THE AUSTRALASIAN

# Radio World

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## EDITORIAL

It has been announced that a National Security order has been issued which provides that radio repairmen are to be licenced and zoned.

All persons engaged in repairing or servicing radio sets who have not applied for a licence should do so before July 19. Applications should be addressed to the State Deputy Director of the Department of War Organisation of Industry at your capital city.

It should be noted that those who do radio work in their spare time, or are capable of doing so, are invited to register and will be officially encouraged to carry on with work of this kind.

At the moment of writing the full details of the scheme, and especially in regard to its control of radio component parts, have not been revealed, but it is evident that radio servicing is at last to receive the attention it warrants.

We strongly advise all of our readers to make a point of sending in their names for registration immediately, as failure to register now may have far-reaching effects in the future.

# POWER AMPLIFIER FOR BATTERIES

**Here is a midget amplifier using only two tubes and giving approximately half-a-watt from a 90-volt supply.**

EVEN half-a-watt is a vast improvement over the usual one-tenth watt of the battery portable. In the good old days, rural schools of the one-teacher type used to use powers of from one-fifth to half watt for dances. Today, more efficient speakers are available and results are quite surprising, even when compared with a 4-watt job. To get the utmost in volume, a short horn can be fitted to the speaker. Of course, the fact that the volume is a bit on the low side allows a higher level of harmonic distortion because the intermodulation or "combination tones" are less audible. Restriction of unnecesary parts of the audio spectrum also helps, preventing the waste of power on nearly inaudible notes, or on scratch or needle hiss.

### Valves

A pair of 1D8GT tubes are employed in class B, or Q.P.P. (quiescent push-pull). That is, the two pentode parts are in push-pull and are biassed practically to cut-off. As no grid current is drawn, a conventional class A audio transformer can be used as the coupling medium or as an alternative, a suitable C.T. speaker transformer can be used as a C.T. push-pull coupling choke (see April issue).

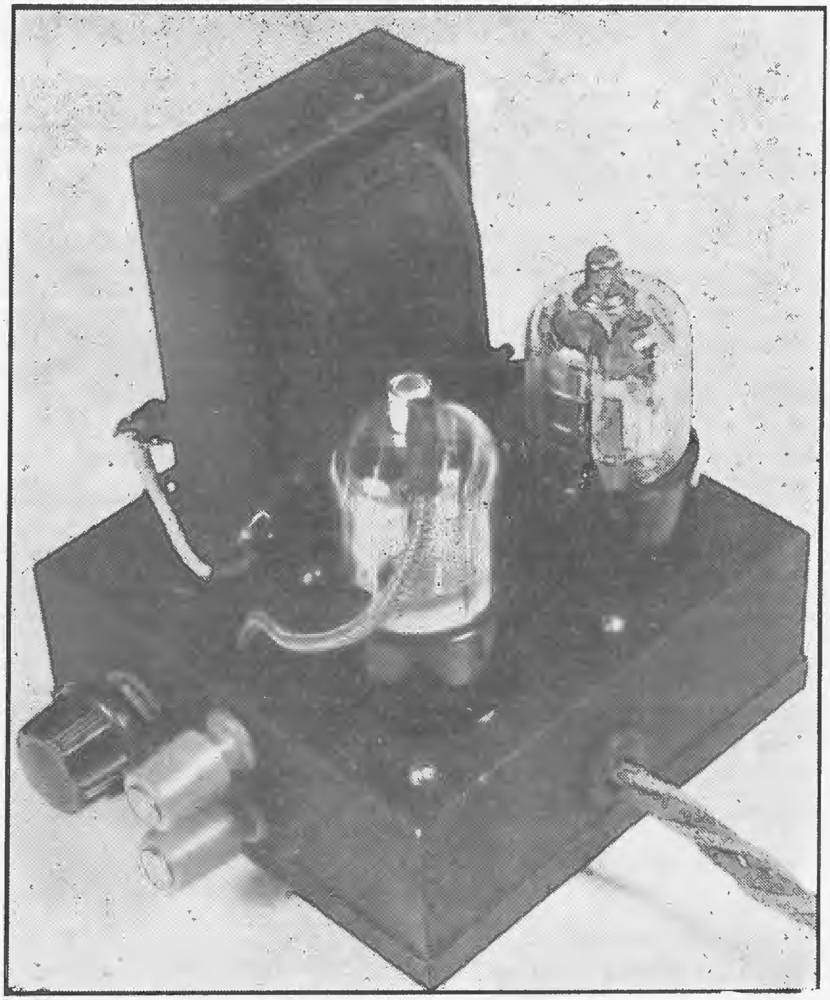
The normal maximum high-tension voltage for a 1D8GT pentode is 90 volts, but this is for class A operation. In practice we found that for cut-off biassing, 120 volts was quite safe; we even used 135 for a while until we remembered the price of valves. These extra-high voltages are for pentode plates only and are not to be applied to the screen-grid. Otherwise an increase of bias would be necessary.


**Designed and described by**

**JOHN. W. STRAEDE, B.Sc.**

**7 Adeline Street, Preston, Victoria**


The triode portions of the valves may be used as two voltage amplifier stages, the first being resistance-capacity coupled and the second transformer coupled. Enough gain is then available for using a high-level crystal microphone or a mike from a 5-in. permag. speaker.



**A photograph of the unique little battery-operated amplifier, which uses only two output pentodes.**

### Speaker

The loudspeaker should be a good quality type with a heavy magnet and a cone designed primarily for sensitivity (most speaker manufacturers supply different kinds of cones for battery sets, A.C. amplifiers, inter-communications, etc.). For our own amplifier we obtained best results with either a Rola 10/42 or an Amplion 8P83. Second-bests were a Rola 8/20, a Magnavox 6-11 and an Amplion 7P20. We were unable to try any others.

The speaker transformer must have a ratio such that the reflected load on each valve is 6250 ohms (or 4 times that, i.e., 25,000 ohms. Plate-to-Plate.)

### Power Supply

For the filaments, an ordinary ½-volt "buzzer" cell can be used. It is a good idea to insert a small resistance in the battery leads when the cell is new to prevent over-heating of the filament. About ½-ohm is enough (say, ½-yard of 40 gauge copper wire)—it can be removed when the cell starts to lose voltage on account of its own resistance increasing.

For the plates and screens a pair of 45-volt batteries or a vibrator-pack can be used. The latter uses a 6-volt accumulator for its input. A suit-

**(Continued on next page)**

# WITH THE RADIOMEN OF THE AIR FORCE

IF there is any branch of the services that warms the blood more than any other, it is the Air Force. The pulse quickens at the surging call that comes to the combat-hungry fighter pilots astride their thunderous steeds. The will stiffens at thought of the rock-firm discipline of bomber crews inexorably grinding along on their missions, coolly slapping off the sharp stings of pursuit attack. Even the vision swells with new breadth in viewing the prosaic — at least so it seems to a high-flying angel-demon — business of chauffeuring men and material across trackless wastes of sea, desert and enemy-polluted air.

If earth-bound groundlings thrill to their deeds, what then of the men who actually ride these warrior vessels of the sky? They are the pilots who steer the course, and the navigators who chart it, and the engineers who keep the engines turning over and the bombardiers whose vital moment comes when the objective is reached. And there the radiomen — two in the air one on the ground for every medium bomber. Their hearts, too, must swell with glory of their role. What do they think about it all?

You know the answer. In combat there's no time for thinking; then's the time for doing. But on the ground, before the flight, and most of all during the time of training while they ready themselves for the dangerous task ahead — that's when they think. At night, perhaps, waiting for sleep to reach one particular Army cot among all the millions of Army cots, or in the day, perhaps, patiently sitting out a ride on bus or train, waiting for it to end so that furlough can begin — then they live or relive past or future engagements, as the case may be.

Take the radio-operator. He sees himself seated in an aluminium-and-canvas seat behind the engineer, tightly wedged in his form-fitting operating position. The bomber rides high above blue water, but not too high too obscure its turbulence or the way its rim meets the haze of the sky. There are wisps of cloud drifting past, and down below there are what look like toy ships sailing in the blue pond.

They look like toys, that is, but they are warships — enemy vessels that must be destroyed. Imperturbably the pilot changes course, the bombardier clutches his bomb-release relay handles. The radio operator fingers his controls, but his eyes stray now and again to glimpse the little he can of the spectacle that follows as the bomber reaches its objective, the bombardier sees the hairlines cross over a battleship through his rubber eyepiece, the open bomb bays discharge their catastrophic cargo and the white plumes burst around and on the enemy craft on the sea below.

Then a lone fighter returning belatedly from patrol flashes down out of the sun. "Enemy fighter coming in — man your guns," the pilot-commander's voice gruffs sharply over the inter-phone. The radio operator slides swiftly out of his seat and goes to his post in the waist of the ship. He slides the fuselage panel back and swings the muzzle of his .50-calibre machine gun sharply. Catching the enemy fighter in his ring sight, he squeezes the trigger in short, precise bursts while the fighter curves in, and leads it down. The gun spouts flashes of flame and the tracers make weirdly-aligned rows of spaced white dashes in the sky. Will that damned Jap come on forever? The radio-gunner steadies himself against the

(Continued on page 26)

## BATTERY AMPLIFIER

**(Continued)**

able one way described in March Radio World.

### Chassis

Following our policy of economical construction, the chassis can be of wood, masonite, metal or a mixture. Small metal tins can be converted into a small chassis. Of course, don't try connecting earth returns of condensers, resistors, etc., to a wood or masonite chassis! (It has been done.) Coating wood with a metallic paint or a suspension of graphite will improve its shielding properties.

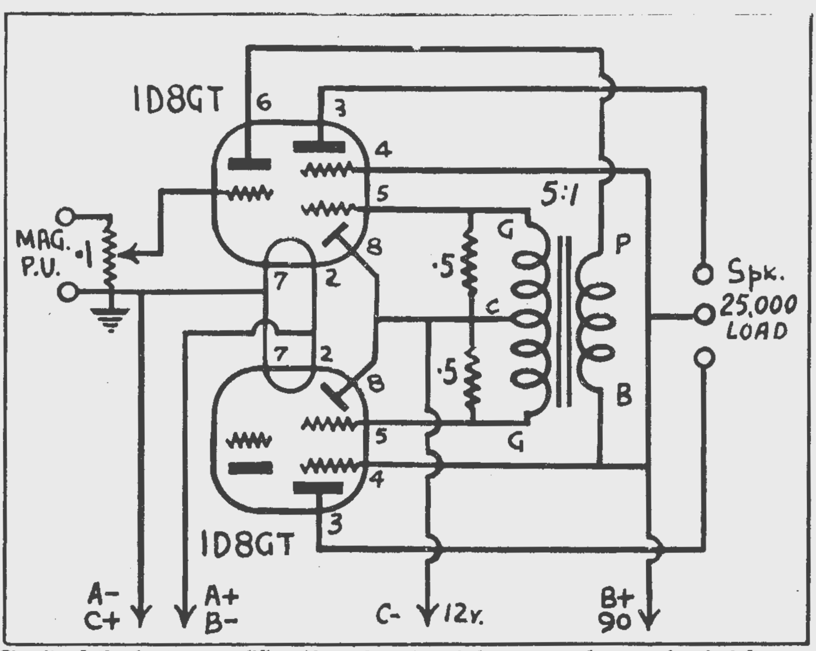
The lay-out is not very critical, so long as a little common sense is used. Don't put the input wires bang up against the output wires. If oscillation is experienced, it may be eliminated by connecting a small condenser between each anode and the earth return. Reversing the leads to the A.F. transformer primary is also helpful.

### Inverse Feedback

A small amount of inverse feedback can be obtained by coupling the grid and anode of each pentode section by a condenser and resistor in series. They need not be exactly the same on each side of the "push-pull" because the C.T. transformer has quite a large balancing action. The condensers should be .0005 and .001 mfd. and of 600 volt working rating. The resistors can be between 1 and 5 megohm. Too much feedback is undesirable.

The results from this little job were amazing. To anyone not knowing the valves it seemed as if there were 2 or 3 watts being pumped into the speaker.

The circuit shown is for pick-up use. For microphone work the other triode is used as an extra voltage amplifier. The results are even more amazing on microphone work.



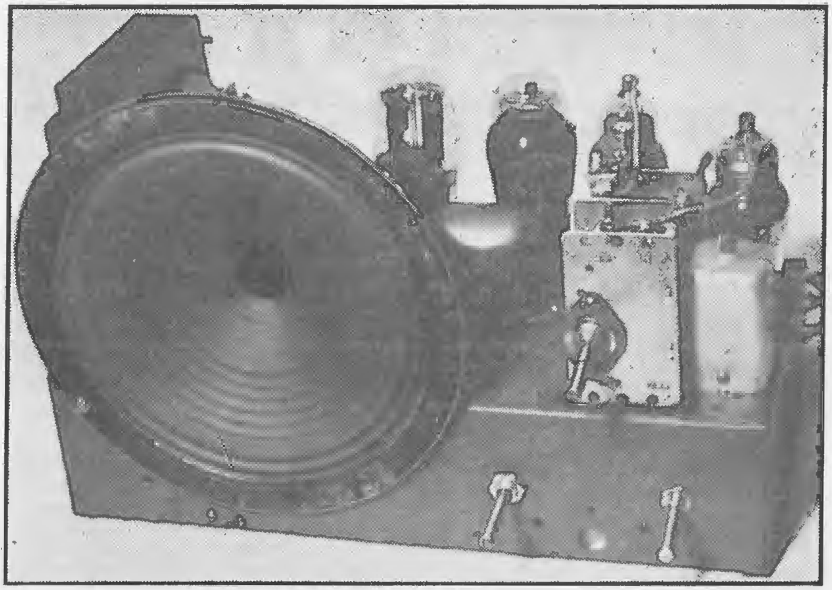

**Circuit of the battery amplifier. Note that the triode portion of one valve is left vacant and can be used as a pre-amplifier for microphone work if so desired.**

# T.R.F. FOR LOCAL HI-FI.

**Constructional details of a simple 4-tube set for the reception of local stations at excellent quality.**

WE have, several times in the past, commented on the superior tone of T.R.F. receivers as compared to superhets, and the various T.R.F. designs we have published have been very popular and successful. We have also given the circuits of hi-fi T.R.F. receivers, but these have either required a multiplicity of valves, or else the valves needed were American types almost unobtainable in Australia.

In the circuit given here, each valve is of a type made in Australia and there are several alternative types for each.



Surprising fidelity is obtained with this simple mantel-model chassis.

