THE AUSTRALASIAN

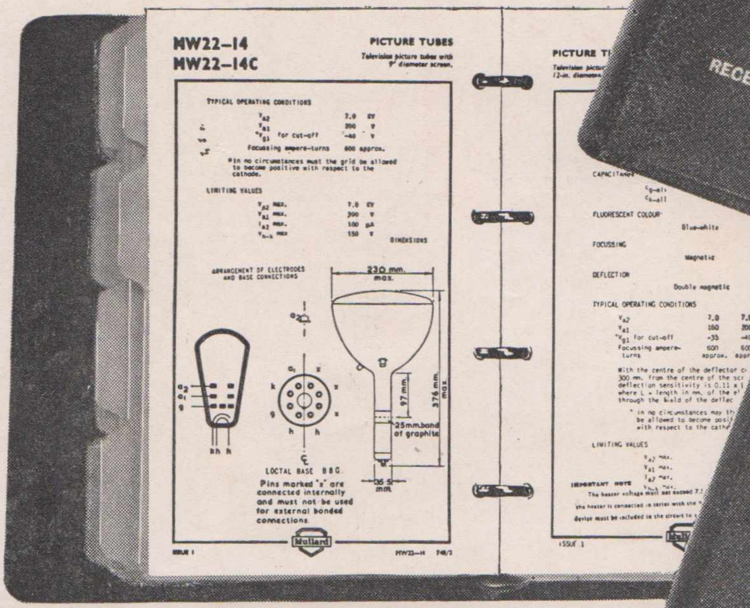
Radio World

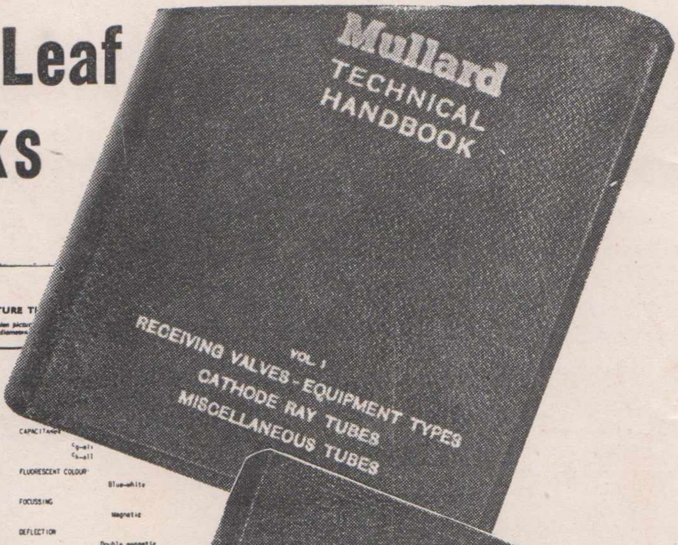
1/6

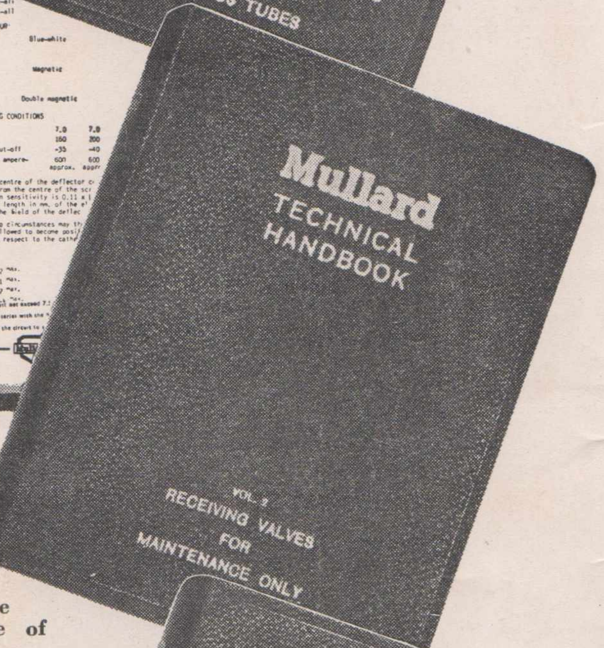
Vol. 14 ... No. 7 December 15, 1949

periodical

Mullard Loose Leaf VALVE DATA HANDBOOKS







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Vol. 14 DECEMBER, 1949 No. 7

CONTENTS

EDITORIAL

THE passing year has not been a happy one in the technical radio trade. Some of the biggest manufacturing firms have gone into liquidation; others are anything but bright, cutting down on the advertising and other expenses. Some seem determined that there shall be a depression, and they are making quite sure they will get the worst of it by withdrawing their support from the technical magazines which do so much to foster interest in the game.

A big factor in the present position of the trade has been the amount of money which has gone direct from radio enthusiasts to the Wireless Institute for the purchase of surplus, ex-army, disposals gear. The Institute has handled many thousands of pounds of money, thereby diverting it from the existing component factories. If this amount of money had been spent in the ordinary way, a large percentage of it would have been expended in the development laboratories, in the making up of new tooling for new lines. Instead, we find the component factories short of buyers, without funds with which to develop new lines or produce them.

Fortunately the cream of the disposals business has now been skimmed, and it is expected that trading conditions will be greatly improved during the coming year.

A lot of money has been wasted by amateur set-builders who blindly followed the enthusiasm of those who recommended the building of F.M. receivers. That phase has now passed, so the future is brighter.

—A. G. HULL.

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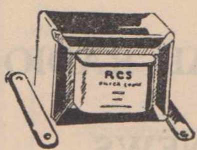

1

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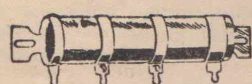

3

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Wound with oxidised nichrome wire on round bakelite formers 3¾in. x ¾in., complete with mounting legs.

VD25 15,000 ohms, 2 variable clips 5 6

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If you are unable to obtain from your local dealer write us and we will arrange for your retailer to receive supplies immediately or advise you where supplies can be obtained

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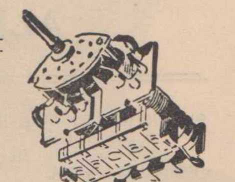
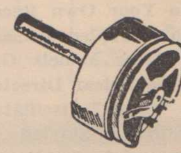


D.W. 37
Dual Wave Unit with R.F. Stage £6/10/-

D.W. 29 .... 4/5
Dual Wave Unit £1/14/-

POTENTIOMETERS AND RHEOSTATS 5



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PT 39	20 ohm 25 amp
PT 34	30 ohm 25 amp
PT 46	400 ohm 50 M/A
PT 47	1,000 ohm 35 M/A
PT 49	2,500 ohm 30 M/A
PT 51	5,000 ohm 30 M/A
PT 52	10,000 ohm 30 M/A

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FEATURE ARTICLE

"SUPER-SIX" AMPLIFIER

With Pre-Amplifier and Equaliser for Gramophone Recording and Reproduction.

By

JOHN McLEAN BENNETT

SOME time ago the occasion arose for a somewhat versatile amplifier, having at least two microphone and two pick-up inputs. The minimum power practicable was considered to be about 10 watts, as the amplifier was to be used for recording, as well as in a hall for P.A. work.

Taking firstly the recording angle, prime consideration is the frequency range. As you near the centre of the disc when recording, the linear velocity of the grooves past the cutting stylus is seriously decreased.

This result is rather a large increase in bass notes on the disc, making reproduction "woolly" or "fuzzy." This state of affairs can be overcome by boosting the treble notes as the recording diameter decreases. Hence the main desirable factor in the amplifier is separate treble and bass control, with a good, wide range. Secondly, there is the matter of output impedance. Some cutting heads are of the high-impedance type, especially the crystal variety. However, we will be concerned mainly with the magnetic type. In general, the impedance of magnetic cutting heads is somewhere in the vicinity of 500 ohms. Thus the unit must have a 500 ohm line output.

So much for the recording. The P.A. system requirements are not at all difficult; the only need being a 500 ohm output.

THE UNIT AS A WHOLE

The first requirement from an operating point of view is that at any instant you can tell at a glance just which turntable or mike is operating.

This is made possible by a system of pilot lights. Another detail to make operation quick and simple is that any mike or pick-up can be switched in or out without altering the gain control and thus the original level of the sound. This is done by using a set of four key-switches in the grids, effectively earthing them when the switch is in the "off" position. Also connected to these switches are the pilot light circuits.

By taking adequate precautions as regards shielding, little trouble is experienced with hum. Two red pilots are used on the mikes and two green pilots on the pick-ups. The lights come on simultaneously with the input in question. Individual gain controls are included in all input circuits and these are followed

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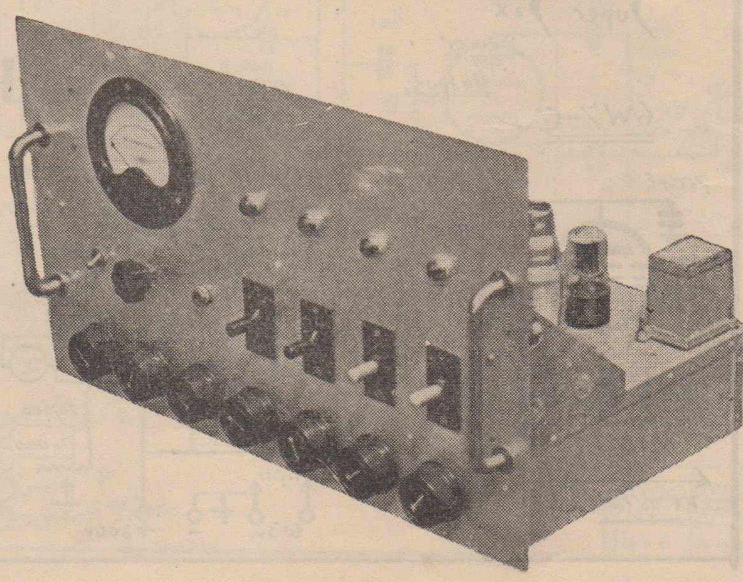

SUPER-SIX

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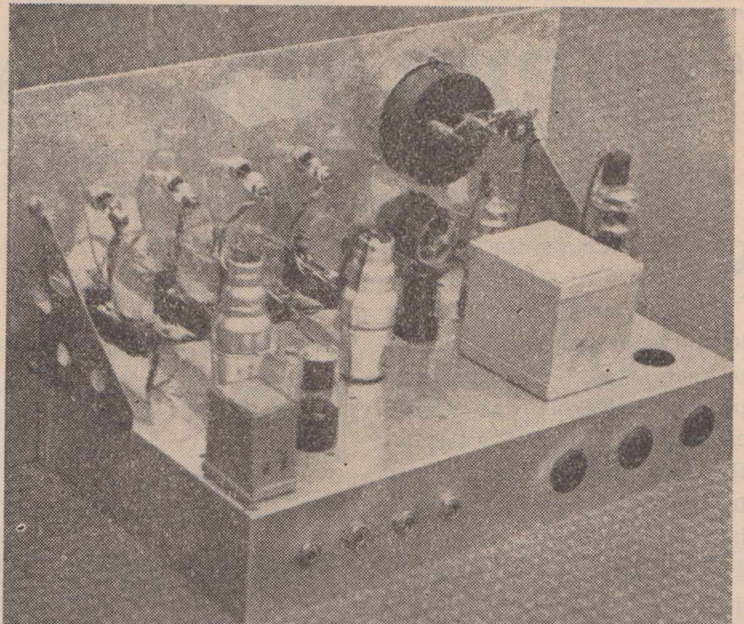


by a main gain control, in the grid of the equalizer.

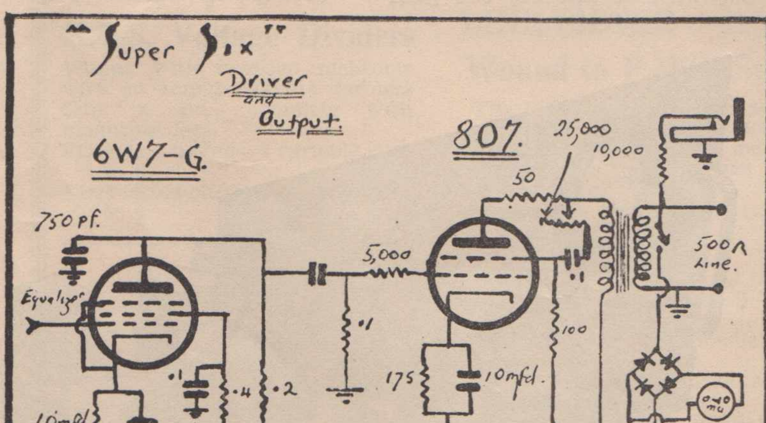
The treble and bass controls give an excellent range of frequency and no trouble is experienced at any stage while recording.

The output transformer is an ex-disposal job with a load impedance of about 3,000 ohms and a 500 ohm output. It is a hi-fi job turned out by U.T.C. of America. Just what it was used in is a bit obscure but it does an excellent job in this piece of equipment.

The level meter, which is an uncalibrated 0-10 ma.., is not intended to give an actual db. reading. It is included merely as a reference level indicator and can be set so that you are able to retain an approximate constant level.

The output measured across the secondary of the output transformer was 8.4 watts.

Assuming an efficiency of 75 per cent. this give an output of 11.2 watts from the valves. All these measurements were made on the secondary into a 10,000 ohm resistive load with a sine wave input of 4,000 c.p.s., with 300 volts on the plate and about the same on the screen.



THE CIRCUIT

There is nothing really complicated about the circuit, but on first inspection it may appear to contain extravagant and unnecessary bits and pieces. This, to a certain extent, may be true, but any equipment which has sufficient scope to make operation simple and efficient is worth its weight in gold.

Many look with contempt upon the idea of pilot lights in **the input circuits, but in use, especially in a dark control room of a theatre, this scheme proves its worth.**

The pre-amplifier for the mikes is quite orthodox, using a twin-triode with the plates separate.

The gain controls are in the second stage to eliminate, as far as possible, any noise from the potentiometers. The divider network in the grids of the two 6J7's does not load them unduly, and the small extra resistance does not result in a great loss in gain. Inverse feedback was incorporated in the parallel 6J7 stage to reduce a little hum from the long grid lines. This results in better bass response and some reduction in stage gain. The feedback introduced here was found to be sufficient and so we did not use it in the output stage. nevertheless, the output stage is linear and is actually a little better than we expected.

The 6C5 compensation stage is straight forward, and although the stage gain is low the additional benefit gained through it being in the amplifier more than repays the cost of the parts for it.

The treble boost obtainable through its use is invaluable when recording at 33 1-3 r.p.m.

The 6W7 driver was used mainly because it happened to be on hand, but we tried a 6AC7 in the same position with a marked increase in gain. If a 6AC7 is used as the driver, the cathode resistor should be replaced by a 1,000 ohm resistor. The 807 output tube is operating in straight-out class A with a load impedance of about 3,000 ohms. A conventional tone control is included in the plate and screen circuits, giving cntrol over high notes.

INPUT CIRCUITS.

When the amplifier was first conceived there was some doubt as to whether there would be any trouble with clicks, due to voltage surge, as the switches were opened and closed. We hoped that by placing the switches in the pre-amplifier grids that this trouble would be cut to a minimum. As it so happened everything worked out as we wanted.

The switches are handy when you are running a show, or using the unit for P.A. work. This amplifier made its debut in the Prahran Town Hall, Melbourne, at a variety show, and was built specially for the job. We were able to cut out noise coming from either mike while the main sound was coming from the other, or on the other hand, use both together and switch at will. This is necessary in stage and theatre work and this box of tricks ran continuously from 7.45 p.m. 'till 11.10 p.m. without any trouble or worry, and

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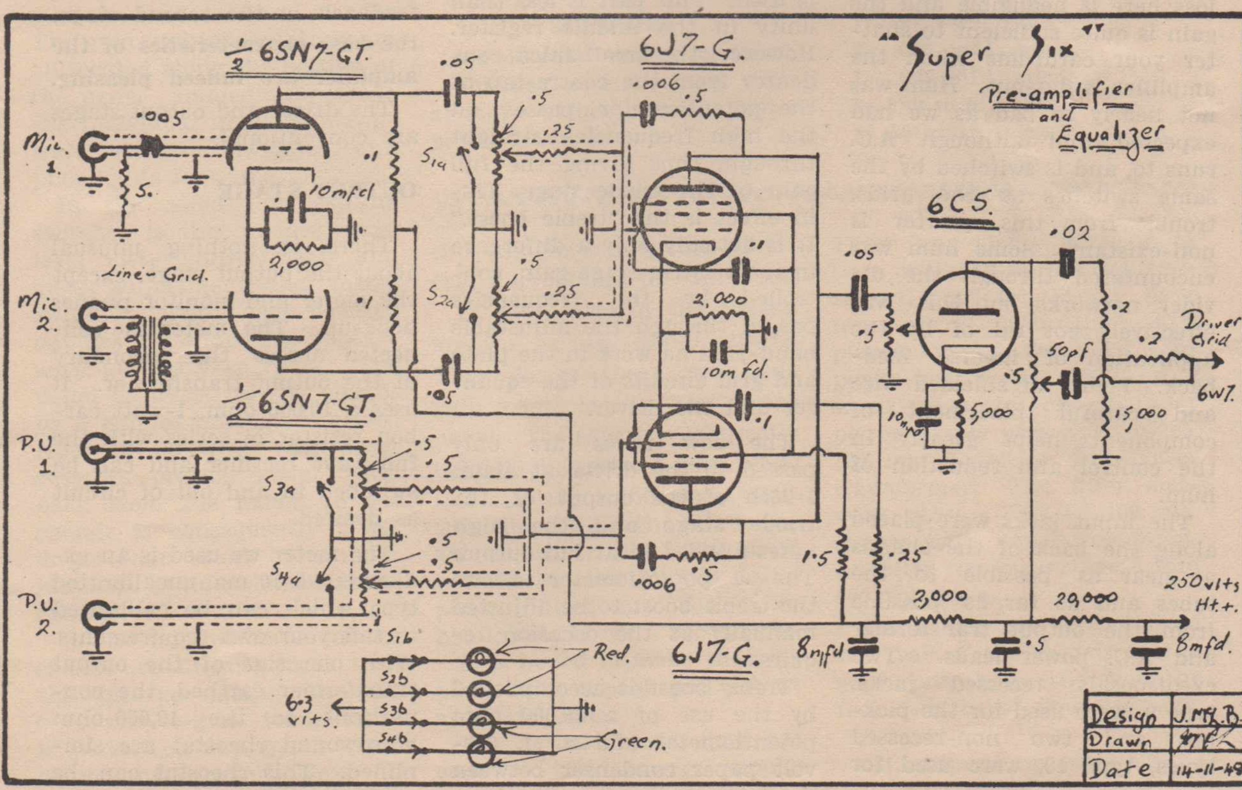


SUPER-SIX

(Continued)

has been running for many hours since.

The mike inputs are universal, providing for high gain crystal or low-impedance-line dynamic types.

We have successfully run 35 yards of ordinary single-core shielded wire, using a D104 crystal mike, and experienced no hum trouble. Alternatively we ran 210 yards of 600 ohm line to the low-impedance jack. These two inputs afford unlimited scope for types of input and impedance of same.

No gain controls are included in the grids of the 6SN7 as there is no possibility of ever overloading this tube.

The pick-up inputs are isolated by a pair of .5, 1-watt, carbon resistors. The treble loss here is negligible and the gain is quite sufficient to shatter your eardrums when the amplifier is flat-out. Hum was not nearly so bad as we had expected, and although A.C. runs to, and is switched by the same switches as the grids, trouble from this quarter is non-existant. Some hum was encountered through the divider networks but this was effectively got rid of by the application of inverse feedback. Plenty of shielded wire and careful placement of components helps greatly in the control and reduction of hum.

