling away in the same room.

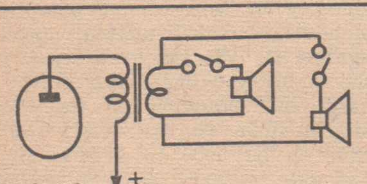

FIG. 1B

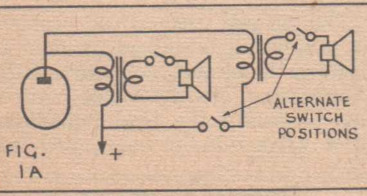

FIG. 1A

Money-Spinners

Both these gadgets can be turned into excellent money-spinners for the wide-awake radio man. A third device is the "personal speaker," a small speaker on a lead, which can be listened to in bed by tucking it under a pillow or installing it close to your head when sitting up.

Both extension speakers and personal speakers are marketed by several firms, while earphones are available at ridiculously low prices at disposal stores.

Connection

Starting off with the extension speaker: There are two ways of connecting it to a receiver, either directly from the output valve or from the secondary of the speaker transformer in the set. In the first case we need a transformer on the extension speaker; in the second case, not. Figs. 1 (a) (b) show the simple connections, with switches arranged so as to enable the silencing of both speakers. Note, however, the very important fact that the switches are so arranged that at no time the plate circuit of the output valve is opened. This would damage the valve by putting the full current on to the screen grid, which would get red hot and eventually break up. The switch to silence the main speaker is therefore always put

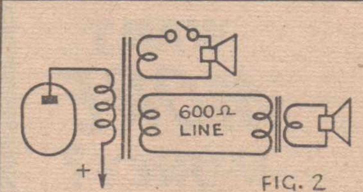

FIG. 2

into the voice coil circuit, while for the extension speaker there are two alternatives, if it is connected by means of a separate transformer. In this case either high or low tension (voice coil) sides can be broken, as the main speaker transformer always forms a closed plate circuit for the output valve.

The considerations leading to the use of one or the other method of connection are not only a matter of cost. If we run a low voltage high current line, such as the secondary circuit of an output transformer over long distances, losses of energy due to ohmic resistance become considerable. We can counter this by using thick wire or flex, which is not only more expensive but also very unsightly when made into a permanent installation. On a 2.5 ohm voice coil impedance and easy to hide bell wire as conductor, the total length should not be more than 40 yards, or about 60 yards for 3.5 ohm voice coils. This, of course, takes into consideration the total length of both wires together, so that the actual distance covered is only half as much. Consider further that the wire for a permanent installation has to be run along the picture rail or skirt-

(Continued on next page)

EXTENSIONS

(Continued)

ing board, following all angles and corners, around door and window frames, etc., and we find that 40 to 60 yards, doubled up to 20 or 30 yards, is not so much after all and will be just enough for the average cottage or flat. If the wire used is of 20 gauge B&S, the losses under these extreme conditions are about 50 per cent., which is already quite a noticeable drop in volume.

For any greater distance "high tension" wiring will be necessary, with a transformer attached to the extension speaker. If the receiver is earthed, these wires will carry the full B voltage of the set, about 250V, to ground, with about 30V D.C. and, according to volume, up to 150 or 200V audio voltage to each other. There is, therefore, no playing around with the insulation of the wire. Good hook-up wire, or, better still, thin 2-core light flex must be used. This is harder to hide and for particular customers much care has to be taken of where to put it.

Long Runs

For very long runs something else crops up: The capacity between the conductors becomes large enough to cut off high notes, just as a condenser across the speaker does. Running of two separate wires, well spaced, is one way to get over this; the other method, generally used with public address systems, is the "600 ohm line" (Fig. 2). A transformer on the set brings the impedance from 5000 or 7000 ohms at the plate of the output valve down to 600 ohms for the long speaker lead. The extension speaker carries another transformer, which reduces it down to voice coil impedance.

Volume Control

A definite "must" on every extension speaker is a volume control. It is a bit of a nuisance to adjust the volume at the set in the lounge for the kitchen speaker, then to find it too loud, rush back to the radio to turn it down, then find it too soft, rush back again and so on. Then, often the volume of the programme changes; gentle crooning is followed by blaring loud music, then soft talk. A volume control on the extension speaker solves this problem in an easy, cheap manner. Fig. 3 shows the circuit. A 25 to 30 ohms wire-wound potentiometer lies across the low impedance line, the voice coil being connected to the moving arm and one end. The same principle could be used on the high tension side, but the fact that the spindles of wire-wound potentiometers are not insulated, speaks against it. Via the grub screw in the knob you may get quite a nasty bite standing on the tiled kitchen floor. The pot. itself would have to be 5000 to 10,000 ohms and able to carry 20 to 30 mA on loud volume in the nearly full on position. This is definitely no proposition, so forget about it.

The largest theoretical problem on extension speakers, which in practice is almost non-existent, is the matter of impedance matching. Actually the load impedance of a valve will be very much re-

(Continued on next page)

EXTENSIONS

(Continued)

duced if two speakers in parallel are connected to it. This is supposed to have a very bad detrimental effect on both output and tone quality. In practice there is only a very slight loss of volume in the main speaker when the extension speaker is switched into circuit and no noticeable change in tone. So we just go ahead with our horrible schemes and leave the sleepless nights to the A.M.I.R.E.'s.

Switches

A far more important matter is the right choice of switches and connecting fittings for a secondary connected extension speaker. Due to the very low voltages encountered here contacts have to be very good or intermittent performance will result. Any kind of plug and socket combination will do to connect the receiver to the extension speaker line and the speaker itself to it on the other end. The only condition is clean contacts and firm springs. Any permanent connection should be soldered.

As for switches, they must be of the self-cleaning type, which means that a certain rubbing action must take place between the contacts whenever the switch is operated. Fig. 4 shows the self-cleaning and non-self cleaning-principle. While the former means a sliding together and apart of the contacts, the latter just causes a touching action between them, so that any piece of non-conducting grit or dust can prevent a proper electrical connection. Slight oxidisation on the contact surfaces will be comparatively high resistance for the low voltages employed and, if not continuously removed, will cause heavy energy losses, will make the extension speaker play intermittently soft or stop altogether. Most of the small, centre mounted toggle swiches sold by radio stores are of the non-self-cleaning type, so better keep away

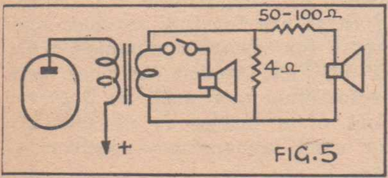

FIG.5

from them. Tone control, wave change or electric light switches, on the other hand, are in principle the right thing, only a bit cumbersome. A light switch of the surface type can be easily screwed on to the back of a wooden radio cabinet to silence the local speaker and as for the extension speaker, turning off of the volume control is often sufficient, although this usually does not cut it out completely, but leaves it playing very softly.

Personal Speakers

Everything said about the connection of a normal extension speaker also holds good for personal speakers or "semi earphones" as we may call them. Out-

FIG 4.

wardly they differ by the fact that they are very small and in most cases attached directly to the receiver by a trailing lead to take them anywhere in the room. By placing them close to your ear, they enable you to listen to a programme distinctly without disturbing other people near by. This means that they are only used on very low volume and we have to adapt them for this purpose.

Just turning down the volume control on the receiver will not do. This will cut down the volume of the programme, but other receiver noises, such as hum, valve and other hisses, etc., will remain at full speaker strength and almost drown speech or music. The incorporation of a speaker volume control would make our little personal speaker a rather cumbersome affair and is also unnecessary in this case. A much easier and cheaper way is to reduce the efficiency of the speaker purposely by putting a resistor of, say, 50 or 100 ohms in series with the voice coil. Another resistor of about 4 ohms across the secondary of the output transformer will keep the speaker valve properly

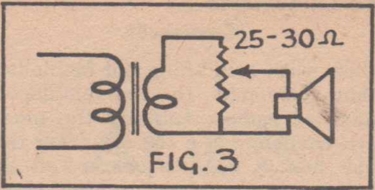

FIG.3

loaded (Fig. 5). The best value for the series resistor has to be tried out. It should be so that at a setting of the volume control, where the main speaker plays at medium room volume, the personal speaker should be loud enough to listen to it comfortably from a distance of about 2 or 3 inches.

There are two types of personal speakers at present available on the market. The first, by Kingsley, consists of a 3-inch permag. speaker in a small, attractive, plastic housing, which is either connected in the above described way or by means of a special connection unit. This unit consists of a small box containing an output transformer and three-position switch for: Extension speaker, set speaker or both. Connection is made by means of an adaptor which fits into the socket of the output valve, the valve then being plugged into the top of the adaptor. This makes connection extremely easy, as no alterations to the set are necessary.

The other personal speaker is marketed by Amplion under the name of "Hushatone" and is a crystal type that works directly off the speaker transformer primary via two .05 safety condensers on either side to block the DC plate voltage. Fig. 6 shows the connection diagram. A DPDT switch enables the changeover from main speaker to the "Hushatone," which finds wide application as under-pillow speaker for hospitals. Up to ten of them can be worked off an ordinary radio set by the arrangement shown in Fig. 6, in which the 5000 ohm resistor provides the dummy speaker load, while the .1 meg. acts as damping resistor for the capacity of the crystal earpiece.

Earphones

These would find far more widespread use these days if people would not continuously associate

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EXTENSIONS
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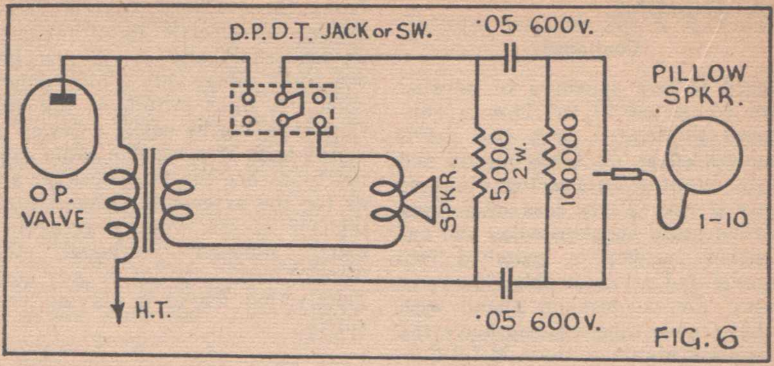

FIG. 6

them with something old-fashioned that belonged to the childhood days of radio. Actually the modern earphone is a far cry from the old heavy head squeezer of 20 years ago. They are lighter, more efficient and of higher fidelity. Some are fitted with sponge rubber cushions which in many cases do not press against the ear at all, but rest against the head around the ear, giving utmost listening comfort and noise insulation from the surroundings. Other, mostly crystal, types fit deaf aid fashion, right into the ear and are light and comfortable to carry, or rather to wear.

Earphones are the final step to privacy in listening; you hear all you want without disturbing anybody and be, at the same time, undisturbed by outside noises, if only to a certain degree.

The best way of connection is directly to the secondary of the speaker transformer, in the same way as extension and personal speakers. If the earphones are of the high ohm type, as they usually are, the mismatch will be so great that they will play only softly when the set is turned to medium volume, thus forming an automatic volume adjustment, when the set is switched from speaker to earphone use. A large number of phones can be connected to an ordinary radio that way, which is being made use of in hospitals where there is a phone terminal at every bed.

The special crystal earpieces brought out by Amplion are mounted on a queerly-shaped plastic base, which enables them to be "screwed" into the outer ear. Their connection is similar to the "Hushatone" crystal speaker described before.

There is a lot of money in extension speakers, earphone and personal speakers for the wide-awake radio man. It does not take much to convince people of the real advantages they get from them and by experience I have found that "one sells the other." Many people get convinced after having seen the scheme working in a friend's home and: "Where did you get it?"—"From Mr. Smith"—and he or she gets it from Mr. Smith too. And if the radio happens to go wrong at the new customer's home, naturally Mr. Smith, who did that wonderful extension speaker installation, will be called in; and once confidence is established, he will be recommended to other people and soon have a good clientele. Yes, there is still good money in radio for those who know how to pick it up—by honest means. As for the others—there is no pity to be wasted.

In Britain the Press is to be allowed certain frequencies for mobile newsgathering etc. 15 frequencies between 67 and 87 mC/s have been allocated. These are in addition to "Business Radio" licences of which more than 50 have been issued by the British P.O. Half of these are for taxi services and others for towage companies, public utilities, vehicle services and professional men such as Doctors. Cost of a licence is £5 plus £5 for each transmitter—receiver in use.

MULTI-CHANNEL TRACER

For the Location of Intermittent Faults

By
H. M. WATSON
89 Botting St.
Albert Park, S.A.

MUCH has been said from time to time about intermittent faults and how they are a nightmare to servicemen, but very little, if anything, has been suggested as a method of tackling such a problem.

This type of complaint is by no means rare and every serviceman receives a fair percentage of such jobs to repair which may possibly be due to the fact that perhaps two or three of them will handle the same set. One will have an intermittent fault to rectify and, after waiting for perhaps an hour or so for the fault to develop, as soon as the voltmeter probe is applied at any point the fault clears itself, perhaps for an hour or more. By this time the serviceman, whose patience is exhausted, takes a potshot and replaces a component, or perhaps two or three to reduce the odds of missing the faulty component from 60 to 1 to about 20 to 1 against. He then runs the set for about half an hour, being a little doubtful that the fault may recur if he plays it any longer and returns it to its owner. Nine times out of then, the odds being so heavy against him, he will have missed

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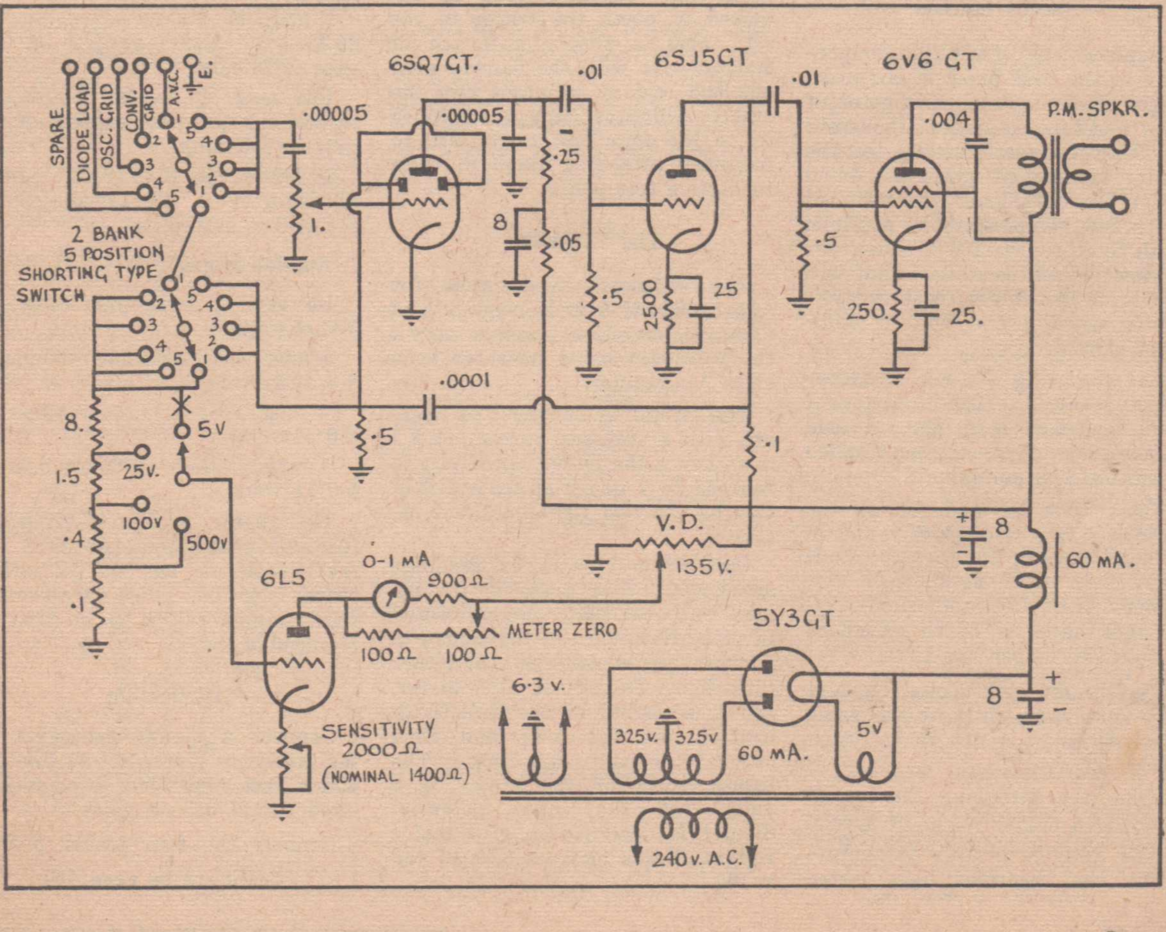

(Continued)

out on the faulty component which could be any one of the fifty or sixty in a standard set.