### Tube Line-up

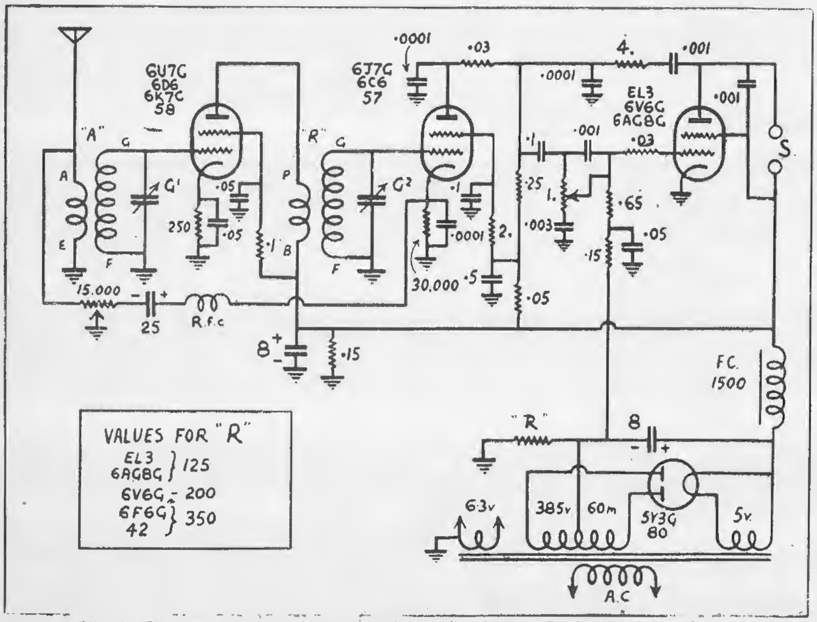
As with most 4-tube T.R.F.'s the first valve is a single R.F. amplifier and may be a 6U7G, 6K7G, 6D6, 58 or 6K7GT. As there is only one R.F. stage, no gain must be wasted, so iron-cored coils are specified (although air-core coils have been used successfully!).

The second tube is a detector which functions as an anode bend detector with or without degeneration according to the position of the volume control.

On strong stations, the volume is reduced and degeneration is applied to the detector stage to make it act more as an "infinite impedance" type which has very low distortion. The tube may be 6J7G, 6C6, 77 or 57.

The detector is resistance-capacity coupled to the third or power-output tube. To obtain a good output (over 4 watts) and retain sensitivity this valve needs to have a high "slope" or mutual-conductance, i.e., a small change in grid voltage must produce a large change in anode current. Suitable valves are the EL3NG, 6AG8G and the 6V6G. These have "slopes" of 9, 9, and 4 ma per volt, respectively.

The fourth, or rectifier valve, may be the good old 80 or its modern equivalent the 5Y3G. Other suitable valves are the 5Z3 larger in bulb and requiring more filament current and the 5V4G which gives a higher output voltage. Other rectifiers are the 5W4G, 5Y4G and 5Z4.




Circuit for the receiver, showing the wide range of alternative valve types.

### Speaker

It is of no use building a hi-fi set if you feed its output into a midget speaker, nor is it of any use feeding it into a large 12-inch speaker, if the speaker field is only half-energised. An 8-inch speaker is the largest suitable for a Mantel cabinet and its field can easily be energised to the optimum value. About 6 watts are available for the field so the speaker can be a Rola F8, an Amplion 7E13 or a Magnavox 968 or 188. The field resistance can be anywhere between 1500 and 2000 ohms. The latter gives more field excitation and greater sensitivity (i.e., higher efficiency) and better tone, but also causes a very slight reduction in power output.

In practice 1000 to 2500 ohms is quite O.K.

The speaker transformer should match the voice-coil and output valve as regards ratio (5000 ohms for 6V6G, 7000 ohms for EL3NG, or 6AG8G) and

(Continued on next page)

## HI-FI
(Continued)

should have plenty of inductance so that the bass response is full.

### Cabinet Design

In order to provide sufficient baffle and sufficient loading, and this is necessary to prevent the speaker damaging itself, as well as for good response, the rear of the cabinet should be covered by a sheet of ply or masonite, except for a gap of about an inch at the end farther from the speaker. The inside of the cabinet joins could be covered with a mixture of sawdust and thin-glue to eliminate buzz. With regard to buzz it is also a good idea to put a spot of paint at the edges of the coil cans, any joins in the chassis and around the mountings of the transformer and speaker. The dial sometimes needs attention, too.

The inside top of the cabinet should be reinforced with one or two battens, or else covered with the sawdust-glue mixture. Avoid thin cabinets. The back (which must be removable) can be perforated with a number of fine holes to reduce resonance. Attention to details like these is just as important as the correct choice of circuit values.

### Layout

The 60 ma. power transformer is mounted vertically to conserve space. Part of the chassis is chopped away to make room for the larger speaker. Both coils are mounted above the chassis, their cans and the earthed frame of the gang, acting as an effective shield between the first two tubes. Our particular gang had a built-in epicyclic drive, but there is enough room for a conventional drum-and-cord drive. If this is used, the fidelity control is moved over nearer the speaker.

### Fidelity Control

In place of the usual high-cut tone control we substituted a "fidelity-control" which cuts both highs and lows simultaneously, thereby preserving a balanced effect. The action of this control was described in Australasion Radio World for November, 1942. Other controls described in our famous series of "Ideas in Circuits" may be used.

### Four-Volt Valves

There are a number of 4-volt A.C. valves still available and if a suitable transformer is obtained, then there is no reason why they cannot be used.

Suitable R.F. tubes are S4VB, AF2, AF3 and VP4. For the detector, the E452T, S4VA, SP4, S4VB or AF7 could be used. The output could be an AL3, Pen4VA, MPT4 or AL2.

# TELEVISION

TELEVISION, so far as the beginner or general student is concerned, has been the subject of many technical articles and books which have frequently been so involved with mathematical formulas that they were very difficult to understand. An attempt has been made to present some of the interesting and important angles of television so that the average reader can understand them.

### Eye a Good Example

The human eye and the mechanism connecting it with the sight-centre in the brain represents a very perfect form of television and one toward which all of our best engineering research is directed. The illustration, fig. 1, shows in simplified form how the image of an object or a scene is viewed by the lens of the eye and focussed on the light-sensitive layer known as the retina, located at the rear of the eyeball. Note that the image flashed on the retina is inverted, but when this image is interpreted by the sight-centre in the brain, it is seen rightside up. Here we see a perfect television system in actual operation. Nature has done a much better job that we have, so far.

The optic nerve carries the image flashed on the retina to the sight-centre in the brain, at which point we mentally perceive the image. This optic nerve is composed of about two million different fibres, or subdivisions, corresponding to the wires of a telephone cables. (Incidentally the transfer of the image along the optic nerve is now believed to be electric in nature.) Nature's television system in the form of the human eye gives us a very perfect reproduction of an image, and the young television student may well ask why our engineers do not follow the same system for our present-day television apparatus.

As a matter of fact, the first attempt at a laboratory demonstration of television, or the projection of an image over a wire circuit, used this self-same principle. The fly in the ointment is that the subdivisions of the light-sensitive surface in the human eye are so great in number (approximately two million) that it would be a very impractical solution of our television problems if we attempted to use two million wires to connect the various light-sensitive cells (see fig. 4) with the image reproducing units at the other end of the circuit. As early as 1908, Ruhmer actually demonstrated the transference of the image of a simple figure in the manner shown in fig. 4. But in any case, he was only able to use a relatively small number of light-sensitive cells (the slow-acting selenium cells were the only ones available at the time), and only the simplest and crudest sort of figures (really shadowgraphs) could be reproduced at the far end of the circuit. In some of these early television experiments the translating units at the receiver were simply small electric lamps.

### Light-Sensitive Units

Figs. 2 and 3 show how the modern light-sensitive unit known as a photo-electric cell makes it possible to transmit different gradations of light and shadow electrically over a wire or radio circuit. There are different types of photo-cells, a number of which are self-generating; that is when a light is flashed on the cell, the photo-chemical effect is such that an electric current is produced and this ef-

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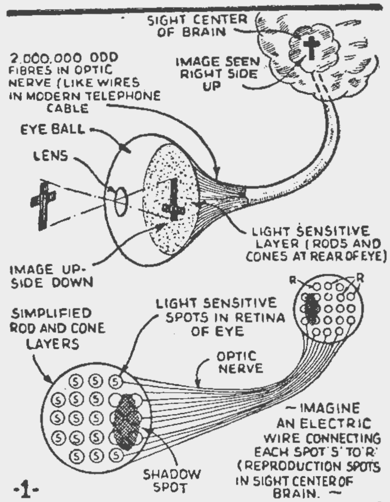

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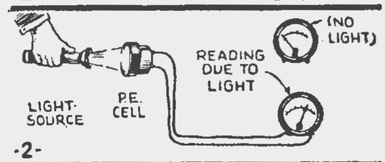

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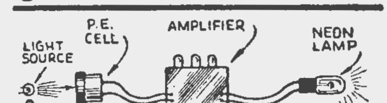

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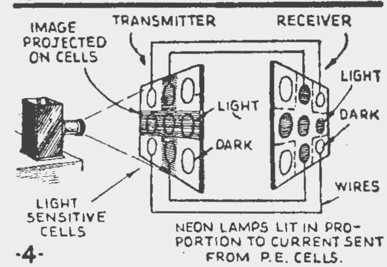

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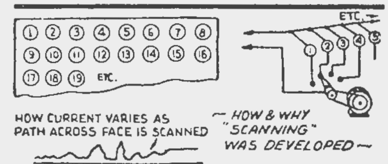
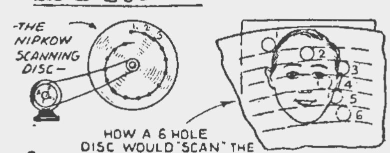
— EARLY "SCANLESS" TELEVISION —



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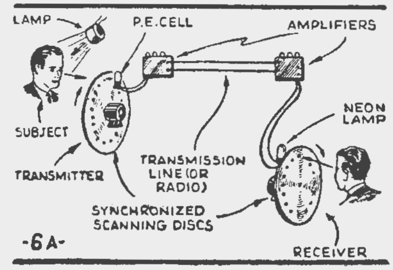

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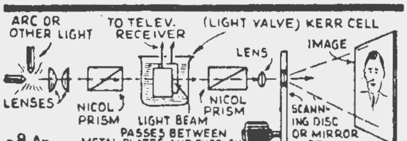

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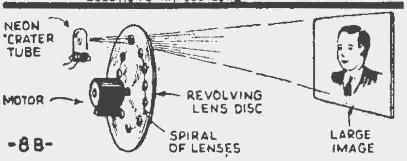

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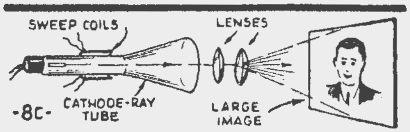

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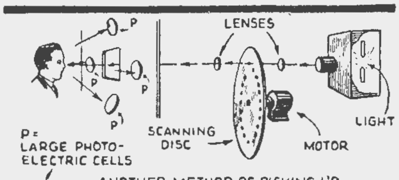
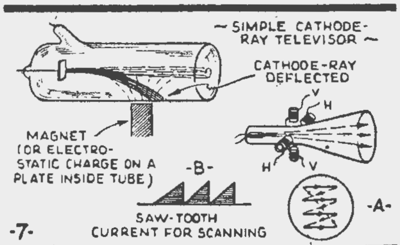


-6B- — ANOTHER METHOD OF PICKING UP IMAGE AT TRANSMITTER —



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## TELEVISION
**(Continued)**

fect can be read directly on a meter as shown in fig. 2.

Another elementary stage in the story of television is that shown in fig. 3, where variations in the degree of light flashed on the photo-electric cell are passed through an amplifier, and these amplified currents caused to produce variations of light in a neon lamp. Up until the advent of the cathode-ray television system at present in vogue, the neon lamp was very useful as it worked sufficiently fast to permit its use in high-speed scanning, which was not the case with filament type lamps. The neon bulb merely has two insulated wires projecting into a glass bulb containing neon gas.

### What is Scanning?

At this point we come to the subject of **scanning,** the bugaboo of many purists in television research who believe that our physicists should be able to provide us with instantaneous transmission, without having to scan an object line by line. We have seen from the foregoing discussion that if we were to have an image pick-up unit provided with 200 cells in a row and 200 rows, that we would have to have 40,000 wires connecting the 40,000 light cells with a similar number of lamps at the image reproducing end of the circuit. Keep in mind that today we are scanning with 441 lines and we are only now reproducing a fairly respectable image, so far as the fidelity of detail is concerned. Multiply 400 x 400 and we find that 160,000 wires or short-wave frequency channels would have to be utilised for the instantaneous transmission of an image, **if scanning was not to be resorted to.**

Now glance at fig. 5, and we see that if we could scan the image subdivisions, such as or points, 1, 2, 3, 4, etc., fast enough so that the eye could not detect it, in the end we would obtain the same effect as if we had provided the immense number of wires required for instantaneous transmission of the image. This is a clever subterfuge of our television engineers and the first attempts at rapidly scanning an image in this fashion were made by Nipkow. He did not attempt electrical scanning, but he provided a means of optically scanning the image by means of a whirling disc containing a spiral of holes as shown in fig. 5. A study of this picture shows that as the number 1 hole on the disc moves across the image, it will describe a path covering the top part of the forehead. Next, as the disc continues to rotate, No. 2 hole scans a second path just below path No. 1. Likewise the 3rd hole will scan another path which might take in the eyes, etc. The number of holes in the disc determines the fidelity of the reproduced image.

Some of the early experiments with scanning discs by Baird and others employed as low as 24 holes, but this gives a coarse reproduction, lacking in the finer details. Later 40 hole scanning was tried and then we had 60 hole discs. A disc containing as high as 100 holes was tried out by the Bell Laboratories, ten years ago, and a very excellent image was reproduced. However, there was always a lack of fine detail and television engineers continuously stepped up the number of lines by which the image was scanned, until it has finally reached 441 lines; 800 lines and more have been predicted for the future.

If you examine any reproduction of a photograph in this magazine with a magnifying glass, you will find that the picture is made up of a series of dots of different sizes. A similar effect takes place in the scanning of a television image, whether it is by means of a rapidly revolving scanning disc or one of the new cathode-ray scanning tubes.

### Scanning Devices Must be Synchronised

It goes without question, of course, that the scanning device used at the transmitter must be synchronised or maintained in perfect step at all times with the scanning device used at the receiver. If scanning discs containing a spiral of holes, of the same number at both the transmitter and receiver are employed, then the discs have to be driven by synchronous motors which will rotate them at exactly the same number of revolutions per minute.

Referring to fig. 6, we see a simple circuit for television by means of a scanning disc. The person or object whose image is to be transmitted by television is illuminated by one or more powerful lamps, and the reflected light rays pass through the openings in the scanning disc onto a light-sensitive device, such as a photo-electric cell. The light pulsations are transformed into varying electric currents and these pass through an amplifier of several stages and finally arrive at the receiving station. Here the impulses may have to be amplified again, and the fluctuating electric currents corresponding to the light variations at the transmitter, are, for example, fed into a neon lamp. In front of the neon tube were placed a scanning disc containing the same number of holes as the one at the transmitter. If we look at the neon lamp through this whirling disc and its spiral of holes, the face of the person in front of the transmitter will be seen. The size of the reproduced image will depend, of course, upon the

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# FORTY-WATT AMPLIFIER

A SERIES of powerful amplifiers with powers ranging from 35 to 44 watts has been built up, and the circuit shown here is typical of all of them. All amplifier design is a compromise between cost, volume, gain, hum level, fidelity, etc. For example, it is easy to design and build a powerful amplifier of good fidelity, but the hum level is apt to be a bit high unless a fair bit of cash goes into the filter system. If the hum level in a 3-watt amplifier is as high as —40 db., it doesn't matter, but 40 db., below 40 watts is 4 milliwats, quite audible when there is no music or speech.