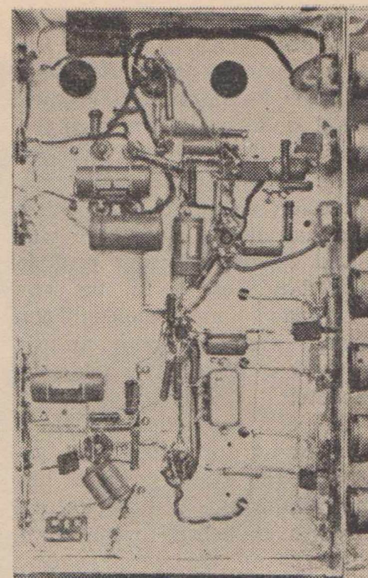
The input jacks were placed along the back of the chassis as near as possible to the tubes and as far as possible from the output transformer and A.C. power leads. Two ex-disposals recessed jacks, type 9, were used for the pick-ups and two non-recessed types, type 10, were used for the mikes. This is purely a safety precaution so that you can't plug a pick-up into a mike jack by mistake and consequently knock the place flat.

EQUALISER & TREBLE BOOST.

The plate of the 6C5 equalizer is fed through a .5 megohm potentiometer. A small condenser from the tapping feeds all the high frequencies straight to the grid of the driver. The divided network in the grid of the 6W7 only allows about 1-20th of the voltage developed across the .5 load to be passed through the .02 coupling condenser to the grid, so that only part of the actual gain of the triode stage is used. This part is less than unity in the middle register. However, the small mica condenser from the centre-tap of the potentiometer passes all the high frequencies straight through, thus giving the full gain of the triode stage. This in effect is the "treble boost." It is actually only a difference in the relative stage gain, controlled by the frequencies passed through the adjustable band-pass network in the plate and grid circuits of the equalizer and the driver.

The low notes are only passed to the driver at about 1-20th of the output of the triode stage and the high notes are fed in at full output. The .1 potentiometer allows the treble boost to be adjusted manually as the occasion requires.

Treble boost is accomplished by the use of a 25,000 ohm potentiometer and a .1, 600-volt paper condenser between



the plate and screen of the 807.

This gives plenty of control over frequency, and working in conjunction with the inverse feedback in the second stage, the bass characteristics of the amplifier are indeed pleasing.

The driver and output stages are conventional.

OUTPUT STAGE

There is nothing unusual about the output stage, except the meter and monitor phones hook-up. The meter is connected across the secondary of the output transformer. It uses a 10,000 ohm, 1-watt carbon resistor in series with the full-wave rectifier and can be switched in and out of circuit as desired.

The meter we used is an ex-disposals 0-10 ma. uncalibrated type which can be calibrated to suit your own requirements. With one side of the output transformer earthed, the connections to the 10,000-ohm wire-wound rheostat are simplified. This rheostat can be placed in series with the 10,000 ohm carbon resistor as a level adjustment.

The phones are also connected across the secondary of the transformer through a 10,000 ohm carbon resistor. This eliminates the need for a gain control on the phones and keeps the power fed to them at a reasonable level. We used a pair of low-impedance phones as monitors. The large resistance across the output does not have any obvious loading effect and there is no decrease in output when the phones are plugged in.

CONSTRUCTIONAL

The amplifier is built on a 17in. x 10in. aluminium chassis, to fit a standard rack.

The front panel is also aluminium, and is 19in. x 11in. The gain and tone controls are all located along the bottom of the panel. Immediately above the individual input gain controls are the switches and pilot lights for same.

In the same line as the switches is the phones jack, level meter adjustment and meter adjustment and meter switch. Two nickel-plated handles are added for appearance and easy carrying. The panel is braced to the chassis by a pair of brackets removed from an old "108." The lever switches project about 3½in. back from the panel, so the chassis is consequently a bit larger than usual. The input jacks are along the back of the chassis.

In the extreme corner of the chassis are the mike jacks, then the pick-up jacks. The 600 ohm line-to-grid transformer is placed on top in the rear right-hand corner. Next to the transformer is the 6SN7-GT. microphone pre-amplifier.

In the centre of the chassis are the parallel 6J7-G mixers. This places them near the gain controls on the front panel. The equalizer is directly behind the master-gain control and the treble boost control, then beside the 6C5 is the 6W1-G. driver tube. The blank hole beside the 6W7 is for a phase-splitter and the other blank hole is for a second 807.

It is hoped to make the amplifier into a push-pull job at at a later date.

The actual chassis does not contain the power supply. There was plenty of room to have included it but we considered that we would have less worry with hum and placement of parts if the power supply was built on a small separate chassis. Our power supply uses a 385-0-385, 100 ma. 6 volt, 4 amp-power transformer. The filter network uses a pair of 100 ma. chokes with condenser input. All filter condensers are 8 mfd 600 volt type.

The inputs are carried from the rear of the chassis to the gain controls on the front by four lengths of shielded wire,

(Continued on page 50)

PARTS LIST

1-Chassis. 17in. x 10in. x 3in.
1-Output transformer. (See text.)
1-0-10 ma. moving coil meter.
4-Double-pole-double - throw level switches.
2-Pilot Lights (green).
8-Knobs.
2-Pilot lights (red).
2-Nickel - plated. cabinet handles.
4-Open-circuit jacks.
1-Closed-circuit phone jack.
1-Single-pole - single - throw
1-Panel, 19in. x 11in.
1-Input Transformer. 600 ohm line-to-grid.
2-Small brackets.

VALVES

1-6SN7-GT, 1-6C5, 1-6W7-G (or 6J7-G, 6AC7, etc.), 2-6J7-G, 1-807.

SOCKETS

5-Octal 2 5-pin, 2 4-pin.

SUNDRIES

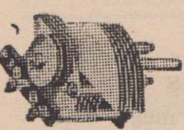
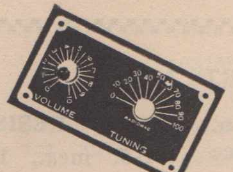
1-Full-wave meter rectifier.
Shielded wire, hook-up wire, anchor strips, nuts, bolts, power leads, etc.

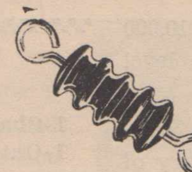
RESISTORS

1-5. meg., 1-1.5 meg., 4-.5 meg., 1-.4 meg., 4-.25 meg., 2-.2 meg, 1-.15 meg., 3-.1 meg., 1-20,000 ohm, 1-15,000 onm, 2-10,000 ohm, 2-5,000 ohm, 4-2,000 ohm,. 1-100. ohm,. 1-50 ohm, 1-3,000 ohm W.W., 1-175 ohm W.W., 6-.5 meg. potentiometers, 1-25,000 ohm potentiometers

CONDENSERS

2-.8 mfd. 525 P.V. electrolytics.
5- 10 mfd. 40 P.V. electrolytics.
1-. 5 mfd. tubular.
4-. 1 mfd. tubular.
3-. 05 mfd. tubular.
1-. 02 mfd. tubular.
1-. 01 mfd. tubular.
2-. 006 mfd. mica.
1-. 005 mfd. mica.
1-.750 mmf. mica.
1-.50 mmf. mica.


Radio Accessories

Whether you wish to build a humble crystal set or a multivalve all-wave radio—PRICE'S RADIO must be your logical choice for the components.

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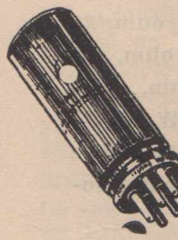

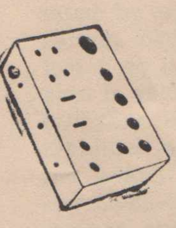



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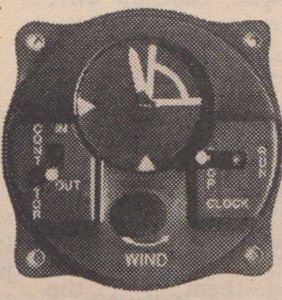

TIMER

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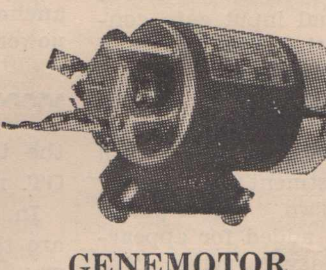

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IN SEARCH OF PLEASING TONE

Sets of Yesterday & Today

A further contribution to the controversy about tonal quality comes from a versatile author who has earned much fame for his articles on test equipment, which have appeared in our columns in recent months.

By
H. M. WATSON,
89 Botling Street
Albert Park, South. Aus.

BEFORE criticising the modern set it is necessary to hear it at the same time as an old-timer. When all is said and done it is purely a matter of relativity. Even the old cracklers of the horn speaker days sounded quite good in their hey-day as there was nothing else with which to draw a comparison. Reception from a crystal set does not seem any better than it did about 25 years ago, although undoubtedly it is, if only due to improvements at the transmitter end. In spite of all this, one has only to listen to a set of the latter prewar years, along with a postwar set, to realize that the former is by far the most pleasant to listen to. But why?

There are so many factors entering into radio design and construction that almost any improvement in one direction results in the introduction of some disadvantage in some other direction. As one so-called refinement is added, it in turn requires another refinement to counteract some ill effect of the first, and so it goes on. Wherever we stop, there is still the last addition requiring some correction. If everything goes according to plan this last disadvantage may be lesser than the first; on the other hand it may not. In any case, why introduce more trouble by adding unneeded circuits? No radio component is 100 per cent. perfect, so the less we use to obtain our objective the greater the efficiency.

It is the endless range of combination of these subsidi-

(Continued on next page)

CATERING FOR THE ENTHUSIAST IN N.Z.

A fine display of radio goods is shown in this photo of the interior of S.O.S. Radio Ltd., 283 Queen St., Auckland. Managing-Director Eckford is a keen supporter of Australasian Radio World.

TONE

(Continued)

ary circuits that is responsible for one never being satisfied with any one circuit, but always rebuilding it, adding this and eliminating that, in search for something better.

An increase of sensitivity by the use of high-gain coils, etc., results in increased selectivity; that is the band width is narrowed down or in other words side band cutting results.

This increased sensitivity enables a set to reproduce a weak signal from a distant station and the increased selectivity cuts out stations on adjacent channels. This is all to the good for the small minority of listeners, whose main object is to listen to interstate stations, and by so doing show that they like distortion in any case. The greater majority, who only listen to their local programmes, have no need for this high degree of sensitivity, and the selectivity that goes with it, as without the sensitivity there would be no stations audible on adjacent channels to interfere; sidebands would not be cut and fidelity would not be impaired.

A.V.C. is a good idea to iron out fading on S.W. reception or to stop the loud blast when tuning through a strong local to a distant station, but then again, anyone who listens to interstate broadcasts and its accompanying noise would not be unduly worried by a loud blast here and there. In any case, with less sensitivity A.V.C. is not required. It introduces harmonic distortion due to shunting of the diode load resistor and in many cases is responsible for noisy volume control operation as it, more or less, dictates the position of the volume control in the circuit.

Simple A.V.C. is not very satisfactory if one is in search of weak stations as the volume is also suppressed on these weak stations; delayed A.V.C. overcomes this difficulty but has the disadvantage of differential distortion, that is distortion just as the A.V.C. commences to overcome the delay voltage. Due to A.V.C. the volume remains constant even when the signal is slightly detuned and one must tune by the quality of reproduction rather than by volume. Quite a number of people cannot, or will not, tune their sets in correctly, being content to spin the pointer to somewhat near the station and let it rest there not seeming to worry about the distortion that results. When delayed A.V.C. is used a high noise level is present when tuning between stations due to A.V.C. being applied only when a station supplying a voltage higher than that of the delay is tuned. The manual volume control has to be advanced further with the A.V.C. applied than if the set were not equipped with A.V.C., hence the high noise level between stations where the set is most sensitive. This, of course, can be remedied by the use of quieting systems, just as stations could be accurately tuned by the use of a magic-eye or other tuning indicator, but then prevention is better than cure.

Take the case of inverse feedback. We build an amplifier with a large output and then feed portion of it back in phase opposition to reduce distortion and, with it, gain. This is somewhat similar to running a powerful engine with the brake on. Isn't it better to start with less power and distortion and let it run free?

Beam power valves, notwithstanding instrument readings to the contrary, are a source of distortion. It has been said that a beam valve with negative feedback will have less distortion than a triode for the same output. Perhaps this may be so with the triode flat out and the beam tube just cruising along with a reserve of power. Who wants to work the triode flat out? Another point is that distortion figures are measured across a resistive load and not across the speaker, in addition to which no one will deny that triode speaker impedences are by no means as critical as those for pentodes or tetrodes.

Instruments, whilst a necessary evil, are not infallible and have their limitations which are governed by whatever they are measuring at the time. If this were not so, we could measure A.V.C. voltages with a low resistance voltmeter or be sure that a valve would work if our tester said so. An instrument is one thing and a speaker another, therefore, how can we judge the quality of output from anything but the speaker? 50-cycle hum can be heard in the speaker because our eardrums will respond to variations of this frequency. Not so with our eyes, however, to which the meter needle would appear stationary; if our eyes could resound to this frequency we would be able to see our electric lights going on and off at a like rate. There is a time lag of something like one-tenth of onc second before the eye responds to a change. This is known as persistence of vision and is made use of in the projection of motion pictures.

Multiple valves are another doubtful advancement. In the case of frequency converters

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TONE

(Continued)

there is the inter-action between the local oscillator and signal circuit in addition to a fairly high level of random noise, while diode pentodes give rise to residual volume effects in some circuits.

The use of fixed padders, which, unless bridge tested, may be of doubtful value, leave much to be desired, also the dials calibrated with station call signs make tracking problems even more difficult.

Single control of aerial and oscillator coil tuning eliminates all hope of maintaining a constant I.F. all around the dial. The trimmers are peaked on the high and low frequency ends of the dial where tracking is achieved, as it is also at a cross-over point somewhere between; at all intermediate positions a tracking error occurs which adds to the distortion already created by the sharply-peaked I.F. transformers. A dual-wave receiver only complicates matters in this regard, as even if the gang condenser plates were to be perfectly shaped and bent in such a way to achieve correct tracking on one band, tracking would still be out on the other.

Then there are the problems of double spots, image frequency, etc., which have appeared with the introduction of the superheterodyne.

Such terms as A.V.C., dual wave, etc., are only names to the average buyer of a radio set who has seen and heard them advertised so often that he thinks a set is useless without their inclusion. Perhaps the most outstanding example of this is the number of people who buy dual wave sets and listen only to local programmes. A few may try the overseas stations when they first procure the set, but quickly give it away after one trial.

Thin plastic cabinets have taken the place of wooden ones for mantel receivers. Little provision for baffling of the speaker is made and the speakers which are small and reedy at the best, are often mounted on the chassis and

(Continued on page 35)

HOME RECORDING

Make Your Own Records

In response to numerous requests, here is the first of a number of articles dealing with the art of cutting your own gramophone records.

By

JOHN McLEAN BENNETT

EVER since the day Edison shouted into a horn on the first phonograph, recordings have been a source of continual joy and happiness to the world. Since that far-off day, many and vast improvements have been made in the field of recording the spoken word on disc and cylinder.

The old acoustic recordings of twenty years ago are looked upon with great amusement to-day. Nevertheless, during that era, in the days when the performers gathered around a funnel-like contraption and shouted at the top of their voices, these cylindrical music boxes were regarded as a luxury. To-day most homes possess a radiogram or turntable and pick-up, the purchase price of which is only a small fraction of the cost of first counterparts.

The method of impressing the sound waves upon the blank disc has advanced beyond sight since the evolution of the electronic amplifier. The day when the performers had to shout have been supplanted by the present system, whereby the merest whisper may be recorded as easily as a brass band.

Originally, the art of making the record was something that had never ventured beyond the laboratories. It was regarded as an involved science, as indeed it was. The greatest difficulty was the search for a suitable material upon which to make the recording. Wax seemed to be the only practicable recording base upon whch high-fidelity recordings could be made. The expense was considerable and the process complicated. The discs made in the wax compound were only of very short playing and wearing quality, and unless hardened by an expensive process, were not at all a practicable business. The wax discs were cast in massive, thick platters. These were hard to store and handle and generally became damaged in a short time.

Many substitutes were tried but none of the attempts proved successful and the quality of the recording was nothing to compare with the wax types. Admittedly, the pre-grooved aluminium and plastic discs were far more practical, but the public was not prepared to tolerate the loss in fidelity.

Like all things in life the problem eventually had a solution worked out for it, and the so-called "acetate" disc made its appearance. The acetate disc opened up unlimited fields, as the reproduced sound was of a quality far surpassing the wax. The wax has almost been replaced by the acetate.

The acetate disc takes the form of a thin circle of light

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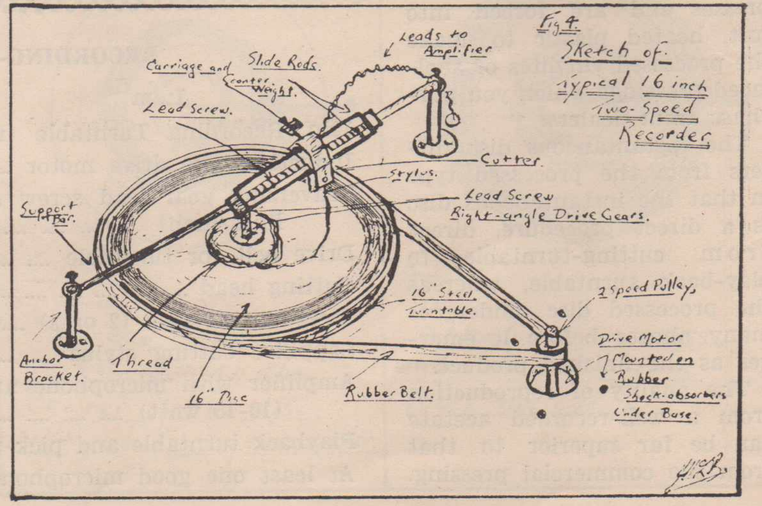


RECORDING

(Continued)

metal, such as aluminium, covered with a thin film of acetate-lacquer. This lacquer is the acetate which has the grooves cut in it and carries the modulation or sound.

Strictly, the term recording should only be applied to an instantaneous recording, i.e., an acetate, the instantaneous recording is one that can be played back as soon as it is cut.

The disc that you buy from the shops as a record, in the strict sense of the word, is not a record. A record, in the language of the sound engineer, is an instantaneous disc of the acetate variety. What is called a record by the general public is actually a processed copy of a record. This processed copy is termed a pressing.

The processing of a record to enable pressings to be made is long and complicated. The master record is cut, then it is silvered or graphited and electroplated. From the electroplating process the stamping matrices are made. These stampers are placed in the presses and are forced into soft, heated plastic to make the processed vinylites or shellaced pressings which you purchase from dealers.

The instantaneous disc differs from the processed type in that the instantaneous disc is a direct procedure, direct from cutting-turntable to play-back turntable, whereas the processed disc undergoes many phases before it emerges as the finished product.

The quality of reproduction from a well-recorded acetate can be far superior to that from the commercial pressing.

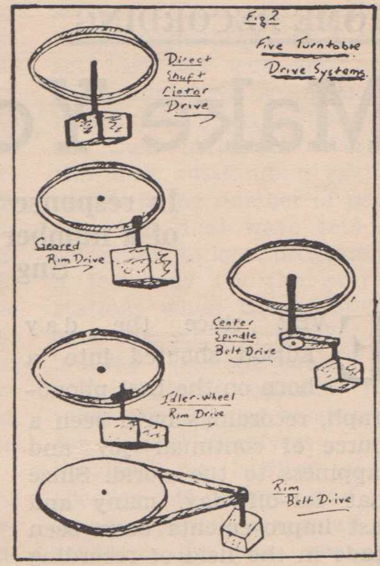
Today the hobby of home recording is within the reach of most persons. It is not a cheap hobby, but offers an unending source of enjoyment. There is nothing that can quite compare with the thrill of playing back recordings that you have made at your parties, dances, or the memorable occasions. You can collect them now and, perhaps, keep them for years, but there is always the feeling that they are there whenever you want them.

Today, radio stations use acetate discs to record their outstanding programme features, special features of presentation, parts of speeches, and every day they find some new application for their equipmeot.

The prices of recording gear range from about £50 to £500.

The small jobs do not cut a disc with anything like the accuracy of the larger and more expensive layouts. Nevertheless, with a well-built, small recorder many outstanding discs have been cut and in some cases the quality of the recording has been exceptional.

