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THE AUSTRALASIAN

RADIO WORLD

DEVOTED ENTIRELY TO TECHNICAL RADIO
and incorporating
ALL - WAVE ALL - WORLD DX NEWS

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Vol. 14 NOVEMBER, 1949 No. 6

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EDITORIAL

IT is interesting to see that the latest issue of "QST" from America contains an editorial on the subject of government control of amateur radio.

It seems that the Federal Communications Commission has in mind to take a firmer grip on U.S. ham radio, with a view to directing the activities of hams along a definite line, making the utmost use of such a valuable communication method in terms of national importance.

Reading this editorial has brought to mind the unhappy state of amateur radio in Australia. Instead of the vast swelling of the ranks which was expected after so many men had received radio training in the Services, we find that post-war amateurs number only about 2,700 for the whole of the Commonwealth.

Since we now have an Australian Broadcasting Control Board, set up to improve radio service, the thought comes to mind that, perhaps, this body will eventually take over the whole ham radio set-up and develop it, with adequate planning, to become a national asset. By encouraging those with the necessary technical knowledge to take out licences, supplying them to those who do not want to waste time on morse code without a test in that painful subject, eliminating the childish "discipline" which is so irritating to grown-up people; it should be possible to organize a vast net-work of amateur stations of incalculable value in times of war or emergency.

—A. G. HULL.

THESE 3 POINTS

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- 2. R.C.S. is the name of the world's finest coils.
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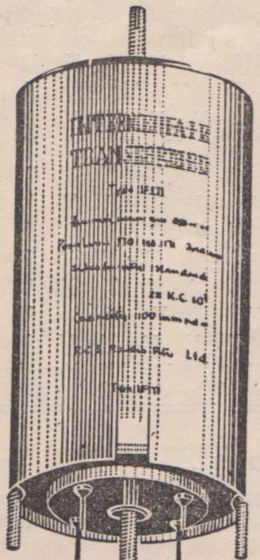

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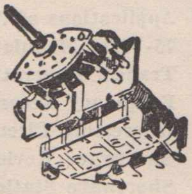

(Above)
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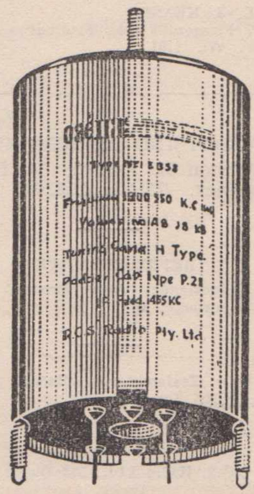

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Universal Output Meter Unit

Align a receiver by ear if you like, but you will find the results much more accurate, and the job completed quicker, with this versatile output meter. Relatively inexpensive, this instrument will find many uses on any repair bench.

By
H. M. WATSON,
89 Botting Street,
Albert Park (S.A.)

THE instrument has provision for switching in any required value of load and field impedance and gives a visual indication of output on the meter.

The output transformer is a power transformer with its L.T. secondaries removed and a new tapped winding added.

To find the position of the various tappings the required impedance. As the turns ratio of the voice coil and the square root of the answer found. This figure is then divided into the rated voltage across the H.T. secondary winding of the power transformer. This will give the turns ratio required, in terms of voltage to give the required impedence. As the turns ratio is equal to the voltage ratio the correct number of turns will be this figure multiplied by the turns per volt. The original H.T. secondary now becomes the new primary, the centre tap serving for the B+ connection of push-pull inputs.

Let us assume that we have a power transformer with a H.T. secondary of 400 volts C.T. 400 volts, and low tension secondaries of 6.3 and 5 volts. The first step is to find the turns per volt by counting the turns on one winding, say the 5-volt turns are counted and found to be 30; this means there are 6 turns per volt. This figure is noted and the low tension secondaries stripped off. The next step is to find the correct number of turns from the common end to each tapping. For example to find those for the 20,000 ohm tapping we have $\sqrt{\frac{20000}{2}}$ (assuming a 2 ohm voice coil impedance) = 100 dividing this figure into 800 = 8 which, multiplied by 6 turns per volt) = 48 turns.

If only half the primary load is used five extra load impedances to those shown in the circuit diagram will be available as well as a duplication of the 5000 and 2500 ohm impedances. These new values will be one quarter of those shown on the diagram and not one half as may at first be imagined. This is because half of the turns ratio is equal to an impedance ratio of the square of one half.

A chart is shown in Fig. 4 which enables the turns ratio to be quickly found for any load you wish to match with whatever particular voice coil you choose for use in your test speaker. This chart has numerous uses for instance, say we have an output transformer designed to match a 5000 ohm load to an 8 ohm voice coil. We find from the chart that

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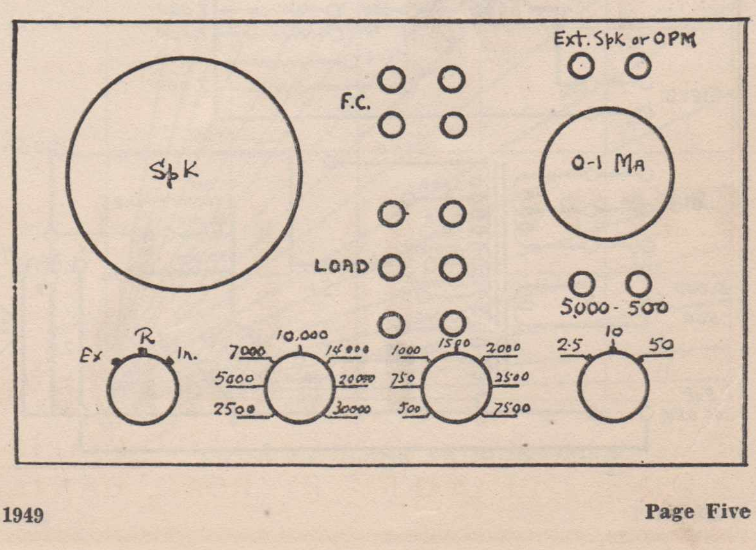
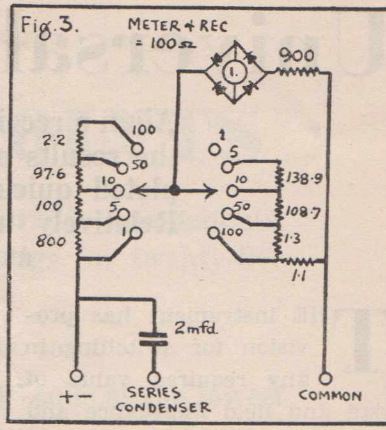


the turns ratio is 25 to 1. On counting the secondary turns we find them to be 50, then the primary turns will be 27 × 50 = 1250. Suppose now that we wish to use this same transformer to match a voice coil of 3.5 ohm to this same load. The turns ratio (from the chart) is in this case 37, which we divide into 1250 and find our secondary turns should be 34. As we have 50 turns we have to strip off 16 to obtain a correct match. It will also be noticed from the chart that the same transformer used to match a 6F6 (load 7000 ohms) to an 8 ohm voice coil, could be used to match a 2A3 (load 2500 ohms) to a 3 ohm voice coil, without alteration.

Switch 1 selects loads as indicated when the input is applied between the top and bottom load terminals. The original 240 volt primary winding is brought out to two terminals on the front panel and serves for a match of 5000 ohms to a 500 ohm line.

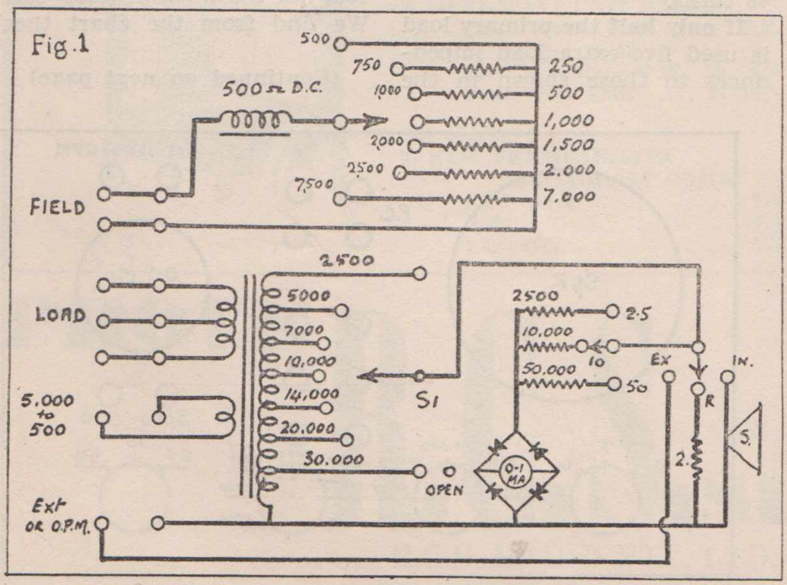
The output meter shown in the speaker circuit diagram consists of a 0-1 m.a. with copper oxide rectifier and multiplier resistors to give three voltage ranges of approximately 2½, 10 and 50 volts as selected by switch 4. For alignment purposes exact voltages are of no importance and the meter scale may be marked off in 10 divisions which will enable a reference level to be observed and increase in output noted. If, however, accurate readings are required for any other purpose the meter should be calibrated from a known source of A.C. voltage.

It will be noticed that the output meter shown in the speaker circuit is shunted across the voice coil of the speaker and not across the primary of the output transformer. The reason being that if measurements were to be taken across the high impedance of the primary of the output transformer a big change in resultant output impedance would take place as the volt-



meter ranges were switched thus giving incorrect readings, in addition a series resistor would have to be included as the primary (in most cases) carries D.C. With the meter across the voice coil, however, the resistance of the meter is high compared to the low impedance of the voice coil on any of the three ranges.

If, on the other hand, a meter is desired to be operated across the primary of the output transformer the necessity arises for a series of shunts and multipliers so arranged that switching to a higher voltage range places less resistance in shunt with the meter and rectifier and at the same time adds the correct amount of series resistance to the meter and rectifier. These shunts and multipiers are calculated so that the total resistance of the meter circuit remains constant irrespective of the range selected. For instance, if the voltage range required is × 10 then the shunt must reduce the sensitivity of the meter by 10 times and a multiplier be included to bring the total resistance of the circuit up to the constant value of resistance decided upon. Such a



meter is shown in Fig. 3 and the method of calculation for shunt and multiplier values is as follows:

On the 1 volt range the total resistance in the circuit is that of the meter and the 900 ohm series resistor = 100 ohms. With one volt applied the meter gives a full scale deflection of 1 m.a.

When the meter is switched to the 5-volt range the total resistance in the circuit must remain at 1000 ohms, which means that the total current in the circuit is now 5 m.a. only 1 m.a. is required for full scale deflection of the meter the sensitivity of the meter must be reduced to 5 m.a. by shunting the remaining 4 m.a. around it. As the 1000 ohm resistance passes 1 m.a. it would require $\frac{1000}{4} = 250$ ohms for the shunt. The resistance of the meter and its shunt is now $\frac{1000 \times 150}{1000 + 250} = 200$ ohm, therefore the multiplier required for this range is 8000 ohms. The values for the other multipliers and shunts are calculated in the same manner and these are shown in the circuit diagram Fig. 3.

Getting back to the circuit of Fig. 1, with S1 in the open position to remove the load and S3 on "EXT," the output meter will be available across the external speaker terminals for application to mantel or other sets with built-in speakers.

An artificial field is included, the filter choke or choke and series resistor as selected by switch 2 substituting for the field of the set under test. For sets requiring a "permag" speaker no connections are made to the field thus doing away with the necessity of an off position on the field switch.

Switch 3 provides for switching in an external speaker to test for most suitable loads, etc., or switching to a third position replaces the voice coil with a resistance so that alignment may be carried out or fading observed with the speaker silent.

All terminals are of the pin-jack type, those for the field and load being duplicated to enable connections to be made from one to another. This is necessary to enable the appropriate connections to be made in cases where the set under test has its output transformer wired directly to its field, either across the speaker plug or at the speaker end of the speaker cable.

Two speaker cables are used, one a four conductor wired to a four-pin plug and the other a five conductor wired to a five-pin plug to the other ends of which all leads are connected to pin jack tips.

It is useful to have a few additional leads that may be plugged in and the other ends clipped on to the speaker

(Continued on page 33)

Those who do not want to go to the trouble of winding their own transformer should remember that there is a type U1 universal output transformer in the Ferguson range, as detailed in our September, 1949, issue.

