THE AUSTRALASIAN Radio World

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VOL. 8 . . . . . NO. 6 NOVEMBER 15 1943

P U 16

★ **Full details of parts priority plan for radio servicemen.**

★ **Special receiver design to operate direct from 32-volt plant.**

★ **Simple feedback circuit makes easy adaption for popular circuits**

★ **Our short-wave station lists are practical reception help.**

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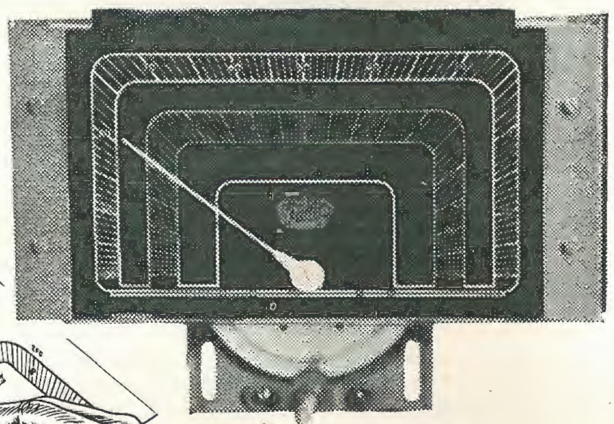

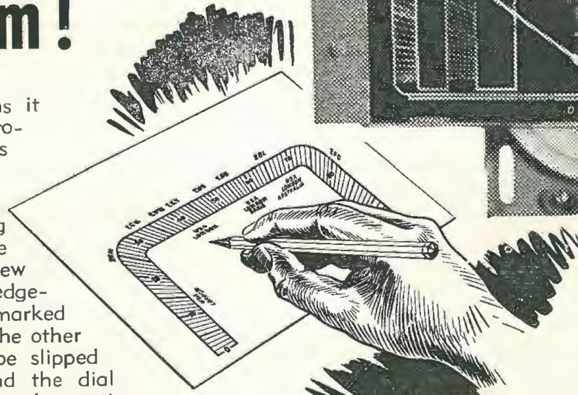

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THE AUSTRALASIAN RADIO WORLD

Devoted entirely to Technical Radio

and incorporating

ALL-WAVE ALL-WORLD DX NEWS

Vol. 8 NOVEMBER, 1943 No. 6

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CONTENTS

EDITORIAL

In this issue will be found the full details of the parts priority plan for radio servicemen. It is bound to be of vital interest to all our readers.

Not actually covered in our issue, but already well publicised in the daily press, is the order controlling the sale of radio receivers. At the moment of writing, Dame Rumour has it that parts are to be frozen, too, and only released to servicemen. This is logical, so we won't be at all surprised if it has become a fact by the time these lines appear in print.

There appear to be two trains of thought on the above moves. One is that control is inevitable; the other, a pious hope that the efficiency factor of the administration will be such that a better result will be achieved than could be obtained if the manpower hours of the organisation involved were applied to the production of materials and components.

When the history of this period is being written, there is a chance that it will not appear as efficient as desirable, especially if account can be taken of the manpower hours wasted in wangling, hunting for black markets, waiting in queues, and so on.

However, be that as it may, it is the clear duty of everyone to do their utmost to accept regulations as they come, abide by them as far as practical, and do everything possible to discourage the corruption of morals and principles which seem to be the unfortunate wake of Regulations.

—A. G. HULL.

Servicemen Get Radio Parts Priority

IT has been decided that radio servicemen holding A class licences under the Control of Radio Service Order shall have prority over those with B class licences for the purpose of purchasing radio spare parts in short supply.

The types of servicemen qualifying for the two classes of licences have been defined in general terms. The basis on which A class licences will be granted is that they will be issued to those radio repairers who have major maintenance responsibilities in servicing the largest numbers of receivers, while those who have comparatively small numbers of sets to maintain will be given B class licences.

Class "A" Licences

The general effect of this adjustment in practice will be that A class licences will be issued to persons who are engaged in servicing receivers as a full-time occupation ,and to firms who employ on a full-time basis, radio mechanics engaged on this work.

A class licences will also be issued to those rural repairers who are not maintaining receivers as a full-time trade, but who are responsible for servicing the receivers in zones allotted to them.

Part-time Men

Generally, B class licences will be granted to men who service sets as a part-time or spare-time occupation.

However, the trade is reminded that licences will not be issued automatically to persons falling into those categories. Issuance will be governed by the terms of the order.

Boundary Operators

When a repairer wishes to operate on both sides of a State boundary he must obtain licences for both States concerned.

Repatriation

Sympathetic consideration will be given future supplementary applications for licences by discharged members of the fighting forces. Efforts will be made to fit such men into the zoning system.

Sub-contractors

The fact that a man may be servicing, repairing or reconditioning radio sets under sub-contract to another person or firm does not relieve him of the necessity to obtain a licence. Similarly, such other person or firm letting out such work on sub-contract must also be licensed.

Licence forms are being prepared now.

In general it is desired to discourage travelling by repairers and to encourage listeners to send their receivers to servicemen's business premises. This would save mechanic's time and fuel. Unnecessary travelling in rural areas can be eliminated in many cases if repairers will arrange to call at centres distant from their headquarters on specified dates.

Minimum Travel

The Department of War Organisation of Industry appeals to all radio servicemen to minimise travel on maintenance work.

Mr. Dedman, Minister for War Organisation of Industry, has appointed radio service advisory committess under the Order for New South Wales, South Australia, Western Australia, Victoria and Tasmania.

The personnel of the appointed committees is as follows:—

Victoria: Mr. L. L. Burch, Victorian Deputy Director of War Organisation of Industry, chairman; Messrs. A. G. Warner, W. Richards, A. Stewart, D. J. Collins, representing servicemen; Messrs. A. D. Goodwin, A. P. Williams, J. B. Mason R. R. Boom, representing mechanics.

New South Wales: Mr. S. A. Maxwell, chairman; Messrs. W. J. J. Wing, W. J. O'Brien, H. G. Blackwood, H. G. Palmer, L. F. Wilson, representing servicemen; Messrs. J. N. Thom, G. R. G. Anderson, V. C. Jones, W. J. Stevenson, L. T. A. McGowan, representing mechanics.

South Australia: Mr. L. T. White, chairman; Messrs. H. R. Pinkerton, T. W. Govenlock, W. A. Ferres, R. W. Brisbane, representing servicemen; Messrs. P. W. Trevorrow, W. G. Huppatz, representing mechanics.

Western Australia: Mr. W. Orr, chairman; Messrs. F. D. Beames, C. S. Baty, A. S. Denning, representing servicemen; Messrs. J. M. B. d'Almeida, C. A. Moore A. V. Rose representing mechanics .

Northern Tasmania: Mr. S. Craw-

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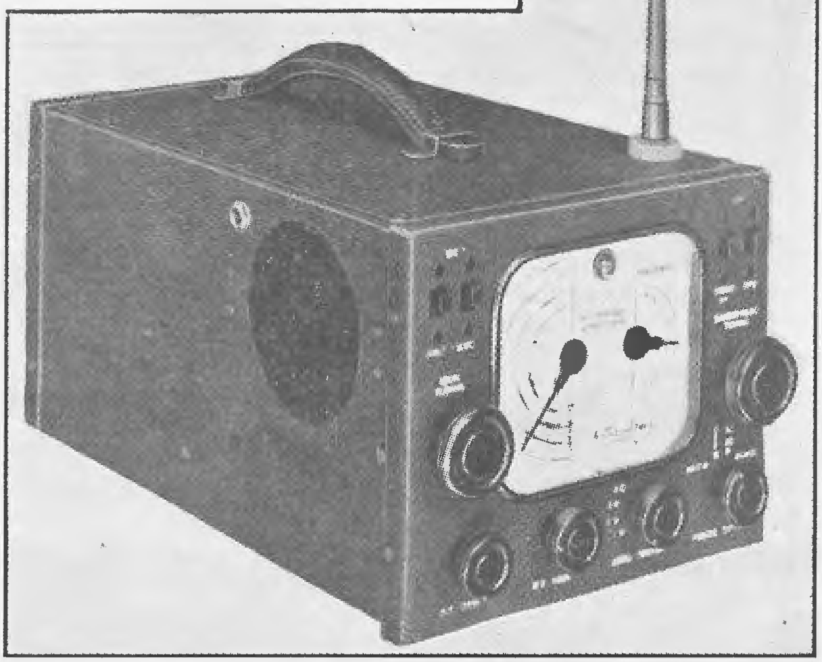


A fine example of radio development in U.S.A. — a self-contained communications receiver made by Hallicrafters.

Long Range Plans For Radio Industry

In his talk before the Annual Luncheon Meeting of the Radio Manufacturers Association (U.S.A.), James L. Fly, Chairman of FCC, made some very pertinent remarks regarding long-range planning for the post-war period.

Said Mr. Fly, "Before plunging into a post-war period we ought to pledge ourselves to ask the same questions we did when entering this present emergency period. The terms peace and war are merely reversed in the query. Sooner or later we must again ask ourselves: Can the radio industry survive the transition from war to peace? Can our post-war economy keep this vastly expanded industry, with its additional plants and its increased payroll, busy in the years to come? Can it meet the great potential public demand in a manner which will result in optimum benefits to the public? And, can the transitional period be bridged without undue dislocation?"

The Answer

Mr. Fly's answer is long-range planning: "For twenty years this industry, just like every other industry, has been completely occupied with short-range planning — with getting ready for next year's model. Soon you will have an opportunity to plan — and to get off the endless treadmill of short-range planning. Ask yourselves 'Along what lines should radio develop over the next decade?'

"No group of producers and engineers have ever had placed upon them a more serious challenge. We must not plan anything that will fall outside the realm of sound engineering and good judgment. But if we can tell during the next year what general lines radio services should and will follow five or even ten years from now, we should be derelict in our greatest duty to ourselves and to the public were we to fail to plan now. This is an opportunity unparalleled in the history of the radio industry and paralleled in very few industries at any time.

Problems of Peace

"When peace comes these problems must be solved. Shall we run headlong into them and solve them on the spur of the moment, or shall we devote what time we can to lay a groundwork in advance? A look at the allocation pattern today should serve as a reminder that planning is well worth the effort. After this war, we must do better still, and insure that all phases of radio will be re-established on a firm and spacious foundation, broad enough and soundly enough designed to make possible indefinite advances along the lines of improved public service. At the same time radio services that can be unified must be unified. The public will not tolerate the idea of a heavy investment in each of several forms of regular radio service, or a living room full of radio boxes.

"Not the least challenging of our ultra-modern developments is the opening of the limitless ranges of the higher frequencies. Yet the development of varied and extensive uses of radio continues to keep demand ahead of supply. We cannot, in the foreseeable future come any nearer to the complete satisfaction of the frequency demand than the greyhound comes to the mechanical rabbit. Yet there is the problem and we must keep after it." —Radio (U.S.A.).

BOMBER RADIO TEST CHAMBER

A simple altitude test chamber for aircraft radio and electronic equipment, in which engineers can now for the first time see the entire apparatus in operation under conditions duplicating the stratosphere seven and one-half miles up, has been developed by the RCA Victor Division of the Radio Corporation of America.

Built of transparent Plexiglas, the chamber is actually the unfinished nose of a bombing plane. Because of the transparent construction, it makes possible the complete testing and inspection of any piece of radio apparatus by several engineers at one time and materially speeds test work. This new construction has eliminated the difficulties found with standard test chambers which are constructed of metal and permit vision only through small portholes.

Defects in design, which normally would remain hidden until actual high altitude flights could be made, are now spotted at a glance. An entire complement of test instruments and meters may be connected to the apparatus under test and plainly viewed by the project engineers.

This chamber is cone-shaped, about four feet high and five feet in diameter at its base. It is just less than one-inch thick and capable of withstanding tremendous shocks and pressures. An air-tight seal is accomplished by fitting a heavy platform, arranged for mounting radio apparatus under test, with a ring of soft rubber. The test chamber cone is then lowered until its base rests on the rubber ring. As the air is withdrawn by a powerful suction pump, the atmospheric pressure on the outside of the chamber forces it down into the rubber ring and creates a perfect air seal.

RECEIVER TO OPERATE FROM 32 VOLTS

FROM Mr. N. O. Darling of Tumby Bay, South Australia, we have received a circuit of a set which he built three years ago. According to Mr. Darling this receiver has proved completely satisfactory in every way, even on shortwave reception. Normally, the valves used are intended to operate with a high tension supply of 250 volts or so. But Mr. Darling has proved that they are also capable of giving satisfactory results with only 32 volts. Of course, this voltage is applied to both plates and screens, making a circuit which is even simple than usual, as hardly any dropping resistors are necessary.

Dual-Waves Used

Mr. Darling used a type DW35 coil kit of R.C.S. brand, and this seems to indicate that a modern and efficient coil unit is all that is required. Similar coil units in Radiokes and Crown brand could be expected to give similar results.

