THE AUSTRALASIAN

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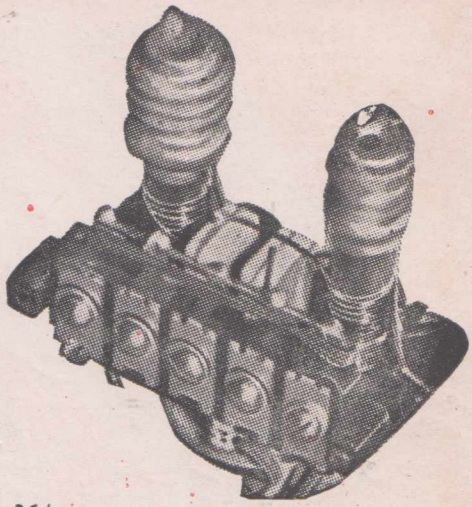
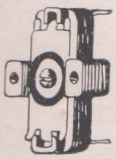
APRIL 15, 1948

CROWN
COMPONENTS





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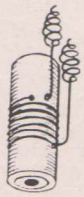

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RADIO WORLD

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CONTENTS

EDITORIAL

Eighteen years ago there were a number of people engaged in floating television companies. They were annoyed when I denied that "television is just around the corner."

Twelve years ago I ran into plenty of abuse when I returned from a world trip and reported adversely on television.

Now again, to day, there is an element in the radio trade which is campaigning for television. I will again risk their displeasure by expressing my opinion that television in Australia is still well "around the corner," and that corner won't be turned for a year or two yet. What is more to the point, I feel sure that when television does come it will not in any way displace the ordinary broadcasting as we know it now. It will not make present radio receivers obsolete or any less useful than they are today.

The problems of television are not technical ones. Back in 1936 I saw several television demonstrations which left little to be desired. The big problems of television are practical ones, especially finance and the provision of sustained programmes. It is easy enough to keep a radio station going all day when you have a big pile of records and a couple of big-mouthed announcers. It is much more difficult to arrange a full-time programme of television, not that it is required, as the looker-in gets a stiff neck after a few hours of intently watching a small screen in a semi-dark room.

For the televising of the Melbourne Cup and that sort of thing a television service would be greatly appreciated, but is it worth millions?

—A. G. HULL.

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COMPONENTS

INTERMEDIATE TRANSFORMERS

Standard 460 k.c.

IF162 1st Stage Permature Iron Core	13 9
IF163 2nd Stage Permature Iron Core	13 9
IF164 Low Gain Permature Iron Core	13 9

Standard 175 k.c.

IE74 1st Stage Permature Iron Core	13 9
IE75 2nd Stage Permature Iron Core	13 9

MAGNASONIC INTERMEDIATE TRANSFORMERS

Dimensions 2" x 1" Round.

IF168 Midget Iron Core Permature 1st	12 6
IF169 Midget Iron Core Permature 2nd	12 6

MIDGET MAGNASONIC BROADCAST COILS

Dimensions 1" x 1" Round.

E352 Iron Core Aerial	6 6
E353 Iron Core R.F.	6 6
E354 Iron Core Osc.	6 6
E355 Iron Core Osc. 6SA7 Valve	6 6

STANDARD SUPERHET. COILS

Dimensions 1-3/8" x 2" square.

E342 Air Core H. Gang Aerial Coil	6 6
E343 Air Core H. Gang R.F. Coil	6 6
E344 Air Core H. Gang Osc. Coil	6 6
E345 Iron Core Permature H. Gang Aerial Coil	8 6
E346 Iron Core Permature H. Gang Aerial Coil	8 6
E347 Iron Core Permature H. Gang Osc. Coil	8 6
E348 Iron Core Permature H. Gang Osc. Coil, 6SA7 Valve	8 6

T.R.F. COILS

T81 Air Core H. Gang Reinartz Coil	5 6
T82 Air Core H. Gang Reinartz Coil in Can	6 6
T87 Air Core H. Gang R.F. with Reaction Coil	6 6
T88 Air Core H. Gang Aerial Coil	6 6
T89 Air Core H. Gang R.F. Coil	6 6

LOOP AERIAL COILS

F125 Standard 6" diam.	7 6
F126 Midget 4" Diam.	7 6

SHORT WAVE COILS

13 to 42 metres.

H121 Iron Core Permature Aerial Coil	5 0
H122 Iron Core Permature R.F. Coil	5 0
H123 Iron Core Permature Osc. Coil	5 0

COIL KITS

K116 Standard Personal Coil Kit	2 2 0
K117 Standard 4/5 Dual Wave Coil Kit (complete with IF's)	2 19 0
K118 Midget Per. Coil Kit	1 19 6
K119 Midget B/C Coil Kit	1 18 0

RADIO FREQUENCY CHOKES

RF81 Silk Honeycomb R.F.	1 9
RF82 3 pie 1.7 M/H R.F.	4 6
RF83 4 pie 2.5 M/H R.F.	4 6
RF84 5 pie 4.0 M/H R.F.	4 6
RF85 6 pie 7.0 M/H R.F.	4 6
RF86 Cotton Honeycomb R.F.	1 6
RF106 Vibrator Low Tension R.F.	4 3

LINE FILTER COIL

RF15 Line Filter Coils	11 0

DUAL WAVE UNITS

DW29 Standard 4/5 Dual Wave Units	1 14 0

LOW LOSS COIL LACQUER

KH34 Type	2 6

COIL FORMERS

1.24 6-Pin Plug in 1¼-in. Diam.	3 3
1.25 6-Pin Plug in 1½-in. Diam.	3 5

DIALS

DA7 D/W Portable Kit Dial	9 0

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	1 8 6

FIVE-IN-ONE TRIMMER

CG19 four-2 plate and one-3 plate	3 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/A	15 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

VIBRATOR TRANSFORMERS

TP81 135 volts, 6 volt	17 6

AUTO TRANSFORMERS

TP80 6.3 volt, 4 volt and 2.5 volt	11 6

SPEAKER TRANSFORMERS

TS23 Single Low Impedance Triode	10 0
TS24 Single High Impedance Triode	10 0
TS25 Push Pull Low Impedance Triode	10 6
TS26 Push Pull High Impedance Triode	10 6
TS27 Single Low Impedance Pentode	10 0
TS28 Single High Impedance Pentode	10 0
TS29 Push Pull Low Impedance Pentode	10 6
TS30 Push Pull High Impedance Pentode	10 6

AUDIO TRANSFORMERS

TB42 A Class single Ratio 3 to 1	1 1 0
TB43 A Class Push Pull Ratio 3 to 1	1 2 6
TB44 B Class Push Pull Ratio 1½ to 1	1 1 0

DIAL DRIVE DRUMS

MO8 Dial Drive Drum, complete with Screws, springs and cord	3 3

SPEAKER TRANSFORMER REPLACEMENT COILS

F132 Single Low Impedance Triode	5 6
F133 Single High Impedance Triode	5 6
F134 Push Pull Low Impedance Triode	5 6
F135 Push Pull High Impedance Triode	5 6
F136 Single Low Impedance Pentode	5 0
F137 Single High Impedance Pentode	5 0
F138 Push Pull Low Impedance Pentode	5 6
F139 Push Pull High Impedance Pentode	5 6

LINE FILTERS

LF20 Line Filter .75 amps.	1 1 0
LF21 Line Filter 3 amps	1 17 6

CENTRE TAPPED RESISTORS

10, 20, 30, 75, 100 and 200 ohms	1 0

WIRE WOUND RESISTORS

0 ohms to 1500 ohms, 100 M/A	1 0
1500 ohms to 2500 ohms, 50 M/A	1 2
25000 ohms to 10000 ohms, 25 M/A	1 2
1000 ohms Field Replacement	4 0

TRIMMING CONDENSERS

CG15 2-plate	1 0

R.C.S. VOLTAGE DIVIDERS

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

PADDING CONDENSERS

P21 460 K.C.	2 6
P22 262 K.C.	3 0
P23 175 K.C.	3 0

POTENTIOMETER & RHEOSTATS

Type	Ohms	M/A	Price
PT40	6	250	5 0
PT38	10	250	5 0
PT39	20	250	5 0
PT34	30	250	5 0
PT46	400	50	5 0
PT47	1000	35	5 0
PT49	2500	30	5 0
PT51	5000	30	5 0
PT52	10000	20	5 0

MIDGET VARIABLE CONDENSERS

Star Type with Face Support.

Type	mmfd.	Plates	Price
CV34	10	2	4 0
CV35	15	3	4 3
CV36	25	4	4 6
CV37	35	5	4 9
CV38	50	7	5 3
CV39	70	9	5 10
CV40	100	14	6 6

MIDGET VARIABLE CONDENSERS

M.C. Type with Face and Back Supports

Type	mmfd.	Plates	Price
CV41	10	2	7 3
CV42	15	3	7 9
CV43	25	4	8 4
CV44	35	5	9 0
CV45	50	7	9 6
CV46	70	9	10 0
CV47	100	14	11 3

RESISTANCE STRIPS

MS7 x 25 12½" long, 25 lugs per side	3 6
MS8 ½" wide—any lengths per inch	1½d.
MB1 Anchor Strip	3d.

TRANSPOSITION BLOCK

AF12 Set of eight	5 6

MAGNETITE FE304 IRON CORES

MO1 3-8" per 100	2 0 0
MO2 7-16" per 100	2 0 0
MO3 ½" per 100	2 0 0
MO4 9-16" per 100	2 0 0
MO5 ¾" per 100	2 0 0

SOLDER LUGS

SL3 Single ended per 1000	10 0
SL4 Pear-shaped per 1000	10 0
SL5 Double-ended per 1000	10 0

6-PIN COIL PLUGS

1.27 1¼"	1 3
1.28 1½"	1 3

DIAL SPINDLE

K1 Dial Spindle	2 0

CLEAR POLYSTYRENE TUBING

MO16 2- 1/8" long x 1⅛" diam.	1 3
MO17 2-1/8" long x 1¼" diam.	1 3

ZAAYER CROSSES ATLANTIC ON "SIX"

Dutch Amateur's Latest Success

The following details are by courtesy of Persbureau Industria, Eindhoven, Holland.

"Readers will recall the article we ran in November, 1947 issue on the achievement of the Dutch amateur transmitter David Zaayer, the Philips engineer at Eindhoven, who succeeded in communicating with Capetown on the 6 metre band. This was at the time claimed to be a unique record in the history of amateur radio communication. The 50 mC/s band is only "open" at certain times, that is to say, DX communication at that frequency is only possible around every eleventh year. The American "Bustans" had reported that some periods last year were favourable and that as a result of ionospheric soundings the best opportunities would occur in March, 1947 and in the October/November period later. Zaayer didn't miss the chances as we already know, and since then he has not been resting on his laurels.

Preparations for the October "opening."

Outsiders saw very little of his many preparations inside the station, but outside, it was another story. Neighbours noticed that the already formidable beam arrays assumed a more complex nature. They grew from a comparatively simple affair to a large structure dominating the surroundings of the Daguerre Street. There was much head shaking as the acrobatic feats performed in tuning up the arrays were observed but David got on with the job undisturbed. He, as before, used the 10 metre band, which provides almost consistently reliable contact with many other countries, to check on his plans, so that everything could be arranged perfectly with regard to schedules. When asked about progress, his answer was to the effect that he was "sitting on a fence all the time."

Holland to America on Six

With a first-rate transmitter and aerial systems second-to-none in Eindhoven or its surroundings, also with a special Dutch PTT permit to use the 6 metre band, PA zero UN was all set to go. It was on October 28th, 1947, that he repeated his Capetown success of a few months before by bridging the Atlantic. Communication was effected with the station of Mr. Ed. Tilton W1HDQ, well-known as the VHF Editor of the ARRL publication "QST." Contacts followed on the same day with three other American amateurs on the 6 metre band. Incredulity was the note struck by many technical authorities, but at this period a great deal began to happen on the 50 mC/s band. In other European countries, England, Switzerland, and France, the PTT authorities granted temporary permits to radio amateurs to use the range 50-54 mC/s. It was soon clear that the

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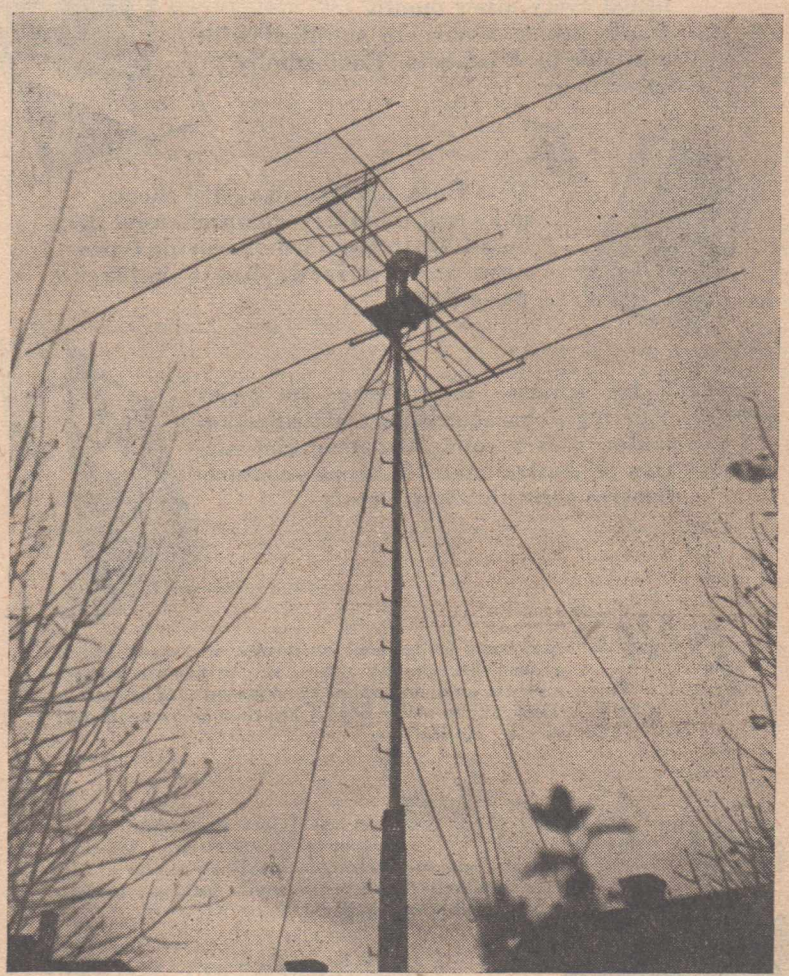

The comprehensive aerial arrays at PA zero UN. Up on the platform can be seen Tim, David Zaayer's right hand man for repairs and adjustments. Evidently he doesn't suffer from vertigo.

(Continued)

report of the American National Bureau of Standards regarding the October/November 1947 period was well substantiated. Hundreds of contacts were made by Europeans and Americans. After November 26th however, the band "folded" and nothing much of note has occurred since then. "Is the 6 metre band really finished for working?" we asked Mr. Zaayer, Zaayer, when we were present to congratulate him on his success. "Well," he replied rather mysteriously, "one never knows, there is always a chance," and he added, "otherwise we shall just have to wait another eleven years." It is our hope that when that time comes we shall be there again to give readers a report on the events of 1958 on "the 6 metre front." Au revoir."

PRIZE CONTEST

The attention of readers is directed to the Prize Contest which is being sponsored by Kelman Industries, as outlined in their advertisement on page 10.

Kelman Industries market a crystal pick-up with an unbreakable cartridge, and in two excellent models which have been designed with great care and attention to detail.

However, Kelman Industries feel sure that there may be something further which someone can suggest to make sure that there is no advantage overlooked. Therefore they have launched this contest and invite all readers to write their views about pick-ups.

The prize list includes two of the "Conniseur" pick-ups of different models, which are well worth winning.

No great amount of skill or technical knowledge is necessary to be successful in this contest, the main requirement for success being sound and practical ideas about what is required to make a pick-up worthy of being classified as an ideal one.

Full details will be found on page 10, including the address to which entries should be forwarded.

The £.s.d. of High Fidelity

How to Suit Your Ear and Your Purse

HIGH fidelity—magic name that we all seek yet few really attain. It has been defined that high fidelity comprises an acoustic output of two watts, free from distortion, and covering a range from 40 C/s to 15 kC/s, within three dB.

Audience tests in various parts of the world have shown that the ear does not notice any difference

By

K. M. COCKING

Kelman Industries,

Box 40, Hawthorn, Vic.

if this frequency range is restricted from 75 C/s to 8 kC/s, it should be noted that the frequency factor is 600,000 in both cases. But it is rarely stated that this is the ACOUSTIC output.

Whilst the maximum frequency range is desirable, it should be remembered that it is futile trying to reproduce frequencies that the EAR CANNOT HEAR. Again the enthusiast overlooks this factor. From exhaustive tests it has been shown that the average response heard by the ear in average surroundings, at medium volume levels, (70 phons), is from C/s to 8.5 kC/s. And it requires an input of some twenty watts to the speaker system before the ear actually can hear the range from 40 C/s to 15 kC/s. Thus it can be seen that few if any home enthusiasts have heard the full frequency spectrum; i.e. from 16 C/s to 20 kC/s, which would require a sound level of 100 phons. A phon being the measure of sound intensity of a pure sine wave at 1 kC/s.

These figures are authoritative, having been conducted by overseas investigators, free from commercial bias.

It is rarely realised that high volume levels are required if a full frequency range, hereafter abreviated to ffr, is to be achieved. But a study of the mechanism of hearing will soon demonstrate this statement.

Never forget that the ear alone determines if the reproduced sound is natural and pleasant, instruments being used to verifly and allow comparisons between different sound sources.

True fidelity requires a lot of money, and it is the intention of this article to demonstrate that by restricting the frequency range to certain limits, then adequate fidelity will result and will not cost many hundreds of pounds. But—it does not mean that full frequency response should not be aimed for, as this is obviously far better, and incidentally very expensive.

Flat Not Enough

It is not sufficient to have a "flat" amplifier because the speaker really determines how the sound will be reproduced, so if the amplifier is free from distortion, (less than 0.5% at maximum output) and the speakers are acoustically "flat" and will reproduce the above frequency range, then high fidelity is achieved.

Acoustic curves are rarely published due to the fact that they have little practical significance, due to the varying influences outside of the control of the manufacturer. However they are of value for laboratory comparison, still in spite of these figures, the ear is used to judge if the unit sounds correct.

Plotting Curves

Plotting acoustic curves is beyond the average laboratory, and there are few laboratories in the world who are capable of plotting the full response curves of an amplifier, and still enable accurate comparison with other laboratories. Thus the home enthusiast should strive for what sounds natural, and not worry unduly about the actual response curve, even though this is of value, if properly interpreted.

One overseas company states "under the most favourable conditions for critical listening, there is only a slight even chance that a

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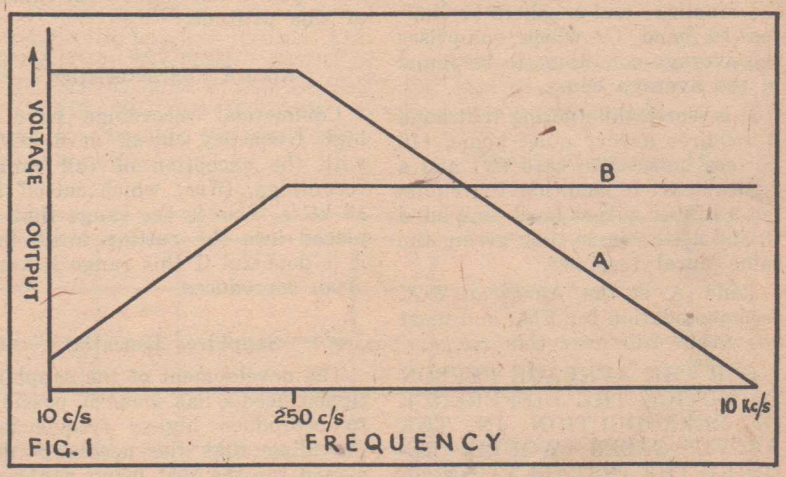


FIG. 1

This graph shows the theoretical output voltages for crystal pick-ups, curve A, and magnetic, curve B. In actual practice the curves will not follow this exact shape.

critical listener would detect a change from 15 kC/s to 7.5 kC/s, in upper frequency cut-off." Therefore the home enthusiast should strive for true tonal reproduction to 8.5 kC/s and forget the upper frequencies.

A comparison of costs for the increased range to 15 kC/s is interesting; the amplifier is rated at ten watts output, with 0.5% distortion in both cases.

Amplifier one, covering from 40 C/s to 15 kC/s, and amplifier two covering from 75 C/s to 8.5 kC/s. Case one would cost about £80, and two would cost about £30, but their respective speakers would cost £250 and £40 each, thus the full range costs £260 more, and it is doubtful if the ear could detect the difference in response.