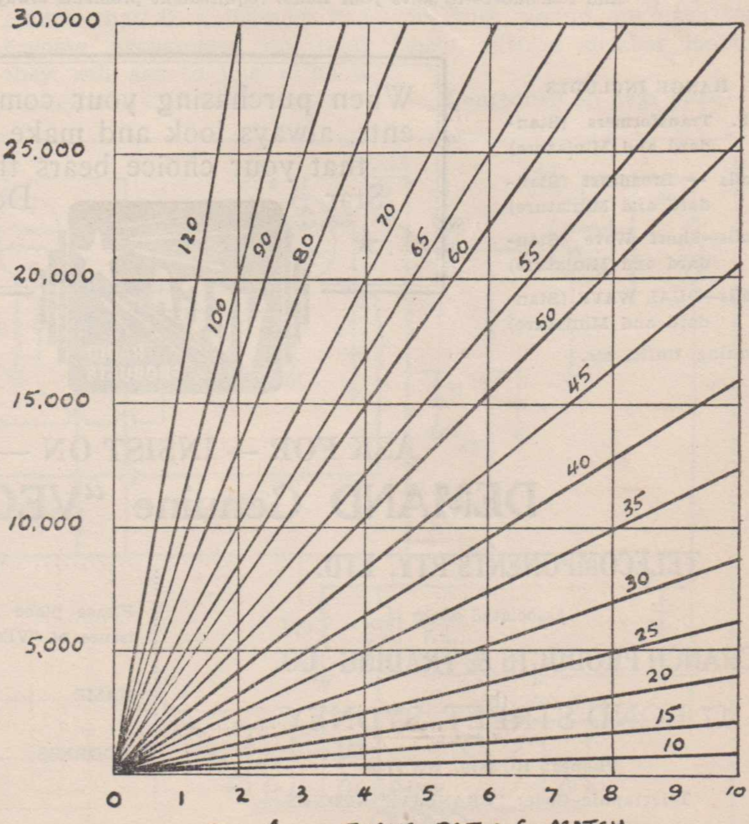


FIG. 4. = TURNS RATIO For MATCH

Customer's Choice No.1

Do you know of any circuit which gives tonal quality which suits the taste of the ordinary listener, irrespective of how it looks on an oscilloscope, or how it sounds in theory?

By
A. G. HULL.

IN the September issue I stirred up an ant's nest with my remarks about the tonal quality of modern sets, the charm of some of the older ones and so on. It is years since any one article has stirred up so much comment. Within a few days of the release of the issue the telephone buzzed three or four times a day with trunk line calls from readers who rang to say that they were in complete accord with the remarks I made.

So far, not one person has rallied to the defence of the modern sets with their beam power valves.

The only dissent from the article comes from one reader who says that I made a mistake when I said that people appreciate quiet sets. He claims that if a listener has become accustomed to hum they will get to like it as a background for their music.

He writes (and I quote, as they say on the radio): "Let me tell you of a dear old lady who asked one of the boys in the wireless section of a certain R.A.A.F. station, at which I was stationed, to find out why the set had stopped. The set was a formidable thing, weighing anything up to half a ton, with great trannies all over the place, mostly resistors wire wound on glass formers, with a speaker looking

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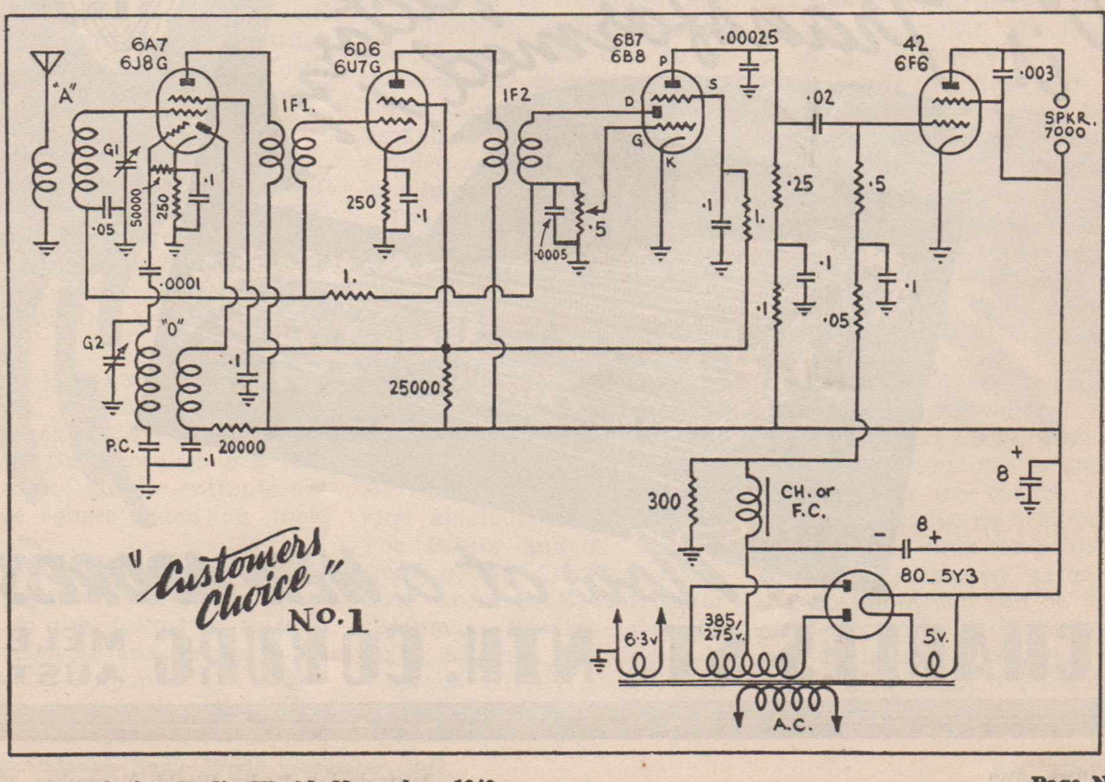


CUSTOMER'S CHOICE (Continued)

like the blunt end of a deathray machine. We traced the trouble to a shorted filter condenser, replacing botn as the other was only a shadow of its former self. To make the story short, the old girl finished up going crook because we had spoiled the tone. We managed to rig up an arrangement to put in slight synthetic filter hum, and sure enough that was our trouble. We had taken out the hum, and had to put it back to make the owner happy. So please, when you check the claims for some old sets, don't just go on what the owner has to say."

Another story to back up our claim that, if you listen long enongh to anything, you can come to think it is good quality, comes from a reader who says: "There is a certain gentleman who actually likes mechanical gramophones, of all things. He has piles of high-cost classical records, some of which I would give quite a bit for. He continues to listen to and enjoy these while the heavy head chops the tripe out of pounds worth of irreplaceable records."

So runs the tenor of most of the letters, but few of them offer anything more constructive than our original promise to publish the circuit of a set which does sound good to many people of normal listening taste. As mentioned in the September issue this circuit is of a 1938 Croydon model, which, in its day did not arouse anything extreme in appreciation, yet, to-day, is so treasured by its owner that he would not part with it for any of the modern receivers which he has heard.

Feature of the circuit is the

use of diode-bias for the detector, with a rather different screen feed arrangement, back bias for the output valve, but nothing really startling or unusual.

This circuit can be recommended as a basis for building up a set or converting an old one. It is not recommended for gramophone pick-up work.

Further letters on the subject of the type of tonal quality which suits the average listener are invited from all readers. Those which contain facts and actual circuit arrangements will be doubly appreciated.

'IDEAL' P.U. CHARACTERISTICS

IN several articles in the past I have mentioned pick-ups with restricted frequency response. Some readers have asked that I should define these more clearly, and so here are a few figures of frequency test runs done with an old Canadian crystal pick-up of pre-war vintage which gives out the kind of tone which is demanded by my 22-year-old son.

As a baby his lullaby was a jazz record played on a direct-coupled amplifier with a Webster pick-up, so it might be said that his musical taste was unduly influenced to appreciate strong lows!

This particular pick-up, however, has also been selected as ideal by at least 90 per cent. of the many visitors who have listened to various amplifiers in our lab. over the past ten years.

Tested with the frequency records, the output measured across the 500 ohm line runs something like this: Starting with a level of 40 volts at 1,000 cycles, then falling away steadily to 20 volts at 6,000, 10 volts at 7,000 and practically nothing at 8,000.

Going down from the 1,000 cycle level, the output rises steeply to 60 volts at 500 cycles, and peaks at 100 cycles with 75 volts.

The output drops to 50 volts at 70 cycles, 40 volts at 50 cycles, and then fades out.

Owing to the high output voltage of this pick-up at the low end it is essential to have an amplifier which will accept a signal of 6 or 7 volts. In other words, the first valve of the amplifier must have a bias of 7 or 8 volts, as otherwise the strong lows will be distorted. Likewise the power output of the amplifier needs to be able to handle about 15 watts on these low notes if the average volume level is kept around full room strength, viz., about five watts.

Looking at these frequency figures on paper you get the impression that such a pick-up on a "flat" amplifier is going to sound far too boomy, and that there can be no brilliance. In actual listening tests this is completely disproved, as quite a good impression can be had of the higher tones, the brassiness of trumpets is not impaired to anything like the extent you would expect.

RECORDING CONTEST

(By JOHN BENNETT)

On Friday night, October 28, at 8 o'clock, I attended the annual recording competition of the Sound Recording Institute of Australia at the Radio Theatre of the Melbourne Technical College.

The competition was divided into two sections, Open and Amateur. There was also a popular vote prize awarded by the votes of those people present in the theatre on the night.

The judges were Mr. King, of Pyrox, and Mr. Ryan, chief engineer of 3AW. The standard of the recordings was very high and all the entrants are to be congratulated on their efforts.

Twenty discs were played during the course of the evening on discs from 10in. to 16in. in diameter and speeds of 78 and 33.1/3 r.p.m.

The open section conditions were that the disc would be the work of the entrant from microphone to recording and the amateur section allowed the whole of the disc to be "intercepted" material.

The time of each entry was limited to five minutes and the number of entries per person was limited to three recordings.

The selected recordings were played on Wide Range Equipment loaned for the occasion by Messrs. J. H. Magrath and Co. Prizes were kindly donated by A.R.C. Pty. Ltd., Byer Inds. Pty. Ltd., Hi-Fi Recording Manufacturers, and Playback Disc Manufacturers.

Winners were: First, open, Mr. Colbeck's Far Away Places. First amateur, Mr. K. Nicoll, The Breeze and I. Second, amateur, Mr. Chapman, Concerto No. 2 in B Flat Major (Brahms). Popular vote: Mr. Inglis, Rhumba Serenade.

Special novelty award.—Mr. Earle, World Championship.

Amateur Radio Activity

Conditions on the bands these last few weeks have been anything but ideal, as you all well know. It would seem that the Aurora Australis is up to its old tricks again. However, the next few months promise to bring forth some really outstanding D.X., if the ionospheric predictions prove to be as accurate as they have been in past months.

Taken as a whole, the best band seems to have been 20. Ten meters D.X. is a thing of the past. Six metres is about as active as a dying duck, in its last death throes. Forty, of course, still remains the old man's band, and interstate QSO's are quite plentiful.

F.M. CIRCUIT

With all the controversy about F.M., many of the boys are using it to quite good advantage on 20 at least. While listening on 20 some weeks back I heard a VK, whose call sign I've mislaid, talking to a ZL. The VK was on F.M., and a discussion arose as to the merits of reactance modulators and the like, eventually the VK said that the modulation system in use on his rig was just a little out of the ordinary. This aroused my interest so I decided to listen a little longer.

It seems that the idea originally came from a W. and to say that its just a little out of the ordinary is a gross understatement. The exact principle by which the scheme ticks is a bit obscure but it all depends on the 1N34 crystal diode. The circuit is the essence of simplicity, and when incorporated in the grid of the isolator in the VFO there is nothing to touch it for quality, if the signal from the VK was anything to judge from. If the 1N34 is omitted the works become unbalanced and bad distortion sets in. It appears that the crystal does some rectifying and that the alternating grid voltage is, perhaps, out of step with the microphone current. Or the explanation could be much more involved, maybe having some connec- with the actual frequency of the modulation. The transformer may have harmonic generated within it and the 1N34 suppresses these on the secondary side.

If anyone can shed any more light on this matter I would be very pleased to hear from them.

NEXT MONTH!

First issue with the New Section devoted to fostering interest in Amateur Transmitting.

Order Your Copy Now!

MULTI-BAND ANTENNAE

With everyone going crazy on antennae, especially the popular G8PO, this would seem to be an opportune time to say something about a new beam we're working on at present.

Multi-band operation on the one antenna has long been well to the fore in ham radio. So also has inductive coupling and lengthening. For instance, a 14 mc/s. antenna, fed with 600 ohm open wire line, can easily be used on 28 mc/s. with the right tuning arrangement. That is to say, you can use an antenna on twice its fundamental frequency.

Secondly, you can reduce the physical length and still retain the same electrical length by placing an inductance in the centre. This helps greatly when space is limited.

We have applied the reverse conditions to a novel new beam. This beam is a two-twin, four-element stacked array. It is cut to a half-wave on 28.4 mc/s. Fed with 158 ohm line this beam has an excellent front-to-back ratio when receiving, especially on twenty metres! Believe it or not, this antenna works equally well on HALF the fundamental as on the fundamental. We hope to publish the details in a later issue and we can assure you that they will be well worth reading.