To start in the hobby really requires quite a long and im-



pressive list of equipment, set out beneath you will find a list of most, if not all you will need to start out. It is advisable to think twice before you actually start buying your equipment. **As was said before, the hobby is not a cheap one.** You may purchase a good deal of material and then decide not to go on. This will prove to be expensive in the long run, so think now and not later.

These are the almost basic essentials for the beginner.

RECORDING—THE COST

Item	Approx. Cost
12in. Recording Turntable (rim drive preferable)	£10 10 0
Induction-type drive motor	8 0 0
Traversing gear lead screw and drive (100 - 120 lines/inch)	12 0 0
Drive belt for turntable	5 0
Cutting head	£5 to 25 0 0
Steel cutting styli (2 or 3)	7 6
Sapphire cutting stylus	£1 to 2 0 0
Amplifier with microphone and pick-up inputs (10-15 watt)	£15 to 25 0 0
Playback turntable and pick-up (preferably 12in.)	£10 0 0
At least one good microphone	£6 to 20 0 0

PLAYBACK TIME : DISC DIAMETER.		
Disc Diameter.	33 1/3 R.P.M.	78 R.P.M.
6 1/2"	not practicable	1 1/4 mins.
8"	"	2 1/4 mins.
10"	3 1/2 mins.	3 1/2 mins.
12"	7 1/2 mins.	5 1/2 mins.
16"	15 mins.	not practicable.

Figure 1.

You could do without the sapphire cutter at the outset, but sooner or later you will need it. You can see that, as we said, the prices are quite high and well worth consideration before taking the plunge.

There are some commercially-produced units incorporating the motor, turntable, traversing gear, cutting head and mounting board. Two of these units that we know of are manufactured in Australia. Imported gear is out of the question now, especially American equipment.

Of the Australian products, one uses a traversing gear of the overhead type, the other uses a screw beneath the mounting board. The traversing gear is the screw and drive mechanism which carries the cutting head in a slow spiral movement towards the centre of the disc. This is done by using a threaded rod which is rotated either from the centre or the rim of the turntable. Travelling along this lead screw ,as it is called, is a type of nut, which is attached to the mounting that holds the cutting head.

This seems an appropriate time to introduce the reader to some of the terms commonly used in recording. Most of the words and expressions are derived from the proper names and are used only as slang, anyway it is just as well to get to know them.

AMPLITUDE. The height of a sound wave measured from the base line (zero) vertically to the crest of the same wave (positive peak).

AUDIBLE RANGE OF SOUND. Those frequencies audible to the human ear. From about 16 c.p.s. to 20,000 c.p.s.

BACKGROUND NOISE. Extraneous noises. sound effects, any noise or sound which is audible behind the main subject of the recording.

BALANCE. The respective levels of high and low frequencies in reproduction.

BASS NOTES. Low frequency musical notes (low pitch).

BASSY. Reproduction in which low notes predominate.

BOUNCING HEAD. When cutting on uneven or bent discs, the cutting head tends to bounce up and down. This can also be traced to poor suspension of the head where the spindle may be loose.

CARRIAGE. The section of the overhead mechanism that carries the cutting head.

CHATTER. The cutting stylus sometimes tends to vibrate or chatter while it is cutting.

CHIPS. The thread of lacquer that is removed as the groove is cut. Sometimes called the thread.

COUNTERWEIGHT. The weight placed on the back of some pick-ups and cutters to reduce the pressure on the surface of the disc.

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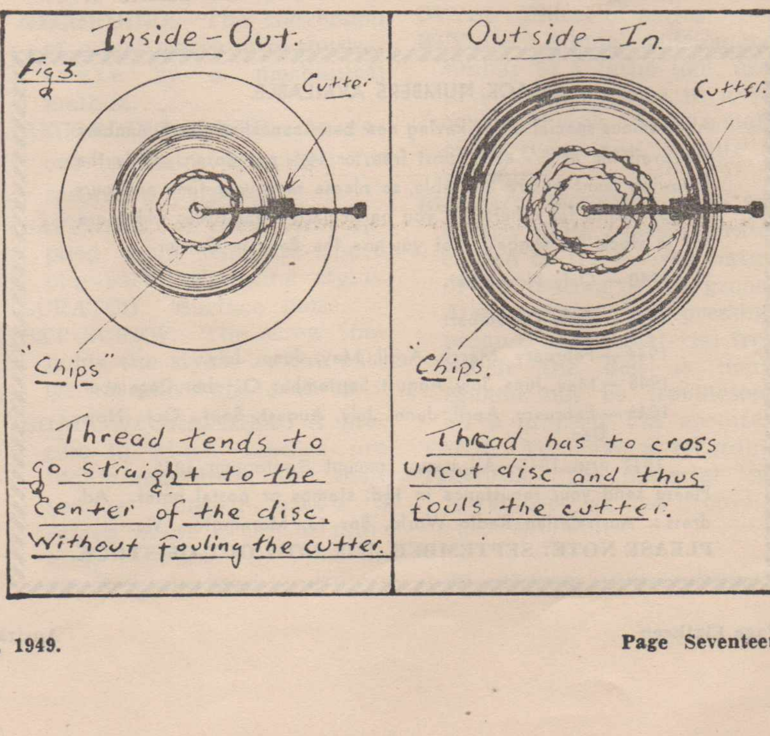

RECORDING

(Continued)

CUT. To cut a groove in the disc. The cut is the groove.

CUTTER. Shortened name for the cutting head.

CUTTING ANGLE. The angle between the vertical face of the cutting stylus and the surface of the disc, measured in degress. Should be a right-angle (90 degrees).

CUTTING HEAD. The piece of equipment which converts the electrical impulses from the amplifier into mechanical movement of the cutting stylus, which, in turn, makes the groove and puts the sound on the disc.

CUTTING OVER. One groove cutting over the space between the grooves into another groove. This is caused by overmodulating; feeding too much power into the cutting head.

CUTTING THROUGH. Cutting through the lacquer coating to the base of the recording, thus ruining the stylus. Caused by having the cutter set too deep.

DEAD ROOM. A room which has been sound-proofed so as to absorb most of the sound. The walls, ceiling, and floor may be covered with sound absorbent material thus preventing echo and reflection of the sound.

DEPTH OF CUT. The depth to which the cutting stylus cuts the groove in the lacquer on the recording disc.

DIG-IN-ANGLE. The angle at which the stylus is digging into the oncoming surface of the disc.

DISC. Short for recording disc.

DRAG-ANGLE. The state of affairs that exists when the stylus is dragging along the surface of the disc (opposite to dig-in-angle).

DRIVE HOLES. Three holes equally spaced around the corner of the disc to engage a drive-pin on the turntable to prevent the disc from slipping while it is being recorded.

DRIVE PIN. The small metal "pin" on the turntable to prevent the disc from slipping by fitting into a drive hole on the disc.

DRIVE PULLEY. The pulley used to give the required speed reduction in rim-driven turntables.

DRY CUT. A poor cut produced by a bad stylus or the wrong cutting angle. Recognised by the chips being brittle and dry.

DUBBING. An expression meaning to re-record from another recording. A "dubbing" is a re-recorded copy of another recording.

ECHO. The "ghost voice" or echo heard on some recordings, caused by overmodulation or cutting too deep.

EQUALIZER. An electronic system used to vary the tonal range of an amplifier. Controls the frequency response.

FADER. A volume control.

FIBRE NEEDLE. A play-back needle made from fibre. Used on commercial pressings to reduce needle scratch, due to its inability to reproduce the high frequencies. Should never be used on acetate instantaneous recordings.

FLUTTER. A high-speed wow caused by faulty drive mechanism or turntable drive.

"GHOSTS." The somewhat phantom voices often heard on recordings. See echo.

GLASS BASE DISC. A high-quality disc, used mainly for commercial "masters."

GREY CUT. See dry cut.

GROOVE. The spiral track cut by the stylus in the coating of the disc.

HEAD. Short for cutting head.

IDLER WHEEL. A small rubber roller used to transmit power from the motor to the shaft of the turntable, in rim-driven types.

INCLUDED ANGLE. The angle included between the sides of the cutting face of the stylus.

INSTANTANEOUS RECORDING. One that can be played back immediately after it has been cut, without the processing that accompanies the manufacture of commercial pressings.

LACQUER. The coating on the surface of recording discs of the instantaneous type.

LAND. The blank, uncut space between the grooves on a recording.

LEAD SCREW. The accurate screw that feeds the cutter across the disc while recording. It is operated from the turntable drive mechanism.

LEVEL (of sound). The volume of the sound.

LINERS PER INCH. The number of grooves per inch on the recording.

LINES. Grooves.

LINEAR VELOCITY. The speed at which a groove on the record passes a given point.

LIVE ROOM. One in which no provision has been made to absorb sound and thus prevent reflection and echos. A room that had not been sound-proofed.

LOWS. Notes of low musical pitch. Bass notes.

MARKER GROOVE. A groove cut to mark the end of a recording.

MODULATION. The sound which causes the cutting stylus to vibrate and thus make the wavy lines on the record. The amount of modulation on the disc determines just how wavy the lines will be. The amplitude (volume) of the modulation can be controlled by altering the power output of the amplifier.

MONITORING. Manually altering the level of the sound during recording. Listening to the output to compensate for different characteristics of different artists.

OVERCUTTING. See cutting over.

OVERLOADING. Feeding to more power than the cutter or speaker can handle without distortion.

OVERMODULATION. Too much volume or modulation.

PEAK. A high point of volume or a response to certain frequencies.

PRESSING. Another name for a phonograph record.

PROCESSING. An involved method by which common phonograph records are made. The term is used to cover the whole process.

RECORDING. The conversion of sound waves into physical state by a mechanical method.

RECORDING BLANK. An uncut or blank disc used for recording purposes.

SAPPHIRE. A short term applied to a sapphire-tipped play-back or cutting stylus.

SCRATCH. Surface noise.

SET SCREW. The screw that holds the stylus in the cutter or play-back pick-up.

SHADOW GRAPHING. A process in which needles are highly magnified, and their shadow thrown onto a screen where it can be minutely examined to show up any imperfections.

SHANK. The portion of a needle which fits into the clamp and is held by a set screw.

SHELLAC. The main ingredient in pressings. Thus Shellac Pressing.

SPOKES. A pattern formed on discs, radiating from the centre.

STELLITE. A tungsten alloy used as a tip for styli. A "stellite" is a stellite-tipped cutting stylus.

STROBOSCOPE. A card or metal disc on which is printed a number of lines, radiating from the centre, which, when viewed under alternating current, gives an accurate indication of speed.

STYLI. Plural of stylus.

STYLUS. A small cutting tool similar to a lathe tool, used to cut the grooves in a recording blank. It is usually made from steel, stellite or sapphire.

SURFACE NOISE. A high-frequency noise (needle scratch caused by the uneven nature of the bottom of the groove. Always found on pressings because of the material from which the disc is made. Should not be troublesome on a properly cut acetate.

TAKE. To make a recording.

THREAD. The material that is removed as the groove is cut. See chips.

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RECORDING

(Continued)

"TINNY." Reproduction that is lacking in lows.

TRACKING. The pick-up track perfectly with the grooves in a recording, i.e., follow them without jumping out.

TRANSCRIPTION. A high-quality commercial vinylite pressing or instantaneous recording, used by broadcasting stations for recorded programmes.

TUNER. The radio frequency section of a receiver, often used in conjunction with an amplifier. If of the superheterodyne type, may consist of the R.F., converter and I.F. stages. If of the T.R.F. type, it is usually of higher quality, and does not have an I.F. stage.

TURNTABLE. The circular, flat table which revolves and turns the record with it.

UNDERCUTTING. A groove that is cut too shallow or without sufficient modulation.

UNMODULATED GROOVE. A groove that has been cut without any sound being fed to the cutter. A silent groove.

VIBRATION. The cause of patterns on recordings, can usually be traced to poor suspension of the drive motor or other mechanical faults in the recorder.

VINYLITE. Short for vinyl resin pressing.

VINYL RESIN. A soft plastic material used for the production of pressings. Used for transcriptions where low surface-noise is more important than long life.

WALLS. The sides of the groove.

"WOW." A change in the speed of the turntable. Causes the reproduced sound to make a sound something like wowowowo——.

This list of terms may seem long, but although some of them are not often used, you may come up against them.

EQUIPMENT AVAILABLE

Having overcome the difficulty of the language, we move on to the more technical side of recording.

In Australia, recorders are not made in a wide range of complete factory built types. One or two firms turn out the complete article, but on the whole, they are of the studio or professional variety.

This places them in a high-price region, generally outside the reach of the home recordist. However, several firms manufacture all the parts separately, thus giving the recordist a chance to construct his own gear.

Byer Industries and Royce Recording make the greater part of the Australian equipment.

In buying your gear, especially the mechanical part of of it, there are some points that are well worth watching.

Firstly, you must decide just what you want from your recorder. Are you going to record on discs greater than 12 inch in diameter? Are you going to record at the normal commercial speed of 78 r.p.m., or at 33 1-3 only, or at both 78 and 33 1-3 r.p.m.? All these things are of major importance. Being able to cut discs at 33 1-3 and 78 r.p.m. is a decided advantage, as is the ability to cut discs up to 16in. in diameter. Nevertheless, the expense of a 16in. turntable is sheer waste of money if you are only to cut discs up to 12in. in diameter. The two-speed turntable does not add a great deal to the cost, as in nine cases out of ten, it means a small change in the type of drive pulley used.

The only practicable type of feed mechanism for use by the home-constructor is the overhead-lead-screw type. There is a commercially-made job with the feed beneath the turntable bed. To get the best results from a home-made type, similar to this, requires a deal of skill in mechanical engineering. Then with the feed mechanism arises the question of the number of lines-per-inch. The optimum number for use by the home recordist is about 100 to 110 lines-per-inch.

RECORDING SPEEDS

Recording speeds are a point worth pondering on 'til you are quite satisfied that you know what you want.

Discs can be cut at 78 r.p.m. on diameters from 6in. to 12in. Recording on 16in. discs is not practicable at 78 r.p.m. Recording at 33 1-3 r,p.m. is used where the length of playing time is the prime consideration.

Recording at 33 1-3 r.p.m. is not satisfactory at diameters of less than 8in. The linear velocity of the grooves drops to such a low figure at this speed that reproruction becomes bassy and hard to listen to.

Fig. 1 sets out the respective playing times for different diameters at both 78 and 33 1-3 r.p.m.

When you have decided on the speed and diameter you are to use, the next point for discussion is the method of drive for the turntable, that will best suit your individual requirements.

You have five popular meth-

(Continued on page 34)

Direct-Coupled Versatile

Interest still runs high in direct-coupled circuits, and there seems to be an unlimited demand for various arrangements for different types of valves.

IN the October issue we gave plans for the construction of an amplifier which lent itself to experimentation.

We have since been playing around with this amplifier with a view to giving a direct-coupled version. We have been lucky enough to come across a combination of standard value resistors which works out well. Some direct-coupled circuits call for odd values of resistors which are not easy to obtain, or have to be made up from series or parallel combinations. But with a 6SQ7GT for the first valve and an 807 or 6A3 for the final, we found a nice balance of voltages with standard resistors as shown in the circuit herewith.

It will be noticed that the plate feed is taken from a voltage divider across from high tension to the top of the main bias resistor of 2,500 ohms. This main bias resistor can be a heavy-duty wire-wound resistor of 20 watt rating, or it can be the field coil of an electro-dynamic speaker.

A voltmeter across this resistor is the best check of correct voltage distribution. With a 6A3 output valve, the voltage across the resistor should be about 150 volts. This seems that the effective plate voltage on the 6A3 is 250 volts, if the total high tension supply works out at about 400 volts, as it should if you have a 385 volt transformer, but running at the lower normal current drain of 60 milliamps.

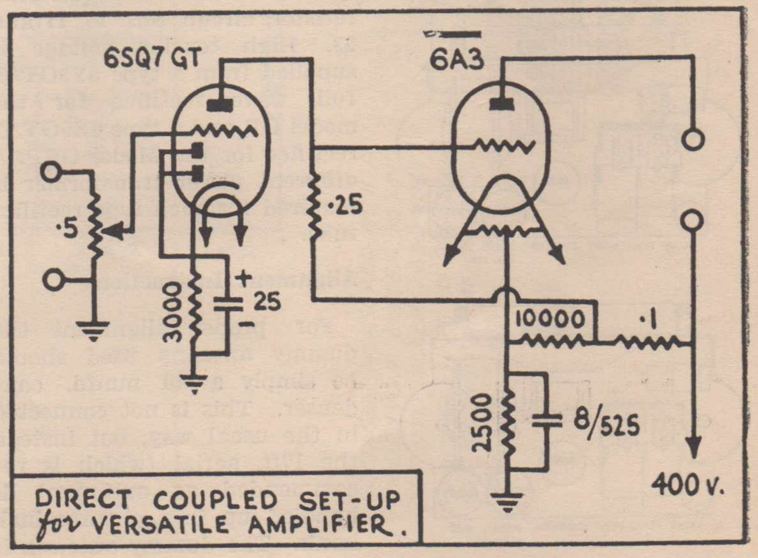
This direct-coupled amplifier is capable of giving most acceptable reproduction at reasonable volume levels, but its maximum power output rates at only about 3 watts. With a good output transformer, with 2,500 ohm load, and an efficient speaker, such as the Rola "0-12," this amount of power gives a fairly solid output in the average room.

The same set-up works out for an 807 as a triode, too, but the maximum power output is quite a bit lower than with the 6A3. With the 807 as a triode, the checking voltage across the main bias resistor will be about 125 volts, leaving about 280 volts for the plate of the 807, measured across from its plate to cathode.

Some idea of the versatility of the arrangement can be gleaned from the fact that it is also possible to use this same set-up, but with the 807 as a pentode.

The voltage across the main bias resistor goes up to a shade over 150 volts, leaving about 250 effective plate and screen voltage for the 807. With this arrangement the power output goes up quite a bit, but the quality of reproduction is not so clean.

There is no doubt that experiments with direct-coupling are always interesting and we have no hesitation in recommending all builders of the "Versatile" to carry out some of the above experiments.



DIRECT COUPLED SET-UP for VERSATILE AMPLIFIER.

NEW—OUR SERVICE SECTION.

The Astor Models G.R. & G.R.P.

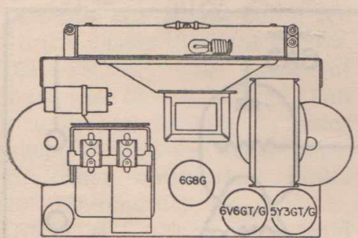
Introducing a new feature, here are the service details of a popular commercial receiver with some rather unusual specifications. If sufficient interest is displayed in this section, it is hoped to extend it to cover all popular commercial receivers.

The Astor models GR and GRP are somewhat different from the usual run of superhets, as they are t.r.f. models with a unique reflexing arrangement. The difference between the two models is only that the GR is for normal 200-250 volt 50-cycle power supply, whilst the GRP is for the 40-cycle power supply found in West Australia.

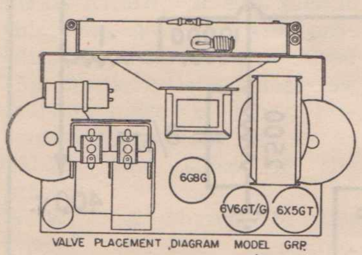
General Description

The Models GR and GRP are three tube reflexed TRF Receivers having a sensitivity of 1000 microvolts for an output of 50 milliwatts with a load impedance of 5000 ohms.

The circuit consists of tuned aerial and RF stages with a type 6G8G tube for diode detection, RF and audio amplification. The rectified audio voltage from the diode is fed via the condenser (circuit No. 4) to the control grid of the pentode section providing reflexed operation. The output from the reflexed stage is resistance capacity coupled to a type 6V6GT/G beam power output amplifier tube.



VALVE PLACEMENT DIAGRAM MODEL GR
368/279



VALVE PLACEMENT DIAGRAM MODEL GRP
374/279

Volume is controlled by varying the bias on the control grid of the variable Mu RF amplifier tube.

Bias is obtained for both tubes from the back bias network in the high tension negative line.