The owner is the next one whose patience becomes exhausted and so the set finds its way to another serviceman, which is not a good advertisement for the first, but which accounts for the increase in the number of servicemen handling such sets. Occasionally an owner will have a great deal of faith in a particular serviceman and give him a second shot at the set, whereupon he is informed that something else must have gone "haywire," as he located the previous fault and tested and replaced the faulty component. He may get away with this once or twice but even the most trusting set-owner will lose faith before his set has been completely renewed component by component by the method of trial and error.

Speedy Method

Replacement of all the components in the first place is not practicable from an economic point of view and hit-and-miss methods are anything but satisfactory, so the faulty component must be found or at least localised and confined to as few components as possible. With this in view, I will endeavour to describe an instrument that will enable us to achieve these requirements speedily and with a minimum of cost.

The following are the specifications required. The instrument must not disturb or place a load on the set under test when applied to various test points.

Tests must be made on all the various stages successively and in a short space of time, as the fault may clear itself again in a few seconds. R.F., I.F., audio and AVC voltages have all to be measured in this short space of time.

Finally the cost should be kept at a minimum while at the same time efficiency is not to be sacrificed.

From the foregoing the logical choice is a signal tracer of special design with a built-in V.T.V.M.

The one described here covers all of these requirements with only one switch being used to achieve the necessary results. The signal voltage being measured is picked off from various test points along the set and switched into the tracer, which consists of a high gain amplifier. R.F. signals are rectified by the 6SQ7 using leaky grid detection, contact potential biassing this tube for audio input. Leads from the two-bank switch are brought out to banana sockets marked AVC—converter grid—osc. grid and diode load, leads from which are connected to these test points on the set under test. These leads consist of microphone or co-axial cable with a banana plug on each to fit into the sockets on the tracer panel. Two probes are required for R.F. (mixer grid and osc. grid) and these consist of a .0001 condenser housed in a test prod. The audio probe does not require the condenser and is wired straight through to the test prod. The AVC probe has a one meg. resistor housed in the prod instead of the condenser. Another lead is required to earth the tracer to the set. This is simply a length of hookup wire with the banana plug one end and an alligator clip the other. Alligator clips are slipped on to the four test prods also to facilitate attaching them to their respective test points.

The Voltmeter

The voltmeter is designed for linear deflection in a positive and negative direction (centre zero), the voltmeter being operated as a class A amplifier.

The circuit is designed to operate with a standing current of 3.5 m.a., hence the meter sensitivity is reduced to 7 m.a. full scale deflection by the two 100-ohm shunt resistors.

Calibration is easy as readings are linear. The scale is divided into ten equal parts and calibrated in units from zero in the centre to 5 at full-scale deflection in either direction. To adjust the meter, select a setting of the sensitivity control, set the zero and then check full-scale deflection. The lowest scale of the meter is 5 volts and the input potential divider is designed to give meter ranges of this figure x 5, x 10 and x 100.

For those interested in the mathematical side of the meter construction the following may be helpful.

R of meter = 100 ohms + 900 ohms = 1,000 ohms passes 1 m.a.

Therefore R of shunt must pass

$$6 \text{ m.a.} = \frac{1000}{6} = 166\tfrac{2}{3} \text{ m.a.}$$

Current through bleed (including 1 meg. in probe):

I through 11 meg. with 5V. applied = 5/11 microamps.

I through 11 meg. with 25V. applied = 5/11 x 5/1 = 25/11 = 2-3/11 microamps.

I through 11 meg. with 100V. applied = 2-3/11 x 4 = 9-1/11 microamps.

I through 11 meg. with 500V. applied = 9-1/11 x 5 = 45-5/11 microamps.

Drop across bleed:

1 meg. @ 5/11 microamps = 5/11V. + 4-6/11 tapped off for grid = 5 volts.

9 meg. @ 2-3/11 microamps = 20-5/11 + 4-6/11 tapped off for grid = 25 volts.

10.5 meg. @ 9-1/11 microamps = 95-5/11 + 4-6/11 tapped off for grid = 100 volts.

10.9 meg. @ 45-5/11 microamps = 495-5/11 + 4-6/11 tapped off for grid = 500 volts.

Applied to grid:

10 meg. @ 5/11 microamps = 4-6/11 volts.

2 meg. @ 2-3/11 microamps = 4-6/11 volts.

.5 meg. @ 9-1/11 microamps = 4-6/11 volts.

.1 meg. @ 45-5/11 microamps = 4-6/11 volts.

The meter will give accurate readings when switched into the AVC position, but on all other switch positions gives only a reference reading which is all that is required of it.

Application

Connect a signal generator to the antenna terminal of the set under test and feed in a modulated signal at, say, 600 kC/s.

Connect the four tracer probes

(Continued on page 46)

Problems With Battery Sets

HERE are a few notes and tips about ways and means of keeping the old set going, or rather, of finding the faults of radios and correcting them.

Being in the country myself, most of the notes will be about battery-operated sets, some of them will in fact be about the five-tube battery mantel set I described in the May 1948 issue of Radio World.

By

BERNARD S. SMITH

Towrana Station

Gascoyne Junction

Carnarvon, W.A.

I do a bit of servicing for my district and I have managed to scrape together a few ideas on battery sets, or rather their troubles and their cure.

Take, for example, the set that was sent down to me with the complaint that after it had run for an hour or so it would refuse to do what it should do; in other words, it would stop playing.

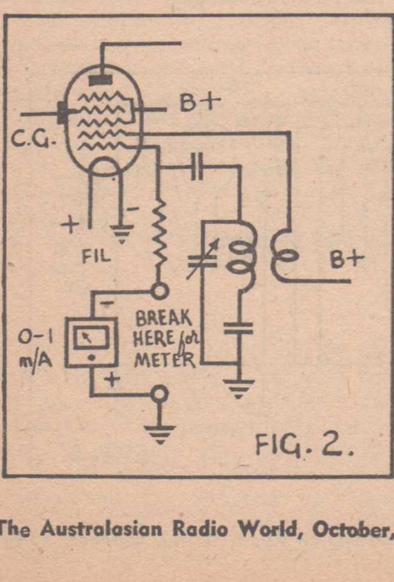

FIG. 2.

It was a commercial job of well-known make, using Continental type 2-volt valves with a vibrator for high tension, the tube line-up being KK2G for frequency changer, KF3G intermediate amp., 1F7GV dem., 1st audio, and KL4G output tube.

I set it playing on the table and then waited for the trouble to develop. It was some wait, too, for this little job with only four tubes gave splendid daylight reception with a good aerial.

It worked quite normally for a couple of hours and then very suddenly it stopped dead! There was a faint hum in the speaker and that was all that could be got from it.

I measured all the voltages and they all seemed to be correct, but it still would not work. On switching off and waiting a few minutes and then switching on again it would work again, but not for long.

The Trouble

I couldn't find anything wrong with the set and had almost given up hope, when curiosity made me open the metal vibrator box.

I found the trouble there all right. One of the bypass condensers across the secondary of the vibrator transformer had come adrift from the earth connection, in this case the chassis. See Fig. 1.

On soldering this condenser back to earth the set worked splendidly and gave no further trouble. Just what effect this condenser was having on the set I don't know, because all the voltages remained the same when it stopped playing.

I suspect that radio frequency voltages caused by the vibrator were building up and entering the negative side of the H.T. line and being rectified by the grid of the power tube, causing cut-off bias.

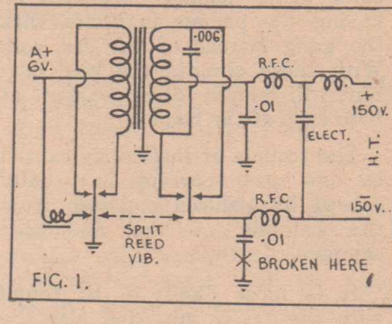

FIG. 1.

More likely the R.F. might have been stopping the KK2G from oscillating, possibly by being rectified on the osc. grid and causing cut-off plate current. A check on grid current would have told me but I didn't think of it at the time.

Grid Current

Speaking of grid current reminds me of another form of trouble I have come across.

It could apply to any form of superhet. receiver, either A.C. or battery, and takes the form of instability with plenty of howls and plops when the set is tuned above about 750 kC/s.

It is not feedback in the I.F. amplifier, and it can be very puzzling, and hard to find. It is caused by the grid current of the oscillator section of the frequency changer dropping very low when the gang condenser is nearly fully meshed, and can be found when the cold end of the osc. grid leak is unstuck and an 0-1 mA meter is placed in series with the leak and earth (or cathode, it depends on where it was returned to originally), when a reading should be obtained. Note that the meter leads should be reversed, that is, positive to earth and negative to the grid leak. See circuit No. 2.

When I say low grid current I mean very low or even no current, as when the gang is fully in mesh

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(Continued)

the current is usually half the value of what it is when the gang is right out. There are exceptions to this rule of course, as in circuits using padder feedback, or having the padder in series with the gang instead of the osc. coil. With these circuits the grid current will remain fairly constant at both ends of the band.

The trouble of instability caused by low grid current is usually caused by reduced emission from the cathode of the frequency changer.

It is most likely to be found with the 1A7G tube and also the 1C7G and 6J8G.

Grid Condensers

When using a condenser for the osc. grid leak-condenser combination be careful to use a good one around about 100 mmfd. in capacity. Beware of those little red ones that look like ½-watt resistors; they are perfectly all right except when the inner lead is heated when soldering them into circuit. The heat causes the lead to part from the silver deposited on the inner surface of the ceramic tube. It does not take much heat to do it and the condenser can cause plenty of trouble with the frequency changer. It makes one wonder how these new printed circuits that are coming into use overseas will last in a hot and humid climate.

Bushman Circuit

And now some notes on the "Bushman I" Country Radio described in the May issue.

When describing that set I said the short-wave band from 5 to 18 megacycles was far better than the band 7 to 22 megacycles. When that set was built there were no dual-wave brackets available with that range (except old type air-core ones) and data was given with the set for winding a set of S.W. coils.

Now, however, a bracket is available in the "Kingsley" range, both standard and miniature types. The type number in the standard range is KU2 and in the miniature range it is KU36 for the IR5 tube.

However, when using a commercial type dual-wave bracket it will be as well to change the intermediate transformers from the J9-J10 types specified in the May article to the J1-J2 types in the Aegis make or to the English Wearite types.

The I.F. channel will have to be amended to circuit No. 3 for the J1-J2 and Wearite type intermediate transformers.

Also when described, the only output valve available was the 334. When using Tripledyne type batteries I would recommend the use of the 3V4 which is now available (sometimes). See circuit No. 3. Inverse feedback can then be applied with a great improvement in tone. Note that the bias resistor should be reduced to 500 ohms for the 3V4.

Also when using a KU36 type dual-wave bracket there is no need for padder feedback on the 1R5.

In conclusion I would like to state that the original set is still giving splendid reception on all three bands. It is triple wave now, and it is very light on batteries, a set of 45-volt Minimax lasting 4 months with the set running at least 3 hours daily.

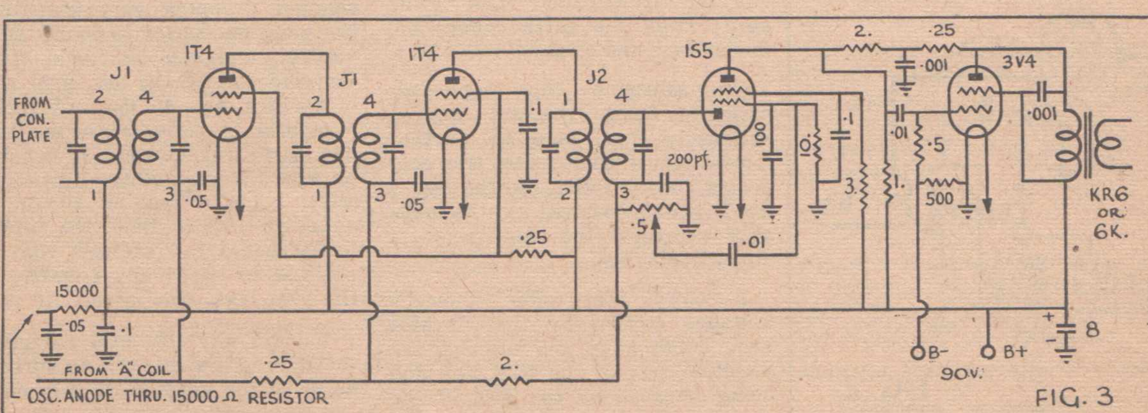


FIG. 3

Your Own Page

AMONG OUR READERS

News of our subscribers and their activities

"I'm a civil engineer (B.E.), aged 22, helping to build a large concrete dam for hydro-electric power production in the wilds of Tasmania. Am interested in better concrete and methods of cooling it, soil mechanics, books—especially G. B. Shaw—ski-ing and, spasmodically, in radio. At irregular intervals I whip up an enthusiasm and knock a simple set together. I have built your All Wave Band Spread Two, and Ferrotune Four, both with excellent results. I am interested most in constructional articles on the simpler and more straightforward sets."—P. E. J. Gardner, Butler's Gorge, Tasmania.

* * *

"I read your paper to keep abreast with the latest of the radio world. Having studied a Diploma of Electrical Engineering and also a short course of Electronics at Melbourne Technical College a few years ago, I am able to understand most of the technical articles published. I am employed as a Test Supervisor in the Meter Laboratory of the State Electricity Commission of Victoria at Yarraville, engaged in the repair, maintenance and calibration of electrical meters of various types, specialising in temperature measurement. My main spare-time hobby is devoted to amplifier building. I am also contemplating building a home recorder shortly, with the hope of using records synchronised with home movies to give talkie films at home."—Les K. Lazarus, 136 Nicholson St., E. Brunswick, N.11, Victoria.

* * *

"I am sixteen years old, in the fifth form at college and have for hobbies radio engineering and mapping. I hope some day to be on the air as a ZL. You can sit for your amateur operator's ticket when you are fourteen in New Zealand. I read Australasian Radio World for the reason that I like to know what is going on across the Tasman. I enjoy Don Knock's articles very much. Yes, the hams are springing up everywhere over here, even one in the same class as myself (ZL2ABQ), while another holds a partial pass. Lastly, may I say that I wish A.R.W. was twice the size as well as twice as often!" — R. J. Meagher, Kirk Street, Otaki, New Zealand.

* * *

"I complete my school career this year; I am in the middle of doing my Leaving Certificate examination now. Next year I intend working at Tasma Radio and doing a Technical College course in radio engineering at night. Within a couple of years I hope to have my own station as well. What I regard as the best features of your publication are the Ham Notes, Calling CQ and articles sent in by hams. I should like to see more of the latter. I should like to see more articles on V.H.F. work and, if possible, a discussion, etc., on converters for V.H.F. and U.H.F. But the main thing is—increase the size!"—Dennis Bradshaw, 46 Gould Street, North Bondi, N.S.W.

* * *

"I am a postman at Malvern and I am very interested in the radio section of your paper. I built the Trade Builder from the August 1941 issue and it is a good set. I used the RCS coils, which are very good."—J. V. Fraser, 1061 High Street, Armadale, Vic.

* * *

"I am a State public servant. Although my work has no connection with radio I am very interested in radio and its vast future. Prior to enlisting in the RAAF in 1941 I had no knowledge of radio. While in the RAAF I gained valuable experience in the subject. It is with a view to furthering the knowledge I gained and to keep abreast of changes that I read your excellent magazine. I consider that your magazine far surpasses any other publication of its kind and is by far the best in Australia. I look forward to reading and studying the contents of future issues for many years to come."—G. C. Parker, 58 Morehead Avenue, East Coorparoo, Brisbane.