CEMENTING VALVE BASES

There is nothing so annoying to the radioman as loose valve bases. Any of the good household cements used for sticking china and pottery can be employed to re-stick loose bases with quite good results. However, care must be taken to see that the cement does not run down into the base between the leads, causing considerable electrical leakage.

Interest In Gramo Reproduction

Extracts from Letters from Subscribers

"I cannot write too long a letter, but would like to express appreciation of the technical articles in your magazine. I like especially the ones on audio work and pick-ups. I have neither the money to spare, nor the time and patience to waste to learn the morse code, so I'll probably never go for my amateur's ticket. So I concentrate on getting the best off records and out of the amplifier. My latest is a portable radiogram, using 1H5, 3Q5 of the radio, with the pentode section of the 1S5 for compensation and pre-amp. Inverse feedback is rather freely used, which results in enough volume to sound loud in a small room or car, as we generally use it for our rat-bag parties with the orchestra.

Using the Connoisseur moving iron pick-up (so I can also play the classical records of my collection), I will back the quality against any portable receiver I've heard to date, and that is quite a few."—(Name withheld by special request, West Australia.)

* * *

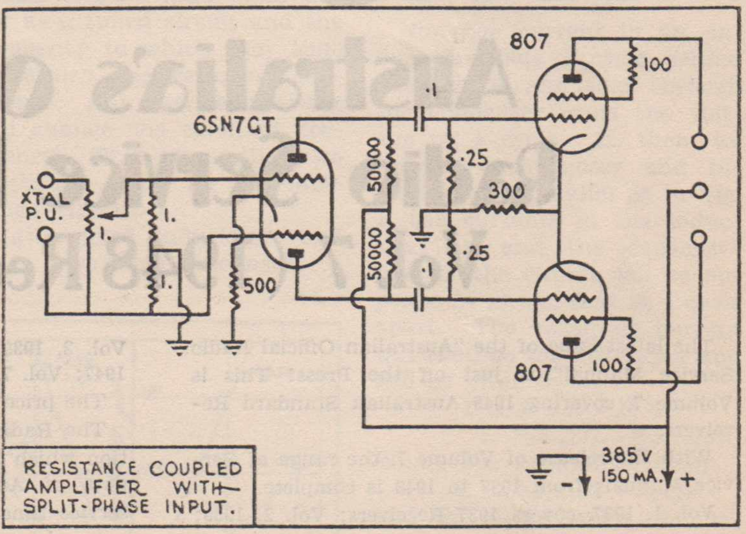
"Have just returned from England, where, a fortnight ago, I saw Radiolympia at Earl's Court. Television is well past the novelty stage, and now in Australia must be regarded as an urgent necessity. The frequency - modulated sound synchronising with the picture is something to be marvelled at, indeed living sound! It puts me to shame whe I look at my so-called hi-fi outfit here now. As the government here has granted itself a monopoly I can only imagine what a long time it will be before we get sound and programmes to equal the U.K. set-up. Although they, too, are government controlled, the television set-up is not so ham-strung. The people have little enough pleasure, and they turn on a good performance to keep them quiet as far as radio and television is concerned. Good luck to your journal; keep the standard the best."—Stewart Adams, South Yarra, Vic.

* * *

"I must applaud the fact that your magazine is a 100 per cent. radio magazine and that it gives the Australian radio authors a chance of expressing themselves and presenting to the readers something practical and free from advertising of certain products." — Peter Boblieff, 15 Wattle St,, Haberfield, N.S.W.

* * *

"I would like to express my appreciation of the job you are doing. Radio World is the only magazine, in my opinion, that adequately covers all branches of radio. As to the features I like best, I find I pay most attention to those on amplifiers and simple test equipment. The latter afford a profitable means of usinig up odd bits and pieces collected during the past." — John W. Down, 3 Stewart Street, Parramatta, N.S.W.



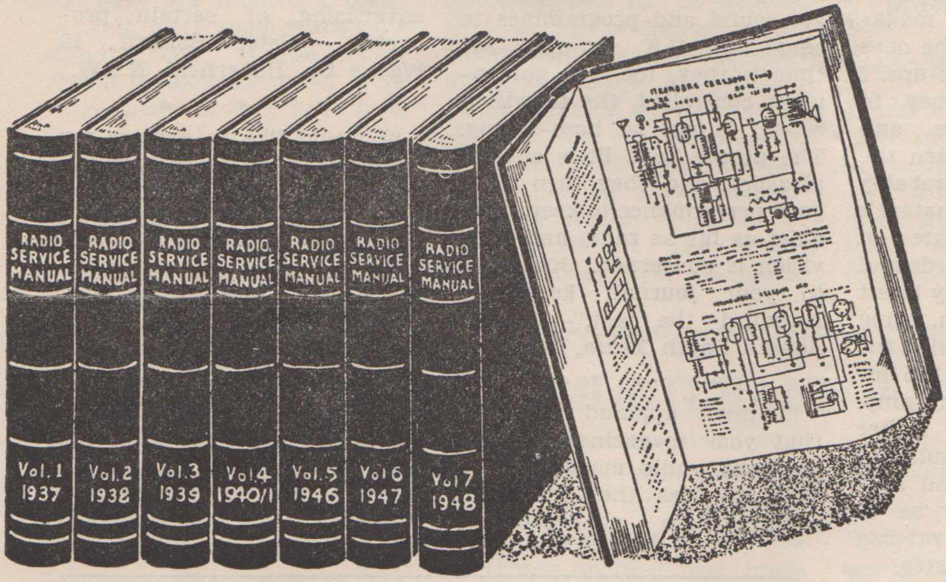
In response to a number of enquiries, here is a typical circuit of the split-phase idea applied to resistance-coupled amplifiers. The above circuit gives splendid results with a suitable type of crystal pick-up.

Just Out!

★

Containing Circuits of 257 Receivers manufactured by 44 Brand-Line Manufacturers during 1948

★



Australia's Official Radio Service Manual

Vol. 7 (1948 Receivers)

The latest issue of the "Australian Official Radio Service Manual" is just off the Press! This is Volume 7, covering 1948 Australian Standard Receivers.

With the release of Volume 7, the range of Service Manuals from 1937 to 1948 is complete.

Vol. 1, 1937, covers 1937 Receivers; Vol. 2, 1939; Vol. 3, 1939; Vol. 4, 1940-41; Vol. 5, 1946; Vol. 6, 1947; Vol. 7, 1948.

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The Radio Service Manual is the only publication which provides you with year by year circuit data of Australian standard receivers. It cuts service time and saves guess-work.

PRICE £1 PER VOLUME

OBTAINABLE DIRECT BY SPEEDY MAIL ORDER SERVICE FROM A. G. HULL, BOX 13, MORNINGTON, VICTORIA.

Applications of A.C. Practice

So far the going has been reasonably easy after a little study. Now we come to the most important part of A.C. theory, its use in everyday radio practice. It is essential that you understand this section perfectly, otherwise later in the course you won't be able to follow anything in the field of radio.

By
W. S. LONDEY,
Barkly Street,
Sale, Vic.

PROBABLY the most important part of alternating current theory, at least as far as the radio engineer is concerned, is resonance and its application to tuned circuits.

Radio receivers have, in general, several tuned circuits, some of which may be varied at will, the others being preset to some fixed frequency. The simple Reinartz circuit has one variable tuned circuit only, while tuned radio frequency type sets may have two, three, or even four variable tuned circuits. The superheterodyne type has at least two variable tuned circuits and one or more circuits tuned to some predetermined intermediate frequency.

Most tuned circuits in radio receivers are of the rejector type, that is they offer a much higher impedance to the required frequency than to any others. This means that all other frequencies than the desired one are virtually short-circuited by the tuned circuit.

Resonance.

Any circuit containing a condenser and an inductance will act as a tuned circuit and the frequency to which they tune is termed the resonant frequency. Any change in either will change the resonant frequency. This gives the two methods used for variable tuned circuits—

(a) a fixed inductance and a variable condenser;

(b) a fixed condenser and a variable inductance.

Parallel Resonance.

It will be remembered that the reactance XL of an inductance is given by—

$$XL = 6.28\ fL$$

and that of a condenser by—

$$XC = 1/6.28\ fC$$

Where

XL and XC = the reactances
C = capacity in farads,
L = inductance in henries,
f = frequency in c.p.s.

Now the current in an inductance lags $\frac{1}{4}$ cycle behind the voltage and that through the condenser leads the voltage by $\frac{1}{4}$ cycle. If, then, we connect a condenser and inductance in parallel as in Fig. 1, the currents in the inductive part and the capacitive part of the circuit will be opposite in phase, that is, $\frac{1}{2}$ cycle apart. The resultant current will then be the difference and will be given by—

$$I = E/XL - E/XC$$
$$= E/6.28fL - E \times 6.28fC$$

Where I = resultant current
E = applied voltage,
and the other terms as before.

The current I will lag or lead according to whether the term E/6.28 fL or Ex6.28fC is greater. If the above expression is positive the current will lag, if

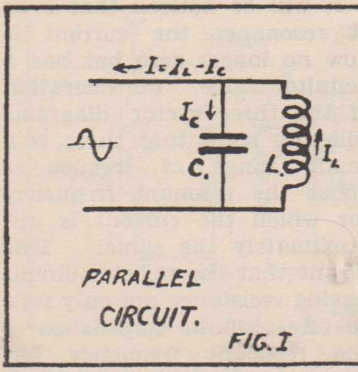


FIG. I

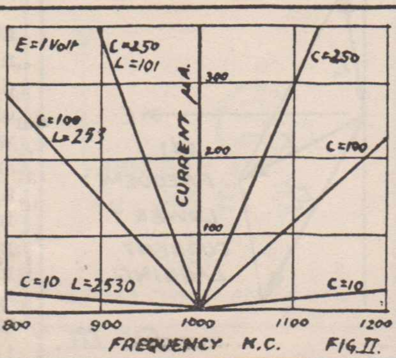


FIG. II.

negative the current will lead.

When the terms E/6.28fL and E x 6.28fC are equal the current will be zero. This zero current is only in the external circuit as there will be appreciable current in the inductance capacity loop.

As the current in the inductance decreases as the frequency increases it is clear that there is only one frequency for which the current will be zero for a given L-C combination. This frequency is the resonant frequency for that L-C combination.

For resonance

E/6.28fL = E x 6.28fC

That is

1/6.28fL = 6.28fC.

Solving this equation for f we get

f = 1/6.28 sq. root LC

This formula allows the resonant frequency of any tuned circuit to be determined from the circuit constants.

It will be noted that the term LC is the variable factor in the frequency equation above, that is, the frequency depends on the product and not the individual values. There are, therefore, any number of values of L and C which will give a certain frequency of resonance.

For example, for a resonant frequency of 1000kc.

If C = 100 mmfd. (.0001 mfd.)

L = 253 microhenries.

If C = 10 mmfd., L = 2530 microhenries,

or if C = 250 mmfd., L = 101 microhenries,

Although the change of the L/C ratio does not alter the resonant frequency, and the current through the parallel circuit at resonance is zero in each case, there is a great difference in the current at frequencies different from resonance. Fig. II shows curves of current v. frequency for the above values drawn approximately to scale. It will be seen that as C is increased (L/C reduced) the current at frequencies differing from the resonant frequency is increased.

Effect of Resistance in the Resonant Circuit.

It is impossible to make inductances without some resistance and the effect of this resistance must be taken into account in the design of tuned circuits.

Consider the circuit shown in Fig. IIIa where there is resistance present in both the capacity and inductance legs of the parallel circuit (in practice these are part of the inductance and condenser and not separate items). The vector diagrams for resonance and above and below resonance are shown in Figs. IIIb, c, and d.