The high tension filter circuit consists of two electrolytic condensers and a 5K ohm resistor, circuit Nos. 10, 11 and 23. High tension voltage is supplied from a type 5Y3GT/G full wave rectifier for the model GR and a type 6X5GT/G rectifier for the Model GRP. A different power transformer is required for each type rectifier tube. ,

Alignment Instructions

For proper alignment the dummy antenna used should be simply a 40 mmfd. condenser. This is not connected in the usual way, but instead the 17ft. aerial (which is recommended as optimum) is bundled up into a three-inch hank. The dummy antenna is then connected to the aerial lead about two inches from where it enters the chassis, by the simple expedient of inserting a pin through the aerial insulation.

First step in the alignment process is to set the dial correctly, by setting the pointer at the end-of-travel mark on the dial calibration near the 550 Kc. marking. Set the tuning condenser plates to the fully meshed position and tighten the dial pointer.

Then, with the dummy antenna fitted as described above, and with the signal generator set at 1400, the dial is swung over the special 1400 marking on the dial scale, and the r.f. and aerial trimmers adjusted for maximum output.

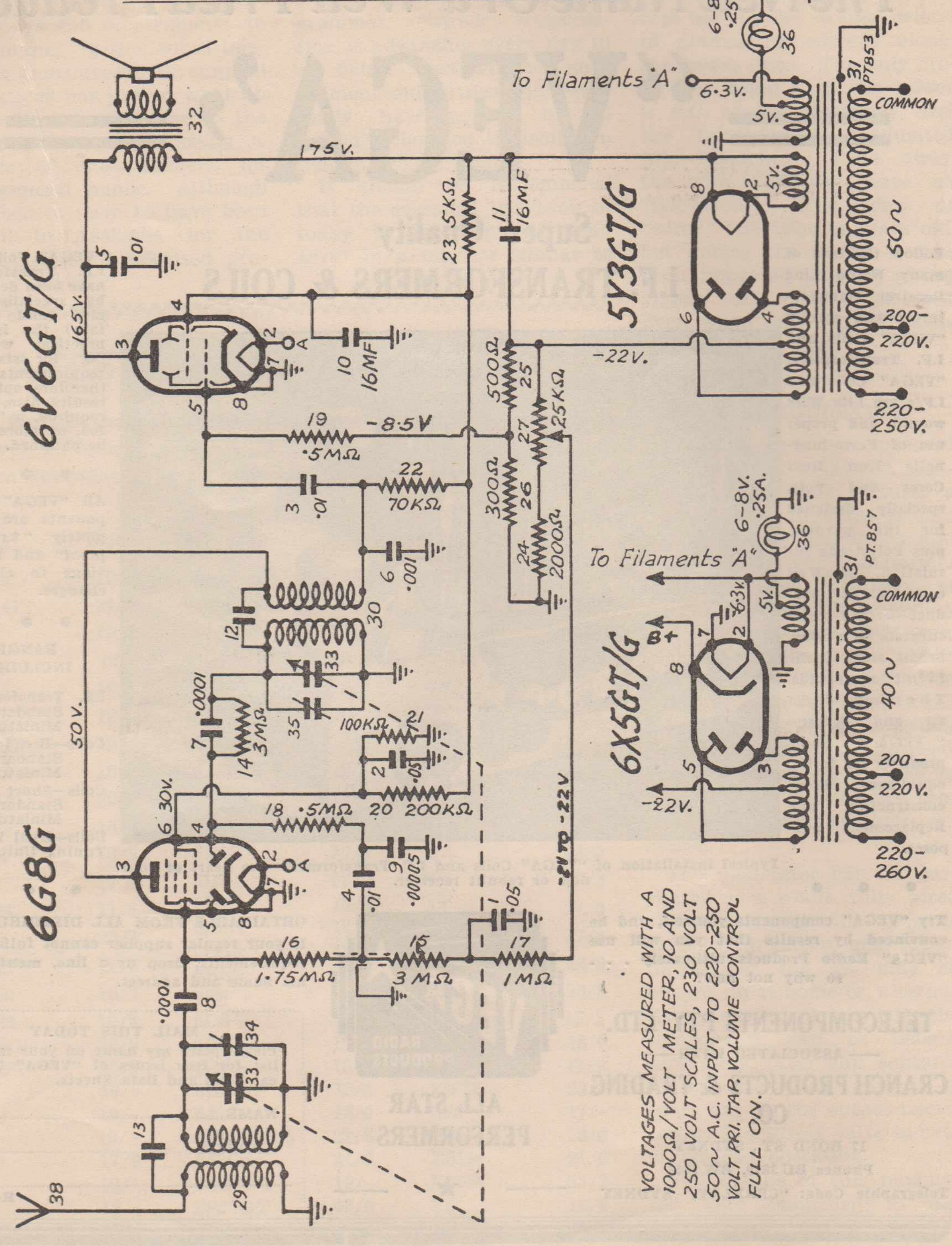
Voltage Checking.

Voltages should be checked with a meter having an internal resistance of 1,000 ohms per volts, with scales for 0-10 and 0-250 volts d.c. and 0-10, 0-250 and 0-500 volts a.c. The volume control is set for full on. Heater voltages are measured across socket heater contacts; tube voltages measured from socket contacts to chassis.

The 6G8G should have 6.3 a.c. on the heater, 50 d.c. on

(Continued on page 50)

Circuit of the Astor Models GR and GRP



Is There A Future For "Wired" Television

The recent experiment, in Melbourne, with wired-television transmission of surgical operations has proved what an asset television can be to the student, as well as being a source of entertainment for the general public. Although no licences seem to have been issued in Australia for the transmission of televised programmes, "wired" transmission is advancing every day in all fields. Just whether government authorities will eventually have control of all "wired" television transmission remains to be seen.

It should be remembered that the so-called television of today is only "piped along wire" in a manner similar to that used in the "transmission" of alternating current along the power lines. The only difference being that the power is A.C. of low frequency, and the television is modulated high-frequency. Take away the wire, and you have no "television." The idea of "wired" television is years old, but during the years it has been improved greatly, giving bigger and clearer pictures. Even when only "wired," television has its uses.

LATEST LIST OF VALVE PRICES

Here is the new list of retail prices for "Preferred-list" valves, as issued by the A. W. Valve Co., to be effective as from November 21, 1949. All prices include excise, duty, or sales tax, which is applicable.

Type	Price	Type	Price	Type	Price
1A4-P	19/6	5U4G	18/3	6SN7GT	21/-
1A7-GT	21/3	5V4G	18/9	6SQ7GT	17/3
1C4	19/6	5Y3GT	14/-	6U7G	18/-
1C6	19/6	6A7	18/9	6V6GT	17/9
1C7G	19/6	6A8G	18/3	6X4	15/-
1D4	19/-	6AL5	18/-	6X5GT	15/-
1D5GP	19/3	6AR7GT	18/9	19	19/6
1H4G	16/9	6AQ5	19/-	30	17/3
1H5GT	20/-	6AU6	18/9	42	17/-
1H6G	16/6	6AV6	17/6	45	16/6
1J6G	16/9	6B6G	17/6	47	23/3
1K4	17/9	6B7	18/9	57	17/3
1K5G	11/3	6B7S	18/9	58	17/3
1K6	20/3	6B8G	18/9	75	17/3
		6BA6	18/3		
1K7G	20/3	6BE6	18/9	80	14/3
1L5G	18/3	6C6	18/6	83V	20/3
1M5G	19/6	6D6	18/6	807	15/3
1P5GT	20/9	6F6G	17/3	DH76	18/6
1Q5GT	20/9	6G8G	18/9	KT61	17/9
1R5	19/-	6H6GT	15/3	KT71	23/-
1S5	19/-	6J7G	18/9	U76	17/-
1T4	19/-	6J7G/1620	22/6	W76	18/6
2A5	17/9	6J8GA	21/9	X61M	21/6
3S4	19/-	6SA7GT	19/-	X76M	23/3
3V4	19/-	6SJ7GT	18/9	Y61	18/6
5R4GY	26/-	6SK7GT	18/6	161	13/-

"HAM" MODULATOR

Recently there has appeared on the market a 75-watt modulator. This unit features a pair of 807's in Class B zero bias operating conditions and the actual output transformer will carry 1,000 volts max., at 150 ma. through the secondary and 1,000 volts max. at 150 ma. each side of the C.T., through the primary. The modulation transformer is versatile; it can be used with 807's, 809's, 830B's, etc. This makes the prospects bright for those who wish to purchase the transformer separately and build up their own design.

The modulator can be purchased as a whole, fully wired and tested, with mic. preamp. or 600 ohm line-to-grid transformer, or the kit may be bought up at home or, alternatively, each and any of the components can be bought separately. The unit contains a negative peak clipper. A spark gap on the output transformer is a safety valve in case of no-load operation.

Full details of this modulator were published in last month's issue.

SOMETHING NEW!

Our Technical Directory

This, our new, improved December issue, introduces to you the latest section—the Technical Directory.

For many months people have been writing to us wanting to know where they can have this done, or where they might be able to get that made for them.

It has long been our opinion that it would be of benefit to the readers, the suppliers, and to us, if we could make known the whereabouts of hard-to-get components and where to have those special jobs done for you.

This is the idea behind this directory. If you have any further suggestions as to what you want in the list, by all means let us know. It is intended to expand the list to several pages, so that everything will be covered, thus helping everyone along.

If you think you have something that will interest other readers, send us the information and we will follow it up.

There is no alphabetical order in the directory at present, but when things become a little more organized we hope the list will be printed in alphabetical order.

CHASSIS PUNCHING
Fast Mail Order Service.
COLLINS RADIO,
409 Lonsdale Street,
Melbourne, C.1.

CRYSTALS.
For frequency control or filter applications.
Maxwell Howden,
15 Claremont Crescent,
Canterbury, E.7. Vic.

WHOLESALE ONLY.
Trade supplies only from:
RADIO PARTS PTY. LTD.,
157 Elizabeth Street,
Melbourne, C.1.

METER REPAIRS.
Send that damaged meter to—
ZENITH RADIO Co. Pty. Ltd.,
131 Palmer Street, Sydney.

HAM GEAR.
Eddystone components, A. and R. Transformers, Transmission lines, etc.
J. H. Magrath & Co.,
208 Little Collins Street,
Melbourne, C.1.

HI-FI EQUIPMENT.
Connoisseur pick-ups, motors and amplifiers, Goodman's speakers, baffles, microphones.
J. H. McGRATH & CO.,
203 Little Lonsdale Street,
Melbourne, C.1.

ROLA LOUDSPEAKER REPAIRS.
Consult ROLA, Australia's foremost manufacturer of loudspeakers.
Rola Co. (Aust.) Pty. Ltd.,
The Boulevard, Richmond, Vic.

EDDYSTONE COMPONENTS.
Trade: R. H. Cunningham and Co., 62 Stanhope Street,
Malvern, S.E.5.

CABINETS MADE TO ORDER
Who can do this job? Let A.R.W. know if YOU can.

A & R TRANSFORMERS.
Trade Supplies:
R. H. Cunningham & Co.,
62 Stanhope St., Malvern, S.E.5.

COMMANDER RECEIVERS.
Xtals and ham gear.
K. G. Allen, Bright Star Radio,
1839 Lower Malvern Road,
Glen Iris, S.E.6. Victoria.

DURAL, ALUMINIUM, BRASS
George White & Co. Pty. Ltd., 280 Post Office Place,
Melbourne, C.1.

DISPOSALS & HAM GEAR
Receivers, valves, etc.
HAM RADIO SUPPLIERS,
5a Melville Street,
Hawthorn, Victoria.

MAIL ORDER SERVICE.
Your need—Our duty.
PRICE'S RADIO,
5 & 6 Angel Place, Sydney.

TRANSFORMERS.
at THE Transformer Engineers. Red Line Equipment Pty. Ltd., 2 Coates Lane,
Melbourne, C.1.

SPEAKER HORNS & FLARES.
All pressed metal work.
CLIFF & BUNTING Pty. Ltd.,
Charles Street,
North Coburg, Vic.

POLYSTYRENE!
Rod and Sheet. Write or call—
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BLUEPRINTS.
To order, or from files:
R. J. Watson,
89 Botting St., Albert Park, South Australia.

"MULLARD" VALVES AND RECEIVERS.
Distributed by reliable retailers.
Mullard Australia Pty. Ltd.,
35 Clarence Street, Sydney.

VEGA COILS.
Obtainable from dealers everywhere. Technical data direct from:
Cranch Products & Trading Co.
17 Bond Street, Sydney.

R C S COILS & COMPONENTS
If your dealer cannot supply you, write direct to R.C.S. Radio Pty. Ltd., 174 Canterbury Road, Canterbury, N.S.W.

COMMERCIAL RECEIVER CIRCUITS.
Every serviceman should have Australia's Official Service Manual. £1 per volume, direct from—
A. G. HULL,
Box 13, Mornington, Vic.

AUTOMATIC RECORD CHANGERS.
Available from all Stromberg-Carlson Retailers.
MAKE YOUR OWN RADIOGRAM WITH A STROMBERG-CARLSON RECORD CHANGER.

"RADIO & ELECTRICAL MERCHANDISER,"
For Radio and Electrical Businesses. 12/- per annum.
Lodge subscriptions with—
A. G. HULL,
Box 13, Mornington, Vic.

AEGIS TUNING UNITS AND COILS.
Technical and Trade Inquiries:
AEGIS MANUFACTURING CO. PTY. LTD., 208 Little Lonsdale Street, Melbourne, C.1.

TRIMAX TRANSFORMERS
Manufactured by—
Trimax Transformers,
Charles St., North Coburg, Vic.

TRANSFORMERS by FERGUSON.
Write for a list of suppliers and send difficulties to—
Ferguson Transformers Pty. Ltd., 12 McMahon Street, Willoughby, N.S.W.

WHO?
Who will manufacture chassis to customers' specifications? Let us know if YOU are able to.

B R S RECORDERS.
Blanks and other Recordists' needs.
BYER INDUSTRIES PTY. LTD.
8 Dorcas Street,
South Melbourne, Vic.

ACOS MICROPHONES AND PICK-UPS.
Amplion (Australasia) Pty. Ltd., 36-40 Parramatta Road, Camperdown, N.S.W.

HARD TO GET HARDWARE.
Small Nuts, Bolts, Screws and Hardware.
Thos. Warburton Pty. Ltd.,
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SOUND SYSTEMS.
Fixed and Mobile Gear.
Major Radio and Electrical Co.,
189 Glenferrie Rd.,
Malvern, Vic.

MOBILE PUBLIC ADDRESS EQUIPMENT.
Radio and Electrical Supplies.
Oliver J. Nilsen & Co. Pty. Ltd.,
45-47 Bourke Street,
Melbourne, C.1.

ELECTRICAL MOTORS.
Lobascher's have single and three-phase motors for all purposes.
Lobascher's Electric Motors,
337 Elizabeth St.,
Melbourne, C.1.

TECHNICAL BOOKS.
Subscriptions to overseas magazines.
Technical Book & Magazine Co.
295 Swanston St.,
Melbourne. Central 3881.

RECORDING SUPPLIES.
All gear and blanks.
Royce Recording Studios,
Box 5041Y, G.P.O., Melbourne.

NEXT MONTH'S ISSUE:—

Contains the circuit and full details of the latest type of 4-valve mantel model designed to use the new high-gain valves. Available in kit form, but equally suitable for general use.

Also featured: A particularly fine article on the construction of a V.T.V.M. multi-meter, tuner for the quality amplifier, details of a long-wire antenna for amateur transmission, and all our regular sections.

ORDER YOUR COPY NOW!

FOR TRANSMITTING

The "Clapp" Oscillator

This small article should be of great interest to all those people who have had difficulty in getting the Clapp to "tick."

Today, by far the most popular home constructed V.F.O. is the Series-tuned Colpitts, or Clapp Oscillator.

The October issue of QST has an interesting article on the Clapp, under the heading of "Tailoring the Series-Tuned V.F.O. to Your Needs." The circuit as used by W1RBK, in QST, is reprinted herein.

The circuit uses a 6C4 as the series-tuned Clapp, followed by two 6F6 untuned isolator stages. The fundamental output frequency is in the 3.5 mc/s. band, and is sufficient to drive anything requiring about 5 ma. grid-drive.

The electrical side of the construction presents no great difficulties, but the mechanical construction is where many fall down and then are disgusted with the results obtained.

Absolute rigidity is essential throughout the whole of the unit. The slightest suggestion of movement of the components should be righted immediately. All resistors, condensers, coils and wiring should be terminated on resistor strips wherever possible. Especially in the oscillator section. Special care must be taken with the filament leads to the tubes. Normally, these are run by either twisted pair or one wire and the chassis as common. In the series-tuned oscillator it is advisable to run the filament leads direct from the power input socket to the tube, keeping them as short as possible, with heavy-gauge, tinned-copper wire. This helps towards mechanical stability.

PRECAUTIONS

Other important features in the construction of the Clapp are:—

(1) All earth connections should be brought to the same point on the chassis.

(2) Heavy, tinned-copper bus bar should be used instead of the usual hook-up wire. Power leads and key leads should be cabled.

(3) Most important of all, the variable condenser for tuning should have no "sloppiness" in the bearings. The double-bearing type being used in preference to the single-bearing type.

When this V.F.O. is built on a substantial steel base, with the oscillator section completely enclosed in a small metal box on top of the chassis, the frequency stability proves to be all that is expected.

The oscillator section, although it is not extremely complicated, is the critical point of the whole unit. No matter how well made the isolator stages and power supply may be, if the oscillator is unstable or erratic, then you may as well not have the thing.

Special care should be taken in the placing of components and wiring in the oscillator.

In the original model, the components are mounted on a piece of sheet polystyrene. This makes all the wiring, etc. mechanically rigid. This sheet is bolted to the top of the small oscillator box. The 6C4 oscillator tube socket is also mounted on this and the tube plugs into it through a hole in the top of the box itself. The coil and band-set condenser are mounted firmly on the bottom of the box. The band-set condenser being adjusted by means of a screw driver, through a hole in the side of the oscillator housing. The tuning condenser is mounted on the front plate of the box, along with the dial scale and knob.

POWER SUPPLY

The unit, as originally constructed, contains the power supply. This may or may not suit your individual require-requirements and the actual chassis layout is also more or less in your hands, apart from the need for the oscillator to be placed in its own completely shielded box.

The switch, S2, is used to set the V.F.O. up on a received signal, without actually placing the transmitter on the air. This switch can be connected in parallel with the remote-control relay for singlee-switch operation of the whole transmitter and receiver. You will note that this switch turns on the high-tension for the oscillator and the two untuned stages and simultaneously closes the cathode circuit of the oscillator.

The key-jack hook-up may cause some concern, as none of the usual click filter network appears across the key. The small usual .01 mfd. condenser usually found across the key in the Clapp circuit is found to be unnecessary. No clicks could be heard on a small broadcast receiver in the same room, and reports indicate that the keynote is quite clean.

If the V.F.O. is keyed, the key is inserted in the jack built into the unit, if the following stage is keyed, the closed circuit jack closes the cathode as soon as the high voltage is tuned on by either S.2 or a remote switch or relay.

Cathode-resistor bias is used on both 6F6 tubes to limit the current when the key is up, keying the oscillator.

Underneath the V.F.O. is also shielded, to minimize effects caused by stray capacity, etc.

R.F. output is taken via a coaxial socket to the next driven stage.

As for tailoring the V.F.O. to your own requirements, first consideration is the band or bands in which you are going to operate. Remembering that the fundamental output is on 3.5 mc/s. The bands to which you wish to double, quadruple or what have you, largely determine the capacity of the band-spread condenser to be used.

Those boys who use only a portion of any band will find that they can have almost 180 degrees of band-spread over perhaps only 50 to 100 kc. On the other hand, you can have 180 degrees band-spread from 3.5 to 3.8 mc/s.