### Fidelity Problems

The output transformer is often one of the biggest snags in obtaining good fidelity. To prevent loss of true bass, the primary must have plenty of inductance and this means plenty of turns, whilst this in turn means saturation of the core unless the core is very large. All this boils down to one thing: expense. The core must be large and there must be plenty of wire, thick enough to carry not only the D.C. to the plates, but also the A.C. produced at full volume. Luckily with AB1, B1 (and B2) operation, the D.C. component almost vanishes when the A.C. component is a maximum. In a couple of amplifiers, heavy duty de luxe Amplion speaker transformers were used in parallel. These will handle quite a large power, although the connecting of two in parallel reduces the effective inductance.

The push-pull audio transformer is not particularly critical in design as it is of the usual Class A, or Class AB, pattern with no D.C. flowing in either primary or secondary and practically no A.C. either. A suitable transformer may be made by winding three "pies" of 4500 turns each on an old midget power transformer core. The wire could be any gauge from 38 to 44 so long as it will fit in. The outer pies are the secondary. A Ferranti AF5CC goes very nicely.

**Full details of a 20-watt amplifier are scheduled for NEXT ISSUE.**

Some of the jobs used four 6L6G beam tubes in push-pull parallel, whilst others used a set of four 6B5 or 6N6G tubes, which are twin-triodes internally coupled, the output sections being in Class AB2 as grid current flows at all times. The input sections are in Class AB1, so no grid current flows through the coupling transformer. There was no perceptible difference to the ear between the tone of the pentode or triode jobs at low volumes, though a curious effect was noticed when incorrect speaker loads were connected. With triode output, too large a load produced distortion similar to too small a load with beam or pentode tubes.

### Screen Voltages

With beam tubes, it was decided to run the screens at the same potential as the anodes, thereby doing away with dropping resistors, a filter condenser, bleed resistors, etc., all in one go. Also the anode dissipations are reduced and there is less drain on the power supply due to bleed current being practically absent. The bias for the output tubes is obtained from a cathode resistor actually made up of number of low voltage resistors wired in parallel. This is quite a good idea as most wire-wound resistors are rated at least 100 per cent over their true value. (A notable exception to this is, of course, the famous IRC type, but alas, they're so good you can't always get them!) We recently had a certain pale blue resistor labelled 5 watts go after 4 hours at 2.8 watts, so beware!

### Pentode-Transformer Coupling

The use of a transformer after a pentode is sure to cause doubts in the minds of some theorists, but look again. There is not only a resistor across the primary (the anode resistor of the pentode) but there is also a

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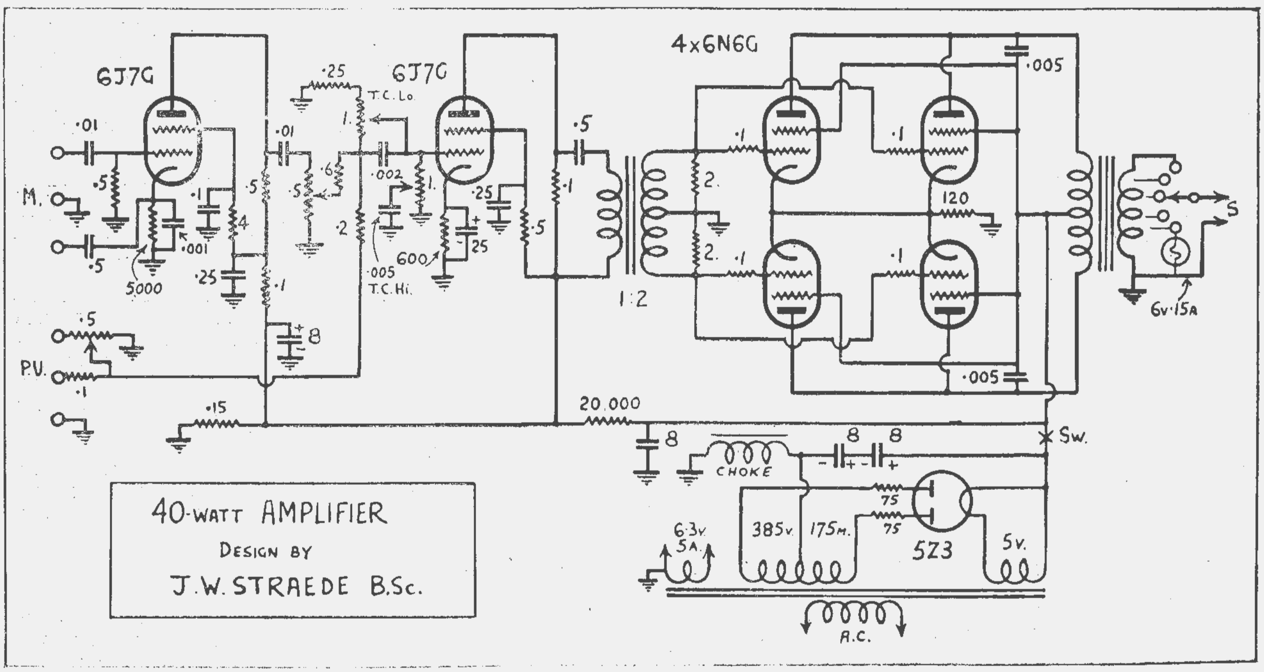


damping resistor across each side of the secondary. By the way, these damping resistors need not be accurately matched, providing the P.P. transformer is genuinely C.T. right at the centre.

Also, there is a grid stopper in series with each control grid to prevent tube capacity tuning the secondary to a resonant frequency in the upper register.

It is not generally known that a certain famous factory used a transformer after a screen-grid valve and still produced sets of outstanding tone. However, the transformer **must** be a good one.

### Choice of Output Operation

Beam-tube enthusiasts may ask why do we not use just a pair of tubes in Class AB2 operation, thereby obtaining 60 watts. Well, there are plenty of answers to that: first, you don't get 60 watts in practice, owing to power supply regulation not being perfect. Second, you chuck away enormous quantities of juice on bleeder and/or stabilising systems. Third, you have two extra valves — a power driver and a bias rectifier. Fourth, Class AB2 pentode tone is not so hot. Fifth, hum level is high as only a single choke and condenser are generally used in the higher-voltage supply of a Class AB2 amplifier. Sixth, it's very difficult to design a really hi-fi Class AB2 transformer—impossible for some valve combinations. Seventh (isn't that enough?) it's a darn sight cheaper, easier, simpler and more efficient to use four tubes in Class AB1 with equal screen and anode voltages than two in Class AB2.

### Portability

The last of these chassis (not quite complete yet, as we are waiting on a suitable output transformer) is built on a chassis measuring only 14½ by 7½ inches. Controls and one input are on the front. Three output sockets and the microphone input are along the back.

### Some Notes

The 6N6G output valves are drawn as tetrodes, their base connections then reading the same as 6L6G, 6V6G or similar beam power valves. The 6B5's can be used as output tubes, if available, but the sockets and connections will then be as though type 42 pentodes were being used.

To use 6L6G type beam power valves in the output section it is only necessary to use 175 ohms for the main bias resistor and reduce the high tension voltage to about 335 volts by inserting a 10 henry 175 milliamp choke, as indicated by a cross on the circuit schematic.

Push-pull microphone input can be obtained by using the two lower pins of the plug. This is suitable for either crystal or ribbon type microphones.

The audio frequency coupling transformer is standard 1 to 4 (overall) step-up ratio, class A or AB1, push-pull type, with a primary inductance as high as possible. With 100 henries for a primary there should be a good low note response.

Remember that it is useless to expect to have the full power output unless the speakers and output transformers are capable of handling it.

Next month we hope to detail an amplifier designed to deliver an undistorted output of about 20 watts, but using a power transformer with a current rating of only 100 ma.

# BATTERY CHARGER FROM SPEAKER PARTS

**The total cost of the original charger was only 5/-.**

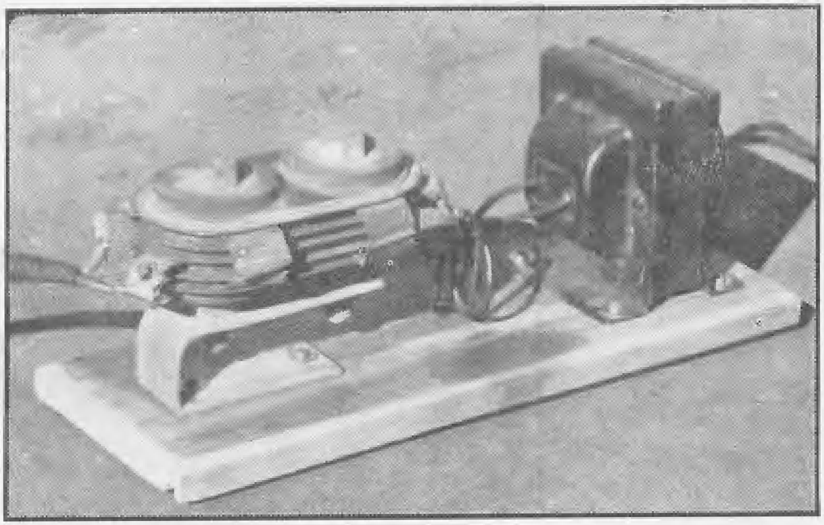
A GOOD little battery charger is a mighty handy piece of equipment to have around the house and one can be made up quite simply if an old-type speaker can be picked up from a junk merchant.

What with petrol rationing and frosty mornings, the car battery is almost sure to become run-down and a little boosting is a great help.

To the radio dealer who can get a few batteries to charge it is a source of considerable profit.

### Junk Parts Used

Being in a bit of a spot with a flat battery recently, we looked around and managed to pick up an old Magnavox speaker for 5/-. The cone had been completely busted, and the speaker appeared to be of no use, but we noted the original metal rectifier and transformer. Mounting these two units up on a piece of wood as shown in photograph, we made a battery charger with a current output of about an ampere, and we found that this was all that was necessary to hitch on to the car battery for about 12 hours at a time to bring it up to fighting trim to deal with the frosty motor.



A photograph of the charger which was made from a junk speaker rectifier and transformer.

Originally designed to put about six watts into the field coil of the speaker, the power transformer has a rating of somewhere around a safe margin beyond this, and may get a little warm on constant load, but this is not serious.

### Charging Rate

The one-amp charging rate is a little on the slow side for the quick charging of car batteries with a hundred amp-hour rating, meaning that (theoretically) a flat battery would take about 100 hours to fully charge. In practice, however, a flat battery is seldom really flat to a point of zero, nor does it need to be charged to maximum in order to give good service.

On the other hand, the low charging rate is a definite advantage in the case of radio batteries of the smaller types and for motor cycle batteries. A low charging rate is good for batteries of this type and often enough a battery which is playing up will have a most favourable reaction to a long slow charge.

### Connections

The connections are exactly the same as originally used for the speaker, the a.c. going into the primary of the transformer, the secondary output being fed into the metal rectifier and the output of the rectifier fed into the battery with due regard to correct polarity. In order to allow adequate ventilation, we suggest mounting the two components on a base as shown, with foolproof flexible power lead for the transformer primary and a pair of heavy leads with battery clips for the output. The clips should have their polarity marked clearly with red and black paint.

## RADIOTHERMICS

High-frequency induction heat has taken the place of gas heat in the soldering of crystal units used in war-radio equipment manufactured by the Electronics Department of the General Electric Co.

Explaining the change-over, J. P. Jordan, G-E engineer, points out that the soldering of the shell of the crystal unit to its base proved a critical operation when performed with gas ring burners.

"The crystal is mounted on a bracket inside a metal shell similar to that of a vacuum tube. The bracket is mounted on a base or 'header,' the shell assembled over it and soldered in place. If the header is overheated, or heated too slowly, the heat is conducted up the bracket to the crystal, sometimes causing internal distortion. There is also a possibility of injurious effects due to products of high temperature gas combustion.

"The above difficulties proved extremely hard to control when the soldering operation was performed by gas ring burners. But with the use of a vacuum-tube oscillator, these difficulties have been largely overcome."

The crystal unit is placed in a fixture which locates it with respect to a two-turn inductor coil and a perforated airblast ring nozzle. Heat is induced in the metal of the unit for a few seconds, after which a cooling air blast is operated for ten seconds. The entire sequence is automatically timed to assure uniform seals. During the heating cycle, the operator twists the shell slightly to assure uniform distribution of the solder.

—Radio (U.S.A.).

## AERIAL DESIGN

Technique and methods improve as experience is gained. Much has been learned, for example, about the design of aerials, and how to construct them, so that they shine, or radiate, a beam of the right width and depth, and as nearly as possible at the right angle to the earth, so that they will be reflected back to earth by the ionosphere and arrive in that part of the world for which they are intended.

Discussing the future of shortwave broadcasting, Sir Noel Ashbridge, the BBC's controller of engineering, says that if the progress in the next 10 years is anything like that in the last 10 years, we may look forward to the day when reception from far-off countries is almost as good as from the local station.

# DESIGNS FOR TRANSPOSED AERIALS

**This article describes how to build a Transposed Aerial that will resonate to the desired frequencies. Many pointers of interest to the short-wave listener and to the experimenter in general are given.**

BELIEVE it or not, a short-wave aerial has to be more efficient than an ordinary broadcast station aerial. The reason for this is that broadcast receivers have very high gain because of the low frequencies employed, while short-wave receivers haven't a very high gain. If you wish good results from distant stations, you will have to use a good aerial on your short-wave receiver. This is easy to see if you will consider these facts: An ordinary midget type broadcast receiver will receive very well at broadcast frequencies, but it is practically dead at short waves, unless a good antenna is used with it. The same applies to practically any average short-wave receiver.

It is of course true that a short-wave receiver even with an ordinary aerial will receive from a very great distance. But it is also true that the same receiver will give very much better results when a good aerial is used.

### Transposition Aerials

The so-called transposition aerial has a great advantage in that it is resonant to the received waves at certain frequencies and so the pick-up is much better. This aerial also has a directional effect because it is normally mounted horizontally, although it could be mounted vertically.

The design of this type of antenna differs. There are, however, so many factors that determine the value of an aerial, that there is little use in splitting hairs over matches and mismatches. I personally don't care whether my aerial is exactly matched or not because, since it is fixed in space, and as no one knows where the desired waves are to come from next, there is little use in trying for such great perfection.

The aerial of Fig. 1 is about as good as the high-priced variety for general use. If you really wished to make use of the directional effect, and had to use a horizontal aerial because you could not use a high pole, use the idea at A in Fig. 1. This is simply two transposition aerials. One of these proceeds north and south, and the other is arranged for east and west reception. Each of these is the same as the large aerial shown in Fig. 1. The centrepiece can be two dowel rods crossing each other, or a square piece of three-ply veneer with four holes in it. Dip the wood in melted paraffin. The insulators in the Fig. 1 aerial are short lengths of dowel rod dipped into melted paraffin, and each about six or so inches long. Drill the ends of the rods with a small drill.

