THE AUSTRALASIAN

Radio World

Registered at the G.P.O. Sydney, for transmission by post as a periodical

VOL. 9 . . . . . NO. 6 NOVEMBER 15 1944

★ Frequency modulation and its effect on future broadcasting.

★ Charlie Mutton does well in Victorian amplifier contest.

★ Wobbler is efficient equipment for advanced radio servicemen.

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EDITORIAL

To some outsiders it is difficult to understand the inspiration which motivates the radio enthusiast. Business acquaintances are amazed at the circulation of "Australasian Radio World." They cannot see why it sells so well at a time when radio parts are difficult to obtain, set construction is controlled and, generally, conditions are adverse for the experimenter.

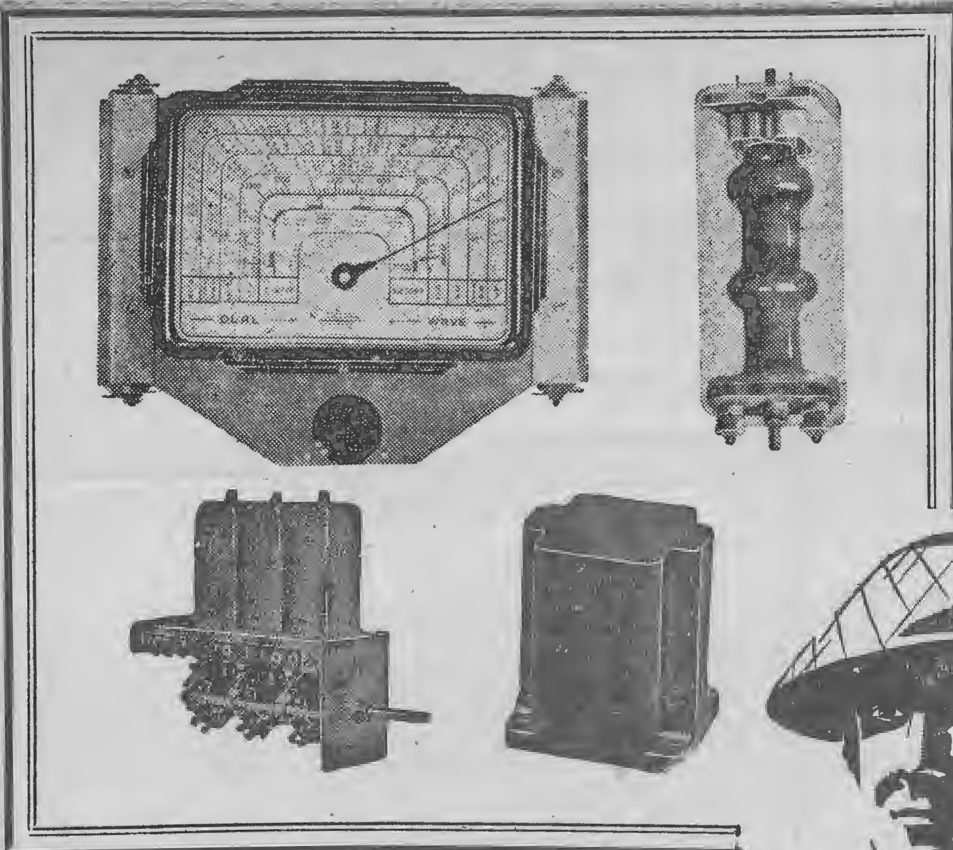
At the moment our sales are more than double the figure they were in 1939, and our subscribers number four times as many. What is the reason?

You know the reason as well as I do.

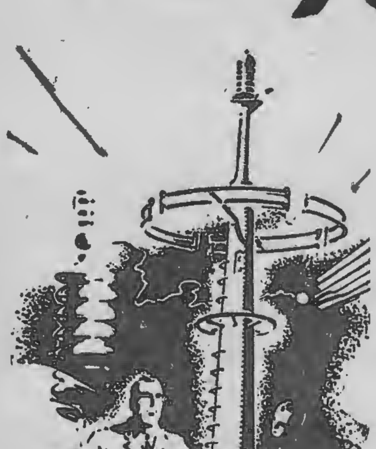
Radio is interesting. Reading about circuit developments is instructive and enjoyable. With simple equipment and a few "junk" parts it is possible to carry out practical experimenting which has excitement, even thrills for the keen radioman. Routine repairs of broken-down sets is not hum-drum work. In most cases it calls for the skill of the fictional detective, tracking down the trouble by careful analysis of clues which point the way. Sometimes the puzzle is quite baffling and the alert radioman pursues a most enjoyable hunt to locate the culprit component.

Considering the practical angles only, the hard-headed realists have long pointed out that you can buy a radio set almost as cheaply as you can build one. But have you ever known anyone to derive so much enjoyment from a factory-built set as he gets from one built with his own hands, adjusted to suit his own taste and inside which he can visualize each component "doing its stuff" as the signal passes from aerial to speaker?

The more we think of it, the greater is our faith in the future of the technical radio enthusiast.



YESTERDAY... TODAY... AND *Tomorrow*



Four years ago the entire activities of the R.C.S. organisation were devoted to the manufacture of quality radio parts. Since then their every effort has naturally been devoted to the production of the precision radio and electrical apparatus needed for the construction of urgent defence equipment.

With the approach of Victory however, a new era in radio is on its way. What the sensational new developments in the field of electronics will mean to the set constructor of the future no one can safely say—but both the professional engineer and the amateur builder can rely on the fact that, when the time comes, R.C.S. will be ready and waiting with the exact type of components required. Plans have, in fact, ALREADY BEEN COMPLETED for the introduction of new insulating materials, new techniques, and new methods of manufacture that will ensure for R.C.S. a standard of quality even higher than that of pre-war years

R.C.S

R. C. S. RADIO PTY. LTD., SYDNEY, N. S. W.

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MUTTON GOOD AT AMPLIFIERS

THE final of the Victorian Amplifier Championship was held at the studios of 3UZ on Saturday night, October 28. An enthusiastic audience of about 250 paid 1/11 each for admittance and crowded the studio.

Charlie Mutton, popular "Radio World" contributor won the Grade 1 (open, professional, all powers).

The "Australasian Radio World" prize of £5/5/- for the Grade 2 contest (home-built amplifiers of under 18 watts power) was won by H. McLean. Other results on page 10.

Well Organized

The contest was well organized by the Australian DX Radio Club, in conjunction with the Melbourne broadcasting weekly "Listener-In". Fifty-one entries were received and from these a team of three judges selected the finalists. Originally it was intended that there should be three finalists in each grade, but the judges were unable to reach a decision at the preliminary judging of Grade 2, and eventually decided to bring along six finalists in that grade.

The Amplifiers

The amplifiers at the final were a representative lot, mostly 2A3 type triodes in push-pull, and it was interesting to note that in every case great care had been taken to ensure adequate "drive" to the final stage. Indirectly-heated power pentodes, connected up as triodes, sometimes in push-pull, were favourites for the driving stage. There were three amplifiers at the final using beam power valves with inverse feedback, but it was pretty evident that their reproduction did not meet with the approval of the judges or the audience.

Good Audio Transformers

Congratulations are in order for the makers of Trimax transformers.

The winning amplifiers in every grade in the contest, as well as the "Champion of Champions" were fitted with audio transformers of "Trimax" brand, manufactured in Melbourne.

Such results are definite proof that these transformers are capable of giving splendid reproduction and are equal or better than even the best of overseas transformers.

Heavy Power Equipment

Another admirable feature of the successful amplifiers was the weight of the power equipment. Most of the successful finalists were using plenty of metal and wire in their power transformers and chokes, giving freedom from hum and ample reserve of high tension for the heavy passages of reproduction.

The Recordings

As is customary with these contests, the competitors were allowed to play a record of their own choosing, and then a portion of a record which was selected by the judges and had to be played by each competitor as soon as he had finished playing his own choice. At least, that was the original intention, but in practice the scheme did not work out too well, for the competitors seemed to show a distinct preference for the Joe Daniels records, which are noted for their brilliant reproduction of the cow-bells, jingles and jangles, but are not exactly soothing to the nerves. As a result the judges, by the time they had listened intently to about ten amplifiers and twenty recordings, were unable to withstand the onslaught. Pressure had to be brought by the Chairman to have the competitors withdraw their selected Hot-shot numbers and play music instead.

The Judging

The weakness of the whole contest was in the manner of judging. The three judges chosen to decide the winners were three men of undoubted integrity and ability, but they were overwhelmed by a hopeless task. During the couple of weeks prior to the final they had to listen to over fifty amplifiers and select a dozen, then sit in the middle of the audience and pick the winners from these dozen finalists, all excellent amplifiers and with very little between them.

It is therefore quite understandable that the results cannot be justified on paper. For example, Mutton beat Keogh in Grade 1, yet when the same amplifiers were played again about an hour later the verdict placed Keogh in second place, with Mutton nowhere! Again, in Grade 2, the judges verdict was McLean first and Keogh second. Half an hour later, these two amplifiers met in a play-off for the honour of runner up to the Champion of Champions, and the verdict was reversed.

For next year the matter of arranging a system of judging to give the judges a lighter load will need looking into, but otherwise everything should be all set for a really good contest with inter-State representation, which should be possible with the war cleaned up.

Congratulations

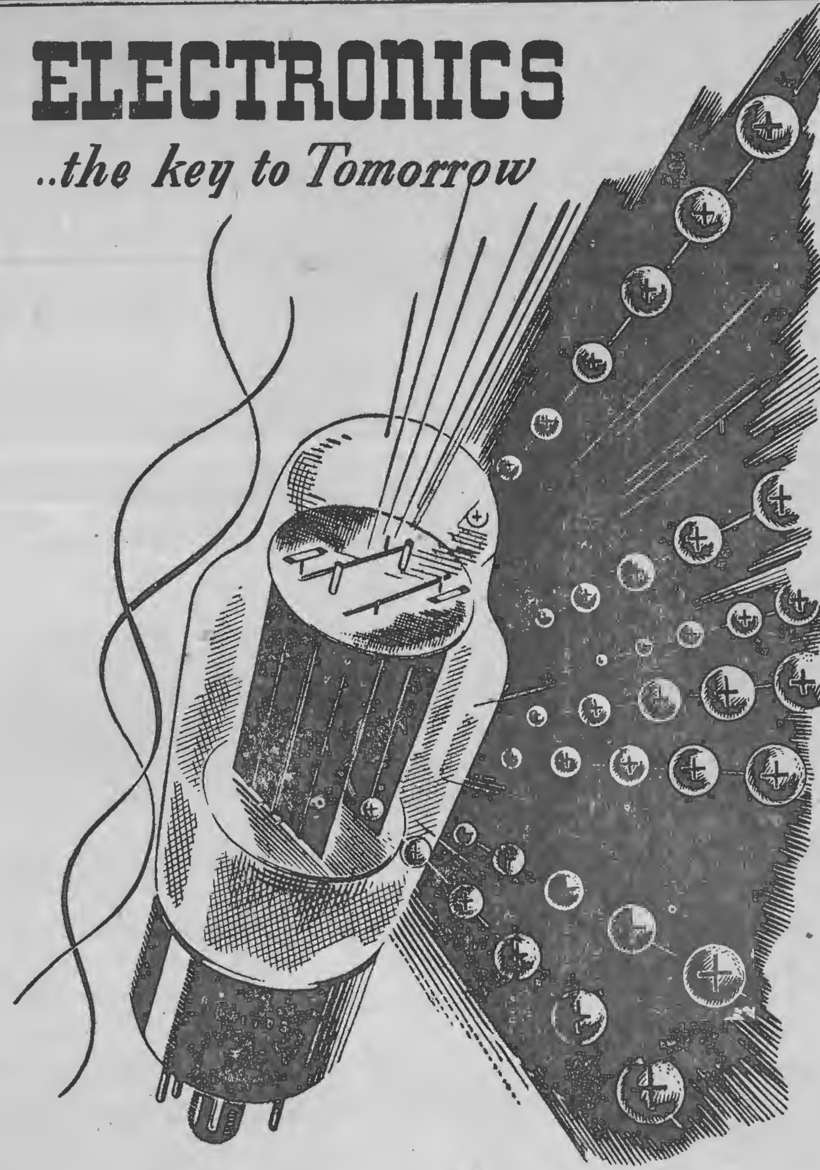
Considering the difficult times and the problem of obtaining good equipment the contest was a wonderful success and great praise is due to the organisers, the judges and the competitors.

Radio equipment is vital in modern warfare, and a favourite target for enemy attack. Here is an Australian installation which has been thoroughly camouflaged.

—Photo from Dept. of Information.

ELECTRONICS

..the key to Tomorrow



THE radio valve is really an electron tube. It controls *electrons*—the smallest particles of matter known to science. It operates in the world of sub-atoms, where these electrons travel at speeds approximating the speed of light—186,000 miles a second!

In the development and applications of electronics to the science of war and of post-war industrial problems, PHILIPS are playing a major role.

Philips scientists and engineers have long been putting the electron to work for the welfare of man. They have pioneered and developed many electronic vacuum tubes, apparatus and appliances whose purpose is to labour, to entertain, to instruct, to heal.

Remember, when you handle a Philips Valve you have in your fingers the key to the most uncanny yet the most potent discovery of modern times.

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POSSIBILITIES OF FREQUENCY MODULATION

By A. G. HULL

As CAN be gathered from its title, frequency modulation varies from our normal amplitude modulation in that the frequency of the carrier is varied according to the audio component, instead of having its amplitude varied as at present. Technically the scheme is fairly simple. A valve is coupled up in such a way that its effect alters the tuning of the transmitter's oscillator according to an audio signal impressed on its grid. By this means the transmitter's frequency is altered according to the modulation. Complication is introduced to get correct phasing, but, one understood, the f.m. transmitter is just as simple, or even simpler, than the a.m. type.

Likewise, the receiver is not complicated. Superhets are conventional, except that U.H.F. practice is followed with frequency converter, an intermediate amplifier and conventional audio. Two main differences are to be noted — the limiter which is used as a noise suppressor against noise of an amplitude modulated variety and the detector, which takes the form of a sort of balanced twin diode, an audio component being obtained when the carrier varies away from normal frequency.

Local technicians have not had much experience with f.m., not having the opportunity, but we haven't any doubt they will take it in their stride when the time comes.

The Practical Aspects.

But to skip the technical angles and get down to the practical aspects, the big feature of frequency modulation is the way in which interference noise, as from static, both natural and man-made, can be almost completely suppressed without affecting the f.m. signal.

This ability to deal with noise does not appear to be important at first glance, but is actually the key to a couple of vital factors which may have a great influence on the future possibilities of frequency modulation. These factors are: (1) Allows the use of low wave-lengths, such as 5 to 7 metres; (2) makes a low-powered signal ample for entertainment purposes. Dealing with the first point, we find that the low wave-length bands (ultra high and very high frequencies) have some most attractive features. For a start the practical range is limited to about 24 miles, even with a fairly high aerial. Considered on present standards, a limited range appears a handicap, but not when considered as a part of a possible f.m. scheme for dozens of stations in each country town or centre, as well as in each metropolitan area.

On the present broadcast band it is desirable to limit each transmitter to occupy a band-width of not more than ten kilocycles, and this does not allow each station to go very far into the realm of high fidelity. Even so, there are only channels enough for about 22 stations. In fact, in capital cities, where six to eight stations share the band, there are many cases of overlapping and selectivity difficulties with receivers, but down between 5 and 7 metres there is room enough for 26 stations, each with a double-width high-fidelity channel of 200 k.c. width. Coupled with the limitation of range, it means that hundreds upon hundreds of new broadcasting licences could be issued to operate all over Australia. **Note clearly that we say "could," not will.**

The f.m. stations would not need to be high-powered, and in practice, it has been found that 250 watts is ample power to cover the limited area served by a station of this type. Comparatively low voltages can be used and the overall cost of the transmitting equipment might be kept down to somewhere between £100 and £200. This low-cost factor is another which helps the imagination to conjure up a vision of broadcasting unlimited. The reason why low power is ample is found in the explanation of the way in which noise is suppressed. Practically all static, both man-made and natural, is in the same form as amplitude-modulated signals; in fact, it can be said that the noise modulates the signal or has exactly the same effect when handled by the receiver. The noise and the signal being so similar in charactistics, it is found almost impossible to separate one from the other when attempting to suppress noise at the receiver. But with frequency modulation we can put in a limiter circuit which will allow the receiver to handle a carrier of up to a certain strength but no stronger. By setting this control to take effect at just a shade higher than the normal f.m. carrier strength, we will limit extraneous noise to this level, yet still pick off our audio component without limit.

Weak Signal Ample

As a result it has been found that a signal strength of 50 microvolts is ample for satisfactory programme on f.m., whereas with ten times that signal strength on the a.m. system there is still difficulty from noise in unfavourable locations.

(Continued on next page)

RADIOMEN AT THE FRONT LINE

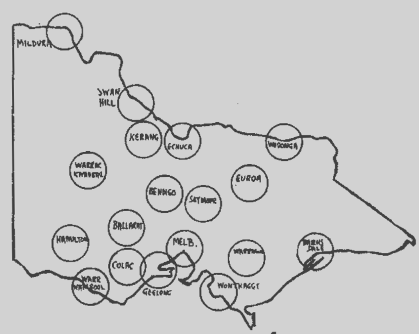
While waiting for the bridge to be completed over the creek of Blucher Point, New Guinea, this mobile observation relay station was still on the job directing fire for the artillery. Reading left to right in the jeep, Private W. A. Langham, Rose Bay, and Gunner R. Hazell, Rose Bay. On the phones and wireless, Bombardier N. R. Jarrett, Enfield, Gunner F. Cummings, Cowra, and Gunner S. Crossland, Hurstville.
—Photo by Department of Information.

FREQUENCY MODULATION

(Continued)

Still another possibility with f.m. transmission is the use of three separate channels in order to get a stereoscopic effect. Imagine three separate microphones arranged amidst an orchestra, three separate transmissions and receptions on different wave-lengths and the resultant three signals fed into three speakers arranged around your sitting-room.

The way in which frequency modulation triumphs over the noise problem is one of the reasons why this method has become popular for communications between tanks on the battlefield and between planes in the skies. In peace it may find similar applications in car radios, not only as regards broadcasting reception, but for headquarters communication from ambulances, police patrol cars, fire brigades and even between delivery trucks and their head office. Imagine the scope for such communication for taxi services, newspaper deliveries, in fact all delivery services.