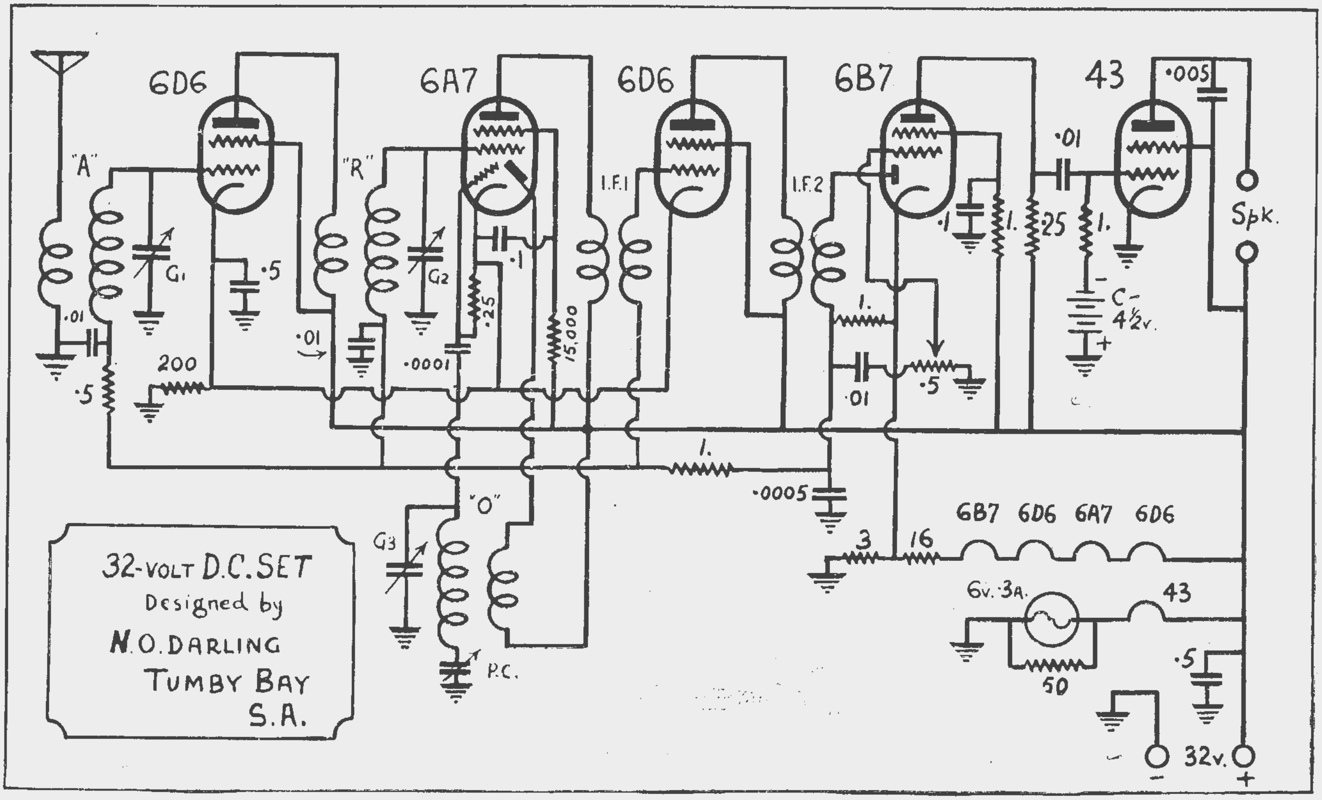
The valve types used by Mr. Darling were those popular at the time, but again this is a point where it should be possible to make substitution without affecting performance. Similar valves in the modern series would be 6U7G, 6A8G, 6U7G, 6B8G, etc. In the case of the output valve, of course, it will be necessary to make certain of using a valve with a similar heater current or else making the necessary alterations to ensure that the voltage distribution in the heater circuit is correctly arranged so that no valve gets more than its normal current, or a greater voltage drop across its heater than normally specified.

Bias by Battery

It will be noticed that a "C" battery is used to provide bias for the output valve. This allows the full high tension voltage to be usefully employed, and although to a certain extent an inconvenience, the bias battery does not require much attention. Normally it should run for about nine to twelve months without need of replacement. Bias for the diode-pentode second detector is taken from the filament circuit by taking the cathode of this valve to the junction of two heavy-duty resistors carrying the heater current.

Heater Circuit

In the heater circuit of the output valve full use is made of the current taken by a dial light. Care should be taken to see that the dial light is of correct type drawing the specified current of .3 amperes. Of course, if so desired, it is a simple matter to work out alternative circuits for other types of valves, or to compensate for using a dial light of different current rating, or in fact, for doing without the dial light. Mr. Darling has given this circuit a thorough try-out in the years that he has had it operating, also building several other sets to the same circuit and selling them. We feel sure that our readers will appreciate his circuit and find it a sound foundation for a novel type of receiver of great value to those who have home lighting plants of the 32-volt type.



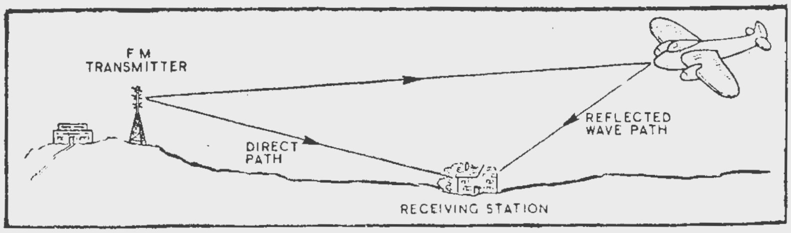
Future Applications Of Frequency Modulation

FREQUENCY modulation can, under certain conditions, offer tremendous advantages over amplitude modulation. A rational appreciation of its true worth has been shown in the planning of the Police Communication system installed on the recently opened Pennsylvania Turnpike. This 160-mile stretch of super highway has an elaborate system of both fixed and mobile transmitters and receivers. Although they all operate on the ultra-short band, frequency modulation has only been used for communication with the patrol cars.

The system is based on a number of automatic relay stations situated on a series of hill tops. Amplitude-modulated transmitters working on the 116-119 Mc/s band have been used for this radio "trunk line," which can be tapped at any point over the whole length of the highway. More than half the receivers on the system are, however, fixed-tuned to the complementary FM transmitters, used for the actual radio link to the patrol cars.

Although these FM transmitters all operate on the same frequency (33.94 Mc/s) their carriers are not locked together. In spite of this, patrolmen are unable to tell from the received speech when they are passing from an area covered by one station to that of another. This is due to the way in which the weaker FM station is suppressed by the stronger. It would have been impossible to achieve this remarkably smooth transition from one station to the next with amplitude modulation. Reception between stations would have been marred by heterodynes, which could only have been overcome by locking all the transmitters to a common carrier.

This modern communication system exemplifies the probable future which lies ahead of frequency modulation in the communication field. While FM may be the only method of achieving a given set of results, other conditions may be better satisfied by the use of amplitude modulation.



Frequency modulation can be affected by reflections, as from a moving aircraft overhead.

Post-war Broadcasting.

The question of whether or not FM should be introduced has to all intents and purposes already been answered in the affirmative by the system itself. In the long run nothing will hold down any system offering theoretically perfect reproduction with an interference level lower than was dreamed possible a few years ago.

Although there will naturally be a period of transition it is possible to look ahead for perhaps ten years, and forecast the changes which FM will have produced in the domestic broadcast receiver. The set of the future will almost certainly have three bands, or, if it is in the higher-priced class, three groups of bands. The first will be the new FM broadcast band extending from perhaps 50 to 60 Mc/s. This band will have largely displaced the existing medium-wave band and will be used by the bulk of the listening public.

The medium-wave will comprise the second group available to the listener. These bands will be used by older or cheaper receivers, portables and midget sets. The listener with an FM receiver will only use the MW band for the reception of stations which are too far away to be received on the FM band. While the quality obtained on the MW band will not be comparable with that from the local FM stations, it will still be considerably better than that obtained on the shortwave band. But, although quality may be inferior on the short-wave band, that is the only part of the frequency spectrum on which world-wide reception is possible, and so the distortion resulting from selective fading will have to be tolerated.

Receivers of the Future

The receiver of the future will therefore have these three groups of bands. The FM band providing superb quality from local stations, the MW band offering good programme value over greater distances, and, lastly, the SW band giving world-wide reception at a low quality level.

Assume for the moment that here, as in America, a band of some 10 Mc/s is allocated for FM broadcasting. Even with a station separation of 250 kc/s there would be room for some 40 channels. At first sight these figures may not seem to be very interesting, but on further investigation it is found that they offer grounds for revising our entire system of home broadcasting. It has earlier been pointed out that the weaker FM station is suppressed by the stronger and that the limit to the service area of each is sharply defined. In the light of these facts it is apparent that the whole 40 channels will be available for local stations. Two hundred miles or less from each station there could be another working on the same frequency. Apart from a very small zone of confusion there would be no interference between the two stations.

Forty Local Programmes

While the prospect of 40 local programmes may make the programme director shudder, there is no reason why they should not all be usefully employed. Some channels could be devoted to services run perhaps by Education or other authorities, others entirely to plays and vaudeville or perhaps news reviews and bulletins.

Wide-band frequency modulation, with its wide frequency response and noise-free reception, offers a resounding challenge to certain projects that have been put forward for "wired wireless" broadcast distribution. It also places all relay systems at a serious disadvantage, as it does most existing methods of obtaining interference-free reception under difficult conditions.

FM and Fading.

The most serious form of distortion which can be caused to an FM transmission results from selective fading, caused by interference between waves arriving by direct and reflected paths of different length. The effect of random variations in the received sideband amplitude is serious enough with amplitude modulation. While it results in severe distortion on the short-wave band, reception is usually intelligible; under the same conditions a wideband FM programme would, however, be almost, if not completely unintelligible.

There is another form of reflection due to "reflection boundaries" which become noticeable at round about these frequencies. This form of reflection differs radically from that due to the ionised layers. It would appear that it takes place at the boundary between two different air masses.

There is still one further type of

(Continued on next page)

FREQUENCY MODULATION

(Continued)

reflection which may well turn out to be the most troublesome. The reflections from a moving aircraft can cause serious distortion to an FM programme. By reasoning similar to that adopted for the boundary layer reflections it can be shown that the difference between the direct and the reflected path lengths can be great enough to result in selective fading.

In addition, aircraft reflections can produce detrimental results due to the shortening or lengthening of the path taken by the reflected wave. Due to the Doppler Effect, the reflected signal frequency will be increased by an amount determined by the rate at which the transmission path is being shortened, conversely the reflected signal frequency will be lowered while the reflection path is being increased. The result at the receiver is a heterodyne due to the frequency difference existing between the reflected and the direct waves. Taking the example shown in Fig. 1, the reflected path length is being shortened at a rate which is twice the speed of the approaching aircraft. Assume that it is travelling at 300 miles per hour (or 134 metres per scond). The length of the reflected path is being shortened by some 268 metres per second. If the carrier wavelength is 6 metres (50Mc/s) the reflected signal frequency will be raised some 45 c/s. The difference frequency between the reflected and direct carriers will therefore result in a 45-cycle heterodyne. The following point should, however, be noted. The example taken is an extreme, and in the majority of cases the heterodyne would be lower in frequency and therefore in all probability below the limit of audibility. It was this same effect which in pre-war days caused a television picture to "flutter" when an aircraft passed low overhead.

Summing up the position, low-frequency heterodynes accompanied by selective fading, due to moving aircraft reflections, may be expected under conditions of low ground field strength with high field strengths above the ground; as for instance in a valley near an aerodrome or any other point at which aircraft pass low overhead.

—Wireless World (England.)

Design Of Screening For Receivers

SCREENING in a radio receiver consists essentially of preventing the magnetic or electrostatic field of one component from extending and linking with the field of another component or with the field of an unwanted signal. That somehow bald explanation might be rather confusing to the non-technical reader, so it would be well to explain that when an alternating or radio-frequency current is passed through a component such as a coil, transformer, or even a length of wire, a magnetic field is set up round that component.

The real difference is that the field of a coil, when connected in a receiver circuit, is constantly fluctuating in strength, whereas that of a permanent magnet remains constant. Actually, the field produced by a coil would be constant if a steady direct current were passed through the windings.

Iron for A.C. Stream

In the case of the magnetic field produced by a permanent magnet, or by an electro-magnet created by passing a steady current through a coil, screening or shielding can be effected by encasing the magnet in a soft-iron box; the iron "absorbs" the magnetism which surrounds the magnet. If the magnet were so screened it would have little or no effect on a compass placed near to it but outside the screen. Partial screening could be effected simply by placing a soft-iron sheet near the magnet. That is, of course, the customary method of shielding or screening a component such as an iron-cored choke or a power transformer.

The screening of components carrying radio or high frequencies is not as easy, however, due partly to the fact that the field is of constantly varying intensity and also to the fact that it is often of far greater extent. As an example of this, consider the electro-magnetic field set up round a transmitting aerial; its effect spreads for hundreds or even thousands of miles. And yet the field of, say, a huge power transformer handling the the same amount of power as the aerial is limited in most cases to a matter of yards.

Non-ferrous Metals for H.F.

To screen high-frequency components it is customary to use a non-ferrous metal such as aluminium or copper. This is because iron is more "absorbent" and takes away most of the energy passed into the coil. The non-ferrous metals act as what are known as electrostatic screens, preventing the spreading of the field without seriously reducing the efficiency of the component that is screened. Nevertheless, the screen does reduce the efficiency of the component to a certain, if limited, extent, especially if it is placed very near to the component. The reduction in efficiency is proportional to the frequency of the current being handled. Thus, screening can cause greater losses on short waves than on medium and long waves.

For a screen to be completely effective it must entirely enclose the component. That is why coil screens are made in the form of small metal canisters with tightly fitting lids. Holes through which connecting wires are taken are kept as small as possible. Another essential if the screen is to be effective is that it will be well earth-connected. It is often found when testing a receiver which has become unstable or prone to incurable self-oscillation that the only trouble is that one of the screening cans is loose or that the earth connection has come adrift.

Minimising Losses.

In screening a coil it is always desirable to have the screen as far as possible away from the ends of the winding, although it can be much nearer to the winding at the sides. The field is most concentrated at the ends of the winding and that a screen placed there completely breaks the circuit of the imaginary so-called "lines of force." A fair rule concerning coil screens is that the screen should not be nearer than the diameter of the coil to the ends of the windings; it can be about one-half the diameter from the sides. This is a very general statement and should not be considered as a fixed rule.

Apart from the external screens—among which should be included the metallised coating of valves — there are various internal ones which are concerned with the design of the components. Thus there is the so-called suppressor-grid in a pentode. This is placed between the auxiliary grid and the anode and is earthed, either due to its internal connection to the filament or cathode, or by an external wire. In some instances it is worth while to experiment with the most satisfactory method of earthing this screen; sometimes it is better to connect it directly to the earth terminal by the shortest and most direct wire that can be arranged, whereas in other instances results are more satisfactory when it is simply joined to the cathode — from there it connects to earth through the bias resistor and, often, the variable-mu volume-control resistor.