### Theory

A transposition aerial is nothing more than an attempt to raise a necessarily short aerial high into the air, realise the advantages of position, but without detracting from its efficiency by the use of a then necessarily long lead-in. The lead-in in the usual aerial adds to the wavelength of the aerial, but not so in the case of a transposition aerial. The explanation of this is shown in Fig. 2. A is a simple horizontal aerial. B is the same aerial divided at its centre while C is the same aerial as A but with a coil at the centre. Such a coil is necessary in practical aerials for coupling purposes. This coil "loads" the aerial and so the two halves of the aerial are then somewhat shorter.

If there is some way of coupling this aerial to a receiver, without shortening it (it is short enough already because of the short wavelength), the advantages of position can be realised. At E, there is an aerial as at A, but the entire aerial has to be used as a lead-in to the receiver! At D, two insulated wires have been attached and crossed over, or "transposed," so that the inductance of the lead-in cancels out and, in effect, the lead-in is non-existent so far as changing the aerial-electrical constants is concerned. The transposition aerial receives its name from the transposed lead that connects it to the receiver or transmitter. In diagram D of Fig. 2, the coil L is now at the foot of the aerial where it can be coupled to the receiver or to the transmitter.

If this aerial was designed for ordinary broadcast reception, you could adjust it to the centre of the broadcast band and realise an advantage over a rather wide range of frequencies because any aerial is rather broad tuning. At short waves, the range to be covered is very extensive so that any such fixed turned aerial would not be a full solution to our problem.

### The Short-Wave Problem

To show you what a problem confronts you, it can be stated that a resonant aerial covering the full short-wave spectrum is almost a practical impossibility. This problem is worse than the tuned circuit problem in the short-wave receiver. In short-wave receivers, different coils have to be used at different frequencies, and the problem can be solved because you have small units, coils and condenser, to work with. But try and tune an aerial over that tremendous short-wave range when you can't get at it!

There would be an advantage in doing it; in fact, I believe ordinary short wave reception would go ahead with a "bang," if everyone could see what a tremendous advantage a tuned aerial that could tune to any desired short-wave would be. When you buy a transposition aerial you usually are getting perhaps the best the technical experts can give you, at quite an expense.

But even these aerials are far short of what we would like to have on our all wave sets. Did you ever try the

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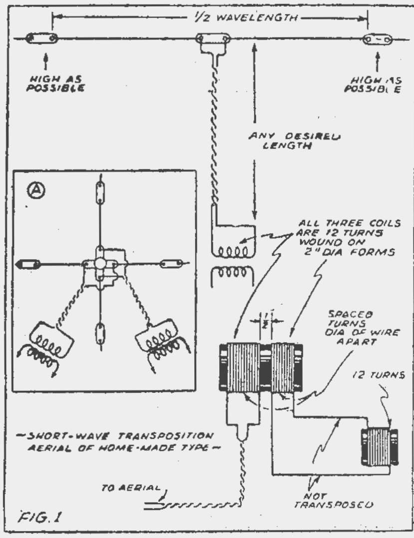
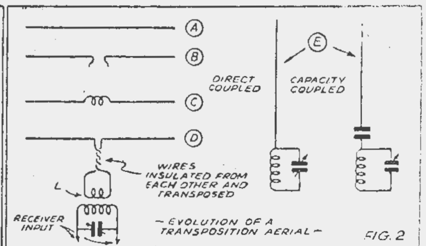
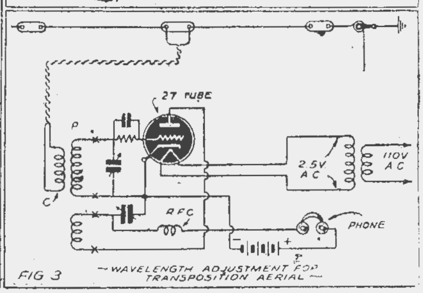


## AERIALS
(Continued)

transposition aerial designed for short waves on your broadcast receiver? Don't seem to work so good; not made for broadcast.

Some people forgot all about aerials, and started to let short lengths of wire dangle to the floor and carpet when the high-gain receivers came in. But, to reduce that noise in the background, it would be a lot better to increase the size of the aerial, and set the volume control back! A good aerial is an asset on any set for all-round results. Ever want a station 1000 miles away, and couldn't get it because the aerial just wasn't right (at broadcast frequencies)? A good aerial might bring it in consistently. Even if you have a midget receiver, the selectivity of which is not so good with a long aerial, you can use a longer aerial if you use a small single pole double throw switch to cut it out for local reception.

### Transposition Aerial Improvements

Some modifications have been made in transposition aerials to improve results or to make them applicable to all-wave conditions, but these have been omitted. This article considers only simple practical aerials for general use at short waves.

The transposition aerial is quite a perfect form of aerial in many respects. It is a very good all-round type. It has only one disadvantage; it is way up in the air and will only resonate over a comparatively limited range of frequencies. The thing to do, then, is to design the aerial for the frequency band you desire to use. Then the aerial will operate at the highest efficiency at the frequencies you wish to receive.

### Design of Practical Aerial

A transposition aerial is, theoretically, as shown in Fig. 1, of a definite length across the top. The length should be one half of the wavelength at which the aerial is to be resonant. There are chances of making some error so the resonant frequency will not fall where it is desired, hence a measuring scheme has been developed to resonate the aerial to the desired frequency. Make a coil as shown in Fig. 1 and couple the receiver to the coupling coil. Then, raise the horizontal aerial into place and adjust the transposed lead-in to the desired length. Everything is then ready, but the top length may not be correct. Be sure you have the same length of wire (No. 12 enamel is good) in each half of the top section. The poles or whatever holds the two ends of the horizontal wire should be of a sufficient distance apart, when the antenna is resonant. But this is exactly what we want the aerialto do no matter what receiver we are going to use with the aerial.

### Adjustment of Transpositian Aerial

Suppose that you wanted an aerial that would resonate to a band of frequencies centering around a wavelength of 20 metres. The total top length (the total length of the two halves) will be 10 metres (.5 wave). There are 3.28 feet in a metre, hence the total top length will be 10 times 3.28 or 32.8 feet, because it should be 10 metres long; this is 16.4 feet each side of the centre insulator. The two halves should be of the same length. Make the two halves each 16.4 feet and raise the aerial into place. Make the coupling coil and have everything in place before you make any measurements.

The total length of the aerial will probably be too long. In Fig. 3, bring the aerial coil, C, next to the coil, P, and tune the regenerative receiver past 20 metres. You will probably notice that part of the dial is "dead" or the receiver will not oscillate at 24 metres and for quite a distance on each side if the coils are close together. The aerial is too long on each side. Drop the aerial by means of the two pulleys and clip off about 6 inches from each outer end next to the insulator. Raise the aerial into place again and again test it for resonant frequency. Lower the aerial, and cut off another small length at each end. Repeat this process until the aerial resonates at 20 metres.

### Reduced Coupling

By reducing the coupling between C and P in Fig .3, the exact point of resonance can be located. This transposition aerial can then be used with the circuit of Fig. 3 or with any other set having an input coil. But remember that the resonant frequency of the aerial may change if you change the coil C or the transposed leads at the high frequencies. Always have everything that is to be connected to the aerial in place before measurements are made. It is perhaps true that many experimenters build aerials to specification but find, after they try them, that they do not work any better. If you expect to get good results, and to be sure of what you are doing, you will have to learn to make some measurements. Working in the dark is exactly what you are doing if you are comparing aerials or the results from aerials which you have taken no time to actually measure. The transposition aerial is a very valuable addition to any short-wave set and it should be carefully adjusted while in place, and some measurements made to see if the aerial has been properly designed. If the aerial resonates to some other frequency than the one you intended it to resonate to, you might as well use just a short wire aerial. But if you take a few measurements and know exactly what frequencies the aerial operates best on, I believe you will be surprised at the fine results that can be ob-

(Continued on page 18)

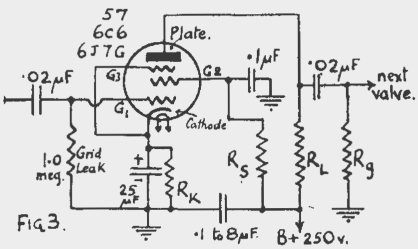
# THE EFFECTS OF LOAD IMPEDANCE

**How the plate resistor or speaker impedance affects the gain, voltage output, power output for triode, tetrode and pentode valves.**

In any valve circuit the plate or anode is connected through some component, usually a resistor, transformer winding or loudspeaker to the positive side of the high-tension suppply. (There are a few odd circuits where no component appears, but either the screen-grid is acting as an anode, or the component is connected between the cathode and the other side of the H.T. supply). The valve generates a fluctuating current in this component producing thereby a dissipation of power in the component. The impedance of the component to the fluctuating current is called the anode load. It may be inductive, capacitive or resistive or a combination of two, in nature, but in this article it will be assumed to be mainly resistive and its value in ohms will be denoted by RL. The voltage developed across RL will be equal to the product of RL and the value of the fluctuating current in amperes. This would indicate that the higher RL is, the greater the voltage output, but there is one factor not yet considered.

### Plate Resistance of Valve

In Figure 1, a resistor is shown inside the valve, connected in series with the plate or anode. This resistor to be denoted in future by RP is the A.C. impedance, or plate resistance of the valve. Normally, it is not shown in circuits but it is there just the same (not an actually pigtail resistor, of course; just a property of the valve!) and part of the voltage gener-

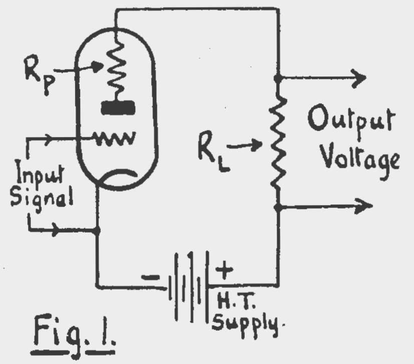



ated is across RP so that the voltage across RL is reduced.

If u = amplification factor of valve, then the effective gain is given by:

$$M = u \times \frac{RL}{RP + RL}$$

If RL is very large, then M is almost equal to u. The same thing applies if RP is very small. It's the ratio that counts. Unfortunately, the anode resistance (RP) of most valves is not constant, but increases when RL is increased.



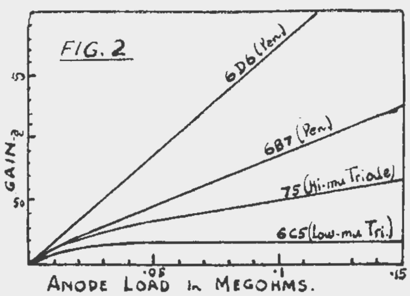




Fig. 2, showing effect of load on gain.

### Power Output

The power dissipated in a resistor is given by $P = E^2/R$ where P is the power in watts, R the resistance in ohms and E the potential difference between its ends in volts.

If P is to be large, E must be large and, therefore, RL must be large. But if RL (the R of the power formula) is large, the power is reduced! A compromise is necessary.

For an "ideal Ariode," i.e., one which had equally spaced, parallel, straight lines for its plate characteristics, the maximum output is obtained when the output impedance RL is equal to, or slightly greater than the internal plate resistance RP.

If RL = RP, such a combination would have an efficiency of 1/6 or 16-2/3 per cent, which is very low. If RL is increased beyond the optimum value, the maximum output is decreased, but the efficiency is raised. When RL = 2RP, the output has decreased very little (it rises in practice and efficiency increases to 25 per cent. As the load increases, the efficiency continues to rise, approaching 50 per cent. as the load becomes infinitely great. The power has meanwhile dropped to zero.

### Mathematics not Accurate

Most simple formulae assume that valve characteristics consist of equally spaced straight lines. This is not so. Such factors as mutual conductance (slope), amplification factor, etc., are not constant. Other electrodes such as screen grid, suppressor,etc., make their presence felt, especially when considering the voltage output or power output; i.e., in cases when the valve is driven to the limit. The grid-swing of a valve is limited; mathematically speaking the formulae are "discontinuous"; at points of grid-current and cut-off. The effects of load variation are best shown in practice by means of graphs. It will be noted from the graphs accompanying this article that the mathematical formula for voltage-gain holds fairly accurately, although the graph applies to ideal conditions only, the nearest approach in practice being a case where a large inductance is used as an anode load impedance.

A very large discrepancy will be noticed between theoretical and actual results for the power output of a pentode. This is because a pentode plate-characteristic graph has nice straight parallel lines over most of its range, but at low plate voltages the lines swing around almost at right angles.

### Limiting Effects

The voltage-gain of a valve increases as the load increases, but

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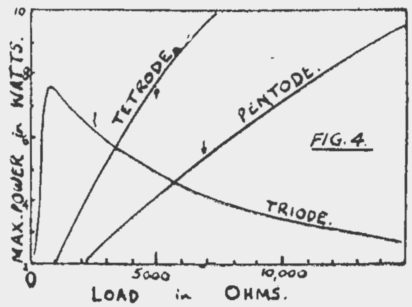



Fig. 4, showing effect of load on output.

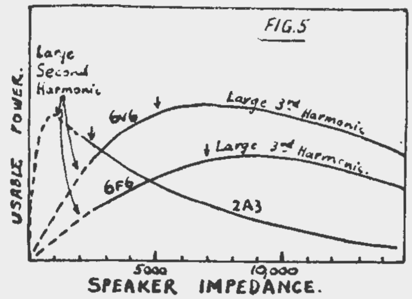



Fig. 5, showing effect of load on usable power.