The relationship between upper and lower response is interesting in relationship to fidelity, and the following figures are quoted.

Type of reproduction	Cut-off frequency Low	High	No.
High fidelity	40	15 kC/s	A
" "	65	11 kC/s	B
" "	75	8.5kC/s	C

This range from type A to C will cause barely perceptable changes in aural response, i.e. The effect is practically the same in all cases, and tonal balance is in no way affected.

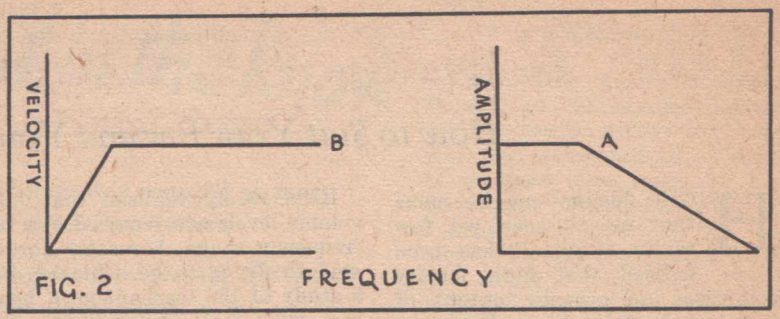
In view of the costs of reproducing band A & B it is seriously suggested that for ffr reproduction the amplifier and speakers be limited to band C, which comprises the average conditions to be found in the average home.

It is worthwhile noting that band B requires a very quiet home, (10 db less noise than case (C) and a critical ear, in addition to requiring a higher output level than band C, and at the same time giving the same aural response.

Band A is the American FCC recommendation for FM.; and must be within 2db over this range.

FOR THE AVERAGE PERSON TO NOTICE THE DIFFERENCE IN REPRODUCTION IN THE ABOVE CASES WOULD REQUIRE THE INSTALLATION OF A SPECIAL SOUND TREATED ROOM.

It should be pointed out that all remarks in this article are from the accoustic output, as it is this which is heard by the ear, if one wishes to listen to your favourite records on the screen of a CRO, then it is only necessary that the unit as a whole must be considered.



This graph demonstrates the vast difference between crystal and magnetic pick-ups; which accounts for the different treatment that is required if comparable results are to be obtained.

We are in no way trying to decry high fidelity, but we are trying to show that by restricting the frequency response, to internationally accepted limits of high fidelity response, then the home enthusiast can really achieve high fidelity, at a cost that he can afford. It is well known that few persons can hear sounds higher than 10 kC/s, at normal volume levels, (65 phons), so why reproduce sounds you cannot hear?

A most interesting point is that of frequency response. To date it has been thought that the publication of a response curve answered all problems, but a little reflection will soon show the fallacy of this attitude.

Record Characteristics

Commercial recordings have a high frequency cut-off at 8 kC/s, with the exception of full range recordings, (ffrr) which cut-off at 14 kC/s. This is the range that is placed into the cutting head, but it is doubtful if this range is very often reproduced.

Sapphires Essential

The development of the sapphire tipped needle has made it possible to reproduce higher frequencies, providing that the needle is designed for the job; being sapphire tipped is not enough. The radius of the point must bear a definite relationship to the recorded sound track. This is why cheaper type of needles that are not individually inspected will not reproduce higher frequencies, and so give that mellow tone to your amplifier. A simple example will demonstrate this point.

If you draw an S on a piece of paper then try to follow the S by tracing over it with a heavy blunt pointed pencil, you will find that it runs across the S, this is the same at high frequencies. In this case the needle point will not follow the wall grooves of the records, but "ploughs" through them, so preventing the reproduction of high frequencies.

Tracking Error

It is by this method of radius control that the special needles for cut-off at 6 kC/s are designed. For ffr reproduction it is essential to use a special sapphire needle.

Thus one factor of high frequency response is the needle used, which determines to top frequency that is capable of being reproduced.

The next point is that of tracking error. It is not very well known that the tracking error besides affecting wear also affects the high frequency response and distortion at these frequencies. Quite often a poorly designed or mounted pick-up will cause 5% distortion, which is often more than that caused by the amplifier. As the tracking error is designed into the pick-up it is necessary to purchase one with the lowest tracking error, other things being equal.

So it is necessary to have a good needle and low tracking error if the pre-requesites for high fidelity are required.

But don't forget that the pick-up is only a chain in the link, the final point being the speaker, which quite often does not reproduce the range that the pick-up will reproduce.

Speaker Curves

Speaker response curves are of little value to others than laboratory workers, due to their unreliability if placed in locations other than that in which they were taken. Remember that the response of a speaker varies as the cost, in the case of recognised makes. One unit not available to the public, reproduces from 25 C/s to 13 kC/s, and is 40% efficient, handling some 30 watts input; but it weighs some 180 lbs. and costs £250. So you can see that high frequency response is costly.

Effects of Hum

From experimental work done it has been found that resonant bass response, due to incorrect baffling; and distortion on transients, in addition to a high, though often almost inaudible hum will completely prevent an otherwise good amplifier from reproducing the expected response range. The presence of slight hum voltages will cause intermodulation products to form in the speaker cone, and so cause cone break up. One case of this caused the complete dismantling of a very big amplifier system, even though this hum was to all extents inaudible.

The specification for a "perfect" amplifier would read as follows:

Power output—15 watts, minimum.

Distortion—0.2% at any harmonic, and 0.5% at 15 watts output, measured at 400 C/s.

Frequency response—20 C/s to 13 kC/s within 0.2 db, which probably sounds like the unattainable, but such amplifiers have been built and designed, as for instance the "High quality amplifier, by D. T. N. Williamson." However such amplifiers are costly, and are infrequently found in the "hi-fi" enthusiasts home.

Another point that is overlooked is that of the volume levels effect on the reproduction of sound. If ffr response is desired then high volume levels are required, in addition to quiet surroundings.

Effects of Volume

Reducing the volume level from 88 phons, (88 db at 1 kC/s) to 55 phons, will restrict the range from 55 C/s to 210 C/s, in the bass register, and from 13 kC/s to 6 kC/s. So that this effect is one which is of importance, as it is not affected or caused by the speaker system, but BY THE EAR, ITSELF.

As previously stated, commercial recordings cut-off at 8 kC/s, as do the majority of speakers at present available, so why try reproducing frequencies that do not exist? As all that is achieved is the reproduction of excessive hiss, and other noises that quite often comprise so called high fidelity. It is interesting to note here, that hiss, from the record, covers the entire frequency spectrum, and it is due to the sensitivity of the ear that it appears to be concentrated at approximately 5 kC/s. If you desire to eliminate hiss, it is necessary to cut-off at frequencies above 6 kC/s, or else buy new records. ALL SCRATCH FILTERS REDUCE THE FREQUENCY RESPONSE OF THE WHOLE SYSTEM, in order to eliminate the most objectionable noises.

If response to 13 kC/s is desired, then the amplifier must not produce more than 0.5% harmonic distortion, as otherwise the extended frequency range will allow the harmonics, that were previously masked by the cut-off frequency, to be heard in their full range, with the consequent unpleasant result to the ear. With the advent of ffr recordings it is essential that phase and intermodulation distortion be reduced to a minimum.

The famous Strad violins actually have a falling response from 5 kC/s, and the cheaper types have the extended response to 7 kC/s, with the attendant thin tone.

To date little mention has been made of bass response as in general this is easier to achieve than the high frequency response. The production of bass notes below 200 C/s require the use of correct baffles. This may appear to be an incorrect statement, as your mantle radio will "reproduce" bass notes below 200 C/s. This is quite correct, but it does not produce resonant free sine wave output at the low frequencies. This being due to the effects of cabinet and speaker resonances, in addition to selective hearing by the ear.

Characteristics of Ear

This effect of selective hearing is caused by the ear hearing a bass note and adding frequencies which it feels should be present, but in effect are actually not there. This principal is used by organists to synthesise deep bass in the region of 16 C/s.

If true resonance free, sine wave output is desired then it is essential that the proper air path be presented to the speaker. At bass

(Continued on page 11)

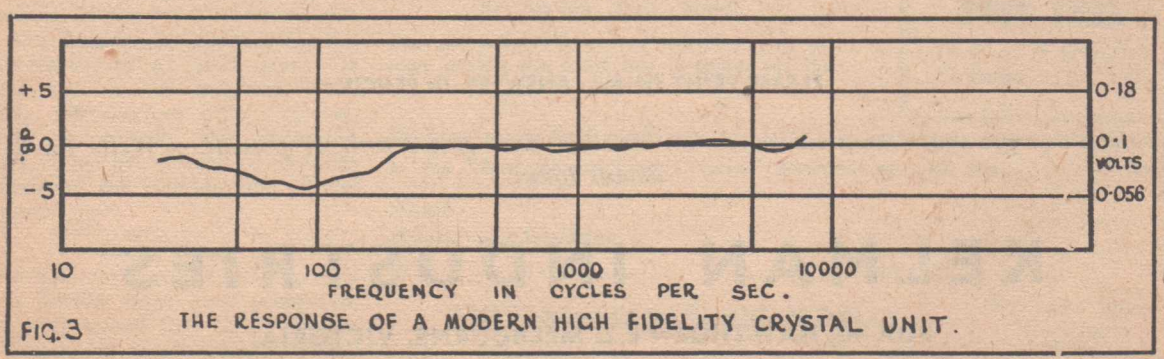


FIG. 3 THE RESPONSE OF A MODERN HIGH FIDELITY CRYSTAL UNIT.

"CONNISEUR"

PICK-UPS — *QUIZ* —

The manufacturers of the unbreakable crystal pick-up wish to make another new model. A MODEL YOU WANT. They ask you to complete this form and mail it to them. No replies will be individually acknowledged, and results will be announced in the July issue The judges' decision will be final, and no correspondence will be entered into.

1st PRIZE, Conniseur T10. 2nd Prize Conniseur J10. 3rd PRIZE Australian Record Companies needles, sapphire type, and other complimentary prizes.

What frequency response is necessary? 8, 9, 10, 12, 17, 20 Kc/s.
What weight is required on the record? 1/8, 1/4, 1/2, 1, 1½, 2 ounces.
What colour do you want?
What should it cost? 55/-, 65/-, 75/-, 85/-, 95/-, 120/-, 150/-, 250/-.
How high should the arm lift from the record?
What length should the arm be? 6-in. 7-in. 8-in. 9-in. 10-in. 12-in. 14-in.
What needle do you want? Permanent? Semi permanent? Removable?
What other features do you think necessary?
Do you possess a pick-up? YES. NO.
What do you think is the fault with all pick-ups?
Do you prefer a MAGNETIC . . . . CRYSTAL?
Any other comments?
What material should it be made of? Aluminium. Die-cast. Bakelite, etc.

Cross out the answer you think is BEST, wherever an alternative is supplied, or state what you want.

NAME ..... ADDRESS .....

.....

PLEASE PRINT IN ALL ANSWERS, IN PENCIL

Don't forget that Conniseur makes an excellent low priced unit at present. Write for details today.

KELMAN INDUSTRIES

BOX 40, HAWTHORN E.2. MELBOURNE, VICTORIA.

HIGH-FIDELITY
(Continued)

frequencies the speaker acts as piston, causing the air column to vibrate.

Consequently the reproduction of bass notes in the region of 30 C/s can be achieved by using a sounding board that prevents the air column from cancelling the vibration nodes. Or in other words, it requires a proper flat baffle, or an enclosed space designed for the job. But this space must not have any air leaks, being wholly and solely a vibrating medium.

Flat Baffles

Flat baffles have limited use, at low frequencies due to their large physical size. This can be calculated from Frequency, in C/s 1100/L, where L is the length of the baffle in feet, measured from the shortest path, back to front of the speaker. From this you can see that a 30 C/s note would require a circular baffle with a radius of 18 feet.

So in the bass region, reflex baffles are used. These require some 19 cubic feet of space, so that bass reproduction is a matter of physical size, in the main.

Box Baffles

Baffles should be constructed in solid wood or ply and lined with some absorbent material like cowhair, celotex etc., and should be airtight if they are to function properly. Quite often a well constructed bass baffle fails due to its not being airtight. By mounting speakers in the corner of the room, it is possible to obtain better overall frequency response, both in the bass register and the high frequency end. This is due to the walls of the room acting as a sounding board, and diffuser to high frequencies, in addition to minimising the reflected wave, due to the longer air path available. This factor of air path length is important, as the reflected wave, being 180 degrees out of phase, tends to cancell the oncoming wave, thus preventing or tending to prevent the reproduction of low frequencies.

The Pick-up

So that some points dealing with high fidelity have been presented, and it is hoped that they will enable a better understanding of the factors which affect reproduction of a full frequency spectrum.

Now we will deal with the source of sound—the pick-up. It is not intended to deal with the merits of crystal versus magnetic types. Both will give excellent results, and it is a matter of personal choice, which one, one decides is the best.

Highs Require Care

Firstly dealing with frequency response. All pick-ups will reproduce a frequency band sufficient for natural response, but care must be taken if this response is to be extended to 8.5 kC/s, or higher.

To produce high frequencies it is first essential to have perfect bass response. This statement will probably surprise the average user of pick-ups.

A heavy turntable, running freely, and powered by a heavy duty motor is essential. A turntable that wobbles and does not run perfectly evenly, will cause the needle to reproduce a bass rumble, that will modulate the upper frequencies and cause severe intermodulation products.

For true bass response below 100 C/s, it is necessary to ensure that the turntable does not suffer from the above defects which are often neglected and anything except the turntable is blamed.

Insulation Needed

With this point in mind it is wise to ensure that the pick-up is insulated from the motor, in order to prevent mechanical modulation of the needle chuck. The pick-up unit cartridge should be insulated from the tone arm. It is necessary to mention that if you compress rubber, by tightening or compressing it, it does not act as a shock absorber, but transmits the noise or movement through its own mass, again this point is quite often neglected.

Now to the high frequency end. To reproduce notes above 5 kC/s requires that the turntable and pick-up are free from all mechanical rumble and wow. Or else, as mentioned previously, the note will warble, with its modulation fre-

(Continued on next page)

HIGH-FIDELITY

(Continued)

quency. This point is often the cause of poor high frequency response.

The use of sapphire, or shadowgraphed needles is essential if the high notes are to be reproduced from the record. Remember, the needle point determines the upper frequency which can be reproduced, so that any needle will not do. Always follow the recommendations made by the pick-up manufacturer.

Likewise with regards to tracking error, it must be small if high frequency response, free from distortion is desired. In this direction one is guided by the manufacturer, who specifies this error. NO ALTERATION CAN BE MADE TO A COMPLETED PICK-UP, THAT WILL IN ANY WAY AFFECT THE TRACKING ERROR. BY MOUNTING THE PICK-UP CARELESSLY ONTO THE BASE BOARD, OR NOT FOLLOWING THE MANUFACTURER'S INSTRUCTIONS, WILL RESULT IN LARGER TRACKING ERRORS, TOGETHER WITH INCREASED DISTORTION, and record wear.

Follow the manufacturers instructions, which are designed to ensure the best performance from his unit, both for your advantage, and the manufacturer's.

Pick-up Bearings

Another point is that of the bearings used in any pick-up. These should be the same as if a large mechanical object was being used. The needle, having such a small area, on the record side walls, has to move the tone arm etc., against the friction of the bearings. Thus the better the bearings the better will be the high frequency response, all things being equal.

Thus it is apparent that some factors are beyond the control of the user, but other factors, often neglected, can materially affect the performance of the unit.

So the manufacturer must design the unit correctly, and yet even today, some units are very poorly designed, without consideration to the basic principles. By just bending the tone arm, it does mean that the tracking error is eliminated, likewise by counterbalancing the tone arm, does not eliminate the vertical inertia, in fact it increases it. And these remarks apply to any pick-up, past present or future.

A pick-up is a precision unit, and should be treated as such. Because a unit is guaranteed, or is claimed to be unbreakable does not mean you should misuse it.

Inserting Needles

Some points often forgotten are very simple, but in time will completely reduce the high frequency response. If your unit has a replaceable needle, then when you tighten it, hold the needle so that your fingers take the torsion from the needle chuck. Never store or place a crystal pick-up in direct sunlight, or excessive heat, as this will destroy the cartridge; heat and humidity rarely improve any electrical component.

(Continued on page 34)

CONNIE PICK-UPS

To avoid confusion we think it worthwhile to point out that there are two pick-ups at present on the market with a similar name.

One is the English-made "Connoisseur," which is a miniature moving-iron type of high-fidelity instrument which requires bass compensation for proper operation, then giving extremely wide-range performance. Australian agents are J. H. Magrath & Co., of 208 Little Lonsdale Street, Melbourne.

The other is the "Conniseur," spelt without the "o" and with only one "s," which is of the crystal type, fitted with an unbreakable crystal cartridge. Being of the crystal type it has high voltage output and does not require bass compensation. It is capable of giving the high-quality performance normal with crystal pick-ups. This pick-up comes from Kelman Industries, of Hawthorn, Victoria.

AMATEUR PERSONALITIES

Victoria–the Third District

More pen-pictures of individual hams as the writer sees and knows them.

By VK2NO

VK3BQ. Maxwell Howden, of Canterbury, Vic., is one of those with whom Australian amateur radio history is wrapped up. A3BQ was well-known in pioneer DX days . . . this writer first heard his signals in London on "85 metres" in 1924. Old "shots" of Max depict him with hirsute adornment . . . a memory that persists with old-time colleagues. Is a quartz crystal expert with lots of experience, and being in that line of biz; naturally doesn't favour VFO's overmuch?

* * *

VK3BD. Eric Ferguson. South Yarra, Vic. . . . has VHF in the blood. Did lots of pioneer work in NSW on 56 mC/s as VK2BP, Hazelbrook in the 30's, and provided the first 'outside' Sydney QSO's on "Five." Does a bit now on "Six" but is sorely handicapped by lack of space and an unsympathetic neighbour who objects to antenna 'projections' over property. Served in 2nd AIF, reached rank of Captain, and did good work in Army Design Division before returning to industry.

* * *

VK3DH. Ivor Morgan, Hawthorn, Vic., is an old hand at the game and one of the prime technical movers behind Kingsley products. Finds time to look in on 6 metres occasionally and has been in the DX picture on that band.

* * *

VK3EG. Ivan Miller, Caulfield, Vic. . . . is a first-rate key wielder and doesn't favour phone overmuch. Always 'up top' in CW section of DX contests and yearns for the facilities for Vee Beams etc. he had pre-war up at Tallangatta. Is a Dental surgeon and in that capicity was Major AIF. At Vic. L of C Dental Unit he put new "china clippers" in many an Army 'phiz,' including this writer's!

* * *

VK3HF. Harold Fuller, Warrnambool, Vic. . . . has been a long time at this hobby and was one of the enthusiasts for amateur 200 metre broadcast operation in those now far-off times when such was the case. A stickler for good quality phone and makes a hobby of recording equipment. Possesses a very well engineered wire recorder of his own design and construction. Is Manager and Chief Engineer of B/C station 3YB.

* * *

VK3KU. Howard K. Love, Mount Waverley, Vic. . . . one of the most colourful of Australian old-timers. Played a leading part in the first 'Trans-Pacifics' on 200 metres along with the late Ross Hull. In those days was A3BM, and today is the moving spirit behind the Kingsley radio business . . . possesses an "all-band" modern station with composite beam arrays. Was a pilot in the AFC in the Kaiser's war and became a POW when his Sopwith Camel motor "conked" over German territory. His factory produced those famous AR7 receivers in the recent war.

* * *

VK3MH. Mart Chaffer, of B/C station 3HA, Hamilton, Vic . . . is to be heard on 7 mC/s CW at intervals, batting along at a steady clip. Is an inveterate rag-chewer with no liking for amateur phone operation. One of the old hands, he was well-known to the "gang" more than 20 years ago as "3XF of Moonee Ponds"

* * *

VK3UK. Vaughan Marshall, Kew, Vic., was prime mover in pre-war formation of RAAF Wireless Reserve, which paid dividends to that Service when the Show-Down came. Rose to the high rank of Group Captain and ended war service as Director of RAAF Signals. Was present with RAF at the invasion of the Normany coast. Recently Federal President of W.I.A.