It will be noticed that even at resonance the current is now no longer zero but has a definite value. Consideration of the three vector diagrams will also show that there is a small range of frequencies about the resonant frequency for which the current is approximately the same. This means that the rejector circuit having resistance not only fails to offer infinite impedance to the resonant frequency but

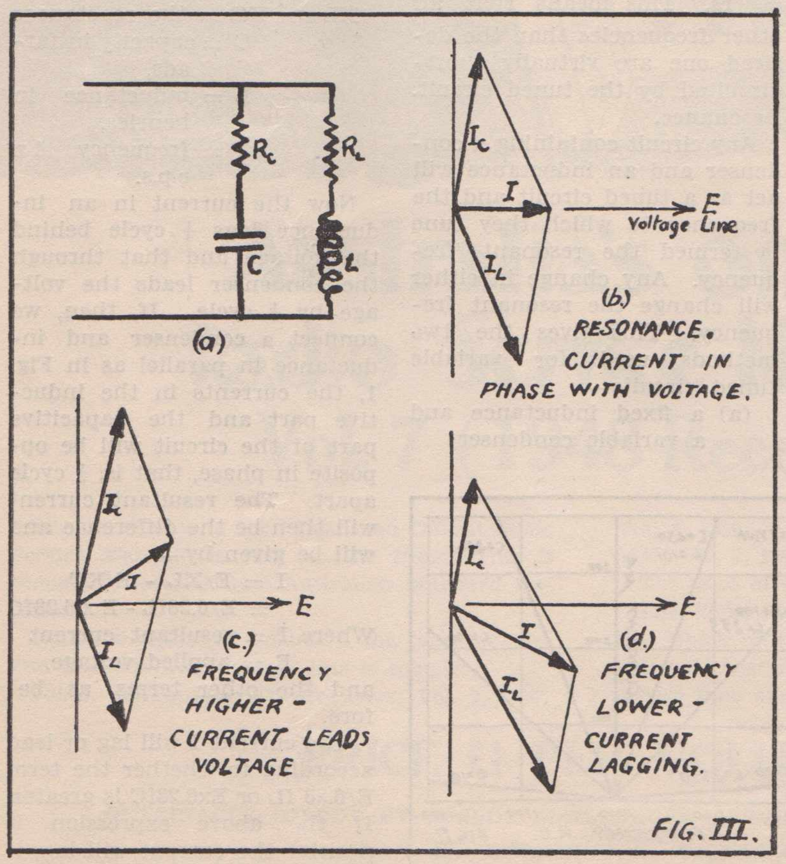


FIG. III.

offers the same impedence to a small band of frequencies on either side of that frequency.

The impedance of a rejector circuit at resonance is given by Z = L/CR (this is strictly true only if the resistance is all in one leg of the circuit but is sufficiently accurate in most cases), Z being in ohms, L in henries, C in farads and R in ohms.

The introduction of resistance into the tuned circuit also makes a slight difference to the resonant frequency but, in general, the difference is so slight that the formula for the case without resistance is sufficiently close for all general purposes.

Applying the formula Z = L/CR to find the current at resonance when a voltage E is applied to the circuit we get

I = E CR/L, where I is the current.

It is seen from this formula that increasing R increases the current passed through the parallel circuit. This is the opposite to the effect of increasing resistance in direct current work.

Selectivity—the factor Q.

It can be shown that the selectivity of a coil is proportional to 1/R times the sq. root of L/C.

Substituting for C from the formula

6.28 f = 1/sq. root LC,

we get Selectivity is proportional to 6.28fL/R.

This fraction is usually represented by the symbol Q and this gives a much more comprehensive idea of the relative selectivity of different coils than can any separate consideration of R or the ratio L/C.

The impedence of the parallel tuned circuit at resonance is Q times the impedence of one branch of the circuit. For example a tuning coil having an inductance of 0.2 millihenry and a resistance of 20 ohms (the D.C. resistance is less than this because high frequency currents tend to travel on or near the surface of conductors) tuned to 1000 K.C.

To find C for resonance—

f = 1/6.28 sq. root LC
then LC = 1/6.28 x 6.28 x f x f
C = 1/39.4 ffL
= 1/39.4 x 1000000 x 1000000 x .0002 farads,
or C = 1/39.4 x 1000000 x .0002 micro-farads
= .000127 mfd.

The impedance at resonance is given by—

Z = L/CR
= .0002/ . 000000000127 x 20
= 2/.00000127 x 20
= 1/..0000127
= 78800 ohms

Q is given by—

Q = 6.28fL/R
= 6.28 x 1000000 x .0002/20
= 1257/20
= 62.8

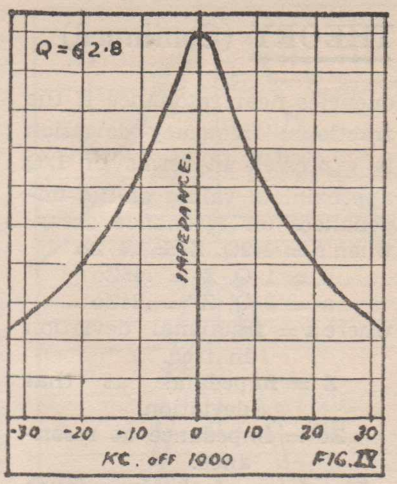


FIG. IV

Z at resonance may be determined by—

Z = Q x 6.28 fL
or Z = Q x 1/6.28 fC
then Z = 62.8 x 1257
= 78800 as before.

It will be remembered that there is a circulating current in the L-C loop which is much larger than the current drawn from the supply.

The supply current is given by—

Is = E/Z
= E/Q x 6.28 fL

But as the circulating current is approximately—

Ic = EI6.28fL
then Is = Ic/Q
or Ic = Q Is
where E = supply voltage
Is = supply current (drawn from the line)
Ic = circulating current.

For a supply voltage of 25 we get supply and circulating currents as follows—

Ic = 25/6.28fL
= 25/1257
= .01985 amps 19.85 ma.)
Is = Ic/Q
= 19.85/62.8
= .321 milliamps.

Over a limited range of fre-

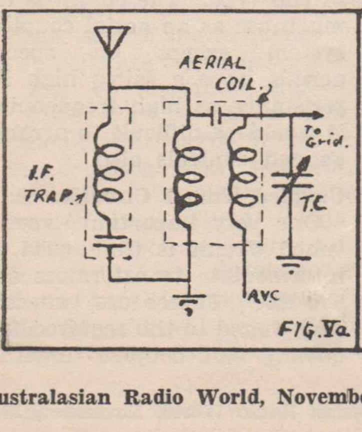
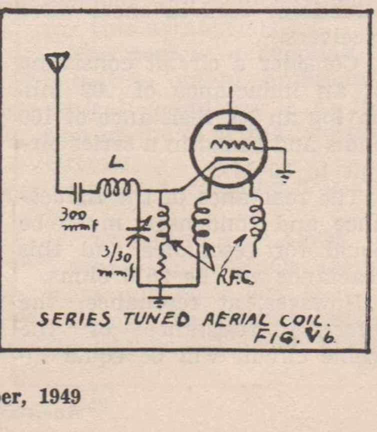


FIG. Va.



SERIES TUNED AERIAL COIL.
FIG. Vb.

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quencies near resonance if the fractional frequency deviation is expressed in terms of 1/Q approximate values of the impedances off resonance are—
when a = 1/2Q, Z = .7 Zo
a = 1/Q, Z = .45Zo
a = 2/Q, Z = .24Zo
where a = fractional deviation in freq.
Z = impedance at that deviation
Zo = impedance at resonance.

The form of the impedance v frequency curve for the above tuned circuit using these results is shown in fig. IV.

The frequency deviations corresponding to 1/2Q, 1/Q and 2/Q are found thus—
a = 1/2Q
= 1/2 x 62.8
= .00795
f' = af
= .00795 x 1000000.
= 7950
= 7.95 K.C.

Therefore, the impedance would be .7 x 78800 (55000) ohms at 7.95 K.C. either side of resonance.

The Q of a coil is fairly constant over fairly wide range of frequencies because the RF resistance of the coil is almost proportional to frequency, particularly at high frequencies.

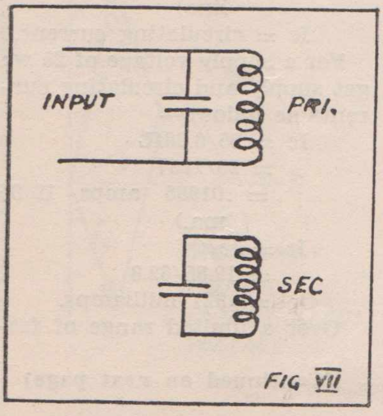


FIG VII

Resonance in Series Circuits.

Although most tuned circuits in radio are of the parallel type rejector circuit occasionally a series circuit is used to obtain some special effect.

The resonant frequency of a series circuit is given by the same formula as for a parallel circuit—
f = 1/6.28 sq. root LC.

There is, however, an important difference between the two circuits. While the parallel circuit offers a maximum impedance at resonance the series circuit offers a minimum. With a perfect inductance and condenser the series circuit would present a short circuit at resonance and increasing impedance at frequencies different from it.

The effect of resistance on the series circuit is to reduce the selectivity in a similar manner to that of the parallel circuit. It also limits the current at resonance to E/R.

Series resonant circuits are sometimes used as trap circuits, for example a series circuit tuned to the intermediate frequency is used on some superheterodyne receivers from aerial to earth to prevent any signals at this frequency entering the set. Fig. Va illustrates this.

There is one other important principle of series circuits sometimes used in short wave receivers.

Consider a circuit consisting of an inductance of .02 mh. having an RF resistance of 100 ohms and tuned in a series circuit to 20 M.C.

The reactance of the inductance and condenser must be equal for resonance and this reactance will be 2514 ohms.

However, at resonance, the effective resistance of the whole circuit will be equal to

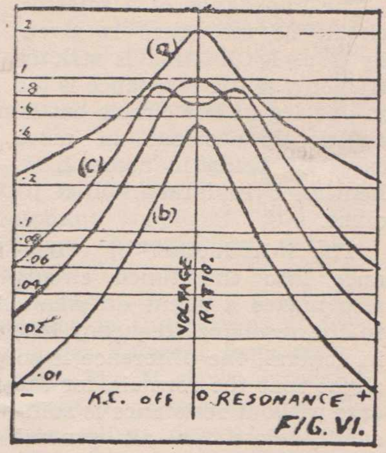


FIG. VI.

the resistance only, the inductive and capacitive reactances having cancelled each other out.

Now consider a voltage of say 10 microvolts (.00001 volt) applied across the series circuit.
Current I = E/Z
= E/R
= .00001/100
= .0000001 amp.

Now the voltage drop across the inductance is given by—
e = IX
then e = .0000001 x 2514.
= .0002514 volts.

This has given a voltage gain of 25.14 times, and this is, it will be noted, equal to the Q of the coil. A coil having a higher Q would give a greater gain. Fig. Vb shows a circuit of this type. The circuit is not much use as an aerial coupling system except on special aerials have a fairly high RF resistance at high frequencies; it would be difficult to arrange ganged controls also.

Coupled Tuned Circuits.

One very important type of tuned circuit is that used in intermediate transformers and the like. Thesee use two coils each tuned to the required frequency and coupled together magnetically (or by some other means). It is found that, in addition to the increase of selectivity due to the second tuned circuit, there is a certain amount of interaction between the two tuned circuits and that the shape of the impedance v. frequency curve can be changed considerably by alteration of the coupling between the coils. When the coils are well separated there is very little of the primary flux threading the secondary and only a small voltage will be induced in the secondary coil. The selectivity curve will be similar to that of a single tuned circuit but, of course much sharper. As the coupling is increased the induced secondary voltage increases as more flux links both the selectivity curve remaining about the same shape. This will only hold, however, up to a certain degree of coupling, termed the critical coupling for this particular pair of coils. When this critical coupling is reached the selectivity curve is of normal shape but slightly broader in the peak than that of under coupled coils. Under this condition the voltage transfer is a maximum and any increase in coupling will not increase the voltage at resonance, in fact it may reduce it, but the selectivity surve will become double humped, there being two resonant frequencies for the circuit as a whole, these resonant frequencies being on either side of the frequency the two coils are tuned to.

Fig. VI illustrates this—

Curve "a" is for a single tuned circuit, curve "b" for under coupling (less than critical), curve "c" is for coupling greater than critical.

These effects are easy to understand if we consider the double tuned coupled circuit in Fig. VII. It will be seen that the primary forms a parallel tuned rejector circuit connected across the supply while the secondary forms a series or acceptor circuit coupled to this. The primary, then, tends to have an increasing impedance at resonance, but the secondary impedance is least at resonance and increases as the frequency differs from resonance. This then, in effect puts a load on the primary by transformer action, but only at resonance. The primary impedance for an overcoupled transformer may, then, be higher at a frequency differing from resonance by a small amount than it is at resonance. Increasing the coupling increases the loading due to the secondary, and, as the tuned circuits are not perfect the effect of the load is over a greater range of frequencies. This spreads the impedance maxima further apart. This overcoupling does not have a very great effect on the impedence at frequencies differing greatly from resonance so the flanks of the selectivity curve for a slightly overcoupled transformer are steeper than those of an under or critically coupled one.

By using one overcoupled transformer, and one critically coupled one it is possible to obtain a selectivity curve for an intermediate amplifier showing a flat response over a narrow band and quite steep flanks. Fig. VIII shows the individual and combined curves for this arrangement.

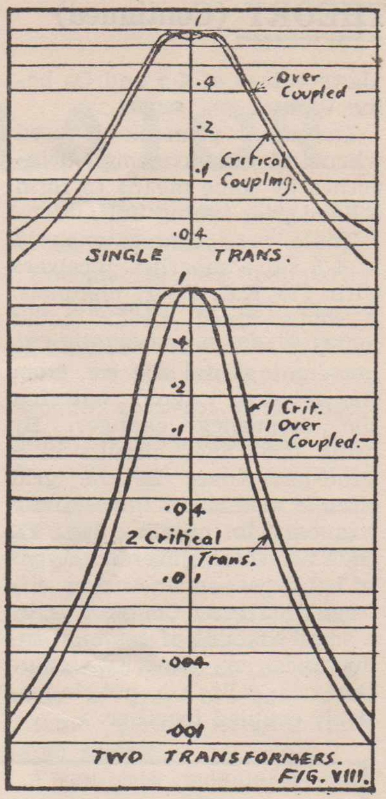
The degree of coupling required to obtain optimum or critical conditions is a function of the Q of the two tuned circuits.