A. Map of Victoria, showing several important towns with a 24 mile radius drawn around them.

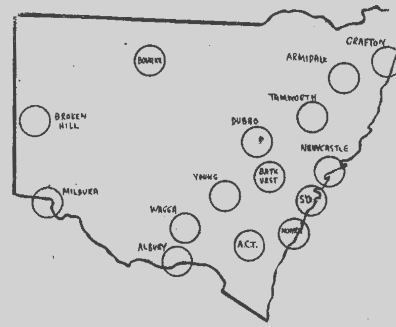
The Political Angle.

Such a revolution in broadcasting and radio communications as suggested above is bound to have its political repercussions. Many people hanker for broadcasting licences, to such an extent that some licences have a goodwill value of over £100,000, and it has been rumoured in the past that some licences have changed hands at this figure. But if hundreds of additional licences are issued it could be expected that these values would be undermined. It is, therefore, reasonable to assume that the introduction of frequency modulation will not be without opposition from certain quarters. These opponents to f.m. can point out that present services are reasonably satisfactory and that the extraneous noise problem can be dealt with by allowing the use of higher-powered transmitters on the present wave-lengths.

The Change-over Period.

There is bound to be plenty of argument regarding the change-over period, if and when it occurs.

Receiver production for civilian requirements having been practically non-existent for some years, it is only reasonable to consider that the receivers in use at present have given years of service in return for their original cost and so their owners should not be upset at the suggestion that they be considered obsolete.



B. Map of New South Wales, showing possible coverage of frequency modulation stations in principal towns.

Sets Still Serviceable

Not that the introduction of frequency modulation on the low wave-lengths would make the present sets any more obsolete than did the introduction of dual-wavers a few years ago. Plenty of receivers cannot tune in the short-wave stations, yet their owners are quite satisfied with them so long as they can tune in to "Salute to Screenland" or whatever session happens to be their favourite. From the reception end the change-over may be quite gradual, the higher-priced post-war sets offering both a.m. and f.m. reception, with cheaper sets available for one or the other. Owners of really good broadcast receivers of the present type may investigate the possibilities of f.m. by first purchasing a cheap auxilliary set. From the transmission point of view the change-over is going to be more difficult, unless pioneered by the A.B.C. service. Until such time as f.m. has a vast listening audience it would be unreasonable to expect advertisers to spend large sums of money on the sponsorship of f.m. programmes. Who, then, will carry the expense of establishing and maintaining the f.m. service until such time as it is self-supporting? Looking to the A.B.C. for guidance is unlikely to be effective, as they are hardly likely to rush into anything without "due con-

(Continued on page 34)

ALIGNMENT BY WOBBLER

A CHECK up on the sale of service oscillators with two of Australia's leading test equipment manufacturers revealed that over the past five years a phenomenal number of servicemen and amateurs finally woke up to the fact that guess work and cut and try methods just wont work, when the problem of correct alignment crops up.

Practical Experience

The writer for the past three years has completely aligned roughly in the region of three thousand large communication receivers, and in so doing can quite justifiably claim to have come across just about all the troubles that the human mind can think of in connection with receiver construction and alignment. Receivers returned from tropical areas, covered in fungus, humidity effects, sweating gang plates, production troubles in coils, variations in iron dust cores and unskilled labour are just some of the many and varied problems which have been encountered by the writer, since this country became embroiled in the war.

In connection with the extreme importance of alignment it might be opportune to point out in a practical example how some people can be easily misled into making completely erroneous statements. Quote: A high ranking official in making comparative tests between two receivers made a statement to the effect that due to making major alterations to one of the two similar receivers and realignment, the sensitivity of the altered receiver was far in advance of the unaltered one, and that due to the increased sensitivity of the said receiver signals were being

By
CHARLES MUTTON
1 Plow Street, Thornbury, N18, Vic.

received at R9 strength, whereas the same signals on the other receiver were conspicuous by their absence. A check on this state of affairs was made accordingly and found to be correct. But—getting down to business with a signal generator revealed quite a different story. On checking the receiver with the apparent phenomenal sensitivity for image ratio, it was found that at a frequency of 12 megacycles the image ratio was 2 : 1 whereas the accepted thing in a good receiver with 2 RF stages and 2 IF stages should be approximately 1,000 to 2,000 : 1.

Perhaps to the uninitiated an explanation of image ratio will help to provide a better appreciation of the extreme importance of correct alignment.

In any receiver of superheterodyne design which is used for multiband communication work or any superhet for that matter, there exists in the plate circuit of the converter tube not only the IF frequency but also other frequencies comprising the incoming signal plus the IF frequency or the sum frequency and the incoming signal minus the IF frequency, the so-called difference frequency. Now when a design engineer figures out his coil design he has two alternatives. He can either design his local oscillator frequency to beat ahead or higher in frequency of incoming signal by an amount equal to the chosen intermediate frequency, or he can design the local oscillator to work below or lower in frequency by the intermediate frequency than the incoming signal. For our purpose we are only interested in the former case where the local oscillator is operating higher in frequency than the input signal. Under these conditions, the oscillator coil for a given frequency band will have less turns or less inductance

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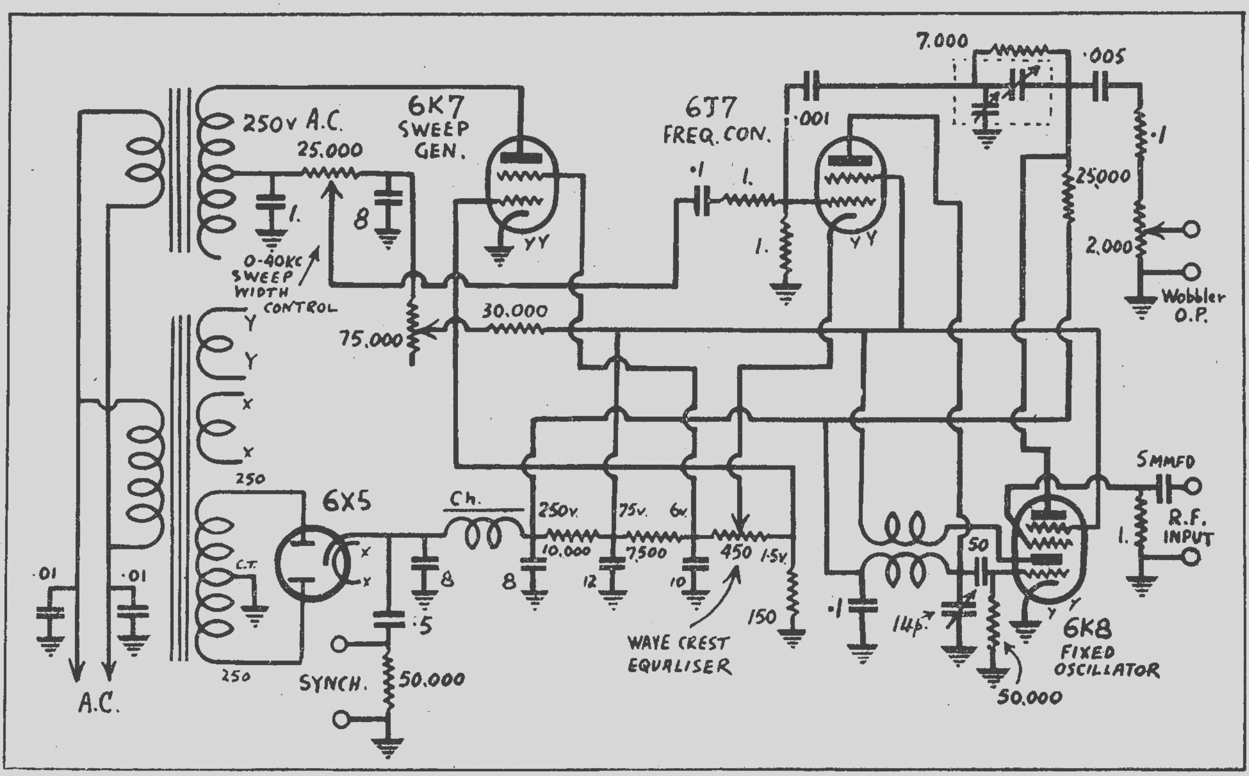


C. Full schematic of the wobbler for alignment.

WOBBLER

(Continued)

than either the aerial or RF coils. It then must become apparent that these are made to track accordingly under those said conditions.

Remember also however that across the oscillator grid inductance there is shunted a trimmer condenser for adjustment purposes. As the range of this condenser covers a fair frequency span it is invariably possible to tune this condenser to two different spots as will be evidenced by two distinct signals on the receiver dial separated by a frequency of twice the intermediate frequency. The correct position of the trimmer is our case and in the majority of cases is the minimum capacity setting, which ensures that the oscillator is working on the correct side of the incoming signal. A sure method of testing by ear whether the oscillator trimmer is set correctly is to tune an ordinary dual wave receiver of reputable make and design to a fairly strong shortwave signal, now somewhere in proximity to this signal by retuning it will probably be possible to pick up another identical signal which is somewhat lower in signal strength. This signal is termed the image signal. If everything is in order the louder signal of the two should be at a position on the receiver dial lower in frequency than the image signal, if the reverse is the case the coil design is badly amiss or the oscillator trimmer has been set incorrectly. Providing, of course, as previously stated, that the oscillator is meant to be higher in frequency than the input signal. There have been certain receivers in the past on the market that were designed for the other mode of operation.

Normally in a well designed RF stage receiver of dual wave design, the extra selectivity provided by the extra stage should make the image signal almost inaudible (if you're lucky). Going to a communication receiver however the extreme selectivity incorporated ensures that it is practically impossible to detect any trace of the image signal, unless, of course, an extremely strong local is tuned in.

Bad Misalignment

Returning to our practical case, this was precisely what had occurred. In attempting to realign one of the said receivers the oscillator trimmer had been set on the image signal, which had the effect of causing hopeless misalignment of the band in question, and the extremely loud signals were merely the images which could not be heard on the other correctly aligned receiver, and the normal sensitivity of one microvolt at a ratio of 1:1 at 50 mw output had dropped to 6 microvolts. (Easy to get sidetracked, isn't it?) This state of affairs was also responsible for the said receiver not having the original band coverage as indicated on the coil graph. Correct adjustment of the oscillator trimmer, and peaking the aerial and RF stages put the receiver back into shape again.

Measuring Image Ratio

Just as a matter of interest the method of measuring image ratio will be briefly described. Assuming all circuits are correctly aligned. Feed a signal of say 1 microvolt into the input of the receiver, with the RF gain flat out, a dummy antennae consisting of a 300 ohm non inductive resistor will serve the purpose of assimilating the correct conditions. Place this in series with the output lead from the generator to the aerial terminal. Now adjust your output meter to a predetermined level and note carefully the reading, then increase your attenuator output from 1 microvolt in steps of ten and retune the receiver dial slowly to a lower frequency until the image is heard. When this is done adjust the attenuator until the same output reading is obtained as was obtained with the 1 microvolt input. The first reading multiplied by the second is equal to the image ratio. If it is 1:1 buy or build a new receiver, if you can buy a receiver or if you can buy a gang, a speaker, a dial or tubes?

This is an exceedingly long introduction to a constructional article but the writer feels it was justified, in order to forcibly bring to our many readers how important it is to realise that correct alignment of a receiver is everything, in fact, so important as to mean saving or ending our fighting men's lives.

Useful Features

Features of the described instrument.

(1) No moving parts, fully electronic in action.

(2) Band width 0-40 k.c. adjustable.

(3) Self contained for IF alignment.

(4) Can be used with all existing forms of oscillator or signal generators.

(5) Pyramid sweep circuit for double trace work.

(6) Band width control is variable.

(7) Self-contained synchronisation with which the image can be locked during alignment.

(8) Output control is incorporated to avoid overload of IF channels. The basic unit is portion or actually the F.M. portion of the R.C.A. developed F.M. signal generator. This famous American firm have on the market the complete generator which covers from 150 k.c. to 30 mc either F.M. or A.M. signals provided. As no Australian manufacturer has yet given the ordinary serviceman this versatile instrument it was thought that a separate F.M. unit could be added to existing service oscillators, thereby saving the expense of buying a new instrument or waiting until war conditions allow our own manufacturers to give us this type of instrument.

To simplify matters we'll divide the unit into four sections: (1) Power supply; (2) fixed frequency oscillator; (3) frequency control; (4) sweep generator.

(1) Power Supply.

It will be noticed from the circuit diagram that there are two small power transformers used. These can be about 30 MA rating as the B drain is negligible. One of these supplies the H.T. voltages and filaments of all the tubes used, while to other uses half the H.T. secondary only to provide 250 volts A.C. to the plate of the sweep frequency tube.

At the cathode of the 6 x 5 rectifier is taken off a 120 cycle sawtooth voltage, which, as will be explained presently, provides the synchronising pulse.

Oscillator Circuit

Examination of the oscillator circuit shown will reveal that it is merely the old and well tried tickler feedback circuit. In the writer's case the coil was constructed from an old 455 k.c. IF transformer of the air core variety by removing the plate bobbin and rewind-

(Continued on page 26)

VICTORIAN AMPLIFIER CHAMPIONSHIP

The results of the Amplifier Championship organized by the Australian DX Radio Club and the "Listener-In" and held at 3UZ studios, Melbourne. October 28 were as follows:—

Grade 1 (Open class, professional or amateur, unlimited power): First, Charles Mutton; 2nd, Mr. Keogh; 3rd, Mr. Wilkins.

Grade 2 (Home-built, limit of 18 watts power): 1st, Mr. McLean; 2nd, Mr. Keogh; 3rd, Mr. Stevens.

Grade 3 (Members of the Australian DX Radio Club only): 1st, H. Graves; 2nd, L. Lowan; 3rd, H. Groves (2 entries).

CHAMPION OF CHAMPIONS: H. Groves. Runner-up, Mr. Keogh.

Further details of the contest and data about the amplifiers used will be given in next month's issue.

PICK-UP PRINCIPLES AND PRACTICE

PART II

TYPES OF ELECTROMAGNETIC PICK-UPS

It is possible to have as many types of pick-ups as there are types of loudspeakers or microphones. There have been carbon-resistance pick-ups (and not bad, either, when working correctly, **when**!), condenser pick-ups, ribbon pick-ups, moving coil pick-ups, and moving iron pick-ups of reed, armature, two-pole and four-pole types. The moving iron pick-up is very firmly established as both cheap varieties and good varieties can be made. Moving coil pick-ups have so far been expensive, low in output and not free from

By

J. W. STRAEDE, B.Sc.

A.M.I.R.E. (Aust.)

Lecturer in Electronics at Melbourne Technical College.

high-frequency resonance (though very free from minor resonances).

Moving-iron pick-ups can be divided into three types: Reed, Armature and Exciter.

Many early amateurs made crude "reed" pick-ups by attaching a needle to a telephone earpiece or to a reed type loudspeaker unit. Early reed pick-ups were comparatively trouble free and had an output around the 1 volt mark but had plenty of resonance due to the reed being long. The old reed pick-up consisted of a vertical tongue of transformer iron fastened at the top to the **centre** of a magnet. The lower end of the tongue (or reed) was made to vibrate between the poles around which were wound several thousand turns of wire. Rubber pads acted as dampers and anti-poling devices.

Future Possibilities

There is a possibility that the reed type may revive some day using a **lateral** reed of hyper-sil (a modern magnetic material), a high efficiency magnet and damper pads of viscaloid. Just think of it—a small compact unit with an output of about 2 volts, a bass resonant frequency below 20 hertz and a high frequency response that is almost unmarked by large resonances.

Armature type pick-ups in their cruder forms occupy the popular place on account of cheapness combined with fairly high output. An ordinary armature may weigh as much as 2 grams—this is far too high and it is suggested that .75 to 1 gram be an acceptable limit for "cheap" pick-ups. (That weight includes the needle). If an armature must be made heavy the weight should be concentrated near the pivots where it is of less importance. The moment of inertia of the needle may be reduced by having the centre of the needle level with or only just below, the pivot centre line.

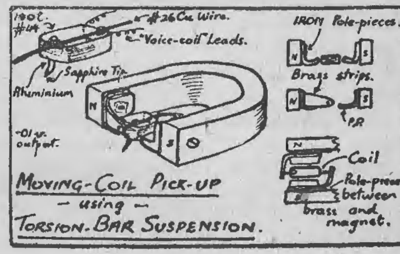
Needle Armatures

Some armature pick-ups use a steel needle as the armature. This certainly results in lightness and improved response, but the voltage output drops thereby removing the pick-up from the "popular" market. Other moving iron pick-ups go still further and use the needle as armature without any clamping or holding device. The output is very low.

With an ordinary steel needle, the high frequency resonance can be raised to about 6,000 or 6,500 hertz, but above that frequency excessive damping is necessary. For that reason, the H.M.V. Company in England designed a special midget needle for their high-fidelity pick-up which is of the moving iron type and uses as armature, a midget needle in a thin metal sleeve. Several attempts have been made to keep down armature weight by dividing the armature into two parts—a fixed part and a moving part. The latter is called the "exciter" and is certainly lighter in weight than a full armature. So far, exciter pick-ups have not been an outstanding success. Philips produced one many years ago, but abandoned it in favour of a more efficient one of conventional type. The Microdyne, an American version, was described in "Radiocraft," May, 1938, but such a pick-up would not survive in Australia owing to very low output, and frequency response being approximately the same as a less expensive pick-up (the famous Astatic Tru Tan).

Suspension Systems

How are the armatures, whatever their shape, held in place? Reed pick-ups, of course, have the reed clamped at one end. Conventional armature pick-ups have either a spring loaded



knife-edge or pivot, a pair of rubber sleeves or a torsion bar effect. Cheaper pick-ups have pivots isolated from their bearings by rubber—in some cases the pivots and bearings are not even round! Spring-loaded mechanical pivots are not used much to-day for pick-ups, but are employed in the better types of magnetic cutters for record making. Torsion bar suspensions are used for the best kind of pick-ups. A small thin rod of phosphor-bronze, a copper wire or a thin steel leaf is attached to the armature and to the pick-up frame. Its elasticity permits the armature to move. Armature suspension and armature damping are done on principles that are the same as automobile suspension and spring damping!

Where a non-rubber suspension is employed, damping may be performed by filling the space between armature and bobbin with a liquid. This liquid must possess certain properties: It must not "creep", evaporate nor corrode the metal.