* * *

"I am only half past seventeen now and an electrical fitting apprentice at the A.W. Valve Company. Your publication helps me to keep up to date with modern trends, any new parts which come on the market and it is easier and far more satisfactory to build a set to one of your designs than try one of my own. The features which I like the most are the constructional articles, while the technical and service pages come in for their share of attention."—A. T. Gibson, 32 Brien's Road, Northmead, N.S.W.

* * *

"I am a student in radio with the A.R.C. and I find the Radio World interesting and helpful in many ways. I have hopes of becoming an amateur operator but I have a long way to go yet. I think

(Continued on next page)

TELECONDA

(Continued from page 11)

quite a few kC off peak. Making use of this fact, which must be due to the change from inductive to capacitive load, we can get very accurate alignment by ear.

The set is now put into the cabinet and screwed down, after making sure that the centre of the dial disk is right behind the centre of the scale on the cabinet. Trimmer and padder are then adjusted in the usual way, after which the aerial trimmer is peaked to a station between 1300 and 1200 kC, the slug of the aerial coil, if any, adjusted to maximum at about 650 kC.

The final check on the set is the operation of the volume control. With the control right off, the minimum volume should be very soft and low pitched, while the maximum volume should be loud, but not too loud. Any faulty component will upset these conditions, even if the fault is not big enough to stop or considerably weaken the receiver.

If the alternative circuit of Fig. 3 is used, the max. volume should be the same, but the set can be completely silenced with the volume control off. The 10 mf electrolytic across the back bias resistor finds its place between volume control and aerial coil, its negative end connected to the cold end of the control and its positive terminal on a lug held by the gang condenser mounting screw in this corner.

PARTS LIST

Teleconda 4841

1—Special chassis.
1—Special cabinet.
1—Power transformer, sec. 2.250 or 285V.
1—5" speaker, 1500 field, 7000 ohm tr.
1—2-gang condenser, H type.
1—Kit dial, spec. type.
1—Aerial coil.
1—Oscillator coil for 6SA7.
2—Trimmers.
2—IF transformers.
1—Padder.
4—Octal valve sockets.
2—8 MF 525V electrolytics.
1—.5 meg. volume control (ev. with sw).
1—Resistor 20,000 ohms ½ watt.
2—Resistors 20,000 ohms 1 wat.
2—Resistors 1 Megohm ½ watt.
2—Resistors .5 Megohm ½ watt.
1—Resistor .1 Megohm 1 watt.
1—Resistor 5000 ohms ½ watt.
1—Resistor 300 ohms w/wd.
3—Condensers .02 MF.
1—Condenser .01 MF 600V wkg.
1—Condensers .002 MF.
2—Condensers .0002 MF.
Flex, hookup wire, grid clip, rubber grommet, nuts and bolts, etc.
FOR SECOND VERSION: Add 1—10 MF, 40V electrolytic. Omit 1—1 Meg. resistor.

OUR READERS

(Continued from page 31)

your paper covers something to interest all radio-interested people. I am well satisfied with it as it is."—K. G. Hall, Hellyer Street, Smithton, Tas.

* * *

"I built up the Ferrotune mantel model from the November 1946 issue and was agreeably surprised with the performance, obtaining good interstate results both in Queensland and here. I should be pleased if you could some day make suggestions for locating causes of frequency drift in dual-wave receivers, lacking oscillator or signal tracer."—D. Boge, Commonwealth Bank, Alice Springs, N.T.

* * *

"I am a student teacher and a radio enthusiast. During 1944-5-6 I was doing Engineering at the University, but the wheels of fate rolled and now I am a teacher. However, next year I hope to have another go at the Uni and hope to do electronics as a subject. At the moment I am doing a service mechanic's course with Marconi School. Interesting comprehensive articles on construction, such as Sally in the last November issue, make the best reading and are useful for all home set-builders. More of these articles, please. Ham articles are not in my line."—A. M. Griffiths, 8 Holyrood Avenue, North Essendon, Vic.

* * *

"By trade I am a medico and have followed radio as a hobby for several years. I have built several small t.r.f. sets and an amplifier but have not tackled a superhet yet. As for your journal, I like it because it is 'devoted exclusively to technical radio.' My main interest is in circuits of A.C. sets, portables and amplifiers."—W. H. Corbett, M.B., B.S., 28A Ingram Road, Wahroonga, N.S.W.

* * *

"I recently returned to Japan to find myself in a totally different sphere. Was commissioned and posted to a strange branch of the service. I have been reading Radio World now for some years. 1939 I think was the beginning of my interest in radio. It is only a hobby and a more interesting and enthralling one would be hard to name. My main interest here is S.W. listening and general experimenting, mostly with receivers. I have two sets in use, one a many times rebuilt and re-designed STC five-valve dual-wave vibrator job and a re-modelled FS6, taken from A.R.W. I have a third set on the construction bench now, as well as a transmitter. Doubtful when I will be able to get on the air, as the licence procedure here is rather lengthy. In conclusion, may I wish yourself and the magazine all the best for the future. I'm fully satisfied with it as it stands except for the usual cry—it doesn't come often enough."—NX203521, Lieut. Mulholland, E. J., 65 Aust. Inf. Bn., B.C.O.F., Japan.

* * *

"I am a wheat and wool grower, just a wheat planter sometimes, with radio and mechanics as my hobbies, which I turn to profit when my neighbour's set or tractor 'goes stopped'."—E. McNabb, Carwarp, Vic.

ONE GOOD TURN—

If you would like bigger and better issues, make a point of supporting those firms who advertise with us.

A Feature Article

FREQUENCY RANGE

AND POWER CONSIDERATIONS FOR MUSIC REPRODUCTION

We have published several articles dealing with this subject and they have aroused so much interest that we devote the next nine pages to giving you the full text of one of the finest technical monographs ever presented, direct from the Jensen Radio Manufacturing Company of Chicago. By the time you have fully studied this article you will have a mighty useful knowledge of the requirements for high quality reproduction.

THERE can be very little doubt that we stand on the threshold of a new era in radio transmission and sound reproduction. We can confidently expect that these facilities can, and shortly will, bring into our homes greatly improved, higher quality services. How much improvement we can expect over previous services and the degree to which potential improvements can actually be utilised, are questions which remain to be answered.

Among the basic questions which must be answered are these: What frequency range is needed if we are to take advantage of improvements in broadcasting made possible by the FM system of transmission? What limitations on frequency range may be imposed by the hearing ability of the listener and the usual noise levels which surround him? What are the principal design and cost factors which must be considered?

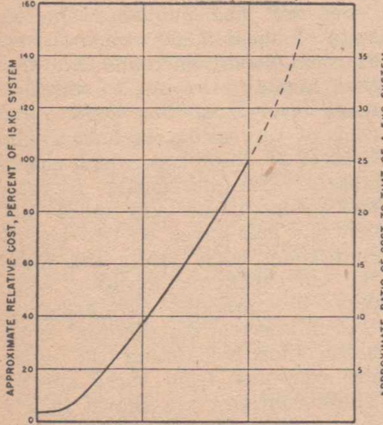


Fig. 1. Approx. costs of reproducing systems at various upper limiting frequencies.

Economics of Wide-Range Reproduction

The reproduction of music is perhaps the most critical application of loud speakers because of the wide range of frequencies and powers covered by the various instruments, the need for low distortion, and the importance of spatial distribution of the reproduced sound. Yet it is a matter of record that a fairly high degree of listener satisfaction is obtained from reproducing systems which fall far short of the theoretical ideal in all of these respects.

As improvements in the overall system performance become technically possible, the question arises as to the lengths to which it is worth while to go to take advantage of these advances, and the nature of the improvement which can be effected in practical systems under average conditions of use. These questions are particularly important at this time, because frequency modulation transmission facilities may be greatly expanded, thus providing a widespread source of potential high quality programme material.

Our problem is to appraise the complete transmission system up to and including the ear of the listener so that we can specify a sound reproducing system which will transmit a full **useful** range of frequencies and powers, and yet not suffer the economic burden imposed by the cost of an over-range design. Some idea of the importance of a fairly accurate estimate of the required frequency range may be gathered from Fig. 1, which shows in a general way the extent to which reproducer costs increase as the upper limiting frequency is moved out beyond 5,000 to 6,000 cycles (5 to 6 kc). Above these frequencies, it becomes imperative to subdivide the range and to use a number of reproducing elements with their associated frequency-dividing networks in order to attain the required efficiency and best possible spatial distribution of sound over the prescribed total frequency spectrum. Actually, of course, the cost curve should be a stepped curve with a vertical increase for each additional reproducer unit with its network, but since the choice of the dividing frequency and other factors vary consider-

(Continued on next page)

FREQUENCY

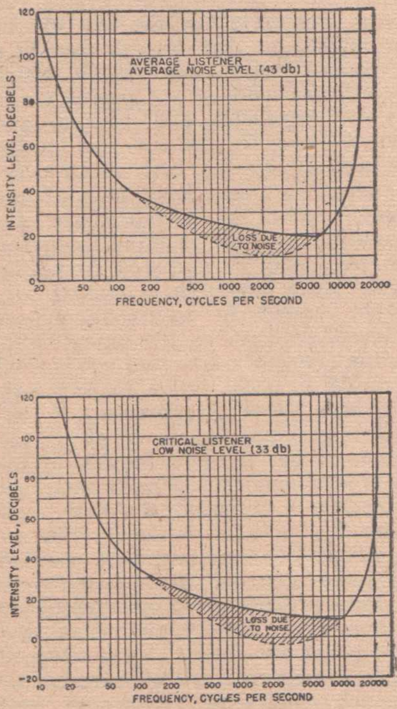
(Continued)

ably in commercial applications, only the trend of the average has been indicated. Obviously, the choice of the lower frequency limit will also affect the cost, as will the power rating of the reproducer. The cost estimates assume a suitable power rating for home reproduction levels with a low cut-off frequency known to be generally acceptable.

Perceived Frequency Ranges

We are not primarily concerned with the question of reproducer costs in this study. The cost element has been mentioned early in order to show the steep upward trend with increased frequency range and to permit the later appraisal of the economic effects of compromises.

What range of frequencies the listener can perceive depends, first of all, on his innate hearing ability, secondly on the average level and spectral composition of the sound and lastly, and of great importance in the determination of the final result, the level and character of the ambient noise background in which he is immersed.



Figs. 4 and 5. Contour for average listener with average noise (top) and critical listener with low noise (below).

All of these factors are variables. First of all, hearing ability differs widely in the population. The extreme range of frequencies which can be perceived by an individual with acute hearing when the sounds are at near-pain intensity is from about 16 to 22,000 cycles. As the intensity is decreased, the perceivable frequency range is shortened at both ends. Only about 5 per cent. of the population is able to perceive such a

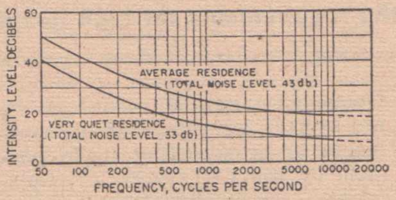


Fig. 3. Masking level contours for noise in average and very quiet residences.

wide range of frequencies, even at the highest sound intensities. The median range for the population is from 20 to 15,000 cycles per second at an intensity level of 120 db. For the 5 per cent. with the poorest hearing, the range is less than 25 to 7,000 cycles. All of these figures are at the threshold of pain, and do not represent the situation at the usual intensity levels where the perceived frequency range is much less. The complete picture of the statistical hearing contours for these groups of the population is given in Fig. 2, which is taken from an analysis by Fletcher[1] of the hearing records of more than 500,000 people[2]. This large sample, representative of a typical population, included people of both sexes and all ages, and thus takes into account recognised trends with age and real differences in the hearing loss of men and women. We are thus able to define statistically with considerable assurance, the hearing ability of an average listener, and of a critical listener. We can then use these two contours as fundamental data in determining the perceived

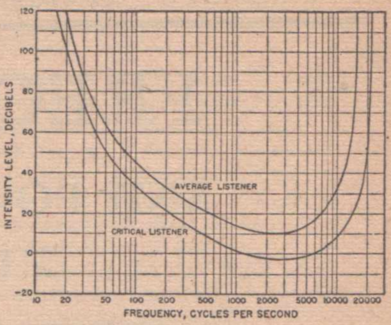


Fig. 2. Hearing contours for average and critical listeners.

frequency range, subject to the masking effects of various noise levels.

Noise is another highly variable element. Noise levels are higher in the summertime when windows are open and traffic is somewhat heavier than in winter. Noise depends on location, being higher in level in heavy urban traffic areas than in quiet suburban districts. It depends also on the number of people in the room, on the proximity of mechanical equipment, and is quite variable from instant to instant. Noise acts as though it deafened the individual situated within it. For any particular level and spectral distribution of noise, there results a masking contour which defines the intensity level of a single frequency tone which will be audible to the listener, provided his normal threshold (in the absence of noise) is equal to or lower than the masking contour.

Seacord[3] has published the results of about 2,200 measurements of room noise which indicate that the annual average residential noise level is 43 db. Only 5 per cent. of the residences had a noise level of 33 db or less, which checks closely with previously reported measurements in very quiet residences. This gives us two significant room noise levels for which the corresponding masking levels may be obtained by assigning typical spectral distribution[4] to the noise, then calculating the masking contours[5] from these spectra. These contours are shown in Fig. 3.

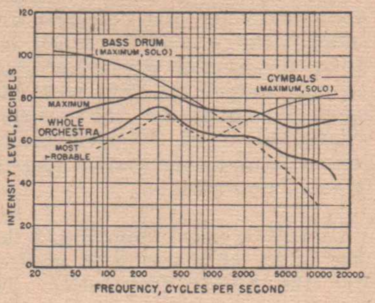
We can now combine the normal hearing contours with the masking contours in a variety of ways, if we choose, in order to determine the ability of a statistical listener to hear in the presence of representative noise conditions. For our purposes, we are interested in the average case which represents a very large segments of the population, and this results from pairing average hearing acuity with the masking contour corresponding to average residential noise. Although it probably involves much less than 1 per cent. of the population, we should also examine the case in which the combination of hearing acuity and masking contour yield the widest possible perceived frequency range. We may take the acuity of our previously defined critical listener and pair it with the masking for 33 db noise for this case. The contours for these two cases are shown in Figs. 4 and 5.

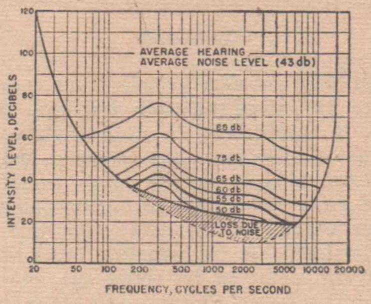
The Nature of Music

To describe music in physical terms is exceedingly difficult. In symphony orchestra music, we know from tradition the kind and probable number of instruments which will be played, but the compositions and conducting technique introduce seemingly almost unlimited variables in frequency and intensity. The only possible approach to a solution is by sampling and statistical analysis of the data. Sivian, Dunn and White[6] have taken such samples for a small number of orchestras playing a variety of different compositions. By use of band filters and a counter system employing gas tubes arranged to fire at intervals over the range of levels involved, they obtained the distribution of sound pressure level for frequency bands covering the entire musical spectrum.

After introducing suitable corrections, Fletcher[1] has arrived at the maximum root-mean-square values in ¼-second intervals in critical frequency bands at a 20-foot distance for symphony orchestra music, based on the data just referred to. These maximum r.m.s. levels are the **effective** values of the **peak intensities*** as perceived by the ear. Now if the total reproduction level is such that the maximum r.m.s. intensity

* Defined as the intensity level which is exceeded only 5 per cent. of the time in the particular critical frequency band.





Figs. 6 and 7. Levels in critical frequency bands for orchestra music and perceivable frequency ranges at various levels.

level in any particular frequency region is just equal to the masking level, then the components of the music in that region will never be heard. Furthermore, since the peak intensities occur relatively infrequently, the average level will be considerably below the masking level. For this reason it appears that the use of average or statistically most probable intensity levels should provide a more representative result in determining the perceivable frequency range.