* * *

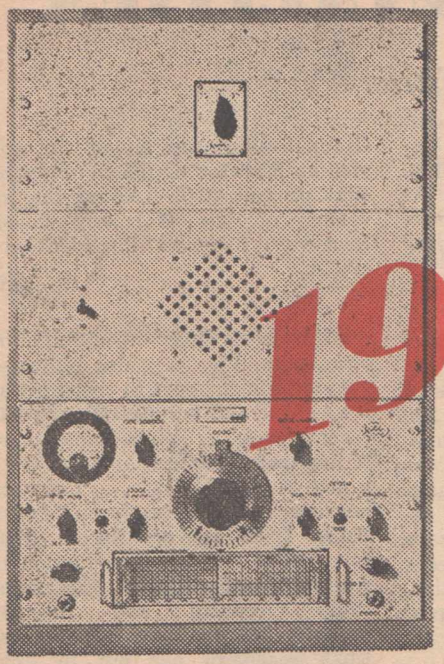
VK3ML. Bob Cunningham, Frankston, Vic. . . . also played a very prominent part in the pre-war RAAFWR and served through the recent fracas as Wing Commander. A first-rate practical amateur with a nice steady CW fist . . . has been heard at intervals lately on 7 mC/s phone from his new locale. Was responsible for the introduction to Australia of British Eddystone radio products and recently brought out the new communications receivers put out by that concern.

* * *

VK2AGW. Bert Hay, Wahroonga, NSW . . . until recently GW3-BHG of Barry, South Wales. Is really a very old hand in Australian radio . . . came to Australia in the early 20's with the Union SS Co., and was R/O on the old "Aorangi." Worked with Australian and other amateurs as GD-VB . . . a pioneer in Mobile Marine contacts. Was also G2KG 25 years ago. Will be on the air on 14 and 28 mC/s DX when settled in.

PLASTIC BOAT

A one-piece, all-plastic boat is being made by the General Electric Plastics Division for the Beetle Boat Company of New Bedford, Massachusetts, U.S.A. This 9-foot dinghy weighs only 80 pounds. It requires practically no maintenance and can be stored without regard to climate, nor attacked by either salt water or worms. Its one-piece construction eliminates seams. It has both tensile and impact strength greater than any similar boat of other materials, weight for weight. Three rope holes and four oar lock sockets are moulded in the boat with metal inserts.



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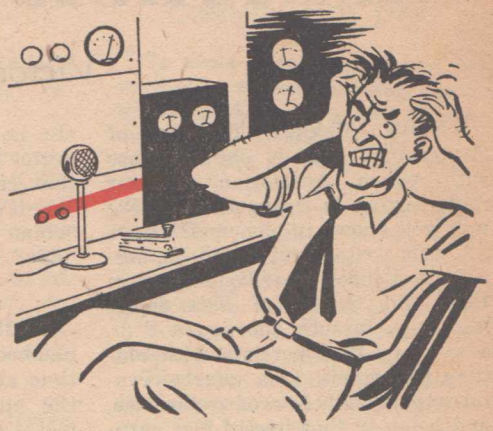


Don't

sit back and curse!

GET AM/FM (NB*) AT WILL

Kingsley's research engineers have perfected an AM/FM (*narrow band) adaptor for use with "Ham" Communication receivers —to be

Released During April

Don't sit back and curse when one of the fellows calls you on F.M. —flip the switch and be in a position to give him a critical report.

SEE ARTICLE IN THIS ISSUE FOR FULL DETAILS

KINGSLEY

SIGNAL BOOSTER TYPE K/S9
6, 10, and 20 Metre Bands

KINGSLEY

S/W CONVERTER TYPE KF/C6
For use on the 6 Metre Bands

IMPORTANT

If your usual supplier is unable to supply your requirements of Kingsley Products, drop us a line mentioning his name and address.

SEND FOR FULL PARTICULARS OF EACH

Ask for–Insist on–DEMAND Genuine Kingsley Parts from your supplier

KINGSLEY QUALITY RADIO PRODUCTS

KINGSLEY RADIO

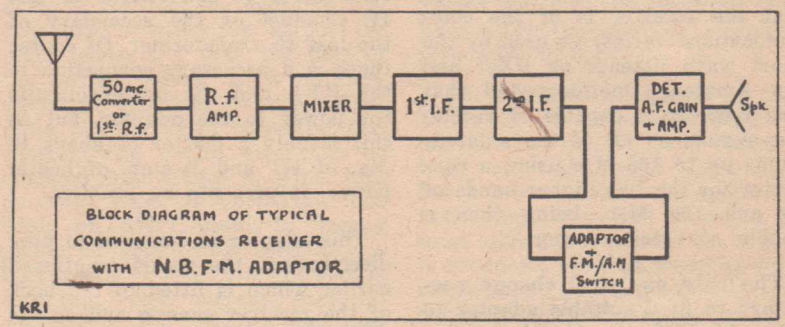
KINGSLEY RADIO PTY. LTD.

380 St. Kilda Road, Melbourne, Victoria . Phones: MX 1159, MX 3653

Latest from Kingsley—

NARROW-BAND F.M. ADAPTOR

HAVING learned that Kingsley Radio Pty. Ltd. had developed a Narrow-band F.M. Adaptor for use with communication receivers we approached them with a request that they furnish us with the details of the unit, and although time did not permit of the photographing of the adaptor we have pleasure in presenting here technical details and circuit diagrams of this new Kingsley N.B.F.M. adaptor.



In the United States of America the F.C.C. has seen fit to permit narrow band frequency modulation on the 14 M/c amateur band for a trial period of twelve months. This is of course in addition to the original regulations permitting N. B.F.M. on the 11 and 6 metre bands and all frequencies above. In Australia we were granted permission to use N.B.F.M. on the same basis with the exception of the 14 M/c band.

In the last few months the amateurs of the world have shown a marked increase in interest in N.B.F.M. The obvious and definite advantages of this method of conveying intelligence is immediately appreciated by the amateur when he actually tries the scheme for the first time and this is particularly apparent on the higher frequencies.

It is admitted that under "band open" conditions on the crowded 14 M/c band F.M. does not show up as well as A.M. but this is the only time it falls down on the job, so to speak. The improved signal to noise ratio on a weak signal can be readily demonstrated regardless of frequency on any of the amateur bands but if all stations for instance on the 14 M/c band used N.B.F.M., then the Q.R.M. problem would not improve since when using F.M. reception, the stronger of two signals on very near frequencies will "capture" the receiver.

However, on not over-crowded conditions, F.M. certainly has the advantage.

Firstly the transmitter is very easily converted for N.B.F.M., and one at the same time effects a very considerable saving in operating and maintenance costs, since there is no expensive modulators to feed and keep in order. The fact is that a transmitter of one kilowatt input (U.S. Law) may be modulated by a type 9001 tube, with every satisfaction in a very simple reactance modulator circuit.

We are not dealing with the originating of an F.M. Signal in these notes so we shall not go into details of transmission methods.

Here is a quite straightforward

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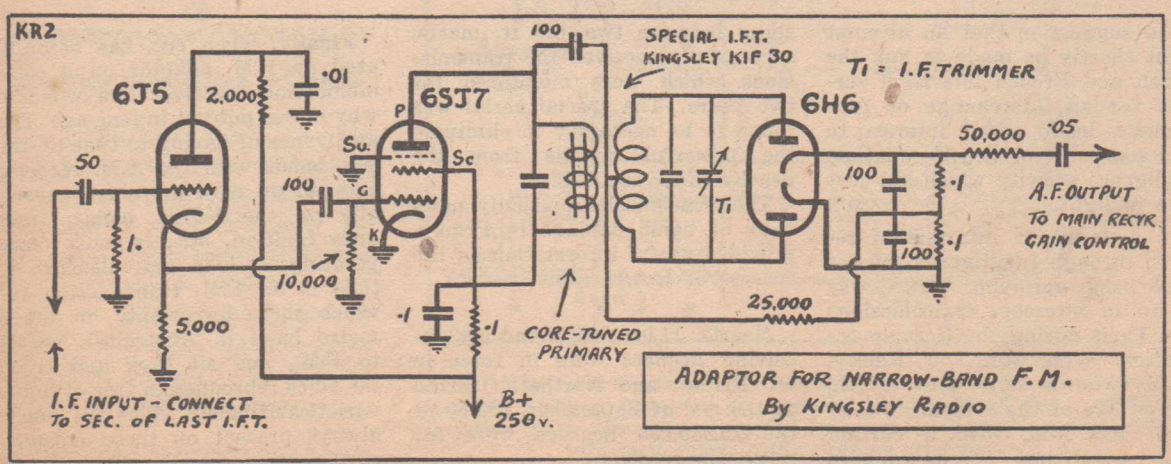


F.M. ADAPTOR

(Continued)

method of converting any communications receiver over for alternate A.M./F.M. reception at the touch of a switch. It is considered that the receiver is of the communications variety as used by the short wave listener or DXer and the Amateur Operator, and that this receiver is capable of receiving signals on all of the amateur bands up to 166 M/c using a converter for the two higher bands of 50 and 166 M/c, being then a double conversion super.

The only electrical change necessary to fit a suitable adaptor to allow for F.M. reception is to open the connection to the input to the audio frequency gain control.

This position in the circuit is very often the point where the diode detector takes place and the gain control may be part of the diode load. If this is the case the connections to the "hot" side of the gain control are merely lifted off at this point and the leads from the socket which will be mounted on the rear of the chassis, are taken to these two points.

In other words the A.F. circuit will go via the socket on chassis rear, through the N.B.F.M. adaptor to the A.M. side of the F.M./A.M. switch.

If the receiver A.F. gain control is after the diode detector and "looking" straight into the audio frequency amplifier channel, no complications develop as the treatment is precisely the same.

The only other connection to the receiver is to the output of the IF Channel or the secondary of the last IF transformer. Of course there is a necessary connection to the HT+ and the heater circuits for power to the adaptor, but as this is only a matter of about 10 Ma. of HT and .9 amp. of heater power, it presents no problem.

This adaptor is designed to plug directly into the socket mentioned earlier which is fitted to the back of the receiver chassis and as the only connection which is critical as to length is the I.F. load from the I.F. channel to the input to the adaptor, the socket for the latter is mounted as close to the output of the I.F. channel as possible and the A.F. leads are run in shielded wire and the A.M./F.M. switch is brought out to the front panel for ease of operation.

Referring to the block diagram Fig. 1, and supposing we are listening to a "W" signal using N.B. F.M. on the 14 M/c band, the H.F. converter is of course switched out and the receiver operation is completely normal up to the second I.F. amplifier stage output. Instead of passing to the diode A.M. detector, this signal detours through the adaptor and of course may go via the switch back to normal A.M. detector, and out through the A.F. channel to the speaker, but when the switch is on F.M. the I.F. signal passes through the cathode follower, the limiter, the discriminator and out to the A.F. channel and speaker. The operation is the same when the V.H.F. converter is switched in for a 50 or 166 M/c signal.

We turn now to Fig. 2 for a brief description of the method employed to recover the speech from a frequency modulated transmission. It will be observed that the first tube in the converter (6J5) is connected as a cathode follower. This system makes possible a satisfactory coupling to the receiver I.F. channel with as little effect on the channel as is possible, due to the very high input impedance and small loading effect.

The 6SJ7 limiter follows and will give good limiting effect on practically any communications receiver due to the considerable amplification prior to this point in this type of multi-stage receiver. The limiter has in its plate circuit the special discriminator transformer which is built with an iron core tuned primary and a balanced secondary which is trimmed by a small variable condenser in parallel with a silvered mica fixed condenser. The discriminator using a 6H6 twin diode tube is conventional and the audio frequency output is connected to the F.M. side of the switch, so that it will feed into the receiver gain control input to replace the normal A.F. receiver.

Finally, when one has actually used an F.M. adaptor on a communications receiver one wonders why it was not put in long ago. The annoyance of having to tune on the side bands with the A.M. receiver and put up with the noise, especially on the V.H.F. bands, from auto ignition, etc., is most exasperating. It is a real pleasure to tune in an F.M. transmission (of which there are plenty on the 6 metre band in Australia), switch to F.M., and sit back and enjoy the voice reproduction free of many varieties of noises which are nearly always present on these frequencies.

FRENCH TELEVISION

The suggestion that an attempt might shortly be made to link the British and French television services for an interchange of programmes lends added interest to an account of an R.A.F. wartime intelligence activity which has just come to light.

As a result of information received through Intelligence sources a television receiving centre was set up to intercept transmissions from Paris during the German occupation. Wing Cdr. G. T. Kelsey, O.B.E., who is now with E.M.I., secured two of the company's television sets and, with a curtain array consisting of 32 dipoles slung between two 150 ft. masts, successfully received the transmissions which were monitored for two years. The special aerial was found to be necessary to eliminate the powerful signals from the nearby radar stations.

The transmissions, usually news reels of bomb damage in France, provided useful information on the success of R.A.F. raids.

* * *

Nearly 11,000,000 broadcast receiving licences were in force in Gt. Britain and Northern Ireland at the end of September. 25,050 of the 10,950,650 licences were for television receivers.

A DIRECT-COUPLED CIRCUIT

Interesting Design From a Reader

WHEN I read about the Negative Feedback Amplifier the immediate thought which struck me, and no doubt others, why not direct couple the output stage and finish the job?

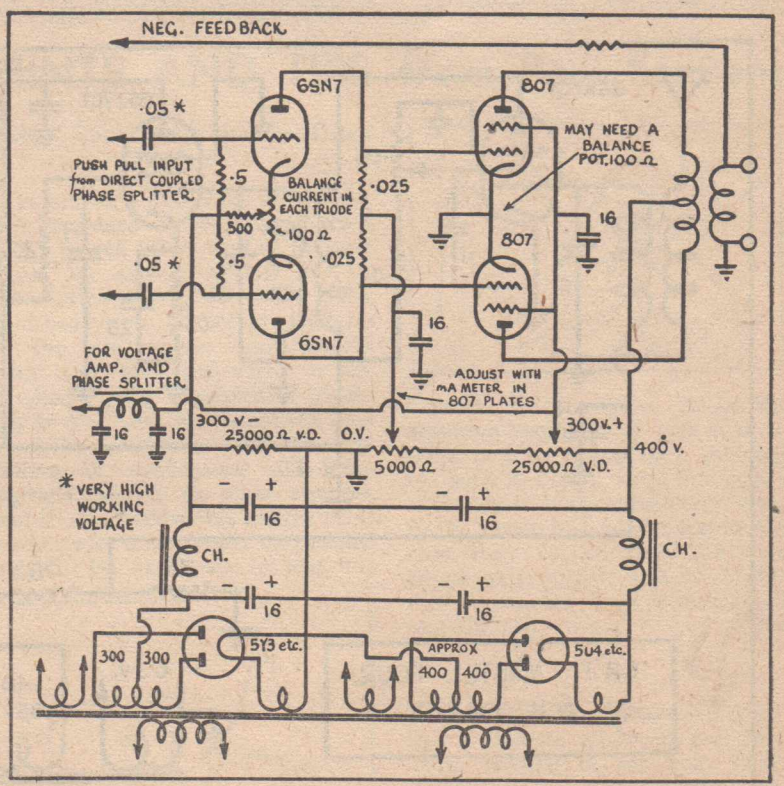
This should mean a further reduction in phase shift and frequency discrimination. In view of the high voltage required from plate to cathode of the output valves some misgivings may be felt, but the solution may be found in a circuit which I came across a couple of years ago in the Navy. A sketch of the circuit is shown herewith, and it should explain itself. As you can see, the output valves are connected as beam power valves, but I feel sure the same circuit would work equally well with the triode connections as per the Negative Feedback Amplifier.

The main feature claimed for this direct-coupled amplifier seems to be the low plate loads for the 6SN7, which apparently constitute a low impedance driving source for the 807's. The 807's are tied down by the 6SN7 which is delivering perfectly balanced output at equal plate current, and as a result, parasitic oscillations cannot occur, assuming of course that the circuit is carefully constructed. There were no plate, screen or grid stoppers in the original circuit.

The 5,000 ohm potentiometer on the positive side of the high tension network controls the negative voltage which will drop across the plate loads, and thus the bias of the output valves, so a milliammeter is required in the output plate circuits when adjusting this control. The circuit can thus be changed from Class A, AB1, AB2 or even class B operation. The 6J5's or 6SN7 seem to supply plenty of grid drive. Obviously a high-quality output transformer is essential. The current carrying capacity of the positive high tension supply also needs to be pretty hefty. A further point is in respect to the coupling condensers from the phase-splitter. With a positive voltage of perhaps 100 volts on one side and 300 volts negative on the other, a fairly high voltage strain is placed across these condensers, so they should be of the type designed for 600 volt working, and have a few thousands of megohms resistance to d.c.

As a dentistry student at the University I have little time to experiment myself, and haven't built up this circuit personally, but I have heard it in operation, and I must say that it would be most difficult to better the sound it produced. Perhaps some of your readers may find it interesting and triode it with the triode connections for the 807's. The front end of the amplifier could be wired up exactly as the Negative Feedback Amplifier.

—from Roy S. Smith, 909 Pacific Highway, Pymble, N.S.W.



High-fidelity enthusiasts will be greatly interested in this direct-coupled amplifier which is suggested by a reader who has heard this amplifier in operation. High voltages are avoided by using two separate power supplies with some rather tricky earthing arrangements.

NEW HEADPHONE DESIGN

The American Telex Co. has produced a new type of headset which looks like a doctor's stethoscope and is worn in exactly the same way—under the chin instead of over the head. Weighing just over 1 oz. only and incorporating its own volume control, the Telex Monoset is claimed to be a great advance in headphone design.

T.R.F. MANTEL FOUR

Simple Circuit With Grand Performance

THIS little set has been designed for city and suburban use only. For this purpose it is quite adequate, and little difference can be noticed in comparison to the average 4-tube mantel superhet. It is extremely simple to build and put into operation and will cost you rather less than a superhet to do the same job. It may be built up in any of the small mantel cabinets that are readily available.

By

S. H. DALEY

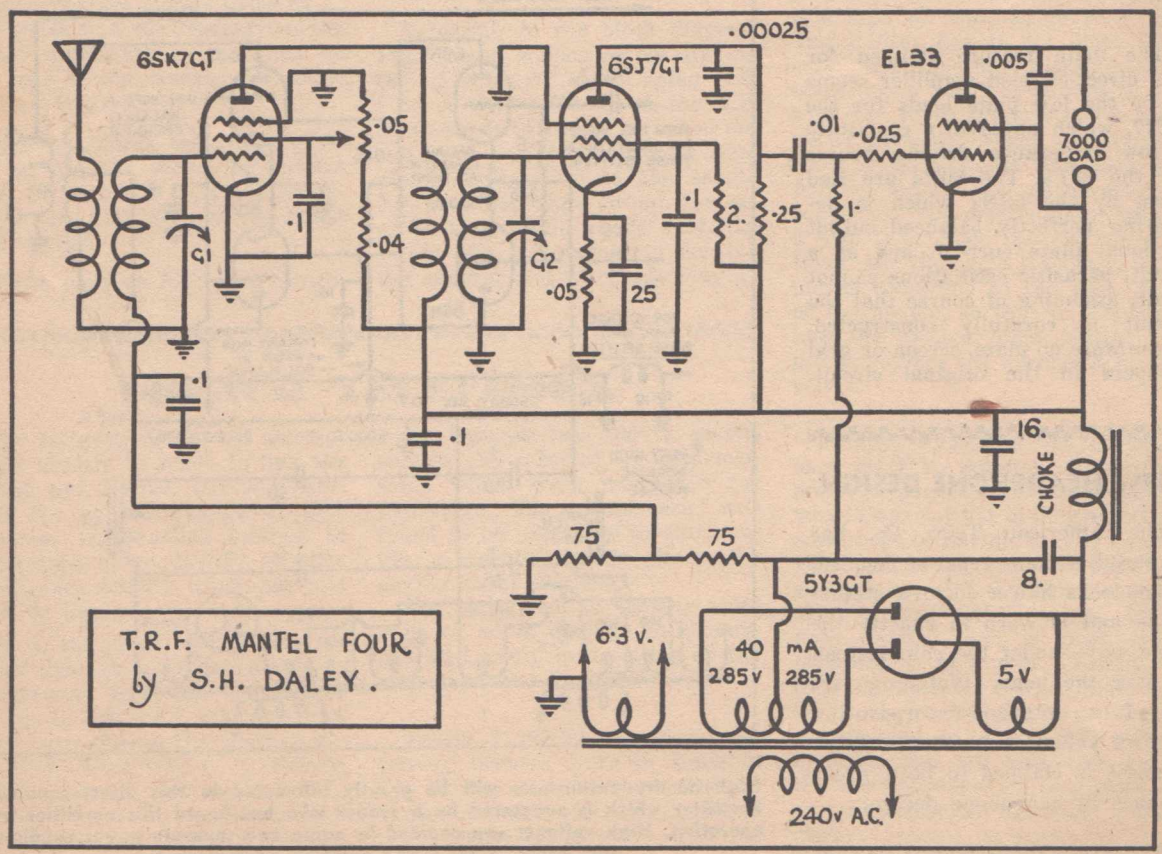
SYDNEY, N.S.W.