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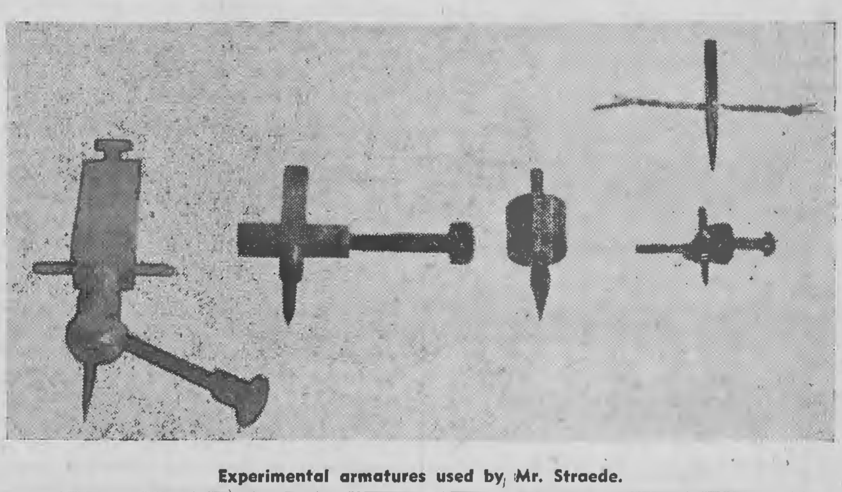


Experimental armatures used by Mr. Straede.

PICK-UPS
(Continued)

Anti-poling Measures

In most moving iron pick-ups the armature is apt to stick to one of the magnetic poles after a large displacement. For that reason the damping material is usually made fairly stiff and elastic which is a bad thing. There are two other possibilities: Either the poles must be so situated that the armature does not touch them, however large the amplitude OR stops must be fitted to prevent poling.

If there is plenty of clearance between armature and pole-pieces then the stops can be thin pieces of paper cemented, to the faces of the pole pieces or the pole pieces can be given a coating of solder.

Moving Coil Pick-Ups

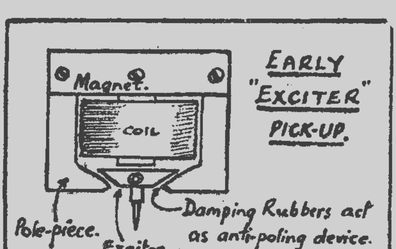
Because moving coil meters have a linear scale, many people imagine that a moving coil pick-up will have a smooth response. This is not so. The frequency response depends mainly on the vibratory system. Some moving coil pick-ups have a rather large resonant peak due to the large moment of inertia of the coil (the coil is too heavy and too bulky). These pick-ups have a bass resonance (**due to the pick-up head vibrating to and fro across the record**) just as a moving iron pick-up has.

The armature resonance in the high frequency register is also well in existence because the coil has just as much moment of inertia as the average iron armature (if not more so). However "moving-coil" is a good sales point.

The main advantage of a moving coil pick-up is that no anti-poling measures are required and damping is easier to arrange. A minor advantage is a reduction in harmonic distortion on the very loudest peaks while a minor disadvantage is the greater liability to hum, on account of the lower output.

Two-coil Pick-ups

There has been at least one attempt to use coils moving along their axes instead of twisting but the moment of inertia is apt to be high unless the coils are very light.

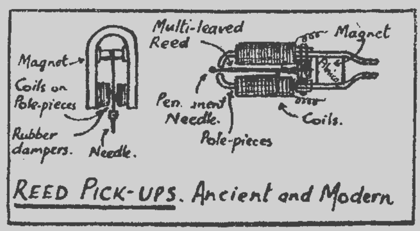


Ribbon Pick-ups

Much fuss has been made over a so-called ribbon pick-up which is ultra-light on records, etc., etc., but it is not a true ribbon pick-up. Instead it is actually a one-turn coil which consists of two ribbons anchored at one end (where they are connected to a step-up transformer) and connected together at the other end where they are attached to a lightweight sapphire-tipped "needle." This sort of pick-up is of no use to the average enthusiast on account of fragility, exceedingly low output, care required in use, liability of saphire tip to chip, liability to pick-up hum.

Needles and Needle Changing

Needle wear is a problem on three counts: Records wear due to the use of worn needles, frequency response suffers and more thrust is necessary on a worn needle than a fresh one.

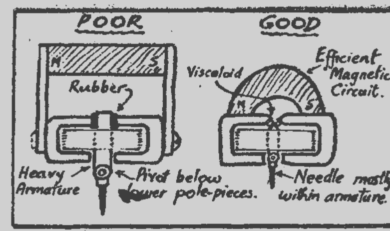


REED PICK-UPS. Ancient and Modern

A flat that is .002 inch wide on a needle will seriously reduce the response above 2000 hertz yet playing two sides of a 10-inch record with a "cheap" pick-up will cause much more wear than that on an ordinary steel needle. No wonder the response is poor from "fibre" needles!

Needle changing is a problem because a clamping screw adds to the moment of inertia of the armature besides being something to be lost, broken or mishandled.

Permanent needles offer a solution. There are two types—the platino-iridium alloy and the sapphire. In each case the tip is set in a shank of some soft metal such as copper or aluminium. Sapphire tips are very liable to chip if dragged across a record—a chipped needle will act as a cutter and carve your records like nobody's business. The precious metal tips are quite rugged but those at present obtainable have far too blunt a tip. (If you can obtain an old-fashioned hypodermic needle try sharpening a piece of it and clinching it in a copper wire. As the needle is hollow the effective tip is made from one wall of the needle).



ARMATURE PICK-UPS.

What We Can Expect Here After the War

American-made crystal pick-ups with thrust less than 1 ounce, permanent needles and moderately high output.

English-made needle-armature and semi-needle-armature pick-ups using midget needles and having both high and low outputs. (The former will incorporate transformers instead of using high impedance windings).

Australian-made moving-coil pick-ups of good frequency response.

All the above, of course, are in addition to cheaper magnetic and crystal pick-ups of types seen in the pre-war period. There will, of course, be English moving-coil pick-ups, Australian needle-armature pick-ups, etc., etc., seen in small quantities.

Part 3 of this article will deal with electrical damping, fitters and equalizers.

RECEIVING YANKS

In the August issue of the "Radio World" a reader asked the question, "Could American stations be received in Australia on the broadcast band." The answer was "probably, but with no entertainment value." I have received two stations from America consistently over the last couple of years on the broadcast band between 1500 and 1600 k.c. One station, I think, has its transmitter in Mexico City but their address is given as Dallas, Texas, the other is in Los Angeles. The Mexico City transmitter broadcast a lot in the Spanish language but also have English sessions. I will admit the reception, as far as I am concerned is often spoiled by local interference. We have a client living out of town (who has a 4 valve Radiolette, battery) receiving these stations better than most local B Class stations, and on account of their superior musical programme, does quite a lot of listening to them during the winter months.

—W. J. Robinson,
Port Macquarie.

CURVES — STRAIGHT OR BENT

Interesting Experiments with Direct Coupling

IN the early days of radio the accepted pinnacle of perfection was to have a straight "curve." We refer, of course, to the curve which represents the frequency response. Early loud-speakers had practically no response below 200 cycles or above 4,000 cycles, but this did not stop the keen enthusiast from proudly boasting that his amplifier had a frequency response "as flat as a board." And so it came

By A. G. HULL

to pass that eventually the response curve was not accepted as the "hall-mark" of reproduction. Even if the enthusiast claimed a flat response you would still judge the merit of his set by whether you could readily understand what the announcer had to say, or not, as the case may be. By 1929 the quality of reproduction has progressed quite a bit and anyone with enough wealth to buy audio transformers at five guineas each, power valves at £2 each and a "dynamic" speaker at £20, could put them together with sundry other parts and obtain excellent reproduction, usually limited by the quality of the broadcasting station's transmission on the standard of perfection achieved in the recording. Then like a bolt from the blue came direct-coupling, an audio amplifier system which gave excellent quality at low cost. Sets with direct coupled audio systems became extremely popular and many thousands were built by keen experimenters working to the articles on the subject which were written by the late Ross Hull and published in "Wireless Weekly" in 1929.

Troubles Encountered

Unfortunately there were troubles. High tension voltages of 475 volts were specified but often enough the actual voltages were up to 525 and 550 volts. Filter condensers did not stand up to the strain, resistors were unreliable and within a year or two the boom had "bust."

A simplified version was introduced by the writer in 1931 and proved completely satisfactory so far as it went, but was eventually displaced by the introduction of sensitive pentodes which brought up the overall gain of resistance-capacity coupled sets, yet were too sensitive for use in direct-coupled circuits where triodes are preferred as they are less critical as regards their bias voltages.

Every now and then someone revives the memories of direct-coupled receivers and always there is a ready response from those who still pin their faith to this type of set. Most of them claim that once having listened to a direct-coupled job they could never be satisfied with "ordinary" reproduction.

Just what the difference is has not been clearly defined, but we recently had the opportunity to borrow a couple of valuable items of laboratory equipment, a General Radio type 700A wide-range beat frequency oscillator, a type 732B distortion meter and a couple of sensitive vacuum-tube voltmeters. Taking these home we put together an experimental amplifier along the lines of the one which was so successful in 1931 and put in a most interesting Sunday morning checking up on frequency response and distortion.

Frequency Response

We found that the direct-coupled circuit has a characteristic which makes it possible to vary the frequency response through wide limits simply by altering the plate load resistor and carrying out the necessary compensations in bias or screen potentials.

As originally described in 1931 the direct-coupler had a terrific rise in the bass response around 70 cycles, was fairly flat from 200 to 5,000 but soon fell away in the highs, beings many decibels down at 7,000 cycles.

By bringing down the plate load to 100,000 ohms it was possible to improve the highs until eventually we had an arrangement that gave a rise of two or three decibels at both the low and high end, thereby compensating for the speaker characteristics and giving a fine overall performance.

Interesting Experiment

To those of our readers who enjoy experimenting and who have a little spare time, we can strongly recommend them to wire up the simple direct-coupled amplifier. Working from our circuits and their response characteristics it is easy to change resistors and then listen intently to the changed reproduction.

For a high tension supply a steady 400 to 425 volts at the comparitively low current drain of about 35 to 65 milliamps is required and this is readilv available from a 385 volt type of standard power transformer if it has a current rating of 100 or 125 milliamps. A filter choke and normal filter condensers are required.

For the actual amplifier a screen-grid or pentode audio valve such as a 24A, 57, 77, 6C6, 6J7G or the pentode section of a 6B8G can be used. For the output a type 45, 2A3 or 6A3 should be used.

A speaker with a field coil of 8,000 ohms is most readily adaptable to several different arrangements, but a 2,500 ohm field can be used with a 2A3 output valve or two 45 type r.f. if used in parallel or push-pull. Probably the most useful of all is a good permagnetic-type speaker.

If your own stock of junk is not sufficient to provide them, a few heavy duty resistors should be obtained from the local junk shop to be used in parallel or series to get the values re-

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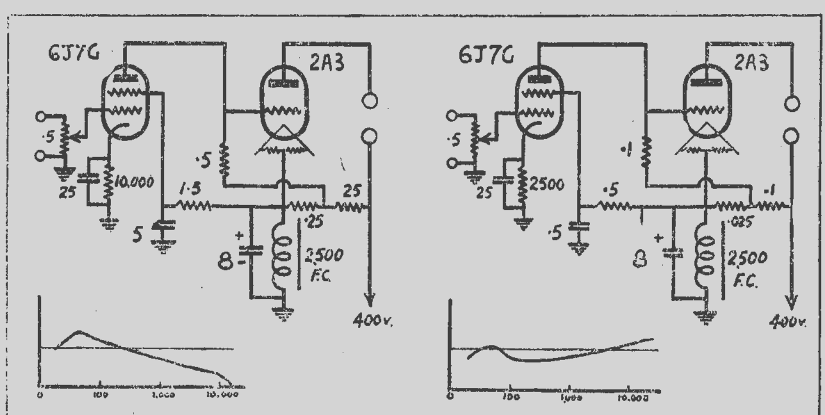


Circuits and response curves, showing effect of altered component valves.

CURVES

(Continued)

quired for the main bias resistor line.

For the bias resistor of the first audio valve a 5,000 or 10,000 ohm potentiometer can be put to good use on account of its versatility. If necessary the pot can have a few thousand ohms of extra resistance added in series in the form of a carbon or wire wound resistance.

Adjustable Components

Those who are really keen for a truly experimental set up can use carbon potentiometers for the higher valve resistors, using them as variables until results are up to standard and then measuring the resistances being used by means of an ohm-meter, and replacing with fixed resistors for service. Carbon potentiometers are unreliable at the best, and cannot be considered as serviceable in any way when carrying current.

During the tests it is highly desirable to have a 0 to 100 milliameter to read the plate current of the output valve as this is a certain indication of the proper balancing of resistance values. An alternative way of getting the same indication is to have a voltmeter across from the centre-tap of the output valve to earth. Using a 2,500 ohm field coil in this position and a 2A3 type valve with a normal plate current of 60 milliamps the voltage across the field should be 150 volts, which can be worked out for all other cases by the simplest application of Ohm's Law.

It is presumed that an elementary knowledge of direct-couplers is a part of the equipment of the would-be experimenter. The actual 400 volts of high tension is split up to give 250 volts for the output valve, measured between plate and centre-tap of heater, and 150 volts from centre-tap to earth.

Voltages Not Critical

A certain amount of tolerance is permissable as the 2A3 will give good quality results with a plate voltage of anything between 200 and 300 volts with a plate current of anything between 30 and 60 milliamps, as will be obtained with an effective bias of anything between 30 and 60 volts. These tolerances are the explanation of why the triode, such as the 2A3, is to be preferred.

If a voltmeter or milliammeter is not available it is still possible to experiment as distortion will surely indicate any incorrect biasing.

At this point we might reassure those who can recall the old tales about the output valves of direct-coupled amplifiers being overloaded whilst the first valve is warming up. Excessive current may flow through the output valve, but as soon as it does so the effective plate voltage is reduced, as the centre-tap to earth voltage rises. For a few seconds the filament of the output valve may be called upon to make high emission, likewise the field of the speaker may receive twice its normal energizing wattage, but this overload can be readily accepted by modern equipment.

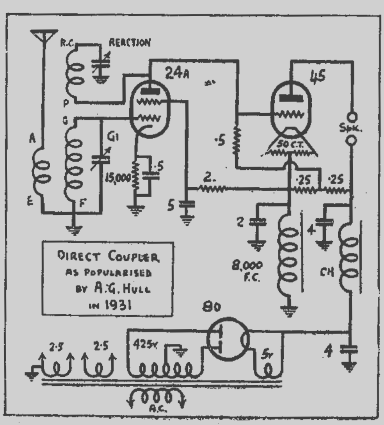
In practice it will be found that an experimenter will be safe enough so long as he does not run the set-up for long periods when distorting.

Inverse Feedback

Direct-coupled amplifiers lend themselves to the application of inverse feedback although it is unlikely to be required, as these amplifiers do not suffer from either frequency discrimination or harmonic distortion. To obtain feedback it is only necessary to connect the high tension end of the plate feed network to the plate side of the speaker transformer instead of the high tension side, as is clearly shown by the switch indicated in the circuit of the experimental set-up. The amount of feedback will be according to the setting of the potentiometer arm from which the plate load resistor is fed. Roughly the percentage feedback will be proportional to the percentage which the arm is moved down from the high tension end. By ear the amount of feedback will be noticed mainly by the degree in which the overall gain is cut back.

Beware of Parasitics

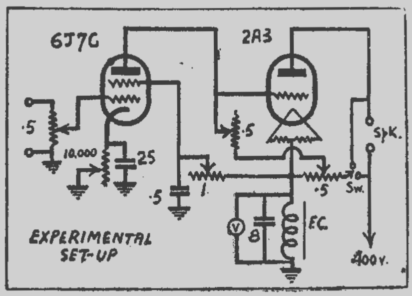
The extremely wide range of frequencies handled by direct-coupled amplifiers makes them prone to oscillate at their own accord or to produce and reproduce radio frequency signals, which you can't hear as they are of a frequency well above the range of the ear, yet which still loads up the output valve. With an amplifier already handling a watt or two of parasitic oscillations, it is only necessary to have a few watts of audio and the job gives every indication of distortion



due to overloading, which is actually the case, although all of the load is not sound. To get the best from your amplifier it should handle audio signals only, so a small condenser, say .00005 may be needed from first audio plate to earth, or a .0005 across the speaker. If the capacity is too large the higher audio signals will also be attenuated. For proof of parisitics put an output meter in circuit. It should indicate no signal output when no input is made to the amplifier. The meter will indicate "signals" which cannot be heard.

The Programme

So far this article has wandered about the subject, but we hope that



it has given the would-be experimenter a background upon which to establish his research.

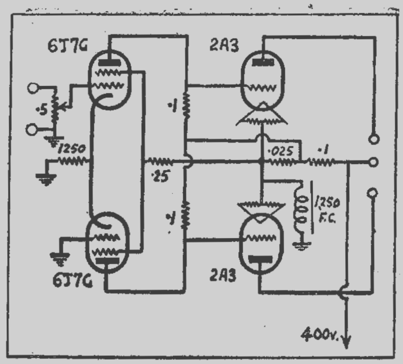
Unlike this aticle, however, the research work should be orderly with a pencil and paper always on hand to note down the effect of various alterations in component values. The idea is always to first of all balance up the network so that the voltage from centre-tap to earth, on the plate current of the output valve, is normal.

The lower the plate load for the first valve the higher will be the frequency response and the lower the gain, other things being equal. If the output valve draws too much current the indication is that the first valve does not draw enough current, so either drop the cathode or screen resistors, or both, which should have the desired effect for any given plate load.

Remember that the effective plate load is the actual plate feed resistance, plus the two voltage dividing resistors in parallel. If desired the effective plate load can be lowered by putting a bypass condenser from the junction of this network to earth, or to either centre-tap or high tension.

As a Detector

One of the strange and attractive features of a direct-coupler is the way in which the first valve will operate as an excellent detector for radio work, with reaction, if necessary.



"Mystery" Circuit

It is possible to put a tuning coil (Reinartz type) and condenser on to any of the amplifiers described here and good results can be expected in satisfactory locations. Selectivity has its limitations but the tone is a revelation, there being little sideband cutting in a single tuned circuit. Reaction is necessary and may be a little fierce, but can be tamed by using a low-capacity midget condenser for the reaction control.

"Mystery" Push-pull Version

Many years ago in "Wireless Weekly" we caused a mild sensation by running a circuit known as the "Barnes' Mystery Circuit" which provided push-pull output with single grid to earth input in a most simple fashion. The grid of one of the push-pull valves was earthed, hence the mystery of how it got its signal input. There was so much argument at the time that we eventually had to drop the subject, but to-day the arrangement is comparitively conventional, especially in cathode-ray amplifiers, and is popularly known as a "long-tailed" amplifier.