With only small relative change in the oscillator frequency, there is no need to retune the buffer, final or antenna. This is ideal for the confirmed C.W. man who only operates from about 7.00 to 7.10 mc/s. Nevertheless, the tuning condenser, C.1, can be about 15 to 90 or 100 pf. for

(Continued on page 33)

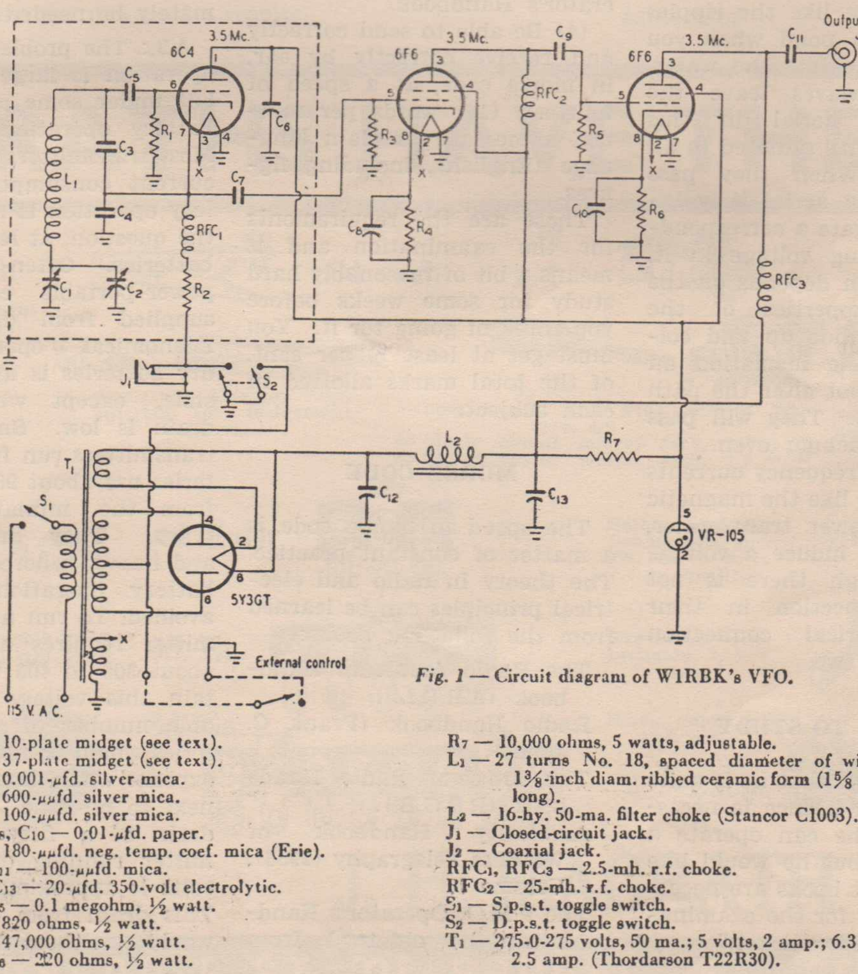


Fig. 1 — Circuit diagram of W1RBK's VFO.

C_1 — 10-plate midget (see text).
C_2 — 37-plate midget (see text).
C_3 — 0.001-μfd. silver mica.
C_4 — 600-μμfd. silver mica.
C_5 — 100-μμfd. silver mica.
C_6, C_8, C_{10} — 0.01-μfd. paper.
C_7 — 180-μμfd. neg. temp. coef. mica (Erie).
C_9, C_{11} — 100-μμfd. mica.
C_{12}, C_{13} — 20-μfd. 350-volt electrolytic.
R_1, R_5 — 0.1 megohm, ½ watt.
R_2 — 820 ohms, ½ watt.
R_3 — 47,000 ohms, ½ watt.
R_4, R_6 — 220 ohms, ½ watt.
R_7 — 10,000 ohms, 5 watts, adjustable.
L_1 — 27 turns No. 18, spaced diameter of wire on 1⅜-inch diam. ribbed ceramic form (1⅝ inches long).
L_2 — 16-hy. 50-ma. filter choke (Stancor C1003).
J_1 — Closed-circuit jack.
J_2 — Coaxial jack.
RFC_1, RFC_3 — 2.5-mh. r.f. choke.
RFC_2 — 25-mh. r.f. choke.
S_1 — S.p.s.t. toggle switch.
S_2 — D.p.s.t. toggle switch.
T_1 — 275-0-275 volts, 50 ma.; 5 volts, 2 amp.; 6.3 volts, 2.5 amp. (Thordarson T22R30).

"HAM" SECTION

How To Get Started

Some notes for those who want to operate amateur transmitters.

"Aspirant" asks a few questions that have probably puzzled quite a number of persons over the last few years.

Q.1.—As rubber is an insulator, how do radio waves pass through the rubber insulation on an aerial made from such wire?

A.1.: The radio waves don't actually pass through the rubber; they are only induced in the aerial. The waves passing the aerial are like the ripples you see on a pond when you throw a stone into the water. The radio waves leave the transmitting aerial in this manner and are radiated in all directions. When they pass your receiving aerial they induce or generate a corresponding alternating voltage in it. This induction depends on the magnetic properties of the field as it builds up and collapses and the insulation on the wire cannot alter the path of the waves. They will pass through a vacuum even.

The radio frequency currents in the air are like the magnetic field in a power transformer, in that they induce a voltage path, although there is not in any connection in their actual electrical connection between the two.

BOOKS TO STUDY

Q.2.—He says that he is quite aware that a licence is necessary before he can operate a transmitter, but he would like to know what books are necessary to study for the examination to get his "ticket."

A.2.: Firstly, we will detail the requirements the P.M.G's. Department sets down for the amateur licence.

(1) A knowledge of radio telegraphy and radio telephony as applied to amateur transmission and reception.

(2) An elementary knowledge of electrical principles.

(3) A general knowledge of the contents of the P.M.G. Amateur Wireless Station Operator's Handbook.

(4) Be able to send correctly and receive correctly by ear, in morse code, at a speed of fourteen (14) words per minute, a message in plain language (English), including figures.

These are the requirements for the examination and it means a bit of reasonably hard study for some weeks before you think of going for it. You must get at least 70 per cent. of the total marks allotted in each subject.

MORSE CODE

The speed in morse code is a matter of constant practice. The theory in radio and electrical principles can be learned from the following books:

The Radio Amateurs Handbook (A.R.R.L.).

Radio Handbook (Frank C. Jones).

The Amateur Radio Handbook (R.S.G.B.).

Admiralty Handbook of Wireless Telegraphy (1938), Volume 1.

The P.M.G. Operator's Handbook can be obtained from the Wireless Branch in your State.

BATTERY POWER

Q.3.—Now we are getting on to the practical side of amateur transmission. Can a transmitter be operated economically from dry batteries; are these batteries of the usual 45-volt type and how many batteries would approximately be needed?

A.3.: The problem of battery operation is large and varied, but under some circumstances battery operation is possible. Most transmitters have a large current consumption, so battery operation is mostly out of the question, at least from dry batteries. Often small, low-power-portable equipment is supplied from dry batteries. Economical operation from dry batteries is almost impossible, except where current drain is low. Small portable transmitters run from dry batteries use about 90 to 135 volts from the miniature 45-volt types. They are expensive and heavy; where possible dry battery operation is to be avoided. To run a large transmitter requires a voltage of about 300 to 400 volts. To obtain this voltage a considerable number of 45-volt batteries would be needed and the expense would break anyone in next to no time. The current drain of a fifty-watt transmitter running on about 400 volts is approximately 130 ma. This drain from dry batteries would run them flat in an extremely short time. You can see then, that dry battery operation of a transmitter is just about out of the question. They may be run from vibrator supplies or genemotors which, in turn, run from 6 or 12-volt accumulators.

THE COST

Q.4.—What would be the approximate cost of a transmitter capable of being heard, say, in the U.S.A., and also what would be the minimum number of valves in such a set?

A.4: Both these questions are difficult to answer in that some of the cheapest transmitters are just as capable of being heard in far-away places as the most expensive. Secondly, the higher the power of the set, the more involved and complex it becomes, thus increasing the number of valves.

The transmission and reception of short-wave signals, especially the transmission, is a series of peculiar phenomena, none of which seem to follow any fixed sequence. On one day, a low power transmitter may be heard plainly, and an hour or so later reception may be impossible. People have had reports of reception from their side of the world on powers ranging from 5 watts to 100 watts. A great deal depends on the conditions prevailing at the time. Height above sea-level, aerial systems, and atmospheric conditions all play a part in transmission results.

Therefore, it is difficult for us to give an approximation of the cost of a transmitter capable of being heard in America. Nevertheless, we can tell you that the approximate cost of a low-powered transmitter with a power input of about 25 watts, starting from scratch, would be in the vicinity of £20. This includes the cost of radio frequency and audio components. The minimum number of valves would be somewhere about 7 or 8. These estimations and prices may not seem to be be very definite but I think you will realize that it is difficult to tell you anything accurately and cover such a wide field at the same time.

Commercials on the Ham Bands

Listening on. 20. and. 40 lately, the number of commercial stations operating in the ham bands is fast becoming more and more noticeable. On Wednesday, 16th November, while tuning over the 20 meter band at 21.35 hours, E.S.T., I noticed a strong carrier on about 14,350 kc. This was about the only strong station on the air at the time so I decided to listen.

The station was decidely English, the announcer had a pronounced Oxford accent. At first I thought that the station was an English ham, but on looking at the "S" meter and noting that it was well beyond the 9 mark, I changed my opinion.

The programme started, when I tuned in, with a news service at 23.45 hours. This was followed by light orchestral music. At midnight the time was given as 14.00 hous, G.M.T. Up to 00.30 hours, E.S.T. there was no mention of call sign, frequency, wavelength or beam transmission. This station definitely was not an image or spot, my receiver, luckily, is not prone to such unfortunate phenomena.

The more we close our eyes to these commercial stations the more cheekly tney will become and eventually there will be no such things as Ham Bands. I think you will agree with me when I say that the number of non-amateur stations operating within the precincts of the approved amateur bands has increased out of sight in the last twelve months. The amateur bands are crowded as things are, but if we sit back and listen to these licensed-pirates and don't do anything about trying to log their calls, frequencies, etc., then the bands, in all probability, will be cut down and things will be even more crowded.

The Victorian Division of the W.I.A. is trying to get results in this field by electing several of its members as official listening posts You can help, whether you are an amateur or not, by dodging your best to log these offenders and sending your completed logs regularly either to us, or the W.I.A.

I know that many of us only get on the air for a few hours each month and during this brief period we like to work as much as possible and don't relish the idea of listening to an unknown station for a while just to find the call sign.

Anyway, chaps, do your best to keep the narrow bands of frequencies that we now call ours!

MOTORS FOR BEAMS

Many of the boys are using the propellor feathering motors to turn beams and other gadgets round the shack. In the April issue we had an article on the conversion of the motor. There seems to have been some worry about the four leads emerging from within the gadget. The motor only requires three of the leads instead of the usual four on a series motor. Some of us have wondered what the fourth lead is for.

J. F. Harris, VK5FD, has supplied us with the information. The motor, in its original condition gave only a slow feather. If an engine went out of action, it would "windmill" and thus seriously affect the speed and flight of the plane, thus the motor was required to give a fast feather to turn the blades edge-on in a hurry. This was- accomplished by the use of about 50 volts. The high voltage was supplied from a gene-motor in the aircraft and the gene-motor was automatically stared. This was the reason for the fourth lead from the motor, the input for 50 volts for fast feathering. Our advice is to tape the wire and forget it.

POWER INCREASE

It was with great interest that I noticed a small paragraph in the New Zealand ham magazine, "Break-in," under the heading, "Council Deliberations."

The council decided, upon instruction from the 1949 conference, to ask the Post and Telegraph Department to provide regulations allocating the portion of the 80-metre band from 3500 to 3550 k/cs. for use by CW stations only.

Secondly, they requested an increase in the limit of power input to the final stage. A letter was sent to the department asking that the maximum power-input to the final R.F. amplifier be increased to 150 watts.

As far as we know, the P. and T. Department has not as yet replied to the requests.

An increase in power-input has long been a point of argument here in VK land. Many countries have the full kilowatt as the limit, others have 150 watts, while we here in Australia are allowed only 100 watts. The point is, that although we can only run 100 watts our D.X. results indicate that we can do anything that the boy running the "full gallon" can hope to do.

Nevertheless, many of us would be happy to see the limit raised to 150 or 200 watts. Even the Commercial Stations run comparatively low powers; an average of about 600 or so watts. Overseas Commercial Stations are considered to be low-powered when they feed about a killowatt to the antenna.

Personally, I think that the actual power delivered by the final is of little importance after you have passed the 100 watt mark. Antenna systems and modulation systems are much more important in communications. Perhaps I am inviting the criticism of many with this view, but, you must admit that we certainly can "go places" with a mere 100 watts.

Single-sideband-suppressed-carrier transmission offers you an effective gain of at least 9 db. over an A.M. signal. This is equivalent to an increase of eight times the original power. Consequently you can run 800 watts, and still only have an approximate power-input of 100 watts. Where then, is the sense in clamouring for an increase in the legal power-input. But, you say, this requires different techniques in reception. When R.T. first came into general use, didn't that mean a change in technique of reception? There is nothing difficult about s.s.s.c. reception. All that is needed is a stable auxiliary oscillator to re-insert the carried at the signal frequency. Admittedly, the transmission is radically diffcult.

Give s.s.s.c. a trial and then see what you think of power increase! Let us know of your doings on s.s.s.c., and we will be pleased to publish your views, experiences and operating hints.

CLAPP OSCILLATOR

(Continued from page 29)

general coverage of the 3.5 mc/s band.

The original model did not use an elaborate slow-motion drive or dial. The dial scale is made from cardboard, the calibrations first being made in pencil, then inked over. The knob has two set-screws making it almost impossible to shift it on the shaft. Fixed to the back of the knob is a perspex cursor with a hair line on it.

Calibration is done in conjunction with a good calibrated receiver or preferably, a hetrodyne frequency meter.

This V.F.O. should give excellent results when properly and painstakingly contructed.

This brings us to another question. A Clapp Oscillator for F.M. I have had some enquiries for such a piece of equipment and at present we are working on an excellent little unit. It combines a stabilized reactance modulator, a high-stability V.F.O., which can be used for straight A.M. and a voltage-regulated power supply. It is hoped to run this early in the New Year.

PHONE MEN

More than all others, take care with the operation of your station. On the quality of your transmissions depends:

- the development of amateur radio;
- the defence of your rights;
- the continuance of your licence;
- the prestige of your country.

Make your transmissions no longer than necessary.

Weigh your words; others listen to you—and the monitoring services also!

—"RADIO REF." (Break-in, N.Z.)

RECORDING

(Continued from page 20)

ods from which to choose, direct-motor drive, rim-gear drive, idler-wheel drive, spindle-belt drive and rim-belt drive. The most used is the belt-rim-drive.

Fig. 3 sets out in sketch form the five drives.

Next in line for consideration is the type of spiral you intend to work on. The normal recording track or spiral is cut outside-in, but in some cases it is desirable to cut inside-out. This is a matter for you to decide, but both have certain advantages and disadvantages.

When cutting outside-in, the thread tends to get in the way of the cutter, this has to be watched carefully while recording as it is liable to tangle round the stylus and make it jump. Cutting inside-out, the thread takes up the same position in the corner of the disc as when cutting outside-in, but with the difference that the thread does not in any way tangle round the stylus. See Fig. 3.

The whole of the mechanical section of the recorder MUST be mounted on a solid base that will keep vibration at a minimum. Rigidity is an absolute necessity where recording is concerned, most trouble with wow and patterns on the recordings can be traced to vibration and poor mechanical construction.

The turntable must have no rumble and the bearings should not be loose or sloppy. The same conditions apply to the lead-screw and cutter carriage. Any pieces of equipment which have poor suspensions, bearings, slipping gear drives or belts must be attended to im, mediately, otherwie you are going to run into trouble before you start.

Actually, there should be no trouble from this angle if the equipment is of reputable manufacture.

Fig. 4 shows a sketch of a recorder using belt-rim-drive and a 16in. turntable for recording at 78 and 33 1-3 r.p.m.

Next month we hope to deal with the electrical and audio side of recording.

TONE

(Continued from page 14)

have no baffle at all. Valves in small envelopes, that will almost melt solder after operating a short time, do not improve the position, and to make matters worse are often positioned with the rectifier and output valve on each side of, and as near to, the speaker as possible, as though so placed for the specific purpose of warping the cone.

The use of small low-wattage resistors and no provision for ventilation cause a good imitation of frying sausages to find its way to the speaker, while a short aerial or no aerial at all, does its best to add to the noise by increasing the noise-to-signal ratio.

Costing is a sound idea as far as economy is concerned, but results in an inferior article being produced. So many spring washers at so much each for so many sets equals so much. If after a short term of operation the components vibrate in sympathy with the various notes reproduced it is for the very good cause of saving .125 of a penny per set.

Mantel sets are thin and reedy, while consoles are inclined to be drumming. Mantels seem to be the most popular, possibly due to portability and the fact that they will serve as second sets if, and when something better comes along. Consoles seem to have had their day. Whether this is because people are waiting for something better or whether the modern house cannot accommodate such huge items as consoles, I do not know. Table models allow ample space for componests and can accommodate a fair sized speaker but a special table or "what not" has to be provided for them. They are anything but cheap. Maybe it is the cost that affects the sales or may be it is the sales that govern the cost. at any rate very few are sold.

Summing up, it seems that apart from economy, quality is sacrificed for high amplification factor, large output and sensivity which are seldom used. How many sets or listeners can stand full volume?

It seems that the best proposition is to design the set for the one job it is required to do instead of trying to make a general-purpose set. This would rule the dual-wave sets out straight away. If one wishes to listen to overseas programmes something of a much higher standard than the average dual wave set is required

AMONG OUR READERS.

Official Goodman's Baffle

Reproduced below is the recommended design for the Goodman's "Axiom 12" speaker. It was sent to us by one of our enthusiastic readers, Mr .E. T. Gibson, of Mt. Martha, Victoria.

"A couple of days ago I was looking through some early issues of Radio World, beginning with No. 2. Although it was a good bob's worth then, it has improved so much over the years that I consider it better value now for 1/6. I have build up several circuits which have been featured and have had no bother with them other than that caused by faulty components. A few years ago I built up the superhet with the direct-coupled phase changer which was used in that circuit, and which came to light again in the Williamson amplifier and in the 1949 World Standard. Apparently this arrangement did not receive the recognition it deserved then, but I have been using it ever since you first published it and have never considered using any other. I am pleased to see that you still set aside a couple of pages in each issue for the beginners, remembering how valuable such articles were to me when I first started in the game."—A. K. Deering, 1 Goldfinch ave., Cowandilla, S.A.

* * *

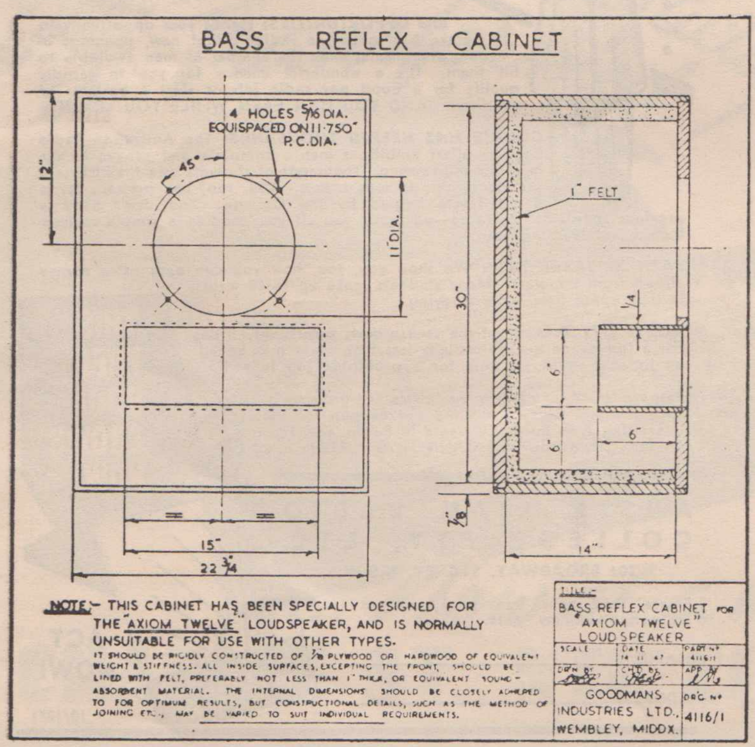
"I still experiment with amplifiers, but I find that the recordings are not up to standard. I am using a Lexington, feeding into its standard pre-amplifier, to the FFR amplifier (December, 1946, issue) into a D482 network, with a 15in. Goodman in a 9 cubic foot vented enclosure and a 12in. Axiom, in a closed baffle. The bass is exceptional, but the highs need cutting off, too much scratch."—J. W. Nairn, 22 McLean Street, Morwell, Vic.