Variable Condensers

Variable condensers are generally of the screened type nowadays, but care should be taken that the screen (through the mounting pillars) is in good contact with the metal chassis or with an earth terminal. When using separate, unscreened condensers it is usually sufficient to erect a vertical screen between them. In the case of short-wave receivers additional screening is often provided by the slow-motion drive — make sure that this is earthed. A metal panel is frequently used to provide additional screening, but this is not always necessary, since if two or three earthed connecting wires run fairly close to the panel and right across it they act as a screen of fairly effective type.

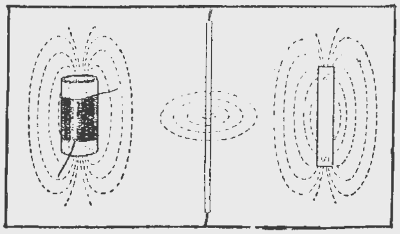


Diagram to illustrate position of magnetic fields.

Connecting Leads.

The screening of connecting wires in grid and anode circuits is often desirable in a highly efficient receiver, but this can be overdone. It will be realised that the screen is very close indeed to the wire, and if this is fairly long the damping effect can be pronounced. For that reason it often pays to use a minimum of screened leads in the first place, screening additional leads if and when it is found necessary; if the receiver is unstable, that is. Remember that the screening must be well earthed; if the lead is more than a few inches long it is not sufficient to earth the screening braid at one end only, but earthing clips should be fitted at about every 6-ins. Also bear in mind that proper screening braid is necessary. If an attempt were made to provide a screen by coiling a length of copper wire round the insulated lead, instability would be encouraged, instead of prevented, because the coiled wire would pick up energy from the connecting lead and increase the field. If a length of

(Continued on next page)

SCREENS
(Continued)

wire is used as an expedient it should be bare and solder should be run along it to short-circuit all the turns.

When two or more portions of a receiver are to be shielded one from the other it is generally desirable that separate screening boxes or partitions be used for each portion. If screens have common screen between two sections it will probably provide an effective means of coupling together the fields of components on its two sides. Another point, if screening boxes are built up from sheet aluminium care should be taken that the corners are a good fit, and that they are riveted or bolted in a number of places.

It is not always realised that screens are ofen provided between the windings of a power transformer. Their purpose is to prevent noise from the primary winding from being induced into the H.T. secondary. The screens in this case generally consist of what might be described as large copper washers with a small portion cut out of each; if they were complete circles they would merely "short-circuit" the transformer, causing considerable over-heating and reducing its output to a mere fraction of what it should be. The screens should, of course, be earthed. Another method of screening, which is often perfectly effective, is to place the L.T. winding between the primary and H.T. secondary windings. In use this is earthed and therefore is effective in preventing the induction of hum into the H.T. circuit.

—Practical Wireless (Eng.)

Radio Analyses Footsteps

TREATMENT of infantile paralysis victims, industrial and war cripples may be improved through data recorded by a twelve-element oscillograph developed in the Myodynamics Laboratory of the University of Rochester School of Medicine. Capable of recording all factors essential for the study of foot functions while walking, this instrument is the result of 17 years of research conducted under the direction of R. Plato Schwartz, M.D., head of the Division of Orthopedics.

Resistance discs are applied to six points on the bottom of each foot. Each disc is smaller, and slightly thicker than a sixpence, so that the records may be made either barefoot or with the subject wearing various types of footwear. The current passed by each of these discs varies in proportion to the pressure exerted upon it as the patient walks. By means of a suitable cable each disc is connected to one of the 12 high sensitivity General Electric galvanometer elements. A tiny mirror in each galvanometer reflects a pin point light beam as the galvanometers deflect in response to pressure changes on respective discs.

Optical System

Focussed through an optical system, these beams strike a strip of photographic paper eight inches wide, 200 feet, long, which is moved past a slit aperture at constant speed by a synchronous motor. Since the light beams swing at right angles to the direction of paper travel, twelve curves are produced revealing the function of six areas on each foot. These curves reveal the duration, amount and seqence of simultaneous pressure changes with 95 per cent. accuracy. The oscillograph was designed and built in the Myodynamics Laboratory by Arthur L. Heath, Research Associate, with assistance from General Electric engineers.

Wider Scope

More recently, the scope of usefulness of the oscillograph has been widened by its application to the recording of Muscle Action current curves. For this purpose four high gain amplifiers were constructed by Dr. H. D. Bouman and matched to the General Electric galvanometer elements. Records of this type are of major importance to the study of infantile paralysis and other forms of neuromuscular pathology. Such records make it possible to demonstrate the presence of spasm in muscles formerly considered to be unaffected by the disease, infantile paralysis.

Are Multiple Valves A Good Proposition?

"IT would not surprise me greatly if when the war is over we found a growing tendency to discard the complex multi-electrode valve in favour of simpler types." writes Diallist in the English "Wireless World." He continues:—

"Personally, I have never been very fond of the valve which, though it is a single component, is really two or three valves assembled in one and the same bulb. In making up sets for my own use, for instance, I have always preferred to have the local oscillator and the mixer separate entities rather than a combined unit of the triode-hexode type. The business of two-in-one and three-in-one valves started, if I remember right, with the German Loewe assemblies. Old readers will recall them. The basic idea was to reduce the length of grid wiring to a minimum and to achieve this the coupling condensers and resistances were actually within the bulb. The next development was to put RC-coupled RF and detector valves, with their condensers and resistances, into one envelope. Alternatively, the assembly might consist of a detector, resistance-capacity coupled to an AF valve. Wasn't there eventually a triple Loewe "valve"; RF-cum-detector-cum-output? I seem to remember that there was. These valves were large things and naturally they had to be treated with no small amount of care.

How it Started.

But the Loewe valves, with their built-in condensers and resistances, hardly deserved to be classed as multi-electrode valves; they were really separate valve assemblies, with their associated couplings, made up in a large glass bulb. I can't recall which of the true two-in-one valves came first, but it was probably the diode-triode. It was a natural development. For years the triode reigned unopposed; it was the only valve. Then a second grid — the space charge grid — made its appearance and we had the first four-electrode valve, the tetrode. The screen grid valve, next in the direct line is, of course, also a four-electrode valve, but the extra grid is differently employed. Some readers will remember the excitement caused by the appearance of the SG at the Radio Exhibition. What year was it? I've no reference books by me at my back-of-beyond station, but 1927 at a guess. It was a queer sausage-shaped double-ended affair. There was a cap at either end, one containing the t wo pins for anode and screening grid and the other the three for control grid and filament. You mounted it in a hole cut in an earthed metal screen, which, you remember, had to be in the same plane as the internal screening grid.

Tetrode to Heptode.

The pentode was first developed in Holland. I heard of it through a friend then living in that country and somehow managed to get a couple smuggled in here, some months before they were known in this country. I remember well the epistolary bricks heaved at my devoted head when I wrote a brief article forecasting the advent (the first pentodes were all of the AF type) of an output valve of enormous anode resistance and an amplification factor of a magnitude then undreamed of! The pentode soon came to stay, for once the RF type was developed and its little ways understood, it was found that there was hardly a limit to the purposes it could be made to serve. But once manufacturers had solved the problem of making valves with three grids the multi-electrode valve began to develop apace and further grids blossomed out. Then came the idea of a diode and a triode in one bulb and combinations, more and more complex, made their appearance. Set designers, seeing the possibilities of such valves, perhaps set the pace for the valve manufacturers.

Points of View.

There is a lot to be said for and against the two-in-one and three-in-one valve, though my own view is that the "cons" outweigh the "pros." To the designer of moderate-priced broadcast receivers, who has to cut his making-up costs to the minimum reconcilable with decent performance, these valves certainly offer enormous help. not only that, but they simplify wiring to some extent and also lend themselves to compactness in the receiver. But from the user's point of view — the broadcast listener, I mean, who is the most likely possessor of the kind of set I'm thinking of — they have one outstanding drawback: they're very expensive to replace. A double- or triple-duty valve is just as easily damaged as a triode — probably more easily — and it's no fun to find that the new one needed is going to cost several times as much as a simple valve.

For the Experimenter

The experimenter and the short-wave addict may use a certain number of complex valves; but most of us have the belief that you can get better performance from a liberal use of the simpler valves than from the employment of a few of the highly complex type. The wartime apparatus used by the Services makes enormous use of the two-, three-, four-, and five-electrode valve and comparatively little of the complicated types. And I have a strong feeling that a return to

Continued on next page)

Circuit Adaption For Easy Feedback

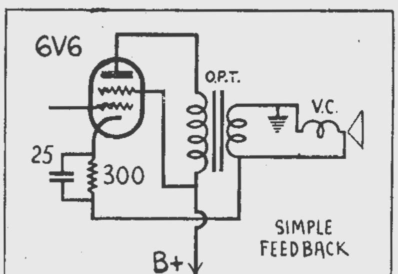
The application of inverse feedback has been a big factor in improving the quality of reproduction of pentodes and beam power valves. Without feedback they tend to give a high percentage of distortion.

Many inverse feedback circuits have been evolved, some of them running to a mass of complication .

For a change, here is a way of introducing a certain amount of inverse feedback without any extra components and without much trouble at all. In practice it is fairly effective and quite worth while. It can be applied to almost any set or amplifier using a single pentode or beam power valve in the output stage.

The idea is to run the self-biassing resistor to the voice-coil side of the speaker transformer, keeping the by-pass condenser across only the bias resistor.

Signal voltages developed across the voice coil are thereby fed back to act as inverse feedback upon the effective bias of the valve.



Two minor points have to be watched. One side of the voice coil must be earthed. Which side is to be earthed can be found by experiment, incorrect connection giving increased gain and distortion, even to a point of setting up a squeal. With correct connection the gain is cut back a bit, but the tone improved quite noticeably.

The scheme can be used with any type of speaker, but will be more effective with those having a high impedance voice coil.

REVIEW OF RADIO WORLD

this state of affairs may possibly be seen in receiving sets of post-war design.

Should We Gain?

We should, I believe, gain a great deal if such a return were made. Were manufacturers (who have learnt a great deal about mass-production methods during the war) free to concentrate their energies on just a few types of valve, none of these being more complex than, say, the pentode or the beam tetrode, production costs, and therefore retail prices, could come down with a run. I do not see why the cost of any of these valves should be more than seven or eight shillings. The public would not mind paying a little more for its receiving sets in the first instance if it felt that it was no longer haunted by the bogy of expensive replacements. Nor, I think, would it object to the cabinets of receiving sets being slightly larger, were this found necessary in order to house the extra valves. Performance could probably be improved and service men would certainly bless the wide use of the simpler types of valve."

JOINS IN AERIAL

Here is a tip for aerials and earths. If by some chance when erecting an aerial or earth the wire has to be cut, or is not long enough, and a joint has to be made, before the joint is made slip about two inches of lead gas piping over the wire ,then make the joint, slip the length of tube over with pliers. This will keep the joint clean and perhaps save a lot of trouble in the future.

—Radiogram (N.Z.)

THE RADIO-ELECTRONIC FIELD

There is as much confusion over what constitutes the field of radio and the field of electronics. But, by averaging the opinions, it would seem that electronics is everything except radio, that radio is communications only, and that radar is a field apart. On the other hand, there is another school of thought supporting the assumption that electronics is radio, radar, television, and anything else using an electron tube.

None of this is really important so long as a popular definition of the word electronics does not make it appear that its scope is limited to the field of communications. Since this possibility exists the term "radio-electronic" is being used as a means of more precisely defining the field of radio-frequency currents, and therefore naturally covers the fields of broadcasting. communications, television, radar, radiothermics, radiolocation, radiocontrol, and the many other applications of radio-frequency currents that are bound to develop in the future.

RADAR EFFECTIVE IN WAR

In the address delivered at the War Production Conference of the Radio Manufacturers' Association of the United States by Ray C. Ellis, Director of WPB Radio and Radar Division, he remarked that the radio-radar equipment used by America's fighting services is much superior to captured German and Japanese apparatus. Combat experiences, with radar in particular, he said, have been such as to hold spellbound and speechless the most experienced and hardened military experts.

Complimenting the radio industry on its military production job, Mr. Ellis stated that through the remainder of this year, and through the first half of 1944 some four billion dollars worth of radio and radar equipment must be produced, with constant changes in design.

"The enormity of our task is so great that it can hardly be conceived," said Mr. Ellis, "The production of one order for a single type of radar model exceeded in value the entire cost of the Boulder Dam hydro-electric project."

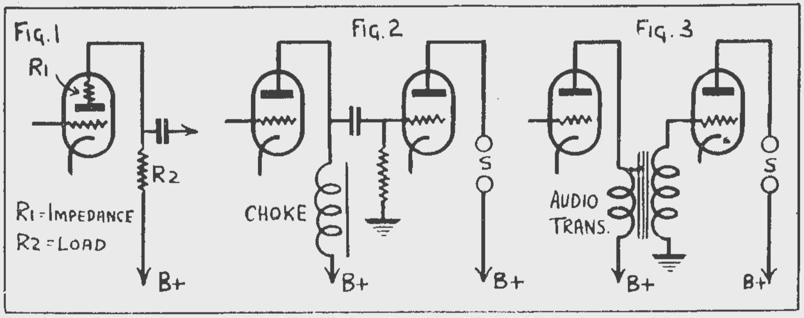
RADIO-MINDED U.S.

Although there is no licensing system in the U.S. whereby the total number of listeners in the country can be ascertained, it has always been considered one of the most radio-minded in the world. This is borne out by the census recently undertaken by the U.S. Bureau of Census, which revealed that 86.8 per cent. of the country's 30,721,894 white households have receivers. Of the 3,168,562 coloured households, however, only 43.3 per cent. are radio-equipped.

The District of Columbia is the most radio-minded of the forty-nin States with a percentage 97.4 of its 127,067 white households owning receivers.

New York is fifth in the list with 95.7 per cent. of its three million-odd white households possess receivers. It has, however, the highest percentage of radio-equipped coloured homes — 92 .