It is a handy arrangement for a direct-coupled push-pull amplifier, as shown in our diagram. As will be immediately evident, this circuit does not have a condenser of any kind in it, apart from the conventional power supply filter. With the valves shown the response is flat within a decibel from 20 to 30,000 cycles and it's only drawback seems to be its habit of picking up stray r.f. and supersonic signals and parasitic oscillations, as might be expected from its extraordinary high note response. Doubtless a couple of grid or plate stoppers could be fitted as a cure for any example where this trouble becomes a real problem.

In conclusion, we would like to stress that an amplifier with a "flat" response is not necessarily perfect, nor will it sound brilliant unless the associated equipment is of an equally high standard.

VALVES IN THEORY AND PRACTICE

By
CHARLES ASTON
21 William St., Double Bay, N.S.W.

As it is necessary to have an understanding of atomic structure and the electron theory of electricity before being able to follow the theory of operation of the thermionic valve an explanation of this will be given first.

The smallest portion of a substance that may exist in a free state is the molecule, which means that if the molecule is divided it no longer retains the properties of the original substance. If this molecule is reduced further the particle is known as an atom. With the exception of when an atom is composed of a molecule, an atom is not capable of free existence for very long.

It is believed that there are 92 different atoms and it is only different combination of these atoms that go to make up all the various substances in the world.

Electron Theory

According to the electron theory atoms consist of neutralised charges of positive and negative electricity. The nucleus may consist purely of a positive charge or a combination of positive and negative charges in which the positive is the greater by an amount which is sufficient to neutralise the orbital electrons.

A hydrogen atom is the simplest of all atoms and consists of a nucleus of one proton and one orbital electron, so can be seen to be electrically neutral.

A helium atom consists of a nucleus of four protons and two electrons, thus the resulting charge will be positive, however, the atom has two orbital electrons so will be neutral.

It should now be clear that for the positive charge of the nucleus there is an equal negative charge of orbital electrons.

In some substances (e.g. insulators) the electrons are closer to the nucleus than in others (e.g. conductors), so that in the former electrons tend to remain with the same nucleus while in the latter a planatery electron may travel from one atom to another with comparative ease if a suitable force is applied.

If force is applied to the atom so that it is made to release an electron it will not be neutral, but will possess a greater positive than negative charge. This loss of an electron does not alter the nature of the atom, only its electrical charge making the atom into a positive ion.

An atom may be either a positive or negative ion. If it has a surplus of electrons it is a negative ion, if a deficit of electrons a positive ion.

As a positive ion has a deficit of electrons it has a strong tendency to attract an electron to it, thus becoming neutral again. The negative ion has a surplus of electrons and is trying to rid itself of this excess and become neutral.

It is unusual for an atom to gain or loose more than one electron at a time.

Electron Flow

It should be obvious from the above that if a number of positive ions are connected to an equal number of negative ions by a suitable conductor there will be a flow of electrons from the negative ions to the positive ions until equilibrium is obtained and the atoms are again neutral.

Edison during the course of experiments introduced a small metal plate into the bulb of a carbon filament electric light globe and found that if this plate was connected to the positive connection of the lighting supply a small current would flow through the conductor and also that the current would flow in one direction only, this effect is known as the "Edison effect."

To avoid confusion it is pointed out that current flow is regarded as being from positive to negative and the electron flow from negative to positive.

Electron Emission

If a substance is heated to a sufficient degree the electrons become agitated enough to break away from the attractive force of the nucleus. This is known as electron emission and the amount of energy that has to be applied to release the electrons is dependant on the composition of the substance. For successful emission ideal conditions are necessary. These conditions are obtained in the valve where there is a vacuum and the heat is supplied by an electric current. The electron emitter is known as the "filament" when the circuit supplying the heat and the electron emitter are not insulated electrically from each other, it usually consists of a hairpin shape loop of wire or wire ribbon.

If alternating current was used to heat an emitter of this type it would modulate the output of the valve. To overcome this a system has been devised for an indirect method of heating the electron emitting substance, this may consist of a hairpin loop of wire as before, but it is coated with an insulating substance such as alumina which is applied by spraying. Around this loop is placed a metal cylinder which has been coated with an electron emitting substance.

In a directly heated circuit the emitter may consist of a plain filament of tugsten or thoriated tugsten. A coated filament may consist of a wire of tugsten, nickel or an alloy on which a coating of certain oxides have been applied, this coating is the electron emitter.

The Bright Emitter

Tugsten is known as a bright emitter because it has to be operated at a high temperature, about 2,200°C., for satisfactory thermionic emission and at this temperature emits a dazzling white light. Considerable power is consumed in keeping the tugsten to this temperature which means that its emission efficiency is low, the lowest of the commonly used emitters.

A tugsten filament has the ability to withstand a fairly heavy positive ion bombardment which is necessary in valves with high voltages between the electrodes and the filament as the emitted electrons travel to the plate at a velocity sufficient upon hitting a residual gas molecule to release an electron from it, this also will be attracted to the plate leaving a positive ion, which in turn will be attracted to the filament hitting it with considerable force. Under these conditions a coated filament would soon disintegrate.

A thoriated-tugsten filament is made of tugsten impregnated with about 1 per cent. thoria (thorium oxide). When the filament has been made it is heated to a high temperature in a hydro-carbon at reduced pressure, the envelope is evacuated, the filament is then heated to about 1,900°C., which is about 10 per cent. more than its usual operating temperature, this causes a very thin coating of pure thorium to be formed on the filament. A filament thus treated will give a greater emission than tugsten at a lower temperature.

Thoriated Filaments

The thoriated tugsten filament is used almost universally in medium

(Continued on next page)

powered transmitting valves. When at its correct emitting temperature it shows a bright yellow light.

The thoriated-tugsten filament is the only type that may be successfully reactivated after a falling off in emission, the process is similar to that used when producing the original coating of thorium.

A burn out is practically unheard of with the thoriated tugsten type filament.

Oxide-Coated Cathodes

The oxide coated cathode has by far the highest emission efficiency in small sizes and is considerably cheaper to manufacture than the previous type and only needs to be operated at a dull-red to orange-red temperature for a copious emission.

The alkaline earth oxides are usually oxides of calcium, barium and strontium. It is now believed that a similar happening of events takes place with these oxides as takes place with the thoria in the thoriated-tugsten filament and that the emission takes place from the pure metal and not the oxide coating itself.

If the emitter is of the directly heated filament type the coating will consist of a substantial layer of an oxide on a nickel-alloy wire or ribbon

The alkaline oxide earth is the only emitter that is used with the indirect heating type. The heater is insulated from the cathode cylinder, which is coated on the outside with one of the oxides. The cylinder is heated by conduction and radiation from the heater. The heater is there for the sole purpose of raising the temperature of the oxide coating to an electron emitting temperature. This type of emitter is also known as unipotential because there is no voltage drop along its length as there is with the filament type of emitter.

As the oxide coated filaments do not require to be heated as much as the other types there will not be as great an expansion; as a result it is possible to bring the grid closer to the filament thus increasing the control of the grid over the passage of electrons.

Returning to the indirectly heated or equipotential cathode. The emitting surface takes about 15 to 30 seconds to arrive at its correct operating temperature and varies with the design. The emission efficiency is also dependent on the efficiency in which the heat is transferred from the heater to the cathode. In the early types the heat was transferred by the vacuum which separated them but this was very inefficient. Now the heater is only separated from the cathode cylinder by a thin layer of insulation with a resulting increase in efficiency. This layer of insulation is usually a coating on the heater so is subject to considerable stress as the heater expands and contracts with its heating and cooling. Efforts are made to overcome this strain on the insulator, one of these being to make the heater as long as possible so that the operating temperature for a given voltage will be reduced, therefore reducing the amount of expansion and contraction.

As the cathode is the emitter care must be taken to see that no emission occurs from the heater, if it does occur it must be prevented from reaching the grids or plates by shielding. If the cathode is at a negative potential with respect the heater there will be no electron flow from the heater to cathode.

The diode is the simplest form of valve and the modern type is only an elaboration of Edison's first valve. A modern diode consists of an emitter of one of the type just described around which is placed on a cylindrical or rectangular shaped metal sheet, this is known as the anode or plate.

Hot Plates

When the plate is positive with respect to the cathode electrons will be attracted to the plate, at high plate potentials the speed of the elctrons will be considerable. This electronic bombardment is sufficient to produce heat. The amount of heat generated in watts is equal to the current flowing through the valve in amps multiplied by the P.D. in volts. In receiving valves the current is in milliamperes and the P.D. two or three hunded volts so that the heat generated is very small, so there is no trouble to obtain materials with suitable melting point, nickel or molybdenum are commonly used for plates in receiving valves and low powered transmitting valves. These metals also have a sufficiently high melting point to withstand the heat that is applied to degas the metal during the evacuation process.

With a transmitting valve great care has to be exercised in the choice of anode materials. When no artificial means of cooling the anode are used it is known as a radiation cooled valve and as the size of the plate is limited by the electrical characteristics of the valve it is usually necessary to operate the anodes at a fairly high temperature which introduces numerous problems and the excluding of occluded gases is probably the greatest. If most of these gases are not driven off in manufacture they will be liberated by their heating in operation. The liberation of these gases wil make the valve "soft."

A black body has ideal thermal emissivity and to obtain a rating of highest plate dissipation efforts are made to reach this ideal.

It is necessary that the material for the anode may be easily worked and when mounted wil not warp when operating as this may change the electrical characteristics of the valve.

Nickel is used for anodes where the operating temperature is moderate. It may be easily worked into the shapes required for the anode, but when the valve is being exhausted care must be taken to see that the anode does not warp. If the nickel is carbonised the thermal emissivity aproaches that of a black body. The comparative melting point of nickel is so low that its use is limited.

Molybdenum has a thermal emissivity that is low, may be degassed easily and is more easily worked than tugsten. Higher plate dissipation may be obtained by the addition of fins.

Tugsten is at present little used for anodes as it is difficult to work into the required shapes. With regard to the other required characteristics tugsten is quite suitable.

Tantalum for Plates

Tantalum has an advantage over other anode materials this being that it helps to maintain the high vacuum as it will clean up gases. Its other characteristics are slightly better than those of molybdenum and recently has found greater use as anode materials.

Carbon-graphite anodes have the disadvantage that they are very difficult to outgas as they occlude large amounts of gas making evacuation a long process. Care is exercised in the selection of carbon as some types produce undesirable effects. Carbon anodes can be easily formed into the required shapes and is made with comparatively thick walls for mechanical strength and are, as a result, not subject to warping. The thick carbon anode due to its good heat conductivity radiates heat almost uniformly over its whole surface. When under correct operating conditions the anode shows practically no colour at all.

It was shown before that suitable filaments emit copious quantities of electrons; these electrons form a negatively charged cloud around the filament which will repel the electrons that would otherwise escape from the filament were this charge not present. This cloud of electrons is known as the "space charge." The electrons in the space charge are continually returning to the filament and others are being emitted to replace them.

The space charge is in effect a store and when the anode is sufficiently positive it will attract electrons from the space charge which the filament will replace owing to the reduction in the negative charge of the space charge. When the plate is sufficiently positive to attract all the electrons before they have a chance to build up a space charge the plate current is said to have reached saturation.

Adding the Grid

The next element that was added to the thermionic valve was the grid which is placed concentric with the plate between the plate and the filament. It usually consists of a spaced helix of wire or a mesh. When the grid has been added the valve is then known as a "triode."

As the electron flow between the filament and plate must pass the grid it can be seen that a positive or negative charge on the grid would encourage or discourage the flow of electrons to the plate. If the grid is made sufficiently negative it will stop the flow of electrons altogether so no plate current would be flowing. A D.C. voltage connected to this control grid is known as "bias," the least negative voltage that has to be applied to the grid to prevent the flow of plate current is the "cut-off bias." Only a small change in the

(Continued on page 20)

VALVES

(Continued)

grid voltage may alter the plate current from zero to maximum.

Materials from which the grid is made should have characteristics similar to the materials used for anodes. It should be suitable for drawing into wire and should be able to hold its shape while operating at high temperatures in transmitting valves for a small alteration in the physical shape of the control grid may result in a large change in the characteristics of the valve.

Envelopes for valves may consist of glass or of fused quartz. The glass type may be sub-divided into soft glass and hard glass. Soft glass will soften at about 620°C. and is suitable for use where the heat dissipation is of a moderate value. Hard glass will soften until a temperature of about 750°C. is reached and is utilised when it is desired to reduce the size of the envelope.

Both types of glass must have good mechanical strength, be a good electrical insulator and should be easily outgassed.

Fused quartz (silica) does not soften until it reaches a temperature of 1500°C., so it is possible to have a valve the same size as a glass one and yet dissipating four times as much heat at the anode.

External connections are made to the valve elements by sealing conductors in the valve envelope — this introduces several problems. If the conductor has a different coefficient of expansion to the envelope it will probably result in the seals becoming loose or a fracture of the envelope.

Nickel-Iron Alloys

In modern receiving valves a nickel-iron alloy is used, as one can be made that will have practically the same co-efficient of expansion as glass. As glass will not adhere to this alloy it is given a coating of copper to which the glass will adhere in a satisfactory manner.

The connections are brought out through the envelope at the "pinch," so called because when the wire is pushed through the hole in the envelope heat is applied to the glass around the wire; this glass is then pinched together with a metal clamp.

As silica has practically no expansion, choosing a suitable conductor is more difficult, especially as such intense heat would have to be applied to the pinch to soften it. What is done is to melt a pencil of lead into a thick walled cylinder of silica formed in the envelope.

If care is not taken when choosing the material for the valve base R.F. losses may occur. A high grade of bakelite is sufficient for ordinary requirements, but when it is desired to reduce losses in the base to a minimum a ceramic is used.

Gaseous Valves

A "soft" valve is one in which there are traces of gas still inside the envelope; some of the disadvantages of this condition were explained before. The valve characteristics usually become erratic and uncontrollable. In some valves traces of certain gases or mercury vapour are introduced into the envelope to give the valve special characteristics.

A "hard" valve is one in which there is a high vacuum inside the envelope, the higher the better, for it will have less effect on the characteristics of the valve and will give the valve a longer life.

When evacuating the valve not only the gas that fills the envelope must be removed but that also occluded by the electrodes of the valve.

To outgas the envelope it is baked in an oven at a temperature approaching the melting point of the glass. The metal parts are outgassed in receiving and small transmitting types by the "eddy current heating process." The valve is placed in the field of a high-frequency coil and eddy currents are induced into the electrodes; that is sufficient to raise their temperature to bright red heat in a few seconds. The filament is left open-circuited, otherwise it will be burnt out.

A different system is used to outgas the electrodes of large transmitting valves and it is the electronic bombardment method. The tungsten filament is lighted, then high voltages are applied between this filament and the other electrodes, in turn which will be heated by the bombardment of the electrons.

All of these processes are carried out with the pumps in operation.

When a sufficiently great vacuum has been obtained in the envelope, heat is applied to the exhausting tube, which the atmospheric pressure will cause to collapse, thus fusing and sealing the tube. This exhausting tube is concealed in the valve base.

"Gettering" is a process that is applied to receiving and small transmitting valves. The "getter" may consist of a substance that will absorb gases, and it has been found to be most effec-

(Continued on page 32)

NEWS OF THE WORLD OF RADIO

HAMS BY THE THOUSAND

According to George W. Bailey, President of the American Radio Relay League, there were 56,000 licensed experimental transmitters in U.S.A. before the war. At least 25,000 of these are now in the services and the majority of the rest are engaged in vital production. Authorities appear to agree that immediately after the war the ranks of licenced amateurs will swell to at least 100,000.

* * *

PLENTY OF SCOPE FOR RADIO

A striking view of the extensive use of radio communication systems appears in a special report recently released by the Superintendent of Fire Alarms at Washington, U.S.A. Approximately 128,000 fire-fighting units will use radio equipment as soon as they can be made available. These units include ladder companies, chiefs, battalion chiefs, service cars, fuel waggons, squad cars, ambulances, utlity trucks, boats and pumping companies.

The report can be considered conservative, as it is based on a 1940 census which shows that there are a thousand cities in the United States with organised fire departments and populations of over ten thousand.

Similarly in Australia there will be a vast scope for radio equipments for fire brigades, as well as ambulances, police and other emergency and essential services. Commercial possibilities for the equipment of newspaper trucks, department store delivery waggons and so on, are quite unlimited.

* * *

SAVING FOR TELEVISION

A savings plan of wartime earnings for peace-time purchases is in operation at an American bank. A recent survey has shown that a large percentage of the savings were intended for the purchase of television receivers which are expected to be available at 400 dollars each.

* * *

Electronic heating has its applications but you have to be practical. There is a story of an American firm which spent 25,000 dollars on electronic schemes for pre-heating castings only to find in the long run that the most effective way was to dip them for a few minutes into boiling water!

* * *

INVASION RADIO

Eight hundred wireless sets to equip a division was the recent estimate given by Lt. Gen. Sir Colville Wemyss, Colonel-Commandant of Royal Signals. "Good communications," he said, "are vital to any operations, especially those involving all the complications of an invasion."

RESEARCH INTO PHASE-CHANGERS

MR. MUTTON'S articles on audio work are most enlightening. In an article submitted by myself some time ago I advanced the case for small audio systems using class AB1 output triodes and shunt-fed transformer coupling to this stage. It would be, as you then inferred, a little too dogmatic to assert that such a system is the last word in radio hookups. No one has ever denied that Direct Coupling provides that final touch. But

By

F/Sgt. PHIL EDWARDS

R.A.A.F., Mt. Gambier, S.A.

owing to the odd values of heavy-duty resistors, and rather excessive voltages involved, the layman stops short of constructing D/C circuits as a rule.

And a point worth quibbling about is—how much justification is there for amplifiers having T.H.D. of less than a couple of per cent.? Surely these are of more academic than practical value.

With this in mind, and a full set of gear to work with (V.T.V.M., Oscilloscope, 20,000 ohm/volt tester and zero to 13,500 cycles audio oscillator) a friend and I recently dug ourselves into the shack for about four days, and found out some surprising facts.

Radiotron "A504"

We started with the "A504" circuit. Everyone knows it, so the circuit will be taken as read. The circuit was first put up without the feedback loop, to correct the amplifier as much as possible BEFORE feedback was applied. The reason is all too obvious. Feedback in our opinion, was not to cure distortion, but to reduce that of an already sound amplifier. And so it began.

The immediate trouble was the single-legged phase splitter.

NO GOOD.

The output of the plate side was greater than that of the the cathode side, and its waveform manifested a nasty little "pip" on the peak. In all fairness, it was reasonably o.k. until we tried to get more than about 20 volts out of it.

The circuit was precisely as stipulated in "A504", all values of resistance and capacity, also the tube, being checked and cross-checked,

STILL NO GOOD.