## LOAD IMPEDANCES

(Continued)

there are various limiting factors. Usually the load is a resistance and a high resistance reduces the effective plate voltage. The plate resistance then rises and the high value of the load is no longer so effective. The effective plate voltage depends on the anode current and this, in turn, on the grid voltage; so by careful adjustment of bias, large anode resistors giving high gains may be employed. For triode valves, the approximate size of bias resistor is given by RL/M, but is not critical. A slightly smaller value usually gives slightly higher gain. The same formula may be employed for pentodes whether sharp cut-off like the 6J7, or variable-mu like the 6D6, providing the screen grid has the correct size of dropping resistor. If the dropping resistor is not large enough, then a larger value of bias resistor is needed, and vise versa. Valve manufacturers vary in their suggested values. Australian manufacturers favour medium to large bias resistors and medium to large screen resistors. American valve manufacturers favour small bias resistors and small screen resistors, whilst American set and amplifier designers seem

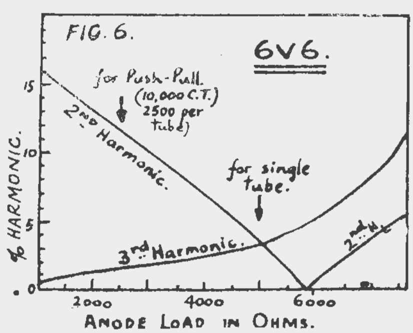


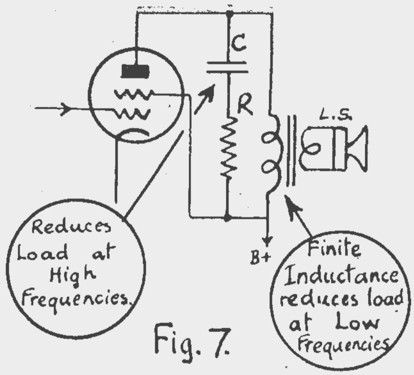

**Fig. 6, showing effect of load on harmonic distortion.**

to prefer very large bias and screen resistors. You will have guessed by now that the values are not critical. Typical values for a 6J7G (.25 meg. for RL and .5 meg. following grid leak) are:

| | A.W.V. Co. | R.C.A. | A.C.A. | Triumph |
|---|---|---|---|---|
| Bias Resistor (ohms) | 2000 | 1200 | 6000 | 4200 |
| Screen Resistors (meg) | 1.5 | 1.2 | 2.0 | .2 (.04 bleed) |

### Influence of Load on Power

This applies particularly to output tubes. As will be seen from the graphs of Maximum Power, the output of a pentode or beam (tetrode) tube, rises with increasing load, whilst that of a triode or pentode with negative feedback to the screen, falls. This is exemplified by the tone of an output valve working a loudspeaker. At very high frequencies and at one particular low frequency (the "resonant frequency"), the impedance of the speaker rises. If the output tube is a pentode, then the output is increased. Hence pentode tubes give a natural high-boost and a natural (or unnatural? Says some!) low boom. With triodes, the opposites happens. High notes are reduced owing to the rise in load impedance. Low notes around the resonant frequency are reduced, but if the speaker is well designed the still lower notes may actually be increased due to a slight drop in the speaker impedance at low frequencies. Usually this increase of the very-lows is absent, due to lack of inductance, or lack of coupling in the speaker transformer. The result is that pentodes are noted for "brilliance" or over-accentuation of highs and lows, whilst triodes seem rather dull in tone to those accustomed to tetrodes and pentodes. All these differences are due solely to the variation in load with frequency.




Output Circuit to prevent rise of Load at Low and High Frequencies.

### Influence of Load on Distortion

With triode valves, too small a load resistance results in large harmonic distortion, especially at high volume levels. This is true both for output stages and voltage-amplifier stages and is one of the explanations why some amplifier-builders using electronic-mixing find themselves faced with poor tone.

If a twin triode such as 6N7, 79 or 6SC7 is used as an electronic mixer, i.e., with separate inputs, but with the plates directly connected, the result is distortion, because each triode acts as a load resistance to the other. As there is an actually resistor as well, the result is that the effective anode impedance is **less** than the plate resistance of the valve instead of being several times its value. Distortion can be reduced by inserting a small resistor (say 30,000 ohms) directly in series with each anode so that the two anodes are no longer directly connected.

With pentodes, the load resistance can vary within very wide limits, providing it is the same at all frequencies, e.g., in resistance-capacity coupled amplifiers. For output pentodes and tetrodes (disguised pentodes), there is generally a value of load resistance for which second-harmonic distortion is minimum. Third-harmonic is small for low values of load resistance, but increases rapidly. The selection of the nominal speaker impedance is largely a matter of taste, except where utmost power is required. Those accustomed to, and favouring triodes, generally prefer pentodes operating with low values of load, i.e., they prefer second harmonic to third. A pentode with insufficient load sounds much the same as a triode with too much. One of the graphs shows the variation in second and third harmonic for a 6V6 at full output. Variations in **power-sensitivity** with load has not been discussed. It varies in much the same way as power does.

## TRANSPOSED AERIALS

(Continued from page 15)

tained at short waves from just a few tubes.

### Transposed Leads

Some transposition aerials used transposition blocks which can be made from three-ply veneer which is afterwards dipped in melted paraffin. This prevents rains from damaging the wooden block or warping it. In any event, the wires are crossed over each other. A simple type of transposed lead consists of lengths of hook-up wire, taped at the joints, or in one long piece, or two long pieces, simply twisted around each other. Transpose the lead all the way up to the centre insulator. The centre insulator holds the two halves of the aerial and also supports the transposed lead. Whatever you do, carry out a few simple measurements to see whether your aerial is resonant at the proper wavelengths. You will be pleased at the better results that can be obtained when a good, measured antenna is used on whatever short-wave receiver you have, or construct. Build a transposition aerial for the foreign broadcast band and you will be surprised how they will roll in, on any kind of short-wave receiver.

## UNUSUAL ITEMS

Who would think that severe sunburn to pilots flying in the sub-stratosphere would be a wartime problem? The problem was acute enough, however, to cause the need for a new type of glass, called golden plate glass, which filters out the ultra-violet rays.

A newly-developed process of melting tin electrolytically deposited on steel sheet, utilises high frequency heating at 200,000 cycles per second. Already at work in one steel plant, the electronic equipment will melt 12 sq. ft. of tin in .7 second. Heating equipment is being designed to operate at speeds up to 1000 feet per minute.

In order to utilise the tremendous power of modern aircraft engines, the Army Air Forces are now using a six bladed coaxial electric propeller. Two sets of three blades rotate in opposite directions. This eliminates tongue effect and improves the control of single engine type planes.

A plane which was built 32 years ago but which was far ahead of its time in design has just been dismantled in Buffalo, New York. This plane had a retractable tricycle landing gear, laminated wood stressed skin construction, and wings tapered in the modern manner. The plane had never been completed because of financial difficulties.

One of the most spectacular of the steel mill processes, that of blowing the Bessemer converter, is now controlled by an electronic device. The colour of the flame from the converter is a critical index for determining the exact instant for shutting off the "blow." Photo-cell colour comparators now replace trained experts to detect the exact colour changes which indicate when necessary chemical reactions have been completed.

A new and special chemical film only six millionths of an inch thick when applied to both sides of a pane of glass will reduce the loss of light due to reflection from 8 per cent to less than 1 per cent. Although not available now this glass promises to be very valuable at a later date.

—"Ohmite News" (U.S.A.)

## THANK YOU, UNCLE SAM

I wonder what we would have done this winter in the evenings were it not for the fine programmes provided by the American stations. With London more or less a wash-out after 6 p.m. till well on past 9 p.m., China almost impossible to hear, Russia talking in their own language and India more concerned about their own country, we can tune in one of the many avenues provided by Uncle Sam and should say, "Thank you." Under "New Stations" will be found particulars of two more transmitters that for the best part of the time they are on the air will be directing their programmes to Australia. And if you want a little more, or perhaps would like to hear some of the items again, you can "look in" while they are directed to Alaska. From just after 1 a.m. till long after most of us have retired, they will be there, and if you so desire you can set the alarm and hear a programme directed to us from 6.15 a.m. till 7.45 a.m.

## TELEVISION

(Continued from page 10)

dimensions of the neon tube and the diameter of the scanning disc. The bigger the tube and the disc, the larger the reproduced image. The fidelity or fineness of detail is dependent upon the number of holes in the disc.

Note the method of picking up the image of a person's face at the transmitter in fig. 6A; at B a second method of picking up the image at the transmitter is shown; this one was widely used a few years ago by leading experimenters. Here a powerful source of light, such as an arc, is mounted behind the scanning disc, and with suitable lenses a beam of light is projected onto the face of a person sitting in front of the large photo-electric cells at P. The light rays reflected from the face are projected onto these photo-electric cells (or light-sensitive cells), and the resultant electric currents are fed to an amplifier and then passed on to the receiver.

Fig. 7 shows the elementary action taking place in a cathode-ray tube; if a magnet is placed near the tube in which a cathode ray is projected on a screen at the end of the tube, the ray will be deflected more or less, depending upon the strength and polarity of the magnet. The cathode beam can also be deflected by placing an electric charge upon a metal plate mounted within the tube. It is easily conceivable that if we utilise a deflection current of constantly changing magnitude that the cathode ray will follow these current changes or pulsations, and move back and forth across the screen, as we see at A—fig. 7. At present there are two methods of scanning or sweeping the cathode ray across the screen. One uses the electro-static plate method, while the second uses magnetic scanning. The sweep currents have to have a saw-tooth wave form as shown at B, so that the ray will be swept back to its starting point very rapidly.

By utilising two sets of sweep coils or plates, placed at right angles and exciting these with pulsating currents, which will cause the ray to sweep rapidly back and forth horizontally and also vertically, the two combined motions will give us complete scanning of the image.

### Large Image Television

One of the problems in television has been to enlarge the image at the receiver, so that a group of people can enjoy the reproduction. In fig. 8, we see three of the principal methods that have been employed to produce a large image at the television receiver. The method of fig. A, which still has many friends, employs either an arc light, a pointalite (tungsten arc in an evacuated glass bulb) or a powerful incandescent lamp as a source of illumination. The trick here is to use a light-valve or modulating device such as a Kerr cell. This cell in its simplest form is composed of a pair of metal plates, immersed in a solution of nitro-benzine, and the sharply focussed light from the lamp passes between these plates. The pulsating television currents picked up from the transmitter are applied to the plates of the Kerr cell and in this way the light beam is modulated (by twisting the light beam). The beam is polarised* by means of a pair of Nicol prisms, with a number of lenses to concentrate the beam. A scanning disc may be used to project the image onto a large screen; a disc containing a spiral of lenses instead of plain holes is usually employed in this case, but a mirror drum has been used, particularly by the English experimenter Baird. About twelve years ago, Dr, Alexanderson, of the G.E. Company, demonstrated theatre-sized television images using this method (with a lens disc driven by a synchronous motor).

Fig. B shows how a neon crater tube (in which the light was highly concentrated, like a crater) was used for supplying a modulated beam of light. The scanning was accomplished by whirling a lens type disc in front of the tube. In some cases an extra stationary lens or two was added to the set-up for concentrating or enlarging purposes. In any case, the disc was rotated by a synchronous motor.

One of the latest methods of producing a large television image is by using a small high-intensity cathode-ray tube, which produces a brightly illuminated image on the screen. A set of projection lenses are mounted in front of the screen-end of the tube and the intensely brilliant image is projected onto a canvas or other screen.

*In polarised light the paths of the light vibrations are in straight lines and in only one plane. (In ordinary unpolarised light the vibrations emanate in all directions and in any plane perpendicular to the light ray.) Light may be polarised by passing it through a crystal manifesting double refraction. A Nicol prism has this property. When a current passes through a certain solution such as nitro-benzol or carbon disulphide, it causes an optical rotation or twisting of the polarisation plane of the light ray passing through the Kerr cell. The degree of twisting depending upon the strength of the current.

When the two Nicol prisms are set into position in the optical train employed in television, one of the prisms is turned at right-angles to the other, or until no light is observed on the television screen, with zero signal current applied to the Kerr cell.

—Shortwave and Television, U.S.A.

# ELECTRONS AND ELECTRODES

The radio tube is a marvellous device. It makes possible the performing of operations, amazing in conception with a precision and a certainy that are astounding. It is an exceedingly sensitive and accurate instrument — the produce of co-ordinated efforts of engineers and craftsmen. Its construction requires materials from every corner of the earth. Its use is worldwide. Its future possibilities, even in the light of present-day accomplishments, are dimly forseen, for each development opens new fields of design and application.

A radio tube consists of a cathode which supplies electrons, and one or more additional electrodes, which control and collect the electrons, mounted in an evacuated envelope. The envelope may be a glass bulb or it may be the more compact metal shell.

The importance of the radio tube lies in its ability to control almost instantly the flight of millions of millions of electrons supplied by the cathode. It accomplishes this with a minimum of control energy. Because it is almost instantaneous in its action the radio tube can operate efficiently and accurately at electrical frequencies much higher than those attainable with rotating machines.

All matter exists in the solid, liquid or gaseous state. These three forms of matter consist entirely of minute divisions known as molecules. Molecules are assumed to be composed of atoms. According to a present accepted theory, atoms have a nucleus which is a positive charge of electricity. Around this nucleus revolve tiny charges of negative electricity known as electrons. Scientists have estimated that these invisible bits of electricity weigh only 1/46 billion, billion, billion billionths of an ounce, and that they may travel a speed of thousands of miles per second.

Electron movement may be accelerated by the addition of energy. Heat is one form of energy which can be conveniently used to speed up the electron. For example, if the temperature of a metal is gradually raised, the electrons in the metal gain velocity. When the metal becomes hot enough to glow, some electrons may acquire sufficient speed to break away from the surface of the metal, This action is utilised in the radio tube to produce the necessary electron supply.

# Shortwave Review

CONDUCTED BY

L. J. KEAST

NOTES FROM MY DIARY—

Received a letter from Austin Condon who is now in Parkes undergoing a stiff training in the Air Force. Guess Austin will go a long way, judging by the enthusiasm he has for his job. Misses his shortwave set nevertheless, and is continually reminded of many hours spent in front of the receiver by the verifications that are still pouring in CR6RA, Benguela, Angola Portguese West Africa, COK, Havana, CFRX, Toronto, are amongst several that have arrived this month.

Drop him a line boys. A penny stamp on an envelope marked: 437779, LAC Condon, A.S., C. Flight, 39 Course, No. 2 WAGES, Parkes, N.S.W. will reach him and be welcomed.

A letter from Dr. Gaden states he will be domiciled in Brisbane from now on. Whilst I am delighted he is so much nearer to us, I sincerely hope he will not forsake the dial lights for the gay lights. If you want to know anything about those South American critters, ask Dr. Gaden, he can certainly drag them in.

TITUSOA

Yes, you've guessed it, it is my shorthand for "This is the United States of America." It is likely to bob up on any part of the dial, but I want to give this warning . . . don't dismiss your signal as another "Voice of America" because, just as Australia has accepted the fine programmes presented by the War Department of America, for rebroadcast, so has the BBC. This morning I heard an old familiar programme feature, "Mail Call," coming from what I thought must be GSB, 3135m., and sure enough at 6.44 I found this was right. It was "Mail Call" conducted by Orson Welles being put over for North Africa in the General Overseas Service of the BBC.

By the way, this is the new title for the Eastern Service, which has been amalgamated with the Forces programme. Opening at 8 p.m. it runs on till 8.45 a.m.

"AIR" YOUR WANTS

If you are short of any commodity, and goodness knows, most of us are tired of hearing "sorry, quota sold," put it over the air. I heard J. B. Priestly in a talk over the BBC tell how he mentioned in a broadcast a few weeks ago he was short of razor blades, and that he had just received a packet from a man in Iceland who had heard his broadcast. Well, when you say it over the radio today, you are telling the world. I wondered this morning when I was listening to a delightful session from Berne through HER-4, 9535 kc., 31.47m., whether the young lady conducting the programme and entertaining us with beautiful Swiss yodelling had any idea, in a peaceful little spot like Carlingford, her session was coming through probably much louder and clearer than in nearby European countries, or for that matter North America, for whom it was intended.