The first two valves are the new locally made single ended variety. They were selected for high gain and ease of wiring. The 6SK7-GT is used as RF amplifier, back bias is applied to the control grid and the gain is controlled by varying the screen voltage. This gives a smooth and easy form of volume control and ensures that overloading will not take place in the latter stages.

The signal is then fed through an RF coil to the control grid of the 6SJ7-GT which operates as a plate detector. Operating bias for the 6SJ7-GT is obtained by a .05 meg. resister in the cathode circuit, this is bypassed with a 25 M.F.D. condenser to avoid degeneration. No extra RF bypassing was found necessary. Screen voltage for this stage is supplied by means of a dropping resister. The plate load resister is bypassed by a small mica condenser to filter out RF voltages.

Grid Stopper

The audio signal is fed through a .01 mica condenser to the EL33 output valve. It was found advisable to include a small grid stopper resistance wired directly at the output socket, this is to prevent the output valve from self-oscillation. The bias for the output



PARTS LIST

1—Aerial Coil, iron core.
1—R.F. Coil, iron core.
1—2 Gang Condensers to suit dial.
1—Dial.
2—Trimmers.
4—Octal Sockets.
1—Power Trans. 285/285, at 40 ma. 6.3V. and 5V.
1—50 ma. midget choke.
1—8 mfd. 525V. electro.
1—16 mfd. 525V. electro.
1—25 mfd. 25V. electro.
3—.1 mfd. 400V. paper cond.
1—.01 mfd. mica cond.
1—.00025 mfd. mica cond.
1—.005 mfd. mica cond.
1—.05 meg. volume control carbon.
1—.04 meg. carbon res. 1 watt.
1—.05 meg. carbon res. ½ watt.
1—2 meg. carbon res. ½ watt.
1—.25 meg. carbon res. ½ watt.
1—.1 meg. carbon res ½ watt.
1—.025 meg. carbon res. ½ watt.
2—75 ohm carbon res. 1 watt (or wire wound.)
1—permag speaker, 7000 trans., size to suit.
1—6SK7-GT tube.
1—6SJ7-GT tube.
1—EL33 tube.
1—5Y3-GT tube.
Chassis, cabinet, knobs, etc.

valve is obtained from the back bias network. A 5" or 6" per-mag speaker with a 7000 ohm transformer shunted by a .005 mica condenser completes the signal circuits.

The power supply is quite conventional, and any combination may be used so long as it will deliver about 250 volts at 40 ma.

There are no special precautions to be taken in the construction of this set other than the usual conventional methods. Keep all leads short where possible in the RF and detector circuits, orienting the tube sockets to achieve this. Bypass condensers should be wired directly at the sockets and all earthed points linked with tinned copper wire. Valve shields were not found to be necessary, but make sure that pin No. 1 on all valves excepting the rectifier is earthed.

The alignment procedure is very simple. The iron slugs in the coils are adjusted for maximum gain at the low frequency and of the dial, whilst the trimmers, which may be wired at the coils, are peaked at the high frequency end of the dial. If short leads are used in the RF end of the set, trimmers are hardly necessary. Operating voltages that are given are only approximate, the most important ones being the bias voltages.

Other type valves may be used if these are on hand. In place of the 6SK7-GT any of the RF amplifier valves such as 6O7G, 6K7G, 6D6, EBF2, may be used with no change in circuit valves. If a 6J7G valve is used in the detector circuit, screen and cathode resistors may have to be altered. The EL33 is the best valve for the output socket, if size is important in a small cabinet, a 6V6-GT could be used, in which case the bias would have to be raised and the grid stopper resistor could be omitted. All voltage and wattage ratings in the parts list are minima and heavier duty components may be used if desired.

This little set is at present being used in the Bondi area with about 8 ft. of aerial wire and during the day receives and separates the eight local stations with enough punch to rattle the best 6" speaker. At night a few of the country stations may be picked up, but the selectivity is not sufficient for good separation. However, for metropolitan use as a mantel model, this little job is quite adequate.

Voltages	No. signal		Volume max.
	Plate	Screen	Cathode
6SK7-GT	260	80	0
6SJ7-GT	220	110	7.2
EL33	255	260	0

Back bias, whole—6.5V.
top—3.2V.
H.T. voltage—260V.

If there is room for improvement it is in the detector circuit operating condition, the values used in this circuit were found by trial and error as no data for the 6SJ7-GT valve was available for these conditions. I would be grateful if any reader who is able to enlighten me in this direction would drop me a line on the subject.

In conclusion I would recommend this little set to the more inexperienced constructors who desire a second set for suburban use.

HINTS AND TIPS from Paul Stevens

Check Your Parts Before Using Them

It will save you a lot of trouble. The standard of workmanship of today is well below that of pre-war days. We encounter coils and IF transformers with litz wires badly soldered to the terminals or shorts to the can, power transformers with badly-anchored wires or the windings badly insulated or shorting to the core, which applies also to chokes; resistors with the ends falling off; condensers with loose pigtails, shorts or open circuits, and so on. Follow this golden rule: never twist a condenser or resistor pigtail. Do as shown in Fig. 10:

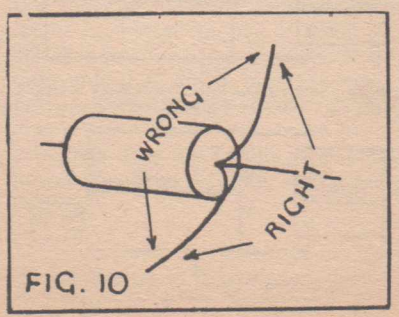


FIG. 10

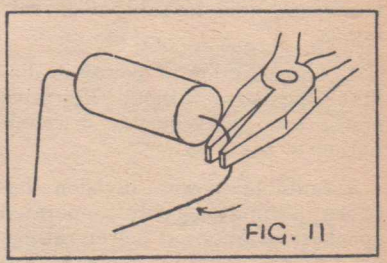


FIG. 11

Stretch it, then bend it in the direction required. If you have to twist it after it has been soldered in, hold it firmly with the points of a pair of long-nosed pliers close to the resistor or condenser, as the case may be, so that the wire twists only outside and not inside the component, where it is soldered in (Fig. 11).

* * *

American Production.—According to figures given at the New York meeting of the U.S. Radio Manufacturers' Association the estimated production of broadcast and television receivers during 1948 will be between 13,000,000 and 15,000,000.

SPEAKER IMPEDANCE MATCHING

And Power Distribution

From the
TECHNICAL SERVICE DEPARTMENT
Jensen Radio Manufacturing Co.
U.S.A.

THE general problem of delivering audio frequency power from an amplifier to a loud speaker or group of speakers at the desired level, and with minimum distortion and maximum power economy, requires that conditions such as the following be met:

1. Efficient transfer of power from source to load. Presentation of a suitable load impedance to the source so that it may attain its maximum undistorted power rating.

2. Transmission of power to distant speakers without excessive power loss or frequency discrimination in the line.

3. Suitable power division between simultaneously operated speakers of different power ratings or different required acoustic output levels.

4. Provision for satisfactory level control at the speaker position if required.

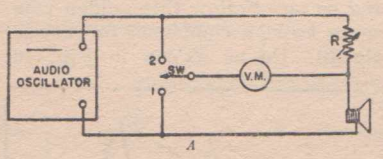
5. Installation in accordance with the principles of good constructional practice so that lines and equipment will not fail from weathering or other service conditions, and will readily permit routine maintenance , extensions and alterations.

In the simplest possible case, that of a single conventional speaker fed from a suitable amplifier, we may be concerned only with Item 1 above. In an extensive and complicated sound system, it is possible that all of the various conditions listed might have to be satisfied at various points in the system. Here the individual problems are simply taken one at a time and solved step by step in the process of laying out the complete system.

In this paper, typical problems will be outlined and practical solutions given. The types of problems analysed will include most of those which are frequently encountered in sound system layout and the methods indicated can be extended to meet any situation which is likely to arise in practical applications. Reference tables and design charts are included to eliminate equation solving wherever possible. No attempt will be made here to deal with the very important matter of acoustic coverage of the service area since this subject will be extensively treated in a subsequent publication in this series.

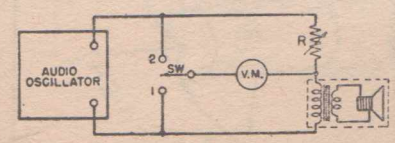
Impedance of Loud Speakers

It is necesary to know the impedance of a loud speaker in order properly to couple it to an amplifier or line, and therefore the rated impedance is always stated in catalogue descriptions. The rated impedance, expressed as a simple number such as "16 ohms," is the value chosen by the speaker manufacturer because it is the best value assignable to the speaker when considering the requirements of amplifier loading and power de-



A

Adjust R until Voltmeter Reads Same in Switch Positions 1 and 2. Then R=Speaker Impedance.



B

Fig. 2. Circuits for Measuring Speaker Impedance

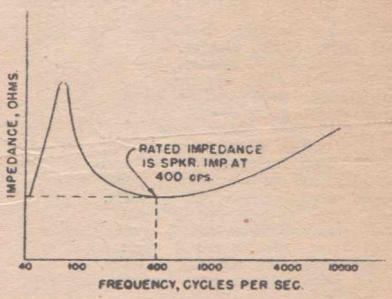


Fig. 1. Impedance Characteristic of Typical Moving Coil Loud Speaker.

terminations with complex input characteristics of speech and music. Actually the impedance of a loud speaker (numerically equal to the voltage across the unit divided by the current through it), varies considerably with frequency as is illustrated in Fig. 1 for a typical moving coil direct radiator unit. Other types of speakers have different impedance characteristics, but since the moving coil type is almost universally employed today, only that type has been considered here. The rated impedance of a moving coil loud speaker is approximately the minimum impedance above the low resonant frequency and this minimum value is usually found at about 400 cycles per second. The increase in impedance for frequencies above and below that at which the minimum is found, is no absolute indication that the response curve will be adversely affected thereby.

If the speaker impedance is not known, it can be measured with the aid of an audio oscillator, calibrated variable resistor and high impedance rectifier type or vacuum tube voltmeter, as indicated in Fig. 2A. The oscillator output should be adjusted to give about full scale reading on the voltmeter when switched across the speaker voice coil (switch position 1), making sure that the signal level does not exceed the speaker power rating. The variable resistor R is then varied until the voltmeter reads the same in positions 1 and 2. The value of R is then numerically equal to the impedance of the voice

coil at the frequency of measurement. A single determination at 400 cycles will probably be satisfactory although if desired the impedance can be measured by this method over any desired range of frequencies. The principle is the same if the speaker is equipped with an input transformer; here the required impedance is that "looking into" the primary, with the secondary connected in the normal manner to the voice coil. In this case the circuit would be as shown in Fig. 2B.

Loud Speaker and Power Output Stage

Moving coil loud speakers are low impedance devices with 4 to 45 ohms representing the usual range of voice coil values. Vacuum tubepower output stages, on the other hand, are high impedance devices and, depending on the type, number and arrangement of output tubes, require load impedances which may be anywhere from 1,000 ohms to 30,000 ohms. As is well known, output or coupling transformers), are inserted between the output tubes and the voice coil to reconcile the widely different impedances. The transformer is an **impedance changer** which, when its secondary is connected to the low-impedance load, will present at its primary terminals the proper impedance for maximum undistorted power output from the output stage. In other words, power is usually taken from the plate circuit at high voltage and low current (a high impedance condition) and delivered to the speaker at low voltage and high current (a low impedance condition).

To illustrate what is undoubtedly a familiar process to many readers, which we review here for the sake of completeness, suppose that two 6L6 tubes in Class A1 Push-Pull are to be coupled to a speaker with a 16-ohm voice coil. Consulting the tube manufacturer's data, we find that the recommended load resistance for this type of operation is 5,000 ohms plate to plate and the maximum undistorted output is 14.5 watts. This is enough information to select a suitable transformer from catalogue listings. Although it is usually sufficient to know the primary and secondary impedances and the rated power, we can also calculate the turns ratio of such a transformer from the expression:

$$\text{Turns ratio (primary to secondary)} = \sqrt{\frac{Z_p}{Z_{vc}}} \quad \text{or}$$

$$\text{Turns ratio} \quad \sqrt{\frac{5000}{16}} = \sqrt{313} = 17.7$$

where Z_p = primary impedance

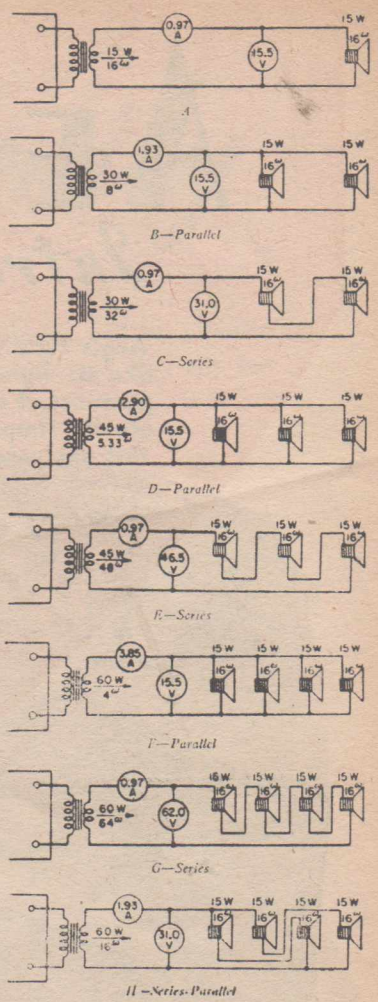
Z_{vc} = voice coil impedance

In other words the primary of the transformer has 17.7 times as many turns as the secondary (voice coil side). This does **not** tell us **how many turns** the windings should have, for this problem belongs to the transformer designer, who must provide the required turns ratio in a unit which will at the same time transmit the necessary power with adequate efficiency and not more than an allowable amount of frequency discrimination.

For low power applications, rather small transformers are commonly employed. A cross section of core (centre leg) ½" x ½" in a standard lamination is satisfactory for 3- to 4-watt applications, while a section of 1¼" x 1¼" is typical for 30- to 50-watt units.

If the output transformer does not reflect the correct impedance into the plate circuit, the maximum undistorted power output will be less than the tube manufacturer's rating. Differences of the order of plus or minus 10% are usually of no importance. Much greater differences should be avoided if possible. If the available choice of output transformers is limited, it is usually best to select one which will present a higher rather than a lower-than-rated impedance to the tubes. Thus where a 5,000-to-16 ohm transformer is needed, as in the previous example, it would probably be better to use a 6,000-to-16 ohm rather than a 4,000-to-16 ohm unit if a choice must be made between the latter two. In any event, the transformer must be of sufficient size to handle the total power required by the loud speakers.

In comercial amplifiers it is common practice to provide an output transformer with secondary terminals for a variety of load impedances, for example 2, 4, 8, 16 or 500 ohms. When a single load of any one of these impedances is connected to the corresponding amplifier output terminals, the amplifier will be properly terminated or loaded. However, if the total loud speaker load impedance is, let us say, 5.3 ohms, it would be preferable to use the 4-ohm output terminals since this will result in a reflected impedance in the plate circuit which is 32% greater than normal, whereas use of the 8-ohm tap would result in an impedance which is 34% low. A general rule for predetermining the probable best tap on an output transformer is: **use the tap within plus or minus 10% of the total speaker load im-**



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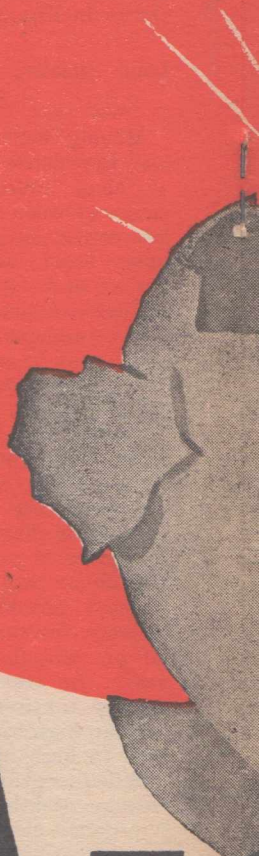

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pedance if such a tap is available; otherwise use the nearest tap which is less than the speaker impedance. A listening test will quickly indicate whether the selected tap will permit the required sound level to be obtained from the speaker or group distortion; if not, it is probable that a closer impedance match must be obtained by one of the methods treated later.

Multiple Speaker Connections

When more than one loud speaker is to be connected to an amplifier, there is a choice between series and parallel connections to be made. In permanent installations, the parallel connection is usually to be preferred since if one speaker becomes open circuited, it will affect only that speaker, whereas in the series arrangement an open circuit will put all speakers in the series group out of operation. As a matter of expediency, however, series, parallel or series-parallel arrangement of speakers may be convenient since the total load impedance can often be made such as to afford a close match to an available amplifier output impedance.

Fig. 3 shows possible connections for one to four speakers with 16-ohm voice coils. It is assumed that all speakers are identical as to power rating, and to permit calculation of the currents and voltages, the power per speaker will be assumed to be 15 watts. Regardless of the method of connection, one speaker will require 15 watts of power from the amplifier; two will require 30 watts; three 45 watts and four 60 watts. The combined impedance of the speakers, the total current into the load and voltage across it, all depend on the number of speakers and the method of connection. These are indicated on each diagram in Fig. 3. A single speaker will of course have a load impedance of 16 ohms, across which the voltage will be 15.5 volts when absorbing 15 watts. The current in this case is 0.97 amperes. Two speakers in parallel will yield a load impedance of 8 ohms, while two in series result in 32 ohms. Three speakers in series will give an impedance of 48 ohms, and if in parallel, 5.33 ohms. Four speakers can be connected in parallel (4 ohms); in series-parallel (16 ohms); or in series (64 ohms). If the amplifier output transformer has any of these impedances available, the amplifier can be properly loaded by utilising the corresponding speaker wiring arrangement, and no auxiliary transformers are required.

The combined impedance of a number of identical speakers in series is of course equal to the number of speakers multiplied by the impedance of the speaker, while the impedance of a group of identical speakers in parallel is the impedance of the speaker divided by the number of speakers. Voltages and currents can be easily calculated by Ohm's Law, or the chart in Fig. 4, which shows voltage, impedance and power relationships in the ranges commonly encountered in sound systems, may be used. It is especially useful to know the voltage corresponding to the desired electrical power in a particular load impedance, since this voltage can be measured with a rectifier type meter and will serve to indicate proper amplifier output level. In addition, there are many occasions when it is necessary to determine operating voltages in order properly to lay out the system. This is particularly true when dissimilar speakers are connected to the same channel.

Connecting Dissimilar Speakers

Suppose that a sound system requires four 16-ohm speakers at 10 watts each and four 4-ohm speakers rated at 5 watts each. Let us assume that each group of speakers is to be connected in parallel and that the entire speaker load is to be driven from a single amplifier output. The four 16-ohm speakers in parallel will have a combined impedance of 4 ohms and will require a total of 40 watts. Referring to the chart (Fig. 4) we find that 40 watts corresponds to a voltage of approximately 12.7 across a load of 4 ohms. Four 4-ohm 5-watt speakers will have an impedance of 1 ohm and will constitute a load of 20 watts. Again from the chart we determine that the load voltage for these speakers must be 4.5 volts. If the amplifier output voltage is established at 12.7 volts, the 4-ohm 40-watt load may be connected directly to the amplifier output line. The 1-ohm 20-watt load will require an auxiliary transformer connected across the 12.7 volt line and delivering 4.5 volts at its secondary as illustrated in Fig. 5. The ratio of primary turns to secondary turns in this transformer will be 12.7 to 4.5 or 2.82 to 1. Transformers are usually purchased on a basis of the impedances between which they work and in this case we know immediately that a 1-ohm secondary is needed. The required primary impedance may be obtained from the chart since, neglecting transformer losses which for this purpose introduce very little error, the power in the primary of the transformer may be assumed equal to the load power (20 watts) and the primary voltage is 12.7 volts. These values intersect on the chart at an impedance of 8 ohms, which is the required primary impedance. The combined impedance of the two speaker groups as seen from the amplifier output can now be calculated, for we have an 8-ohm load in parallel with a 4-ohm load, or a combined impedance of 2.66 ohms. This is an odd impedance value and in all probability such a tap will not be available. As explained previously, a 3-ohm output would be sufficiently close, as would a 2-ohm tap. If neither of these impedances are provided, but the amplifier does have a 500-ohm output, an auxiliary 500-ohm to 2-ohm, 500-ohm to 2.5-ohm, or 500-ohm to 3-ohm transformer may be inserted between the amplifier and the combined 2.66-ohm load to afford a satisfactory amplifier termination.