* * *

"I would like to hear from others who have built the FFR amplifier from the December, 1946, issue. I find it very hard to get anyone to talk to who knows about these things. I find in many subjects, particularly radio and amplifiers, mutual conversation and discussion brings knowledge to both sides."—R. G. Taylor, 12 Mildura Street, Killara, N.S.W.

* * *

"Please encourage and print articles by local writers, who write a more refreshing and straightforward article than those in overseas journals of a similar nature."—J. S. Cuming, 25 Claremont Road, Enfield, N.S.W.



RADIO THEORY COURSE — Part 6.

TRANSMISSION & RECEPTION

The study of radio theory is not tiresome, as you will be forced to agree after you have read this month's chapter of our series.

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

THERE are four operations necessary for any system of electrical communication. They are:

(1) The generation of some effect which can be transmitted.

(2) Modulation or moulding of the current so produced in accordance with the desired signal.

(3) Transmission to the destination.

(4) Detection or conversion of the transmitted effect into intelligible signals at that point.

Two other operations may also be introduced at the receiving end of the chain, they are (a) selection, which enables one signal to be picked out from several transmitted simultaneously, and (b) amplification, which is the process of increasing the magnitude of the signal by some means.

The electric telegraph, which, after all, was the first step towards radio, uses all these processes in a very simple form.

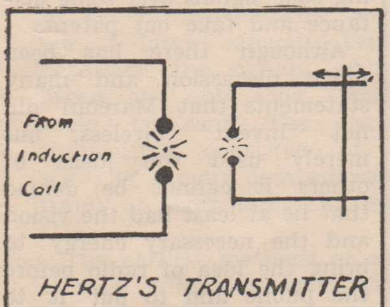
In this case the effect generated is simply an electric current, the modulation is simply keying this current, the signal is transmitted along the wire to its destination, and the process of detection is changing the signals into intelligible clicks of the sounder. The selection used in this case is only the use of separate wires and selecting the required one by switching of some form of amplification.

Wireless communication was made possible, not entirely by the efforts of any one person but as a consequence of the efforts of several, often working separately and independently along similar lines.

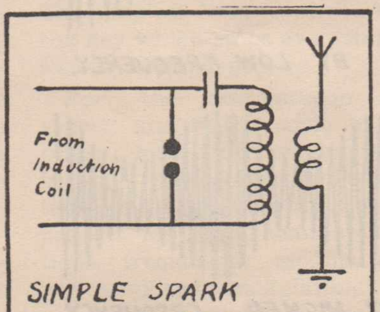
A short historical survey of the developments up to the time of Marconi gives some indication of the number of men who had some part in that development. Most of the names mentioned will be familiar, not for the work in this field but because their names have been remembered and honoured by applying them to some electrical unit or measurement.

In 1842 Joseph Henry discovered the existence of electrical oscillations which appear during the spark discharge of a condenser. Although the nature and properties of these oscillations were not comprehended at the time Henry surmised some similarity between them and light.

Based on the large amount of data which had been accumulated by the efforts and experiments of Faraday on electric currents and Henry and Lodge on oscillations James Clerk Maxwell uroduced in 1856 a purely theoretical paper—"A Dynamical Theory of the Electromagnetic Field"—in which he stated that if electrical waves could ever be generated they would travel through space with the speed of light, and that light is an electromagnetic phenomenon. He further pointed out that light and electromagnetic waves differ only in wavelength and frequency, which



HERTZ'S TRANSMITTER and RECEIVER. Fig. I.



SIMPLE SPARK TRANSMITTER Fig. II.

(Continued on next page)

THEORY

(Continued)

would account for some differences in behaviour.

It has since been accepted that gamma rays, X rays, aultra-violet and visible light, infra red and heat rays, and radio waves are all electromagnetic phenomena.

This paper caused much discussion, one scientist even publishing a paper on the impossibility of originating wave disturbances in the ether.

Little further was done until 1888, when Heinrich Hertz produced and demonstrated these wames and showed them to be capable of being reflected and refracted and to obey the laws of interference as do light rays. Hertz used a very simple transmitter and receiver for his demonstrations and the range was only a few feet. Fig. 1 shows the apparatus diagrammatically. It consisted of a spark gap connected to the terminals of an induction coil for the transmitter and the receiver was a rectangular conductor with a small spark gap. A sliding rod which made contact with the outer wires allowed the receiver to be adjusted to suit the transmitter.

When the sliding rod was properly adjusted a spark discharge at the transmitter gap produced a small but definite spark at the second gap thus proving that energy did pass from the transmitter to the receiver.

Branly, in France, invented the coherer in 1890 and several notably Lodge in England, Popoff in Russia, and Branly all carried out experiments but none realised that a means of wireless communication was within their grasp. Sir Oliver Lodge even had a workable outfit and transmitted signals some 40 yards.

Sir William Crookes in 1892 was the first to predict the use of electromagnetic waves for telegraphic communication and even suggested the possibility of tuning.

It was left to Guglielma Marconi in 1894 to read an article on the work of Hertz and receive the inspiration which, within two years, allowed him to succeed in sending code signals over some distance and take out patents.

Although there has been much discussion and many statements that Marconi did not "invent" wireless, but merely used the ideas of others it cannot be denied that he at least had the vision and the necessary energy to bring the idea of radio before the public and to put it to practical use.

From this point onwards it

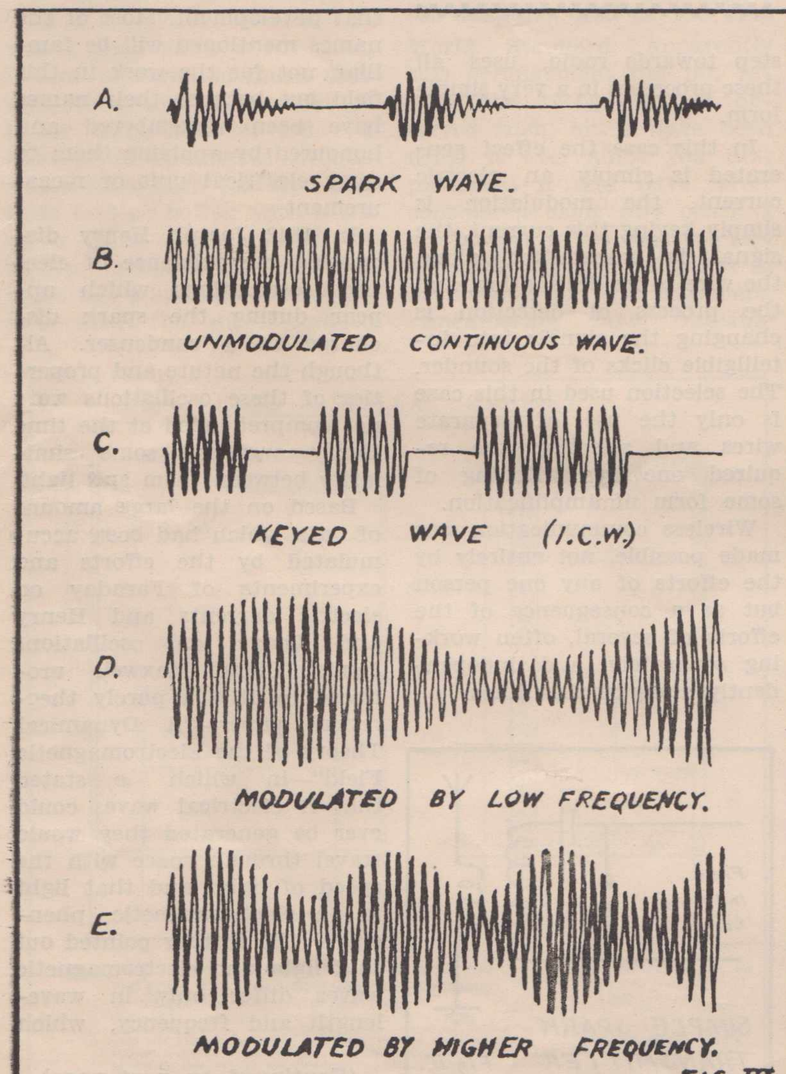


FIG. III

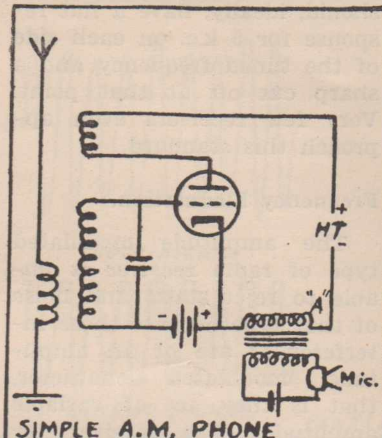
was only a matter of development, Muirhead and Sir Oliver Lodge did much to develop the coherer, which was the only means of detection suitable for the reception of code signals available at that time.

The coherer, which has, of course, been replaced by more sensitive and rapid methods, consisted of a tube filled with metal filings which, being loosely packed, had a high resistance. It was found that when a radio signal was passed through the filings they stuck together, or cohered, reducing the resistance. It was necessary, however, to shake the tube to loosen them before another signal could be detected. This resulted in some quite complex mechanisms as decoherers.

The development of the radio valve, with its amplification, made the detection of much smaller signals possible and, in reality, marked the beginning of radio as we know it, with telephony, television and the like.

Early transmitters were of the spark type, a simple form being shown diagrammatically in Fig. II. A condenser was charged by some means to a sufficiently high voltage to cause a gap to spark over. This discharged the condenser trough the inductance, and the oscillatory current in the inductance1capacity combination was coupled to the aerial. In general, frequencies were low, a large capacity being necessary, the signals rather broad, and only code signals could be sent. The signal transmitted consisted of a series of rapidly damped wave trains at short interval. Fig. IIIa.

The earliest methods of obtaining continuous waves, that is, waves which has a constant amplitude all the time



SIMPLE A.M. PHONE TRANSMITTER Fig. IVa

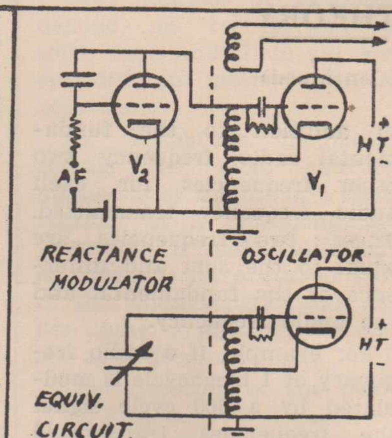


Fig IVb

the key is depressed, was by means of the tuned arc and the high frequency alternator. Both these system had several disadvantages, the principle one being the inability to generate high frequencies, the highest possible frequency with the alternator being about 100 k.c. and with the arc. 250 k.c. approx.

The development of the triode valve in 1906 completely changed the conditions and made the transmission of continuous waves of any frequency (within limits) as well as telephony, possible.

Modulation.

This, as was mentioned before, is the process whereby the required signal is impressed on that to be transmitted. The simplest form is, of course, the key which stops everything except when depressed.

For the transmission of speech and music some more orate form of modulation is used. There are two systems of modulation in use at present for radio communication — frequency modulation and amplitude modulation.

Amplitude modulation is by far the most common and uses a continuous wave of some frequency the amplitude of which is so controlled by the applied speech wave that its amplitude varies at a rate equal to the frequency of the applied signal and the magnitude of that variation is proportional to the intensity. Fig. IIIb shows diagrammatically a continuous wave as generated (unmodulated); IIIc shows the effect of keying, while IIId and IIIe show the signal modulated by different audio frequencies. It is possible to modulate the wave until the inward peaks just reduce the signal to zero. If we assume that the outward peaks are equal to the inward ones—this is generally so in practice—the signal amplitude can vary from zero to twice that of the unmodulated wave. It is for this reason that transmitting valves have different ratings for telegraphy and telephony. The modulation is generally expressed as a percentage. The modulation is classed as 100 per cent. when the signal reaches zero on the inward peaks.

As a consequence of the modulation process there are,

(Continued on next page)

THEORY

(Continued)

in addition to the fundamental radio frequency two other frequencies for each audio frequency transmitted. These two frequencies are equal to the sum and difference of the fundamental and the audio frequency.

For example, if a radio frequency of 1 megacycle is modulated by a 500 cycle signal the frequencies transmitted will be 1,000,000, 999,500 and 1,000,500 c.p.s. If the modulating signal is 3000 c.p.s. the transmitted frequencies will be 1,000,000, 997,000 and 1,003,000 c.p.s. These extra frequencies are termed side bands and it is necessary that the rceiver have sufficient band-width to allow them to pass to the detector. If the selectivity of the receiver is too great some of the higher modulating frequencies will be lost, and it is these high frequencies which give music its brilliance and impart intelligence to speech.

Most transmitters modulate with audio signals up to at least 5000 c.p.s. and a receiver should, ideally, have a flat response for 5 k.c. on each side of the tuned frequency and a sharp cut off at that point. Very few receivers even approach this standard.

Frequency Modulation.

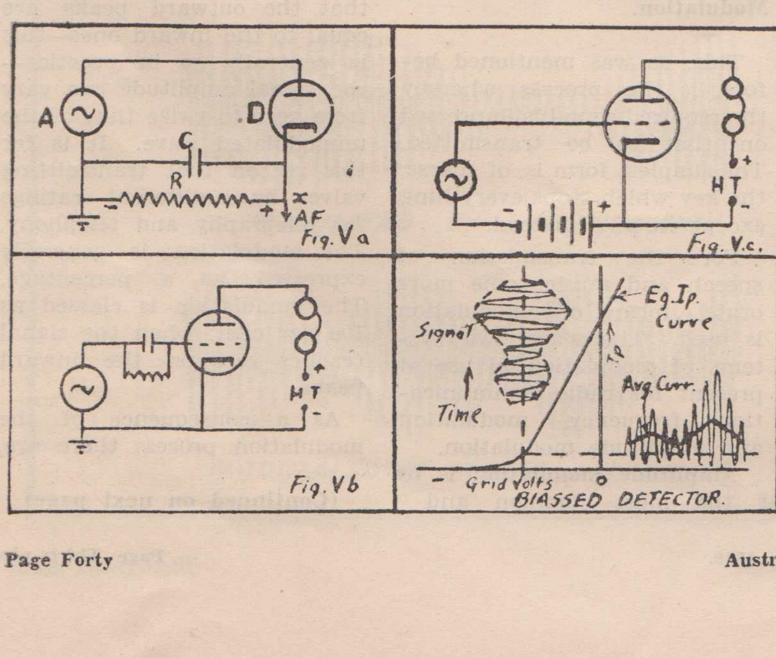
The amplitude modulated type of radio receiver is unable to rejct static and noise of that type because these interferences are of an amplitude modulated character, that is they are of variable amplitude. The receiver for frequency modulated signals, on the other hand, may be made insensitive to any amplitude modulated signals and will allow reception in noisy localities without interference.

The frequency modulated signal, instead of varying in amplitude in accordance with the frequency of the modulating signal, varies in frequency, the amount of frequency variation depending on the audio amplitude, while the rate of variation depends on the frequency. The amplitude of the transmitted signal does not vary. For example, a signal of 100 megacycles per second is modulated by an audio freq. of (say) 1 volt peak and 120 c.p.s. This may be designed to cause a frequency variation of 30 k.c. and the frequency will then vary from 99,970 k.c. to 100,030 k.c. 120 times per second. A 1 volt signal at 1500 c.p.s. will cause frequency variations of the same amount but 1500 times per second. A 2 volt signal will double the variation making it 99,940 to 100,060, while a ¼ volt signal will only cause a variation of 7.5 k.c. each way.

Although the methods of modulating the R.F. signal in the transmission of A.M. and F.M. signals is beyond the scope of this series the basic principles may be briefly explained.

A simple A.M. transmitter is shown in Fig. IV and consists of an oscillating triode valve the anode voltage of which is controlled by the microphone (and transformer) in the H.T. line. When the audio voltage "A" swings positive it increases the voltage on the valve anode and the r.f. voltage produced increases. When the audio voltage swings negative the anode voltage, and the r.f. output are reduced. Practical transmitters use much more elaborate methods than this.

A frequency modulated transmitter works on an entirely different principle. A simple type that is useful for obtaining F.M. signals is shown in Fig. IVb. The triode valve V_1 is the oscillator, being more or less conventional in operation, while V_2 is termed a reactance modulator. In this case it acts as a condenser, or, in other words, draws a leading current ¼ cycle ahead of the oscillator voltage. By carying the grid voltage of V_2 the magnitude of this leading current can be varied. This tube, then acts as a variable capacity across the oscillator coil—with the advantage that it will re-



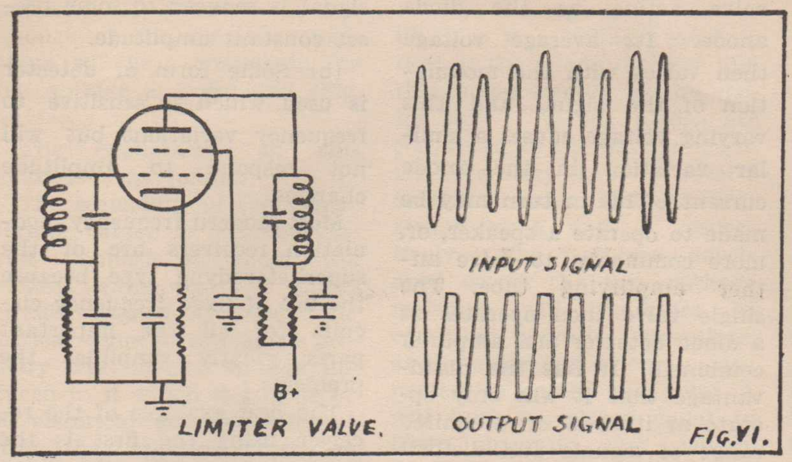


FIG. VI.

spond to any frequency and magnitude of audio signal.

One important advantage of frequency modulation over amplitude modulation is that it is possible to modulate with higher audio frequencies than are normally used in A.M. work. On the other hand the F.M. transmitter requires a much greater band width than does an A.M. transmitter. Because of this F.M. transmitters are operated at about 100 m.c. and can only be received at points comparatively close to the transmitter (up to about 20 miles) except in special circumstances or locations.

Selection.

The process of selection of the desired signal is accomplished by the use of one or more tuned circuits. The basic principle of tuning was explained in part V of this series.

Amplification.

By the use of one or more of the various types of triode, tetrode, or pentode valves the magnitude of the selected signal may be increased as required. This is termed amplification and will be considered in more detail when considering practical receivers. The signal may be amplified before detection (r.f. or i.f. amplification), or after detection (a.f. amplification).

Detection.

Before the selected signal can become intelligible it must be separated from the r.f. nal detection.

Most methods of detection depend on rectification in some form and there are several different methods used in practice.

For amplitude modulated signals the most common method is by the use of a diode rectifier or a semi-conductor (crystal). A radio valve may be operated on a curved part of its characteristic and under these conditions will also act as a detector.