SUNDAY AFTERNOON

As most listeners know, at about 3.8 p.m. the BBC give call-signs and wavelengths of the Pacific Service. I should say they do if you are lucky enough to hear Isobel Ann Shead at the microphone. I will forgive Jean Metcalfe as she is now to us, but for old-timers to get the times, countries and wave lengths mixed in order of rotation, is unpardonable.

I have before me the notes I made on May 9, when that delightful equestrienne, Miss Ann Shead, gave them in this order: country, wave-length, time. And I have before me the notes I made on June 13 . . . They look more like a pak-a-pu ticket than reliable references.

And now perhaps someone nearer than Great Britain than I will have protested and we will tune in again next Sunday and hope for the best.

HELP WANTED

Mr. Walker. of Applecross, W.A., writes: "A Spanish speaking station (or is it Portuguese?) on 11,710 kc., 25.62 metres, is heard opening at 9.30 a.m., and closing at 11 a.m. The announcer is a lady, and in addition, a man is sometimes heard with her. Interval signal is stroke on a brass gong (different from Portugal's chime). At about 10.50 the news is given by a woman (in Spanish or Portuguese) and after one gong the station signs off with a choir singing a very slow hymn type of anthem (which is not the Portuguese anthem). Strength is fairly good.

(The station is —, Berne, Switzerland on 11.72 m.c., 25.69 metres. I have been hearing quite often for a few weeks now.—L.J.K.).

★

STOP PRESS

KWY, 'Frisco, announced on Saturday evening "As and from Monday, June 28, KROJ will replace KWY in programmes to Australia. The programme of KWY on KROJ will be on the same days and at the same times. Listen to KROJ on 9.89 m.c.

No reference was made to the 10.30 p.m.—12.30 a.m. special programme to N.E.I.)

## ALL-WAVE ALL-WORLD DX CLUB

## Application for Membership

**The Secretary,**
**All-Wave All-World DX Club,**
**243 Elizabeth Street, Sydney.**
**Dear Sir,**

I am very interested in dxing, and am keen to join your Club.

**Name** ..............................................................

**Address** ..............................................................
**(Please print both plainly)** ..............................................................

..............................................................

**My set is a** ..............................................................

I enclose herewith the Life Membership fee of 2/– (Postal Notes or Money Order), for which I will receive, post free, a Membership Certificate showing my Official Club Number. NOTE—Club Badges are not available.

**(Signed)** ..............................................................

**(Readers who do not want to mutilate their copies can write out the details required.)**

# Shortwave Notes and Observations

I trust reporters will not take umbrage if their notes are not shown in this issue as, with a desire to bring the magazine out earlier, we have gone to press sooner than is usual. Reports should reach me at Carlingford not later than 21st of the month.

### AUSTRALIA

VLI-9, Sydney, 7280 kc, 41.21 m, has replaced VLI, 9615 kc, 31.2 m, in the session to North America (East) from 10 till 10.45 p.m. George Thomas Folster can be heard at about 10.10 just after the news (L.J.K.)

Received verification for 7.30—8 p.m. session to A.I.F. (Cushen).

VLG-7, Melbourne, 19.79 m, is terrific at 6.45 a.m. (Perkins).

VLW-3, Perth, 11,830 kc., 25.36 m. Schedule is: 8.30—11.45 a.m.; 1.30—8.45 p.m. daily. On Sundays 8.45 a.m. till 8.45 p.m. (Walker).

VLW-5, Perth, 9680 kc, 30.99 m.: Schedule is: 9 p.m. till 1.30 a.m. (Walker).

VLQ-3, Brisbane, 9660 kc, 31.05m: Signal is R-7 to 8 on most nights. Fading of a very slow period is often evident, but as this is never very deep it does not really affect readibility. (Walker) R-6-7 at 8.45 a.m., but no good from about 6 p.m. (Perkins) R-3 at 5.15 p.m. with plenty of fading but cannot hear at 7.15 p.m. R-4-5 at 7.15 a.m.

### NEW ZEALAND

ZLT-7, Wellington 6715 kc, 44.68 m.: R-5 from 8 to 8.15 p.m. (Perkins). Heard here, but very weakly (Walker).

### OCEANIA

FK8AA, Noumea, 6162 kc., 48.62 m., R-5 when closing at 6.59 p.m. (Perkins).

### GREAT BRITAIN

London still using several transmitters for which no call sign has been given, or it has, then I missed it. Here are a few at random: 19.92 m, 31.41 m., 31.19m., 25.58m, 16.92m, 19.45m, and 31.12m.

Would be glad of any information regarding these laddies (L.J.K.).

GRV, 24.92, gives an R-8 signal in the Latin-American session, and GRF, 24.80m, R-5 in same programme (Perkins).

London during the North American Service from 7.15 a.m. till 2.45 p.m. bring into play as many as 10 transmitters. (L.J.K.)

GSA, 49.59 m, very strong at 7.30 am; GRB, 49.92 m., gets through the noise when giving news at 6.45 am (Gillett).

### INDIA

VUB-2, Bombay, 7.24 mc., 41.44m., is putting in a nice signal at 10 p.m. and I prefer it to VUD-4, 9.59 m.c., 31.28m, or VUD-2, 7.29 m.c., 41.15m, when listening to the news (L.J.K.).

### MIDDLE CONGO ICELAND

TFJ, 24.52 m, still heard from 3.15 to 3.30 pm, but not as good as past weeks. Easily identified by high-pitched voice of announcer (Gillett).

FZI, Radio Brazzaville, 11,970 kc, 25.06m: As from June 18 our old friends in Frenh Equatorial Africa have been using their new and powerful transmitter. I hear them nearly every afternoon around 4.20. I think they open about 4 p.m., but morse is unfortunately evident. A young lady announces the musical items. Schedule is: 5—7.30 a.m.; News at 5.45 a.m.; 1—2 p.m.; 4—5 p.m.; 11.30—11.45 p.m. Am sure these good people would welcome reports, and as mail is accepted for that part of Africa, I understand, I am certain listeners would receive a grateful acknowledgement. My first report was mailed on November 2, 1940, covering their programme of October 25, 1940. In reply to my query regarding their interval signal they explained it is called the Kissantzi. It is made of wood and is fitted with five strings attached to flexible pieces of wood. It is played with the thumb as the guitar is played.

### ALGERIA

"Radio France" appears to be the new name for TPZ, who quite recently we christened AFH, so in the Log Book we will write, "Radio France", 12.12 m.c., 24.75m. Schedule is: 7.45—8.15 a.m.; 4—6 p.m.; 9—11 p.m.; 3—7.30 a.m. (L.J.K.).

### AMERICA

If you tune to KWID, 31.35m, at 3 p.m. when they are beamed to the Orient and not Australia as some people think, and you find the signal zizzy, the offender is not Khabarovsk, but a foreigner on the same frequency talking in Russian till they sign at 3.45 p.m.

Khabarovsk has kindly moved to 9565 kc, or 31.37 m. (L.J.K.)

KGEI, Frisco, 11.79 mc., 25.43 m., when closing at 2.45 p.m. say comments on programmes together with reports on reception will be welcomed, simply address your letters to "The United Network, Fairmount Hotel, San Francisco." Have a soft spot in my heart for KGEI, I remembeor when from Treasure Island they gave us such fine programmes and long before U.S.A. came into the war, they beseeched us to 'please stand by, further war news will be given momentarily." And what a programme sheet they used to forward us. (L.J.K.).

While the Ball Game is being given through the newcomer, KROJ on 30.31 metres from 8.15 till 9 p.m. there appears to be someone else on the same frequency. As they can still be heard a little after 9 p.m., it is most likely WKRD, New York, who are scheduled to stay on from 6.45 till 9.30.

WLWO, Cincinnati, 15250 kc, 19.67m. now closes at 6.30 p.m. (L.J.K.).

WLWO, Cincinnat, 15250 kc, 19.67 m, now close at 7.15 a.m. opening again at 7.30 where they stay till 9 o'clock and give identification note telling you they are switching to 9590 kc., in fifteen minutes, and this will help you to find station. (L.J.K.).

Hugh Perkins hands out a terriffic to KWV around 5 p.m., KWID, from 5

### NEW STATIONS

KROJ, 'Frisco, 9897.5 kc., 30.31 metres: Opened at 6.15 pm., on Monday, June 21. Another of "The Voice of America" stations directed to Australia and notwithstanding opposition from morse in the early part of the transmission, signal works up from R-7, Q-4 to a good R-8, Q-5 when closing at 10.59 p.m.
When opening is in parallel with KWID, 9.57 m.c., and KES-3, 10.62 m.c. At 7.15 KWY, 7.56 joins in but from 8 pm KROJ only has KWY for company and when leaving the air at 11 pm announces "KROJ now concludes its present transmission to Australia. Your next transmission will be at 1.15 pm PWT (6.15 am EAS) on 17.76 m.c." "Star Spangled Banner" concluded a very fine programme and a session that will doubtless be popular with S.W. ilsteners here. If you stay on without altering your tuning, KROJ comes back at 11.15 p.m. with a programme directed to Alaska. Signal drops considerably as can be imagined, but what time they conclude their programme to the cold country I do not know. At about 1.30 in the afternoon they have another programme directed to Alaska and signal is fine till they close at 5.45 pm.
KROJ, 'Frisco, 17.760 kc, 16.89metres: Making its debut in a programme specially directed to Australia, it commenced business at 6.15 am on Tuesday, June 22. When opening signal was only R-2, Q-2, but conditions were poor for reception judging by the way KWU came in at 6.30 and joined KROJ. KROJ as did KWU, improved quickly and when closing at 7.45 am after a delightful half hour of "Californian Melodies" was classed by me as through KROJ would be at 1.15 am PWT (EAS R-8, Q-5. Reminded that next transmission 6.15 pm). American National Anthem faded them out and KWU was left to Fred Waring and his 55 Californians.
You will note they said next transmission to Australia would be at 1.15 am PWT, actually it is at 1 am (EAS 6 pm).
KROJ, 'Frisco, 15.19 m.c., 19.75 metres: Still another outlet for this station which I feel certain will be very popular in this country. As these notes are being rushed to catch "dead line", I can only say heard them at 8.1 am on Saturday, June 26. This is their announced frequency, but they did not say to where they were beamed. Signal was R-5, Q-3.
GVV, London, 11,730 kc, 25.58 metres: I have not heard the call sign but am taking it from "The Broadcaster". It is heard in the Pacific Service from 5 till 7 pm, and later in the General Overseas Service from 1.30 am till 6.30 am.
——, London, 9640 kc, 31.12 metres: This is the chap I have been talking about since the May issue. Down he goes without a monnicker till we hear it. Can be heard regularly from 4 till 6 am and irregularly at 3.15 pm or thereabouts in foreign languages.
——, London, 17.73 mc., 16.92 metres: Another BBC transmitter without a call sign so far. On air from 11.30 pm till 1.30 am directed to South and West Africa.
GWE, London, 15.432 m.c., 19.44 metres: Still waiting a call sign for this one. Directed to India, is heard from 12.45 till 1.15 am.
——, Leopoldville, 11,670 kc, 25.71 metres.: Radio Congo Belge is being heard on this new frequency in the afternoons and like their nearby neighbours in Brazzaville have several and short transmissions. I am not sure of exact schedule, but they are on the air some days from 2—3 pm, from 5.15 to 5.30 pm, and on others from 6 to 6.30 pm. Have several slogans and according to programme are "Radio National Belge," "Here Leopoldville Belge National Radio Anruf" or "Here Leopoldville Stadt."

till 8 p.m., WLWO 39.6 from 5 till 6.30 and KWY from 6.45 till 9.05 p.m. Says he heard a Yank on approximately 43 metres talking to Chungking at 9.45 p.m. on June 12. A (?) at the end of his remarks suggests Whaffor, or who is it? Can only say most likely WGEA, Schenectady on 7000 kc, 42.86 metres. Their regular schedule is 10 a.m. till 2 p.m. but I cannot bring them in here loud enough to know what it is all about (L.J.K.). Can hear WGEA sign at 2 p.m. (Cushen). WCBX, 31.61 m. signs at 1.30 p.m. (Cushen).

WLWO on 7575 kc, certainly pumps in here till closing at 6.30 p.m. (Walker). Providing at R-7 signal at 6 p.m. (Churcher).

WKRD, New York (heard signing off at 6.45 p.m. when they announce as being on 5,985 kc, 50.12 m. Signal R6, Q-3 (Walker). Heard at 3 p.m. (Cushen).

WGEA is now using WGEO's frequency of 9563 kc, in the afternoon when directed to Europe. This replaces the 6190 kc, transmission to advantage as signal is R-7 on closing at 8 p.m. (Walker).

KWID, 19.62 me. O.K. around 9 a.m. (Perkins).

WKTM, 47.01 m, is R-3 here at 5.45 p.m. (Churcher).

WLWO, 9590 kc, 31.30 m, 9.15 a.m. till noon. A very strong regular signal to South America (Walker, Perkins, Maguire).

KGEI, 25.43 m: R-4 at 2.45 p.m. (Perkins, Maguire). Can only hear their carrier at noon, and only just audible at 2 p.m. (Churcher).

KWID, 9570 kc, 31.35 m. A pity this fine signal closes so early. (Walker). (Now taken care of by KROJ, 30.31 m. L.J.K.).

WKRX, 38.36 m, R-3 around 7 p.m. (Perkins). I hear them at 8.30 p.m. (Cushen).

WKRD, on 23.13 m., was just audible at 8.15 the other morning, but is much better at night and news can be heard at 10 and 11 p.m. (L.J.K.).

Received a card from WBOS (6140 kc, 48.86 m.) and a nice letter from N.B.C. giving latest schedules of WBOS, 19.72 m., supposed to be on from 2.30 till 7.40 a.m. (Gillett). (I think correct schedule is 10.15 p.m. till 7.15 a.m., L.J.K.)

KROJ, the new Yank on 9.89 m.c., was R-6 here at 8 p.m.; WKTM,47 m., and WKRD, 50.12 m., are only just fair at 6 p.m. (Gillett).

WRUS, 49.67 m., is poor in the afternoon while KWV and KWID are splendid.

WCBX, 31.61 m, are good on opening at 10 a.m. (Gillett).

### AMERICA, CENTRAL

TGWA, Guatemala, 15,170 kc, 19.78 m: Received a card verifying my report of several months ago. Accompanying same was a fine booklet on Guatemala (Gillett).

### AFRICA

Radio Congo Belge, Leopoldville, 11:67 m.c, 25.71 m. Heard in afternoons at fair strength (Gillett).

—, Leopoldville, 11,670 kc, 25.71m. See particulars under "New Stations."

### MEXICO

An excellent signal from XEWW, 9500 kc., 31.58 metres is to be had from 3 to 4 p.m. Dance music interspersed with some high speed Mexicano, and a generous application of the gong (L.J.K.).

XEWW, 31. 57m., surprsingly loud signal when closing at 4 pm on Sunday (Gillett).