Another case in which dissimilar speakers are interconnected is that which occurs when a monitor speaker is to be used at the amplifier output. Usually the monitor speaker is of a different type from those providing the main acoustic output and the level is low. Suppose it is desired to connect a monitor speaker across a combined speaker load of 4 ohms which is absorbing 40 watts of power. The voltage across the speaker line is thus 12.7 volts (Fig. 4). Suppose the monitor speaker to have an 8-ohm voice coil and that satisfactory output level will require a power of about one watt. Ob-

viously an auxiliary transformer will be needed and our problem is to determine the specifications for this transformer. The secondary voltage from the transformer must be that which will deliver one watt to an 8-ohm load, or 2.83 volts. The primary of the transformer will be connected across the main speaker line where the voltage is 12.7 volts. Therefore we need a voltage ratio of 12.7 to 2.83 or 4.5 to 1. The primary impedance will be that corresponding to 1 watt and 12.7 volts (Fig. 4), or 162 ohms. However, we do not find such a transformer listed in the catalogues, although a 200-to-8-ohm transformer can be obtained instead of the 162-to-8-ohm unit for which we are looking. Let us see how much power such a transfor-

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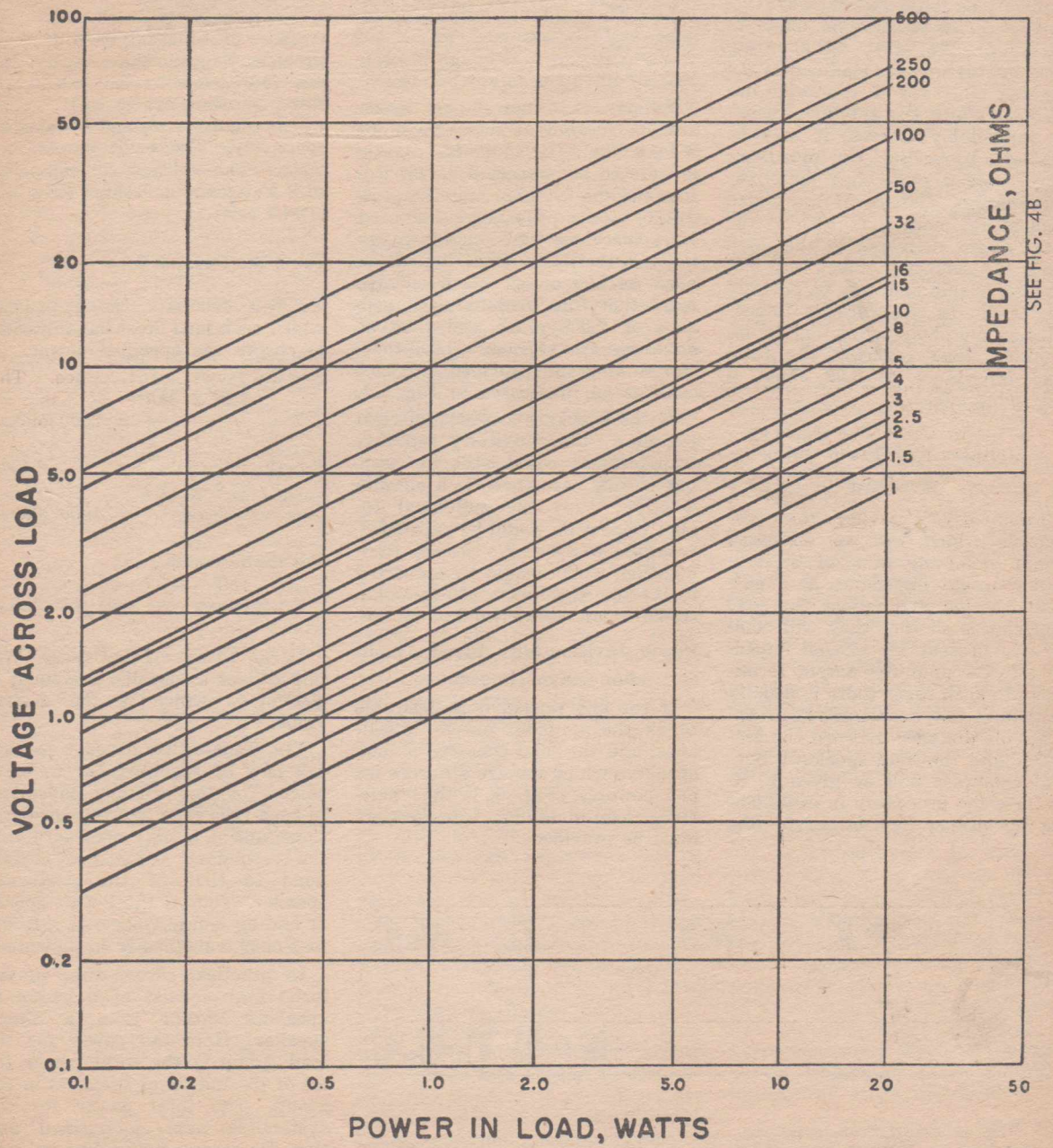


This is a handy graph for those who wish to put a meter across the voice coil of the speaker in order to measure the actual power being fed into the speaker. It covers all voice coil impedances from 1 ohm and line impedances up to 500 ohms.

mer will deliver to the monitor speaker. An impedance of 200 ohms and a voltage of 12.7 corresponds to 0.8 watt which is only slightly less than the 1-watt level sought and hence this transformer will probably be quite satisfactory. One further check should be made to determine the effect of shunting the monitor speaker load across the speaker line, for if the total impedance which the amplifier "sees" is appreciably altered, it may be desirable to readjust the impedance to provide a more ideal amplifier termination. Usually if the added load is not more than 10% of the total power delivered to the main load, the shunting effect will not be appreciable and may be entirely neglected. In this case an impedance of 200 ohms is shunted across 4 ohms, thus reducing the total load impedance to 3.92 ohms, a negligible effect.

Amplifiers with Fixed Output Impedance

Frequently it is desirable (for reasons which will be discussed later) to fix the value of the amplifier output impedance at a particular value and adjust the load impedances so that they will combine to present the chosen impedance to the amplifier output terminals. In such cases there is usually (although not necessarily) an appreciable distance between the amplifier and the loud speakers. Several examples will be given to illustrate the procedure in establishing the proper impedances for the loads. The amplifier output impedance will be assumed to be 500 ohms in all cases, although in practice other values might be chosen.

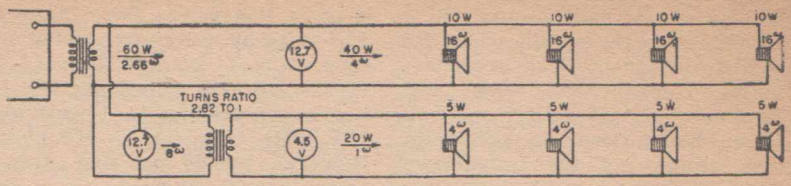


Fig. 5. Method of Connecting Speakers of Different Impedances and Power Ratings to the Same Amplifier

Suppose that four 16-ohm speakers are located at intervals along a long line. The individual speakers are to be connected across this line and the 500-ohm amplifier output is to be properly terminated. Here there are four loads in parallel and their combined impedance must be 500 ohms. Each speaker must therefore present an impedance of 2,000 ohms and thus an auxiliary transformer (2,000-to-16 ohms) must be provided for each speaker as illustrated in Fig. 6A.

If the speakers are located close together, the auxiliary speaker transformers could still be used, but in this case there is a simpler solution. Here the individual 16-ohm voice coils would be paralleled, resulting in a 4-ohm voice coil combination, which would be connected to the line through a 500-to-4-ohm transformer, as shown in Fig. 6B.

Power Division with Fixed Amplifier Output Impedance

If for any reason it is desirable to fix the amplifier output impedance, and the load consists of loud speakers which require different input powers, (Fig. 6C), then suitable load-dividing transformers must be provided.

An example will illustrate the method of handling this type of problem. Suppose the amplifier output impedance is 250 ohms and three speakers are to be connected which require 1, 2, and 5 watts respectively. The total power is 8 watts. The voltage corresponding to 8 watts and 250 ohms (Fig. 6C) is 44.7 volts.

From the formula $Z = \frac{E^2}{W}$

we can calculate the impedance which each load must have in order to absorb the specified power.

For the 1-watt load:

$$Z = \frac{44.7 \times 44.7}{1} = 2000 \text{ ohms.}$$

For the 2-watt load:

$$Z = \frac{44.7 \times 44.7}{2} = 1000 \text{ ohms.}$$

For the 5-watt load:

$$Z = \frac{44.7 \times 44.7}{5} = 400 \text{ ohms.}$$

It can be shown that these three impedances in parallel are equal to 250 ohms which is the desired value.

The transformer for each speaker can now be specified, for we have solved for the primary impedance in each case from power considerations, and it is only necessary that the secondary impedance correspond to that of the particular speaker. Thus if the 1-watt speaker had an 8-ohm voice coil, a 2,000-to-8-ohm transformer is indicated.

In practical cases, some of the loads may consist of a group of speakers rather than a single speaker. Here the power for the load group is the total power for all of the indvidual speakers in the group. The total power for the system is next determined and then the corresponding line voltage in the manner described previously. The group load impedance can now be calculated and this specifies the transformer primary impedance.

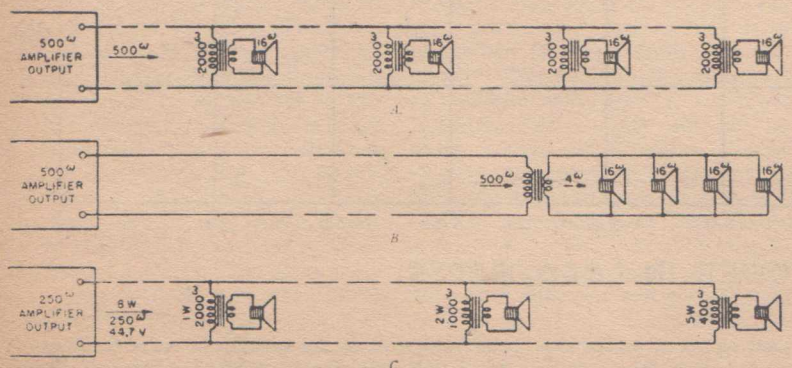


Fig. 6. Connecting Speakers of Various Impedances to an Amplifier of Fixed Output Impedance

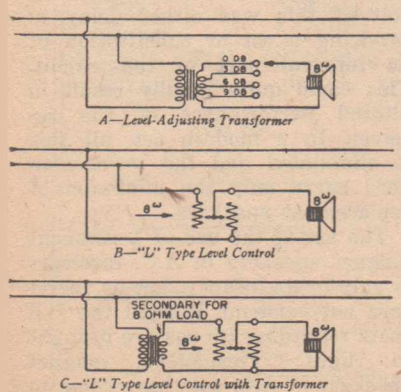
The secondary impedance will be equal to the combined impedance of the group of speakers, and depends on the manner of interconnection (parallel, series, or series-parallel). The same steps are followed if there are other group loads on the system.

It is emphasised that the power values with which we are concerned in all such problems are those actually required to give the necessary acoustic output from the speaker under final operating conditions. There is no relationship between these power values and the maximum input power ratings of the speakers except, of course, that the actual power input must never exceed the power rating of the speaker. For example, the 5-watt speaker in this problem might be one rated at 15 watts, but operated at 5 watts to produce the sound level needed for appropriate sound coverage.

Volume Control at the Speaker

It is often necessary to be able to adjust the level of sound produced by particular speakers in a sound system. This may be due to inability to predict the required fixed level for the speakers in question because of unknown noise conditions or other uncertain factors, or it may be necessary or desirable to control level to suit listener preference, over-ride variable noise levels, or permit temporary reduction of level when it would otherwise interfere with speech or other

We have previously discussed methods of providing proper input to speakers requiring different input powers when they are fed from a common-voltage line (See "Connecting Dissimilar Speakers") and in the same manner, by proper choice of a coupling transformer,



A—Level-Adjusting Transformer

B—"L" Type Level Control

C—"L" Type Level Control with Transformer

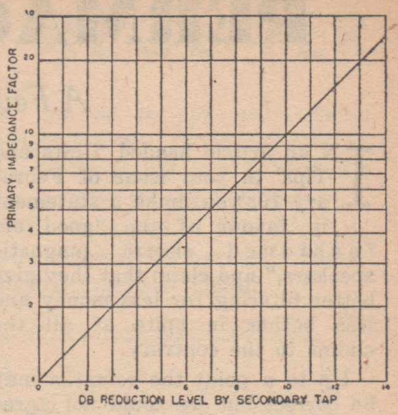
Fig. 7.

we can alter the power delivered to any speaker in the system. If the transformer is tapped, it is possible to adjust the level in corresponding steps. Such an arrangement is shown in Fig. 7A. The full secondary is assumed to provide full forms of communication.

We have previously discussed methods of providing proper input to speakers requiring different input powers when they are fed from a common-voltage line (See "Connecting Dissimilar Speakers") and in the same manner, by proper choice of a coupling transformer, we can alter the power delivered to any speaker in the system. If the transformer is tapped, it is possible to adjust the level in corresponding steps. Such an arrangement is shown in Fig. 7A. The full secondary is assumed to provide full power to the speaker, or 0 db loss. For 3 db lower level (an appreciable though not large reduction as judged by the ear) half the power would be delivered to the speaker and this would be accomplished by reducing the secondary voltage to

Tap	% of Full Voltage or Turns	Primary Impedance (% of Normal)
0 db	100%	100%
3 db	70.7	200
6 db	50	400
9 db	35.3	800

70.7% of the maximum by using 70.7% of the total turns. However, the impedance ratio is automatically changed at the same time and the primary impedance becomes twice normal. The primary impedance is still higher for greater attenuation values as shown in the table, Fig. 7A. If, as is usual, the level is to be reduced on only a few speakers of the group, the total impedance will be only slightly higher than the normal value for conventional operation. For example, it can be shown that if one-quarter of the speakers in a parallel group are adjusted for 3-db level reduction, the total load impedance at the amplifier will be approximately 15% higher than normal. In most cases this would not necessitate readjustment of amplifier loading if a fairly close approximation of the correct value based on normal speaker impedance had been provided prior to level adjustments. In any case, of course, it is a simple matter to measure or calculate the final impedance of



the speaker group, after which a readjustment of amplifier loading can be made if necessary. The chart in Fig. 8 shows the factor by which the primary impedance is changed by connecting the speaker to a secondary tap giving the indicated level reduction. For example, if the primary impedance is 2,000 ohms when the full secondary is used, it will be increased to 3.2 times 2,000 ohms (6,400 ohms) if a 5-db tap is employed.

The use of level-adjusting transformers on individual speakers or groups of speakers is best confined to systems in which the speakers or groups are operated in parallel across a common-voltage line. In such a system there is far less disturbance of the total load impedance and much less reaction on the level from other speakers, in the process of level adjustments, than would be the case for a series system. For these reasons the method is most logically applied in circuits where transformers are inherently needed.

A particular advantage of the use of transformers in level adjustments is that they do not require more power from the system than is actually needed to produce the necessary acoustic output. A disadvantage is that the method is not flexible and is confined largely to applications where adjustments are initially determined and set permanently or where only occasional readjustments in a limited number of steps are needed.

A large variety of resistive networks, either fixed, or variable for continuous control of volume, have

(Continued on next page)

PERMAGS HERE TO STAY!

A Few Words From the Rola Company

IN an article headed 'Hints and Tips' in your issue of February 15, you make a statement in favour of the "good old fashioned electro magnetic speakers," and claim that they give better filtering for less money and less bother in spite of all the claims to the contrary.

Up to a point the remarks may be correct but we could not agree that the old fashioned electro dynamic speakers provide better filtering for **less money and bother.**

A few years ago, this statement undoubtedly would have been correct. Electros then were selling at a lower price than permanent magnetic speakers and logically were used in A.C. sets. Nowadays, permanent speakers are considerably lower in price than the electros and it is cheaper to provide smoothing by chokes than to use electro dynamic speakers.

The two chokes readily available are 6/60 (6 henries at 60 ma) and 14/60 (14 henries at 60 ma), both low in price and suitable for modern circuit conditions. These were designed to replace a K5 1500 ohm field and F8 or F5B 1500 ohm field respectively.

If a greater amount of filtering is required, two 6/60 chokes with an extra electrolytic condenser will provide all that is required; or alternatively, a single larger choke.

The science of filtering is moving rapidly and the modern radio engineer does not take a choke of relatively low inductance, put it in a circuit in the orthodox way and expect his set to be free of hum. He employs modern design methods to his entire circuit and as a result produces a set far cheaper and more readily serviced than the good old fashioned types of which your correspondent speaks.

When your article speaks of bother, what do you mean? Bother to the serviceman who has to replace the electro dynamic type with permanent magnet type, or extra troubles or faults developing?

It is a simple matter to replace the field of an electro dynamic speaker with a choke providing the smoothing of the choke is of the same order as the field replaced. To instal a choke of two-thirds the smoothing ability of the field is to ask for trouble and bother.

Filtering is only one aspect of the whole question of the use of permanent magnet speakers in A.C. receivers. Here are some of the advantages:

1. The absence of distortion in receivers using permanent magnet speakers due to hum neutralisation. Hum is only neutralised when the cone and voice coil are at rest. Any displacement either way upsets this balance and hum results, this hum being amplitude modulated by the force moving the voice coil to and fro.

2. Lower heat dissipation in the receiver. This is of very great importance in small receivers.

3. Greater power handling capacity because the voice coil is operating in a lower ambient temperature.

4. More efficient chokes (efficiency implying better filtering for lower expenditure), can be constructed of laminated cores with optimum airgaps. The same value and inductance as given by the field coil can be obtained from properly designed chokes having much lower D.C. losses.

5. The voltage drop across a properly designed choke is considerably less than across the field coil resulting in general economy of receiver design, better regulation and lower voltage electrolytic condensers.

6. Simplicity of inventory of factories and servicemen. When electro dynamic speakers were used, a multitude of field coils was in use with the result that no serviceman could carry an adequate replacement stock. The result of this was either delay in servicing a set or substitution of an integral part of the circuit. This could quite readily result in altered performance of the receiver. In a modern set, all this is eliminated and the serviceman need carry only the minimum of replacement speakers.

The art of the use of permanent magnet speakers in A.C. receivers is only in its infancy. Let us therefore not condemn it until the full facts regarding its use are brought to light. Permanent magnet speakers in A.C. sets have come to stay.

IMPEDANCE (Continued)

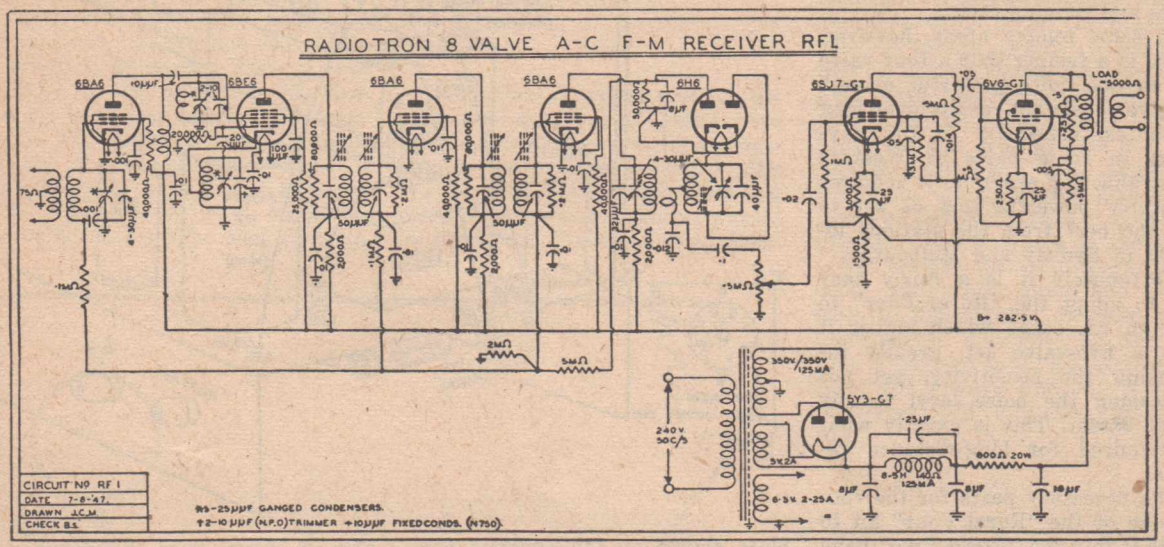
been employed as level controls. The principal requirements for such a network are that it presents approximately the same impedance at its **input** terminals as the speaker itself (when the speaker is connected to the network), and that it be able to handle the requisite power. The most simple network is the "L" type and it is usually made continuously variable to afford stepless control as illustrated in Fig. 7B. Since it is usually important to keep the impedance constant, looking into the control, the "L" type serves the purpose adequately. "L" level controls are available in a number of standard impedances such as 6, 8 and 16 ohms to correspond to common speaker voice coil impedances. They may be used in any speaker circuit (series or parallel) so long as they are associated with the proper voice coil impedance. The combination of "L" network and voice coil is treated as a single impedance (of voice coil value) in circuit calculations. The controls have their resistive elements tapered so as to maintain the input impedance relatively constant regardless of setting.