The Limits To Audio Amplification



MANY constructors appear to have the opinion that the amplification of a signal is simply a question of adding valves to an existing circuit. They seem to think that the process can be carried on indefinitely, and that any odd type of valve will do in the intermediate and/or output stages while many more are under the impression that if a valve is classed as an output valve, it can handle whatever power you care to inflict on it.

Every would-be designer, and every constructor at all interested in radio, should tackle the question of getting out his own circuits, and must realise that a valve can handle only a certain amount of work and, if you start giving it more than it is designed to cope with, it will make every attempt to get on with the work; **but something will suffer.** The quality of the output will be the first thing and, secondly, it will start to crack up under the strain. If a little consideration, plus even a smattering of elementary knowledge of the operation of a thermionic valve, is applied to the circuit under design, it will soon be appreciated that for any given operating conditions or particular type of valve a certain maximum input and output only can be handled, without running the risk of overloading and introducing the consequent distortion and strain on the valve or valves.

Stage Gain.

Every valve has what is known as an amplification factor, and this factor plays a very important part in the amplification which will be obtained.

Take the simple circuit shown in Fig. 1, which is used purely to make this statement more clear. Assume the valve to have an amplification factor of 20. If a signal having a value of 1 volt is applied to its grid, it would be natural to think that it would be amplified twenty times, and that 20 volts would be available at the anode for passing on to the next stage. Such an arrangement, if possible, would be ideal, but, unfortunately, there are other things which have to be considered.

Impedance.

Every valve has a certain internal resistance known technically as its **impedance.** This impedance, the same as the resistance in any ordinary circuit, imposes a certain amount of work on the valve, and results in a voltage loss.

Referring to the diagram, the resistance R1 represents the impedance of the valve, while R2 is used to denote the anode load resistance of the external circuit. It can be considered for our purpose as the anode resistance of a resistance-capacity coupling, ignoring any additional external resistance.

The signal voltage which will be available at the anode for passing on to the next stage is directly proportional to the ratio of the external resistance, i.e., R2 to the total resistance of the circuit, i.e., including the valve resistance. Suppose, for example, that R1 and R2 are equal, or in other words that R2 is half of the total resistance. Bearing in mind the above, if 1 volt is now applied to the grid the resultant voltage due to the amplification of the valve will be split up between R1 and R2 to the extent of 10 volts only being available across R2. With this arrangement, therefore, it would appear that the efficiency is very low, but in practice it is possible to increase the effective amplification by increasing the value of the anode load resistance, although it is not usually possible to get more than, say, 60 to 75 per cent. of the total magnification of the valve.

The actual voltage amplification can be found from the formula:

$$\text{V.amp.} = \frac{uR2}{(R1+R2)}$$

when u is the amplification factor of the valve. Many might ask why not increase the anode resistance to such a value that would give even higher magnification. This can be easily answered by asking them to remember that a D.C. voltage has to be applied to the anode of the valve, from the usual source of high tension through the anode resistance, and according to the current flowing so will a voltage drop be produced across R2 which would tend to starve the valve if the resistance was too high in value.

The actual voltage drop can be calculated from the simple formula:

$$\text{voltage dropped} = \frac{\text{current flowing} \times R2}{1{,}000}$$

Choke and Transformer

This defect can be overcome by using a suitable L.F. choke in the anode circuit of the valve. This will have a comparatively low direct current resistance, but by virtue of the reactance offered by the inductance to the alternating current which forms the signal, it will produce a similar effect, as far as allowing the signal voltage to be developed across it, as the anode resistance.

With the I.F. transformer, however, one must take into consideration the additional amplification produced by the ratio of the primary winding to the secondary, and as this is usually of a step-up order, a greater overall amplification will be obtained than with a resistance-capacity coupling.

It would appear from this that the transformer method is the most efficient, but it suffers from a defect when the quality of reproduction is taken to a fine point.

The impedance offered to an alternating current by an inductance varies with frequency and, therefore, causes uneven amplification over the complete musical scale.

—Practical Wireless (Eng.)

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APPLYING THE SERVICE OSCILLATOR

When aligning receivers with a service oscillator it is usual to employ the dummy antenna coupling unit supplied with the instrument. When the oscillator signal is being fed into the aerial circuit for final alignment it is quite correct to use the dummy antenna in this way, but for alignment of the i.f. transformers there are often cases where such procedure will result in improper alignment.

Some manufacturers recommend leaving the clip on the cap of the converter valve, applying the signal from the oscillator through a mica condenser of .01 capacity, the other side of the output being "earthed" as usual.

The Construction And Amplification Of Pick-Ups

RADIO listeners are legion—every home is a listener's stronghold. The average set owner requires of his receiver average reproduction and usually nothing more.

But here and there in the ranks of the average, you come across the music lover, the person who must hear that particular record again. He is the fellow you are after, if you handle him correctly you will fit a pick-up to his set in no time.

Recordings.

Gramophone recording is achieved by impressing sound variations or waves, which have been changed originally from sound to electrical impulses and frem electrical impulses to movement of the cutting styles, on a circular disc of suitable material.

The finished disc of present systems is cut with a continuance spiral groove which varies from side to side forming waves identical to the original sound waves. Coming in rapid succession these waves indicate a high original frequency, when slow a low original frequency has been recorded.

The Needle.

The needle of the reproducing unit runs along the groove in the disc and is vibrated by these waves, the frequency being reproduced depending on the rapidity of vibration and the amplitude of sideways movements. To adopt the reproduction of sound from records to radio principles, it is necessary to produce from the vibrations of the needle, changes in electrical impulses which correspond to the original sound and which after amplification may be changed back to sound by the loudspeaker.

There are several ways the above result may be achieved, the first attempt, the carbon type of gramophone pick-up, is now obsolete and is not therefore of any particular interest to us; other types, such as the oil damped magnetic type are so expensive that they are ou of the question for everyday work, except perhaps in their application to talking picture work. The two types of interest to us mainly are the crystal and magnetic types.

Crystal Types.

The crystal pick-up makes use of the principle that when the surfaces of two crystals are bent in relation to one another a voltage difference is generated between them.

The actual unit itself consists of two Rochelle salt crystals cemented together, one end of the combination being fixed, the other attached to the needle holder.

Foil is cemented to the outside surfaces of these crystals and leads taken from these foils form the output terminal of the unit.

With the needle running in the record groove, the vibrations set up cause a bending of the crystals at a frequency and amplitude determined by the original sound. The voltage produced by this flexing of the crystal is amplified and produced by the loud speaker.

Theoretically, the frequency response of crystal is excellent, but due to constructional difficulties, considerable distortion may be introduced. The crystal itself being a salt, absorbs moisture from the air, and is therefore more satisfactory in dry climates, it also requires considerable care in handling as the crystal is liable to crack if the needle is jarred. The voltage output from this type is very high, little audio gain being necessary to drive the power output tube of the average set.

Magnetic Types.

Of more robust construction is the magnetic type of pick-up which makes use of a changing magnetic path between the pole pieces of a permanent magnet.

This magnet is of the horseshoe type, having pole pieces which concentrate the magnetic field across a small gap approximately 1/16 to 3/32 inch wide. The pole pieces are slotted or bent to take the coil, through the centre of which, and extending into a gap between the pole pieces, is the armature, a thin vein of iron which also forms the holder for the needle. The lower side of the pole pieces forms the pivot on which the armature moves.

The size of the coil varies with different types of pick-ups, but is usually made up of many thousands of turns of very fine wire.

To prevent any mechanical resonance of the armature, it is necessary that its movement be damped, the most common methods employing rubber. The armature is pivoted in rubber sleeving and may either be brought through a rubber block in the centre of the coil or supported by rubber at the top gap. This damping allows the armature to move only at the recorded frequency, preventing it from oscillating at and over-emphasising its own mechanical resonant frfequency.

When a recording is being reproduced, the needle running in the groove is moved from side to side, moving the top of the armature close to one side and then the other of the pole pieces. The movement of the armature closer to one pole piece provides an easier magnetic path from the top of that pole piece down through the armature to the opposite pole piece. This creates a movement of lines of force. When the needle moves the armature in the reverse direction, the same effect takes place, only the movement of lines of force is also in the reverse direction. Applying this to one complete cycle of the needle, the lines of force will increase in one direction as the armature moves towards one pole piece, will decrease to normal as it moves back and increase in the opposite direction as it moves towards the other pole piece and again return to normal as the armature comes back to its central position. This movement of lines of force cutting through the turns of the coil generates a voltage in the coil which will vary in frequency and amplitude in accordance with the original recorded sound.

Needle Armature.

Another type of magnetic pick-up is that known as the needle armature type in which the needle itself forms the armature. Due to the reduction of weight of the moving section, this type can be made to give better re-

OUTLOOK AFTER WAR

The present prohibition of civilian radio receiver production would cause a shortage of receivers among the public, said the managing director of Electronic Industries Ltd. (Mr. A. G. Warner) at the annual meeting, held in Melbourne recently.

The company, he said, after the war, could look forward to a market ready to receive not only the future normal day to day replacement demand, but also a demand created artificially by the present prohibitions.

Life of a radio receiver was estimated at from seven to ten years. On this basis replacement market in Australia would not be less than 150,000 receivers yearly. To this had to be added the shortage that would result from present restrictions and also the increased number of families who wanted more than one receiver in their homes.

The only broadcast receivers produced by the company now were those manufactured under special permit for troop amenity purposes.

The company, said Mr. Warner, was the only radio manufacturing company mining for crystals in Australia. The mine was at Kingsgate, N.S.W., and some success was now being met in obtaining raw crystal requirements.

PICK-UPS
(Continued)

sponse characteristics that the average type of magnetic pick-up.

Magnetic pick-ups can be made to give excellent response characteristics and sufficient voltage output for any normal application, they will stand a lot of abuse and can be obtained at a comparatively low price.

P.U. Terminals.

The average commercial set is already equipped with pick-up terminals to which the pick-up may be attached without further circuit alteration, and quite sufficient output obtained to lead the output tube. In some types, however, namely, those in which the power tube is driven straight from the diodes of a diode detector, it is impossible to fit a pick-up without an additional stage being added.

In some cases, slight circuit alterations are necessary. A set using a bias detector may in some cases need to be equipped with some method of reducing the bias when the detector tube is being fed from the pick-up.

The easiest way to do this is to use about a 2,500 ohm resistor between the already existing bias resistor and the cathode and short the intersection between the two resistors to earth when the pick-up is required. With sets using grid leak detection, a resistor of the same size, 2,500 ohms, and a bypass condenser of 10 to 25 mfd. should be switched into the cathode circuit, the best means being to connect the combination between cathode and earth, and short them out for radio reception.

Distortion with Diodes.

In receivers incorporating diode bias, considerable distortion may be present for two reasons: (1) the tube has zero bias, and grid current will therefore flow on the positive half cycles; (2) the diodes are across the input and draw current when the signal voltage is positive.

Corrections

To correct the first, connect a resistor of approximately 5,000 ohms in the case of triodes, and 1,500 ohms in the case of a pentode, together with a by-pass condenser of 10 to 25 mfd. between cathode and earth, return the diode load direct to cathode and resistance capacity, couple the grid to the diode load with .05 mfd. and a 1 meg. leak to complete the connection, and to cure the second form of distortion, use three pick-up terminals, one being connected to the coupling condenser from the diode load, the second to the grid of the tube and the grid leak, and the third to earth. The first two are connected together by a link for radio reception, and the pick-up inserted between two and three with the link disconnected for gramophone work.

If the volume control forms the diode load, it is advisable to attach a volume control to the pick-up itself if it is not already equipped with one. (Only very rare cases.—Ed.)

Pick-ups are designed to work into a stated load, the values being given

(Continued on page 18)

Speaker Location For High - Power Amplifiers

The actual positioning of loudspeaker units in any particular installation will depend upon the area to be covered and the actual shape of the room or workshop.

FOR example, four loudspeakers in a cluster in the middle of a square-shaped workshop would be heard quite well over the whole of the area, but a long, narrow room having the same amount of floor space would be better served by four loudspeakers located at intervals along the length of the shop. Another consideration, when deciding upon the number and position of loudspeaker units, is the type of "furnishings" in the workshop and the number of people employed in the shop. More speakers will be required to cover a certain area in a textile factory where there may be large expanses of cloth or stores having a number of shelves filled with soft materials, than would be the case of an installation in a factory workshop in which machinery only was present.

Quite apart from the power required, there is also the tonal value of the reproduction to be considered. In large workshops, loudspeakers should not be placed more than 30 to 40 feet apart, otherwise the time lag between the reproduction from each loudspeaker will be too great. For example, a person situated equidistant from two loudspeakers would hear the reproduction from each one at the same time, but another person situated nearer one loudspeaker than the other could still hear the second loudspeaker and the effect would be confusing if the distance between the speakers was very great. The reproduction of the second speaker when not too far away would appear as an echo, but from a more distant position the resultant reproduction might be utter confusion and quite unintelligible.

This trouble can be overcome by using a greater number of speakers, each radiating at a lower power, rather than fewer loudspeakers placed a longer way apart, each operating at a high volume level.

Industrial Installations.

In industrial installations there is generally no need to conceal or camouflage the loudspeakers, and they may be fixed to the girders supporting the ceiling or to the ceiling itself. As has been previously mentioned in this series of articles, different speakers have various characteristics; low-pitched speakers such as directional baffle, industrial types, etc., are good for workshops where there is a high-pitched background noise, while higher-pitched projector horn-type speakers are more suitable for use where the background noise consists of heavy rumbling noises.

In a quiet assembly bay, the more normal domestic types of moving-coil cabinet types are very suitable, when arranged on the wall all round the room for general diffusion of sound at a medium or low volume level.

Directional baffle loudspeakers and cabinet types should not be installed with their backs close to a wall, otherwise the quality of reproduction will suffer. These types of loudspeakers have louvres and holes cut in the back of the speaker casing to relieve the back pressure of the air generated by the cone, and if this back pressure is not relieved, the movement of the cone will be restricted and, consequently, distortion will result.