## NOTICE TO DX CLUB MEMBERS

**Members of the All-Wave All-World DX Club are advised that they should make a point of replenishing their stock of stationery immediately, as all paper prices have risen, and we expect that it will be necessary to increase prices by at least 25%.**

**Already it has been found necessary to abandon the log-sheets and club stickers. However, while stocks last, the following stationery is available at the prices shown:—**

**REPORT FORMS.—Save time and make sure of supplying all the information required by using these official forms, which identify you with an established DX organisation.**
**Price .... .... .... .... .... .... .... .... .... .... 2/- for 50, post free**

**NOTEPAPER.—Headed Club notepaper for members' correspondence is also available.**
**Price .... .... .... .... .... .... .... .... ....2/- for 50 sheets, post free**

**ALL-WAVE ALL-WORLD DX CLUB, 243 Elizabeth Street, Sydney.**

# Allied and Neutral Countries Short-Wave Schedules

These schedules, which have been compiled from listener's reports, my own observations, and the acknowledged help of "Globe Circler" and "Universalite" 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." The great number of stations on the air makes it necessary to print schedules in two sections, 13,16, 19, 25 and 31 metre bands appeared in June issue.

Please make the following alterations to Bands shown in June issue:
WDL, 9.75 mc, 30.77m. New call-sign is WKLJ
VLW-3, Perth, 25.36m: Schedule is: See S-W. Notes
VLW-5, Perth, 30.99m. Schedules is: See S-W Notes.

And make the following additions:—
KROJ, 'Frisco, 17.76 mc., 16.89 m. See particulars under "New Stations."
KROJ, 'Frisco, 9.89mc, 30.31m. See particulars under "New Stations."
GVV, London, 11.73mc., 25.58m. See particulars under "New Stations."
——, London, 17.73 mc., 16.92m. See particulars under "New Stations."
GWE, London, 15.432mc, 19.44m. See particulars under "New Statinos."
KROJ, 'Frisco, 15.19mc, 19.75m. See particulars under "New Stations."

Symbols: N—New Stations; S—Change of Schedule; F—Change of frequency.

| Call Sign | Location | Mc. | M. | Time: Eastern Australian St'dard |
|---|---|---|---|---|
| WNBI | New York | 9.67 | 31.02 | 7.15 am—4 pm. |
| VLQ-3 | Brisbane | 9.66 | 31.05 | 6.30 am—11.30 pm (Sundays 6.45—11.30 pm). |
| LRX | B'nos Aires | 9.66 | 31.06 | 8.30—9; 10.30 pm—1.10 pm (Sundays 3 pm). |
| HVJ | Vatican City | 9.66 | 31.06 | Tues., Thurs., and Sun. 1—2 am 2.30—4 am; Sun 7.30—8 pm; Wed. 3.30—4.15 am. |
| HHBM | P't-au-Pr'ce | 9.65 | 31.06 | 10.30—11 pm; 3—4 am; 9 am —12.30 pm. |
| WGEO | Schenectady | 9.65 | 31.08 | Not in use at present. |
| WCBX | New York | 9.65 | 31.09 | 1.45—4 pm. |
| COX | Havana | 9.64 | 31.12 | 2.50 am—2 pm. |
| XGOY | Chungking | 9.64 | 31.10 | 11.30—2.15 am; News midnight 12.30, 1 and 2 am. |
| LRI | B'nos Aires | 9.64 | 31.12 | 7.57—10 pm; 3.30—4.30 am; 5 am—1 pm. |
| — | London | 9.64 | 31.12 | 4—7 am. |
| CXA-6 | Montevideo | 9.62 | 31.17 | 1—9 am |
| — | Addis Ababa | 9.62 | 31.17 | 12.15—1.30 am; 3.15—4.15 am |
| — | London | 9.62 | 31.19 | 1.30—8.45 am. |
| VLI | Sydney | 9.61 | 31.12 | Not in use at present |
| XERQ | Mexico City | 9.61 | 31.21 | 11.30 pm—1 am; 9 am—3 pm |
| ZRL | Capetown | 9.60 | 31.22 | 5.15 pm—12.30 am. |
| HP5J | Panama City | 9.60 | 31.23 | 10 pm — 4.30 am; 11.30 am—1.30 pm; Sun. 11 pm—1 pm Mon. |
| CE960 | Santiago | 9.60 | 31.24 | 9 am—2 pm. |
| GRY | London | 9.60 | 31.25 | 7.15—8.45 am; 3—4.45 pm; 5.30—6.30 pm; 1—7 am. News 6.45 am, 4.15 pm, 2 and 4 am. |
| — | Athlone | 9.59 | 31.27 | 7.05—7.25 am; News 7.10 am |
| VUD-4 | Delhi | 9.59 | 31.28 | 11 am —1.35 pm; 3—6 pm; 7.30—7.45 pm; 8.30—11.35 pm; 12.15—1 am; 2.30—4 am. News 11.45 om; 1.30, 5, 10 pm and 12.50 am |
| WLWO | Cincinnati | 9.59 | 31.30 | 9.15—2 pm. |
| VLR | Melbourne | 9.58 | 31.32 | 6.45—11.30 pm (Sun. from 7 pm) |
| VLG | Melbourne | | 31.32 | 1—1.45 am for N America (W States) |
| GSC | London | 9.58 | 31.32 | 2.30—2.45 pm. News 7.45, 8.45 11—6 am, 12.45 and 2.30 pm |
| KWID | 'Frisco | 9.57 | 31.35 | 11.30 am—2.45 pm, 3.45— 5 pm; 5—8.15 pm |
| — | Khabarovsk | 9.56 | 31.37 | 5.30—7.12 am; 7 40—8.45 am; noon—1.12 pm; 1.45—2.40 pm; 6—9.30 pm; 10.30 pm—midnight |
| OAX4T | Lima | 9.56 | 31.37 | 11 pm—midnight |
| XETT | Mexico | 9.55 | 31.39 | Continuous |
| — | London | 9.55 | 31.41 | Heard around 6.45 |
| XEFT | Vera Cruz | 9.54 | 31.42 | 11 pm—4.15 pm |
| — | Moscow | 9.54 | 31.43 | 9.40—10.20 pm; 12.15—12.30 am |
| VLG-2 | Melbourne | 9.54 | 31.45 | 10—10.45 pm for N. America (E. States) 11 pm—midnight for Asia (French & Thai) |

| Call Sign | Location | Mc. | M. | Time: Eastern Australian St'dard |
|---|---|---|---|---|
| SBU | Stockholm | 9.53 | 31.47 | 7.20—7.35 am; 11 am—noon, News 7.20 and 11 am. |
| HER-4 | Berne | 9.53 | 31.47 | 9.45—11.15 am. Except Sundays |
| WGEO | Schenectady | 9.53 | 31.48 | 5.45—7.15 am; 7.30 am—2 pm |
| ZRG | Joh'burg | 9.52 | 31.50 | 5.30 pm—12.30 am |
| COCQ | Havana | 9.51 | 31.53 | 10 am—1 pm; 8.20—11 pm |
| GSB | London | 9.51 | 31.55 | 3—6.30 pm; midnight—1.15 am, 4.15—7 am; 7.45—8.45 am, 9 am—12.45 pm. |
| PRL-7 | R de Janeiro | 9.50 | 31.57 | 8 am—1 pm |
| XEWW | Mexico City | 9.50 | 31.58 | 11.58—5.45 pm |
| OAX5C | Ica | 9.50 | 31.58 | Think off the air. |
| KRCA | 'Frisco | 9.49 | 31.61 | 3 pm—3 am |
| WCBX | New York | 9.49 | 31.61 | 9.50 am—1.30 pm |
| — | Moscow | 9.48 | 31.65 | 4—5 pm; 8.30 pm—12.45 am; 1.45—2.15 am. |
| CR6RA | Loanda | 9.47 | 31.69 | 9.30—10.45 pm; 5.30—7 am |
| TAP | Ankara | 9.46 | 31.70 | 12.15—5.47 pm; News 2.15 am |
| GRU | London | 9.45 | 31.75 | 3—8.15 am; 1.45—3.15 pm; 1 —1.15 am |
| COCH | Havana | 9.43 | 31.80 | 8.45 am—3.15 pm |
| — | Moscow | 9.43 | 31.81 | 7—7.25 am; 2.15—2.45 pm; 3.30—4 pm |
| GRI | London | 9.41 | 31.86 | 2.45—8.30 am; 5—7.45 pm |
| FGA | Dakar | 9.41 | 31.88 | 3—4.15 am. |
| — | Moscow | 9.39 | 31.95 | 9.30—11 pm; 1.30—3 am; 10 am—1 pm |
| COBC | Havana | 9.37 | 32.00 | 11 pm—3.15 pm |
| OAX4J | Lima | 9.34 | 32.12 | 9 am—4 pm; 11 pm—midnight 3—6 am |
| LRS | B'nos Aires | 9.32 | 32.19 | 8 am—noon, 10—11 pm; 4—4.30 am |
| COCX | Havana | 9.27 | 32.26 | 10.45 pm—3 pm |
| HC2ET | Guayaquil | 9.19 | 32.64 | 10.30 pm—3.30 pm |
| CNIR1 | Rabat | 9.08 | 33.03 | 4—8.50 am; 4.30—4.50 pm; 9.30—11 pm |
| COBZ | Havana | 9.03 | 33.23 | 10.45 pm—2 pm |
| — | Kuibyshev | 8.99 | 33.37 | 5.50—6 am |
| AFHQ | Algiers | 8.96 | 33.48 | 8.30—9.45 am; 3—3.30 am |
| KES-2 | 'Frisco | 8.93 | 33.58 | 8.15 pm—3 am |
| — | Dakar | 8.83 | 33.95 | 5.15—6.45 am; 5.30—5.50 pm; 10.15—11 pm. |
| COCQ | Havana | 8.83 | 33.98 | 8.20 pm—2.15 pm |
| COCO | Havana | 8.70 | 34.48 | 7.30 pm—3.30 pm |
| COJK | Camaguey | 8.66 | 34.62 | 2.30—3.30 am; 6.30—9 am; 11—11.30 am; |
| WOO4 | New York | 8.66 | 34.64 | 10 am—4 pm; 4.15—7 pm |
| — | Kuibyshev | 8.05 | 37.27 | 1—1.30 am; 2—4.15 am; 7.15 —8.45 am |
| FXE | Beirut | 8.02 | 37.41 | 11 pm—7 am |
| FIA6 | Douala | 8.00 | 37.50 | 4.45—5.45 am; 8.45—9.30 pm |
| PSL | R de Janeiro | 7.93 | 37.81 | Sundays 9—10 am |
| YSD | San Salvador | 7.89 | 38.00 | 10 am—1.30 pm |
| SUX | Cairo | 7.86 | 38.15 | 3.30—4.30 am; 5.15—7.45 am |
| WKRD | New York | 7.82 | 38.36 | 7.15 am—2 pm; 2 pm—6.30 pm |
| WKRX | New York | 7.82 | 38.36 | 7—10 pm |
| YNDG | Leon | 7.66 | 39.16 | 9 am—1 pm |
| YNLAT | Granada | 7.61 | 39.40 | 9.30 am—1.15 pm |
| WLWO | Cincinnati | 7.57 | 39.6 | 5—6.30 pm |
| WDJ | New York | 7.56 | 39.66 | 9.15 am—6 pm |
| KWY | 'Frisco | 7.56 | 39.66 | 6.45—9.05 pm; 10.30 pm—12.30 am |
| — | Moscow | 7.56 | 39.68 | 1—6.30 am; 8—9 am; 11.10—11.30 am |
| YN2FT | Granada | 7.49 | 40.05 | 10 am—1 pm |
| GRJ | London | 7.32 | 40.98 | 5—7 am; 2.15 pm—5.15 pm |
| — | Moscow | 7.30 | 41.10 | 2—9.30 am; 10—11 am; 1—3.45 pm; 4.30—5 pm |
| ZOY | Accra | 7.29 | 41.13 | 2.15—5.15 am |
| VUD-2 | Delhi | 7.29 | 41.15 | 8.30—11.25 pm |
| VLI-9 | Sydney | 7.28 | 41.21 | 10—10.45 pm |
| VUM-2 | Madras | 7.26 | 41.32 | 6—6.40 pm; 9.45—11.30 pm; 12.45—12.50 am. News 10 pm and 12.45 am |
| KGEI | 'Frisco | 7.25 | 41.38 | 1 pm—2.45 am. |
| VUB-2 | Bombay | 7.24 | 41.44 | 4.15—5.10 pm; 9.25—10.45 pm. News 5, 9.25 and 10 pm |
| VLQ | Brisbane | 7.24 | 41.44 | Not on air at present |
| KWID | 'Frisco | 7.23 | 41.49 | 8.30 pm—3.05 am |
| GSW | London | 7.23 | 41.49 | 5.15—8.45 am; 1.45—4.45 pm |
| VLI-4 | Sydney | 7.22 | 41.55 | Not in use |
| VUC-2 | Calcutta | 7.21 | 41.61 | 5—5.55 pm; 8.30—9.20 pm |
| — | Moscow | 7.21 | 41.61 | 7.50—9.30 am |
| — | Madrid | 7.20 | 41.63 | 6—9 am |
| YSY | San Salvador | 7.20 | 41.65 | 10.30 am—2 pm |
| CM21 | Havana | 7.19 | 41.72 | 8 am—2 pm; midnight—3 am |
| GRK | London | 7.18 | 41.75 | |

| Call Sign | Location | Mc. | M. | Time: Eastern Australian St'dard |
|---|---|---|---|---|
| XGOY | Chungking | | 41.80 | 8 pm—3 am; 4.30—7 am |
| — | Moscow | 7.17 | 41.80 | 5.20—6.30 am; 7.15—9.55 am; 10—10.30 pm; 1—4.30 am |
| GRT | London | 7.15 | 41.96 | 9.15 am—2 pm; 3—4.45 pm |
| EAJ-9 | Malaga | 7.14 | 42.00 | 6—9.05 am |
| HC4FA | Porto Viejo | 7.14 | 42.02 | 7 am—1 pm |
| — | Ovideo | 7.13 | 42.05 | 5—7.30 am |
| GRM | London | 7.12 | 42.13 | 10.45 am—2.45 pm; 3—6.30 pm |
| EA9AA | Melilla | 7.09 | 42.31 | Heord around 7 am |
| GRS .. .... | London | 7.06 | 42.41 | 4—8.45 am; 11.45 am—2 pm |
| EAJ24 | Cordoba | 7.04 | 42.61 | 6.40—8 am |
| EAJ-3 | Valencia | 7.03 | 42.65 | 6—10 am |
| — | Ponto Delgada | 7.02 | 42.74 | 5—6 am |
| EAJ47 | Valladolid | 7.00 | 42.82 | 6.30—7.15 am. |
| WGEA | Schenectody | 7.00 | 42.86 | 10 am—2 pm |
| FO8,AA | Papeete | 6.98 | 42.95 | Wed. & Sot. 1.57—2.45 pm |
| — | Moscow | 6.98 | 42.98 | 2 am—9.23 am; 10—10.30 am |
| YNOW | Managua | 6.87 | 43.67 | 10 om—2.30 pm |
| HIH | San Pedro | 6.77 | 44.28 | 10—11.30 am; Mon. 8.20—9.40 am |
| YNDS | Managua | 6.76 | 44.28 | 3—6 am; 8 am—2.30 pm; 10 pm—midnight |
| — | Oran | 6.73 | 44.56 | 6.30—7 am |
| ZLT-7 | Wellington | 6.71 | 44.68 | 8 pm in news session only. |
| TGWB | G'temala | 6.54 | 45.87 | 9.30 am—3 pm |