Optimum coupling K is given by—

K = 1/sq. root QpQs.

Where Qp and Qs are primary and secondary Q.

It must be remembered that Qp will have to take into ac-



count the loading due to the plate resistance of the preceding valve. This plate resistance acts as a parallel resistance across the tuned circuit reducing the impedance, and therefore the Q of the coil. In practice the parallel plate resistance of a valve such as a 6SK7 with a plate resistance of 0.8 megohm will reduce the Q of an average coil from 130 to about 80. The input resistance which is usually in the order of several megohms has a much smaller effect.

Substituting Q values of 80 and 125 for primary and secondary in the formula for coupling factor we get—

K = 1/sq. root QpQs
= 1/sq. root 80 x 125
= 1/100.

Optimum coupling then is in the order of 1 per cent., the

(Continued on next page)

above values of Qp and Qs being typical.

The same principle is used when two coils are coupled together by some means to form a band pass tuning unit.

These were used extensively in 4/5 valve superhet. receivers with 175 K.C. I.F.T. channels. A single tuned circuit could not give sufficient selectivity to prevent a signal 350 k.c. from the required signal entering the frequency changer. By using two tuned circuits in a band-pass tuner in the grid circuit sufficient selectivity was easy to obtain. Fig. IX shows several different types of band-pass tuner used by different makers. Coupling is by a small amount of common inductance or capacity where the two coils are not inductively coupled together.

Capacity Variation for a Given Frequency Coverage.

Remembering the rule—

f = 1/6.28 sq. root LC

we will determine the capacity range required to tune over a given frequency range.

The minimum frequency to be tuned is f and the maximum f'. If f' = n times f then, as L is fixed, f'/f = 6.28 sq. root LC/6.28 sq. root LC' nf/f = sq. root (LC/LC'), and C/C' = n^2.

That is the capacity range is equal to the square of the frequency range. For example to cover the broadcast band of 540 to K.Cs. the frequency ratio is—

1600/540 = 2.96

and the capacity ratio is the square of this, that is 8.8.

If the maximum capacity of the tuning condenser is 450 mmfd. then the minimum will have to be 450/8.8 mmfd.

This gives a minimum capacity of 51 mmfd. which must include all stray and trimmer capacities. Taking average values for these we get—

Valve input (6A8) 9.5 mmfd.

Trimmer (3-30) 20 mmfd. average.

Tuning condenser 15 mmfd (usual min.).

Stray wiring 6.5 mmfd.

In practice the average receiver tunes a little beyond each end of the band.

The Effect of Series Capacity on Tuning Range.

If a condenser of small capacity (comparatively) be connected in series with a tuning condenser it greatly reduces the tuning range. This is used for band spread systems and to obtain oscillator tracking in superheterodyne receivers.

For example a tuning condenser of 15-450 mmfd. has a condenser of 100 mmfd. connected in series with it as well as the trimmer and stray capacities across the whole (make these 30 mmfd.). The minimum capacity of the combination is—

C = C1C2/(C1 + C2) + Cs

C = resultant capacity

C1 = tuning condenser capacity

C2 = series capacity

Cs = shunt (stray and trimmer) capacity.

C = 15 x 100/115 + 30

= 13 + 30

= 43 mmfd

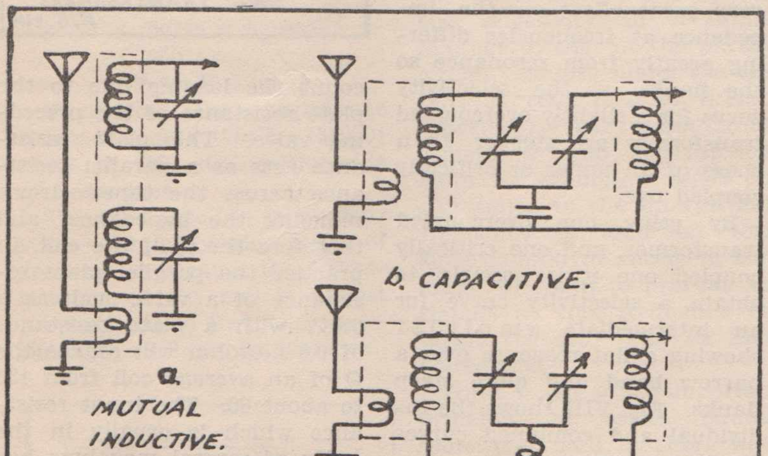
The maximum capacity is found by using the same rule—

C' = 450 x 100/550 + 30

= 82 + 30

= 112 mmfd.

The tuning range, instead of being about three times is only 1.6 times. This will be dealt with more fully in a later part.



75-watt MODULATOR

Here are the details of a compact 75 Watt Modulator, based on the circuit, of 807's as zero bias Class B triodes, that appeared in "Amateur Radio," August, 1948. A & R Electronic Equipment Co. Pty. advise that they are now manufacturing Modulation Equipment suitable for use by Amateurs, and provided the following information, illustrations, circuit, etc.

A & R. Modulators, Type M2-75 and M3-75, are complete units (less power supplies) designed for voice frequency modulation of a transformer, and each is capable of 75 watts audo output at the secondary of the modulation transformer when terminated in a suitable load, and used in conjunction with adequate power supply equipment.

The units are available ready for any or all of the major components may be purchased separately. The chassis, panel, handles, and brackets, etc., are also supplied separately in sets.

Both types are similar, except that M2-75 includes a two stage pre-amplifier for use with a high impedance microphone and M3-75 is provided with a 600 ohm line input transformer (no pre-amp.) requiring an input level of 1 milliwatt or 0.75 volt (zero d.b.m.) for full output.

Each unit of either type includes a negative peak clipping circuit with a special filament transformer for the valve.

The modulator circuit is based on information appearing originally in R.C.A. "Ham Tips," re-printed in "Amateur Radio, August, 1948, and "Radiotronics," July-August, 1949, showing a method of using 807 valves as zero bias Class B modulators. Tests have proved that this system produces the results claimed and does this without the usual complications of bias and screen voltages, etc.

Considering the popularity and low price of 807 valves, this circuit has much to commend it. In designing the mechanical layout of the modulator, it was apparent that the most useful and universal arrangement would be a standard 19in. x i10½in. rack mounting panel and chassis, as this can also be mounted in a metal cabinet, which is available for this panel size.

External finish of the equipment is grey brocade, with chrome plated handles and panel screws.

A complete modulator unit with pre-amplifier was designed, built and tested as a prototype, and all relevant tests were made including actual operation with a 100 watt transmitter. The performance of the modulator was very satisfactory, after one or two modifications were made to the original circuit in order to produce the required fre-

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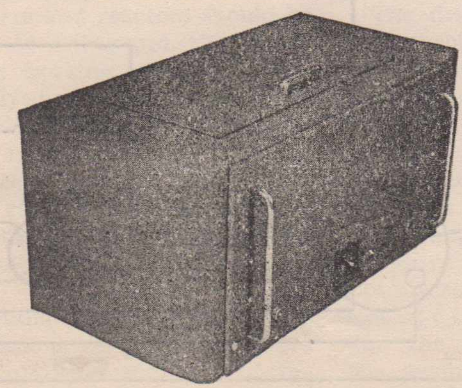
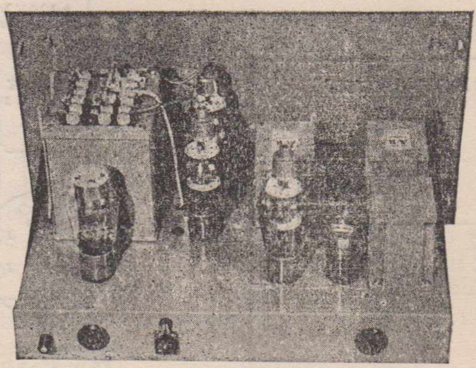




MODULATOR (Continued)

quency response. The pre-amplifier provides sufficient gain for most high impedance type microphones.

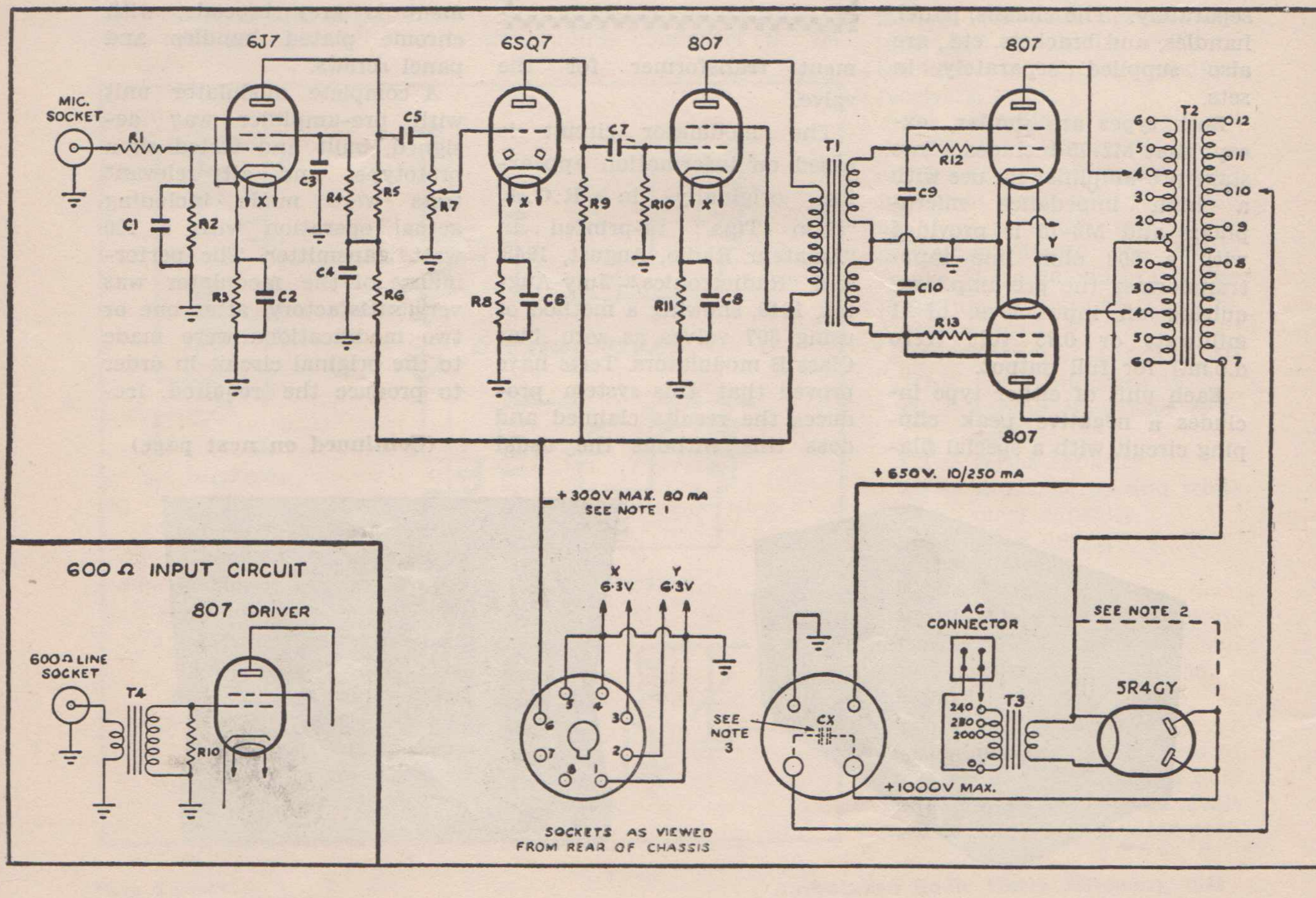
Test results were as follows:

The frequency response was taken overall from the input of the driver valve to the secondary of the modulation transformer, terminated in a resistive load of 10,000 ohms, and with 100 Ma. d.c. through secondary winding.

At full output of 75 watts the frequency response was within 1.5 db from 200 to 7,000 c.p.s. The distortion present at full output over the frequency range was quite low and aural tests showed that the speech quality was excellent. The response of the pre-amplifier stages can be modified to suit a particular microphone by altering the coupling condenser values and in the case of a crystal microphone by reducing the resistor value from grid to earth on the first valve. It will be noted that the low frequency response falls off below 200 c.p.s., the transformers being designed to aid in this respect.

Reduction of the high frequency response and harmonics produced by the negative peak clipping valve is also desirable, and can be achieved by the use of a filter or to a degree by a suitable by-pass condenser.