In Lecture Halls.

All permanent magnet loudspeakers should be enclosed in a dust bag to prevent any foreign matter entering the speech-coil gap, and, in the case of factory installations, to prevent metal filings adhering to the pole pieces.

The arrangement of loudspeakers in a lecture hall or auditorium is naturally governed by the characteristics of the building, but in general it is always advisable to aim at making the amplified sound of the loudspeaker come from the same direction as the original sound. For example, it is very unnatural for people in the audience to see a man lecturing in front of them but to hear his voice coming from behind them! This will not occur if the loudspeakers are ranged on either side of the dias or stage pointing towards the audience, and of sufficient height to be directed slightly downwards towards the rear of the hall.

Not only is the direction of the sound in a straight line between the listeners and the loudspeakers, but there is less likelihood of trouble arising from the acoustic properties of the hall.

Dead Areas.

Wherever possible, loudspeakers should not be so positioned that they face directly on to a hard surface, whether it be straight as in the case of a wall, or curved as in the case of a domed roof. All kinds of unpleasant reflections and, in some cases, almost complete silence, may be created if care is not taken over this matter. The areas of complete silence are caused by direct sounds from the loudspeakers arriving completely out of phase with the sound of the echo. The waves are then cancelled out and very little, if anything, is heard. Should the distance be such that the two waves arrive at the point at some other phase-difference, the sound may still be quite unintelligible, or have an unpleasant echo.

If, for example, it is desired to "cover" the upper gallery in a theatre, it would be far better to employ loudspeakers high up above the stage, almost at roof level, pointing slightly downwards towards the upper gallery, rather than to use loudspeakers at stage level, pointing upwards.

If matters cannot be arranged as would be desired in this way, the places which receive direct sound waves, and which are reflecting them, must be covered with soft curtaining, or a soft type of partition boarding so that the sound is absorbed. Sometimes, in the case of old types of cinemas which have been fitted with sound equipment, the straight ceiling must be broken up by suspending lengths of material right across the width of the hall, so as to prevent the sound waves striking the rear part of the ceiling and the rear part of the wall of the building at an intensity which would cause serious reflections and echoes.

(To be Continued)

PICK-UPS

(Continued from page 17)

by the manufacturers. The potentiometer value should be adhered to, lowering this value will reduce the bass response with crystal types, and the highs with magnetic types.

Volume Controls

A 500,000 ohms potentiometer is the most suitable value for use with crystal pick-ups, while 100,000 ohms is a suitable value for magnetic types.

Before the introduction of radio, gramophones were very popular, and in many homes have now fallen into disuse through the better quality provided by radio. This condition provides a potential source of opportunity for the alert radio man, as these homes already equipped with records and turntables suggest the addition of a pick-up. Such an installation gives to the record quality and pleasure that the average gramophone cannot supply.

—N.Z. "Radiogram."

COMMON ERRORS OF RADIO TESTING

IT is very easy to make a slip when carrying out even routine tests of a receiver, especially if a copy of the wiring diagram is not kept in sight. An example of this was exemplified recently when a thoroughly experience experimenter made what he later found to be a foolish blunder in checking through the power supply of an amplifier.

Before connecting it to the amplifier valves he wished to make a test of the output and to ascertain that all voltages were correct. And as he had made use of a transformer which had not been in use for some time he thought it desirable to make sure that this was not below par. A high-grade multi-range meter was used, this being set to read A.C., and the voltage on each side of the centre tap of the H.T. winding of the transformer was measured. A similar reading of slightly under 400 volts was obtained for each half, which was correct, for the component was to be used with a full-wave rectifying valve taking up to 500 volts on each anode.

As a check for leakage between H.T. and filament windings, the meter was temporarily connected between the centre tapping of each. Of course, there was a voltage reading because the valve had not been removed from its holder. The valve was then removed and the test repeated; no reading. Another test was made by connecting the meter to one end of each of the two windings. To his surprise, a reading of approximately 380 volts was shown by the A.C. meter. For a few minutes the experimenter was stumped; and probably you would have been. It was not until he had made some additional tests with the transformer disconnected from its external circuit that he realised why a reading had previously been obtained — for there was no doubt that the component was in perfectly good condition and entirely free from inter-winding or core-winding leakage.

The Reason.

The explanation should be clear from Fig. 1. Have you spotted the slip? When the transformer was connected and the rectifying valve was removed from its socket there was no reading between the points marked 1, but there was one between those marked 2. If you have not yet "tumbled", the explanation is that the supply was A.C., and that the circuit between the centre tapping of the H.T. winding and the L.T. winding was completed by the two smoothing condensers. These would have been insulators for D.C., but on A.C. an 8-mfd. condenser (the capacity of the two in parallel) has an effective resistance of only about 400 ohms at 50 cycles. When using a high-resistance meter such a resistance is negligible as far as the reading is concerned.

Measuring Anode Voltage.

A mistake is often made in determining the voltage applied to the anode of a valve. Even when a battery is used for H.T. supply you cannot tell the voltage by noting the tapping used to feed that anode, for there is always a resistance of some kind in the anode circuit. This might be only a few hundred ohms, through the primary winding of an L.F. transformer, or several thousand ohms, through a coupling and/or decoupling resistor. Thus, an initial voltage of 100 would be reduced to 50 if there were a series resistor of 5,000 ohms and the valve passed 10 mA. In the same conditions the voltage drop would be only 5 if the total anode resistance were only 500 ohms.

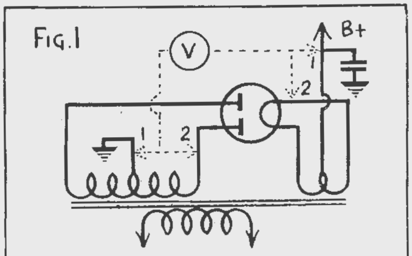
The matter is not greatly simplified even when a good-quality high-resistance voltmeter is available, for reasons which are shown diagrammatically in Fig. 2. If the negative terminal of the meter were connected to the earth line, and the positive one to H.T. + (the point marked a) the reading would be valueless. In the first place, the reading would not take into account the voltage drop across the two series resistors in the anode lead. In the second place, the resistance of the meter would be in parallel with that of the valve and its anode resistors in series; consequently, part of the H.T. supply would pass through the meter so that the reading would be slightly less than the voltage provided by the H.T. point.

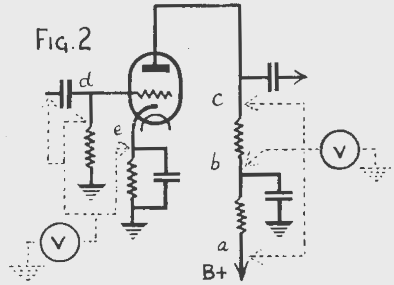
Parallel Resistances.

The position is not improved by transferring the positive lead from the meter to the points marked b and c. When connected to b there is still the anode resistance in series with the valve anode, and when connected to c there are actually three resistances in parallel; that of the valve (A.C. resistance or impedance), that of the meter, and that of the two resistors and H.T. supply all in series. It will be seen, therefore, that the indicated voltage might differ appreciably from the actual voltage. In fact, the only value of this test would be in finding whether or not an anode voltage was being applied to the valve. with a cheap, low-resistance meter it is even possible that no voltage reading would be given.

Voltage from Current.

The only convenient method of determining the corectness of the ap-





plied anode voltage is, peculiarly enough, by measuring the anode current by means of a milliameter. If this were inserted at the point marked c, the current consumed by the valve could easily be found (provided that the resistance of the meter were not high by comparison with that of the anode-circuit load). By comparing the current with that shown on the curves for the particular valve in use it would be possible to obtain a fairly accurate indication of the actual plate voltage.

To permit of this being done, however, it would be necessary to know the grid-bias voltage. This could be measured with sufficient accuracy for most purposes by connecting a high-resistance voltmeter between the earth line and the upper end of the bias resistor — in the case of a mains set — to the point marked e in Fig. 2. It is important that the meter should have a very high resistance compared with the value of the bias resistor because if this were not the case we should again have the position of two parallel resistances, the overall value of which is less than that of either component separately. A factor which might easily be overlooked is that a correct reading might not be obtained if the negative side of the meter were connected directly to the grid of the valve. In that case the grid-leak resistor would be in series with the meter, and since this might have a value up to one megohm or so its effect would be marked. In normal running conditions there is not, of course, any voltage drop across the

(Continued on page 26)

Shortwave Review

CONDUCTED BY L. J. KEAST

NOTES FROM MY DIARY—

HERE WE ARE AGAIN!

The return of the summer transmitters always reminds me of the clowns in the circus who come into the ring, turn a couple of flip- flaps and yell out, "Here we are again." And that's just what the old announcers seem to say about this time of the year — certainly there are quite a number of new ones, but a great many of the oldtimers are still heard, but they have competition this circus time.

If you want to test the selectivity of your set, just try the 23 metre band after 9 pm. As a matter of fact, all bands with the exception of the 13 metre seems to be giving splendid signal strength. I have not heard a whisper on 13 metres—yet; but it is still a fair step till Xmas and that appears to be the time when this delightful spot-on-the-dial responds.

If you have time before leaving for the city in the morning, just tune-in to the 31 and 49 metre bands and run quickly over it — and I'll bet you'll promise to sort them out tomorrow, or maybe Sunday. And amongst them you, like myself, will find that "Here We Are Again."

Just to add to the general cramming our old friend Morse seems to want to have company and has popped himself in all over what we have always claimed was **our** part of the dial — but it's ten to one he is on Military Service and we just have to take it and trust they have secured a clear channel to get that message through and perhaps shorten the war by one day.

KGEI

Remember in September issue I said I was sorry KGEI had let 15.33 m.c. and gone back to 11.79 mc? Well, I carried my moan to 'Frisco, and have now received a reply from the Regional Director of the office of Coordinator of Inter-American Affairs. The explanation is that the new frequency did not reach Latin America well in the evenings, so back it went to 11.79 mc., so that's that. Literature enclosed with the mail explains The United Network is:—

KMI, 17.09mc, 17.5m, 2.30—5 am.

KWID, 15.29mc, 19.62m., 4.30am—noon.

KGEI, 11.79mc, 25.43m. 8. am—3.45 pm

KWIX, 9.57mc, 31.35m. 11 am—3.45 pm.

The above schedule is for The Americas.

Of course, KWID, opens up again from 4—5.45 pm and KWIX also both dircted to the East.

THROUGH THE AIR

And through the air we hear what is on the air by mail from Arthur Cushen, the Pacific Panther, who, prowling around at any old hour always seems to catch the new ones. Latest is LRR, Santa Fe, Argentina, 11.88 mc., 25.25 m. Heard testing at good strength at 7 pm. Followed them till 9 pm then signal was weakening. They announced every ten minutes in Spanish and then in English, "This is Radio Olivier Larus, Santa Fe, Argentina. Station LLR Radio Olivier Larls transmitting on 11,880 kc., with an antenna power of 10. kilowatts. We would appreciate your letters and cards; please send them to Radio Olivier Larus — 733, Santa Fe, Argentina." (Nice catch, Arthur).

Mr. Cushen sends a copy of Radio Brazzaville schedules which is shown elsewhere.

Mr. Roy Matthews, secretary of The Short Wave League of West Australia writes also by air mail: I have been hearing a station on 9490 kc, around 10.30 am which gives one gong at 10.45 am and says "Colonia." I take it to be Uruguay. (10.45 am Sydney is 8.45 pm the previous day in Uruguay, L.J.K.). Mr. Matthews says VQ7LO, Nairobi, seems to have shifted frequency. (According to the ABC Weekly, are now on 6083 kc 49.32m. L.J.K.). He sends the schedule of Leopoldville on 9765 kc, 30.72 m. which is shown in Short Wave and Observations.

Mr. R. J. Nolan of Perth air-mails re KROJ on 17.76 mc, and says when listening to All India Radio on 41.15 m. at 5.15 am announcer said: "We have been operating on 31, 41, 48 and 85 metre bands."

U.S.S.R.

Daily we are reminded in the press of the splendid fighting spirit of our all, and daily through our radio receivers we can also hear their love for music. Some really delightful programmes are to be heard in the afternoon over 24.45 and 30.43 metres and from 9 to 10.15 pm again through 30.43 and also 24.65 metres.

Mr. Hugh Perkins, Malanda, telegraphs: VPD-2, Suva, 11.9 mc, 25.22m, 6.30 to 8.30 pm., 8.30 to 10.30 am.

Here are some Schedules too late for Classification:

BBC service for Japanese Occupied Territories:—

GRD, 19.42m.; GWD, 19.46m.; GVU 25.47 m. Sun, Tues., Thurs. and Friday in Japanese, 8.30—8.45 pm.

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

AFRICA

Algeria

AFHQ, Algiers, 33.48m. heard at 7 am (Gaden, Perkins). (Same news is on WLW 25.62m.—L.J.K.).

Belgian Congo

RNB, Leopoldville, 16.88m. is heard again around 9.55 pm. RNB on 30.73m. gives schedules as follows: 8.45—9.15 am; 5—5.30 pm; 3—3.30 am; morning signal is good, evening weak on open-in, but rapidly improves, have not heard early morning (Matthews).

RNB, 11.67 mc, 25.71 m. was quite good the other day from 8 till 9 pm which seems later than the scheduled time .Only trouble—morse (Walker). (Best time here is around 3.50 pm.—L.J.K.)

Egypt.

SU—, Cairo, 7.50 mc, 40m. Lady announced 6 am; time pips; news in English followed by a commentary read by man. French at 6.20 (Walker, Matthews). (This is the new station mentioned in September issue, but erroneously omitted from October schedules. Is heard here opening at 2.30 am.—L.J.K.)

SUX, Cairo, 7.86 mc, 38.15m. was heard at excellent strength. Programme was all native in content and station signed at 6.30 am without any English announcement (Walker).

French Equatorial Africa

FZI, Brazzaville, 25.06m. Heard up till 10.30 am at good strength (Matthews). Can be heard every evening now, at fair strength from around 10.30 till 11.15. Classical music announced by a lady in French and sometimes in English. Morse is the only trouble (Walker). Morse, unfortunately, seems to be creeping in on most of the bands.—L.J.K.