Over to a 6F5 in the socket, with 10 megs of grid leak and matched 100,000 loads. Better, but still unbalanced. And so, after sorrowfully shaking our heads over the page on "splitters" in the Radiotron Designers' Handbook, we savagely cast the tube to one side and tried again.

This time, a 6N7GT was tested, and put in the socket. It could well have been a 6SC7, 6F8 or 6Z7, I guess. But a 6N7 is a proven "bottle" for paraphase work, so in it went.

The floating paraphase was rejected as dubious, because we had read too much about it. The "straight-version", therefore, was adopted, and Grid Number 2 drove off the moving arm of a selected ½ meg. potentiometer. Conventional plate loads (the matched 100,000 pair) were inserted.

The bias resistor was as laid down by R.C.A., 1500 ohms. Now we got volt after volt of ouput from it, so we balanced the second side of the 'scope and found sinusoidal waveforms in the output until the latter was sufficient to drive any output stage absolutely dizzy with grid volts.

Then on to the 6v6's.

A furry pattern on the 'scope gave us to believe that they were oscillating, grid stoppers or no grid stoppers. (These were 10,000 ohms in each grid.) In these positions we substituted 25,000 stoppers. Still no good.

It took a pair of 50,000 resistors to cure it completely.

We admit that it was probably the wiring, but emphatically insist that 50,000 is the SAFE value if you have no oscilloscope.

The 6v6's could now be given their 30-odd volts of grid to grid drive, and with 200 ohms in the cathode and about 260 plate and screen, behayed very sweetly. We then turned the audio oscillator into the first grid at a predetermined value, and opened the main gain up. With a resistive load across the output, the 6v6's gave 10 watts without batting a figurative eyelid, and when they finally DID run into positive grid current, the oscilloscope pattern across the load showed a perfect, square-topped, typical overload pattern with no complications.

It was then that the inverse feedback loop was added.

We had heard about phase-shift using inverse-feedback over a paraphase circuit, but we confidently relied on the oscilloscope to give us the "high sign" if there was to be a troublesome amount of it.

Note that the feedback percentage is considerably LESS than A.W.V. use, with the A504 circuit. Could this be because their phase-splitter is not so hot?

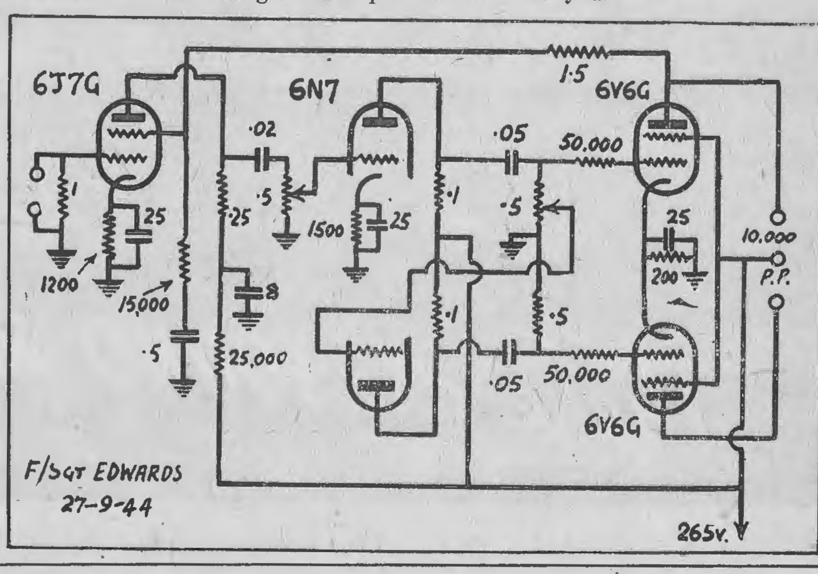
Anyway, the percentage used is sufficient to give the amplifier absolute linearity from about 45 cycles to the upper end of our audio oscillator, which is 13,500. As a final gesture we put a microphone pre-amplifier on it—a 6SJ7. This showed a very "jagged" waveform with a certain plate load and output coupling (.5 meg and .006 mica condenser, with about 2¼ megs in the screen, these being an R.C.A. group for super-gain).

The cure was to revert to the 250,000 plate load, 1200 ohm bias, and 1.2 meg screen.

But this is coincidental.

The point to be made is that here is an experimental circuit which gave us great satisfaction, both visually and aurally.

Someone might like to hear about it. If you think so, go ahead and print it. Over to you.



REPAIRING AND ADJUSTING VIBRATORS

By

W. ROBINSON

Port Macquarie, N.S.W.

NEW vibrator points are very scarce now and there are probably quite a number of old ones about (either in use or in the junk box) which can, with a little time spent on them, be made to perform almost as well as new.

Like everything else in radio, you must have the gear to do the job. The gear needed to service vibrator points is a test panel consisting of a transformer tapped for 2, 4, 6 and 12 volt input, with an H.T. output of 150 volts and a current drain of 20 m/amps, through a suitable resistor condenser network, and wired to 4, 5, 6 and 7 pin sockets to take all types of vibrators.

I will not draw up a circuit as the one I use is much like the one you published a few months back with one notable exception. I have not used a m/a meter. Its inclusion is not warranted, as according to Ohm's Law a certain voltage will force a certain current at all times through a fixed resistance, and we have a voltmeter to indicate the voltage and a fixed load, so can easily calculate the current. With a little practice the current can be read off the voltmeter, as a certain voltage will at once indicate a corresponding current.

Instead of a m/a meter, a 5-amp meter should be substituted and wired in the primary circuit, to read the input to the transformer and vibrator electro magnet coil. I have found points that will give a reasonably good output voltage take up to 2 amps at 6 volts input, which is far too much.

The rest of the gear will be a flexible contact file of the carborundum type as used to dress ignition points on cars and can be purchased at any garage: a .003 feeler gauge for adjusting the point gap; and a tool for bending the arm carrying the points. This last can be made from an 8 inch piece of $\frac{1}{4}$ in. bright round steel, bent at right angles 2 inches from one end and slot cut in the other end about $\frac{1}{2}$in. deep by the width of a hacksaw blade. This tool is used to adjust the points by bending the arms.

Although .003 inch gap is recommended for point settings, the best test is the meters. A good average test seems to be .9 amp input, 150 volts

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A RECEIVER WITHOUT GANG

By
D. C. FRENCH
15 Cecil Road, Rose Bay

THE utility receiver circuit described herein enables the builder to satisfy the following requirements of the prospective user; compactness, self contained antenna, simplicity of operation, selectivity, faithful reproduction and good volume.

Compactness—Selectivity

A superheterodyne circuit is used to give arithmetical selectivity without the use of a large number of valves normally required in tuned radio frequency types. Using standard components this receiver can be built on a metal chassis measuring 8 x 6 x 2 inches deep.

Self Contained Antenna

The antenna is self contained and consists of 32 turns of 26 gauge cotton covered wire flat wound on a sheet of ⅛-in. fibre of appropriate size to be attached to the rear edge of the chassis. First turn dimensions are 5 x 2½ in. For operation using the conventional antenna a coupling coil of 4 turns is wound on the inside of the main loop. Connections are brought out to two terminals on the fibre sheet.

Simplicity of Operation

The elimination of the usual 2-gang tuning condenser and dial permits a reduction in itial cost as well as permitting compactness. The use of a double deck 10 contact rotary switch for station selection is an innovation yet provides immediate and accurate station selection once the circuits are aligned. The elimination of tracking adjustments provides ease in servicing. In order that the station selector switch cover the entire broadcast band the pads should have a capacitance of 0 to 430 micro-microfarads.

Faithful Reproduction

Faithful reproduction is obtained by the use of an infinite impedance type of second detector which combines the high signal handling capabilities of the diode type with good linearity yet does not load nor affect the selectivity of the tuned circuit to which it is connected. In this circuit the cathode is by-passed for radio frequency currents while the plate is by-passed for both radio and audio frequencies. A radio frequency filter circuit is interposed between the cathode resistor and the volume control to prevent distortion in the amplifier circuit.

Sufficient volume is obtained by using a beam power amplifier. The use of a constant voltage inverse feed back circuit improves reproduction over the complete audio frequency range. Correct voltage phasing can be obtained experimentally.

Power Supply

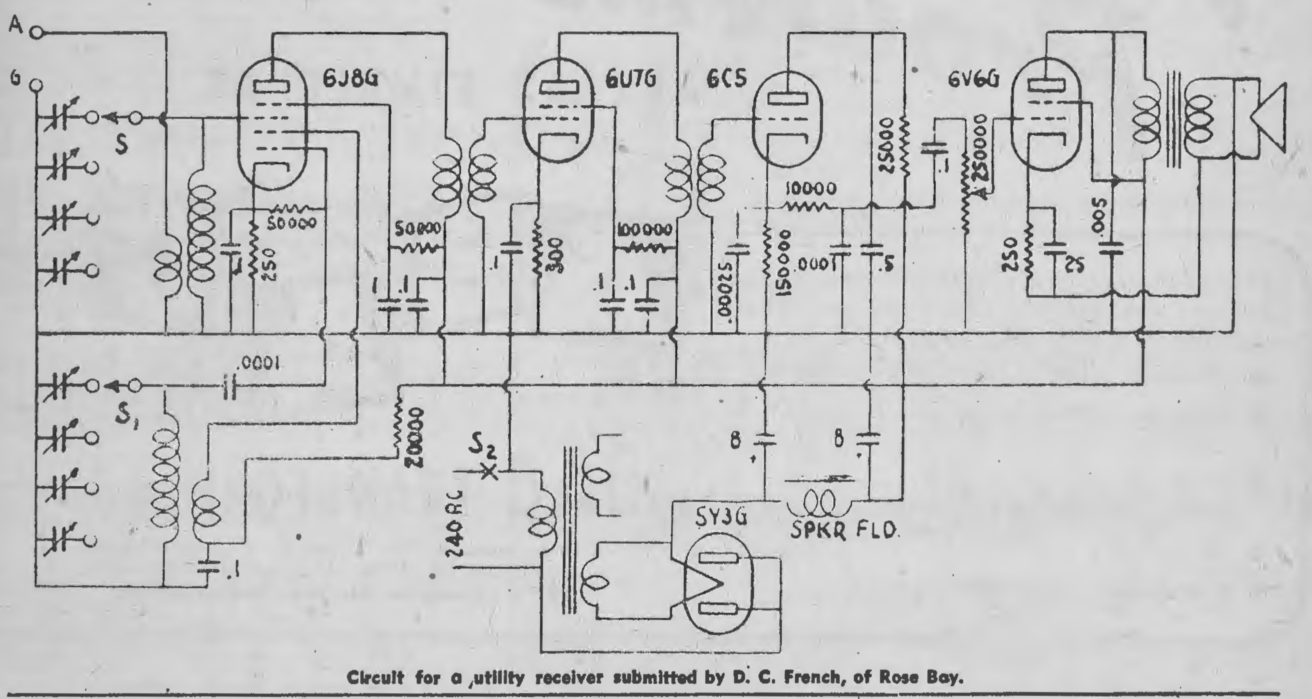
Another innovation resulting in an initial cost reduction as well as a reduction in the space required is the use of a 5Y3G in a half wave rectifier circuit giving an operating voltage of 250 volts direct from the 240 volt mains without the use of a high voltage power transformer. A dual winding filament transformer is required.

Summary—Construction Notes

As most sets of this type are used for the reception of local broadcast programmes the use of an AVC circuit was deemed unnecessary.

The oscillator coil for this set consists of 80 turns of 30 gauge silk enamel wire close wound on a .875 diameter form. The oscillator plate coil is wound on top of the grid coil starting at the cathode end and consists of 30 turns of 30 gauge silk enamel wire. The lower end of this coil is connected to the oscillator anode and the top end to plate supply.

The general arrangement of the set places the 5 inch dynamic speaker at the centre with the station selector switch on the left and the volume control on the right.



Circuit for a utility receiver submitted by D. C. French, of Rose Bay.

THE FUTURE FOR RECORDINGS

CONSIDERABLE interest is being shown in the future processes likely to be developed to secure a more satisfactory form of recording and reproduction, and we give below a precis of a very interesting discussion which took place at a recent meeting of the Institute of Electrical Engineers, held in London.

The disc system, in spite of its age, offers a great many facilities for home use and for broadcasting. It is relatively easy to handle; it provides a self-contained and compact unit; processing is relatively cheap; short numbers can be catered for, and the record is accessible for extracting short portions for programmes or educational use.

The development of the cellulose recording-disc has given the recording companies a new tool. We are now able to assess the quality of the recording and reproducer by direct playback, without the doubtful intermediary stage of processing as was necessary when wax discs had to be made. The reproduction from a few direct cellulose records will be given.

The relative merits of the lateral-cut and the hill-and-dale systems are very close. The hill-and-dale system is the older and has now been largely replaced by lateral-cut.

Suggested Improvements

The chief improvements required for the disc system are: signal to noise ratio; intensity range; frequency range; freedom from non-linear distortion: constancy of results and life; storage, and playing time.

The frequency range on the average pre-war record was limited at the high end to 6,000 c/s. Very few gramophones could utilise even this limited range because of the response characterestics of the pick-ups and the surface noise of the records.

The recording range can be taken up to 12,000 c/s, and this range can be preserved without appreciable loss during the factory processing, provided certain precautions are taken. The desirability of an extended range has been a debatable point, and the issue has always been clouded by the intervention of noise. With the direct cellulose playback, we can now better appreciate the advantages of extending the frequency range.

Before an extended frequency range can be utilised, attention has to be paid to the record processing, record material, needle point, and the pick-up system. The size and shape of record grooves and of the needle point must receive special attention. Only by use of the correctly-shaped needle tip can quiet surface records be used. Broadly speaking, the record disc consists of a mixture of thermoplastic resins in suitable proportions to give strength, good plastic flow in the press and ultimate stability. Whether or not a mineral filler is to be added, depends on the type of needle to be used in the pick-up, and the pressure of the needle point when playing. The optimum shape of needle has a hemispherical end 0.00025in. radius, when working with the accepted standard shape of groove. Ordinary commercial needles depart from this ideal shape, many presenting extremely sharp points which exert such a pressure on the record that the surface is broken. In the past, therefore, a record filler has had to be used to grind these sharp points to a reasonable bearing surface within a few inches of travel. A practically noiseless record without a filler is possible, and any introduction of filler will increase noise in proportion to the amount and to the particle size. The wear on the needle will also depend on the filler used. The war has seen the development of a number of plastics which are extremely interesting from a record-manufacturing point of view, and no doubt these will be tried out when they become available for this type of work after the war.

Ultra-Violet Recording

The introduction of ultra-violet recordings has increased the resolution to such an extent that the film may be taken with little or no loss up to 12,000 c/s, using the standard film speed of 90 ft./min. The intermodulation, which was at one time a common type of distortion, is now reduced to a small value by the aid of special tests. The use of normal silver photographic emulsions for printing copies is expensive for domestic gramophones. There are, however, several diazo-dye printing processes which are a great deal cheaper. It is also well known that film can be arranged with two tracks working in opposite directions, so that one track can be used when unwinding, and the other track for rewinding the spool. The future of the strip or film reproduction depends on the processing costs.

No sound-recording system can claim to have high fidelity unless it records and reproduces the direction of the original sounds. At least two channels are necessary and the expense is considerable. The lack of binaural effect in single-channel normal recording, has been corrected to a large extent by positioning the microphone and by special acoustic conditions of the studio.

Demonstrations were given from recordings of the disc type and also of the film type.

Two speakers later emphasised the great interest of sound recording to the British Broadcasting Corporation, especially in connection with repeat programmes, an interest which has been greately increased under war conditions. An indication was given of the manner in which the technique has developed and improved. At the moment discs play a large part in the B.B.C. recordings, but some are of larger diameter than the normal 10in. or 12in. record and revolve at a lower speed to secure a longer playing time.

Portable Apparatus

A special feature in this connection is the design of portable apparatus for securing material which cannot be brought to the studio. On the general question of high-grade recording, the comment was made that the B.B.C. is

(Continued on page 32)

WOBBLER

(Continued from page 10)

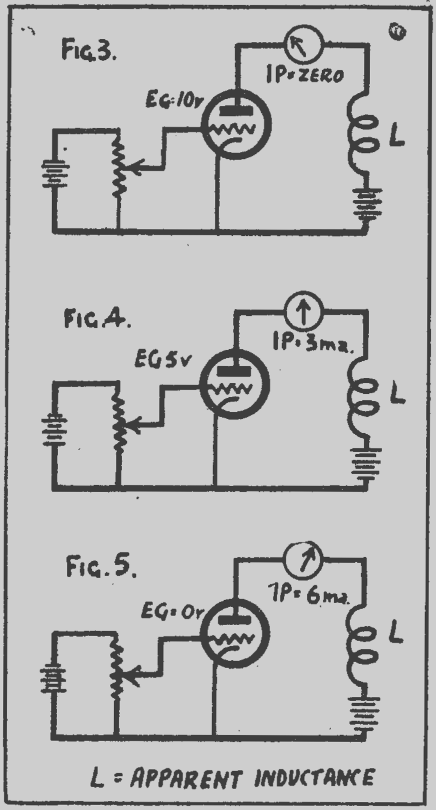
ing in its place 20-25 turns of 38 S.W.G. D.S.C. wire spaced approximately one eighth of an inch away from the remaining old bobbin. This new primary must be wound in the same direction as the grid winding IP will go to the oscillator plate on the 6K8 socket and O.P. goes to the H.T. voltage. A 0—1 milliameter connected between the bottom of the 50,000 oscillator grid-leak and earth and the unit switched on should show a grid current of not less than 100 microamps and not more than 250. If greater than 250 reduce primary turns, if less than 100 increase primary turns.

So much for the actual coil construction. However, the connections to the coil itself are not standard as will be noticed by studying the diagram. Firstly the secondary or grid winding which feeds the oscillator grid of the 6K8 has the H.T. voltage connected to the bottom end then through the coil direct to the plate of the 6J7 frequency control tube. It will also be found that the penthode plate of the 6K8 feeds the input grid of the 6J7. All of which simply means, that the 6J7 is in parallel with the grid winding of the oscillator. A simplified drawing of this appears in Fig. 2. One other point which the writer omitted refers to the variable condensor shown across the oscillator grid winding. I happened to have on hand a 14 plate reaction condenser which when tried suited the purpose admirably. If one of the old type large diameter aluminium coil shields is kicking about the coil unit and the reaction condenser can all be mounted in this. Drill a suitable hole in the top of the can and mount your variable condenser in this hole, with a pointer knob attached to the spindle.