It is well known that speech wave-form is of a very peaky nature, and this means generally that either a low average modulation level must be tolerated, or some means must be provided to overcome this limitation. Without suitable precautions, an increase of the audo gain above a vertain level will cause some of the higher negative voltage peaks at the modulation transformer secondary to exceed the final r.f. stage d.c. plate voltage. This will reduce the effective voltage acting on the r.f. stage to zero for the period of time that



there is no positive voltage applied, thus causing discontinuity of the carrier power and so-called splatter takes place.

Volume compression and a.m.c. circuits reduce the peaks and increase the average modulation, but the time constants normally used allow high speed speech peaks of some frequencies to pass through to the modulator output circuit. The solution to this is to add a high level negative peak clipping valve with a low pass filter following.

The negative peak clipping circuit is included in the modulator so that those who use the equipment will be provided with the basis for possible improvement of their transmissions if they desire a high average modulation level with minimum interference to other stations.

It is not claimed that the best results will be possible without a low pass filter between the modulation transformer and the r.f. final stage of the transmitter, although useful suppression of high frequency response can be obtained by providing as large a capacitance as possible (2,000 c.w.) in the position marked CX il the circuit. A filter, if used, will carry the final stage d.c. current and the audo frequency currents. The condensers and reactors should be able to withstand the maximum working voltage continuously; i.e., approximately 2,000 volts r.m.s. at full audio output and 1,000 volts d.c. It is best to use "air core" reactors for the reason that less trouble will be experienced from noisy operation under heavy modulation.

Details of the design and operation of suitable filters and of other methods of reducing the r.f. channel width will be found in "QST," April, 1948; R.S.G.B. Bulletin, February, 1949, and in other publications.

The following description and details of operation of the M2-75 modulator apply also to the M3-75 unit, allowing for the difference previously explained.

Type M2-75 modulator includes pre-amplifier stages, and is intended for use with a high impedance microphone. The overall gain is more than sufficient for full output using a D104 type crystal microphone. A 6J7 metal valve was used in the original unit, and should this type be difficult to obtain a 6J7G would be quite suitable if provided with a metal shield to completely enclose the valve, grid resistor and r.f. filter circuit. A single ended valve, such as a 6SQ7, and this valve and the following valves are readily obtainable.

?It was found that a single 807 valve as a tetrode provided adequate driving power for the modulator valves, when used as shown in the circuit diagram. Negative feedback was not necessary, as the distortion visible on the c.r.o. screen was not excessive at 75 watts output, over the voice frequency range for which the unit was designed.

The driver transformer is a type specially designed for use in this circuit, but the modulation transformer is a semi-universal type suitable for use with many other Class A, AB_1, AB_2 or B circuits, using such valves as 807s. 809s, 830Bs, etc. The maximum signal modulator valve plate current should not exceed 150 Ma. d.c. per side of c.t. on the primary side, and the d.c. current through the secondary should not exceed 150 Ma. A maximum d.c. voltage of 1,000 may be applied to the primary and/or secondary windings. The transformer is fitted with a spark gap to provide protection against excessive peak voltages which may occur in the event of loss or reduction of load during transmitter adjustment or tuning operations.

This gap should be carefully adjusted so that during full modulation the points are as close as possible, but do not spark over under normal peaks.

The modulation transformer has been carefully designed and is not likely to break down with normal use if the maximum voltage and current ratings are not exceeded. The primary and secondary impedance ranges should be suitable for most modulator and transmitter valve combinations usual with a transformer of 75 watts rating.

It is necessary now to point out that full power output with low distortion from this or similar audio equipment, is not

MODULATION TRANSFORMER IMPEDANCES

PRIMARY

1	H.T.+
2-2	3,800 ohms
3-3	5,000 „
4-4	6,600 „
5-5	8,500 „
6-6	10,000 „

SECONDARY

7-8	4,000 ohms
7-9	5,000 „
7-10	6,000 „
7-11	8,000 „
7-12	10,000 „

(Continued on next page)

MODULATOR (Continued)

possible without power supplies having the necessary voltage regulation under minimum to maximum signal conditions.

The power supply for the pre-amplifier and driver stages should provide 275/300 volts at about 80 Ma. with sufficient filament windings for all valves (except the 5R4GY). It is advisable to check the filament voltages at the valve sockets, as low voltage, particularly on 807 valves, is to be avoided.

The power supply for the modulator valves is most important, and should be a separate unit with good regulation. The voltage output should be approximately 650 volts at the no signal current of 10 Ma., and should not drop to less than about 600 volts if full output of 75 watts is required, the maximum signal current for both valves being approximately 220 Ma. It is possible to use up to 750 volts (maximum at no signal) on the valves, and obtain the power output with poorer power supply regulation. A power supply with good regulation and additional current capacity may also be used for both the modulator valves and the Class C final r.f. amplifier.

The degree of voltage regulation required can be obtained by using 866a rectifier valves, with a choke input filter (preferably a swinging choke) and a second filter choke, both with low d.c. resistance of the order of 50-60 ohms. The filter condensers may be 2 uF. after the first choke and 4 uF. after the second choke.

For those who wish to assemble and wire their own unit, illustrations show the layout of the various components. All necessary holes are included in the chassis and panel assembly.

The top view of the M2-75 modulator shows the 600 ohm input transformer mounted in the r.h. corner near the panel.

(Continued on page 33)

Trade Co-operation Essential

(From Our English Correspondent)

THE war and increased governmental control have probably had at least one good result — they have led to closer consultation and co-ordination between the various branches of the British radio industry, increased pooling of technical knowledge and research, and closer contacts between the best scientific brains in the firms comprising the industry.

It is only since the war that the British radio industry has had one organisation to coordinate its activities and to enable it to speak with one voice in its dealings with the Government, the B.B.C. and other bodies. This organisation is the Radio Industry Council (R.I.C.) whose four constituent bodies represent respectively the receiving set makers, the makers of communication equipment and navigational aids, the component and test gear manufacturers and the valve manufacturers. Each body has its own council; each sends representatives to the R.I.C. and to the various committees of the Council. Each has its own technical and other committees and sends representatives to many joint committees which may include representatives of other "legs" of the R.I.C. or other bodies, such as the B.B.C., General Post Office, British Standards Institution, Institution of Electrical Engineers, and so on.

The R.I.C. has a Technical Directive Board, Technical Executive Committee and Television Policy Committee, but television from the point of view of receiver manufacture is in the first place the responsibility of the British Radio Equipment Manufacturers' Association, and it is in its committees that much detailed work is done. The B.R.E.M.A. Technical Committee, which meets monthly to direct technical policy for the handling of all problems relating to the design, development and manufacture of domestic radio and television receivers, consists of the senior technicians of each of the 12 firms represented on the Council of the Association. The Television Technical Sub-Committee, which sits regularly, is appointed by the main committee and consists of the senior television engineers of each of the same firms under the chairmanship of one of the members of the main Technical Committee. This sub-committee has a large number of items constantly before it, and to deal with them effectively appoints panels of two or three members who meet as required. Some of the subjects are referred to it from above; many others are raised by its own members and representations passed up to the main Committee.

Aims of the highly complex system of technical committees are to maintain a high standard of quality, design and workmanship, to give advice on manufacturing problems, to promote research in the interests of the industry, and to promote desirable standardisation of equipment. Individual manufacturers are free to introduce new circuits and other improvements without pooling their ideas and designs, but technical data coming to the knowledge of the Association from outside the industry is made available to all and leads to a steady and fairly uniform progression in design and manufacture.

Often a problem before the technical sub-cmomittee will require research before recommendations can be made, and in this event a few members will collaborate in carrying out experimental work in their companies' laboratories.

Periodical meetings between members of the Technical Committee, sub-committee and B.B.C. television engineers take place, and problems of mutual interest are discussed informally. A number of improvements in the television service have been made as a direct result of this liaison, and the dustry has been able to design receivers to give the full benefit from these improvements.

One of the problems continually before the sub-committee is the abatement of interference with television reception. On this the sub-committee has direct liaison with the G.P.O. and the Association is directly represented on var-

(Continued on next page)

ious technical committees of the B.S.I. and the I.E.E.

A specification for the performance of television aerials, which will later have to be referred to the Radio Component Manufacturers' Federation, the standardisation of plugs and sockets for television input, and the synchronisation of main supply frequencies are among other subjects of current investigation and discussion.

It was the Television Policy Committee of the R.I.C. which suggested that the question of international television standards in Europe should be raised at the C.C.I.R. conference at Stockholm last July, and a special Standards Advisory Committee was formed. The G.P.D., which provided the official British delegation to the conference, was accordingly accompanied by three advisers nominated by the industry from variuos technical committees, and international standards are now to be one of the subjects before a study group of the C.C.I.R.

Enough will have been said, perhaps, to indicate that the British television experts are looking ahead all the time, and that the R.I.C. organisation, including its various constituent bodies, committees and sub-committee, is the repository of an amount of technical knowledge and experience of television which is probably unequalled in the world, and which is at the disposal of all countries contemplating the establishment of a television service.

NEW FACTORY AND OFFICES

We have been advised that the Factory and Registered Office of Trimax Transformers (Cliff and Bunting Pty. Ltd.) have been transferred (as from September 19, 1949) to Charles Street, North Coburg.

Please note the following details:—

Postal address: The postal address for ALL MAIL will be —Box 2, Coburg Post Office.

Telephone: FL1203.

Transport: The following directions will help you to reach the new address: Rail: Take Fawkner train from Flinders or Spencer Streets or North Melbourne station and alight at Batman station. Tram: Take North Coburg tram from corner of Elizabeth and Flinders Streets and go through to Gaffney Street, North Coburg. Road: Follow Sydney Road through Brunswick and Coburg. At Gaffney Street, turn left and cross railway line. At Lincoln Mills, turn right along Williams Road, turn right at Charles Street.

Deliveries: The Company will continue deliveries to the City as at present. All rail consignment to the Company to be addressed to Trimax Transformers, Spencer Street, except Passenger train consignments from Gippsland, which should be addressed to Flinders Street.

FOR QUALITY EXPONENTS

Frequency Records Available

AMPLIFIER enthusiasts will be pleased to know that constant frequency records are now available.

These records offer a quick and simple method of testing the overall fidelity of a record reproducing amplifier, right from pick-up to output.

The records have pure musical tones recorded on them in separate grooves, with the bass attenuation to the same degree as found on most commercial recordings. If you play these records on your amplifier, with an output meter across the voice coil or plate circuit of the output stage, and your meter reads the same voltage for all frequencies, then you have the perfect amplifier. Simple, isn't it?

There are two records available, priced at 9/- each. They are H.M.V. recordings, available in Melbourne from John L. Harrower, 71 Little Lonsdale Street, and in Sydney from the Electrosound Company, 422 Kent Street.

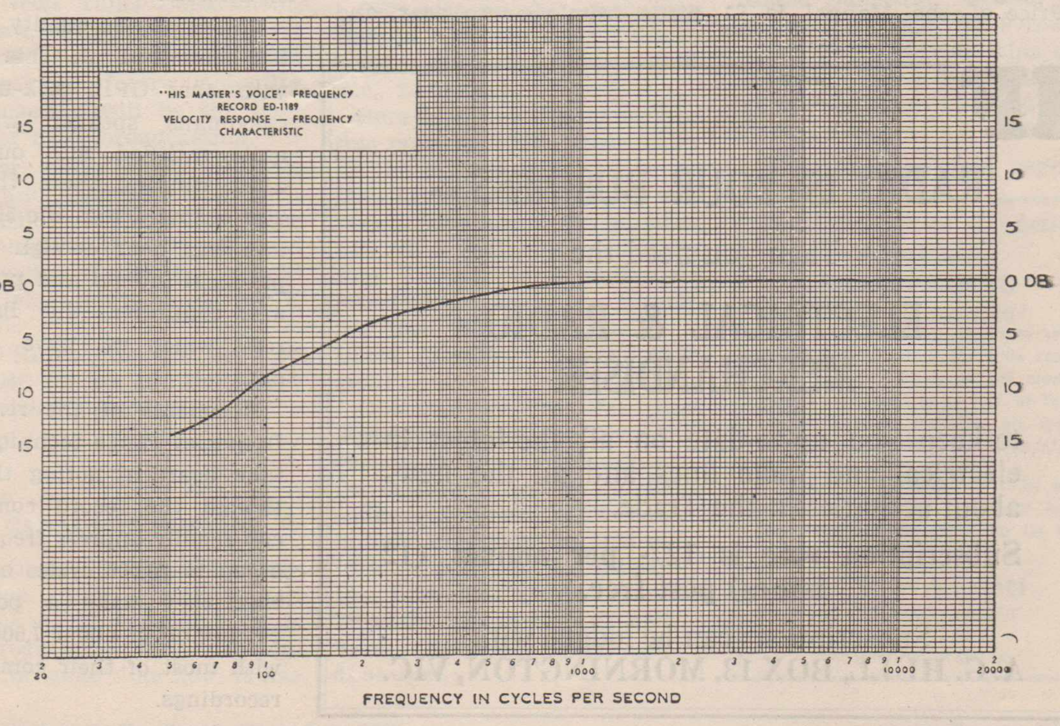
The first is No. ED1189, and on one side has grooves for 50, 100, 250, 1,000, 3,000, 4,000, 5,000, 7,000, 9,000; 11,000, 13,000, 15,000, 17,000 and 19,000 cycles per second. On the other side are 70, 160, 500, 2,000, 3,500, 4,500, 6,000, 8,000, 10,000, 12,000, 14,000, 16,000, 18,000 and 20,000 cycles. Up till now, many people have held that wax would not be any good for recording frequencies above about 7,000 cycles, but the fact that these records are available with 20,000 c.p.s. on them settles that point, doesn't it?