Morocco

CNR-1, Rabat, 37.34m. Prefer this to AFHQ of a morning — less morse (Gaden) R4 around 7 am (Perkins).

South Africa

ZRH, Johannesburg, 49.95m. and ZNB 50.90m. were heard in English at 6.15 am (Walker). Both R4 around 6.45 with news (Perkins).

VQ7LO, Nairobi, seems to be nearer 6040 kc than 6060. (Walker).

CHINA.

XGOY, 25.21. Signal R6 at night, but noisy; XGOA, 30.86 R5 around 9.15 pm; XGOY 31.1 R6 at 10.45 pm, also heard at midnight; XGOY 41.48 not heard for two or three weeks and finally, XGOY 49.02 m. R6 around 10.45 pm. (Perkins).

(Nice work, Hugh, agree with you signal on 25.21 is woeful as regards modulation.—L.J.K.).

GREAT BRITAIN

Mr. Roy Matthews of Perth advises receipt of letter from BBC. Inter alia, they state the following are the call signs for European transmitters: GWA, 6.12 mc, 48.98m.; GWF, 9.49 mc, 31.61m; GWB, 9.55 mc, 31.41m. (In October issue I showed GWA as call sign for 31.41m. so am correcting it in this issue.—L.J.K.).

Mr. Cushen of N.Z. advises GVZ is call sign for 9.64mc, 31.12m.

Another new call sign is GVY and at 9 pm can be found on 11.95 mc, 25.09m, with one of the best signals on the air.—L.J.K.

GVZ, 31.12 is better than GRH. Night reception is certainly improving and the 19 metre band seems to be here for good (Gaden).

GRJ, 40.98 R6 at 7.05 am; GSA, 49.59 R5 at 7 am; GRN 48.43 R6 at 7 am; GRO 48.54 R6 at 6.50 am (Perkins). Mr. Perkins says he has not heard GRF 24.8 m., and GRV, 24.92m, for two or three weeks. I heard the former very weakly on October 21 at 10.15 am, and GRV a little stronger at the same time. GRV closed at 1.45 pm—L.J.K.

GRH, 30.53m, when giving Radio News Reel best BBC on air (Perkins, Ferguson).

GRM, 42.13m, and GRG, 25.68m. Excellent in Pacific service (Ferguson).

. . . —, London, 25.64m. heard calling "The People of Holland." This is the Voice of America". Then in Dutch at 10 pm.—L.J.K.

GRO, 48.54 used for Home Service, is good at 1.45 am.—L.J.K.

GRD, 19.42m. still warn people of Japanese occupied territories to be sure and tune receiver to a Jap station after listening to the BBC—L.J.K.

INDIA

—. Colombo, 5920 kc, 50.67m. A very good signal all evening, relays London, 1 am news (Matthews).

Delhi on 6.19 mc, 48.47m fair with news at 11 pm (Cushen).

VUD—, Delhi, 9.67 mc, 31.04m. Heard from 10 pm (Nolan). (This is a new one to me.—L.J.K.).

VUD-3, 19.62m. Good with news at 6 pm (Nolan). A corker at night (Perkins).

VUD-2, 41.15m. Excellent with news at 1.50 am (Nolan).

VUD-6, 25.45m. Fair in Asiatic at 11 pm. (Nolan). Great station (Perkins).

Colombo still fair with BBC news at 2 am on 4.88mc, (Cushen). Mr. Nolan of Perth writes that he heard announcement at midnight, "This is Colombo on 4900 kc, 61.2m."

MEXICO

XEWW, Mexico City, 9.50 mc, 31.58 m. Very good in afternoons, sometimes till 4.45—L.J.K.

NEW CALEDONIA

FK8AA, Noumea, 48.39m, R7 in French at 6.20 pm and R7 when closing with Marseillaise at 8.58 (Perkins).

(Have not heard any English for weeks.—L.J.K.)

SCANDINAVIA

—, Stockholm, 11,780 kc, 25.47m at 12.15 am. news in English, closed at 12.40. Hard to separate from Saigon. Think they announced as SBT (Matthews). Stockholm on 19.80m, and 25.63m has been heard as early as 11 pm lately (L.J.K.).

SOUTH AMERICA

Ecuador

HCJB, Quito, 24.08m. Good at 10 am (Matthews, Perkins).

HCJB, Quito, 30.12 m. Also good at 10 am (Matthews). Seems to be on more than its sister (Perkins).

SWITZERLAND

HER-5, Berne, 11.86, 25.28 m. Heard at 12.20 am the other morning in Italian with an R8 Q5 signal. At

12.37, "Switzerland Calling" in Swiss. From 12.42 till closing at 1.30 am a beautiful concert from Lugarno.—L.J.K.

—, Berne, 7.39 mc, 40.56 m. This new Swiss outlet mentioned in September issue is excellent at 2 am.—L.J.K.

HER-5, Berne, 25.61m. excellent on Tuesdays (English) and Saturdays (Foreign) from 6.30 till 8 pm. also fair in mornings from 5 till 8.45—L.J.K.

HER-3 Berne, 48.66 m. Now withdrawn in favour of 47.28m. in mornings and a great signal from 5 till 8.45.

SYRIA

Radio Levant 8035 kc, at 3 am gives a session in English lasting 45 minutes. Strength is only fair (Walker). (Is this the same station is FXE, Beirut?—L.J.K.)

U.S.A.

WNBI, 9.67 mc. 31.02m. signs at 5 pm. (Cushen).

KES-3, 10.62 mc, 28.25 m., relays KGEI at 5.30 pm (Cushen).

WRUS, 6.04 mc, 49.66m. and WCDA 6.06 mc, 49.50 m. signs at 5 pm (Cushen).

WLWO 11.71 mc., 25.62m. is excellent from 10 pm; from 11.15 to 11.30 pm is beamed to the German Garrison in Norway and strength is nearly as good as KWID (Nolan, W.A.).

KWID, 9.57 mc, 31.35m. Heard daily from 6 pm, excellent (Ferguson).

KKR, 19.4 m. This is a really good one, seems to have taken the place of KLL, 21.9m. (Gaden). KROJ 16.89 m. Too much morse for me. (Gaden).

KWIX is better at night than KWID (41.49. (Gaden).

KWID, 31.35, very disappointing at night. Signal seems weaker and is badly QRM'd, signal only R5 (Perkins). Am afraid that is the case down here too, very often.—L.J.K.

WRUW 30.93m. heard around 6.45 am (Perkins).

Mr. R. J. Nolan of West Perth says he has not heard WKRD on 12.96mc. lately. I think the evening session has been withdrawn, but WKRD is audible most days on 23.13m. at 10 am —L.J.K.

NEW STATIONS

HER—, Berne, 6.345 mc. 47.8m: This new outlet for the Swiss Broadcasts has replaced our old friend of so many years, HER-3 who, on 48.66 m. was as well known as any transmitter on the air. Our new acquaintance, whose call-sign I do not know, nor can I obtain it from the Swiss Consulate, is on the air from 5 till 8.45 am with news at 7.53. Signal at news times is R8 Q-5.

WRUA, Boston, 11.145 mc, 26.92m.: This is an addition to the World Radio University set-up and from 7.15 till 8.30 am. puts in an R8 Q5 signal. Think when opening, language is Portuguese. News at 8 in English is at great strength.

WRUA, Boston, 9.57 mc, 31.35m.: Opens at 9 am with an R7 Q4 signal. At 9.15 language sounds like Norweigian.

WRUS, Boston, 15.13mc, 19.83m.: A new freqency for WRUS and opens at 7.15 in parallel with WRUA, but continues after WRUA signs at 8.30. Signal on opening is R6 Q4, but drops to R4 Q3 by 9.30 am.

KKR, Bolinas, 15.46 mc, 19.4m.: This is one of the R.C.A. Point-to-Point transmitters heard from 1 till 1.30 pm in news and commentary.

KEL, Bolinas, 6.86 mc, 43.7m.: This is another of the R.C.A. Point-to-Point stations and is actually not new to us. It will be remembered as much in the limelight around January, '42, when it was heard in parallel with KGEI. At the present time it mostly carries KGEI news, sometimes KWID, and is heard around 8 pm for about 25 minutes. I am indebted to Dr. Gaden for reminding me that this station has been omitted from our schedule list. I would remind QSL hunters not to write for verifications as P-tP stations do not verify.

VUC—, Colombo, 4.90 mc, 61.2m.: This new outlet for India was mentioned in Shortwave Notes in October issue, but was excluded from New Stations. It was first notified by Mr. Cushen of Invercargill who gave frequency at 4.88 mc. Mr. Nolan of Perth, in an air-mail letter, says he heard announcement at midnight: "This is Colombo on 4900 kc, 61.2m." He thinks they open at 10.30. BBC news is given at midnight and 2 am. When closing at 3.20 give next day's programme details. Signal is terrific.

——, Antanarivo, 6.16 mc, 48.62 m.: This is a new station in Madagascar and is on the air from 2 till 3 am. Programme is in French and Mr. Matthews of Perth says strength is very good.

KEL, 6.86 mc., 43.7m. relays KGEI news at 8 pm. (Nolan, W.A.) (Gaden).

WLWO 25.62m. terrific till 11.30 pm (Nolan).

KKR, 19.44 m. R7-8 at 10.17 am when broadcasting a sports session. (Perkins).

KROJ on 16.89 m. is a wonderful signal up here, a good R8. Wish it stayed on longer than 1 o'clock (Perkins). This session from noon till 1 pm is evidently meant for the Forces up north, as it does not reach anything like that strength down here. L.J.K). KROJ on 17.76 mc heard well here (Nolan, Perth).

WLWO 25.62m is fair around 7 am, but can't find her of a night (Perkins).

(WLWO opens at 9.30 and can be sorted out on favourable nights, but that part of the band is very crowded. —L.J.K.)

U.S.S.R.
Moscow

19.05m. Heard at 11 pm (Cushen).

19.54 m. Calls BBC for Paul Winterton commentary at 10.53 pm.—L.J.K.

19.7m. One of the most consistent Moscow transmitter. News at 8.15 every morning, closes at 8.40. Also on at 9.47 with news for America. Opens at 10.40 pm but is difficult to follow, at 11.20 Yiddish.—L.J.K. R6 at 9.50 am (Perkins). Heard at 11 pm. (Cushen).

19.85 m. R6 at 10 am (Perkins). Is in parallel with 19.7 and at this hour is fair.—L.J.K.

25.36m. Hindustani at 12.30 am. English news at 1 am—L.J.K.

VATICAN CITY

HVJ, 50.26m. Rang a lot of Church Bells at 6.30 am (Walker).

(See memo under Diary.—L.J.K.).

HVJ R6 at 6 pm with POW session (Perkins).

WEST INDIES
Cuba

C.CQ, Havana, 33.9m. Still R4 at 10.30 pm (Perkins)

COHI, Havana, 46.48m. R4 around 10.30 pm but noisy (Perkins).

COBC, Havana, 32.00m. Fair at 10.20 am (Nolan, W.A.).

COCX, Havana, 32.38m. Good at 10.45 am (Nolan, W.A.).

COCM, Havana, 30.51m. Weak at 1.25 am (Nolan, W.A.).

Allied and Neutral Countries Short-Wave Schedules

These schedules which have been compiled from listeners' 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." Symbols: N—New stations; S—Change of Schedule; F—Change of frequency.

NOTE: S indicates change of schedule other than those affected by change of time system.

Call Sign	Location	Mc.	M.	Time: East. Australian Daylight
GRZ	London	21.64	13.86	10—12.15 am.
GSH	London	21.47	13.97	9.30—2.15 am
OPL	Leopoldville	20.04	14.97	9.55—11.15 pm
—,	L'poldville	19.20	15.63	3.45—4.30 am; 5.30—5.45 am; 10.15—10.30 pm.
HBH	Berne	18.48	16.23	Tues & Sat 12.45 am—2.15 am
GVO	London	18.08	16.59	2—3.15 am
GRQ	London	18.02	16.64	Midnight—2.15 am.
GRP	London	17.87 N	16.79	9 pm—2.15 am
EIRE	Athlone	17.84	16.82	11—12.30 am; 4.30—5 am; News 3.45 a m
WCDA	New York	17.83	16.83	12 am—5.30 am.
WCRC	New York	17.83	16.83	8.15—10.15 am
GSV	London	17.81 S	16.84	6—8 pm
WLWO	Cincinnati	17.80 S	16.85	8.30—9.45 am; 12.15—6.30 am
GSG	London	17.79	16.86	9.45—11 pm; 2.30—2.45 am
WRCA	New York	17.78	16.87	12—3.45 am
OPL	Leopoldville	17.77	16.88	9.55—11.15 pm; 5.30—7.30 am
KROJ	'Frisca	17.76 S	16.89	Noon—1 pm; News at noon.
WRUW	Boston	17.75	16.90	2—4.15 am
GVQ	London	17.73 S	16.92	6—8 pm; 12.30—2.30 am
LRA-5	B'nos Aires	17.72	16.93	Sats. 7.45—7.30 am
—,	Brazzaville	17.71	16.94	7.30—8 am
GRA,	London	17.71	16.94	7 pm—3.45 am; News 7 pm
HVJ,	Vatican City	17.44	17.20	Mon. Wed. & Sat.: 12—2 am Tues 12—2.20 am; Fri. 12—1 pm
WCW	New York	15.85	18.93	4 am—8 am
—,	Moscow	15.75	19.05	10.40—12.30 am
WCB	Hicksville	15.58	19.28	8.15—8 am
KKR	Bolinas	15.46 N	19.4	News and commentary 1—1.30 pm
GRD	London	15.45 S	1942	9—10.15 pm.
—	Accra, G. Coast	15.42	19.45	9—9.30 pm; 4—5 am
GWE,	London	15.43 S	19.44	6—8.45 pm
GWD	London	15.42 S	19.46	9—9.30 pm; 10.30—10.45 pm; Midnight—1.45 am; 2.15—2.45 am.
GRE	London	15.39	19.50	6.45—8 pm; 11.15—2 am; 2.30—5 am.
KWU	'Frisco	15.35	19.53	Daily except Thurs. 7.30—9.15 am (Mon. 8—9 am) Daily except Mon. & Thurs. 10.45—12.30 pm.
—	Masocw	15.35 N	19.54	9.15—11.20 pm. (English from 10.40)
WRUW/L	Boston	15.35	19.54	9 pm—4.15 am; 3.30—4.30 am
FGA	Dakar	15.34	19.55	6.15—8 am.
WGEA	Schenectady	15,33	19.57	8.30—9.45 am
KGEI	'Frisco	15.53	19.57	Not in use
WGEO	——	15,33	19.57	11.15 pm—6.30 am.
VLI-3	Sydney	15.32 S	19.58	8.30 pm—Midnight
GSP	London	15.31 S	19.60	6—8 pm; 10 pm—1 am
HER-6	Berne	15.30	19.60	Testing Tues and Sat. from 7.30—9 pm
KWID	'Frisco	15.29	19.62	4.30—12 pm; 4—5.45 pm
LRU	B'nos Aires	15.29	19.62	10.15—11.15 pm
VUD-3	Delhi	15.29 S	19.62	2.15—3.05 pm; 4—7.15 pm; 8.45—10.15 pm; News 2.30, 6 and 8.45 pm 9.30—11.15 pm.
WCBX	New York	15.27	19.64	19 pm—7.45 am; 8—10.45 am
GSI	London	15.26	19.66	5—8 pm; 9.45 pm —2.15 am; 2.30—7.45 am
WLWK	Cincinnati	15.25 S	19.67	8.30—11.15 am; 11.30 pm—8.15 am.
VLG-6	Melbourne	15.23 S	19.69	11.45 am—12.20 pm; 1.40—1.50 pm (Sun. 1.15—1.50)
—	Moscow	15.22 S	19.70	8.15—8.40 am; 9.47—10.30 am; 12.15—12.40 pm; 10.40—11.20 pm