The **most probable levels** in critical frequency bands are substantially lower than the maximum levels. The values which we have calculated[7] from the original data[6] are shown in Fig. 6 along with Fletcher's maximum values. At 300 cycles per second, the most probable intensity is about 7 db below the maximum, while for most of the frequency range up to 5,000 cycles per second, it averages about 12 db below the maximum. Above this point, the divergence is greater, the most probable value being 28 db below the maximum at 15,000 cycles per second.

Now if we adopt the most probable intensity level curve as the spectral distribution which is most representative of the average acoustic intensity levels encountered in listening to symphony orchestra music, we are in a position to determine the perceived frequency range on a statistical basis, using the effective hearing contours for the average listener and the "critical listener" shown in Figs. 4 and 5.

The position of the most probable intensity level curve is determined by the total level of reproduction. In Fig. 6 it is shown for concert hall levels at a distance of 20 feet from the orchestra. This is for a long average total level of 88 db. It has been estimated from Seacord's data[3] that the average total level for home radio reproduction is about 55 db at probable listening positions[7]. Therefore, assuming an ideal transmitting and reproducing system, we may determine the perceivable frequency limits within the home under average conditions by lowering the curve 33 db and noting the frequencies at which the hearing threshold curve is intersected. The manner in which the perceivable range varies with the level of reproduction can be studied similarly by raising or lowering the curve.

This process is illustrated in Fig. 7 for the average listener case. For reproduction levels down to 60 db, it will be seen that the limiting frequencies are determined purely by the normal hearing contour. At average radio level (55 db), masking due to noise is already appreciable and limits the perceivable range to 175 to 5,800 cycles per second; as the level is decreased further, the effect of masking rises very rapidly. At a reproduction level of 50 db, only 5 db below the assumed average radio level, the frequency range has been restricted to 220 to 3,300 cycles per second, and midrange masking has set in between 700 and 1,200 cycles

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per second. Many radio receivers are operating at such low levels. It is interesting to note that, in the complete absence of noise, the perceivable frequency range would be from about 200 to 5,000 cycles per second at the same reproduction level. A reproduction level of 50 db seems to be about the lowest for which the average listener could claim any valid interest in the quality of reproduction. In this connection, it must be remembered that this analysis is based on an **ideal transmission and receiving system which is capable of reproducing an unlimited band of frequencies with complete uniformity.** We know that the great majority of existing AM radio receivers have a non-uniform response characteristic and reproduce a limited frequency range, determined principally by the r.f. selective circuits. Thus for actual radio listening, the perceived frequency range may be much less than the ranges given here, the actual range in any particular case depending on the response characteristic of the receiver and sound reproducing system and the level of reproduction.

It will be noted from Fig. 7 that the effect of masking is greatest for the higher frequencies. The ear is the controlling factor at the low frequency end, except at abnormally low levels. At the high frequency end, the ear determines the frequency limit at above-average levels, while for lower-than-average levels the limit is set by masking due to noise.

By the same process, the perceivable ranges may be determined for the critical listener in a low noise level. The results for both types of listeners are summarised in chart form in Fig. 8 for the usual intensity ranges encountered in home listening.

It is immediately apparent that under the assumed ideal conditions of perfect transmission into the home, the listener is able to perceive only a restricted range of frequencies. For the average listener (at average reproduction level) the range of 175 to 5,800 cycles per second represents only about 62 per cent. of the total number of octaves assumed transmitted in the whole range of 40 to 15,000 cycles per second. The critical listener has an evident advantage, for under the assumed conditions, he is able to perceive a range of 120 to 12,000 cycles which represents about 81 per cent. of the total number of octaves transmitted. The frequency range is greater for higher levels and lesser for lower levels as indicated in Fig. 8. The broken bars indicate the obliteration of a part

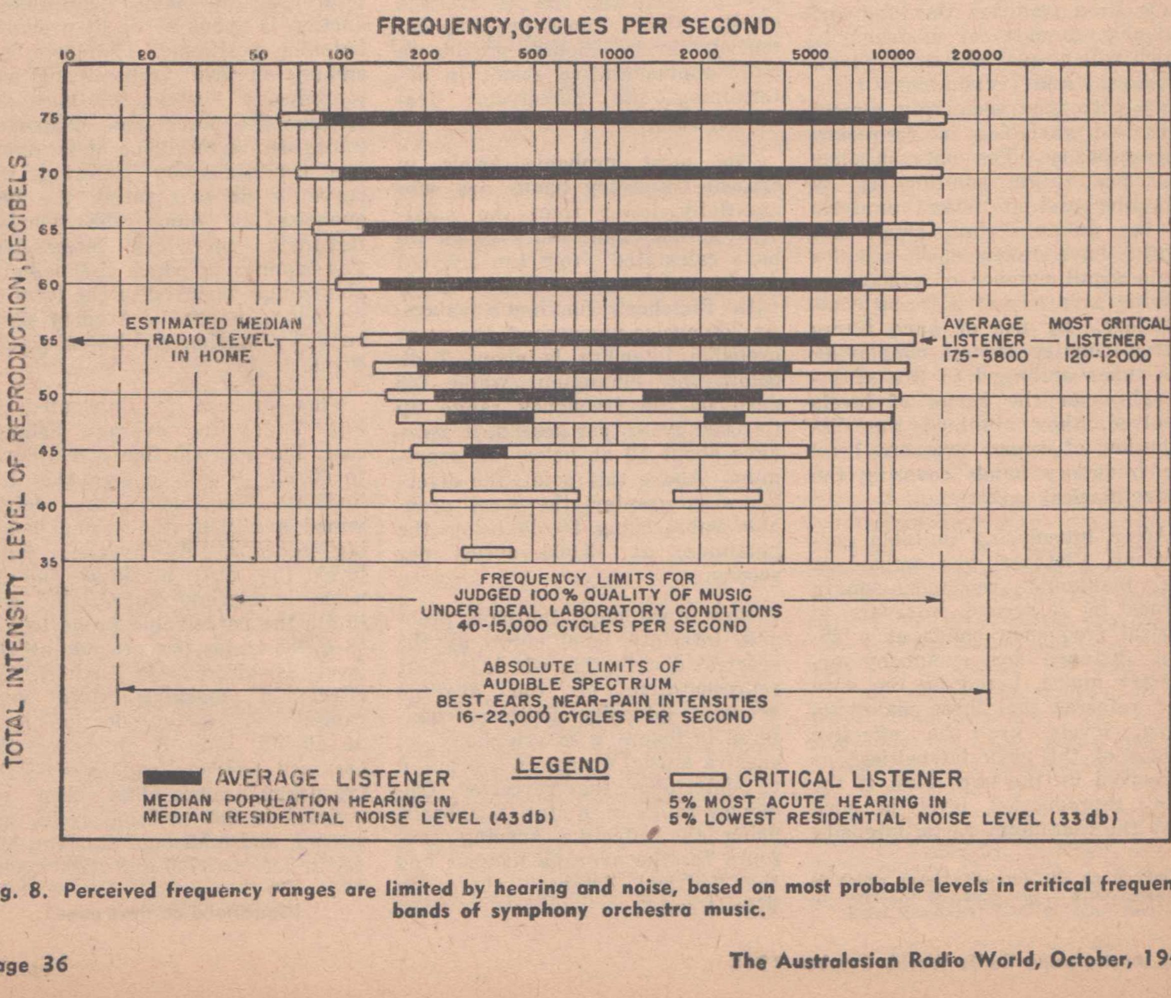

Fig. 8. Perceived frequency ranges are limited by hearing and noise, based on most probable levels in critical frequency bands of symphony orchestra music.

of the mid-range due to masking.

Difference Limens

The foregoing analysis gives us a picture of the perceivable frequency ranges for a perfect transmission system operating at various reproduction levels in the home. It shows us statistically what the situation is at average level and at any other level. If we are interested in establishing the widest useful frequency ranges, then the conditions at higher-than-average levels must be examined.

Fig. 8 shows that at a reproduction level of 75 db, the critical listener may perceive a range of 60 to 15,000 cycles. For the average listener the range is 85 to 11,000 cycles. This reproduction level is 13 db below assumed concert hall level and represents about the maximum likely to be employed, on the average, in the home. Now since these frequencies approach ideal requirements, it would be useful to know to what extent the listener can detect changes in the upper limiting frequency.

Gannett and Kerney[8] have determined the minimum perceptible change in band width with direct comparison between the bands being judged. Their tests were made on a variety of musical programme material and with a very low noise level (30 db). An average of sixteen observers, who were engineers accustomed to judging programme quality, were used for the tests. The **difference limen** was taken as the difference in band width (i.e., difference in high frequency cut-off) when 75 per cent. of the observers correctly identified the wider of the two bands presented for comparison. It is reasoned that the difference limen is equivalent to (1) **the difference in band width which is actually detectable to half the observers or (2) the threshold difference in band width for which there is an even chance of its discernment by a listener.** The sensation due to a change of one difference limen is defined as one **liminal unit, for** which we propose the symbol "LIM."

The result of these tests may be expressed in the family of transmission characteristics given in Fig. 9*, in which the cut-off frequencies differ by steps of 1 LIM. Thus 11,000 cycles per second is 1 LIM down from the full musical spectrum band of 15,000 cycles per second; 8,000 cps. is 2 LIM down from full band, or 1 LIM down from 11,000 cps., etc. The 1 and 2 LIM steps at the low frequency end are a matter of conjecture by Gannett and Kerney and have not been established by test.

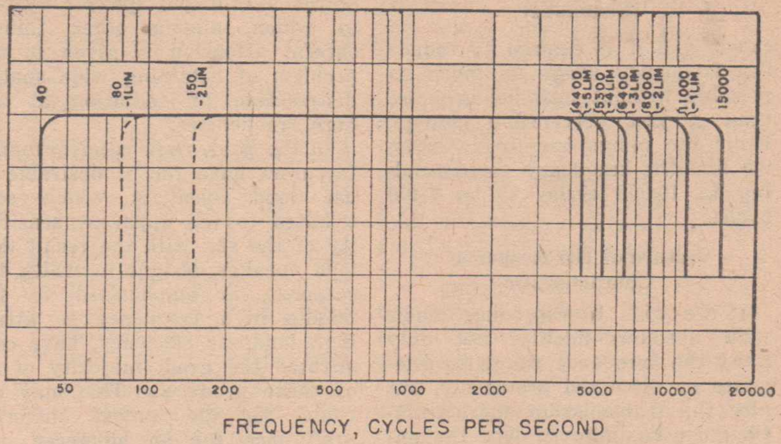

Fig. 9. Transmission bands differing by one liminal unit for music.

The previous training of the test crews, the relatively high reproduction level, and the use of repeated direct comparisons, undoubtedly results in liminal values which are too small for home listening conditions or for commercial demonstrations of radio receivers. The average listener seldom if ever has an opportunity to make a direct comparison involving **change of band width only** under properly controlled conditions. Moreover, it is not possible to appraise properly relatively small differences in band width if the response characteristics otherwise differ even slightly, particularly near the frequency region being judged. This difficulty is always present when comparing two different commercial products. Under ordinary conditions, then, the use of these liminal values will yield perceivable frequency ranges which are greater than those actually realisable.

* These are for music. One liminal unit for speech is equal to about two liminal units for music.

Now if, as shown previously, the critical listener can perceive an upper frequency limit of 15,000 cycles at a reproduction level of 75 db, the frequency range can be reduced to 11,000 cycles (-1 LIM) without detectable difference. Therefore 11,000 cycles is the maximum frequency which need be reproduced for the critical listener. Similarly, for the average listener who can perceive an 11,000-cycle upper frequency limit, a maximum frequency of 8,000 cycles is sufficient. These frequency limits appear to be the maximum which can be economically justified for home reproduction for these classes of listeners. They represent frequencies not merely at which the return is diminishing, but beyond which the return is substantially zero.

The size of the frequency intervals for one liminal unit provides a useful measure of the effect of changes in the upper frequency limit. Fig. 10 enables the frequency corresponding to one liminal unit plus or minus to be determined for any reference frequency. Suppose that a system transmits to 9,000 cycles. How much would this upper frequency limit have to be extended to make a perceptible difference? From the plus one limen curve we find that the frequency corresponding to 9,000 cycles is 12,200 cycles. Thus the frequency range must be extended to at least 12,200 cycles to be noticeable. Again, suppose that the system transmits to 10,000

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cycles and it is desired to reduce the frequency range as much as possible without introducing more than a just perceptible change. From the minus one limen curve, we find the frequency corresponding to 10,000 cycles to be 7,400 cycles.

Nature of the Response Characteristic

If we wish to reproduce music with absolute fidelity, not only must the frequency range be adequate as discussed previously, but also the transmission characteristic must be uniform over the entire frequency range. Such absolute fidelity is, of course, not realisable except under laboratory conditions with highly special equipment. It is possible, however, to approach uniformity sufficiently closely in a well designed sound reproducing system. To do this over extreme frequency ranges requires a multiple speaker system in which, among other things, careful attention is given to the problem of attaining wide spatial distribution of radiation at the high frequencies.

In the past, radio receiver manufacturers have felt it desirable to use loud speakers which contributed to the apparent sensitivity of the set, with the result that loud speaker designs in which the response is emphasised in the middle high frequency to attain high loudness efficiency, have constituted the great majority of all of those produced. This may account for the almost universal preference for an advanced setting of the tone control which drastically reduces the high frequency response.

The situation is illustrated in Fig. 11 which shows in curve A the loudness versus frequency characteristic for symphony orchestra music (after Fletcher). It will be observed that the ear is stimulated most in the 2,000 to 3,000 cycle region despite the fact that the maximum and most probable intensity levels are highest in the 200 to 400 cycle region as shown in Fig. 6. If such music is reproduced over a loud speaker in which the middle high frequency response has been accentuated, the listener will experience loudness sensations something like curve B. Excessive stimulation in the middle high frequency region seems to be universally objectionable to most listeners. The irritation of such excess stimulation can be reduced by lowering the response in this frequency region. With the usual type of high frequency tone control, this is accompanied by excessive shortening of the high frequency range, with a final result which is approximated in curve C. It should be remembered that these are loudness curves and not conventional response curves. One is led to conclude that listeners predominantly prefer the loss of the upper frequency region to excessive middle high frequency response. **This is no indication that high frequency components at the top of the range are not wanted.** There is considerable evidence that most listeners prefer a wide frequency range to a restricted range when listening to high quality programme material over a system with a relatively uniform response characteristic and proper spatial distribution of the high frequency sound radiation.

Low Frequency Limit; Balance

Thus far we have been mainly concerned with the total reproduction band width in order to establish the necessary high frequency limits. It has long been recognised, however, that the high- and low-frequency cut-offs are related to each other for limited fidelity reproduction (i.e., when the complete theoretical music spectrum is not reproduced(if the listener is to gain the most pleasing impression of appropriate aural balance between the high and low frequency components. Thus, if the upper cut-off is at 5,000 cycles per second, it has previously been considered that the lower cut-off should be somewhere between 100 and 130 cycles per second. If the upper cut-off were raised to 7,000 cycles per second, according to the established view, the lower cut-off should be at about 70 to 90 cycles per second. A relationship of this type corresponds to a constant product of the cut-off frequencies and different authorities have given values for the constant ranging from 500,000 to 640,000.*

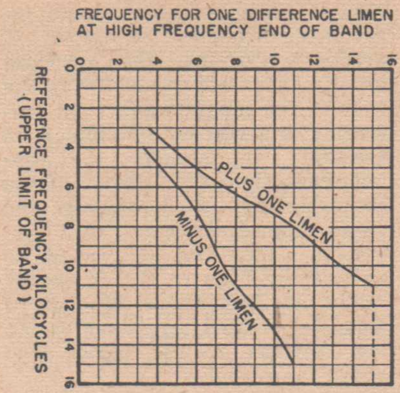

Fig. 10. Frequencies for one difference limen plus or minus at high frequency end of band.

There is no doubt that the constant product relationship with constants of 500,000 to 640,000 will give excellent high-quality reproduction, completely satisfactory to most listeners, when applied to high-fidelity systems. However, we need to re-examine this concept, particularly in the light of the work recently published by Gannett and Kerney[8] on order to establish what is perhaps frequency difference limens, in the whole permissible range of values and to provide a basis for good engineering practice taking into account the economic factor. Extensions of the low frequency range downward involve increasing cost and bulk, neither of which ought to be carried any further than is necessary to insure a completely satisfactory result.