The second record is the same on both sides, with 35, 50, 70, 100, 140, 250, 500, 1,000, 2,000, 3,000, 4,000, 5,000, 6,000, 7,000, 8,000, 9,000, 10,000, 11,000, 12,000 and 13,000 c.p.s. It is No. ED1190.

A graph is given with each recording, showing, in decibels, the velocity response frequency characteristics.

No amplifier enthusiast

(Continued on next page)



BOOK REVIEW

Interesting Circuit Book

Anyone engaged in the repair and servicing of radio receivers will find the Radio Service Manual an invaluable aid. Many modern receivers use rather complex circuit arrangements and it is possible to spend hours of valuable time trying to work out the what's what of a broken-down set.

Time is money, as we have said before, so it pays to have the Service Manual on hand. Six service manuals have been published in the past, covering circuits of all Australian receivers from 1937 onwards. Now the seventh volumt has just been released, covering the 1948 model receivers.

Price of the Manual is £1 per volume, which may seem a bit steep at first thought, but it can be recommended as a sound investment for those who want to make money out of radio repairs.

Glancing through the manual with its hundreds of hand-drawn circuit diagrams and many tables of component values, it is soon evident what a terrific amount of work has gone into its preparation. It makes the price appear quite reasonable.

Students of radio design will also find the Manual an entertaining and instructive volume. It is most interesting to study the various factory designs, noting the changes which are made from year to year, and working out the reasons for the changes.

There is no doubt about it, every radio bench should have a bookshelf behind it, with the Radio Service Manuals within easy reach.

The Radio Service Manuals are available direct from our speedy mail order service at £1 per volume. Be sure to state which volume or volumes you require, and address your order to A. G. Hull, Box 13, Mornington, Vic.

Frequency Records

(Continued)

should be without this pair of records. They provide plenty of interest.

Tested on the quality amplifier described in this issue, with Acos GP12 pick-up and Goodmans speaker we felt quite satisfied with ourselves after running them through. The output across the 500 ohm line was near enough for all practical intents and purposes, and confirmed the listening tests which we have carried out.

Exponents of the restricted frequency range technique will take heart in noting that although the record companies can readily impress frequencies of up to 20,000 cycles on their wax, they make a point of cutting off at about 7,500 cycles with most of their commercial recordings.

Shortwave Review

Conducted By
L. J. Keast

NOTES FROM MY DIARY

PLEASE OBLIGE

I notice the Director-General of Posts and Telegraphs, Mr. Chippindall, has asked Russia to co-operate in removing radio interference in channels used by Australian airlines.

The offending station is believed to be at Cyongyang, in Korea. As one of the Australian transmitting stations at the request of Russia recently changed its wave-length it is confidently hoped Russia will reciprocate.

At Geneva a conference is now sitting to allot world radio transmitting frequencies and thus cut interference to a minimum.

SAY IT FROM HERE

Edwin Hinchcliffe, of the BBC News Talks Department, who is now in Australia for six months, is of the opinion that in the near future Actuality Broadcasting will be the only kind of news broadcasting.

After seven years with the BBC, and associated with such dsamatic "newsreels" as those connected with Hitler's and Roosevelt's death he should know what the listening public want.

Mr. Hinchcliffe will be with the ABC for six months whilst Frederick Simpson is with the BBC.

OUR CANADIAN COUSINS

Old time DX-ers will remember how often I used to say how we would welcome a regular programme from Canada. Well, for some time now, it has been coming through and directed to Australia and New Zealand.

At the time of typing these notes (7 o'clock on Sunday, October 9) my "Ultimate" is tuned to CKLO, Montreal, 9.63 m.c. 31.15 met., and what a signal and what a programme. I unhesitatingly recommended this to anyone desiring a really fine programme. It can also be heard on CHOL 11.72 m.c. 25.60 met. but strength at my location is not so good. Schedule is 6.45-8.30 p.m.

NEW STATIONS

WABC, New York, 11.83 m.c. 25.36 met.:

Arthur Cushen is first to announce this new CBS station, which is used for broadcasts in Russian from 1.15-1.45 p.m.

WABC, New York, 21.57 m.c., 13.91 met.:

CBS also on this frequency from 6 a.m. till noon.

FO8AA, Papeete, Tahiti, 12.08 m.c., 24.83 met.:

Here is a new frequency for this country. Like their sister station on 6.98 m.c. 42.98 met., the broadcast is short and sweet, just about 45 minutes, 2.15 till 3 p.m. Unfortunately with a weak signal and more interference, reception is only fair from Radio Oceania.

DZH6, Manilla, 6.03 m.c., 49.75 met.:

Operated by The Far East Broadcasting Company this station is heard from 8 p.m. till midnight, and is the forerunner of several other transmitters to be used by this company. Look out for DZH7 by the time this paper goes to press on 9.73 m.c., 30.82 met.

VLM, Brisbane, 4.917 m.c., 61.01 met.:

This new ABC transmitter was omitted from October issue by accident. It carries the same programme as 4QG, and is scheduled from 6 a.m. till 11.30 p.m. (M/N Sats.) daily 6.45 a.m.-11.30 p.m. on Sundays. Signal is quite good but like most of the 60 metre band is noisy.

. . . ., Malta, 4.78 m.c. 62.76 met.:

Recording to "Radio Coll" a new station announcing as "This is your Forces Broadcasting Service, Middle East," which, incidentally, is a new country as regards Radio transmissions, has been heard around 6.30 a.m. Reception until 7 a.m. is quite good when interference from VKC, the Melbourne police station makes logging difficult.

Listeners should watch for other frequencies which may be used by Malta shortly. They are: 6.14, 7.22, 7.27, and 11.785 m.c.

"Radio Sumatra," Medan, Sumatra, 7.355 m.c., 40.79 met.:

Rex Gillett advises this new frequency being heard at excellent strength at 12.30 a.m. Station closes at 2 o'clock with

(Continued on next page)

"Marching Through Georgia" and the Dutch National Anthem.

LATEST SWEDEN BROADCAST SCHEDULES

(Received by Air-mail)

10.00 a.m.-11.30 a.m., SBO, 6.065 m.c., 49.46 met.; SDB2, 10.78, 27.83.

3.15 p.m.-5.30 p.m., SBO and SDB2.

5.30 p.m.-1.15 a.m., SBP, 11.705 m.c., 25.63 met.; SBT, 15.155, 10.80.

1.15 a.m.-4.00 a.m., SDB2, 10.78, 27.83; SBT, 16.155, 19.80.

4.00 a.m.-4.30 a.m., SBO, 6.065, 49.46; SDB2, 10.78, 27.83.

4.30 a.m.-4.45 a.m., SDB2, 10.78, 27.83.

4.45 a.m.-End, SBO, 6.065, 49.46; SDB2, 10.78, 27.83.

MAKE A NOTE OF THESE ALTERATIONS

Greek Army Station, 6.745 m.c., 44.51 met.: Schedule is now 2.30-4.30 p.m.; 7.30-10.30 p.m.; 3-7 a.m. They hope to reinstate the news in English session soon.

Forces Broadcasting Service, Middle East, 4.96 m.c., 60.48 met.: Note new frequency from 4.30-7 a.m. Very good signal. Relays BBC.

Radio Noumea, 3.40 m.c., 88.32 met:. This new transmitter is intended to give better reception in inland areas of New Caledonia.

Athens, 9.605 m.c., 31.24 met.: Good signal at 4 p.m.

Salisbury, 7.29 m.c., 41.17 met.: Heard till 1 a.m. with Rugby broadcasts.

VERIFICATIONS

Verifications 1698; countries verified 123. What a lovely record and justifiably earned by Arthur Cushen, of New Zealanr. Yet in his latest air-mail to me he, with remarkable modesty, "A little news from here; recent verifs. from Noumea (3.40); HC2AN (7.35), OAX4P (5.94), ZL2 (9.62), Johannesburg (3.45), Salisbury (3.325), VLA4, ZUD24 (Stuggart (6.03), OIX4, Singapore (7.25, 9.825).

RADIO BATAVIA'S NEW 100KW TRANSMITTER

From the N.Z. DX Times comes the following information. Radio Batavia's new 100 kw transmitter is located in the suburb of Kebajoran and has been installed by the Post and Telegraph Department, being of General Electric manufacture. The transmitter is the most modern obtainable, and the complete installations are in keeping. Three diesel motors each supply 270 horse-power for the power supply.

The new transmitter will commence testing shortly, and go into operation in September as YDC with 24 doublets, without reflectors, bearing on Australia and New Zealand and in reverse to India and West Europe. As soon as a rhombic is completed they will also operate on 11795 kcs to Europe and West Coast, U.S.A., and on 6045 kcs directed to Northern Australia and South-East Asia. These latter frequencies will be in use before July, 1950, when the Mexico proposals take effect.

DZH3 (9.50). — Good, apart from interference.

SHORT-WAVE STATIONS OF U.S.A.

As I figure most short-wave listeners choose one wave-band and run right through it, most likely in the hope of perhaps striking a "new" one amongst their favourite station or stations, I am setting out hereunder a list of United States Broadcasting Stations and Overseas Relay Stations taken from the latest list to arrive by air-mail.

Although in New South Wales we have already had a touch of spring, may be, there are some more cold days still to be reckoned with before we go all "surf" minded, and I am therefore including some daylight times that will certainly fade as the warmer weather approaches. However, the unexpected is the rule with DXing as I have found in my 23 years of listening-in.

Met.	K.C.		A.E.S.T.	Call Sign — Beam
49.34	6080		1.15-8 a.m.	Munich III—Europe
			10 a.m.-Noon	WLWU—W. S. America
41.39	7250		1.15-8.15 a.m.	Munich IV—Europe
31.48	9530		10 a.m.- 1 p.m.	WGEU—E. S. America
31.45	9540		1.15-8 a.m.	Munich II—Europe
31.35	9570		10 p.m.-12.15 a.m.	KWID—East Asia
			10 a.m.-Noon	WRUM—Cent. America
		W/SU	Noon-1 p.m.	WRUW—Cent. America (U.N.)
			1.15-6.15 p.m.	KWIX—Alaska (Aleut.)
31.09	9650	W/SU	5.15-6.45 p.m.	KNBI—Hawaii/Aust. (U.N.)
			7 p.m.-12.15 a.m.	KNBI—Hawaii/Aust.
31.02	9670		7 p.m.-8.30 p.m.	KCEI—Mid-Pacific
			8.45-12.15 a.m.	KCEI—Marianas/Phil.
		T/S	9-10 a.m.	WNRX—So. America (U.N.)
			10.30-Noon.	WNRX—So. America
30.93	9700		7 p.m.-12.15 a.m.	KSBF—Japan
			10 a.m.-1 p.m.	WLW-2—W.S. America
30.77	9750		7 p.m.-12.15 a.m.	KNBA—East Asia
25.62	11710	T/S	0-10 a.m.	WLRI-1—W.S. America (U.N.)
			10 a.m.-1 p.m.	WLRI-1—W.S. America
25.58	11730		7 p.m.-12.15 a.m.	KGEX—Phil/E. Indies
25.49	11770		10 a.m.-Noon	KNBI—So. America
25.45	11790		7 p.m.-12.15 a.m.	KNBX—East Asia
			6-8.30 a.m.	WRUS—Europe
			10.30-Noon	WRUL—E.S. America
		W/SU	Noon-1.30 p.m.	WRUL—E.S. America (U.N.)
25.29	11860		6.30 p.m.-12.15 a.m.	KWIX—Japan
25.27	11870		1.15-1.45 a.m.	Munich IV—Europe
			3.30-8.15 a.m.	Munich I—Europe
25.23	11890		7 p.m.-12.15 a.m.	Manila I—Far East
			8-10 a.m.	Manila I—China
25.21	11900		3.30-9.30 a.m.	KWID—So. Pacific
29.83	15130	W/SU	5.15-6.45 p.m.	KNBA—East Asia/U.N.
			7 p.m.-12.15 a.m.	KSBR—Phil./E. Indies
			1.15-8.30 a.m.	WOOC—Europe (U.N.)
			9-10 a.m.	WRUL—Caribbean (U.N.)
			11 a.m.-Noon	WRUA—Cent. America
19.81	15150		4-7.45 a.m.	WRCA—Europe
			11.15 a.m.-6.30 p.m.	KCBA—Alaska/Aleu.
19.72	15210		3.30-6.45 p.m.	KGEI—Mid.-Pacific
			7 p.m.-12.15 a.m.	KCBA—Marianas/Phil.
			2-3.45 p.m.	WRUA—Europe