All resistive networks operate by wasting power. The power delivered to a speaker and "L" volume control is constant; as the control is varied from the zero loss (full volume) position, more power is absorbed by the control and less by the speaker until in the maximum loss (zero volume) position all of the power is dissipated in the control and none is delivered to the voice coil. It is necessary to allow the assigned maximum power to each "L" control-speaker combination regardless of the final acoustic output.

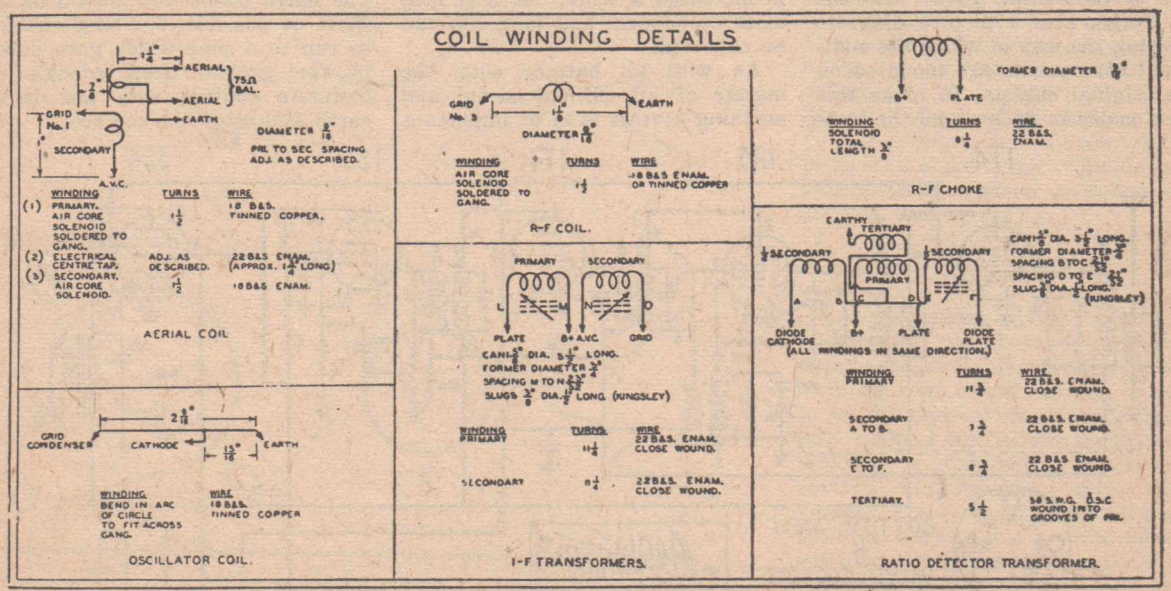
CIRCUIT FOR AN F.M. RECEIVER

EXPERIMENTAL F.M. transmissions in Sydney and Melbourne have brought a demand for a circuit of a receiver suitable for this type of signal. Our policy at the moment is to discourage readers from spending too much time or money on building an F.M. set until the future of the F.M. transmissions is clearer. However, purely as an item of interest we re-print this circuit from "Radiotronics" which shows one type of possible circuit for F.M. together with coil data for the 88 to 108 mC/s band. Ordinary types of valves such as the 6U7G would not be suitable for use with this high frequency.

The audio end of this circuit is quite interesting, having a rather unusual feedback circuit.



Circuit Diagram of F-M Receiver for the signal frequency range 88-108 Mc/s. The intermediate frequency is 10.7 Mc/s and the oscillator tuning range is 98.7—118.7 Mc/s. An additional 0.5 Mc/s is allowed at each end of the band; making the maximum coverage 87.5—108.5 Mc/s for the signal circuits and 98.2—119.2 Mc/s for the oscillator tuning range.



Circuit and coil winding data for an F.M. Receiver.

GREATER RANGE FOR RURAL 4

How to Add an R.F. Amplifier

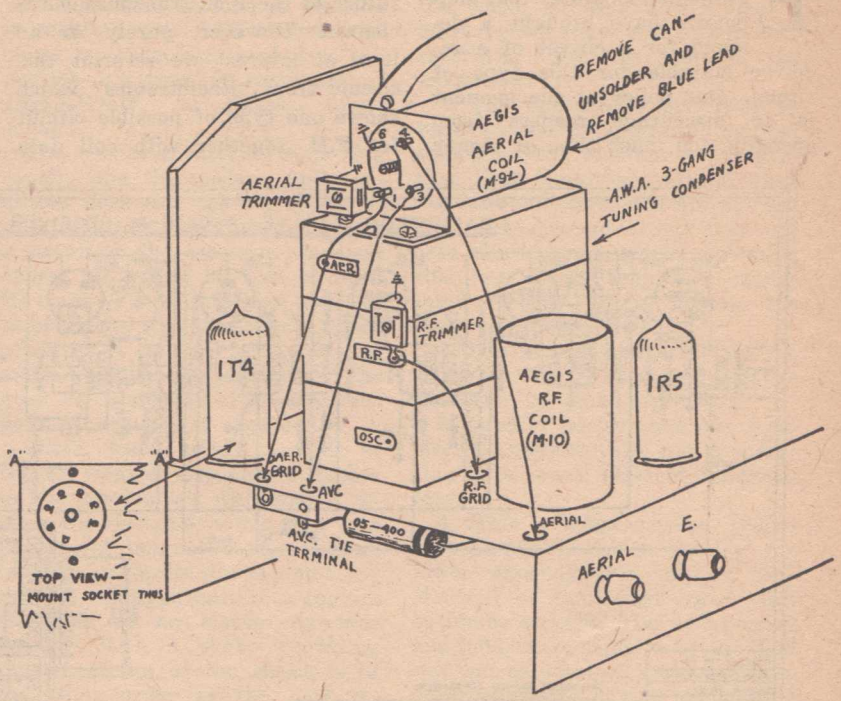
The "Rural Four" kitset, which was detailed in the issue of last October, has proved a fine little set, and excellent reports about its performance have been received from all parts of the country. As battery-operated sets go, it presents splendid value for the initial price and running cost.

In some remote areas, however, there is a feeling that a four-valve set is not quite powerful enough to give consistent results over long distances, especially in the daytime. In some parts of Western Australia, for example, it requires a pretty powerful sort of set to get the best from the stations located in Sydney and Melbourne.

Fortunately it is a fairly easy job to adapt the "Rural Four" to add an r.f. stage which makes it into a five-valve set, greatly increasing the sensitivity, yet not increasing the noise level to any great extent. This is exactly what is required for long-distance results.

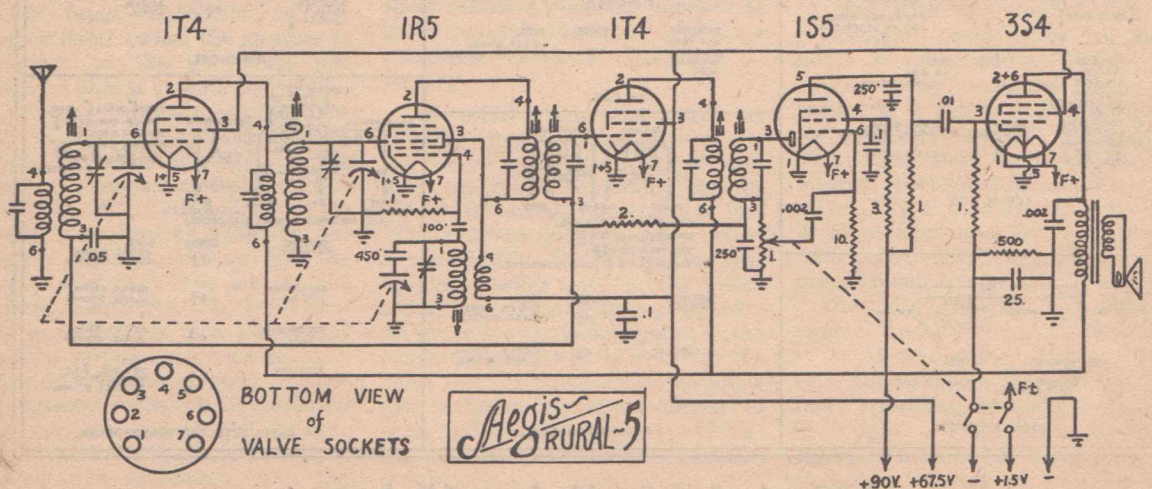
The necessary parts for the conversion of the "Rural Four" kit to make it into the "Rural Five" have been made available as an auxiliary kit by the Aegis Manufacturing Company and are now available from all Aegis distributors.

On this page we show the circuit of the "Rural Five" with the r.f. stage, also a picture diagram showing the way in which the additional components are mounted on the original chassis. To make this even easier to understand the template shown on the opposite page has been prepared to show you exactly where to drill the additional holes required.



With the extra valve in operation the battery drain of the set is increased a trifle, but it is still most economical and long life can be expected.

As with all battery sets, the matter of an efficient aerial and earthing system is most important and it pays good dividends to watch these two points carefully. For preference the aerial should not be too long, but well up off the ground, clear of buildings and running directly in one direction. The earth connection should be as short as possible, but long enough to run to a pipe which goes down in the ground deep enough to maintain contact with the damp earth well below the surface.



AMONG OUR READERS

News From Subscribers

"In the two years that I have been reading your friendly magazine I have found it always to contain at least three articles interesting to me. I am a very keen listener to the Ham bands, hoping to become one myself some day. After building a Teleconda Three I was amazed at its reception of Melbourne stations; equal to a four-valve set. I would love to see an article on the construction of a wire recorder as a friend tells me that the wire is now becoming available. Let's hope that radio in Australia is carefully handled and that it suffers no setbacks or flops. Thanking you for a fine publication.—Marcus Herman, 6 Nicholson Street, South Yarra, Vic.

* * *

"I am now nineteen, and for the past two and a half years have been employed as a radio serviceman in the business owned by Mr. W. Bennett of Lilydale. Having completed correspondence courses in Electrical Trades Maths., Electrical Science, with the Melbourne Tech., I am now doing Radio Receiving and will shortly do Radio Servicing. As theory alone is insufficient I began taking Radio World to catch up on the practical side of things. Radio World has proved beyond doubt that you can give even coverage of all the phases of the radio game. I have found articles dealing with hi-fi receivers, amplifiers and amplifier technique, signal tracers and other types of test equipment of greatest interest. Radio World is the best of its kind in Australia because it deals with radio alone and deals with it thoroughly. If past performance is indicative of the future, I say 'go to it, Radio World.' You will always find me a firm supporter."—B. J. Garth, Wandin, Vic.

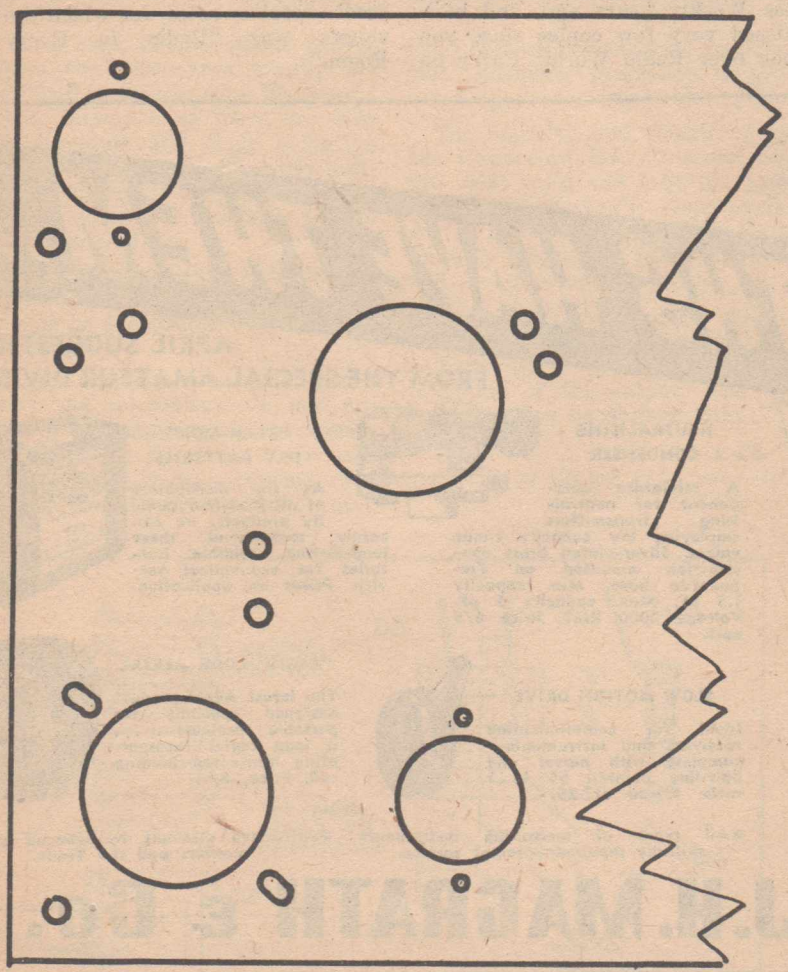
* * *

"In my opinion your February issue was splendid. Now I have a small grudge to work off. I have the greatest admiration for Paul Stevens—but in the August, 1945, issue he stressed the use of indirectly-heated rectifiers. If, therefore, Mr. Stevens showed a 5V4 instead of a 5Y3 in his circuits he would be practising what he preaches."—A. D. Hunt, 122 Hope Street, West Brunswick, Vic. (Paper is short, but will always be pleased to make space available for letters from readers, criticism of articles, etc.—A.G.H.)

* * *

"As I am more or less an invalid of the 1937 paralysis epidemic, I appreciate Radio World more than most of your other readers. I am in bed till mid-day, so my copy gets well read. I am in the middle of building a four-valve miniature portable at present. I think the kit-sets are a good idea, having built up the Rural 4 a while back, but generally I prefer to make my own chassis and cabinet. My in-

(Continued on next page)



Template for the "Rural 5."

Place template on top of chassis, match up holes already drilled and punched, then drill or punch remaining holes.

OUR READERS

(Continued)

tention is to use two 45-ohm dynamic headphone units together as the speaker for the portable, making them easily detachable so that they can also be used with a head-band. Thanking you for your interesting magazine." — Howard Linsdell, Bungaree, Vic.

* * *

"I became interested in radio as a schoolboy, starting with a crystal set in the old Wireless Weekly days, and have been building and re-building sets ever since. The usual method has been to read technical literature, adding bits from published circuits until the chassis has overflowed, then to design the super set from accumulated data and start a new chassis." —W. Poggendorff, 85 Beaconsfield Road, Chatswood, N.S.W.

* * *

"My interest in radio goes back to 1924, when I built a crystal receiver to listen to 'hams' operating on the 1,000-metre band. In 1926 I built my first valve receiver. About 1930 the short waves attracted me, and ever since all my interest has been on the high frequencies.

"One of the best little short-wave receivers I ever built was Don Knock's 'Wide-World Two,' described early in 1932. Using this set on the ham bands the DX just rolled in. I heard thousands of 'hams' on c.w. and phone. Among my 3,000 QSL's I have verifications from 130 countries. After being a short-wave listener for so many years I now have the urge to talk back, and I am going all out to get my ticket this year."—George W. Mawman, 149 Bay Road, Sandringham, Vic.

* * *

"I followed your articles in Wireless Weekly years ago, and have missed very few copies since you took over Radio World. Carry on with the good work. Here it is all D.C. power supply, so would welcome anything in the D.C. line which you could publish. Would like to know more about the new 100 ma. range of D.C. valves, as to their performance, etc. Have just finished a D.C. version of a Ferrotune set. It sounds good. Will let you have the hook-up later, as others may be interested."—H. G. L. Andre, Esperance, West Aust. (Will be pleased to publish anything on D.C. sets which readers are able to supply, especially on the subject of the new valves. Will look forward to receiving the circuit promised.—A.G.H.)

* * *

U.S. Radio Week.—America's third annual National Radio Week brought to a close the year's campaign organised by the U.S. Radio Manufacturers' Association to increase receiver sales, for which the slogan was "Radio in Every Room."

COSMOCORD SOUND CELLS

How to Make up a Microphone With Them

The Sound Cell was originally developed to meet laboratory requirements for a microphone having a straight line response. It is now extensively used for normal commercial applications which call for high fidelity reproduction. In the latter cases, however, it is usual to mount two or more Sound Cells in a bank, connected in parallel or series or combination of both to suit line conditions. Parallel connections increases the capacity of the Microphone, but not the voltage output. Series connection increases voltage output but reduces the capacity of the Microphone.

This type of microphone is free from the resonances usually associated with the cone diaphragm type, inasmuch as there are only the crystals and their mounting to consider. It is particularly suitable for public address purposes where acoustical feedback has to be considered.

One or more Sound Cells in any suitable combination maybe enclosed in a convenient microphone housing.

Care should be taken to ensure that the microphone is not exposed to temperatures in excess of 50/60° C. as, under these conditions, the crystal element will change its characteristics, or may even become permanently inoperative. Adequate protection is provided against moisture absorption.

TABLE I

Entry No.	No. of Sound Cells	How Connected	Capacity mFd	Sensitivity db
1	2	In series	.0012	—62
2	4	2 in series parallel to the other 2 in series	.0024	—62
3	6	3 in series paralleled to the other 3 in series	.0016	—58.5
4	6	2 in series paralleled to both other pairs in series	.0036	—62
5	12	4 in series, 4 in series, 4 in series, 3 groups in parallel	.0018	—56
6	12	3 in series, 3 in series, 3 in series, 3 in series, 4 groups in parallel	.0032	—58.5

The capacity and sensitivity of the Cosmocord MIC-12 sound cell are .0024 mFd and —68 db. (odb = 1 volt/dyne/cm²) respectively. As it is customary to use these units in groups the following data will be of some assistance.

The cable connecting the microphone to the amplifier should have a low capacity to avoid severe attenuation of the output. The attenuation can be derived from:

$$\text{db loss} = 20 \log \left(1 + \frac{1 \times CL}{Cm}\right)$$

where 1 = length of cable in ft.
CL = capacity of cable in mFd per foot.
CM = capacity of microphone in mFd.

e.g., with 12 units connected as in Table 1, entry five and 100 ft. of co-axial cable have a capacity of 5mm Fd./foot:

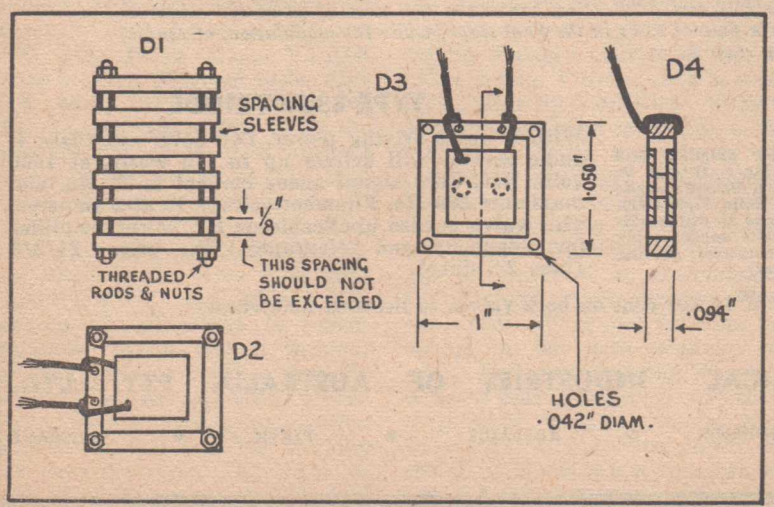
$$\text{db loss} = 20 \text{ lg } \left(1 + \frac{.0005}{.0018}\right)$$

$$= 2.15$$

or with ordinary twin screened cable of the same length and having a capacity of 40mm Fd/ft.:

$$\text{db loss} = 20 \log \left(1 + \frac{.004}{.0018}\right)$$

$$= 10.18$$



The outer frame of the Sound Cell which is impregnated fabric board is pierced at each corner with a hole .042" diameter, and whilst these are covered by a thin tissue paper and wax, it is quite easy to locate them.

The complete assembly D .1 should now be fixed in the microphone housing in a resilient mounting, i.e. suspended in rubber or on springs, and the Sound Cells should be in a horizontal plane.

With regard to the design of housing; whilst this may be the orthodox type of case with a grill at one end it is recommended that

(Continued on page 42)

HIGH-FIDELITY

(Continued)

Figure one shows the amplitude of swing for crystal and magnetic units. Figure two showing the vast difference between these two classes of pick-ups. The magnetic is a velocity operated unit, whereas the crystal is an amplitude operated unit; both units reversing in the characteristics below the cut-off frequency, generally 250 C/s.