* Values as low as 400,000 are to be found in earlier literature.

A system reproducing the entire musical range from 40 to 15,000 cycles is obviously a balanced system. We know that in such a system a change in the high frequency cut-off to 11,000 cycles or a step of -1 LIM, is just discernible. Under practical listening conditions, this is an exceedingly subtle difference, and it is reasonable to assume, and experience confirms, that the change in aural balance is also exceedingly slight and is undoubtedly still satisfactory. In the light of experience, it appears likely that the balance is also satisfactory for a further reduction to 8,000 cycles (-2 LIM). On this basis, then, a low-frequency cut-off of 40 cycles is adequately balanced by a high-frequency cut-off of 8,000 cycles or higher. Likewise, if one liminal unit at the low frequency end corresponds to 80 cycles, as suggested by Gannett and Kerney, then a high-frequency cut-off of 11,000 cycles or higher would be adequately balanced by a low-frequency cut-off of 80 cycles or lower. These conditions have been plotted in Fig. 12, along with the constant product data, which leads to an area of satisfactory aural balance indicated by cross-hatching. This indicates that there is considerable latitude in the choice of cut-off frequencies above about 8,000 and below about 80 cycles. This is as we would expect it in view of the rather low probable intensity levels in the end regions.

Another criterion of balance is that which results from the pairing of low and high cut-off frequencies which in judgment tests have yielded equal reduction in quality in the opinion of listeners skilled in such observations. Such a curve, Fig. 12, has been obtained from the data of Snow[9]. Above a high-frequency cut-off of about

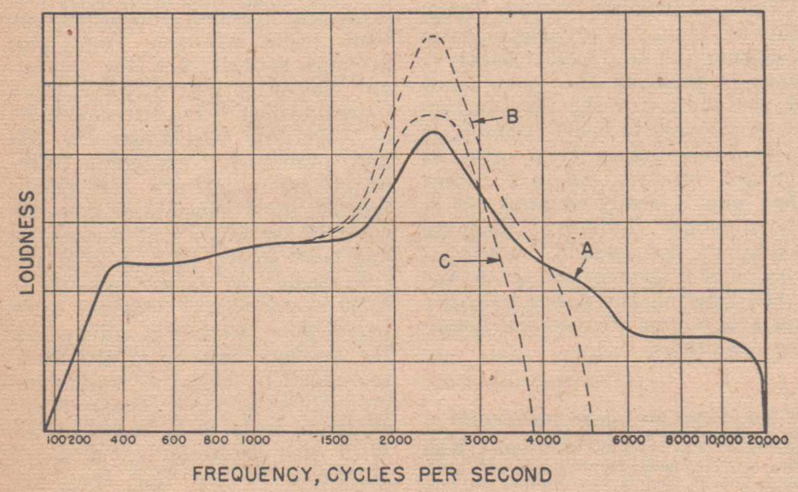

Fig. 11. Loudness versus frequency for a symphony orchestra. Curve A is for live listening. Curve B for speaker with excessive middle frequency response. Curve C shows the use of tone control.

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6,500 cycles, this curve gives higher values for the low cut-off than a constant product of 640,000 and is well within the postulated area of balance. It will be observed that Snow's data would also suggest higher values of low-frequency cut-off for frequency bands less wide than 6,500 cycles.

With all of the above considerations in mind, and remembering that popular preference is on the side of what may be termed "full" rather than "light" treatment of the bass, it seems reasonable to propose the relationship indicated in Fig. 12 as an objective for good engineering practice. The possible advantages of the proposed relationship are that it (1) provides a definite basis for calculations, (2) establishes an approximate mean of the extreme criteria which might be applied, and (3) is in the direction of relatively economical low-frequency components. It should be pointed out again that balance requirements are not rigid and considerable latitude is possible in acceptable reproducing systems. Moreover in practical systems, the response usually trails off gradually at the ends of the range rather than presenting a sharp cut-off, and it is necessary to consider the contributions from the "skirts" of the characteristic in appraising the aural balance situation. In a system in which the low cut-off is undesirably high in the frequency range an impression of balance may be created by accentuating the response in the region just above the cut-off.

A Preferred Series of Frequency Bands

From all of the foregoing, it is possible to construct a rational series of audio frequency reproduction bands with equal, just discernible differences in band width. This may be done by successive reduction of the high-frequency cut-off in steps of 1 LIM and assigning the corresponding low-frequency cut-off from the aural balance relationship just previously developed*. Uniform transmission between cut-off frequencies is assumed. Such a series is extremely useful in appraising the whole problem of higher fidelity, in classifying reproducing systems and programme sources on a basis of relative merit from a standpoint of frequency range, and in setting realistic engineering design objectives.

Table 1 presents 8 such bands ranging from the complete music spectrum (40 to 15,000 cycles) to what is probably the lower limit of usefulness for the reproduction of music (200 to 3,000 cycles)[7]. It is probable that a band must be changed by two numbers rather than one if really marked differences under ordinary listening conditions are sought. Explanatory notes are appended to the table, relating the bands to existing programme sources and listening conditions.

* This is not the same as a series of bands providing equal judged quality differences. The 1 LIM differential basis was used instead because published quality judgment data is very limited in scope and more test work is needed. However, Snow's results (loc. cit.) indicate that for the principal bands of interest (Nos. 3 through 6) the differences are approximately equal percentages of judged quality.

Table 1. A Preferred Series of Audio Frequency Bands for Sound Reproducing Systems.

Band Number	Classification	Cut-off Frequencies Low	High
1	High Fidelity	40	15,000
2	High Fidelity	65	11,000
3	High Fidelity	75	8,000
4	Medium Fidelity	90	6,400
5	Medium Fidelity	110	5,300
6	Medium Fidelity	130	4,400
7	Low Fidelity	160	3,600
8	Low Fidelity	200	3,000

A. Band 1 is the assumed complete spectrum of music. FCC requirements for FM transmission call for a range of 30 to 15,000, uniform within 2 db.

B. Band 2 affords as complete fidelity as Band 1 for a critical listener (5 per cent. most acute hearing) in very quiet homes (5 per cent. quietest, 33 db noise level) at usual reproduction levels.

C. Band 3 affords as complete fidelity as Band 1 for an average listener (median population hearing) in an average home (median annual noise level, 43 db) at usual reproduction levels.

D. Band 2 or 3 is approximate maximum range of high quality transcriptions.

E. Band 5 or 6 is approximate maximum useful range for night-time and rural reproduction of AM broadcasting and commercial lateral phonograph records.

F. Bands 2 to 6 probably require console type radio receivers for reproduction of low end.

G. Aural balance will probably be acceptable if one cut-off is paired with that in an adjacent band. Thus: 65-90 to 8,000; 90-130 to 5,300, etc.

It is evident that the whole fidelity problem is a relative one, in which listening conditions, the band width available from programme sources, and the important matter of cost in its relation to real value to the listener, must be carefully considered. In FM and improved phonograph transcriptions, there are the potentialities for a substantial improvement in the quality of service. It has been shown that on a statistical basis, the range from 75 to 8,000 cycles will provide the same perceivable frequency range for the average listener at the usual reproduction levels as would reproduction of the whole music spectrum from 40 to 15,000 cycles. With the exception of a slight difference in the low frequency limit this conclusion is in accordance with Fletcher's suggested range of 60 to 8,000 cycles, made after a study which included not only the orchestra but also most of the individual instruments.

The term "High Fidelity" deserves careful use. If the term is to retain any meaning, it does not seem to be proper to apply it to a band less narrow than No. 3 (75 to 8,000 cycles). The term "Medium Fidelity" seems appropriate for Bands 4 and 5 (down to 110 to 5,300 cycles), while narrower bands, in view of the present state of the art are "Low Fidelity" in their performance.

Power Requirements

The reproduction of symphony orchestra music in a fairly large living room at concert hall levels would require an average acoustic power of about 5 milliwatts. The peak power in brief intervals may be 20 db higher than the average, so the peak acoustical power required is 0.5 watts. If the loud speaker is 10 per cent. efficient, it would therefore require a peak electrical input of 5 watts. It is usually found to be desirable to provide amplifier capacity considerably in excess of this figure to keep the distortion to low values.

The more usual maximum levels in the home are about 20 db below concert hall levels. This requires a peak electrical power of 5 milliwatts and an average power of about .05 milliwatts. The exact power required depends on the loud speaker efficiency, the volume of the room, the intensity level of reproduction and the reverberation time.

Reference to the intensity level curves for the orchestra shown in Fig. 6 suggests the need for relatively uniform power handling capacity in the loud speaker system over the entire frequency range. This is necessary in order to accommodate the high maximum levels which are of about the same order of intensity in both the high and low frequency regions. This suggests that in the highest quality reproducing systems, the power rating should be sufficiently high for high level reproduction, and about the same over the whole frequency range. However, this entails considerably higher cost than the practice which is permissible at lower levels, i.e., the use of a lower power rating in the high frequency range because of the lower most probable intensity levels in that region.

SUMMARY

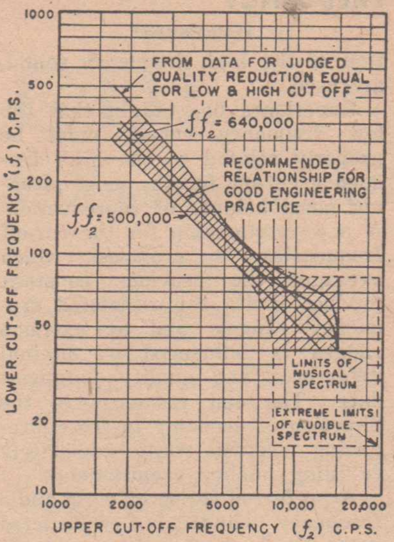
The audible frequency range is known to extend from about 16 to 22,000 cycles for persons with very acute hearing and at near-pain intensities. Judgment tests under laboratory conditions have shown that a band from 40 to 15,000 cycles will transmit the full frequency range of orchestral music with complete fidelity.

Fletcher and his colleagues have made studies which lead to the conclusion that a band less wide will provide substantially complete fidelity in the presence of average noise levels for persons of average hearing ability.

Because of the fact that the cost of sound reproducers rises sharply as the upper limit of the reproduced band is extended, it is important to establish the perceivable frequency ranges at the usual home reproduction levels for an average listener (average hearing ability situated in average residential noise conditions) and for a critical listener (relatively acute hearing ability situated in low residential noise conditions).

By statistical use of the available published data, it can be shown that for symphony orchestra music, the average listener can perceive a frequency range from 175 to 5,800 cycles per second, while for a critical listener the range is from 120 to 12,000 cycles per second at a reproduction level of 55 db. At higher reproduction levels the perceived frequency range is widened, but the principal of liminal differences and balance considerations indicate that a reproduced band from approximately 75 to 8,000 cycles for the average listener, and approximately 65 to 11,000 cycles for the critical listener, would be practically indistinguishable from unlimited band reproduction over the usual range of reproduction levels in the home.

These data are believed to be useful in the economic attainment of practical high-quality and medium-high-quality sound reproducing systems generally, as well as setting upper limits for quantity produced home radio receivers. The average listener



criterion closely approximates the situation in moving picture theatres, while application of the critical listener criterion enables us to predict the requirements for concert hall and broadcast monitoring applications. It is estimated that for large quantity applications, the cost of components for a satisfactory 11 kc reproducing system would be roughly half that for a 15 kc system, while an 8 kc system would cost approximately one-fifth as much as a 15 kc system. These cost indications refer to systems of the same power rating, and suitable generally for use in the home as a part of a broadcast receiver.

It is pointed out that the loudness contribution for music is greatest in the 2,000 to 3,000 cycle region despite the fact that the higest maximum and most probable intensity levels are lower down in the frequency scale. When the loud speaker is chosen largely on the basis of loudness efficiency (accentuated response in the 2,000 to 3,000 cycle region) many listeners prefer to accept the excessively restricted high frequency range resulting from advanced setting of the conventional tone control, to obtain relief from an otherwise annoyingly "shrill' effect. The need for such an undesirable compromise is avoided when loud speakers designed for level middle high frequency response and proper spatial distribu-

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tion of the high frequency sound, are used.

Experience has taught that the low frequency cut-off must be properly related to the high frequency cut-off for the most pleasing aural balance of reproduction. A new relationship for the cut-off frequencies is proposed which averages the previous constant product limits for restricted frequency ranges, and at extreme ranges is influenced by liminal differences and quality judgment data. The end result is in the direction of economy in the reproducing system while adequately fulfilling fidelity requirements.

A preferred series of eight audio frequency bands is constructed with the high frequency cut-offs differing in steps of 1 LIM and with corresponding low-frequency limits determined from the above aural balance relationship. The step from one band to another is probably barely discernible as a difference in band width for music. For the more important bands, the differences yield closely equal steps of "quality." These preferred bands are thought to be useful for classifying sources and reproducing systems, in ascertaining the probable change in quality of a system due to changes in band width, and in establishing realistic engineering specifications.

It is shown that very substantial improvements in quality can be realised without attempting to reproduce the entire music range of 40 to 15,000 cycles per second. It has been shown on a statistical basis that a band from 75 to 8,000 cycles will provide the same perceivable frequency range for the average listener, as will reproduction of the whole range from 40 to 15,000 cycles.

It is suggested that the term "High Fidelity" be limited to bands of 75 to 8,000 cycles and wider. Suggestions as to the classification of the other bands as "Medium Fidelity" and "Low Fidelity" are given.

The power required for the reproduction of music is briefly discussed. If it is desired to reproduce at concert hall levels in the home, a peak power of about five watts must be delivered in brief intervals to the loud speaker. The required power is a function of the sound intensity, the volume of the room and its reverberation time. The usual maximum listening levels in the home would be about 20 db below concert hall levels and this would correspond to a peak power of about 50 milliwatts. The average power at this level would be about .05 milliwatts.

For the reproduction of symphony orchestra music at high levels, it is important to provide adequate peak power handling capacity in the reproducer over the entire frequency range. In high quality systems, it seems advisable to make the power rating of the sound reproducer about the same over the entire frequency range.

BIBLIOGRAPHY

1—Harvey Fletcher, "Hearing, the Determining Factor for High-Fidelity Transmission," Proc. I.R.E., Vol. 30, pp. 266-277; June, 1942.

2—J. C. Steinberg, H. C. Montgomery, and M. B. Gardner, "Results of the World's Fair Hearing Tests," Bell Sys. Tech. Jour., Vol. 19, pp. 533-562; October, 1940.

3—D. F. Seacord, "Room Noise at Subscribers' Telephone Locations," Jour. Acous. Soc. Amer., Vol. 12, pp. 183-187; July, 1940.

4—D. F. Hoth, "Room Noise Spectra at Subscribers' Telephone Locations," Jour. Acous. Soc. Amer., Vol. 12, pp. 499-504; April, 1941.

5—H. Fletcher and W. A. Munson, "Relation Between Loudness and Masking," Jour. Acous. Soc. Amer., Vol. 9, pp. 1-10; July, 1937.

6—L. J. Sivian, H. K. Dunn, and S. D. White, "Absolute Amplitudes and Spectra of Certain Musical Instruments and Orchestras," Jour. Acous. Soc. Amer., Vol. 2, pp. 330-371; January, 1931.

7—From a hitherto unpublished study by Ralph P. Glover.

8—D. K. Gannett and Iden Kerney, "The Discernibility of Changes in Programme Band Width," Bell Sys. Tech. Journ., Vol. 23, pp. 1-10; January, 1944.

9—W. B. Snow, "Audible Frequency Ranges of Music, Speech and Noise," Jour. Acous. Soc. Amer., Vol. 3, pp. 155-165; July, 1931.

TELEVISION FOR MELBOURNE AND SYDNEY

IN accordance with the recent decision reached by the Federal Cabinet, tenders have been invited by the Postal Department for the supply of equipment for monochrome broadcast television transmissions in Sydney and Melbourne and, alternatively, in the six State capital cities. Tenders close with the Deputy Director, Posts and Telegraphs, Melbourne, C.I, at 3 p.m. on November 25, 1948.