Frequency Control Tube

In effect this 6J7 tube acts as a variable inductance connected in shunt with the oscillator grid winding, as shown in Fig. 3. If the reader is familiar with his fundamentals on A.C. theory he will remember that when current flows through an inductance it lags the voltage by a phase angle of 90°. In a condenser, however, the reverse is the case, in this instance the current leads the voltage by 90°. By referring to the diagrams in the text it will be seen that the following action takes place. The grid of the control tube has impressed on it an alternating voltage from the oscillator tube, via the phase shifting network R.C. This voltage "lags" 90° behind the current through C. In this tube the grid voltage and plate current are in phase, as a result of this, the "lag" in grid voltage is equal to a 90° "lag" in plate current. This is exactly the same set of conditions existing in an ordinary inductance which means we have done what we set out to do, and that is provide a 90° current lag. In so doing, the lagging current drawn by the control tube flows through the oscillator grid winding, that is from plate to cathode of the control tube, then the apparent inductance of the tube is in parallel with the actual inductance of L.

The amount of lagging current drawn by the control tube determines how large the apparent inductance will be and this can be controlled by varying the grid bias on the control tube. Thus for individual plate current values there is a different amount of apparent inductance, as shown in the accompanying diagrams.



Sweep Generator

For visual alignment purposes with a F.M. signal generator and a C.R. tube we want what is termed a double image pattern to appear on the screen. To do this we require the bias voltage to vary from a small amount to a large amount and return again to a low value at a definite period with respect to time, and in so doing must perform this function linearly. This portion of the circuit is named the "pyramid linear sweep."

Examining the circuit diagram will reveal that the 6K7 or 6U7G or equivalent sweep generator tube is passing direct current continuously, but in addition, on each positive alternation of A.C. half the time. Hence the high tension secondary winding of the power transformer carries both direct and alternating current. Under these conditions the following sequence of events takes place. On the first quarter cycle, i.e., the positive A.C. loop the A.C. and the D.C. voltages add and attain their peak value at the top of the rising quarter cycle. Coming to the second (descending) quarter cycle, the combined A.C. and D.C. voltages proceed to zero value 90° ahead of the combined alternating and direct currents, which continue to flow in the third quarter cycle. However, the rectifier cuts off the third and fourth quarter cycles, which operating under normal conditions would mean no current flows. But, don't forget the 90° current "lag" in the secondary winding. At this stage the fourth quarter cycle, the D.C. voltage at the commencement of the quarter cycle was bucked by the peak negative A.C. loop. Now, however, it is no longer opposed and hence travels 90° ahead of its direct current.

On the 4th quarter cycle neither alternating current nor direct current flows. At the zero point of the new cycle, however, the direct current commences to flow, first quarter rising. 90° later alternating current starts to flow and adds with the direct current. At this stage the A.C. and D.C. have

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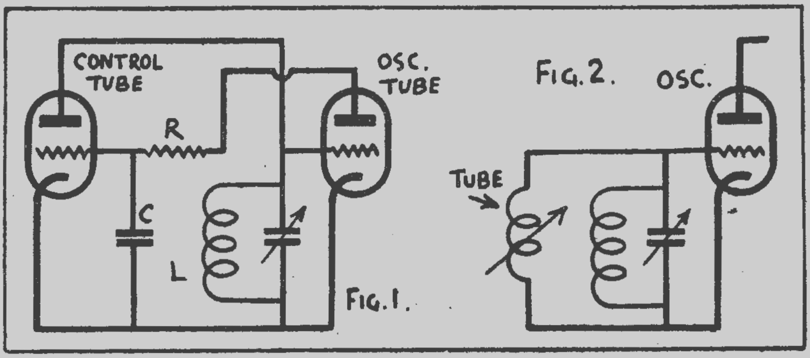

Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY

LADIES AND GENTLEMEN, HOW DO YOU DO?

That opening sentence, which has called us to attention so often, prefacing as it does a most informative commentary from the U.S.A. Ace Radio News Analyst, William Winter, is now not only being still heard in Australia, but being said in Australia.

Yes, William Winter arrived in Australia on September 29th, and was introduced over station VLC-6 by John Heistand. I was glad I heard him on that occasion, and rumaging through my files I found I first heard Mr. Winter in March, 1942. In October of that year I received a photo from him which was reproduced in this magazine the following month, affording short wave listeners an opportunity of "meeting" the man who was later to address them regularly over our local Broadcast Band.

William Winter will spend six weeks in Australia before going North as a War Correspondent.

Since he left the States his place on the 'Frisco Stations has been taken by Sidney Roger, also well known to S/W listeners by his "Hello to My Friends Everywhere."

THIS IS THE PHILIPPINE HOUR

It certainly was on October 20th, and I heard the first account of the Invasion through KWV, 'Frisco, 27.68 metres. Later on my mind went back to the start of this War by KWY requesting us to "Stay tuned to this station for further news." Remember away back in 1939 when KGEI, one of the few regular evening transmitters from America at that time promised us "more news momentarily." And on October 20th, KWV threw programme lists overboard and instead of going Dutch at 5.45 p.m. kept to News and at 5.55 gave us General MacArthur's message.

GREAT BRITAIN

Pacific Service is coming through fine on new schedule, 3.45-8 p.m., and the newcomer, GVY 11.955 m.c., 25.08 metres, is at his best when withdrawn at 7 p.m.

In the evenings there is a great choice from the BBC and if your receiver goes down to the 13 metre band, try GVR, 21.675 m.c., 13.84 met. from 7 till 10.15 p.m. beamed to India, Ceylon, Burma, Malaya and South East Asia, and GSH, 21.47 mc. 13.97 met. from 9.45 till 1.30 a.m. directed to Central and South Africa. Signals are great but tuning is sharp. The 16 metre band offers also some delightful signals and on the 19 metres some fine practice in tuning can be had. If care is exercised, and it is required to separate the many stations on that particular part of the dial this time of the year, some splendid programmes will be found.

Do not be afraid to open up the volume control as several "weak sisters" will be found loitering about. As a matter of fact, it was this method that brought the new B.B.C. lassie to light, further particulars of which are given under "New Stations."

THEY VERIFIED

Received an acknowledgment of my report to Cable And Wireless (West Indies) Limited on the reception here of their tests to the B.B.C. on 25th March. The Engineer says, "very many thanks for your letter of the 25th March, which provided us with useful information. The occasions you heard were tests and transmissions for recordings by the B.B.C. and R.C.A. You will be interested to know that the material you heard was, later, rebroadcast by U.K. and American transmitters.

"We do not normally undertake broadcast work in Barbados, so it is doubtful if you will hear our transmitters again for a long time."

HELP WANTED

Who is behind KROJ 6.10 m.c., 49.15 metres, from about 6.45 till 10.50 p.m.? Somebody is there causing a most objectionable heterodyne hum. Would be glad of any help in this direction.—L.J.K.

NEW STATIONS

VLC-7, Shepparton, 11.84 mc., 25.35 m.: This addition to the Department of Information transmitters came into operation on 16th October. Broadcasts daily to North America from 3.10 to 3.45 pm and to Tahiti, in French, from 4 till 4.40 pm.—L.J.K.

WLWL, Cincinnati, 13.022.5 mc. 23.03 m.: This Crosley outlet opens at 7.30 pm with fair signal and is still audible at midnight. But watch for changes in schedules which are as frequent as thunderstorms lately. Am sure the frequency particulars will be of inestimable value to those who are calibrating their sets.—L.J.K.

WLWR, Cincinnati, 6.37 mc, 47.10 mc. Unfortunately this new one, also conducted by the Crosley Corp., is right in amongst the morse, an otherwise good signal being spoilt just before closing at 5 p.m.—L.J.K.

XBC, Somewhere in New Guinea. Heard at various times of the day on any of the following frequencies and wave-lengths: 15.26 mc, 19.66 m.; 14.80 mc, 20.27 m.; 12.65 mc, 23.72 m.; 7.63 mc, 39.30 m.; 7.50 mc, 40.05 m. Signal is generally good as the frequency and time have been selected with this all important object in view.

(Continued on next page)

Shortwave Notes and Observations

OCEANIA

Australia

VLC-4, Shepparton, 15.315 mc, 19.59 m.: Good from 9-10.15 am (Perkins, Ferguson).

VLC-6, Shepparton, 9.615 mc, 31.2 m.: Terrific from 7-8 pm (Perkins).

VLC-7, Shepparton, 11.84 mc, 25.35 m.: Heard in transmission to America (Ferguson). (See "New Stations"—L.J.K.)

New Caledonia

FK8AA, Noumea, 6.20 mc, 48.39 m.: Very fine from 7 pm (Gaden).

New Guinea

See "New Stations"

Hawaii

NPM, Pearl Harbour. See "New Stations."

New Stations—(Cont. from page 27)

FZI, Brazzaville, 9.83 mc, 30.52 m.: Dr. Gaden reports this new one from French Equatorial Africa. He hears them around 8.30 am.

SEAC (South East Asia Command), Colombo, 15.275 mc, 19.64 m.: Roy Matthews, of Perth, reports this station as being heard around 3.30 pm at good strength. (Schedule now appears to be 1.30 to 3.30 pm. When closing at 3.30, they gave frequency, etc., and said, "We shall be on the air again at 12.30 Indian Standard Time (5 pm, Sydney), on 11.810 kilocycles in the 25 metre band."—L.J.K.)

——, Kandy, Ceylon, 15.275 mc., 19.64 m.: This one is reported by Hugh Perkins, of Malanda, Queensland, and Wally Young, of Adelaide. Both heard Kandy testing with the BBC at 7 pm. At 8.30 pm were in parallel with VUD-6, 25.45 m.

VUD, Delhi, 15.16 mc, 19.79 m.: And another new Indian heard at great strength around 1.10 pm. At 1.15 announced they were also to be heard on 19.54, 25.27 and 25.51 m.—L.J.K.

NPM, Pearl Harbour, 17.445 mc, 17.20 m.: Wally Young, of Adelaide, reports this one Like other Point-to-Point transmitters, is likely to be heard at any time. I had heard them several times, but I am grateful to Mr. Young for call-sign which if given when I was listening was missed.

——, London, approx. 15.01 mc, 19.98 m.: Appears to be a new BBC transmitter heard in parallel with GWC in Foreign broadcasts, around 9.30 pm. French was being used when Mr. Edel rang me to ask the call-sign. I have not heard the call-sign, nor does it appear in the latest lists I have from the BBC. I am in communication with the BBC representative in Sydney, and will publish any information forthcoming. Signal is weak, and is at times overpowered by WWV, Washington, on 15 mc.

PARIS heard, 9.62 mc, 31.19 m.: Mr. Howe, Short Wave Editor, "Universalite", in a letter dated 28th August, mentions inter-alia. "PARIS, LIBERATED, first heard August 25th, day of final liberation, from just before 10.30 am, to sign off with Marseillaise at 11.15 am. English announcements. An announcer for BBC and NBC at 10.30, Frenchman carries the rest, great excitement, De Gaulle's speech with shooting recorded. Many cheers and Marseillaise played and sung dozens of times." The above is the old spot for Paris which has had several aliases since the good old days of Radio Mondial. I find in my Log Book that I heard a man and woman talking for a long while, in French, on this wave-length at 4.45 pm, on Friday, September 1. The next day at the same time Mr. Edel and I listened and the same two were there, but we could not establish location.

HH3W, Port-au-Prince (Haiti), 10.13 m.c., 29.62 m.: This is not exactly a new station, but I cannot find any reference to it being logged, no recently at any rate, so, as it deserves prominence, it will be placed in this category. For several weeks Mr. Edel and I have been trying to run this chap to earth, but morse or static always happened when call-sign was given. However, patience was rewarded, and on November 5 call was plainly heard during a pause in the almost incessant morse at 10 p.m., five strokes on a bell, similar to Big Ben, is heard and they sometimes relay C.B.S. at 10.15. Call is again heard around 10.30. Signal is quite strong but spoilt by morse. The five strokes on the bell are hard to reconcile as the time in Haiti corresponding to 10 p.m.; in Sydney would be 8 a.m.—L.J.K.

WVLC, Leyte, Philippine Islands, 7.795 m.c., 38.44 m.: This transmitter, which is apparently at Gen. MacArthur's H.Q., is at great strength from around 9 p.m. until late at night, when transmissions to Australia and overseas newspapers can be heard—L.J.K.

Paris Radio, 9.555 m.c., 31.40 m.: "Ici Paris Radio" reported by Mr. Arthur Cushen as putting in a very good signal at 4.15 p.m. with exercises and getting-up tunes. News at 4.30 and talk on Maquis. Modern numbers, like "Tipperary," "Hang Out the Washing," etc., heard till 5 p.m., when news is again broadcast. Now clear of GWB.

WLWR, Cincinnati, 6.386 m.c., 46.97 m.: Mr. Ted Whiting submits this new spot for The Crosley Corporation. He hears them at 4 p.m. in English.

New BBC Transmitters: Here is a list supplied by Mr. Ted Whiting, the call-signs of which are so far unknown:

15.21 m.c., 19.72 m.: Heard with GSO at midnight.

15.095 m.c., 19.87 m.: Heard with GSO at 1.15 a.m.

12.36 m.c., 24.26 m.: Heard with GRV at 1 a.m.

12.02 m.c., 24.95 m.: Heard in News in English at 2.30 a.m.

9.60 m.c., 31.22 m.: Heard in foreign language at 7 a.m.

And Mr. Matthews submits:

5.80 m.c., 51.72 m.: Heard with news at 1 a.m.

WCQD, location somewhere in Pacific, 7.87 m.c., 38.14 m.: Mr. Whiting is hearing this one around 8 p.m.

AFRICA

Belgian Congo

RNB, Leopoldville, 15.17 mc. 19.78 m.: Only fair at 9 pm (Matthews).

RNB, Leopoldville, 11.645 mc, 25.76 m.: Heard 2-11 am and 2.45-3.50 pm (Howe, "Universalite").

Egypt

SUP-2, Cairo, 6.32 mc, 47.47 m.: No broadcasts recently (Howe).

French Equatorial Africa

FZI, Brazzaville, 15.595 mc, 19.25 m.: Fair to good from 8.30 pm (Matthews).

On 11.97 mc, 25.06 m. is good in the morning (Gaden).

On 12.12 mc, 24.75 m. Heard at 8.30 pm (Young).

See "New Stations" for 9.83 mc, 30.52 m.

On 9.44 mc, 31.78 m.: News in English at 4.45 and 9.30 am (Cushen).

Heard well from 3—4.40 pm (Howe, "Universalite").

Brazzaville is using a 1 kilowatt station on 9680 kilocycles and two stations of 500 watts on 7023 and 5858 kilocycles. Operating times are not known (Nolan).

Senegal

FGA, Dakar, 11.41 mc, 26.29 m.: Heard at 6.30 am (Gillett). Heard at good strength. Sched. is: 5.15—7.20 am (Cushen).

Mozambique

CR7BD, Lourenco Marques, 9.863 mc, 30.42 m.: Heard at 5.55 am (Gillett).

CR7-AA is the call on 5.86 mc, 51.19 m. They have a swell card, too (Nolan). (Congratulations, Ray.—L.J.K.)

The call on 3490 kc, 85.96 m, is CR7-AB (Nolan). (I think this one was logged by Rex Gillett last August.—L.J.K.)

CHINA

XGOY, Chungking, 11.909 mc, 25.19 m: Modulation has improved lately and news at 8.03 pm can be followed. Schedule is 8—9.30 pm.—L.J.K.

WSCO, Somewhere in China, 8.01 mc, 37.48 m.: This Armed Forces Radio Station transmits from 10.30 pm a programme for the troops. (Cushen).

INDIA

See also "New Stations"

VUD, Delhi, on 15.29 and 15.35 mc, good, morning, afternoon and night (Matthews). From about 9.45 pm can hear news on 6.19, 6.15 and 6.13 mc (Gaden).

VUC-2, Calcutta, 7.21 mc., 41.61 m.: Being heard at 5.45 am (Gillett).

U.S.S.R.

Moscow on 15.75, 15.37 and 9.565 mc. all good at 9.40 pm in English (Matthews).

CENTRAL AMERICA

Costa Rica

TIPG, San Jose, 9.617 mc, 31.20 m.: Fair to good from 10 pm, have a bit of a job to scrape off VLC-6, 9.615 mc, but managed to get out a report to him (Matthews). (VLC-6 now goes off at 9.45 pm, returning at 11 pm.—L.J.K.)

Gautemala

TGWA, Guatemala, 15.17 mc. 19.78 m.: Heard signing off at 11.30 am. No English, but letters easily followed (Gaden).

SOUTH AMERICA

Argentine

LRE, Buenos Aires, 6.085 mc, 49.30 m.: Heard at 8.45 pm (Young).

Brazil

Mr. Howe of "Universalite" writes: "In regard to Mr. Gillett's enquiry in July issue of "A.R.W.", it may be PRE-9, Fortaleza Brazil, it not CP-2." (PRE-9 is shown as 6.105 mc and on the air from 7 am till— L.J.K.)

U.S.A.

San Francisco, unless otherwise mentioned.

KROJ, 17.76 mc, 16.89 m.: Very good at mid-day (Perkins).

KROJ, 9.897.5 mc, 30.31 m.: Closes at 8.45 am, but very poor signal (Gaden). (Not audible down here.—L.J.K.)

KWIX, 9.855 mc, 30.44 m.: Better than KROJ at 6 pm (Gaden). Good at night, except for heterodyne (Perkins). Some nights is overpowered by WNRA.—L.J.K.)

KGEI, 9.53 mc, 31.48 m.: Opens at 8.45 pm, at excellent strength (Matthews).

KRCA, 9.49 mc, 31.61 m.: Fair all evening (Matthews).

KES-2, 8.93 mc, 33.58 m.: Fair at night (Matthews). Ruined by morse down here.—L.J.K.

KWY, 7.565 mc. 39.66 m.: Opens strongly at 10.30 pm, but too much interference for really pleasant reception (Gaden). Spoilt by morse, here, too.—L.J.K.

KGEX, 7.25 mc, 41.38 m.: Excellent at night (Gaden, Matthews, Edel, Perkins).

KWID, 7.23 mc, 41.49 m.: Very good at night (Gaden).

KEL, Bolinas, 6.86 mc, 43.73 m.: Good at 7.15 pm (Perkins).

KROJ, 6.10 mc, 49.15 m.: Has an awful heterodyne most of the time—dreadful (Nolan, Perkins, Edel, Matthews). The same objectional HUM is prevalent here, from 6.50 till 10.50 pm. The last five or ten minutes of reception is perfect.—L.J.K.

U.S.A.