Because of this difference it is necessary to treat each unit in a different manner if the same results are to be achieved. Figure two shows that a perfect magnetic unit, will have a flat response above 250 C/s, whereas the crystal unit has a falling response above 250 C/s. This does not mean that the crystal unit cannot reproduce high frequencies, but it does show that a crystal unit requires compensation for a flat response, such as that shown in figure three.

The present day magnetic unit requires compensation and quite often a pre-amplifier, due to its low voltage out-put. The crystal unit requiring high frequency compensation. Because of this, modern units have high voltage out-put from the cartridge, in order to allow compensation, without requiring a special pre-amplifier.

The pre-amplifier for moving coil magnetic units is a special unit to suit each make and therefore a circuit is not included. Another point of interest is that these units should not be used with magnetic turntables, due to its influence on the magnetic path of the needle.

Over the last twelve months tremendous publicity has been given to the new moving coil type pick-ups, with a result of a modern unit that will offer the high fidelity enthusiast comparable results with the moving coil types.

The modern crystal unit has overcome the disadvantages found in older units, namely, fragility, temperature affects, and frequency response, voltage out-put characteristics.

One modern unit, is unbreakable, and can be compensated to produce an output linear from 40 C/s to 8.5 kC/s, yet still not requiring a pre-amplifier. The distortion from this unit being less than 1%. The response curve being shown in figure three.

Present day crystal pick-ups produce some one or two volts, across their out-put, and if prior practice is followed then poor results will be achieved. This voltage is that produced at 1 kC/s, and as the unit is generally plus 10 db at 50 C/s, it means some 3.2 volts RMS are present. Thus, if this is fed direct into the first valve, distortion will result. This being due to the valve being overloaded and causing distortion, particularly on peaks. This distortion is poor, and yet is rarely recognised. Transient distortion is a cause of poor reproduction and yet this fact is rarely recognised, due to its pulsed appearance, which will not show up on normal measurements.

Thus modern practice is to equalise the pick-up, so that its response is flat, and yet has sufficient out-put to drive an amplifier, this

(Continued on page 42)

CALLING CQ!

By Don Knock, VK2NO

Average Australian amateur is impervious to jargon and "radioese," for the reason that he uses lots of it himself. Nevertheless it comes as a bit of a shock to hear a G station sign off verbally with "Diddle de Bump de Bump"! Wooden it?

* * *

Characteristic styles of "fist" remain in the memory for years with dyed-in-the-wool CW men. Two old hands still batting over the DX on 14 mC/s CW; they have been doing ever since there has been such a band . . . can be recognised by their distinctive style long before they sign. Harold Ackling VP2PX is one, and the other is Charles Luckman VK2JT. Recently however, Charles has broken out on phone and can be heard having DX fun thereby.

There are certain G stations that establish continuous skeds on 14 mC/s phone with VK's and ZL's (and vice versa) who really miss out on lots of communication fun. Skeds of the "Century Marathon" variety, whilst no doubt affording some satisfaction to the participants, can be rather irritating to others. One gets so accustomed to hearing certain prominent G stations ALWAYS in QSO with the SAME VK or ZL that one is inclined to adopt the idea . . . "what's the use of calling **HIM**, HE's always tied up"!

* * *

Congratulations to an old friend that many pre-war CW VK's will recall. "Beau" of G6HB recently got 'spliced' to keep him on one spot after a somewhat adventurous life. This writer first met him in Sydney as R/O on a Blue Funnel Liner during which he got around with a few of the VK2 56 mC/s group. Next time he showed up as R/O on the Acquitania, here in 1940 to take Six Divvy blokes away to the M.E. Prior to seafaring "Beau" had held a commission in the Indian Army and it wasn't surprising that he should next be heard from as a skipper in Royal Signals in the Italian war theatre. He is still in khaki, now as a regular Sigs. Officer and shows up occasionally on 14 mC/s CW . . . never uses phone. At one time he was one of the first mobile marine Hams afloat, but to quote the callsign would be spilling beans.

* * *

Unheralded and unsung, a pioneer British amateur is at present visiting Australia for a health trip, which is the reason no doubt why he hasn't met more than a handful of VK's. He is Leslie McMichael, Head of a well-known radio manufacturing concern bearing his name. He was known to all who grew up with amateur radio in the Old Country as "2FG" . . . it was in 1905 when he put his first station on the air. Leslie McMichael was a founder also of the original London Wireless Society from which the present RSGB was born. No longer an active Ham himself, he nevertheless takes a very keen interest in all that goes on in the hobby. One of his business executives is Bert Allen, well-known to 14 mC/s VK phone men as G8IG, of Bromley, Kent.

* * *

NSW Division's answer to the 7 mC/s "dog-pile" after the Sunday morn W.I.A. broadcast on that band has been a logical one. It

(Continued on next page).

WESTRALIANS HEAR EASTERNERS ON "SIX"

The barrier of 50 mC/s silence between VK2's, 3's, 4's, and the other side of the Continent was partially lifted on the evening of March 2, 1948. Between 1900 and 2000 hrs. Perth time, VK6HM heard stations reported to be VK's 3KX, 4FQ, 2SP, 2KN, 2MD, and 2LD. In the case of the VK2's the calls do not check with stations known to be active at the time stated. Sydney stations on the 50 mC/s band at that period were, VK's 2XG, 2JU, 2WJ, 2VC, 2EM, and 2NO. In the Blue Mountains region VK2LY was active. Misreading of call-letters is understandable where distant stations are engaged in working casually locally, plus the possibility of distortion during fades, a feature that is most marked in VHF working over long distances. VK's 6SA and 6GB tried to raise the Eastern stations heard on CW, but did not succeed in attracting attention. News of the reception in Perth came when VK2JU overheard VK6HM on 14 mC/s phone excitedly calling Eastern Australia for 50 mC/s action. Further details were given later by VK6DD to VK2NO and arrangements made for a big attempt to break through for the following evening. Consequently the band in Sydney, Brisbane, Melbourne and other Eastern areas was a mass of activity on the evening of March 3 up to midnight E.A.T. Beams were directed West and much calling and listening indulged in, but with negative results. It is encouraging however to know that under some conditions it may be possible yet to work those VK6's and thus notch up the 50 mC/s W.A.S.'s that are all still a hopeful dream.

is to ignore stations "Veefo'd" on to the W.I.A. frequency, and to make use of the QLM, QLH method. Thus people who would like to bring up some matter for discussion get a chance as well as those who like to bask in their own sunshine. It can't be emphasised enough that amateur radio is a hobby for the little man as well as the self-preening bird that flaps his noisy wings. It is time too, that a campaign be considered to direct world-wide attention to QMH etc. The habit of listening for replies only on one's own frequency for DX replies is more or less derived from laziness. Too much trouble to shift the dial, especially if there is plenty of bandspread to the RX. Multi-station operation on the one frequency is all very well for a "round table" over relatively local distances, but when a mass of QRM piles up on the frequency of a choice DX Caller, the sound thing to do is to ignore that scramble and to look elsewhere.

* * *

In Eastern Australia the 14 mC/s band is showing signs of its usual DX form, after a long period of the doldrums. Americans are again workable in the evenings with good solid S9 level and the G's and Europeans are putting in consistent appearance in the late evenings. Short skip is a bit of a problem at times and inter-state and VK/ZL interference with each other's DX is acute. One hears a VK4 growling that a VK2 has blotted out his DX catch, or a VK2 remarking scathingly that ZL2 so-and-so seems to want the band as his special prerogative. Too bad brothers, but the best outlook is to bear in mind the fact that all this 'nattering' or 'chunnering' or whatever you like to call it is supposed to be a hobby, enjoyed by a fraternity. Too often it savours of a bellicose atmosphere set up by individuals who smugly consider that they have the loudest say.

* * *

That goes too for 7 mC/s, the band where so many newcomers cut their radio eye-teeth. Because one or two appear to blow trumpets over-much is no reason why the new hand should take the slightest notice. Nobody has any right to any frequency channel or particular mode of operation in the band; and remember that there is but one official authority; who in NSW, is to be found on the 3rd floor of the GPO. Plenty of DX is to be heard at times on "40", but it isn't so easily workable as on "20." The B/C station QRM problem is terrific in Europe, so that if one hears a G, don't conclude after calling him fruitlessly, that your antenna is on the 'deck.' Your signal probably does not have a ghost of a chance through that iron curtain. A station heard at intervals is VK1AA, which is the callsign allocated to the Polar vessel "Wyatt Earp." He has been using phone around 7000 kC/s and has worked with several VK2's and ?'s. A station using portable phone both in NSW and Victoria has been VK3JR; heard at intervals from various locations. At nightime Americans are workable on CW with comparative ease, signals being strong enough both ways for VK's to talk back to the W's on phone, which process of course, doesn't improve the QRM situation for the CW boys. 7 mC/s is the most useful domestic band available for City/country and interstate working, and despite congestion, there are periods when this band is relatively free from overcrowding in comparison to "20."

* * *

There isn't much to say about 3.5 mC/s except that this band has suffered from the machine-gun static that prevails at this time of the year. Nevertheless there are evenings when comparative quiet reigns and a few VK's are to be heard working among themselves or with ZL's. Staunch users of "80" are VK's, 2HC, 2CM, 2VN, and others; and an old hand, silent for many years, but now back on the air is Crief Retallick, VK2XO of Bellingen, NSW.

* * *

28 mC/s remains the amazing dilatory band it is known to be, productive of terrific phone signals

EXPERIMENTAL RADIO SOCIETY OF N.S.W.

President Reg Anthony, VK2TR, found it necessary to relinquish office owing to business pressure; a decided loss to ERS. Popular member Ron Blades VK2VP, was elected to the vacancy and ARW congratulates members on their choice. Terry Hammond, ZL1OE, arrived on the yacht "Drifter" and held interest at the recent meeting by his account of the terrific cyclone that battered the vessels taking part in the Trans-Tasman crossing. At a forthcoming meeting an auction sale of members' surplus gear is planned. The pre-war Chanex Cup Contest is to be revived. A Field Day was held, with successful attendance on March 14. DX interest among members centres mainly around G contacts on 14 mC/s and G81G promises to forward photographs of his well-known station. Hon: Secretary of ERS is W. Hayes, 34 Nicholson St., Chatswood, NSW. Intending members are welcomed.

from Americans, Japanese territories, Africans, and Europeans. From early morn until late at night, this band is probably the Number one DX stamping ground. The way "10" and "20" behave just now, would augur well for "15", IF we had the band. But that time will come, and at least it should result in slight relief in the ants nest now seething on "20."

* * *

In pre-war days RAAF Wireless Reserve exercises were conducted at frequencies outside the regular amateur allocations because of congestion inside. It was in those times, a mild crowding compared to the seething jostling that prevails today. One wonders if RAAF-WR is to be reconstituted, and if so, whether frequency packed conditions would provide similarly for channels external to 7 and 3.5 mC/s as before? Or does RAAF intend to follow the latest Army edict, and abolish morse code training, excepting for certain Signals sections? Such a decision is proof enough of life in a changing world.

* * *

In the Sydney area activity on 6 metres is at a very low ebb, perhaps no doubt because the DX period seems to have moved on. Sporadic E conditions do abound at intervals and indications are that many Interstate contacts would be the order of things if stations were active; but instead there is silence. Taking all things into consideration, the distances involved between Capital cities, and the sparseness of amateur population compared to U.S.A. and Britain, VK's haven't done at all badly. But the long expected overseas DX has not materialised and doesn't seem likely to do so at this stage. Another factor militating against 6 metre activity is the renewed interest in 166 mC/s. VK2BZ of Newcastle is heard by one or two stations in the Sydney area at S8 on that band; and his signal is also reaching the Blue Mountains where VK's 2LZ, 2AFO and 2LY are consistently on the job. A new station on 6 metres from Turramurra is George Gray, VK2XG; well-known as a constant G- hunter on 20 metre phone. His transmission on 6 is just as powerful as on the other band. Another station, on the southern side of Sydney, is Vince Cahill, VK2VC.

* * *

From Canberra ACT, VK2GU writes:— "My present receiver for 6 metres seems to have plenty of sensitivity and gain, because at his peaks VK2JU lays the signal meter needle on the pin. VK4's, 5's, 7's and New Zealanders are much louder under skip conditions, but all the other Sydney stations—and by this time I have heard a number of additional carriers undoubtedly from Sydney—are all very weak. The grounded-grid set-up will be used in the hope of improving the signal/noise ratio and thus bringing up modulation which is now unreadable by the freer use of I.F. amplifier gain which is at present completely unused in the second channel of the receiver. That seems to be the only approach to the reception of the average Sydney station on 6 metres."

THE JOLLY ROGER AND SOUR GRAPES

Seamy Side of a Fine Hobby

The Roger referred to isn't the brand so much overdone by continually 'rogering' and 'wilcoing' people who didn't even know what they signified in the Big Upheaval; but to the Black Flag, under which some 7 mC/s undesirables have been sailing lately. Depredations of individuals dubbed "Horace" have, alone, been enough to put a caustic edge on things, but now comes along a brand of transmission piracy that beats the band at all times. It is that of "borrowing" a relatively inactive licencee's callsign. In pre-war 7 mC/s days and nights, there appeared from time to time, pirates of the not-so-aggressive kind, fellows who 'manufactured' or allocated to themselves calls that hadn't reached so far as that down the PMG list. They usually went as suddenly as they came, and in one case at least, the miscreant was apprehended. Today, he is of more mature years, and works lots of DX under the same callsign; legit: of course. He earned it too . . . was an air-crew Sgt. in the RAAF. But piracy in radio transmission is something that cannot be condoned, even in a mild form. It is much less tolerable when established callsigns are "pinched," and at the most doesn't make for ultimate good-will in amateur ranks. On 7 mC/s, this kind of thing has been rife in NSW, and probably in other States. Two victims of such practice have been VK2JQ and VK2GS. The former is one of the old hands in Australian amateur radio; Rev. "Monty" Nell, one of the most liked of VK2's. He learned of the occurrence by receipt of a "bluey" from the Advisory Committee. As he was conducting Divine Service at the times the callsign VK2JQ was heard istensibly contravening some regulation or other; "Monty" couldn't have been responsible; he was otherwise occupied. Added to which, the "bluey" said something about poor form of morse operation, which is adding insult to injury for VK2JQ. His "fist" is up in the front ranks. Phil Edwards, VK2GS, didn't, as yet, receive any Departmental notification; it was another amateur who informed him that his callsign was being used. Phil is one of our really copperplate operators . . . and an ex RAAF Navigator who loves punching a key as functioned normally by tape machines . . . his sending (and copy) at speeds high or low is outstanding. But some 'bird' who might as well incur the wrath of the Olympan Gods had the temerity to use 'VK2GS,' and withall, in very indifferent operating manner. Method of using callsigns thus seems to be as follows: . . . note is taken by the outlaw who is completely or relatively inactive on the band, and then he hops in on the callsign. It doesn't always come off, so many callsigns are well-known, and CW "fist" style is fully familiar to colleagues. Pirates and "Horaces" of any breed court the trouble they richly deserve; and the adage of enough rope for a hanging still holds good.

The one about the fox and the grapes or the barking canine in the horse's feed-box is also in evidence. For these one must turn to the seething DX-laden 14 mC/s band where phones large and small . . . deep and piping, hold sway the clock round. Most rationally minded amateurs derive real satisfaction in helping a struggling fellow-being to snare DX; but there are the exceptions. They are tinged with a green-hued outlook that considers the phone DX world to be their own particular pigeon. They are childishly jealous of the near-by Dogged Joe, who, mainly by reason of a better antenna, perhaps more usefully orientated, does so much better with his DX contacts. So the Foxes "gang up" on Joe, causing him "accidental" interference from their VFO outfits plumped on his DX. Further to that, they one-sidedly get the ear of authority and accuse him of over-modulation, parasitics, or that his Modus Operandi is not according to the Book. Joe gets a "please explain" but is unruffled although inwardly indignant . . . he has a right to be . . . he was one of the men who started Australian amateur radio off in 1910 . . he's no youngster. But the jealous types in his vicinity . . . what do they care? Their outlook is one of a fanatical nature about DX, Countries worked, and QSL cards. No wonder the Old Man of "QST" had occasion to 'spit on kitty' at the antics of the "lids" of his time. They are still around, and in more blatant form.

FINE TESTIMONIAL FOR "RURAL 4"

The following letter was received recently by the Aegis Manufacturing Co. It speaks for itself:

Railway Gatehouse,
Grange Road,
East Caulfield, S.E.5,
1/3/48.

I would like to place an order for another of your "Rural 4" Kitsets, to be picked up tomorrow morning, 2/3/48.

I have completed the one I got last week and I must say that it is the easiest, and also the most satisfactory set that I have ever built. It is certainly a wonderful performer. I have received country stations, including Wagga, N.S.W., from Melbourne, here using only a ten foot indoor aerial.

The kit, as you claim, was complete to the last nut and bolt and inch of wire, and went together without any trouble, the alignment is so simple that I found it simplicity itself to align it perfectly, using no instruments whatever.

You may use this letter as you wish, either wholly or in part, I feel I am only doing my duty by fellow set builders by recommending your kitsets to them, whether they be a chap building his "first," or the professional builder your prices allow for a handsome profit from a few hours simple work.

Sincerely yours,
S. B. Mason.

* * *

The "Rural 4" was detailed in full in our issue of October, 1947.

Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY

BETTER LISTENING CONDITIONS

Listeners to the shortwaves will find comfort in the remarks of T. W. Bennington, of the BBC Engineering Division. He predicts that 1948 will be a "year of generally good conditions, particularly on the shorter wavelengths." In an article in the latest copy of "London Calling" to arrive, he says: "The year 1947 was an extremely interesting year for shortwave radio transmission; during its course, there occurred several events of great importance in this particular field. These events have enabled our knowledge of the behaviour of the ionosphere and of its effect upon short radio waves to be considerably extended, and have confirmed that our present techniques for predicting ionospheric conditions, and for applying this knowledge to our shortwave planning operations, are, substantially correct."

* * *

BROADCASTING HOUSE

Broadcasting House, the BBC's headquarters in London, which officially became the centre of British broadcasting on May 15, 1932, has thrown off its war-time camouflage and is now restored to its original whiteness. It was twice hit by bombs, but remained fully operative, and despite the damage, maintained its broadcasting service without interruption.

* * *

GENEVA MOVEMENT

According to "Radio Craft", the most powerful broadcast station in the world will be erected at Geneva by the United Nations. Power will be 1000 kilowatts. This station will operate on 1200 metres and has been designed to blanket all Europe. Strategically located in Switzerland, it is certain to reach practically every radio receiver on the Continent. Europe has a very large number of crystal receivers which normally cannot receive signals beyond 25-50 miles, but it is hoped and expected every crystal set in Europe will tune in the new United Nations' station.

* * *

SHORTS

VLW-5, Perth, has moved from 9.52 mc and is now heard on 9.61 at much better strength and with greater clarity. Schedule at present is: 8 a.m.—12.15 p.m.; 8.15 p.m. —2 a.m.

OTC-2, Leopoldville, has moved from 9.745 mc and from 6.30 a.m. gives programme to the British Isles on 9.775 mc.

Here is one to watch for—our old friend HCJB, Quito, Ecuador, who, according to "Radio News", will shortly be on the 16 metre band.

Radio Australia reports Cable and Wireless Ltd., Aden, as being heard carrying out tests on 6.085 mc.

* * *

Latest advice from Washington, U.S.A., give following information re Munich shortwave stations: Munich I 6.10 mc beamed to East Europe 5.15—8 a.m.

Munich III, 6.17 mc beamed to East Europe, 4—5 a.m.

Munich II, 7.29 mc, beamed to East Europe 2.15—8 a.m.

Munich IV, 9.54 mc, beamed to East Europe, 9.15 p.m.—8 a.m.

Munich I, 11.87 mc, beamed to East Europe, 2.15 a.m.—5 a.m.

* * *

The United States International Station at Manila is scheduled as follows: to the Far East on 11.89 mc, 7 p.m.—1.05 a.m.

India/Pakistan, on 15.33 mc, 5.30—6.45 p.m.

"Universalite" advises LRA-1, Buenos Aires, Argentina, 9.69 mc, is likely to increase its strength from 5000 watts to 20,000 watts. This will be a temporary measure, as they expect to receive soon a 100,000 watt transmitter to provide for good international broadcasting. (If this is realised, it will be the most powerful transmitter in all Latin America.)