			4-7.45 a.m.	WBUS—Europe
		T/S	9-10 a.m.	WRCA—E.S. America (U.N.)
			10.30 a.m.-Noon	WRCA—E.S. America
19.69	15240		8 a.m.-10 a.m.	KNBX—Hawaii
19.67	15250		3.30-6.30 p.m.	KNBX—So. Pacific
			7 p.m.-12.15 a.m.	KRHO—East Asia
			1.15-7.30 a.m.	WLNR-1—Europe
			8-8.30 a.m.	WLWR-1—Europe
			8-10 a.m.	Manila II—East Africa
			10 a.m.-Noon	KCBR—So. America
19.64	15270		1.15-7.30 a.m.	WCBN—Europe
			10 a.m.-1 p.m.	WCBN—So. America
19.63	15280		2-3 a.m.	Munich I—Middle East
19.62	15285		3.30-8.15 a.m.	WNRE—Europe
19.57	15330	W/SU	5.15-6.45 p.m.	Manilla II—S.E. Asia (U.N.)
			7 p.m.-12.15 a.m.	Manila II—East Asia
			7-8.15 a.m.	WGEU—Europe
		T/S	9-10 a.m.	WLWR-2—W.S. America (U.N.)
			10 a.m.-1 p.m.	WLWR-2—W.S. America
19.54	15350		11 p.m.- M/N	WLWR-1—W.S. America
			3.30-6 a.m.	WRNL—Europe
			6 a.m.-7 a.m.	WRUL—Europe (W.W.)
			7-8.30 a.m.	WRUL—Europe
16.90	17750		9-10 a.m.	WRUX—Caribbean (W.W.)
16.90	17755		2-6 a.m.	WRUW—Europe
			6-7 a.m.	WRUX—Europe (W.W.)
			7.30-8.30 a.m.	WRUW—Europe
16.89	17760		7 p.m.-12.15 a.m.	Manilla III—E. Asia
			10 a.m.-Noon	KWID—So. America
16.88	17770		8-10 a.m.	KCBF—Philippines
			11.15 a.m.-6.30 p.m.	KCBF—Alaska/Aleu.
16.87	17780		3.30-6.45 p.m.	KGEX—Mid.-Pacific
			1.15-8.30 a.m.	WNBI—Europe
			10 .am.-Noon	WNBI—So. America
		W/SU	Noon-1 p.m.	WNBI—So. America (U.N.)
16.85	17800	W/SU	5.15-6.45 p.m.	KRHO—Phil./E. Indies (U.N.)
			7 p.m.-12.15 a.m.	KRHO—Phil./E. Indies
			8-10 a.m.	KRHO—Philippines
			11 a.m.-Noon	WLWK—W.S. America
		W/SU	Noon-1 p.m.	WLNK—W.S. America (U.N.)
16.83	17830		11 p.m.-M/N	WLWS-1—W.S. America
			2-8.15 a.m.	WCBX—Europe
		T/S	8.30-10 a.m.	WCBX—So. America (U.N.)
			10.30 a.m.-Noon	WCBX—E.S. America
16.79	17880		2-7.45 a.m.	WGEX—Europe
16.52	18160		1.15-8.30 a.m.	WNRI—Europe (U.N.)
13.97	21460		10 a.m.-Noon	KNBA—So. America
13.96	21500		1.15-8.30 a.m.	WOOW—Europe
13.91	21570		2-8.30 a.m.	WCRC—Europe
			10 a.m.-Noon	WCRC—So. America
13.89	21590		2-8.15 a.m.	WGEA—Europe
13.88	21610		1.15-8.30 a.m.	WNRA—Europe (U.N.)
13.85	21650		1.15-8.30 a.m.	WLWS-1—Europe
13.83	21690		2-8.15 a.m.	WLWL-1—Europe
13.82	21730		2-7.45 a.m.	WNRX—Europe
13.81	21740		8-10 a.m.	KCBA—East Asia

T/S—Tuesday through Saturday. W/SU—Wednesday through Sunday. (W.W.)-World-wide Broadcast. Corp.

MODULATOR (Continued from page 24)

This transformer is not normally fitted unless the pre-amplifier is omitted as in Type M3-75 modulator. A cover plate is provided for the mounting hole. Behind the 807 driver valve is seen the driver transformer, to the right is the 6SQ7 valve, and at the extreme right is the die cast case shielding the 6J7 valve and R1, R2 and C1. A taller metal shield would be required if a 6J7G valve is to be used.

The underneath view shows the location of the filament transformer T3 adjacent to the 5R4GY socket, and the a.c. mains connector on the back of the chassis. The four-pin power socket is near the earth terminal, the eight-pin power socket being at the back r.h. end of the chassis. At the front from left to right is the pilot lamp socket, volume control and microphone connector.

When wiring, make all earth connections to a bus-bar, and earth at one point only on the chassis.

Output Meter Unit

(Continued from page| 7)

socket of the set under test for cases in which the speaker connections are from octals or other sockets that are only encountered on add occasions.

Finally there is another method of finding the turns ratio of an output transformer and that is to apply a known A.C. voltage to one winding of the output transformer (preferably the primary) and measure the voltage across the other, the voltage ratio between the two will be equal to the turns ratio. The output meter described herein could be used for this measurement.

Speedy Query Service

R.C.G. (Tamworth) writes and asks about hum in a high-gain pre-amp and how he might cure it.

A.—Hum is rather a wide and difficult field to cover here in a few lines. In a pre-amp, especially a high-gain one, efficient and extensive shielding is a MUST if you are to have an amplifier without hum. Running your heater lines near grid leads is asking for trouble, so twist your heater leads and keep them as far as possible away from the grids. Bypass the screen on pentodes direct to the cathode at the tube and not to earth. Earth one side of the heater circuit at the transformer only and bypass the other side on each tube with a small condenser, about .001. If hum is still present it is possible to apply inverse feedback to the affected stage. This results in slightly lower gain from the stage with an increase in bass response and a reduction in hum level, caused by returning an out-of-phase hum voltage from the plate to the grid circuit.

* * *

P.G. (Hughesdale) asks what fault would cause the screen of an output pentode to glow red.

A.—The screen grid of an output tube constitutes part of the load of the tube, across which the power is generated. The total plate and screen current is equal to the cathode current, now if the plate connection is removed, the screen still connected, then the screen has to carry the whole of the current. The screen current in only a fraction of the plate current normally, so when the screen has to carry both its own and the plate current it becomes seriously over-loaded and so runs red hot. Thus if the plate lead is disconnected, or the speaker transformer open circuited, the screen glows red.

* * *

M.R.K. (Ipswich) has a query about the alignment of a superhet. He asks whether the signal generator is set for its maximum output when aligning a superhet.

A.—No, the signal generator is not set for maximum output for the simple reason that most superhets are equipped with A.V.C. and the function of the A.V.C. is to alter the bias on the circuits which it controls, thus reducing the sensitivity of the receiver. Now, if you were to align the set with the signal generator at maximum output you would bring the A.V.C. into operation, thus reducing the sensitivity and so the set would be incorrectly aligned and you would not get the most out of the receiver. So the signal generator should always be set at a low level when aligning a superhetrodyne.

* * *

M.D.R. (Perth) writes and asks if it is possible to check the operation of the A.V.C. circuit in a receiver merely by using an oscillator and a voltmeter.

A.—Yes, it is quite possible to check the operation of the A.V.C. with only an oscillator and a voltmeter. The voltmeter is set on a low range of about 10 volts and is connected across the cathode resistor of one of the controlled stages. The oscillator is hooked to the input of the receiver and the reading of the voltmeter noted. When the output of the oscillator is increased the cathode voltage should fall, if the A.V.C. is working properly.

* * *

T.G. (Dandenong) enquires about using one side of the A.C. mains as an aerial and as to the safety of the scheme.

A.—It is quite common practice in many small mantel sets now on the market to use one side of the mains as an aerial. The idea is to use a good mica condenser with a high voltage rating between the aerial terminal and one side of the mains. The idea achieves quite good results and is safe so long as the condenser is of good quality and high working voltage. If the condenser should fail, it lets the A.C. flow through the aerial coil, thus burning it out and possibly charging the chassis, making it lethal.

* * *

T.W. (Malvern) enquires about cathode followers and their application to general audio amplifiers. He also asks about their gain and frequency response.

A.—Cathode follower circuits have found a wide application in many electronic designs and systems where a really wide frequency range is required in F.M., T.V. and radar. The special feature of the design is flexibility where impedance is concerned. It is possible to match any two impedances merely by calculating the appropriate cathode resistors for the two coupled stages. Another valuable point is the fact that the input impedance is high and the output impedance is low, thus enabling you to run any length of low impedance line from a pre-amplifier to the actual power amplifier. This eliminates the need for line to-grid transwormers. Although the actual stage gain is not high, the consideration of frequency response and impedance matching cannot be disregarded.

* * *

R.B. (Finley) asks whether 32-volt vibrators are available.

A.—As far as we can find out, through enquiries to the principal suppliers, 32-volt vibrators are not available at the present. We have not investigated all fields as yet. We hope that we will be able to procure them, because we would like to run an article on a 32-volt vibrator-powered farm radio.

BARGAIN CORNER

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

WANTED.—Plugs and Cables for connecting Bendix RA1OFA receiver to remove control unit. K. Semmler, Box 26, Murtoa, Vic.

FOR SALE. — Valve and Circuit Testor. "Tranpro," a.c. or 6v. d.c. operation, with adaptor panel. New condition; £26 or offer. G. Russell, 36 McLachlan Street, Northcote, Vic.

WANTED. — Type A, Mark III, Transceiver. Telegram to 8AF, Weekatharra, West Australia, collect, will get prompt reply. Henry McLeod, Onslow, W.A.

FOR SALE—Sturdy, well-built amplifier, with two 807's, four 6J7's, variable output matching. A/C 230v. or D/C 12 volts, 2 cone speakers, 2 meters, mike and stand, 2 generators. Worth £65, but will sell for £28. A. H. Davies, 8 Lavina Street, Gympie, Queensland.

FOR Model Aeroplane Motors, new and second-hand, Ohlssons, McCoy and Eta. Write "8514," care of Box 13, Mornington, Vic.

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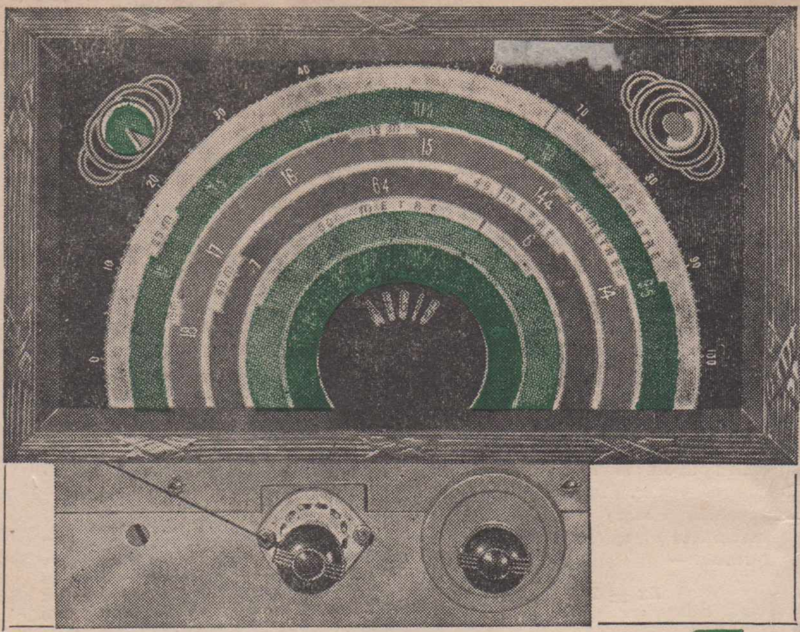

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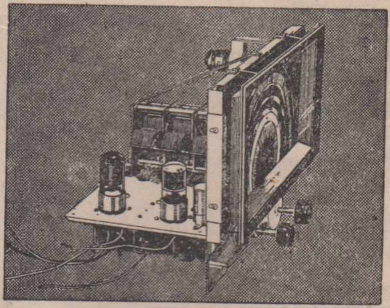

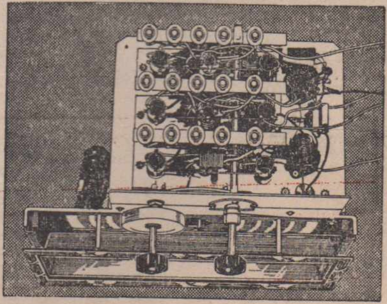

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