(Other than California)

WLWL, Cincinnati, 15.23 mc, 19.69 m.: New schedule is 8—10 pm (Cushen). Little early in the year for us to hear East Coast stations on 19 metre band at night, but they are coming in well in the west.

WGEO, 15.33; WCBX, 15.27; WLWK, 15.25; WOOC, 15.19; WNBI, 15.15 and WRUS, 15.13 mc, are classed as fair to good by Mr. Matthews around 10 p.m.

WNRX, New York, 14.55 mc, 20.61 m: Heard around 7.45 am and 9 pm.—L.J.K.

WNRI, New York, 13.05 mc, 22.98 m.: Closes 9 am (Gaden, Ferguson). Opens at 9 pm with terrific punch (Nolan, Matthews).

WLWL, C'nnati, 13.022.5 mc, 23.03 m.: Opens 7.30 pm (Gaden). Fair at m/n (Nolan).

WLWR, C'nnati, 12.967 mc. 23.13 m.: Opens at 7.30 pm (Gaden, Nolan).

WLWK, C'nnati, 11.71 mc, 25.62 m.: Good at 10 pm (Matthews).

WRUL, Boston, 11.73 mc, 25.58 m.: Excellent at 10.30 pm (Gaden). (Jolly nuisance in the afternoon at times, spoiling KGEI from 3 till 5.45.—L.J.K.)

WLWL, C'nnati, 9.897.5 mc., 30.31 m.: Opens at 9.15 a.m. and WLWR on same frequency closes at 5 pm, reopening at 5.15.

WNRA, New York, 9.855 mc., 30.44 m.: Closes at 9 am and re-opens at 5.15 pm (Gaden, Nolan).

Causes bad heterodyne on KWIX from 6 till 8.30; closes 9 pm.—L.J.K.

WNRI on same frequency opens at 9.15 am and closes at 5 pm (Gaden). Good at 10 am (Matthews).

WRUW, Boston, 9.70 mc, 30.93 m.: Very good at 10.30 pm (Gaden).

WNBI, New York, 9.67 mc., 31.02 m.: Fair at 9 pm (Matthews).

WOOC, New York, 9.65 mc, 31.08 m.: Good at 11 am (Matthews).

WLWO, C'nnati, 9.59 mc, 31.30 m.: Fair at 10 am (Matthews).

WBOS, Boston, 9.57 mc, 31.35 m.: Signs at 7.30 pm (Cushen).

WGEA, New York, 9.53 mc, 31.48 m.: Good at 9 p.m. (Matthews). (Not in the race, here, with KGEI—L.J.K.).

WLWL, C'nnati, 7.832.5 mc, 38.3 m.: Signs at 5 pm (Cushen).

WLWR on same frequency opens at 5.15 pm (Gaden). (Think you will find WOOW is the call at that hour, closing at 6.30—, WLWR opens at 5.15 on 9.89.—L.J.K.)

WOOW, New York, 7.82 mc, 38.36 m.: Good at 11 am (Matthews).

WLWO, C'nnati, 7.575 mc, 39.6 m.: Very good around 5 p.m. (Gaden).

WNRX, New York, 7.565 mc, 39.66 m.: Good at 9 am (Matthews).

The pick of the "Voice Lads" towards 5 pm—but often spoilt by morse. (Gaden). (Closes at 5 pm.—L.J.K.)

WLWR, C'nnati, 6.37 mc., 47.10 m.: Splendid signal ruined by morse towards 5 pm (Cushen). (Closes at 5.—L.J.K.)

MISCELLANEOUS

Arabia

ZNR, Aden, 12.115 mc, 24.77 m.: At 2.55 am, "You are listening to station ZNR, Aden, Arabia on a wavelength of 24.77 metres." (Edel).

Canada

CBFX, Montreal, 9.63 mc, 31.15 m.: Good at 10 pm (Matthews). Splendid, here, too.—L.J.K.)

Newfoundland

VONH, St. Johns, 5.97 mc, 50.25 m.: Was delighted to receive a card from these people and surprised to read they only use 300 watts power (Nolan). (Nice catch, Ray.—L.J.K.)

Portugal

CSW-6, Lisbon 11.04 mc, 27.17 m.: Being heard again with operatic music around 7.15 am.—L.J.K.

Mexico

XETT, Monterey, 9.55 mc, 31.39 m.: Heard on a few occasions with good signal at 10.55 pm (Gillett).

XEWW, Mexico City, 9.50 mc., 31.58 m.: Fair at 9 am, but the outstanding Latin-American any afternoon (Gaden, Gillett).

Sweden

SDB-2, Stockholm 10.775 mc, 27.83 m.: Heard at 4.30 pm (Young). Morse spoils musical programme at 2 am (Edel). Being heard well in U.S.A. from 2—8 am (Howe, "Universalite").

SBT, Stockholm, 15.155 mc, 19.80 m.: Good on Sundays at 9 pm, also on 11.705 mc at times (Matthews) (Edel).

Switzerland

HER-5, Berne, 11.96 mc, 25.08 m.: Excellent on Tuesday and Sats., 3—4.30 pm (Gaden, Edel, Cushen, Gillett, Young).

(The above paragraph together with other Swiss items was squeezed out of October issue owing to pressure on space. The position now is that with GVY on 11.955 beamed to Australia the Swiss Broadcasting Corporation may confine their broadcasts to Australia to 26.31 metres (the transmitter that replaced 23.14 metres) and alter their schedule to an hour or so later. It would therefore be wise to keep an ear to the dial in case this happens.

HER-5, Berne, 11.865 mc, 25.28 m.: Heard at 12.25 am, signing off transmission to the Orient (Edel).

HER-, Berne, 11.775 mc, 25.48 m.: Transmission to Central and South Africa at 1.50 am. Announces wavelength in Suisse and French Signal R8 Q5 (Edel).

——, Berne, 11.402 mc, 26.31 m.: Used by Swiss Broadcasting Corp. on Tuesdays and Saturdays from 3 till 4.30 pm, replacing 23.14 mc, but see remarks under 25.08 m.—L.J.K.

HEO-4, Berne 10.338 mc, 29.01 m.: Heard 5.40—6.15 am; 9.30—11 am (Howe, "Universalite").

(Note: Slightly lower frequency than that previously listed—10.345 mc. —L.J.K.)

HER-4, Berne, 9.539 mc, 31.45 m.: Heard 11.30 am—1 pm (Howe, "Universalite").

HER, Berne, 8.185 mc, 32.66 m.: Fair at 9.30 am (Matthews).

HER-, Berne, 7.395 mc., 40.56 m.: In relay with 25.48 to West Africa at 2.15 am (Edel).

HEK-3, Berne 7.38 mc, 40.65 m.: Heard 11.30 am—1 pm, except Sundays (Howe, "Universalite").

HET-3, Berne, 7.36 mc., 40.76 m.: Good at 1.30 am (Matthews).

SHORTWAVE NOTES TOO LATE FOR CLASSIFICATION

Ceylon

Heard Kandy again, testing on 15.275 m.c. at 9.45 p.m. Mentioned KDU but I cannot hook these letters up with anything (Perkins).

Africa

CNR, "Radio Moroc," 8.035 m.c. 37.34 m.: Heard closing with "March Lorraine" at 2.45 p.m. (Cushen).

STOP PRESS

As from November 4, The Swiss Broadcasting Corporation are transmitting to Australia and the Pacific from 6-7.30 p.m. on 23.14 and 25.61 m.

The signal on 25.61 is excellent right through, but on 23.14 very poor owing to Morse.

Brazzaville

Re FZI on 11.67 m.c., 25.71 m.: Dr. Gaden writes, "From my listening, station is still RNB, Leopoldville. Relays or takes programme from Yank at 5.15 a.m. At 5.30 Dutch given by man. At 5.40 call by female is "Ici Leopoldville, etc." At -.45 man gives schedules and Leopoldville is called and so on. Have been on him, on and off, till nearly 9 a.m. and call is Leopoldville. Incidentally, WLWO, on 11.71 m.c., at 6.30 a.m., mentions that Leopoldville, on 25.77 m., transmits for South Africa at 5 p.m. South African time."

Great Britain

GSN, 11.82 m.c., 25.38 m.: A failure, much more the worse of all in Pacific service. Have cabled the BBC recommending withdrawal of GSN and replacing with GRX—think this would be much better (Cushen). (GSN is not a good signal in Sydney until last fifteen minutes or so of transmission. It is directed to New Zealand till 8 p.m. GRX, which closes at 5.30, is also beamed to New Zealand and is a great signal here when closing, so the suggestion, if entertained, would win approval in this city.—L.J.K.).

Allied and Neutral Countries Short-Wave Schedules

These schedules which have been compiled from listeners' reports, my own observations, and the acknowledged help of "Universalite" and "Victory News," are believed to be correct at time of going to press, but are subject to change without notice. Readers will show a grateful consideration for others if they will notify me of any alterations. Please send reports to: L. J. Keast, 23 Honiton Ave. W., Carlingford. Urgent reports, 'phone Epping 2511.

Loggings are shown under "Short Wave Notes and Observations." Symbols: N—New sations; S—Change of Schedule; F—Change of frequency; X—See Short-wave Notes.

Call Sign Location Mc. M. Time: East. Australian Stand'd

GVR, London—21.67 N 13.84—7-10.15 p.m.
GSH, London—21.47 S 13.97—9.45 p.m.-1.30 a.m.
GVO, London—18.08 16.59
AFHQ, Algiers—18.02 16.64
GRQ, London—18.02 16.64
VWY, Kirkee—17.94 16.72—Around 9.30 p.m.
XBC, D. New Guinea—17.91 N 16.75—Irreg. 9 a.m.
GRP, London—17.87 S 7-11.45 p.m.; 1.30-3.45 a.m. 16.79
EIRE, Athlone—17.84 16.82—3.30-4 a.m.
VUD-5, Delhi—17.83 N 16.83
WCDA, New York—17.83 16.83—Idle
WCRC, New York—17.83 16.83—Idle.
WCBN, New York—17.83 N 16.83—10.15 p.m.-9 a.m.
GSV, London—17.81 S 16.84—7 p.m.-1.15 a.m.
VLI-8, Sydney—17.80 16.85—Idle
WLWO, C'nnati—17.80 16.85—7.30-8.45 a.m.; 10 p.m.-4.30 a.m.
GSG, London—17.79 S 16.86—9-10.30 p.m.
WRCA, New York—17.78 16.87—11 p.m.-2.45 a.m.
WNBI, New York—17.78 16.87—7.30-8.45 a.m.
OPL, Leopoldville—17.79 16.88—4.55-6.15 a.m.
KWID, 'Frisco—17.76 N 16.89—6-9.45 a.m.
KROJ, 'Frisco—17.76 16.89—11 a.m.-1.45 p.m.
WRUW, Boston—17.75 16.90—9.30-11.15 a.m.; 12.15 a.m.-4.30 a.m.
GVQ, London—17.73 16.92
LRA-5, B'nos Aires—17.72 16.93
——, B'ville—17.71 16.94—6.30-7 a.m.
GRA, London—17.71 16.94
GVP, London—17.70 N 16.95—8.45-9 p.m.
KMI, 'Frisco—17.09 17.5—Irreg.
WCW, New York—15.85 18.93
LSL-3, B. Aires—15.81 18.97
——, Moscow—15.75 S 19.05—8.47 a.m.-Noon; 9.20-11.30 p.m.; 2-3 a.m.
FZI, B'ville—15.59 S 19.25—8.15-10.45 p.m.
RNB, L'ville—15.53 19.33—9-11 p.m.
KKR, Bolinas—15.46 19.4—Irreg. around noon.
GRD, London—15.45 S 19.43—1.30-5.15 a.m.
GWE, London—15.43 S 19.44—3.45 p.m.-1.15 a.m.
GWD, London—15.42 19.46—5.45 p.m.-8 p.m.
——, Moscow—15.40 F 19.47—See 19.51.
GRE, London—15.37 19.51

Call Sign Location Mc. M. Time: East. Australian Stand'd

——, Moscow—15.37 S 19.51
KWU, 'Frisco—15.35 19.53—9.45-11.30 a.m.
VUD-3, Delhi—15.35 19.54
WRUL, Boston—15.35 S 19.54—M/N-3.30 a.m.; 3.45-4.30 a.m.
WRUW, Boston S—15.34 S 19.54—4.45-8 a.m.; 8.15-9.15 a.m.
WGEO, S'tady—15.33 S 19.57—5.45-7.15 a.m.; 9-11.15 p.m.; 11.30 p.m.-5.30 a.m.
KGEX, Frisco—15.33. 19.57—8.15 a.m.-3 p.m.
KGEI, 'Frisco—15.33 19.57—Idle.
VLI-3, Sydney—15.32 S 19.58—8.15-9.45 p.m.; 10-11 p.m.
VLC-4, Shep'ton—1.31 S 19.59—9-10.15 a.m.; 1-1.25 p.m.
GSP, London—15.31 S 19.60—4-6 p.m.; 9-10 p.m.; 1-1.45 a.m.; 2-2.15 a.m.
KGEX, 'Frisco—15.29 N 19.62—2-6.55 a.m.
KGEI, 'Frisco—15.29 N 19.62—7 a.m.-3 p.m.
VUD-3, Delhi—15.29 19.62—1-7.30 p.m.; 9.30-11 p.m.
S.E.A.C., Colombo—15.27 N 19.64—1-3.30 p.m.
WCBX, New York—15.27 S 19.64—9 p.m.-6.45 a.m. 5
GSI, London—15.26 19.65—1.30-7 a.m.
XBCD, New Guinea—15.26 N 19.66—Irreg.
WLWK, C'nnati—15.25 19.67—7.30-10.15 a.m.; 10.15 p.m.-7.15 a.m.
WLWL, C'nnati—15.23 N 19.69—7-10 a.m.; 8-11.45 p.m.; M/N-12.30 a.m.; 12.45-3.15 a.m.
VLG-6, Melbourne—15.23 S 19.69—1-1.25 p.m.
——, Moscow—15.22 19.70—7.15-7.40 a.m.; 8.47-9.30 a.m.; 11.15-11.40 a.m.—9.40-10.20 p.m.
WBOS, Boston—15.21 S 19.72—7.30-10.15 a.m.; 9.45 p.m.-7.15 am.
XGOY, C. King—15.20 19.73—Irreg.
WLWL-1, C'nnati—15.20 N 19.73—8-11.45 p.m.; M/N-12.30 a.m.
TAQ, Ankara—15.19 19.75—7.30-10.15 p.m.
VUD-5, Delhi—15.19 N 19.75—8 pm.-
KROJ, 'Frisco—15.19 S 19.75—2-4.45 a.m.; 5-6.45 a.m.; 7-10.45 a.m.
WOOC, New York—15.19 S 19.75—9.45 p.m.-7 a.m.
WKRX, New York—15.19 S 19.75—Think now idle
XGOX, Chungking—15.18 19.76—Wed. only 10-10.45.
GSO, London—15.18 S 19.76—2-6.30 a.m.; 4-6 pm.; 10.30 p.m.-1.45 a.m.
TGWA, Guatemala—15.17 19.78—3.45-4.55 a.m. (Mon. till 8.15)
VLG-7, Melb.—15.6 19.79—6-8.10 a.m. (Sun. from 6.45)
SBT, Stockholm—15.15 19.80—1-4.15 a.m., News 1.01 a.m.
WNBI, New York—15.15 S 19.81—9.45 p.m.-5.30 a.m.
WRCA, New York—15.15 S 19.81—7-9.45 a.m.
GSF, London—15.14 S 19.82—3-6 p.m.; 7 p.m.-1.15 a.m.
KGEI, 'Frisco—15.13 S 19.83—6-8.30 p.m.
WRUS, Boston—15.13 S 19.83—6.45-8 a.m.; 9.45 p.m.-3.30 a.m.; 3.45-6.30 a.m.
HVJ, Vatican C—15.12 19.84—Irreg. in afternoons
——, Moscow—15.11 19.85—P/I with 19.70 met.
GWC, London—15.07 S 19.91—5.30-6.30 p.m.; 8.15 p.m.-6.45 a.m.
GWG, London—15.06 19.92—No schedule
——, London—15.01 N 19.98—See "New Stations"
WWV, Washington—15.00 20.00—Frequency check.

RETURNED FOR KEEPS

Listening to Radio News-Reel Pacific Edition No. 1453 last night (November 6), I learnt that the bells and the shepherd's flute—the identification signal of Athens Radio, handed to the BBC on April 29, 1941, for safe keeping, have been handed back to the Greek Minister in London.

I remember well, hearing the last broadcast, under Greek regime, on April 28, 1941, of the Athens Radio (see "A.R.W.," May, 1941, page 42) and I also call to mind the handing over of the identification signal to the BBC (see "A.R.W.," October 1941, page 19).

So, when Greek meets Greek, let us hope they will reopen their radio station and that the signal has been returned for keeps.

Therefore, watch out for SVM. The wavelength chiefly heard in Sydney was 30.19 metres from 5.40-6 a.m. The twenty minutes was in English, with news at 5.45. Another wavelength for the same call-sign was 42.4 metres, with a schedule of 4.45-8.30 a.m., but it was seldom audible in Sydney.

During the occupation of Athens the Germans were heard occassionally using 24.60 metres around 6.15 a.m. Announcements were in German, followed by a woman in Greek.

Test Equipment Released

The Director of Radio and Signal Supplies announces that the control at present operating on the release of test equipment and meters for civilian purposes has now been lifted. It will, therefore, be no longer necessary for applicants such as radio servicemen to obtain permission or make application for the purchase of any of these items required for the maintenance of civilian receivers. It is pointed out that this relaxation in the control only applies to the disposal and not to the manufacture of this equipment.

ONE STATION THAT WILL VERIFY

To celebrate the completion of the erection of their new 220 ft. self-supporting vertical steel radiator, it is the intention of 5KA, Adelaide, to broadcast a special DX programme on Saturday, 2nd December, from 12.30 to 1.30 a.m. (Sydney time).

Wavelength is 250 metres, 1200 kilocycles, and the power 500 Watts.

Each report received will be acknowledged with a special DX card.

Seldom any reference to medium wave creeps into these pages, but as a South Australian born, and a soft spot in my heart for the City of Culture, it just had to go in.

VALVES

(Continued from page 20)

tive if it is of the same material as the electron emitter; thus, if barium oxide is used as an emitter, barium would be used as the getter. The getter is placed in the valve during assembly in such a position that it may be heated independently by eddy currents. Just before or after the exhausting tube is sealed the getter is heated, causing it to volatilise; it will then settle on the cold glass envelope, giving it its mirror-like finish. Care must be taken so that the getter does not condense on any part of the valve where it will cause leakage paths between the electrodes. The getter will clean up any occluded gas.