**Latin-American and other stations seldom, or unlikely to be heard, have been omitted.**

| Call Sign | Location | Mc. | M. | Time: Eastern Australian St'dard |
|---|---|---|---|---|
| WKTM | New York | 6.38 | 47.01 | 5.15—7 pm |
| GRN | London | 6.19 | 48.43 | 5.45—6.30 am; 9.30 am—2.45 pm; 5.20—5.35 pm; 2.15—2.30 om; 3.30—3.45 am |
| VUD-2 | Delhi | 6.19 | 48.47 | 9.30—10.15 pm; 11 pm—1.35 am; News 10 ond 11.45 pm |
| XECC | Puebla | 6.19 | 48.47 | From 2—4 pm |
| WGEA | Schenectady | 6.19 | 48.47 | 2.15—4.10 pm |
| LRM | Mendoza | 6.18 | 48.51 | 8.30 am—1 pm |
| GRO | London | 6.18 | 48.54 | 5—10.45 am; 2.40—7.45 pm |
| WCRC | New York | 6.17 | 48.62 | 2.15—5 pm |
| FK8AA | Noumea | 6.16 | 48.62 | 5.30—7 pm; News 6.18 pm |
| HER-3 | Berne | 6.16 | 48.66 | 4—7.45 am |
| HJCD | Bogota | 6.16 | 48.70 | Around 2 pm |

| Call Sign | Location | Mc. | M. | Time: Eastern Australian St'dard |
|---|---|---|---|---|
| CBRX | Vancouver | 6.16 | 48.70 | 11.30 pm—4.30 pm |
| CS2WD | Lisbon | 6.15 | 48.74 | 5.30—8 am |
| EQB | Teheran | 6.15 | 48.74 | 4.30—6 am; News 5.15 am |
| WBOS .. .. | Boston | 6.14 | 48.86 | 6—8 pm |
| CXA4 | Montevideo | 6.12 | 48.98 | Around 2 pm |
| HP5H | Panama City | 6.12 | 48.99 | 9 am—2 pm |
| YV3RN | B'quisimeto | 6.12 | 49.02 | Around 1.30 pm |
| XGOY .. | Chunking | 6.12 | 49.02 | 9.35 pm—2.30 am |
| XEUZ | Mexico | 6.11 | 49.02 | Around 2—3 pm |
| GSL | London | 6.11 | 49.10 | 9.30 am—4.45 pm; News 11—6 am; 12.45 and 2.30 pm |
| CBFW | Montreal | 6.09 | 49.25 | 9.30 pm—1.30 pm |
| ZNS-2 | Nasau | 6.09 | 49.25 | 11—11.15 pm; 3.45—4.15 am |
| WLWO | Cincinnati | 6.08 | 49.34 | 2.15—5 pm |
| GRR | London | 6.08 | 49.34 | 1.45—6.30 pm. News 5.30 pm |
| CKFX | Vancouver | 6.08 | 49.34 | 11.30 pm—4.30 pm |
| CFRX | Toronto | 6.07 | 49.42 | 9 pm—3.30 pm |
| — | Moscow | | 49.42 | 6.30—7.30 pm |
| SBO | Stockholm | 6.06 | 49.46 | Try around 7.30 am |
| VQ7LO | Nairobi | 6.06 | 49.50 | 2—5 am |
| WCDA | New York | 6.06 | 49.50 | 9.30 am—4 pm |
| GSA | London | 6.05 | 49.59 | 8.45—10.45 am; 1.45—6.30 pm News 5.30 pm |
| XETW | Tampico | 6.04 | 49.66 | 10 pm—4 pm |
| WRUW | Boston | 6.04 | 49.66 | 2.15—4 pm |
| HP5B | Panama City | 6.03 | 49.73 | 9 am—1 pm; 1.30 am—5 am |
| — | Moscow | 6.03 | 49.73 | 9.40—10.19 pm |
| CJCX | Sydney (Nova Scotia) | 6.01 | 49.92 | 9 pm—4.30 am; 8 am—1 pm |
| VUD-3 | Delhi | 6.01 | 49.92 | 10.25—11.35 pm |
| GRB | London | 6.01 | 49.92 | 8.45—10.45 am; 1.45—6.30 pm |
| ZRH | Joh'burg | 6.00 | 49.95 | 1—7 am |
| CFCX | Montreal | 6.00 | 49.96 | 10 pm—1.15 pm |
| HP5 | Colon | 6.00 | 49.96 | 10 pm—4 am; 8 am—2 pm |
| ZOY | Accra | 6.00 | 49.96 | 8.30—9.15 pm; 2.15—5.15 am. News 5 am. |
| XEBT | Mexico City | 6.00 | 50.00 | 1 am—3.30 pm |
| WKRD | New York | 5.98 | 50.12 | 5 to 7 pm |
| VONH | St. John's | 5.97 | 50.25 | 10.30 pm—4.30 am; 7—11.35 am; News 7.30 am |
| HVJ | Vatican City | 5.96 | 50.26 | 4.30—6.30 am |
| — | Khabarovsk | 5.93 | 50.54 | 8 pm—midnight |
| — | Moscow | 5.89 | 50.90 | 8 pm—6 am |

# SPEEDY QUERY SERVICE

**Conducted under the personal supervision of A. G. HULL**

**M.V.R. (Caulfield) has built a set which is O.K. except for a faint high-pitched whistle when the volume control (of the A.F. type) is full on.**

A.—We think you are having positive feedback of the very high A.F. frequencies, possibly from the anode of the output tube to the grid of the preceding tube. See that the input and output leads are well separated. Other cures are the connection of a .00025 mfd. condenser from each of the last two anodes to the chassis and the insertion of .1 meg. resistors ("stoppers") in the grid leads of the last two tubes. Earthing the metal frame of the speaker sometimes helps.

●

**S.P.R. (address not given) wants constructional details of a de luxe communications set.**

A.—Sorry, we're not running articles of that type at present as readers cannot obtain the parts. We promise to give you something pretty good after the war and in the meantime refer you to the August 1940, and January, 1941, issues of 'Radio World."

**H.K.R. (Warrnambool) asks what impedance you get by connecting two similar speakers in parallel.**

A.—It's just like resistors in parallel. The resultant impedance is half the impedance of each and this holds true whether the two voice-coils are connected together in parallel and one transformer used, or the two transformer primaries are connected in parallel. For example, if you want to connect two 8/20's to a pair of 6V6G's requiring 10,000 ohm C.T. then you can either connect the two voice-coils in parallel and use a single 20,000 ohm C.T. transformer or use two separate 20,000 C.T. transformers in parallel, one for each speaker. The former system gives better tone and better frequency response, up to medium volume levels. The latter system handles a shade more power, but bass response is not quite so good.

●

**A.A.R. (Broken Hill) wants to over-bias his output tube and wants to know what effects it will have.**

A.—A slight over-bias (say 25 per cent increase in voltage) will have only a negligible effect. Probably there will be no noticeable difference in the response. The normal bias resistor for a 6V6G is 250 ohms, but we have tried up to 750 ohms and it still works fairly well with only a slight dropping off in power and sensitivity. Increasing the speaker load reduces the effect of increased bias. If the increase in bias cuts the plate current down to two-thirds of its original value, then the speaker transformer could be changed to one about 1½ to 2 times the original value.

●

**F.E.S. (Glenelg) wants the circuit for an electric-guitar amplifier.** ...... ... ....

A.—There's one scheduled for next month. Alternatively you could use the Standard 4-watt Amplifier of the January, 1943, issue. For more power the "direct-coupled phase-changer" circuit shown in the issue could be used.

●

**P.S.S. (Bridport) asks if it is safe to draw 10 ma. from an 80 ma. power transformer.**

A.—Yes, IF. But it's a big IF. You must use a choke-input filter, thereby losing in voltage what you gain in current. The choke input filter makes the 100 ma. equivalent to about 85 ma. from a condenser-input filter. Still an overload, but not bad if it's a good quality job. Taking less than the full allowance from the filament windings is a great help as then only one winding (the H.T.) is overloaded (and overheated). Loosen the transformer screws and run shellac-alcohol varnish between the laminations to reduce core loss from eddy currents. One last tip—have plenty of ventilation.

●

**Hiker (Q.). My neighbours complain that my set causes interference. Can they stop me from using my set?**

A.—Yes. All they need to do is to complain to the local radio inspector, and you will be having an unpleasant visit. You **must not** operate your set in an oscillating (squealing) condition. It is against the law. Do no advance your reaction control so far.

## MAKING CRYSTALS

To make a Radio Crystal a piece of lead the size of a pea and a gramme of sulphur are needed. Melt the lead and put the sulphur into it, and you will have quite a good crystal.

## INSTALLATION HINTS

Indifferent performance of a radio receiver is often due to indifferent installation and operation in the home. A little time spent on the receiver when installing and operating is a safeguard against noisy or inferior reception. The following hints are included to aid you in getting the best from your receiver:—

1. HIGH BACKGROUND NOISES OR HISS ON STATIONS. This effect can be due to lack of, or inefficient aerial. An aerial, as previously mentioned, is recommended for localities outside of the suburban area and a reasonable indoor aerial for suburban areas if an outdoor aerial is impracticable. The effect is to increase the signal pickup and lift the signal out of the background noise.

2. HIGH HISS LEVEL AND DISTORTION. Poor reception of this type is often due to inaccurate tuning, especially when the receiver has a high degree of selectivity. One method is to tune by the background noise which will be at its minimum when the receiver is accurately tuned to the centre of the station.

3. ELECTRICAL INTERFERENCE. An intermittent crackle can be caused by faulty electric light globes, loose contacts in mains, plugs or sockets, or faulty electrical appliances such as vacuum cleaners, etc. Try removing all globes and plugs one at a time and inspect the contacts before replacing. If signs of arcing are noticed the faulty part should be renewed. Try the receiver in another building if the trouble ceases have the house wiring checked for intermittent connections.

4. TONE. Do not place the receiver flush against the wall, but leave a small space. Avoid placing near soft hangings are curtain, as these can impair the tone.

—From an "Astor" instruction book.

## AIR FORCE

(Continued from page 6)

bomber's movement and the 300-mile-per hour blast of the air stream. He makes himself aim deliberately, forces his tensed muscles to traverse smoothly. It seems that the fighter will never stop . . . And then it veers, a stream of black smoke pours out of the fuselage behind the cockpit hatch — and the Jap slips with slanted wings downward to the sea and oblivion. . . .

The giant bomber pitches sulkily among the puffs of a.a. fire. The radio operator, back at his post, mentally tightens the headphones on his ears. He must not miss a letter of the squadron commander's instruction that will follow. The order comes in coded staccato, the operator relays the information on the interphone, and the pilot points the bomber's nose on the new course in response. . . .

A hundred times they have lived that scene or its equivalent in their minds — the pilot, the bombardier, the navigator, the engineer . . . and the radio operator. A hundred times during the weeks and months at the technical training schools where they learn their trade.

—From an article in "Q.S.T." by Clinton De Soto.

## electronic briefs: FM

Radio is simply a method by which electrical energy is transmitted through space. By varying the intensity or frequency of this electrical energy, an intelligible signal can be created. The principle is the same whether dot dash code messages or voice and music are being transmitted. In the case of voice and music transmission the radio wave must be varied (modulated) at the same speed as the vibrations of the voice or music. The characteristics of electrical energy which can be varied or modulated are three: voltage, frequency and phase. Radio transmitters which vary the intensity (voltage) are called amplitude modulated and those which vary the frequency are called frequency modulated. The differences of these two systems can be understood easily by visualizing a beam of light. An audible signal can be transmitted by varying the light intensity (amplitude modulation) or by varying the color of the light beam (frequency modulation).

Static and other man-made electrical disturbances are identical in character to the amplitude modulated signal. Hence these disturbances are extremely bothersome to AM broadcasts. On the other hand these electrical disturbances do not essentially vary in frequency and consequently do not interfere with FM transmission. Another fortunate characteristic of FM is the fact that the stronger of two signals predominates, thus eliminating much inter-station interference and cross-talk. Further, and of great importance, the fidelity of tone can be made nearly perfect even when the heaviest of musical scores is being broadcast.

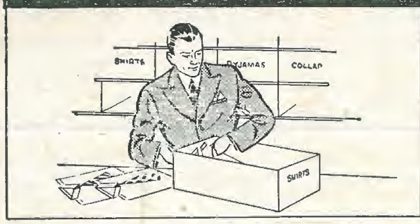
In frequency modulation as in all things in the field of electronics, vacuum valves are the most important component. Eimac valves have the distinction of being first choice of most of the leading electronic engineers throughout the world. They are consequently first in the most important new developments in electronics . . . FM for example


**EITEL-McCULLOUGH, INC.**
SAN BRUNO, CALIFORNIA

*Export Agents: Frazar & Hansen . 301 Clay Street, San Francisco, California*

*y-Navy "E" awarded for achievement production r material.*

# How John Stepped Out . . . .

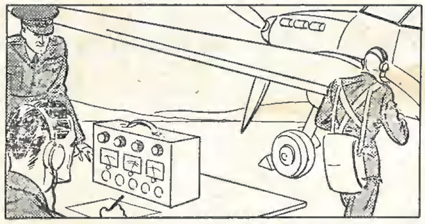



Not so very long ago, there was a young shop assistant named John, who wanted to do his best in the War effort. Being untrained, he did not know what do about it.

Until he heard about A.R.C. Radio Engineering training, and wrote for details of the course. He quickly saw the advantages of learning Radio Engineering, and started the A.R.C. course in his spare time.

John quickly learned enough to take a position at Radio Defence work, which was found for him by the College. This meant more money and good opportunities for advancement.

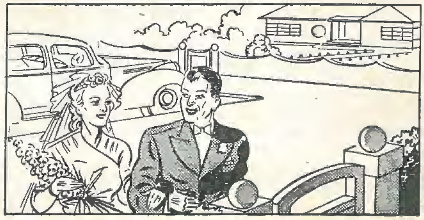
Had he wished at that time, he could have joined a Radio Unit in the Army at communications work, radio maintenance, or some other form of military radio work.



Or in the R.A.A.F. as a Radio Operator in air crew, or on the ground staff. Radio maintenance work, and radio location work, were also open to him.

Still on Defence Work, he carries on with his spare-time Radio training with the Australian Radio College. All the time making himself more and more proficient at Radio work.

Soon, by reason of his training, he is promoted to take control of his section of the work. This means another rise and prospects of even more promotion.



This extra money means wedding bells for John, and a home of his own. He can see the fulfilment of his highest ambitions quickly taking shape.

When his Radio Training is completed he will be ready to take up an executive Radio position. This may come during or after the end of the War. What is most important—HIS FUTURE IS ASSURED.

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