This was announced recently by the Postmaster-General (Senator Cameron), who said that the action was being taken to enable consideration to be given by the Government to the matter of the introduction into Australia of a television broadcasting service, with due regard to the cost of equipment that would be suitable for conditions in the Commonwealth and the availability of apparatus from local or overseas sources.

In order to encourage the widest response to tenders, the Department has not laid down specific standards, and tenderers have been invited to submit offers for equipment embodying technical standards consistent with the present state of development of television systems and which incorporate all features that have been found to be desirable as the result of research and experience.

Senator Cameron emphasised that the calling of tenders must not be regarded as committing the Government in any way to the adoption of television. The rapid developments which are taking place in other countries were known and appreciated and, in the light of the tenders received, the matter would be examined from all standpoints.

Senator Cameron concluded by saying that the question of calling tenders for television receivers for experimental use would be considered when the offers for transmitting equipment had been received and the type of apparatus (if any) to be purchased had been determined.

CALLING CQ!

Conducted by Don B. Knock, VK2NO

ON July 29, 1948, there passed from the ken of amateur radio one of Australia's most respected and widely-known pioneers, when Howard Love, VK3KU, died suddenly at his home at Mount Waverley, Victoria. Words cannot express adequately the deep sense of personal loss felt by his many friends in the world of amateur radio and industry. To Howard, the hobby and business side of radio were synonymous; he furthered the interests of the Australian radio amateur through his business activities, and all radio amateurs were reckoned among his friends.

His history in the world of radio is extensive, for he, as A3RM, in the now distant venturesome days of HF communication, played the foremost part in organising the first "Trans-Pacifics" in 1922. He was a foundation member and a past Federal President of the Wireless Institute of Australia and was the driving force behind the pre-1939 RAAF Wireless Reserve. In the first World War he flew as an AFC pilot, and was a prisoner of war in Germany for some time. World War II placed a tremendous strain on him, for his factory, Kingsley Radio Pty. Ltd., at St. Kilda Road, Melbourne, was called upon very suddenly to fill vital Defence needs, especially for the RAAF. From this factory, with Howard Love's keen personality behind the project, came a continuous flow in short order of the Service communication receivers known as the "AR7." Some manufacturers thought it couldn't be done, but it remained for Howard Love to show them how. In recent years that factory where the "AR7" took shape has catered extensively for amateur radio requirements, and in each instance Howard submitted prototype equipment to rigid "air" tests at his home station. The equipment at VK3KU represents a fine example of a progressive and modern amateur station, designed both for experimentation and DX telephony communication. The beautifully-engineered multiple rotary beam array is typical of the orderly mentality of the designer. Howard Love had many friends overseas, with whom he maintained schedules consistently on 28 and 14 mC/s. Inside Australia, he was

(Continued on next page)

AUSTRALIAN AMATEUR TRANSMITTING LICENCES

Information from the P.M.G. Dept. gives the following current details of VK licences:

Alterations

VK2XO, J. M. Retallick, now Clarence River Council, Raleigh, N.S.W.

VK2OX, J. Stewart, 53 Burwood Rd., Belmore, N.S.W.

VK2XC, L. W. Cranch, 47 Russell St., Vaucluse, N.S.W.

VK2XW, A. J. Voysey, 23 Victoria St., Burwood, N.S.W.

VK2MB, H. J. Banks, 111 Hewlett St., Waverley, N.S.W.

VK2AJI, V. T. Evans, 245 Bourke St., Darlinghurst, Sydney, N.S.W.

VK2AJE, B. L. Mills, 60 Albert St., Leichhardt, N.S.W.

VK3NI, N. R. Boase, 7 Park Av., Glenhuntly, Vic.

VK3JC, R. W. Amos, 23 Bealiba Rd., Caulfield, Vic.

VK3AYV, H. G. Wohlers (Mobile), 107 Templeton St., Wangaratta, Vic.

VK4AR, G. S. Hamilton, c/- Elizabeth St., Toowong, Qld.

VK4TY, N. R. W. Tyas, Brookstead, Milmenam Lines, Qld.

VK5HJ, M. J. Champion, c/- Civil Aviation, Tennant's Creek.

Issues

VK2ADS, D. G. Rogers, 28 Inland Av., Mayfield, West Newcastle, N.S.W.

VK2AKG, N. H. Koscroft, 23 Lansdowne St., Arncliffe, N.S.W.

VK2ANA, N. Smith, 29 Vini St., Mayfield, Newcastle.

VK2AKY, S. J. K. Adshead, 63 Thorne St., Wagga Wagga, N.S.W.

VK2RJ, J. C. Bray, 1 Wyalong St., Willoughby, N.S.W.

VK3TK, J. F. McCrohan, 15 Rockbeare Grove, Ivanhoe, Vic.

VK3TM, A. T. Morton, 1 Smith St., St. Kilda, Vic.

VK3ARE, W. J. Hehir, Kent Rd., (Mobile), Hamilton, Vic.

VK3AUT, W. A. Ross (Portable), Ballangeich, Vic.

VK3AWM, W. R. Moffatt, 137 Stewart St., East Brunswick, Vic.

VK3AJD, A. J. Egan, 54 Wendella Av., East Kew, Vic.

VK3ASW, J. S. Walker, 21 Kelson St., Coburg, Vic.

VK4KD, V. R. Birks, Blackall St., Thursday Island.

VK4KR, C. C. E. Christensen, 71 Malcomson St., North Mackay, Qld.

VK5JW, J. B. Watson, 32 Glenhuntly St., Woodville, S.A.

VK6GK, D. R. Annesley, 22 Teague St., Victoria Park, W.A.

VK6GR, D. A. Miles, 109 Mathieson Rd., Belmont, W.A.

VK6ZK, E. E. Grey, 74 Thomas St., West Perth, W.A.

VK7FM, T. F. Moore, 62 Augusta Rd., Lenah Valley, Tas.

Cancellations

VK2IH, Dr. A. P. Balthasar, 574 New South Head Rd., Edgecliffe, N.S.W.

VK3AAB, H. V. Eastwood, SS "Empire Prospect," c/- McIlwraith McEarchern.

VK9ID, I. D. Henderson, Dept. of Civil Aviation, Rabaul.

(Continued)

an ardent user also of 7 and 3.5 mC/s, where he would be found each Sunday evening. His cheery voice will be missed in Britain, Canada and America no less than in his native land. It is with sorrowful heart that his untimely passing is recorded, and to his next of kin the sincerest sympathy is extended.

Farewell, Howard, your memory will be cherished by all who knew you.

—DON B. KNOCK.

* * *

VK2FB has a new tag for some ear in these times. It is "S.S.S.Q." of the rotten phones assailing one's . . . meaning "Spurious Sideband Suppressed Quality."

* * *

It doesn't pay to use old-time condensers in the tank circuit of a hefty final stage, where the insulation material may be of the moulded mud variety. Better at the outset to change the strips for polystyrene or loaded ebonite. A 3-stage TX was anode-modulated with the final running at 400 volts and around 70 mA. Excellent results were obtained on 7 and 14 mC/s, and then it was decided to use it at 3.5 mC/s. To hit this band with the existing 7 mC/s coil a small condenser was clipped across the tank condenser, which, having a maximum capacity of about 100 Pfd., was too small to cover both bands on the one coil. Modulation became very indifferent and the antenna current rose on the lesser and dropped sharply on the heavier peaks unless very small drive and grid bias be applied to the stage. Quality was poor and showed excessive cut-off on modulation peaks. By accident, the final stage was thrown off resonance during a peak and the insulation of the extra condenser started smoking. Replacement by a condenser with ceramic insulation instead of the black-coloured moulding of the other effected an immediate cure. The old condenser, which was quite well-made except for the poor insulating materialing, showed that it was useless for RF, but would show no leakage or failure with 500 volts DC across it. When modulation trouble of this kind persists in a newly-completed transmitter, despite correct adjustment of working voltages, it is a good scheme to look into the insulation, both in the variable capacity, and in the coil mounting or former.

—D.B.K.

A REPLY TO VK2EA (June Issue)

Dear Leith,

I have been reading your letter to VK2NO, published in June A.R.W. Amongst your opening comments is the remark that you can't agree with Don on every count. Therefore you will take no offence when another correspondent—myself—does not agree with you, in turn, about certain issues.

As far as the age business is concerned, we have all long since wearily concluded that it is a matter for the W.I.A. to represent to the P.M.G. Obviously the latter are disinclined to modify the ruling. So why beef about it? And, what's worse, you are recommending a form of 'loosening-up' which would be most regrettable on 420 Mc. or any other band.

However, you are entitled to your opinion on the foregoing matter, and you have had the conviction sufficiently strongly to come to print with it. Like the rest of us who occasionally 'say a few well-chosen . . . ' you are apt to be sniped-at by those who hold dissimilar views.

But what I personally will not stand for, at any price, is your assertion that some chaps deserve all the jamming, etc., that they get. If your 'etc.' covers the pernicious pirates who warble VFO's deliberately over the transmissions of intelligent Amateurs, I recommend that you revise drastically some of your conceptions of Amateur Radio. Whilst we are pursuing this particular topic, the responsibility of apprehending and disciplining these persons rests on the shoulders of the P.M.G. and the Police. Many active Amateurs have made patient and careful observations on the illegal transmissions, and have faithfully reported their observations. Net result—NIL. So, if you want something to beef about, I suggest that the foregoing is a much more legitimate complaint.

As far as the complaint re the 'C.W. hounds'—an unfortunate phrase—the writer happens to be one. Or, at least, by your particular definition, it seems that your description could be extended to cover the writer. All right, then! Let's get our fangs into **this** one.

You live, fortunately or otherwise, in Lower Kangaroo Creek, which we gather is via South Grafton. How do you suppose your signal compares with local Sydney stations with 100 (?) watts! I should say you would be "scratching," at times, to get a QSO at all, even on C.W.

You allergy towards C.W. seems to be born of your lack of experience, or perhaps patience —or maybe effort. Regardless of what you read or hear, C.W. is a more reliable, solid form of communication than Phone. And, to those who can cope, more flavoursome and more satisfying, too. Listen to VK's 3FC, 2ACP, 2AIH, 2NP, 2NO, 2PA, 4XP, 2DQ and 2ML on the key some time, and try to grasp the significance of their courtesy, tradition and sincerity. A contact with such folk on C.W. is, to the **mind,** what a liqueur is to the palate.

A typical Ham will never drag you, unwillingly, on C.W. if you want to use Phone—unless the QRM is really heavy, or unless he is interested in ascertaining whether you are worth your Licence or not.

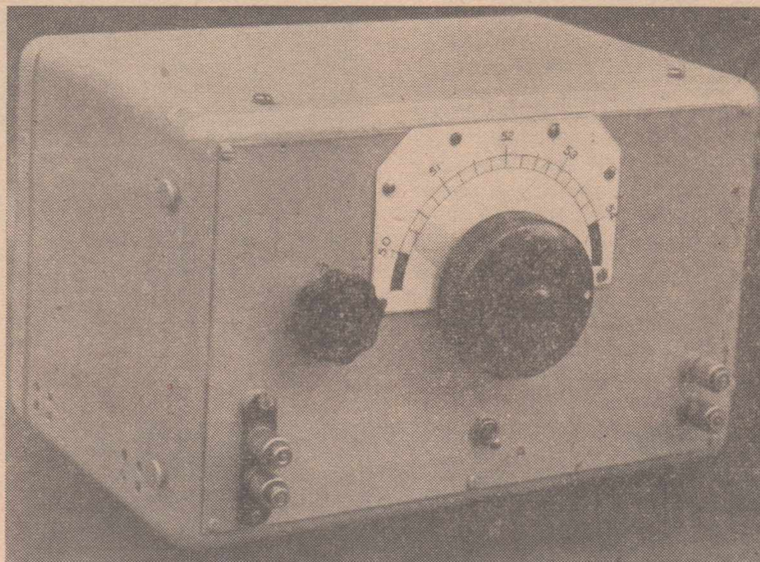
Having expressed these views, the writer will now sit back, figuratively speaking, quite secure in the knowledge that the sniping will now begin in the opposite direction! Until we QSO again, therefore, Farewell from the Old Firm at the Original Stand.

Phil Edwards—VK2GS.

A Converter For 50 Mc.

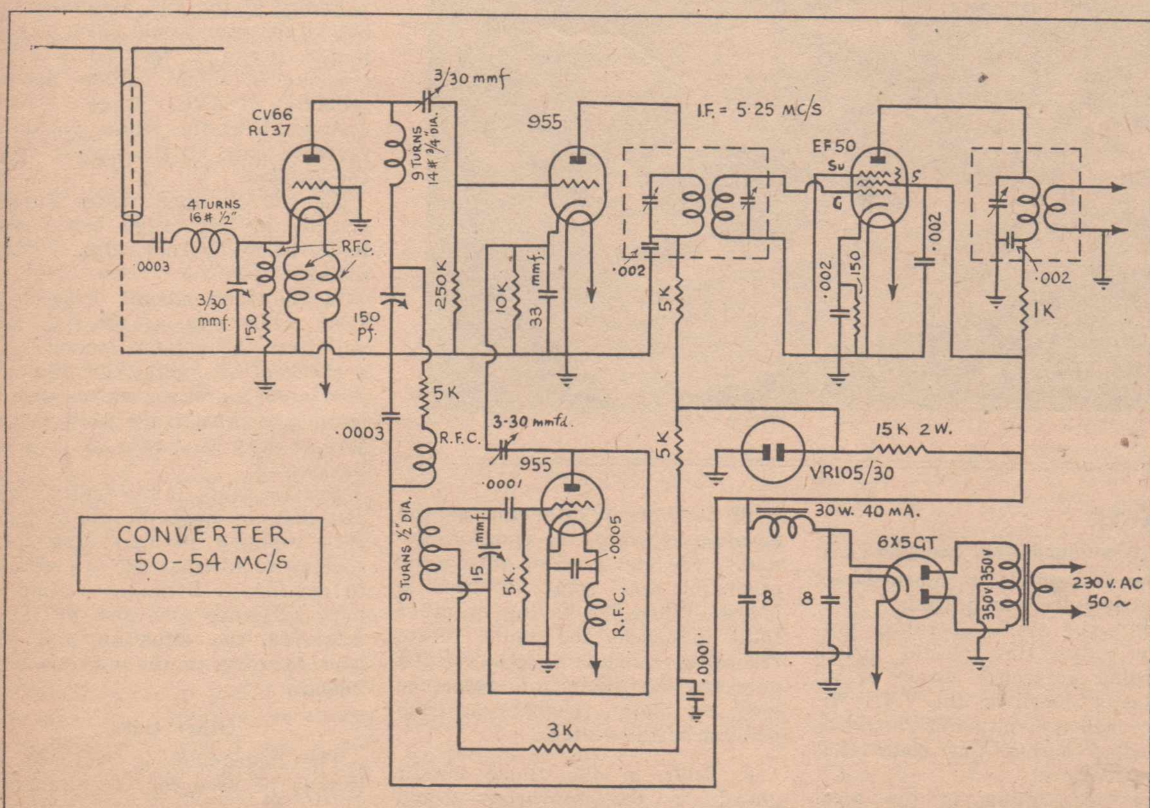
With R.F. Stage and In-built I.F. Stage

HERE is the circuit and photographs of a converter for the 50 mC/s ham band which was built recently by Lt.-Col. Every (VK3GE), commanding officer at the Army School of Signals at Balcombe camp. This converter has been giving exceptional performance and has been a big factor in the success which the Colonel has achieved on 50 mC/s. It will be noticed that the circuit is somewhat similar to the one detailed in the August issue, but, of course, without the band-switching feature. An RL37 is used as an r.f. stage ahead of an acorn mixer, with another acorn as separate oscillator.