* * *

HH12T, Ciudad, Trujillo, who moved from 6.48 mc to 7.275 round about June last year have made another change; this time they can be found on 9.73 mc. It comes on the air about 9.40 p.m. and at 9.45 seven notes repeated at short intervals identify it. The station actually opens just on 10 o'clock with a four note chime followed by the slogan, "La Voz del Yuna." It is a particularly good signal, in fact, as loud and clear as any Latin American and is certainly worth trying for.

* * *

Radio Monaco, Monte Carlo, which was first reported in this country by Ern Suffolk on September 6, 1946, from information supplied by Arne Skoog of Stockholm and referred to in these pages in October issue, 1946, has now been logged, but not on the frequency then being used, viz., 6.13 mc. It is now on 6.038 mc and is best heard at 5 p.m. Listen for "Ici Radio Monte Carlo." For the all-nighters, or the before breakfast boys, it is fair at 3.30 a.m., but stronger at 6 o'clock; but afternoon is best.

* * *

Here are some announcements heard on April 1, regarding AFRS stations operative from April 5:

KWIX, 'Frisco, 11.86 mc, 7 p.m. —12.30 a.m.

KGEI, 'Frisco, 15.21 mc, 3.30—8.30 p.m.

KGEI, 'Frisco, 9.53 mc, 8.45 p.m.—12.30 a.m.

KGEX, 'Frisco, 17.78, 3.30 p.m. —6.45 p.m.

KNBX, 'Frisco, 15.25 mc, 3.30 p.m.—6.45 p.m.

KWID, 'Frisco, 11.90 mc, 3.30 p.m.—9.30 p.m.

KWIX, 'Frisco, 9.57 mc, 1.15 p.m.—6.45 p.m.

* * *

The old favourite, "Command Performance" is given at 2.30—3 p.m. on Wednesdays. "Mail Call" is heard at these times on Thursdays, whilst "Jubilee" is given on Fridays and "Jill's Jute Box" on Saturdays.

* * *

XURA, Taiwan, 7.22 mc, is reported as fair at 5.45 p.m.—"Radio Listening Post."

* * *

"Radio News" reports: "Under the unusual call sign of X12C, The Austrian Post, Telephone and Telegraphs, Vienna, has been operating a circuit with New York since September 12, 1946, on 17.60 mc, for the exclusive use of U.S. Army and civilian personnel. Station is Austrian staffed, but under American supervision. Schedule is 12 hours daily: 11 p.m.—1 p.m. Other frequencies available are, 19.73 mc, 9.13 mc, and 7.478 mc (on voice). The transmitter is 2.5 kw. and since they use single side-band, some degree of intelligibility can be understood without use of BFO."

Radio Sofia III, 9.35 mc, has replaced Radio Rodina (Military Radio) on same frequency, latter having been suspended. News in English daily at 6.30 a.m. and for a time 7.50 a.m. to compensate for BCB, 850 kc., which is temporarily off the air.—"Radio News."

* * *

The Norwegian outlets on 6.185 and 9.54 mc have increased power to 100 kw.

Here is a splendid list of loggings from Miss Dorothy Sanderson, of Malvern, Victoria:

Africa

CR7BU, 61.09, 4.91, 6.15 p.m.: Musical programme with messages.

CSX2, 61.98, 4.84, 6.30 p.m.: Musical programme.

FZI, 25.05 11.97, 3.30 p.m.: News in English and Music.

OTC2, 30.80, 9.74, 6.30 a.m.: News and listeners' letters answered.

EPB, 19.86, 15.10, 9.30 p.m.: News in French. Good signal.

Capetown, 51.00, 5.88, 6.15 a.m.: Good musical programme.

FZI, 31.80, 9.44, 6.45 p.m.: News in English and good programme.

Europe

ORL2A, 49.92, 6.01, 6.45 a.m.: News in English and music.

RNE, 32.00, 9.38, 7.0 a.m.: English news and music.

Milan, 31.15, 9.63, 6.15 a.m.: News in Italian and music.

PCJ, 19.70, 15.22, 8.45 p.m.: English news and music.

PHI, 16.88, 17.77, 9 p.m.: Rebroadcast by Queen Wilhelmina: Music.

Leipzig: 30.83, 9.73, 5.30 p.m.: News in German and music. Good programme.

SPB, 25.63, 11.70, 5.45 p.m.: English lesson and music.

ZAA, 38.15, 7.87, 5.30 a.m.: News in French.

Warsaw, 48,21, 6.21, 6.30 a.m.: News in English on United Nations R9.

HER5, 25.28, 11.865, 5 p.m.: News in English. Service to Australia.

HEI5, 25.62, 11.715, 5.15 p.m.: Views on the News and Spotlight on News.

Central and South America

HCJB, 19.185, 15.11, 1.30 p.m.:

English news and usual programme, music etc.

LRM, 48.54, 6.18, 8 p.m.: Musical programme and news in Spanish.

CE1180, 25.00, 12.00, 9.45 p.m.: Good signal in Spanish, news and music.

COKG, 33.50, 8.95, 9.30 p.m.: News in Spanish and music.

COCQ, 33.98, 8.83, 9.45 p.m.: Fair signal in news and music, some QRM.

HCJB, 30.12, 9.95, 9.30 p.m.: Usual programme of Hymns and talks.

HH3W, 29.63, 10.13, 9.45 p.m.: News in French and musical programme, R9.

XERQ, 31.21, 9.615, 3 p.m.: Good musical programme and news. Spanish, R8.

XEWW, 31.58, 9.50, 3.15 p.m.: Excellent musical programme. News, Spanish, R9.

COBQ, 32.31, 9.22, 7.30 a.m.: Spanish news and music. Fair signal.

COBC, 32.00, 9.37, 7.35 a.m.: Fair signal in news and music.

HIIZ, 47.54, 6.31, 9.45 p.m.: Good musical programme. Spanish news. QRM.

HCJB, 24.11, 12.445, 3.30 p.m.: Hymns and talks.

ZPA5, 25.12, 11.94, 9.30 p.m.: Good signal in Spanish. News and music.

HP5K, 49.96, 6.005, 9.30 p.m.: News in Spanish and music. Opens at 9.30.

Canada

CHOL, 25.60, 11.72, 8 p.m.: Short story session. News, music.

CHLS, 31.22, 9.61, 8.15 p.m.: Canada and the United Nations.

CKLO, 31.15, 9.63, 7.15 a.m.: News in English and music.

CKCS, 19.58, 15.32, 8.15 a.m.: Sport news and music from Schumann.

CFRX, 49.42, 6.07, 9.30 p.m.: Good signal in news. Weather reports.

Philippines

KZRH, 31.64, 9.64, 9.15 p.m.: News and good programme of music.

KZRC, 48.94, 6.13, 9.45 p.m.: News and music. Good clear signals.

KZFM, 25.21, 11.90, 8 p.m.: Peoples' station. News and music.

KKZPI, 31.58, 9.50, 9 p.m.: QRM bad at this frequency, but can hear sessions in news and music.

China

XGOA, 25.35, 11.835, 8.15 p.m.: English news and music.

XGOY, 19.77, 15.17, 8.30 p.m.: Dancing discs session and news in Mandarin.

XGOY, 48.79, 6.15, 9.45 p.m.: Opens with news in Chinese and English, then concert hall session.

XTPA, 25.75, 11.69, 9.15 p.m.: Chinese news and western music.

XLRA, 26.10, 11.49, 9.30 p.m.: Western type music, orchestral.

ZBW3, 31.51, 9.52, 9 p.m.: BBC relay of news and music. Signal fair.

XORA, 25.66, 11.69, 9 p.m.: News in English and frequency details.

XPSA, 42.80, 7.01, 9.30 p.m.: Western type music and short English news at 10 p.m.

XURA, 41.55, 7.22, 9 p.m.: News in Chinese and good programme of music.

XMNG, 40.80, 7.34, 9.15 p.m.: News in Chinese, some QRM.

XGOE, 30.42, 9.86, 9 p.m.: American marches and music. News in Chinese.

XGIO, 35.73, 8.45, 8.30 p.m.: QRM bad. AFRS programmes.

XGAF, 25.68, 11.68. 7.30 p.m.: News in Chinese, good musical programme.

XMAG, 67.01, 4.27, 9 p.m.: AFRS programme. Good sessions.

XGIO, 30.01, 9.99, 9.45 p.m.: Fair signal in Chinese. News and music. Very close to WWV.

India

VUD9, 25.27, 11.870, 9.30 p.m.: English news and music.

VUD2, 41.17, 7.29, 10.30 p.m.: English news and music.

VUD2, 41.44, 7.24, 10.30 p.m.: Round up of news. World and local.

Singapore, 44.31, 6.77, 9 p.m.: News in Chinese and English.

Singapore, 13.81, 21.72, 7 p.m.: Opens at 7 p.m. in frequency details. News, etc.

Singapore, 25.56, 11.73, 7.30 p.m.: News in English and talk on Television.

Ceylon, 19.84, 15.12, 11 a.m.: News and music.

Ceylon, 16.82, 17.82, 11.15 a.m.: BBC news relay and music.

Saigon, 25.47, 11.78, 8.30 p.m.: English news and music.

Saigon, 48.66, 6.165, 10.15 p.m.: News in French and music.

PNOMPENH, 24.26, 12.36, 9.15 p.m.: News in Chinese and French.

Radio France, 49.67, 6.04, 10 p.m.: English news and music announced call sign and frequency. Good signal.

Speedy Query Service

F.A. (Chatswood) is worried about frequency response.

A.—The present trend in talking about amplifiers which are flat to 80,000 cycles and other such supersonic (inaudible) frequencies is a little inclined to cloud the issue. Few records have anything on them over 5,000 cycles, except scratch and distortion. Latest Astatic pick-ups in U.S.A. are proudly advertised as having a sharp cut-off at 4,000 c.p.s. When broadcasting records the stations usually arrange to cut off everything over 5,000 cycles, but in several cases the cut-off is arranged at 4,000. Stations using the lower cut-off claim that listeners are much happier with the lower scratch, noise and distortion.

HIGH-FIDELITY

(Continued from page 34)

output being approximately 0.1 volts RMS. The output is then fed into a bass amplifier where the 6 db per octave cut in recording is compensated for, magnetic units requiring this, the same as crystal units.

One manufacturer is now marketing a unit that is a flat response and yet meets the above requirements. Thus the choice between the two types, magnetic or crystal is one that is left to popular choice, both achieving excellent results.

The reason the curve of figure three ceases at 8.5 kC/s is due to present day test records, which cut-off at 8.5 kC/, but the newer records, yet to be released will continue to 10 kC/s. Because of this it has not been possible to verify overseas claims of respone to 13 kC/s. We have yet to hear a sine wave out-put of 13 kC/s, originating from a record, yet it can be done, and has been done, but not in Australia, as yet.

The author wishes to acknowledge information supplied by Messrs. Cosmocord, England; Messrs. Australian Record Company, Sydney, and Western Electric (Asia).

R.B. (Yallourn) wants constructional details for a service oscillator for F.M. receivers.

A.—So far our policy has been to discourage readers from spending time or money on F.M. receivers or equipment until such time as it is clear what the future holds. Would expect any service oscillator to have sufficient frequency modulation to work an F.M. receiver!

* * *

R.L. (Ballarat) draws our attention to certain happenings in the publishing business and asks about our plans.

A.—Present indications point to our paper supply being able to keep present size issues going for at least twelve months and we are cutting out bulk distribution in New Zealand in order to save enough to take care of present rise in local demand. So long as present support is maintained by advertisers and subscribers we will not need to raise price or cut down number of pages in each issue.

* * *

D.Z. (Christchurch, N.Z.) is not satisfied with the FS6 articles in July and November issues and wants easier instructions for simpler refinements.

A.—Have you seen the article on the FS6 in the February, 1947, issue? Possibly that would help you, but otherwise we have nothing on hand at the moment.

* * *

S.H. (Lindfield) has built a vented speaker baffle but is not happy with results.

A.—This often happens, due to resonance effects of various kinds. At the Rola factory only last week the head technician was heard to deplore most attempts at super-baffling. He recommends a flat baffle "big as you can get it." Our experience indicates that flat baffles can also have resonances, and a yard square of five-ply gives a solid rumble on lows which is entirely eliminated when the speaker is removed and fitted into a dividing wall between two rooms. Some people say that a yard-square baffle won't allow the speaker to handle anything under about 250 cycles, but that is bunk. Look at the way it brings up a.c. hum.

BARGAIN CORNER

FOR SALE: Communications receivers, type AR7, with latest modifications and valve types. Reasonable price. Write for full details. Kingsley Radio, 380 St. Kilda Road, Melbourne.

FOR SALE: Philips 25-watt amplifier, slightly defective. Circuit supplied, also K12 speaker, 23 copies of "Wireless World," two pick-ups. G. V. Flint, 51 Mary Street, Hawthorn, E2., Vic. WA 2061.

WANTED: FS6 Vibrator Pack, complete with connecting lead if possible. Write stating price, L. P. Smith, Dunsborough, West Australia.

FOR SALE: "Coyne" Trouble Shooting Manual, Electronics, Applied Practical Electricity (7 vols.). Latest editions, cost £15. What offers? Kevin Butler, Monaro Theatre, Cooma, N.S.W.

FOR SALE, Kingsley K/C/R11 receiver as new, perfect order. £40 or offer. Must sell. R. Fraser, 24 Crawford Street, Queanbeyan, N.S.W.

FOR SALE: P.P. 807, 32 watt public address amplifier. Two microphones, two pick-up circuits, individual faders. For details, G. R. Coster, Box. 127, Swan Hill, Vic.

Will the person from Rocklea, Queensland, who sent 14/- for back numbers please send his name and address?

SOUND CELLS

(Continued from page 33)

the most suitable method is to form wire mesh into a rectangular or spherical shape, thus permitting the entry of sounds from all directions and at the same time avoiding undesirable resonances which would occur with the more orthodox case.

RED LINE

EQUIPMENT

for

THE NEGATIVE FEEDBACK AMPLIFIER ★

OUTPUT TRANSFORMER

Primary Impedance 10,000 Ohms 807 (T) P.P.

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Frequency Response: Linear within 0.2 db.
20 cps. to 30,000 cps.

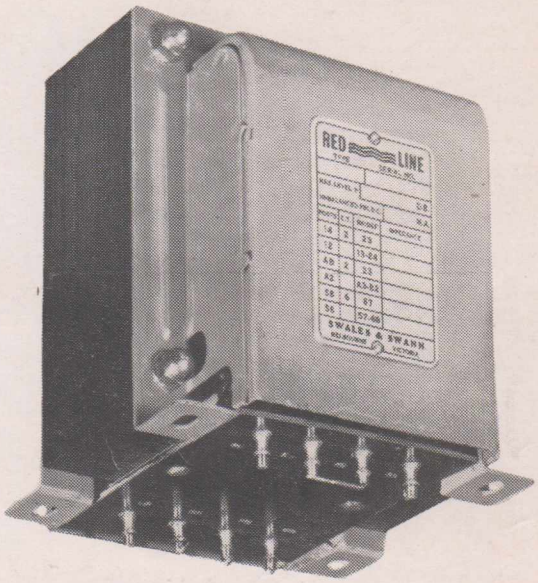
Primary Inductance (at low ac flux) not less than 125 Henries.

Leakage Inductance: 17 Millihenries.

Insertion Loss: 0.4 Decibels

This transformer may be used to obtain a gain reduction of up to 25 db. across 4 Stages in a suitable negative feedback circuit★

★ *to 500 Ohm Line if required (AF10)*



TYPE No. AF15
Weight 7 lbs. Price: £6

POWER TRANSFORMER

10v, 210v, 230v, 250v, 50 cps. Sec. H.T. 500/500v at 175 ma. 5v 3a 6.3v; 2a 6.3v 3a .... Type 17503 £3/12/6

FILTER CHOKE

12 Henries
175 mA .... Type 201515 £1/11/–

SMOOTHING CHOKE

25 Henries
60 mA .... Type 50825 £1/7/–

A Choke Input Power Supply shown in Radiotronics 128 requires:

Power Transformer, Type No. 25563. Price £4/10/4
Choke (1), Type No. 102512. Price £1/16/1
Choke (2), Type No. 201515. Price £1/11/-
Choke (3), Type No. 50825. Price £1/7/-

★ *as described by Mr. D. T. N. Williamson in "Wireless World," April and May, 1947.*

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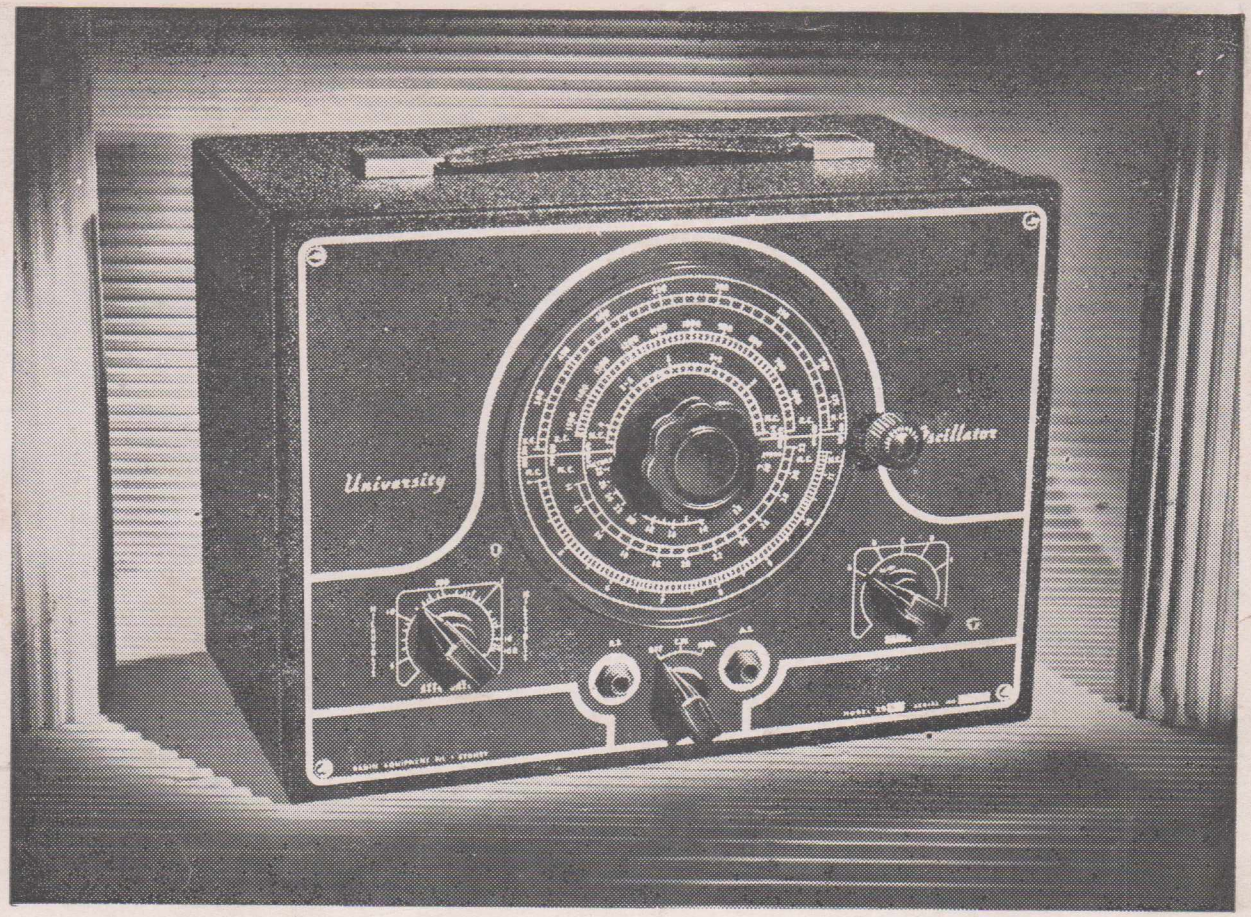

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This is the outstanding new "University" oscillator. It has been developed in accordance with Radio Equipment's policy of bringing out new and improved goods capable of giving better service and bringing bigger returns to the radio service man and radio repair man. First of our new series, this oscillator is available either as an A.C. operated instrument totally self-contained, or the battery operated instrument known as model X.O.B. operated from internal batteries. It is moderately priced and is especially suitable for the alignment and general testing of radio receivers.

The new oscillator has continuous band coverage from 160 kilocycles to 32 megacycles. The accuracy of calibration is plus or minus 1% and most important of all the attenuator has negligible effect of frequency on all bands and at all attenuator settings.

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(3) Providing a modulated carrier wave modulated at 400 cycles.

The instrument is in a handy size of 11¾" x 8½" x 7½" and has a total unpacked weight of 17½lbs. It is finished in black brocade and is fitted with a flat carrying handle. The panel is outstanding in the new "University" colour of dark red with clear nickel plated raised markings.
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A University INSTRUMENT

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