Capacity Factors

The interelectrode capacities between the different elements of the valve are of considerable importance, and in a triode are three in number: (1) Grid-plate capacity — the leakage capacity; (2) grid-cathode capacity — the input capacity; (3) cathode-plate capacity — the output capacity. To these capacities must be added the capacities of their associated supports and leads.

The leakage capacity may cause energy to be fed back from the output circuit to the input circuit, which at high frequencies is in most applications undesirable. Efforts to reduce or overcome the leakage have been made by the size and positioning of the elements and their supports.

Screen Grids

A most effective way to reduce the leakage capacity is to introduce an electrostatic screen between the grid and plate. The screen takes the form of a grid and is known as the "screen grid." The shielding action of the screen grid is made more effective by connecting a suitable by-pass condenser between the screen grid and cathode, giving the screen grid a radio-frequency cathode potential.

As the screen is operated at a positive voltage there will be a current flow from the cathode to "screen." Most of the electrons attacted by it will pass through to the plate, so it can be seen that the screen is a force that will attract electrons from the cathode to the plate. The screen is also a shield on the attractive force between the plate and the space charge, so that the current flowing through the valve is dependent on the screen voltage, which makes it possible to obtain higher amplification with the screen grid valve than with a triode.

The screen-grid valve having four electrodes is known as a "tetrode."

The introduction of the screen grid will not entirely eliminate the leakage capacity, but in the case of a receiving valve will reduce it from 8 microfarads to .01 microfarads.

Secondary emission may take place from the plate and is due to the bombardment of the surface of the plate by electrons, which is sufficient to release electrons from the material of the plate. In a triode this is of little consequence, as the electrons will return to the plate, but in the tetrode will be attracted to the screen especially when the plate voltage falls below that of the screen. This results in the plate current being lowered with a decrease in amplification.

Suppressor Grid

Another grid is interposed between the screen and the plate and is known as the "suppressor-grid"; the valve is then known as a pentode. The suppressor is of very open construction and is at a negative potential to the lowest voltage to which the plate may fall. This negative potential is obtained by connecting it directly to the cathode. Any secondary emission from the plate is kept out of the influence of the screen by the suppressor and finally will return back to the plate, so that the plate current is not reduced, which increases the possibilities of amplification.

Another method to overcome the secondary emission is used in the English discovery of the "beam-power" valve. The screen and control-grids are wound so that their corresponding turns are directly opposite and are of the same pitch. This will reduce the screen current; the better the alignment the less the screen current. Between each of the grid supports and the plate is placed an earthed shield in the form of a plate and are utilised to shield the anode from electrons which come under the influence of grid support wires where electron focussing is imperfect.

The Beam Effect

If the electrodes are correctly placed the electrons travelling to the anode are slowed down and may almost stop, which causes, in effect, a space charge which will repel any secondary emission which will return to the anode.

As the screen current is so low and the suppressor action is so effective, this type of valve has for its characteristics high efficiency, high sensitivity and high power output.

The introduction of the superhetrodyne principle brought with it the requirement for a valve to mix two frequencies together, so another grid was introduced into the pentode which is known as the "injector-grid." This grid is so designed that it will have sufficient control over the electron stream without causing too much interaction between the oscillator and the mixer valves.

Other types of receiving valves usually consist of combinations of the standard types in the one envelope.

THE FUTURE FOR RECORDINGS (Continued from page 25)

unable to purchase in this country equipment which will fill their requirements and they are now using their own design of equipment which will take 17in. discs having 150 grooves per inch. 10,000 cycles has been adopted as the upper limit of the frequency range.

More than one speaker saw in the discussion an excellent opportunity of taking stock of the present position of the art and assessing the prospects for the future. In this connection the comment was made that in the past there has been a tendency to disregard the fact that the reproduced sound should at least resemble the original! Cheap gramophones were blamed for this and although it was suggested that as regards film reproduction of sound the same criticism did not apply, it was hinted that in this field also the cheap-jack was beginning to make his influence felt. The importance of the co-ordination of electro-acoustic research work was stressed, there being various lines of development under investigation at the present time. A published list of standards was necessary, but nothing authoritative had yet been done in this country. The warning was given that this question would have to be faced very soon. The demand was made for standards of speeds, disc cutters, dimensions of grooves, etc., and dissatisfaction was expressed as regards the present position concerning background noise.

The weight of pick-ups received considerable attention and the hope was expressed that there would be no more 120 gm. pick-ups and no more motors of uncertain speeds. Pick-ups of not more than 40 gm. were recommended. The 120 gm. pick-up was said to give a pressure of some 20 tons to the sq. inch. on the needle point.

For home use, at least for a long time, it was felt that the disc must predominate over the film owing to the higher cost of film apparatus and the greater expense of processing.

—"Practical Wireless" (Eng.)

WOBBLER

(Continued from page 26)

reached their peak value at the apex of the ascending quarter cycle. This sequence of events occurs over and over again.

Method of applying the Pyramid Sweep

The sweep voltage is applied to the grid of the control tube through the 25,000 ohm sweep width control potentiometer. The magnitude of this impressed voltage will then determine the band width of the oscillator signal. In practice varying this control from minimum to maximum will change the output frequency from 440 k.c. to 480 k.c., a total band width of 40 k.c. The other potentiometer in series with the band width control is used to balance the ratio of A.C. to D.C. voltage so that the pattern appearing on the screen of the "scope" will have an equal ascending and descending slope.

The potentiometer on the cathode of the control tube is called the wave crest equaliser and is a means of adjusting the two peaks of the resonance curves so that they appear as one directly behind the other, with no overlapping at the edges.

Unless the phase shifting network is adjusted correctly the rise of the curve at resonance will not have the same amount of slope either side. In other words one side of waveform will be steeply inclined or practically perpendicular and the other side will taper away with a very gradual slope.

The synchronising pulse from the "wobbler" connects to the terminals on your oscilloscope marked External Synch. The sweep voltage on the "scope" is set to 120 cycles. During one pyramid cycle there are two sawtooth cycles.

The wobbler frequency varies from 440 k.c. to 480 k.c. during the first half of the pyramid cycle. During this time interval the sawtooth sweep draws a horizontal line from left to right on the cathode ray screen. In 1/120 part of a second the sawtooth voltage moves to the left invisibly and draws a second line in the same direction in the next 1/120 second, the wobbler frequency is now going from 480 k.c. down to 440 k.c.

Testing the Wobbler.

Firstly a superhet which has the I.F.'s tuned accurately by a reliable generator will be needed. Any I.F. frequency from 450 to 480 k.c. will suffice. The oscilloscope is connected across the diode load resistor. Set the "scope" frequency to 120 cycles and connect the wobbler output to the Aerial and Earth terminals on the receiver. Adjust receiver dial to the 2nd harmonic of the I.F. peak which in most cases will be somewhere in the vicinity of 3UZ's wavelength. Now set the band width control to 40 k.c. and rotate the condenser which tunes the 6K8 oscillator coil until the double image on the "scope" screen merges into one. The image may drift across the screen in which case the Sync. control on the scope will have to be carefully adjusted until the image appears stationary. It is a good plan to deliberately throw the set out of alignment and watch the various wave shapes that occur as we approach resonance. When the correct setting of the I.F. trimmers is reached the peak of the resonance curve will be at its maximum height and the double image on the screen will merge into one, or one image is directly behind the other.

SPEEDY QUERY SERVICE

Conducted under the personal supervision of A. G. HULL

P.A.S. (A.I.F.) enquires about obtaining a radio serviceman's licence, as he is doing repair work at the camp in his spare time.

A.—We are not sure what the position would be under the circumstances as outlined by you but we suggest that you lay the facts before the Department of War Organization of Industry at the capital city of the State in which you are stationed at present. This Department handles the issue of licences and they will be able to advise you. No licence fee is charged.

●

D.E. (Maldon) suggests ways of means of avoiding the problem of the scarcity of gang condensers.

A.—Permeability tuning is a fairly practical scheme and the inductance of a suitable coil can be varied over a considerable range by moving iron slugs through its "core." It is also possible to use switched coils for each station or an inductance with a sliding or revolving contact to tap off the desired number of turns. For short-wave work it is possible to make quite an effective condenser out of plates cut from a kerosene tin with tinsnips and soldered on to a shaft. Early experiments often surmounted more difficult problems.

●

P.S. (Manly) is in doubt about direct-coupling.

A.—The effective plate voltage on a valve can only be measured between its plate and cathode or filament as the case may be. With direct-couplers the filament is kept at a potential of 150 to 250 volts above earth. Measured between plate and earth may then read from 400 to 500 volts without the effective plate voltage being more than the 250 which is normal.

●

S.D.R. (Mudgee) is finding it hard to procure a replacement vibrator.

A.—Vibrators are in very short supply and are used extensively in receivers and other equipment for the services. We can only suggest that you leave it to your usual dealer to do his best to obtain one for you. It would be possible to convert to dry battery operation, as you suggest. This should be quite a simple job, but batteries are also in short supply and you may find them hard to buy.

●

W.A. (Brighton) is worried about his test equipment as a check reveals that one of his meters must be nearly 5 per cent. out, as the two meters read differently when placed in parallel.

A.—This is a disquieting indication but not worth losing sleep over unless you are doing accurate work. For ordinary radio repair work it is seldom that voltages are critical to within 5 or 10 per cent. On the other hand it is always comforting to have faith in your equipment. You should have little difficulty in having the meters tested, but if you want a standard to work on them yourself we suggest a fresh torch battery. These are remarkably reliable as an indication of a voltage of $1\frac{1}{2}$ volts.

●

P.R.T. (North Sydney) enquires about speaker resonance.

A.—The speaker may resonate at 70 cycles, giving an increased audible output at around this frequency, but it does not mean that the speaker cannot and will not reproduce low notes of a frequency under 70. This is an entirely erroneous impression which appears to be current.

●

L.T.W. (Tamworth) is an amplifier enthusiast who seeks guidance to detect distortion.

A.—It is most difficult to detect distortion without equipment. With almost any amplifier it i sonly a matter of listening to it long enough and hard enough and you may eventually gain the impression that it sounds all right. One test we have seen recommended is to operate the speaker without a baffle. This should curtail the reproduction of the low notes and only the high should be heard and they should come through clearly and cleanly. If they appear to be drowned out by a hash and mush of background, the indication will be that harmonic distortion of the original low notes must be present or perhaps parasitic oscillation. To carry out this test most effectively you should use an organ recording with plenty of lows, as few highs as possible and operate the speaker without a baffle of any kind and then stand back from it at least five feet.

●

M.P. (Moorabbin, Vic.) asks what wi'l be the effect of operating a triode power valve into a speaker fitted with an input transformer intended far a pentode.

A.—This will mean a higher load for the triode and should give you slightly lower maximum power output but also less second harmonic distortion. The loading on a triode is not critical over fairly wide limits.

●

L.N.G. (Beaufort, Vic.) enquires as to the actual output of accumulators.

A.—If the battery has an 80 ampere-hour rating it should give you approximately 80 hours running at a current drain of 1 ampere or 160 hours at a current drain of half an ampere, and so on. If you greatly exceed the normal discharge rate, as for example, trying to draw out 80 amperes for one hour, you would probably buckle the plates, overheat the accumulator and generally ruin it. There is a certain amount of latitude in the way different manufacturers apply capacity rating, and you can also consider it bad practice to completely discharge the battery, so we suggest you work on about 80 per cent. of rating.

B.G. (Caulfield) has just returned from overseas after two years and taken his radiogram out of storage, but finds that the motor will not run at full speed even when control regulator is in fastest position.

A.—Afraid this will call for a careful mechanical inspection, and entail the dismantling of the motor, which is not a big job. The trouble is almost certain to be due to grease hardening. Clean and re-assemble the moving parts, making sure that they are free as they go together and that there is some freeness of end play on the main shaft. Of course the improper speed will have a bad effect on the tonal quality, but you may also find that the pick-up needs attention to the rubber bushing in which the needle holder is mounted. This little job is a rather ticklish one, but not beyond the normal ability of many of many of our readers, according to reports often received from them. You may need to cut a new bushing from a piece of scrap rubber, using a wet razor blade. The idea is to have a free and spongy mounting for the needle holder so that it can move freely to follow the vibrations recorded in the groove of the record.

●

M.B. (Castlemaine) raises a question about coil efficiencies.

A.—To get the maximum gain from an r.f. amplifier you neer a high plate loading, obtainable only with efficient coils, i.e., those having a high impedance when tuned to resonance. Home-wound coils are seldom efficient when made in the smaller sizes, but you should do alright if you use a former of two or three inches diameter, and a can with at least another inch of diameter. For best results of all, avoid using cans and shielding as much as possible.

FREQ.-MOD.

(Continued from page 8)

sideration" which may take up to five or ten years, possibly to wait and see how the B.B.C. get along with f.m. and so far there is no indication that the B.B.C. is aware that there is any such thing as frequency modulation. A possibility would be to allow the "hams" (amateur experimental transmitters) to pioneer broadcasting on short wave lengths with frequency modulation. Many "hams" would jump at such an opportunity, and those who gave good service in this way could be rewarded later by the granting of commercial licences for an extension of a similar service.

VIBRATORS

(Continued from page 22)

output. Of course the ideal test is with a cathode ray oscilloscope for then the wave form can be seen and adjustment easily carried out. But everyone hasn't an oscilloscope so we have to do the next best, and meters will do a remarkably good job providing a little patience is used to see that the faces of the points are kept square with each other and the gaps are all the same.

Broken Springs

A lot of a certain Australian-made points had a bad habit of breaking their springs when first put into use, especially the split reed type, and this naturally ruined them for further use. In the days when points were plentiful these were consigned to the junk box, but when they became scarce they were given another lease of life by dismantling them and removing the contacts from the broken spring and re-riveting it to a spring taken from a worn out unit, as these springs were usually in good order.

In conclusion, a word about transformers. I have serviced quite a few sets having a transformer fitted which was made by a well known firm of transformer manufacturers in Melbourne, and were excellent in every way except that the finish of the primary winding was brought back across the outside of the winding without any insulation between them other than the enamel on the wire. After they were in operation for a few months, the outside layer was shorted out, with disastrous results to vibrator contacts and battery charge. I have seen the battery drain go up to as much as 3 amps. An easy remedy is to remove the windings from the core and place some insulation under the wire where it crosses the coil. This will remedy the defect as the turns do not short to each other, but only to the wire that is across them. **Manufacturers please note.**

A Further Note.

I have just read an article in a radio magazine wherein the writer remarks that vibrator points will give from one to two years service. Well, I know dozens that have given consistent service for four to five years and a few up to seven years and are still going strong. Some of them are of a manufacture not well respected by the trade

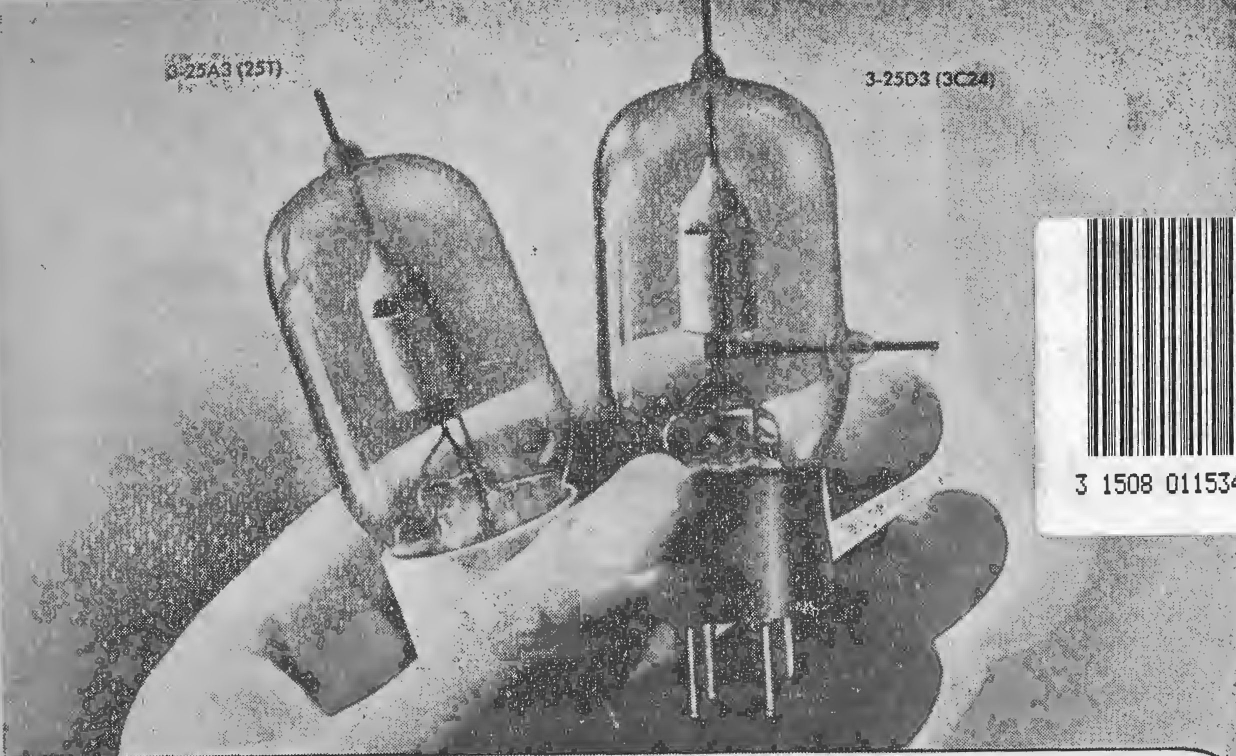

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Plate Dissipation (watts)	[illegible]	[illegible]
Amplification Factor	[illegible]	[illegible]
Filament Volts	[illegible]	[illegible]
Filament Current	[illegible]	[illegible]
Interelectrode Ca[illegible]		
Grid to Fil[illegible]	[illegible]	[illegible]
Grid to Pl[illegible]	[illegible]	[illegible]
Plate to Fil[illegible]	[illegible]	[illegible]
Maximum Ratings		
Class C [illegible]		
Plate Voltage	[illegible] volts	2000 volts
Plate Current	[illegible] mils	75 mils
Grid Current	20 mils	20 mils
Maximum Plate Dissipation (watts)	25	25

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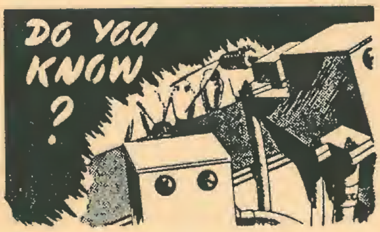

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