The operation of the diode is as follows:

Consider the circuit shown in Fig. Va. A is an alternating voltage (incoming mod. r.f. signal), D is the diode which will allow current to pass only from anode to cathode when cathode is negative with respect to the anode, and C and R are a resistance and condenser which form the load. Assume that C has no charge and that A is tend-

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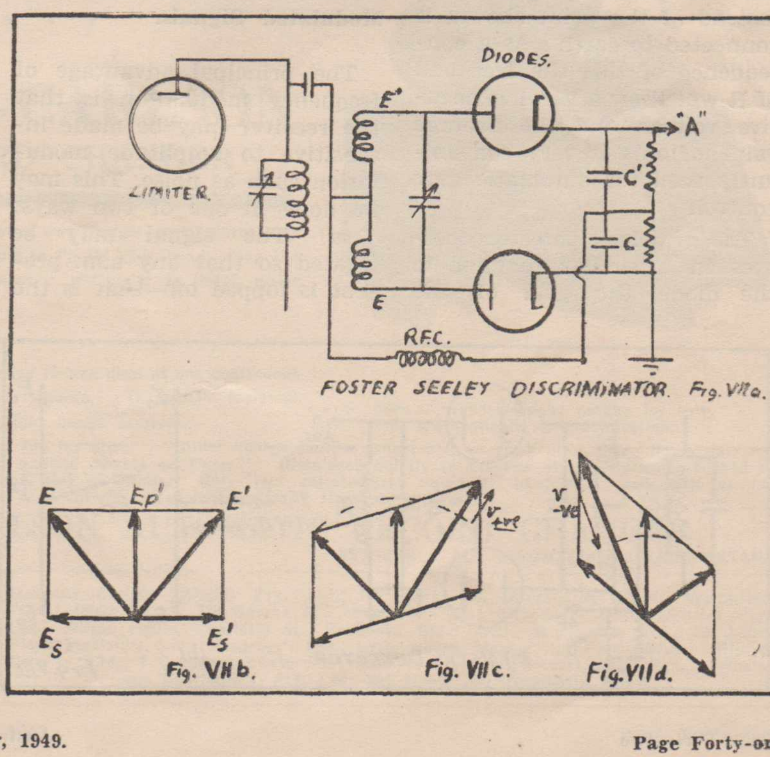

Fig. VIIa. Fig. VIIb. Fig. VIIc. Fig. VIId.

THEORY

(Continued)

ing to make the anode positive (cathode is at earth or zero potential). The diode will pass current, charging C, until point x is at the same positive potential as the upper end of A. As A swings negative the diode becomes non-conducting and C is slowly discharged by R which is made large. Before C is discharged very far A is again positive and makes up the small loss in voltage of C. It is seen that if the signal intensity is varying that the voltage of point x will vary at the same rate and by the same amount as the signal. That is point x will have a d.c. potential varying exactly as did the modulation of the r.f. signal. A condenser will separate the a.f. from the d.c. so that this circuit effectively separates the modulation from the signal. In practice the cathode instead of the point shown, is connected to earth. As a consequence of this the free end of R will show a varying negative voltage and the average value of this is very conveniently used for automatic gain control.

The grid leak detector operates in a similar manner to the diode, the grid of the valve acting as the diode anode. Its average voltage then varies with the modulation of the signal and this varying voltage causes a similar variation in the anode current. This in turn may be made to operate a speaker, or, more commonly, to drive anther amplifying tube. The single valve then operates as a diode detector and amplifier combined. It has the disadvantage that it will only operate at its best on a limited range of signals and distorts badly if overloaded.

A triode or tetrode valve may be used as a detector by biassing it so that it is near cut-off—under these conditions a positive voltage on the grid (really a less negative one) will cause a greater increase in anode current than the decrease due to an equal negative signal. Fig. V illustrates this.

Detectors for Frequency Modulated Signals.

The principal advantage of frequency modulation is that the receiver may be made insensitive to amplitude modulation such as noise. This may be done in one of two ways:

(a) The signal may be treated so that any a.m. present is lopped off—that is the signal is reduced to some preset constant amplitude.

(b) Some form of detector is used which is sensitive to frequency variations but will not respond to amplitude changes.

Most modern frequency modulation receivers are of the superheterodyne type because the use of fixed frequency circuits for all the important parts greatly simplifies the problems.

The best example of the receiver using the first is the type using a limitr tube which is an amplifier (usually a pentode of the sharp cut-off type) in the last i.f. stage which is operated at low plate and screen voltages, and with a high resistance in the grid circuit. Under these conditions the tube will overload on almost any usable signal so that the peak value of the signal reaching the detector is substantially constant. This treatment effectively eliminates any A.M. from the signal.

The detector used with this system is termed a discriminator, a good example being the Foster-Seeley discriminator.

Fig. VIIa shows the circuit for this discriminator, which, like most F.M. detectors, uses two diodes and a special transformer. The transformer, it will be seen has a primary and a centre-tapped secondary, both of which are tuned to the same frequency. In addition to the voltage introduced into the secondary by transformer action, there is an additional voltage applied to the centre tap by means of the condenser from the i.f. amplifier plate. When the frequency of the signal received is the same as that to which the circuits are adjusted the voltages across the two halves of the diode load will be equal and

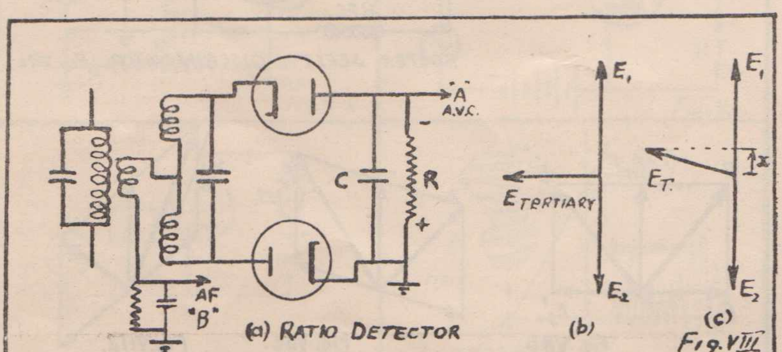

Fig. VIII

opposite. If, however, the frequency of the signal changes there will be a change in the d.c. voltage at point "A" (Fig. VIIa).

The explanation of this change is as follows:

The secondary of the transformer, which is a tuned circuit coupled at about the critical value to the tuned circuit coupled at about the critical value to the tuned primary will have a voltage induced in it which is ¼ cycle or 90 electrical degrees different from that applied across the primary. This may be conveniently represented by the vectors shown in Fig. VIIb, Ep is the primary vector and Es and Es' are the secondary voltages; the secondary being centre-tapped. Now the condenser connecting the centre-tap to the anode of the limiter tube has negligible impedance at the intermediate frequency used so the centre-tap has applied to it a voltage equal to that at the anode (i.e. Ep) and this is represented by the vector Ep'. As the diodes are connected to the outer ends of the secondary they will receive on their anodes voltages represented by E and F respectively. The voltages developed across the two cathode resistors will therefore be equal but opposite. Therefore, as the outer end of one is connected to earth, the point A will have a voltage equal to their algebraic sum, which, for this condition, will be zero.

When the incoming signal changes in frequency, however, an entirely different set of conditions apply. When the frequency of a tuned circuit is different from that of the applied signal the voltage across the secondary of the transformer suffers a phase shift, that is it is no longer 90 deg. from the primary, but leads or lags that value by an amount which depends on the amount of frequency difference, the tuned frequency, and the circuit constants (L/C, Q, etc.). This occurs because a tuned circuit off resonance draws a current which lags or leads the applied voltage, depending on whether the frequency is below or above the resonat frequency. The corresponding vector diagrams for a rise and a fall in frequency are shown in Figs. VIIc and VIId. Now under these circumstances the voltages applied to the two diodes are no longer equal and the voltage of point "A," which will be their difference will be either positive or negative, depending on whether the signal is lower or higher in frequency than the tuned frequency. The actual value,

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THEORY

(Continued)

also will increase with greater deviation, which is the desired condition for F.M. detection.

This detector must be preceded by a limiter stage because a change in signal strength will cause a change in the voltage at "A" (except at resonance) as all voltages will increase and therefore the difference between the diode voltages will increase, too. This means that any amplitude modulation present in the signal at the discriminator will be reproduced in the audio signal.

The **Ratio Detector**, however, is not sensitive to A.M. present in the signal and is therefore an example of the second type of F.M. detector. Fig. VIIIa gives the circuit of the ratio detector and it will be noticed that the diodes are connected differently, and that the A.F. is taken off at a different point. For this system the voltage in phase with the anode voltage is obtained by using a winding called a tertiary winding which is untuned and is coupled as closely as possible to the primary. (This winding can be used instead of the condenser from the limiter plate in a Foster Seeley circuit.) Now, in this system the two diodes are connected in series across the secondary and will therefore conduct only at the instant when the secondary voltage is at its peak value. For the remainder of the cycle the whole transformer may be considered as being disconnected (except for the single connection at "B"). Fig. VIIIb gives the vector diagram at the instant when the diodes conduct. At this instant there is no voltage aiross the tertiary winding (voltage from a vector is the **vertical** distance between the end of the vector and the horizontal, i.e., the projection on to a vertical exis.) So that the voltage at "B" will be equal to that at the centre of R. Now, if the frequency varies the voltage across the tertiary winding will become different in phase relative to the secondary and will appear as in Fig. VIIIc. The voltage of "B," then, will not be that of the electrical centre-tap of R but will be greater or less by an amount equal to x. This change will be positive or negative according to the direction of the frequency change and the amount will depend on the amount of frequency change. By making the condenser C, which is connected across R, very large (8-10 mfd.) the voltage of point "A" will remain steady, even when tevere A.M. is present in the signal. This means that the sum of the voltages from earth to "B" and from "B" to "A" is a set amount and that only their **ratio** may be varied—hence the name ratio detector. The ratio is dependent only on the frequency changes and is independent of amplitude. This detector, therefore, does not require a limiter stage for its operation.

The output from the point "A" of the ratio detector being very steady and, with the diodes the right way round, negative with respect to earth, may quite readily be applied to provide automatic volume control bias. No a.v.c. is necessary ith the Foster-Seeley detector as the signal to the limiter should be kept as large as possible to ensure its operation.

As the actual voltage input to the transmitter at high frequencies is quite small compared to that at low frequencies it is customary to give some boost or pre-emphasis to the higher frequencies, the rise tarting at about 200 c.p.s. and rising to about 17 d.b. at 15 k.c. Because of this it is usual to fit F.M. receivers with a much larger R.F. by-pass condenser than is used in A.M. receivers on the detector output. **(Part 7—Next Issue)**

RADIO CLUB FOR MOORABBIN-BENTLEIGH

This club held its first meeting on October 25. The response to the idea of forming the club was most gratifying and it would seem that it has quite a rosy future.

The turn-up of hams, S.W.L's and radio enthusiasts showed that the club is going to be popular, and offers great prospects to those who are prepared to devote some of their time to helping it along.

Jim Keenes (VK3KE), well-known to the boys on 2, was elected president; Ted Scott (S.W.L.), secretary; and Ed. Manifold (VK3EM), treasurer.

The programme for the coming meetings is interesting and should provide the members with plenty to keep them amused and out of mischief for many days to come. Displays of U.H.F. gear, pictures on T.V., morse code practice, field days and socials are all up and coming. So chaps, give this club your support if you live in the surrounding district. New members are always welcome. President's address is: 73 Daley Street, Bentleigh.

Is there a radio club in YOUR district? If not, why not try and form one! Go to it, and let us know of all club doings!

Shortwave Review

Conducted by L. J. KEAST

Rex Gillett sends some interesting notes:—

I am hearing Angola on 7140 k.c. in relay with 9470 k.c. till closing at 7 a.m. (E.S.T.) with the Portuguese National Anthem; call sign unknown.

Haifa, 8170 k.c. heard with news in English at 5.30 a.m. (E.S.T.). This one noted until after 7.45 a.m. (E.S.T.).

It is presumed the Spanish station being heard on 7940 k.c. from about 4.30 a.m. (E.S.T.) is Alicante, Spain; signals are poor.

Radio Sumatra, Medan, signs off at 2 a.m. (E.S.T.) on 7355 k.c. with "Marching Through Georgia" and the Dutch National Anthem.

Radio Somali, Hargeisa, on 7125 k.c. is being logged until sign off at 12.30 a.m. (E.S.T.). Signals here are fairly good, but programmes are typically Arabic. VED, Edmonton, on 8265 k.c. is good strength, opening at m/n (E.S.T.). It announces as "This is the Canadian Broadcasting Corp."

"This is your Forces Broadcasting Service, Middle East," is being heard here after 7 a.m. (the time quoted from most sources). Frequency is 4780 k.c. VKC, Melbourne police take the air on the same channel soon after this/ time and put F.B.S. out of business.

Believe I am hearing the Canary Island Station, EA8AB on 7520 k.c. which is on schedule from 7 to 8 a.m., according to overseas sources. The station heard with Spanish programmes has not been noted before 7 p.m. but has been heard to close down at 8 a.m., hence my belief.

"This is Radio Republic, Indonesia, broadcasting from Djokjakarta on 59.2 metres, 5060 k.c." is the way the Indonesian on 5060 k.c. identifies during an English session between m/n. and 12.30 a.m. (E.S.T.)

ZL7 on 6080, is good strength here in relay with ZL4 on 15280 nightly about 8.30 (E.S.T.).

HELP WANTED

A French speaking stat ion 7.17 m.c. was heard closing at 12.15 a.m. with "Marseillaise"' announces "Ici Radio . . . .?" Firstly thought (or really hoped was Reunion, which is scheduled for 11.45 p.m.-12.30 a.m. on this frequency). However have heard it a little before 11.45. Another station with Indian or Chinese programme use same or almost the same channel causing some interference.

A Spanish speaking station on 7.09/7.10 m.c. heard about 7 a.m. till after 7.15. Signals vary from fair to good.

Have R.A. DX script 166 in front of me and am wondering if the item, F.B.S. Kabrit, in the Canal Zone of Egypt,

(Continued on next page)

New Stations

VLX, Perth, 4.897.5 m.c. 61.26 met.:

Once more the ABC have opened a new station in the 60 metre band. VLX has replaced VLX-2 (6.13 m.c.) and present schedule is: Sun.-Friday, 8 a.m.-12.15 p.m.; Saturday from 10.45; Monday-Friday, 8.15 a.m.-1.30 a.m.; Saturday till 2 a.m.; Sundays 8.45 p.m.-1.30 a.m.

Radio St. Denis, Reunion, 7.17 m.c. 41.85 met.:

Here is a new and interesting station reported by Rex Gillett. He says: "Good news! Have just received by airmail a letter verie from Radio St. Denis, Reunion on 7.17 m.c. Although they do not say so, I believe this is the first Australasian verie. Schedule is: 11.30 p.m.-12.30 a.m. Programme is in French and concludes with the Marseillaise. (Reunion, formerly Bourbob, is a French Island in the Indian Ocean, between Mauritius and Madagascar; area 1000 miles; sugar growing. Population 175,000. Capital is St. Denis.—L.J.K.)

FBS Malto, 7.27 m.c. 41.27 met.:

Rex says: "I am hearing FBS, Middle East, on this frequency, where it is mixed with Moscow. I hear it best about 6.30 a.m. till after 7.30. (It will be remembered I mentioned that FBS said they expected to use 7.27 m.c. as also 6.14 and 11.785 m.c.—L.J.K.)

BED2 & BED4, Taiwan, 11.80 m.c. 25.42 met.:

Miss Sanderson reports this new Chinese station announcing as "Voice of Free China," opening at 8 p.m. when news in Chinese is given, followed by music. Signal is very good. (Although frequency is announced as 11.80 m.c. it seems to be nearer 11.725 m.c.)

CHANGE OF FREQUENCY

Pakistan, 11.77 m.c. 25.49 met.:

Announced at 10 a.m. as announcing from Dacca, Lahore and Karachi. News was heard at 10 p.m. in English.

S.W. REVIEW

(Continued)

has been testing on 7.37 m.c. relaying their 1393 k.c. outlet (Bluman-Israel) applies to my mystery. On September 21, I have details of a station on 7.375 with recorded music and announcements by a lady. At 11.30 p.m. announcer said, "You are listening to Radio . . . . ? and two wave-lengths were mentioned. Station then closed with a song sung by a choral group.

Another reference I have to a station about this frequency is 7.38 m.c.; native type programme . . . faint signals 10 p.m. . . . may be same station

On September 20 good signals were heard on about 6.95 m.c. at 7.15 a.m. Recorded music (swing) was played without interruption till 7.30 when a man announced in French. Further music continued. Although I have tried several times since I have not been able to tune the station.

A foreigner about 6.55 m.c. has been heard at 5.45 a.m. Information is vague, but that is all I can give you at this stage.

Another station with Arabic type programme at the same time is on about 6.785 m.c. (I am not beinf confused by KOL ISRAEL on 6.825 or Larissa, Greece on 6.745 m.c.). The above "mysteries" are supplied by Rex Gillett . . . so the ball is in your corner . . . can anyone oblige?

VERIFICATIONS

Rex Gillett, of Prospect, Sth. Australia, has received a nice batch of veries. They are as follows: DZH-2, DZH-4, DZH-6; Bucharest (6.21); Brazzaville (15.595); HCJB (17.89); HCJB (12.455); YDB-3 (7.27); YDE (11.77); PLB-4; Fort de Kock (Sumatra) (10.60); Belgrade (6.10); Sofia (7.67); YdQ-2; YDO-3; Damascus (11.00); CR6RG; YNVP; LLP; LLN; LKV; Luxembourg (6.09); OTH (9.21); ZYK-3; YDA-2; and LDY.

Miss Sanderson has also added to her list by receiving veries from: KZCA; Radio Continente (Venezuela); Fort de Kock; VLX and VLM; Radio HUE; Annam; Pakistan; CE622 and ZYK-2.

Arthur Cushen's list: VLX, Perth, 4.897 m.c., 61.26 m.c.; ZOY, Accra, 4.915 m.c.; HJAG, 4.92 (Colombia); HCJX, 6.018; ZYK-2, 6.085; FZP-8, 12.08.

A GOOD LIST FOR CHECKING YOUR RECEPTION

Miss Dorothy Sanderson sends me a fine list of loggings. Here they are:—

Europe	M.C.	A.E.S. Time	Subject
Budapest	9.83	8.15 a.m.	Talk on Tito and Yugoslavia in Home Service.
LKV	15.17	9.00 p.m.	Good signal in Norweigan, news and music.
LLP	21.67	11.30 p.m.	Mailbag and music, English session.
LLN	17.82	9.15 p.m.	Norweigan news and music; good signal.
OZH2	15.16	8.30 p.m.	Good signal in Danish, news and music.
Leipzig	9.73	3.45 p.m.	German news and good musical programme.
SDB2	10.78	5.15 p.m.	Good clear signal in English news and music.
PCJ	15.22	7.15 p.m.	Waltz music from Gipsy Love and English news.
PCJ	21.48	7.30 p.m.	Happy station programme in news and music.
Paris	15.10	9.30 p.m.	French news for 15 minutes and music.
OIX5	17.80	7.30 p.m.	Orchestral concert for home service.
SBP	11.70	5.35 p.m.	Programme details, English news and music. R9.
PCJ	9.59	6.35 a.m.	Happy station programme in news and music.
Rome	9.63	6.30 a.m.	News in Italian and music.
Rome	11.81	8.05 p.m.	30 Minutes of English news and music.
LKQ	11.73	9.30 p.m.	Good signal in Norweigan, news and music.
Rome	15.12	8.00 p.m.	Fair signal in news and music.
HER8	21.52	8.00 p.m.	German programme in news an dmusic.
VP4RD	9.62	8.00 p.m.	Church in the Wildwood, then news, music.
YDE	11.77	7.45 p.m.	News for Indonesia and music.
CR7BU	4.91	6.45 a.m.	Request session of music, then news.
ZRK	5.88	6.55 a.m.	Musical programme and news.