Output from the mixer valve is then amplified at an intermediate

(Continued on next page)



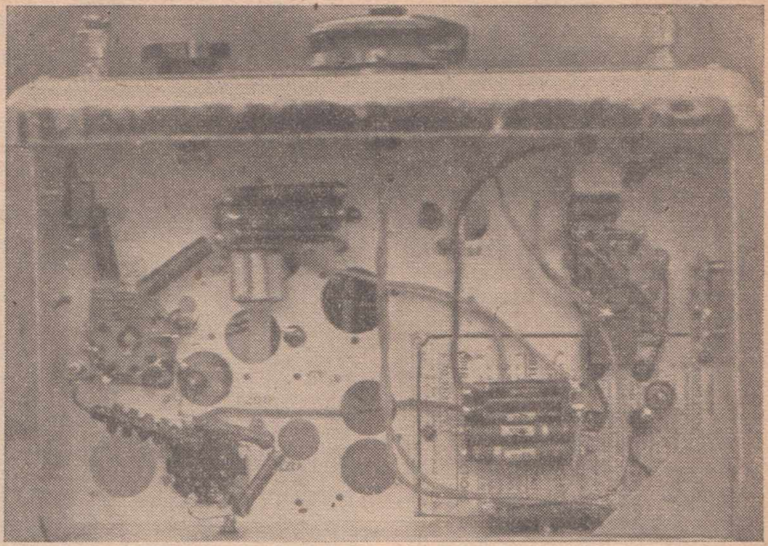
CONVERTER

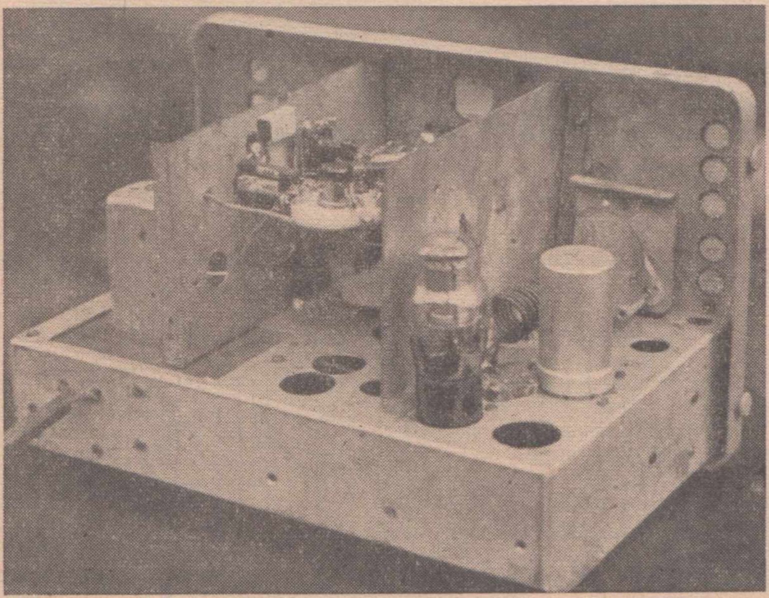
(Continued)

frequency of 5.25 mC/s, with an EF50 in this stage. Voltage to the mixer stage is stabilised by means of a VR105/30 regulator, which ensures adequate stability.

As will be seen from the photographs, the converter has been built into a cabinet and chassis from salvage, which has not detracted from its efficiency. Two vertical screens are used to isolate the stages, with the acorn socket mounted up between them to allow shortest leads.

A slow-motion knob and a home-made dial give a wide coverage for the band from 50 to 54 megacycles, with easily-read scale.





TRACER

(Continued from page 28)

to the test points as marked, not forgetting the earth lead.

While the set is operating normally rotate the selector switch recording reference levels at all points as shown on the V.T.V.M.

An ordinary voltmeter should be connected across the main H.T. supply.

The next thing is the most tedious of all, waiting for the fault to develop although, as the speaker is used to monitor the audio, you can proceed with some other job until some variation is heard. When the fading or other fault influences the audio, rotate the selector switch once again and note any deviation from reference level on meter readings at each position of the switch.

A fault in the tuned circuit ahead of the converter would cause a decrease in signal strength, AVC voltage and audio; the oscillator may also vary owing to reflected loading.

Drift or decrease in the oscillator output would not vary the reading at switch position 2, but would decrease at test point 3 and also at test point 1.

Faults in the I.F. amplifier and second detector would show at test points 1 and 4, test point 1 increasing in signal voltage due to reduction of AVC voltage.

A fault in the audio would be revealed only by the output from the speaker.

Shorted or open power supply circuits in any stage would also be revealed by the ordinary voltmeter.

If the fault should happen to clear while you are testing you will hear the volume increase but a check of all stages can be made in a second or two, so you should be able to beat it, the fault taking just as long to locate as it takes to develop.

Further tests of the faulty stage can then be made or all components replaced in that stage, according to whether one is prepared to sacrifice a little more time or not. In either case you will have mastered the situation and can look forward to the owner's confidence.

Other Uses

The instrument is versatile, as it may be used for the alignment

(Continued on page 50)

Shortwave Review

CONDUCTED BY L. J. KEAST

NOTES FROM MY DIARY

THE POSTMAN KNOCKS TWICE

And last week among the usual big mail from U.S.A. was my certificate as monitor for international short-wave during the year 1948-49. This came from that champion DX-er, Kenneth R. Boord, Shortwave Editor, of W. Virginia, U.S.A.

B.B.C. TEACHES "ENGLISH BY RADIO"

July brought the fifth anniversary of the introduction in the B.B.C.'s external services of "English by Radio," probably the most widely heard B.B.C. programme outside the field of news. These broadcast lessons began as one of the wartime services to European countries; they have developed into a major task of peacetime broadcasting.

For some time past, "English by Radio," while its place in the European Services has been fully maintained, has been a regular and important feature of the foreign-language services for the Far East, for India, Pakistan, and Ceylon, and for Latin-America.

Within the past few weeks, it has been introduced in the transmissions in Arabic, Persian, and Turkish for the Near East. Today, therefore, the lessons are available to students of English—in their own homes—in most parts of the world.

IT'S HARD TO SHAKE OFF

When one thoroughly takes up DX-listening it is pretty hard to give up. There seems to be always something new, and if one is not in an exploratory mood you can always return to the old favourites.

It is therefore little wonder that Jack Butler writes that he intends doing some dial twisting again very shortly.

Most regular readers of these pages will remember his consistently good and informative reports to me just before the war.

Incidentally, he has one of the finest albums of verifications I have seen.

Like a good Australian, Jack enlisted—saw the war out—returned and took unto himself a wife, who, like Arthur Cushen's good lady, has raised no objections to him "burning the midnight oil"—so here's looking forward to some good reports.

CHANGE OF FREQUENCY

RADIO-HAMBURG is reported by DX Bulletin Sweden as having moved from 6.115mc, 49.06m, to 6.36mc, 47.20m.

KZMB, Manila, 6.005mc, 49.96 m: Here is a new station in the Philippines using the slogan "Voice of America" which can be heard with a little difficulty most nights from around 9 o'clock. It is not only in a position on the dial with which is usually associated a lot of static but it is further impaired by a station in Tokyo only 5 kC/s away.

This is not actually a new station, as they have been on medium waves for quite a while, but only recently came on to short-waves.

RADIO MANAGUA, Managua, 8.32mc: This new Nicaraguan station is reported by Arthur Cushen as heard by him till 2 p.m.

New Stations

RADIO COPENHAGEN are testing a new high-powered transmitter on 9.52 mc, 31.51m, from 8-9 p.m.

RADIO INTER-AMERICANA, Panama City, 6.05mc, 49.59m: This new Central American is reported by "Sweden Calling" but no schedule is given.

VERIFICATIONS

Miss Dorothy Sanderson of Malvern, Victoria, advises having received veries from: HLKA, Korea; Leipzig; Monte Carlo, and a card and letter from Poland, who advise they had been carrying out tests on 31.48 metres (9.53mc).

Mr. C. R. Woolsey of Terrigal, N.S.W., is also on the way to reap a big crop of veries. In his own words, "I report all stations I hear." Already as a result of his labours, cards have arrived from Canada, Germany, Philippines, U.S.A., Saigon, Holland, Italy and Singapore.

Arthur Cushen, as usual, has been receiving more verifications: Johannesburg, 4.895mc; CR-7BU, 4.81mc; Vienna, 7.245mc; CXA-19; CSW2D, 6.155mc; YV-1RV; VLB2; HCJB, 5.995; and KZCA, 7.22mc; KZCA, Salzberg, Austria, formerly KOFA, power 350 watts, changed call August 1, 1947; very nice card showing map of Austria and antenna tower; KZCA stands for "K Zone Command, Austria"; CS2WD, give address as Rua Capelo 5, Lisbon; power is 500 watts on 6.155mc; schedule is 5.30-10 a.m.

Radio Munchen, 6.08mc; Stuttgart, 6.18—used only 900w. when reported; ZBW, 9.52—at long last; PRL-8—another long overdue; Damascus, 12mc—sent a book completely in Arabic; KZCA, 7.22; CXA-19, 11.835; Noumea, 6.00; Macassar, 9.55; HCJB, 5.99).

SHORT WAVE STATIONS

(Continued from last issue)

Here is a list of short-wave stations that should be heard at various times of the day or night on any reasonably good Dual-wave receiver.

This list does not represent all the stations in the 13, 16, 19, 25 and 31 metre bands but is given as a start for the new convert to this all absorbing hobby. Commence now and "Tour the World" by short-wave. Schedules are given in our regular monthly issues.

11.76		ZYB8—Brazil News Spanish.
11.76	25.51	CKRA — Montreal.
		OLR4B—Prague.
		VLA8 — Melbourne.
		VLC-3 — Shepparton.
		VLB3 — Melbourne.
11.75	25.53	GSD—London.
		Radio Centre Moscow.
11.74		HVJ — Vatican City.
11.73	25.56	COCY — Cuba
		Radio Centre Moscow.
11.73	25.56	Singapore.
		LKQ—Norway.
11.73	25.57	KGEX—San Francisco.
		PCJ—Holland.
		WRUA—Boston.
		GVV—London.
11.72	25.60	WRUL/W — Boston.
11.72	25.60	CHOL — Saskville.
		CE1173—Chile.
		Radio Paris — France.
11.71	25.61	HE15 — Switzerland.
		FGA—Dakar.
11.71	25.62	VLG3 — Melbourne.
		WLWR-1 — Cincinnati.
		Radio Centre Moscow.
11.70	25.63	SBP — Stockholm.
		WLWS-½ — Cincinnati.
11.7	25.64	GVW — London.
11.69	25.66	HP5J—Panama.
11.68	25.68	GRG—London.
11.67	25.7	OTC—Leo'ville.
11.65	25.73	XTPA—Canton.
11.64	25.74	OTC—Leo'ville.
11.63	25.79	Moscow.
11.57	25.93	PMB—Java.
11.5	25.08	XLRA — Hankow.
11.44	26.22	Radio Batavia.
11.03	27.18	YDH2 — Samarang.
11.02	27.2	CS2MK — Portugal
11.0	27.27	YHN—Java.
10.78	27.83	SDB2 — Stockholm.
10.73	27.96	VQ7LO — Nairobi.
10.05	29.84	SUV—Cairo.
10.0	30.0	WWV — Washington.
9.98	30.1	FZI — Brazzaville.
9.95	30.12	HCJB—Ecuador.
9.91	30.27	GRU—London.
9.86	30.42	XGOE — Kweilin.
9.86	30.43	EAQ—Madrid.
9.85	30.45	Java.
9.83	30.5	COBL—Havana.
9.82	30.53	GRH—London.
9.82	39.56	XORA — Shanghai.
9.78	30.66	TGWA — Guatemala.
9.76	30.7	OTC—Leo'ville.
9.76	30.78	TGWA — Guatemala.
9.75	30.79	KCBR—San Francisco.
9.73	30.84	XGOA — Nanking.
9.72	30.85	CSW7—Lisbon.
9.72	30.86	PRL7—Brazil.
N9.71	30.88	CR7BE — Mozambique.
9.7	30.93	WLWS-2 — Cincinnati.
		KCBF—San Francisco.
		KNBI—San Francisco.
		WOOW — New York.
9.69	30.95	Madagascar.

9.69	30.95	KZOK—Manila.
9.69	30.96	GRX—London.
9.68	30.99	EQC—Iran.
		XEQQ—Mexico.
9.68	30.99	YDC Java.
9.67	31.01	GWT—London.
9.67	31.02	WNRX — New York.
		VUD4—Delhi.
		WGET — Schenectady.
		KGEI—San Francisco.
9.66	31.06	VLQ—Brisbane.
9.66	31.06	XGOY — Chungking.
		HVJ — Vatican City.
9.65	31.09	WCBN — New York.
		KRHO — Honolulu.
		KNBA—San Francisco.
9.64	31.12	GVZ—London.
9.63	31.15	CKLO — Montreal.
		VUD2—Delhi.
		VLT — Port Moresby.
9.62	31.17	GWO—London.
9.62	31.17	XEBT—Mexico.
9.62	31.19	XGNC—Kalgan.
		Radio Paris.
		TIPG Costa Rica.
		Radio Addis Ababa.
9.61	31.20	VLB9 — Shepparton.
9.61	31.20	VLW5—Perth.
9.62	31.21	KZFM Manila.
9.61	31.22	LLG—Norway.
		CHLS — Montreal.
9.60	31.22	ZRL — Capetown
9.60	31.22	HP5J—Panama.
9.6	31.23	GRY—London.
9.59	31.26	CE960—Chlie.
9.59	31.28	VUD5—Delhi.
		PCJ Holland.
		VUM2—Madras.
		WLWO — New York.
9.58	31.32	VLH3 — Lyndhurst.
		VLG—Lyndhurst.
9.58	31.32.	GSC—London..
9.57	31.35	KWIX—San Francisco.
		KWID—San Francisco.
		WRUW—Boston.
		WRUS—Boston.
		Radio Algiers
9.56	31.36	Moscow.
9.56	31.37	Paris.
9.55	31.41	VUB2—Bombay.
		OLR3A—Prague.
9.55	31.4	Radio Macassar.
		GUB—London.
9.54	31.42	HED5 — Switzerland.
9.54	31.45	Munich Germany.
		VLB — Melbourne.
		Radio Centre Moscow.
		VLR — Melbourne.
		LKJ—Oslo.
9.53	31.47	SBU — Stockholm.
		HER4 — Switzerland.
9.53	31.48	WRUX—Boston.
		SPW—Poland.
		KGEI—San Francisco.
		VUC2 — Calcutta.
9.52	31.49	WGEV — Schenectady.
9.52	31.51	Jo'burg.
9.52	31.51	Paris.
		ZBW—Victoria.
		SEAC—Ceylon.
9.51	31.55	GSB—London.
9.50	31.57	OIX2—Lahti.
9.50		JVW2—Japan.
9.5	31.58	XEWW—Mexico.
		KZPI—Manila.
9.48	31.65	Moscow.
9.46	31.7	TAP—Ankara.
9.45	31.73	LRY—Argentine.
9.44	31.75	COCO—Cuba.
9.44	31.8	FZI — Brazzaville.
9.42	31.85	Radio Belgrade.
9.41	31.88	GRI—London.
9.4	31.9	Moscow.
9.38		Radio National Eepana.
		OTC—Leo'ville.
7.95	37.7	French Cameroons.
7.94		CQM4—Bissua.
7.94	37.7	Radio Falange Spain.
7.93		Korea.
7.87	38.1	HCICG—Ecuador.
7.86	38.15	SUX—Cairo.
7.85	38.15	Radio Tirana Albania.
7.7		ZM2AP—W. Samoa.
7.49		Radio Centre Moscow.
7.41	40.5	HYP5—Java.
7.38	40.62	Sanaa Yemem.
7.38	40.65	HEK3—Berne.
7.34	40.8	XNNG — Nanking.
7.33	40.9	Italy.
7.32	40.98	GRJ—London.
7.30	41.15	ZOY—Accra.
7.29	41.16	Athens.
7.29	41.17	VUD2—Delhi.
		Munich-11 Munich.
7.28	41.19	JKA—Japan.
7.28	41.21	GWN—London.
		Paris.
		VLT—Port Moresby.
7.27	41.24	Radio Dalat F.I.C.
		Santa Cruz, Canary Isles.
7.27	41.25	Italy.
		HI2T—Dom Republic.
7.26	41.32	GSU—London.
		Hanoi.
		VUM2 — Madras
7.25	41.34	JKC—Japan.
7.24	41.44	VUB2 — BOMBAY.
		VUD8—Delhi.
		VLQ—Brisbane.
		Radio Wein Austria.
7.23	41.49	GSW—London.
7.22	41.55	Radio Sumatra.
		XURA—Taiwan.
		Blue Danube Network-Austria.
7.21	41.61	GWL—London.