Call Sign	Location	Mc.	M.	Time: East. Australian Daylight
WBOS	Boston	15.21	19.72	11.15 pm—2 am; 2.15 am—3.45 pm
XGOY	Chungking	15.20 S	19.73	See 25.32.
TAQ	Ankara	15.19	19.75	8.30—10 pm; 12.30 am—1.45 am
KROJ,	'Frisco	15.19	19.74	7.15—8.45 am; 9—10 am
WKRX	New York	15.19	19.75	6.30—8 am
XGOY	Chungking	15.18	19.76	Wed. only, 11—11.45 am
GSO	London	15.18	19.76	9.45—10 pm; 11.15—12.15 am; 2.30—2.45 am; 4.30—5 am
TGWA	Guatemala	15.17	19.78	4.45—5.55 am (Mon. till 9.15 am)
PRE-9	Fortaleza	15.16	19.78	8—12.05 pm
VLG-7	Melbourne	15.16 S	19.79	6—8.10 am (Sun. 6.45—8 am)
SBT	Stockholm	15.15	19.80	2—5.15 am. News 2.01 am
WNBI	New York	15.15	19.81	11 pm—8 am.
GSF	London	15.14	19.82	9.45 pm—2.15 am; 4.30—4.45 am.
KGEI	'Frisco	15.13	19.83	4.15—5.15 am
HVJ	Vatican City	15.12	19.84	Mon. 11—11.15 am; 11.30—11.50 am; 12—12.20 pm; Wd. 2.25-3.25 am; Fri 3—4.20 am
—	Moscow	15.11	19.85	8.15—8.40 am; 9.48—10.30 am; 12.15—12.40 pm; 2.15—2.40 pm; 10.30—11.20 pm
HVJ	Vatican City	15.09	19.87	Thurs, m/n. to 2 am Fri.; Fri. m/n. to 2 am Sat
GWC,	London	15.06 S	19.91	4.45—8.45 pm
PSE	R de Janiero	14.93	20.07	See 10 m.c.
WWV	Washington	15.00 N	20.00	Fri 8—8.30 am; 11.—11.30 am
WDO	N.Y.	14.47	20.73	12—6 am
—	Malaga	14.45	20.75	M/n.—1 pm
—	Tunis	14.40	20.83	10—11 pm; 4—8 am
—	Dakar	13.34	22.48	No schedule
WKRD	New York	12.96	12.13	11 pm—10.15 am
CNR	Rabat	12.83	23.38	10.30—11 pm
FIA	Douala	12.70	23.61	9.45—10.30 pm; 6.15—6.45 am
HCJB	Quito	12.45	24.11	10.45—12.45 pm; 3.30—6.30 am; 9 am—1.45 pm
—	Brazzaville	12.27	24.45	5.30—7 am
—	Moscow	12.26	24.47	2 pm to 3 am (this is Russian—for Home Service. Often heard in parallel with 30.43 and 24.65 at 9.15 pm
TFJ	Reykjavik	12.23	24.54	4.15—4.30 pm
—	Moscow	12.19	24.61	8.45—10.23 am; 11—11.50 am
—	Moscow	12.17	24.65	7—9 am; 3.40—4.45 pm; 5.45—6 pm; 8.30—9.50 pm; 12—12.15 pm; 1.30—1.45 am; 2.15—2.45 am
R. France	Algiers	12.12	24.75	3.30—5.30 am; 6—8.30 am; 8.45—9.15 am
ZNR	Aden	12.11	24.77	3.13—4.30 am
GRF	London	12.09	24.80	9 pm—3.45 am
GRV	London	12.04	24.92	4.45—7.45 pm; 9.45—10 pm; 11.15—12.30 pm; 12.45 pm—3.30 am; 3.45—5.45 am; News 5.15 and 7 pm
CE1180	Santiago	11.97	25.04	10.30 pm—1; 3.30 am—2 pm
FZI	Brazzaville	11.97	25.06	6—8.30 am; News 6.45 am; 2—3 pm; 4.55—5.40 pm; 10.15—11.30 pm; 3—4 am
ZPAS	Encarnacion	11.95	25.10	9.30—11 am
GVY	London	11.95	25.09	9 pm—.45 am; News 19 pm, midnight and 2 am.
. . . —	London	11.93	25.15	8 pm—1.30 pm; 2.30—6 am; (Eng 8.15—8.45 pm; 12—12.30 pm
XGOY	Chungking	11.90	25.21	9—10.30 pm; midnight—3 am
VLG-9	Melbourne	11.90 S	25.21	Not in use
CXAIO	Montevideo	11.90	25.21	10.5 am—1.10 pm
WRCA	N.Y.	11.89	25.22	7—11.45 pm; 4—7.45 am; 8 am—2.30 pm
WKTM	New York	11.89	25.23	9.—11 am.
VLR-3	Melbourne	11.88 S	25.25	2—5.30 um (Sun. 1—5.30 um)
H13-X	Trujillo City	11.88	25.25	9.30 am—1.15 pm.
VLI-2	Sydney	11.87	25.27	5.55—6.25 pm
WBOS	Boston	11.87	25.27	9.15—11 pm; 4—8.15 am; 8.30 am—3 pm
HER-5	Berne	11.86	25.28	11.55—12.30 pm; 7.50—8.35 am; 12.45 pm—1 pm
GSE	London	11.86 S	25.29	9.45 pm—2.15 am
WGEA	Schenectady	11.84	25.33	11 pm—8.15 am
CXA, 14	Colonia	11.84	25.35	8 am—3 pm.

Call Sign	Location	Mc.	M.	Time: East. Australian Daylight
VLG-4	Melbourne	11.84 S	25.34	Noon—1.45 pm (for Nth America); 7.25—8.25 pm (French) 8.30—9 pm (for Aust. Forces in S.W. Pacific) 9.15—10.45 pm (for Shanghai in English)
VLW-3	Perth	11.83 S	25.36	9.30 am—12.45 pm; 2.30—9.15 pm; (Sun. 9.45 am—9.15 pm)
—	Moscow	11.83	25.36	3—3.45 pm; 4—5 pm; 10—10.30 pm; 12—12.4 am; 1.30—4.45 am.
WCRC	N.Y.	11.83	25.36	10.30 am—3 pm
WCDA	N.Y.	11.83	25.36	9 pm—9.30 am
GSN	London	11.82	25.38	4—6.30 pm; 6—7.45 am.
XEBR	Hermosillo	11.82	25.38	12—4 pm
COGF	Matanzas	11.80	25.41	3.30—6 am
KGEI	'Frisco	11.79	25.43	8 am—3.45 pm
WRUL	Boston	11.79	25.45	4.30—9 am; 9.15—10.25 am; 10.30—5 pm
VUD-6	Delhi	11.79 N	25.45	8.45 pm—1 am; News 8.45
GVU	London	11.78	25.47	4—6.30 pm
HP5G	Panama	11.78	25.47	12.15 pm—1.30 am; 3.45—7 am
ZYB8	Sao Paulo	11.76	25.50	8 am 1 pm
VLR-8	Melbourne	11.76 S	25.51	6—10 am (Sun. 6.45 am—12.45 pm)
GSD	London	11.75 S	25.53	12.15—3 pm; 4.45—8.45 pm; 9 pm—2.30 am; 8.30 am;—12.45 pm
—,	Moscow	11.75	25.53	10.30—10.55 am.
HVJ	Vatican City	11.74	25.55	Mon. & Thurs: Calls correspondent in Lonndan at 5 pm; Thurs & Sat.: calls correspondent in Sydney at 6 pm.
COCY	Havona	11.73	25.56	12. pm—5.15 pm.
GVV,	London	11.73	25.58	6—8 pm; 2.30—7.30 am
WRUL,	Boston	11.73	25.58	10.15 am; 3—4 pm
KGEI	San F'cisco	11.73	25.58	8 am—1.45 pm (Think has been withdrawn).
ZPA-2	Asuncion	11.72	25.60	9.30—1.10 pm.
—,	Leopoldville	11.72	25.60	9.55—11.15 pm; 5—7.30 am
PRL-8	R de J'niero	11.72	25.60	6 am—2.10 pm
—,	Lisbon	11.72	25.60	11 pm—1 am.
HER-5	Berne	11.71 S	25.60	Daily: 5—8.45 am; Tues & Sat. 6.30—8 pm
YSM,	San Salvador	11.71	25.62	5—6 am.
VLG-3	Melbourne	11.71 S	25.62	4.55—5.40 pm; 5.55—6.25 pm; 6.30—6.50 pm.
WLWO	Cincinnati	11.71 S	25.62	6.45—8.15 am; 9.30 pm—midnight; News 10 and 11 pm.
CXA-19	M'tevideo	11.70	25.63	10—11 pm; 8 am—2 pm
SBP	Motala	11.70	25.63	2—5.15 am; 8.20—8.40 am; 12 am—1 pm
CBFY	Montreal	11.70	25.63	10.30 pm—2.30 pm
. . . —	London	11.70	25.64	2.30—3 am. Italian: 3.15—7 am. Various languages.
HP5A	Panama City	11.70	25.64	12—pm—4 am; 12.10 pm—4 pm
CE1170	Santiago	11.70	25.64	11pm—1 am
GRG	London	11.68 S	25.68	4.45—8.45 pm; M/n—2.15 am; 8.15 am;—12.45 pm.
—,	L'poldville	11.67	25.71	6.15—6.30 am; 3—4 pm; 7.30—7.45
COK	Havana	11.62	25.83	3 am—2 pm (Mon. 4—10 am)
WRUA	Boston	11.14 N	26.92	7.15—8.30 am. News at 8
CSW6	Lisbon	11.04 S	27.17	8.45—9.30 am.
KWV	San F'cisco	10.84 S	27.68	5—7.45 pm
VQ7LO	Nairobi	10.73	27.96	1.45—6 am
CEC	Santiago	10.67	28.12	11—11.15 am
KES-3	Bolinas	10.62	28.25	4—9 pm.
VLN-8	Sydney	10.52	28.51	Idle at present.
WOA-4	New York	10.5.	28.53	9—11 am; 7.45—9 pm
—	Moscow	10.44	28.72	7 pm—2.45 am (often news at 10.40 pm)
PSH	R de Janiero	10.22	29.35	11.30—11.48 am
HH3W	P't-au-Pr'ce	10.13	29.62	3.30—9.45 am; 10 am—2.30 pm
SUV	Cairo	10.05	29.84	5.30—6 am; 9.45—10.30 am
WWV	Washington	10.00 N	30.00	Notionol Bureau of Standords frequency check, in speech on hour and half hour.
—	Brazzaville	9.98	30.06	5—6.20 am; 8—8.30 am
HCJB	Quito	9958	30.12	10.45—12.45 am; 3.30—6.30 am; 9 am—1.45 pm (Sunday 11 pm—8.30 am)
WRX	New York	9905	30.29	9 am—3 pm; 3.15—8 pm
WKRD	New York	9897	30.31	7.45—9.30 pm; 6—8 am.
WKRX	New York	9897 S	30.31	9—11.45 am.
KROJ,	'Frsco	9.89	30.31	2—6.45 pm; 7—12 pm; 12.15—am—3.45 am.
LSN-2	B'nos Aires	9890	30.33	1 pm—1.30 pm
—	Moscow	9.88 N	30.34	Irregular, but often heard around 9.30 pm
EAQ	Madrid	9860 S	30.43	5—6 am; News 5.15
—	Moscow	9860	30.43	9—10.15 pm
CR7BE	L. Marques	9843	30.48	4—5 am; 8.30—11 am
COCM	Havana	9833	30.51	10.45 pm—4 pm
GRH	London	9825 S	30.53	4.45—7.30 pm; 11.30 pm—2.15 am; 6—8 am;8.30 am—3.45 pm
—	Moscow	9770	30.71	11—11.30 am.
ZRO	Durban	9755	30.75	1—8 am
WKLJ	New York	9750	30.77	7.45—9 pm; 9—12 am.
T14NRH	Heredia	9740	30.80	11—12 pm (Wed, Fri, & Sun. 2.30—4.30 pm).
CSW-7	Lisbon	9735	30.82	5—8.30 am
CE970	V'paraisa	9730	30.82	10.30—12 pm; 8.30—3.30 pm
XGOA	Chungking	9720 S	30.86	6—7 am; 10 pm—2 am; News 1 am
OAX4K	Lima	9715	30.88	9.30 am—3.20 pm
WRUW	Boston	9.70	30.93	5.45—10 am; 3—4 pm
FIQA	Tananarive	9700	30.93	1.30—2 am.
GRX	London	9690 S	30.96	1.45—3.45 pm.
TGWA	Guatemala	9685	30.96	12.50 pm—3.45 pm (Mon. 11 am—3.45 pm)
LRA-1	B'nos Aires	9688	30.96	2.30—5 am; 6.30—7.30 am; 7 am—1 pm
VLG-8	Melbourne	9.68 N	30.99	2—3.30 pm (for Nth America)
XEQQ	Mexico City	9680	30.99	1 am—5.45 pm
VLW-5	Perth	9.68 S	30.99	9.30 pm—2.30 am
WNBI	New York	9.67 ..	31.02	8.15—5 pm
VLQ-3	Brisbane	9.66	31.05	11.45 am—5.15 pm. (Sun. 11 am—5.15 pm).
LRX	B'nos Aires	9.66	31.06	9.30—10.; 11.30 pm —2.10 pm (Sundays 4 pm)
HVJ	Vatican City	9.66	31.06	3—5.30 am
HHBM	P't-au-Pr'ce	9.65	31.06	11.30—12 pm;4—5 am; 10 am 1.30 pm.
WGEO	Schenectady	9.65	31.08	Not in use at present.
WCBX	New York	9.65	31.09	2.45—5 pm.
COX	Havana	9.64	31.12	3.50—3 pm
XGOY	Chungking	9.64 S	31.10	10.35 pm—2.40 am; News 1 and 2 am
LRI	B'nos Aires	9.64	31.12	8.57—11 pm; 4.30—5.30 am; 6 am—2 pm
GVZ	London	9.64	31.12	7.45—9.45 am; 4.30—8 pm
CXA-6	Montevideo	9.62	31.17	2—10 am.
—	Addis Ababa	9.62	31.17	2.40—3.30 am
VLI	Sydney	9.61	31.12	Not in use at present.
XERQ	Mexico City	9.61	31.21	12.30 am—2 am 10 am—4 pm
ZRL	Capetown	9.60	31.22	6.15 pm—1.30 am
HP5J	Panama City	9.60	31.23	11 pm—5.30 am; 12.30 am—2.30 pm; Sun. 12 pm—2 pm. Mon.
CE960	Santiago	9.60	31.24	10 am—3 pm.
GRY	London	9.60 S	31.25	7.15—8.45 am; 4.45—5.45 pm
—	Athlone	9.59	31.27	8.05—8.25 am; News 8.10 am
VUD-4	Delhi	9.59	31.28	12 am;—2.35 pm; 4—6 pm; 8.30—8.45 pm; 9.30—12.35 pm; 1.15—2 am; 3.30—6 am. News 12.45 am; 2.30, 6. 11 pm, 1.50 am and 5 am.
WLWO	Cincinnati	9.59 S	31.30	10 am—3 pm
WLWK	Cincinnati	9.59 S	31.30	Idle
VLR	Melbourne	9.58 S	31.32	6.30—11.30 pm. daily
VLI-10	Sydney	9.58 S	31.32	Idle at present.
VLG	Melbourne	9.58 S	31.32	1.15—1.45 am (Eng. for India) 2—2.45 am (for Nth America
GSC	London	9.58 S	31.32	4.45—5.45 pm; 8.15 am—3.45 pm
KWIX	'Frisco	9.57	31.35	11 am—3.45 pm; 4—5.45 pm; 10.30 pm—1 am.
KWID	'Frisco	9.57	31.35	6—9.15 pm; Believ opens again at 1.30 am.
—	Khabarovsk	9.56	31.37	6.30—8.12 am; 8.40—9.45 am; noon—2.12 pum; 2.45—3.40 pm; 7—10.30 pm; 11.30 pm—1 am.
OAX4T	Lima	9.56	31.37	Midnight—1 pm
XETT	Mexico	9.55	31.39	Continuous
GWB	London	9.55	31.41	6.30—8 am; 5—8 pm; 2.30—5.30 am.
WGEA	Schenectady	9.55	31.41	Not in use at present.
XEFT	Vera Cruz	9.54	31.42	12pm—5.15 pm.
—	Moscow	9.54	31.43	10.40—11.20 pm; 1.15—1.30 am
VLG-2	Melbourne	9.54 S	31.45	11—11.45 pm (for Nth America 11.55—M/n (Malay); M/n—12.30 am (French) 12.30—1 am (Thai).
SBU	Stockholm	9.53	31.47	8.20—8.35 am; 12 am—1 pm, News 8.20 and 12 am.
HER-4	Berne	9.53	31.47	See 25.61 metres.
WGEO	Schenectady	9.53 S	31.48	6.45—8.15 am; 8.30 am—10.30
ZRG	Joh'burg	9.52	31.50	6.30 pm—1.30 am
COCQ	Havana	9.51	31.53	11 am—2 pm; 9.20—12 pm
GSB	London	9.51 S	31.55	4.45—8 pm; 5.15—8 am; 8.45—9.45 am; 19 am—12.45 pm
PRL-7	R de Janeiro	9.50	31.57	9 am—2 pm