Canada	M.C.	A.E.S. Time	
CBRX	6.16	5.45 p.m.	English news and music; freq. and program. details.
CBLX	11.09	11.15 p.m.	News, weather reports and music.
CKRP	21.60	Noon	U.N. commentary to South Africa.
CKRA	11.76	1 p.m.	Latin American service in news and music.
CKCX	15.19	2.45 p.m.	Music and news in Latin American service.
CHNX	6.13	8 p.m.	News, weather reports and music; general news.
CKLO	9.63	7.45 a.m.	French and English news and music.
CHOL	11.72	8.45 a.m.	English and French news and music.
South and Central America			
LRM	6.18	8 p.m.	Good signal in Spanish, news and music.
LRS2	11.84	8.00 a.m.	Spanish news and music.
HH3W	10.13	10.00 p.m.	French news and music; good signal.
XEBT	9.62	3.30 p.m.	Good musical programme and Spanish news.
LRT	11.84	8.00 p.m.	Test programme of Spanish news and music.
HCJB	15.11	2.30 p.m.	Usual programme of hymns and talk.
HI2T	9.72	10.00 p.m.	Opens with good signal in Spanish news and music.
PRL8	11.72	7.15 p.m.	Spanish news and music. Merry Widow Waltz.
XEWW	9.50	11.00 p.m.	Spanish programme of world, 7 locals, news, music.
COKG	8.96	10.30 a.m.	Good programme of music and Spanish news.
U.S.A.			
KCBA	6.14	6.00 p.m.	Music and baseball recreation.
WABC	21.57	7.30 a.m.	Press opinion and news.
KCBR	9.51	7.15 p.m.	News commentary.
KRHO	15.25	7.00 p.m.	News to Far East and music.
KNBX	17.83	1.15 p.m.	Russian session.
WOOW	9.70	8.00 a.m.	Service to Europe in French.
WCBX	17.83	7.45 a.m.	European service, news and music.
WOOC	15.13	9.30 a.m.	News and music in European service.
WLWK	17.80	7.00 a.m.	Service to Europe in French. Music.
KGEX	17.78	1.15 p.m.	News in Russian.
China, Ceylon, India and Malaya.			
BEA8	9.73	11.45 p.m.	Talk in English on People's Republic and music.
New China	10.26	11.00 p.m.	Talk on New Republic.
BEL2	11.50	9.30 a.m.	Chinese news and music. (Identifies as BEL2 & 7.)
XGOE	9.86	8.30 a.m.	Chinese and music; fair signal.
ZBW3	9.52	7.30 a.m.	Good signal; news and musical programme.
BEF8	15.175	8.30 p.m.	Bdingin Christ to the Nations and Chinese news.
SEAC	17.73	7.00 p.m.	Request session and news; signature tune is "Roses of the South."
VUM2	9.59	9.00 p.m.	Thirty minutes of good programme and good signal.
Pakistan	11.88	10.00 p.m.	News in English for ten minutes.
Radio Malaya	9.712	8.30 p.m.	News in English and music.
Singapore	6.77	10.15 p.m.	News in English—then Chinese.
Siam	11.65	9.15 p.m.	News in English for ten minutes—then music.
HS8PD	6.01	9.15 p.m.	News; closes at 9.30.
DZH6	6.03	9.20 p.m.	News in English.
DUH5	11.84	7.30 p.m.	Music and News.
DYH2	6.14	11.30 p.m.	Request session of music.
Saigon	11.78	8.00 p.m.	World and local news.
BEE2			
BEE4	11.72	8.00 p.m.	Open at 8 o'clock announcing location as Taiwan.
KRHK	15.25	9.15 p.m.	Commentary and news in parallel with KRHO.
KRHK	11.79	8.00 p.m.	Far East service in news and music.

OUR LEADING QUERY

Distortion Percentages

H.F.D., of Glen Iris, Vic., writes:—

I intend building a high-fidelity amplifier, class A, push-pull and haven't made up my mind yet what circuit arrangement I intend adopting yet, and want to study one or two varieties first. I read your article in the October issue dealing with the H.F. amplifier using 807's.

Is this circuit pure class A push-pull; also what percentage of distortion is there with this circuit?

Secondly, I believe there is an H.F. amplifier called the Williamson, which gives efficiency to the value of one-tenth of a per cent. distortion. I am in favor of 15 watts of undistorted power output, but do you think I would have ample with 10 watts? Is 10 watts enough power for a Rola G12 or a Goodman's 12-inch speaker?

A.—Yours is a typical query of the type we get at the rate of so many per week. There are dozens of people chasing the same elusive goal; satisfying gramophone reproduction.

Here are a few pertinent comments which may help you to get a better understanding of the present state of the art. It is fairly easy to get a satisfactory amplifier circuit; it is getting it to perform without parasitics, phase displacement, etc., which is difficult. The Williamson amplifier was an English design. Its equivalent, but to use valves obtainable in Australia, was detailed in our issue for February, 1948. It is a good circuit, but in practice not every amplifier built to this circuit gives 100 per cent. performance. It is fairly critical, and the slightest instability will quickly write off any claims for one-tenth of a per cent. We have tested a good sample of the Williamson up against our direct-coupled job and we have switched quickly from one to another. The difference takes quite a bit of detecting, but we like the direct-coupled job for our particular set-up. With different styles of records, pick-ups, speakers or room acoustics the verdict might be different. But we think that there is a better

OVERSEAS SERVICES OF THE S.W.

A.E.S.T.	Call Sign	Freq. Mc/S	Target Area
6 a.m.-7.30 a.m.	VLA4	11.85	British Isles and Europe
6 a.m.-7.30 a.m.	VLB2	9.65	British Isles and Europe
6 a.m.-7.45 a.m.	VLC11	15.22	British Isles and Europe
7.43-9.15 a.m.	VLR4	11.85	North America (East)
7.43-9.15 a.m.	VLB6	15.20	Forces; Japan, North Pacific, Isles
7-9.15 a.m.	VLG6	15.23	British Isles and Europe
8.10-9.15 a.m.	VLC9	17.84	South America
12.58-2.15 p.m.	VLB5	21.54	Forces; Japan, North Pacific Isles
(Noon-2.15 p.m. Sat. and Sun only)	VLC9	17.84	Malaya, India, Pakistan, Ceylon
	VLG6	15.32	Forces; Japan, North Pacific Isles
	VLA6	15.20	Sat. Only) Japan,. North Pacific
	VLA6	15.20	(Sun. Only) Malaya
1.12-5.30 p.m. Sports	VLB5	21.54	Forces; Japan, North Pacific Isles
Sat. Only	VLG6	15.32	Forces; Japan, North Pacific Isles
2.30-3.45 p.m.	VLA8	11.76	North America (West)
	VLC9	17.84	North America (West)
	VLG6	15.32	North America (West) (Not Sat.)
	VLB5	21.54	Africa (Not Sat.)
4.45 p.m.	VLA4	11.85	Europe
	VLG6	15.24	Tahiti (Not Sat.) (French)
	VLC	15.20	Tahiti (Sat. Only) (French)
4.30-4.50 p.m.	VLC	15.20	Thailand (Wed. Only) (Thai.)
5-5.45 p.m.	VLC9	17.84	British Isles and Europe
5-6.15 p.m.	VLA6	15.20	British Isles, Europe, N.Z.
5-6.15 p.m.	BLB4	11.85	(Not Sat.) British Isles, Europe, New Zealand
5.45-6.15 p.m.	VLG3	11.71	New Caledonia (French)

chance of an amateur builder getting the direct-coupled job into 100 per cent. performance, as it is not so complicated. Frequency response and distortion percentages are only two things to be considered. There are many other things, such as phase displacement, transient response, and half a dozen other finer points.

Wide frequency range is a severe drawback if you intend to use ordinary commercial gramophone recordings. For these most listeners prefer a response with a rising bass and a sharp cut-off at about 7,000 cycles.

Remember that the amplifier is only one link in the chain. The record ,pick-up, turntable, needle, speaker, baffling and room acoustics are all points where the performance of any amplifier set-up can be completely ruined.

To get down to brass tacks on your query: Both circuits are pure class A triode. We do not have the equipment to measure the actual distortion of the direct-coupled amplifier, and doubt whether anyone, anywhere, is in a position to measure one-tenth of a per cent distortion or to claim that any amplifier built to any circuit will necessarily have this amount of distortion. All valves, resistors and condensers have tolerances which would make it impossible to ensure that all amplifiers built to the circuit would have one-tenth of a per cent. Most authorities on reproduction claim that the human ear cannot distinguish distortion of less than 3 per cent. Dealing with the matter of power: Ten watts will load up a G12 or Goodman's nicely and is ample for normal home use. The human ear will not distinguish between 10 and 15 watts. The sound level does not go up according to the electrical power, you know. Fifteen watts doesn't sound half as loud again as ten watts.

DIVISION, DEPT. OF INFORMATION

616.45 p.m.	VLC	15.32	New Caledonia
6.30-7.10 p.m.	VLB4	11.85	Malaya, Indonesia
6.30-9.30 p.m.	VLA6	15.20	Forces; Japan, N. Asia, N. Pacific
6.55-7.10 p.m.	VLG10	11.76	New Zealand
6.55-9.30 p.m.	VLC4	15.32	India, Pakistan, Ceylon
8.00-9.30 p.m.	VLG10	11.76	New Zealand
7.108.00 p.m.	VLG10	11.76	New Zealand
7.10-9.30 p.m.	VLB4	11.85	Malaya, Indonesia (Indonesian and Dutch)
9.30-9.45 p.m.	VLC4	15.32	India, Pakistan, Ceylon
9.30-11.00 p.m.	VLA6	15.20	Forces; Japan, N. Asia
9.30-11.00 p.m.	VLB4	11.85	Malaya, Indonesia
9.45-11.00 p.m.	VLG6	15.32	India, Pakistan, Ceylon
10.00-M/N	VLC7	11.81	North America (East)
11.00-11.55 p.m.	VLA6	15.20	Forces; Japan, N. Asia, N. Pacific
11.00-M/N	VLB4	11.85	Malaya, India, Pakistan, Ceylon, Burma
11.00-M/N	VLG6	15.32	India, Pakistan, Ceylon
M/N-12.45 a.m.	VL34	11.85	British Isles, India, Pakistan, Malaya
M/N-1.00 a.m.	VLA6	15.20	British Isles, India, Pakistan, Malaya
M/N-1.00 a.m.	VLG6	15.32	British Isles, India, Pakistan, Malaya
M/N-1.00 a.m.	VLC7	11.81	North America (Central and Mountain Zone)
1-1.45 a.m.	VLB9	9.615	North America (West)
1-2.15 a.m.	VL C7	11.81	North America (West)
1.25-2.15 a.m.	VLA8	11.76	India, Pakistan, Malaya, Burma, Ceylon
1.15-2.15 a.m.	VLG2	9.54	Africa
2.00-3.15 a.m.	VLB9	9.58	Europe (German)
2.30-3.15 a.m.	VLA8	11.88	Europe (German)
2.30-3.15 a.m.	VLC	15.20	Europe (German)

Speedy Query Service

A.D.W. (Murchison) is worried about the sensitivity and selectivity of a receiver and asks whether we can help out.

A.—The idea of a receiver is to intercept incoming signals and, through a series of stages in the set, to make the signal audible in a loudspeaker or 'phones. Some receivers will only intercept and detect strong signals while others will pick up much weaker signals. The set which is able to pick up the weaker signal is said to be the most sensitive. Selectivity refers to the ability of the receiver to separate two signals on almost the same frequency. A set which brings in two signals simultaneously is said to be unselective, while a set which will discriminate between signals on adjacent frequencies is said to be selective. Selectivity is a very desirable feature in an amateur receiver where the bands are rather congested.

* * *

B.J. (Portland) asks how he can obtain sufficient voltage to operate a cathode ray tube which was intended to normally operate on 2000 volts without going to the expense of high voltage transformers. . .

A.—Most C.R. tubes will function quite well on at least half their normal voltage, and usually with much greater sensitivity. Therefore you are faced with the problem of raising only 1,000 volts. This can be done in either of two ways. Firstly, you could use a voltage doubling circuit in conjunction with an ordinary 385 volt-per-side receiver transformer used in a half-wave hook-up. As the C.R.T. pulls only about 1 m.a. this arrangement will give you about 1,300 or 1,400 volts. Another set-up, known as power supply uses a single 6V6 as the R.F. oscillator and the voltage output is somewhere in the vicinity of 3,000 volts. With an R.F. supply the main worry is shielding. The unit must be well shielded to prevent interference with neighbouring equipment and receivers. This is easily done by building it in a small metal box. Both schemes require only a small power transformer and a couple of tubes which cost nothing like a 2,000 volt transformer, which, by the way, is much more dangerous.

"SUPER SIX"

(Continued from page 9)

laced together, running around the end and along the front. The power input and speaker output sockets are at the same end as the 807, to keep them away from the inputs. Two four-pin sockets are used for the speakers and a five-pin socket is used for the power input. All heater leads are twisted, and one side earthed at the input plug only.

The 750 mmf. by-passes on the plate of the driver is necessary to prevent the stage from oscillating at high frequency setting of the treble contorl.

The job of wiring the amplifier should present no difficulty to anyone who has had some experience in radio. The parts placement diagram should be a help to those who have any difficulty.

The output transformer we used is not generally available, now, but any output transformer with a 2.500 ohm or 3,000 ohm load impedance and a 500 ohm line output would do the job. In the "A and R" brand type OT776/9 is suitable. In the Ferguson brand type OP1A is suitable.

If the amplifier is to be used to drive more than one speaker with a 500 ohm transformer on it, you should use an output transformer with a 250 ohm secondary for two speakers in parallel, or one with a 125 ohm secondary for four speakers in parallel. On the other hand, you could use a divider network with 500 ohm input, and any desired number of extra 500 ohm. windings on the secondary side.

ASTOR

(Continued from page 22)

the plate; 30 on the screen, and the bias should vary from 2 to 22 volts negative as the setting of the volume control is varied.

The 6V6GT/G should have 6.3 volts a.c. on the heater, 165 volts d.c. on the plate, 155 on the screen and a bias of 8.5 volts negative, measured at the "bottom" of the grid resistor.

The 5Y3 should show 5 volts a.c. on the filament and 185 volts r.m.s. on each plate.

RED LINE

TRANSFORMERS OF DISTINCTION

UNIVERSAL TYPE MODULATION TRANSFORMERS

The following modulation transformers are designed to fit in closely with the requirements of the amateur experimenter concerned mainly with the transmission of speech frequencies 200 cps to 4 Kc/s.

However, close coupling of coils to minimise power losses in Class B circuits call for a type of construction with interleaved coils that makes the useful frequency range from 100 cps to 7 Kc/s.

They are universal types with a wide range of primary and secondary impedance suitable for nearly all valve combinations, and their general construction and the use of "UI" type mountings give a particularly handsome and professional appearance. In all cases. adjustments are made on an incremental inductance bridge to maintain close control on gap radios so that the designed inductance is obtained for the stated secondary DC current.

ITEM 74. **Type No. UM25**

Primary .. .. .. 8000-6500 ohms CT
Rating: 25 Watts .. .. Audio/Speech
Sec: 10,000—7500—6500—5500—4500—3500 ohms.
Unbalance Secondary DC 125mA
Base: 4" x 4⅛ x 3½" H. Wt. 7lbs. 6ozs.
Mntg: U1 10 .. .. "S" is 2"

ITEM 75. **Type No. UM50**

Primary .. .. 8000—5200—3800 oms CT
Rating: 50 Watts .. .. Audio-Speech
Sec: 10,000—7500—6500—5500—4500—3500 ohms.
Unbalanced Secondary DC .. 160 mA
Base: 4 x 3⅝ x 4⅛" H Weight 9lbs.
Mntg: U1 11 .. .. "S" is 2⅛"

ITEM 76. **Type No. UM125**

Primary .. 8000—6500—5000 ohms CT
Rating: 125 Watts .. .. Audio-Speech
Sec. 8000—7000—6000—5000—4000 ohms
Unbalanced Secondary DC .. 200 mA
Base: 5 x 5½ x 4¼" H . Wgt. 17 lbs.
Mntg: U1 15 .. .. "S" is 3"

DOUBLE WOUND STEPDOWN VOLTAGE TRANSFORMERS

ITEM 77. **Type No. 1107**

Primary: 230v. .. .. 50 cps
Secondary: 115v 75vA
Base: 3¼ x 4 x 3¾" H .. Wgt. 6 lbs.
Mntg: VS10 Mod. .. .. .. "S" is 1½"

ITEM 78. **Type No. 1115**

Primary: 230v .. .. 50 cps
Secondary: 115v .. .. 150 vA
Base: 4¾ x 4 x 3¾" H .. Wgt. 11 lbs.
Mntg: VS10 Mod. .. .. .. "S" is 3"

ITEM 79. **Type No. 1135**

Primary: 230v .. .. 50 cps
Secondary: 115v .. .. 350 vA
Base: 5¾ x 5 x 4⅝" H .. Wgt. 18 lbs.
Mntg: V15 .. .. "S" is 3"

ITEM 80. **Type No. 1160**

Primary: 230v .. .. 50 cps
Secondary: 115v .. .. 600 vA
Base: 6 x 5 x 7" H. Wgt. 25 lbs. app.
Mntg: .. .. Special

ITEM 81. **Type No. 1100**

Primary: 230v .. .. 50 cps
Secondary: 115v. .. .. 1000 vA
Base: 6 x 7 x 7" H .. Wgt. 40 lbs. app.
Mntg .. .. Special

SPECIAL EQUIPMENT

While there is a very large range of units dealt with in this series, it covers, nevertheless, a part only of an exceedingly wide field, and your particular requirements may be slightly or largely different. If so, we would welcome your enquiries, as we're specialists in the design of transformers and chokes to individual requirements, and it is practically certain that you will not pose a problem of this nature that our very wide experience and manufacturing facilities cannot solve.

Unlike most manufacturers in this field, we operate our own tool room, press shop and laboratory, and this close integration of our internal organisation has been of particular benefit to manufacturers using our products.

GUARANTEE

"RED LINE' equipment is unconditionally guaranteed against faulty design, workmanship and material. If a claim is made, however, under this guarantee we reserve the right to reject such claim if the unit in question has been wrongly used or has been in service for more than twelve months.

QUOTATIONS

On receipt of the necessary information, a quotation form will be mailed promptly. Quotations for country and interstate enquiries include an accurate assessment of the rail or postal charges involved, and it is our normal practice to send goods freight forward by goods rail and freight prepaid by post, passenger rail or air freight.

TECHNICAL SERVICE

A free service is available for all who require assistance with technical problems concerning transformers and their applications. For information ring our technical department at Central 4773.

RED LINE EQUIPMENT PTY. LTD.

TRANSFORMER ENGINEERS

WORKSHOP: Cent. 4773, 2 Coates Lane. Melb.
CITY OFFICE: MU6895 (3 lines), 157 Elizabeth Street, Melbourne.

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A GUARANTEE OF DEPENDABILITY

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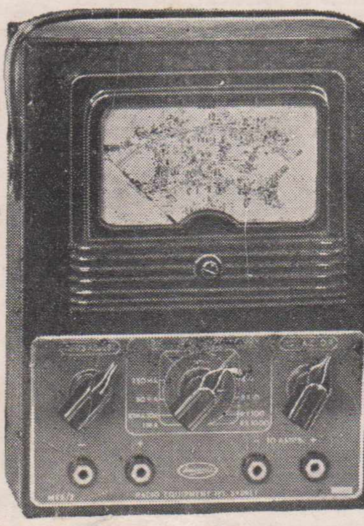
Successful Twins In The Multimeter Field!



Two New Multimeters With
Many New Features:
In Attractive Cases

MODEL MVA/2 : AC/DC

Used extensively in trade circles, military organisations and government departments, the new model MVA/2 now has a modern appearance—is for use on the bench or for portable use in the field. The latest "University" four-inch square type meter is a feature and its ranges in D.C. Volts, A.C. Volts, Output Volts—D.C. Current—Resistance—and Output are outstanding and may be extended with "University" plug-in shunts. Size: 8 in. x 6 in. x 3in.

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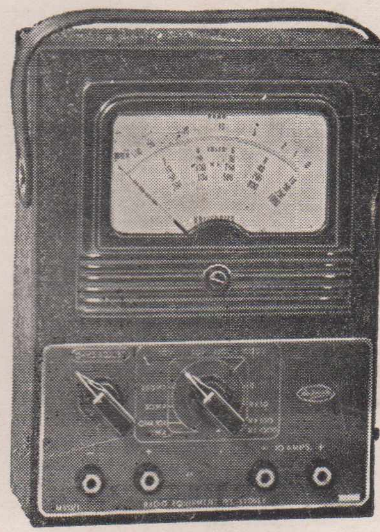

MODEL MVD : DC

Popular with radio men and electrical men alike—the model MVD Multimeter is built into a sturdy brocade finished metal box—has built-in batteries—yet measures only 8 in. x 6 in. x 3 in.

Range is 10 Amperes (which can be extended with plug-in shunts).

The various ranges of volts, ohms and milliamperes are selected by means of fool-proof switching system and the meter is the well-known "University" Model R4 rectangular type.

RADIO & ELECTRONIC TEST EQUIPMENT

University

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