Speedy Query Service

Conducted under the personal supervision of A. G. Hull

W.D. (Footscray) went along to hear a demonstration of high-fidelity reproduction, but was most disappointed.

A.—Yes, this is quite possible. There are all sorts of views about what is, and what isn't, good reproduction and it often happens that one is disappointed when hearing other people's amplifiers. A lot depends on the type of reproduction to which your ears have become accustomed, especially as regards such things as highs and lows. A great many people build up amplifiers which are practically free from distortion, but then feed them with uncompensated pick-ups with poor quality records wobbling on a woggy turntable. Then it is just a matter of having a mis-matched output transformer and a speaker in a resonant box baffle and the final result is terrible. To get really good reproduction calls for great attention to detail.

* * *

F.S. (Ouyen) is in doubt about the use of a pentagrid converter on the ten-metre ham band.

A.—It is quite possible to get the pentagrid converters working on 28 megacycles, but we doubt if they would be as efficient as when working on 14 mC/s. Would suggest you would do better with the ECH35 or the 6K8. Great care will be needed with lengths of leads to grids and so on, and results are never up to expectations on the ten-metre band unless you pay adequate attention to the use of an efficient aerial. This is just as important with receiving as with transmitting when you are working on "ten."

G.W. (Port Fairy) wants advice on suppressing noise from a vibrator unit, which is giving him trouble on the short-wave bands.

A.—This is likely to be troublesome and we cannot go into all the possibilities in this column. However, we have a fine article on vibrator units set up ready to run as soon as space is available. We may be able to get it into the special September issue or, failing that, it should be in the October issue. Full details are given for the noise suppressing chokes.

* * *

R.N. (Adelaide) asks about back numbers.

A.—No, we have only the back numbers listed and it is useless to write to us for others. In several cases we haven't even a file copy, let alone spare copies lying about. We have published several requests for back numbers in our columns from time to time and they have usually brought results. We suggest you let us have a full list of the numbers you require and we will run it in the Bargain Corner.

* * *

C.R. (New Farm, Q.) asks about Goodmans speakers.

A.—We are not sure of the delivery position at present, but suggest you write to John Bristoe of Denradio Industries, Maryborough, Queensland. If you mention you are a reader of A.R.W. he will give you extra special attention.

* * *

M.R.P. (Fremantle) asks whether we know of any local speaker manufacturers who contemplate turning out high-fidelity speakers.

A.—No, so far as we know all the local speaker factories are up to their eyes in commercial production and there is little chance of them offering high-fidelity speakers such as the types you mention. Frankly, we wouldn't hesitate to invest in the English job you mention as it is a good all-rounder and will last a lifetime if properly looked after.

* * *

L.G. (Camberwell) asks several questions about short-wave coil coverage.

A.—Afraid that it would take too much space to try and answer your query in these columns, but you will find the whole subject fully covered in a simple table form in last month's special Data and Handbook issue.

* * *

B.R.S. (Port Adelaide) asks about a component.

A.—Yes, by all means write direct to the maker. Mention our name and you will be sure of getting prompt attention.

KINGSLEY RADIO

The directors of Kingsley Radio Pty. Ltd. wish to thank all members of the Radio and Electrical Industry, and those associated, for their kind expressions of sympathy following the untimely passing on of Mr. H. Kingsley Love.

They further advise that the company will "carry on" as heretofore, and that Mr. L. W. Cranch has been appointed to carry out the duties of the late managing director.

BARGAIN CORNER

Advertisements for insertion in this column are accepted free of charge from readers who are direct subscribers or who have a regular order placed with a newsagent. Only one advertisement per issue is allowed to any subscriber. Maximum 16 words. When sending in your advertisement be sure to mention the name of the agent with whom you have your order placed, or your receipt number if you are a direct subscriber.

FOR SALE: Kit Set for four-valve reflex super, modern bakelite cabinet, £14/19/6 f.o.r. D. Paice, 10 Byron Street, Moonee Ponds, W4, Vic.

SALE: Quantity of new and used radio parts, 10" and 12" speakers, 1 to 4 gangs, Uni test oscillator, Palec VCT tester. All cheap, must be sold. John Ambers, 82 Prince's Highway, Arncliffe, N.S.W.

WANTED TO BUY: New 3Q5GT type valve. E. Wellard, 430 Peel Street, Tamworth, N.S.W.

NOTICE re text books advertised August issue: all sold and unable to answer all enquiries; many thanks, "Tex."

TRACER

(Continued from page 46)

of receivers, as a high resistance voltmeter, signal tracer for all faults, testing pickups and microphones, as an audio amplifier for electronic instruments and measuring stage gain. Further, valves can be tested under their normal working conditions. If it is desired to use a magic eye in place of the V.T.V.M. for reference level indication the following circuit could be adapted.

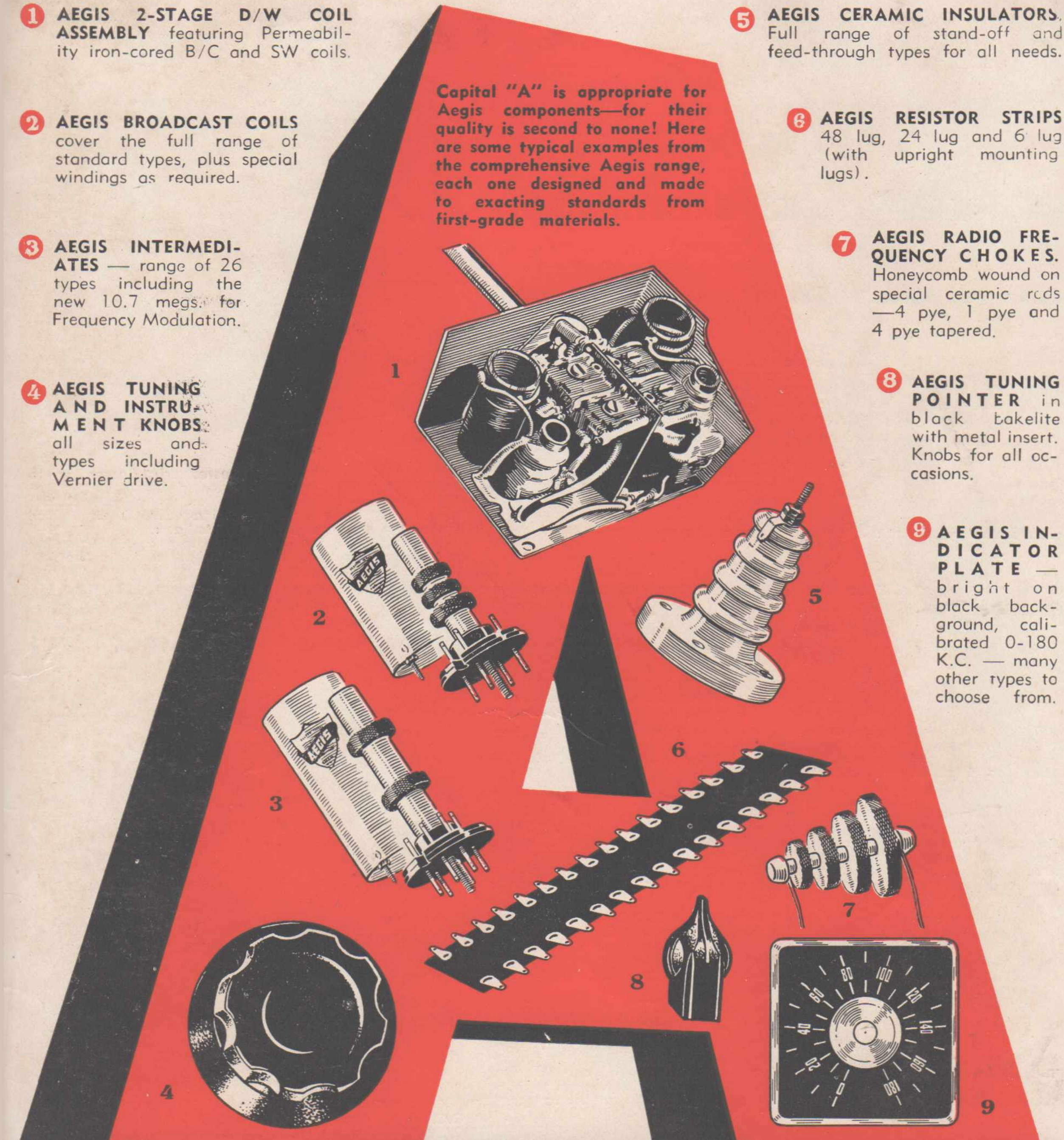
1 AEGIS 2-STAGE D/W COIL ASSEMBLY featuring Permeability iron-cored B/C and SW coils.

2 AEGIS BROADCAST COILS cover the full range of standard types, plus special windings as required.

3 AEGIS INTERMEDIATES — range of 26 types including the new 10.7 megs. for Frequency Modulation.

4 AEGIS TUNING AND INSTRUMENT KNOBS all sizes and types including Vernier drive.

Capital "A" is appropriate for Aegis components—for their quality is second to none! Here are some typical examples from the comprehensive Aegis range, each one designed and made to exacting standards from first-grade materials.



5 AEGIS CERAMIC INSULATORS. Full range of stand-off and feed-through types for all needs.

6 AEGIS RESISTOR STRIPS 48 lug, 24 lug and 6 lug (with upright mounting lugs).

7 AEGIS RADIO FREQUENCY CHOKES. Honeycomb wound on special ceramic rods —4 pye, 1 pye and 4 pye tapered.

8 AEGIS TUNING POINTER in black bakelite with metal insert. Knobs for all occasions.

9 AEGIS INDICATOR PLATE — bright on black background, calibrated 0-180 K.C. — many other types to choose from.

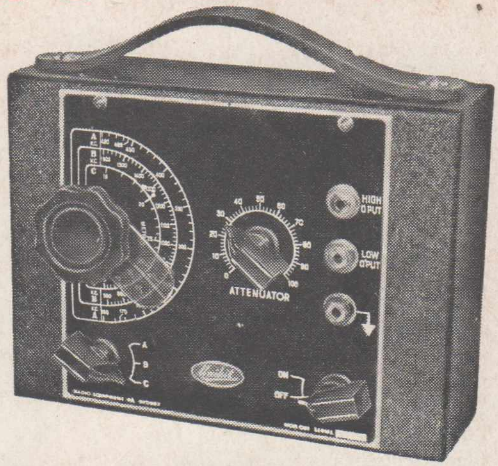
AEGIS COMPONENTS

AEGIS MANUFACTURING CO. PTY. LTD., 208 LT. LONSDALE ST., MELBOURNE, VIC.

Distributors:

MELBOURNE: Lawrence & Hanson Electrical Pty. Ltd.; Replacement Parts Pty. Ltd.; Vealls Electrical & Radio Pty. Ltd.; Homecrafts Pty. Ltd.; J. H. Magrath & Co.; John Martin Electrical and Radio Co. **TASMANIA:** Lawrence & Hanson Electrical Pty. Ltd. (Hobart); Lawrence & Hanson Electrical Pty. Ltd. (Launceston). **ADELAIDE:** George Procter (Factory Rep.); Newton, McLaren Ltd.; A. G. Healing Ltd.; Harris, Scarfe Ltd.; Oliver J. Nilsen & Co. Ltd.; Gerard & Goodman Ltd.; Unbehaun & Johnstone Ltd. **PERTH:** Nicholsons Ltd **SYDNEY:** John Martin Pty. Ltd.; George Brown & Co. Pty. Ltd.; Fox & Macgillycuddy Ltd.; Australian General Electric Pty. Ltd.; Cook Bros. Pty. Ltd. **BRISBANE:** Chandlers Pty. Ltd.; A. E. Harrold Pty. Ltd.; B. Martin Pty. Ltd

Build These Two Fine Kits



• MODEL OKI OSCILLATOR

Here's the kit you've waited for—an oscillator kit which covers all the fundamental frequencies necessary to line up the modern receivers.

EASY TO CONSTRUCT WITH ORDINARY TOOLS

The new OKI oscillator is a simple kit which you can build at hame with a few ordinary tools yet which, when completed, will give accurate and lasting service for many years. A complete book, giving pictures and wiring diagrams, and constructional details, included in every kit. All fundamental frequency ranges are covered by this oscillator and are in three distinctive separate bands. The A band covers 150 to 490 kilocycles, the B band covers from 550 to 1600 kilocycles, and the C band covers from 16 to 45 metres. Lining up is permanent and simple.

USES STANDARD BATTERIES

"University" pioneered oscillator kits and many are still in use. Model OKI is a companion to our famous multimeter kit model MKI and they make a handy pair—readily portable and easily built.

The OKI oscillator operates from built-in batteries and these batteries are standard types that may be easily purchased everywhere.

PRECALIBRATED DIAL

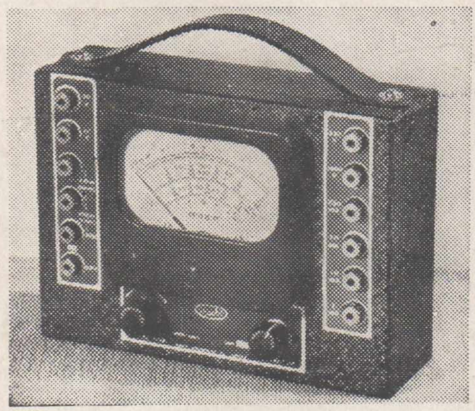
The "University" OKI oscillatoı kit comes with a dial precalibrated in the factory.

This means that when you construct according to directions you have a calibrated dial off which frequencies can be read direct. Most home-builders' kits in the past have had an ordinary 0/100 dial which limited the effective use of the oscillator.

The OKI oscillator is available to you at a new low price with everything included, right down to the last nut and bolt.

Price £8-0-0 Plus Tax

• MODEL MK1 MULTIMETER



This multimeter is an attractive looking instrument—handy size 6" x 8" x 2½", with leather carrying handle fitted to the top of the case. It is housed in a steel box, finished in black brocade. Etched brass labels in black and nickel finish set off the instrument.

HAS 4" SQUARE METER

The popular 4" square type of meter is used with a clear multi scale. Controls have been kept down to an absolute minimum by the use of tip jacks and a new circuit which does away with the troublesome double circuit tip jack. In this whole instrument only one double circuit tip jack is used and even then that is only on the low ohms scale and can be easily fitted.

The instrument is primarily available as an A.C.-D.C. kit although it can be purchased as a D.C. kit if so desired and the A.C. section added later. In the D.C. kit only one knob is required, being an ohms adjustment to compensate for battery variation as the battery ages. In the A.C.-D.C. version a simple change-over switch allows the operator to change over from A.C. volts to D.C. ranges.

SIMPLE CONSTRUCTION

Construction is simple and all voltage multipliers and shunts are predetermined at the factory to an accuracy of 1% so that when construction is finalised, the whole instrument will give accurate reading on all ranges. This is important because it is very difficult for home constructors to make shunts to enable them to get accurate readings on all current ranges.

COMPREHENSIVE RANGES

The ranges are: 0/10, 0/50, 2/250, and 0/1000 volts D.C., 0/10, 0/50, 0/250 and 0/1000 volts A.C., 0/10, 0/50, 0/250 and 0/1000 output volts, 0/1, 0/10, 0/50, and 0/250 milliamperes D.C. and 0/1000 ohms and 0/100,000 ohms D.C. The 0/1000 ohm range is particularly helpful in checking open circuits and short circuits in coils and I.F.'s. The lowest division on the 0/1000 ohms scale is a quarter of an ohm. Only one standard type torch cell is used, and sensitivity of the instrument is 1000 ohms per volt. All wiring instructions and constructional details are given with the kit and photographs and circuit diagrams make it easy to assemble the instrument. All parts are prefabricated so that fitting is easy and everything is supplied including the wire, panels, solder, lugs, etc.

When the construction of the instrument is finished, no calibration is necessary because of the pre-determined resistors and shunts being made to accurate standards. If the instrument is wired correctly it is available for immediate use and will give many years of accurate service.

Price £8-0-0 Plus Tax

University

INSTRUMENTS

Made by RADIO EQUIPMENT PTY. LTD.

5 NORTH YORK STREET, SYDNEY. PHONES B3678, B1960

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