Call Sign	Location	Mc.	M.	Time: East. Australian Daylight
XEWW	Mexico City	9.50	31.58	12.58—6.45 pm.
OAX5C	Ica	9.50	31.58	Think off the air.
GWF	London	9.49	31.61	6.30 pm—1.30 am; 2.30—9.45 am
KRCA	'Frisco	9.49	31.61	4 pm—3 am
WCBX	New York	9.49	31.61	10.50 am—2.30 pm
—	Moscow	9.48	31.65	5—6 pm; 9.30 pm—1.45 am; 2.45—3.15 am.
CR6RA	Loanda	9.47	31.69	10.30—11.45 pm; 6.30—7 am.
TAP	Ankara	9.46	31.70	2—6.45 am; News 4 am.
GRU	London	9.45	31.75	4—5.45 pm; 2—2.15 am.
COCH	Havana	9.43	31.80	9.45 am—4.15 pm
—	Moscow	9.43	31.81	8—8.25 am; 3.15—3.45 pm; 4.30—5 pm.
GRI	London	9.41	31.86	3.45—9.30 am; 6—8.45 pm
FGA	Dakar	9.41	31.88	4—5.15 am
—	Moscow	9.39	31.95	10.30—12 pm; 2.30—3 am; 11 am—2 pm.
COBC	Havana	9.37	32.00	12 pm—4.15 pm.
OAX4J	Lima	9.34	32.12	10 am—5 pm; 12 pm—1 am; 4—7 am
LRS ..	B'nos Aires	9.32	32.19	9 am—1 pm; 11—12 pm; 5—5.30 am
COCX	Havana	9.27	32.26	11.45—4 pm.
HC2ET	Guayaquil	9.19	32.64	11.30 pm—4.30 pm
CNIR1	Rabat	9.08	33.03	5—9.50 am; 5.30—5.50 pm; 10.30—12 pm.
COBZ	Havana	9.03	33.23	11.45 pm—3 pm
—	Kuibyshev	8.99	33.37	6.50—7 am.
AFHQ	Algiers	8.96 S	33.48	3—9.30 am; News 5.15; 6 7 and 9 am.
KES-2	'Frisco	8.93	33.58	9.15 pm—4 am
—	Dakar	8.83	33.95	6.15—7.45 am; 6.30—6.50 pm; 11.15—12 pm.
COCQ	Havana	8.83	33.98	9.20 pm—3.15 pm
COCO	Havana	8.70	34.48	8.30 pm—4.30 pm
COJK	Camaguey	8.66	34.62	3.30—4.30 am; 7.30—10 am; 12—12.30 pm:
WOO4	New York	8.66	34.64	11 am—5 pm; 5.15—8 pm.
—	Kuibyshev	8.05	37.27	2—2.30 am; 3—5.15 am; 8.15 9.45 am
CNRI	Rabat	8.03	37.34	5—10.45 am; 4—6 pm
FXE	Beirut	8.02	37.41	12 pm—8 am.
FIA6	Douala	8.00	37.50	5.45—6.45 am; 9.45—10.30 pm
PSL	R de Janeiro	7.93	37.81	Sundays —10—11 am
YSD	San Salvador	7.89	38.00	11 am—2.30 pm
SUX	Cairo	7.86	38.15	4.30—5.30 am; 6.15—8.45 am
WKRD	New York	7.82	38.36	10.30—12.15 pm
WKRX	New York	7.82	38.36	8—11 pm.
WRUL	Boston	7.80 S	38.44	1.30—5 pm; 7—9 pm
YNDG	Leon	7.66	39.16	10 am—2 pm
YNLAT	Granada	7.61	39.40	10.30 am—2.15 pm
WLWO	Cincinnati	7.57 S	39.6	3.15—5.30 pm
WDJ	New York	7.56	39.66	10.15 am—7 pm
KWY	'Frisco	7.56	39.66	7.45—10.05 pm; 11.30 pm—1.30 am.
WKTS	New York	7.57	39.6	11 am—1 pm
—	Moscow	7.56	39.68	2—7.30 am; 9—10 am; 12.10—12.30 pm.
SU—	Cairo	7.50 N	40.00	2.30—4 am
YN2FT	Granada	7.49	40.05	11 am—2 pm
HER—	Berne	7.39 N	40.56	2.15—2.47 am
GRJ	London	7.32	40.98	6—8 am; 3.15 pm—6.15 pm
. . . —,	London	7.31	41.01	6.30—9.45 am; 3.30—7.30 pm
—	Moscow	7.30	41.10	3—10.30 am; 11—12 am; 2—4.45 pm; 5.30—6 pm
ZOY	Accra	7.29	41.13	3.15—6.15 am
VUD-2	Delhi	7.29 S	41.15	9.30 pm—12.25 am; News for 15 mins at 5 am.
VLI-9	Sydney	7.28 S	41.21	12.35—1 am (Thai), 1—1.45 am (Eng. for India), 2—2.45 am (for Nth America).
VUM-2	Madras	7.26	41.32	7—7.40 pm; 10.45—12.30 pm; 1.45—1.50 pm. News 11 pm and 1.45 am.
GSU	London	7.26	41.32	5.30—11.30 am; 2.45—7.30 pm; (Eng. 7.15—7.30 pm)
KGEI	'Frisco	7.25	41.38	2 pm—3.45 am
VUB-2	Bombay	7.24	41.44	5.15—6.10 pm; 10.25—11.45 pm. News 6, 10.25 & 11 pm
VLQ	Brisbane	7.24	41.44	6—10 am.
KWID	'Frisco	7.23	41.49	9.30—4.05 am
GSW	London	7.23	41.49	6.15—9.45 am; 2.45—5.45 pm
VLI-4	Sydney	7.22	41.55	Not in use
VUC-2	Calcutta	7.21 S	41.61	Schedule unknown; News at M/n
VLQ-2	Brisbane	7.21	41.58	5.30—11.30 pm
—	Moscow	7.21	41.61	8.50—10.30 am
—	Madrid	7.20	41.63	7—10 am
YSY	San Salvador	7.20	41.65	11.30 am—3 pm
CM21	Havana	7.19	41.72	9 am—3 pm; 1pm—4 am
GRK	London	7.18	41.75	
XGOY	Chungking		41.80	9 pm—4 am; 5.30—8 am
—	Moscow	7.17	41.80	6.20—7.30 am; 8.15—10.55 am 11—11.30 pm; 2—5.30 am
GRT	London	7.15 S	41.96	1.45—3 pm
EAJ-9	Malaga	7.14	42.00	7—10.05 am
HC4FA	Porto Viejo	7.14	42.02	8 am—2 pm
—	Ovideo	7.13	42.05	6—8.30 am
GRM	London	7.12 S	42.13	11.45 am—3.45 pm; 4.45—8.45 pm; 6—8 pm.
EA9AA	Melilla	7.09	42.31	Heard around 8 am
GRS	London	7.06 S	42.46	5—9.45 am; 12.45—3 pm.
EAJ24	Cordoba	7.04	42.61	7.40—8 am
EAJ-3	Valencia	7.03	42.65	7—11 am
—	Ponto Delgada	7.02	42.74	6—7 am
EAJ47	Valladolid	7.00	42.82	7.30—8.15 am
WGEA	Schenectady	7.00	42.86	11 am—3 pm
FO8,AA	Papeete	6.98	42.95	Wed & Sat. 2.57—3.45 pm
—	Moscow	6.98	42.98	3 am—10.23 am; 11—11.30 am
YNOW	Managua	6.87	43.67	11 am—3.30 pm
KEL	Bolinas	6.86 N	43.7	8—8.25 pm
HIH	San Pedro	6.77	44.28	11—12.3 pm; Moon. 9.20—10.40 am
YNDS	Managua	6.76	44.28	4—7 am; 9 am—3.30 pm; 11 pm 1 am
—	Oran	6.73	44.56	7.30—8 am
ZLT-7	Wellington	6.71	44.68	9 pm in news session only
TGWB	G'temala	6.54	45.87	10.30 am—4 pm

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

Call Sign	Location	Mc.	M.	Time: East. Australian Daylight
WKTM	New York	6.38	47.01	6.15—8 pm
	Berne	6.34 N	47.28	5—8.45 am; News 7.53
SUP-2	Cairo	6.32	47.47	5—8 am
FK8AA	Noumea	6.20	48.39	6.15—6.27 pm; 8—9 pm
GRN	London	6.19	48.43	6.45—7.30 am; 1—3.45 pm
VUD-2	Delhi	6.19 S	48.47	10.30—11.75 pm; M/n—2.35 am News 11 pm; 12.45 am; Special 15 mins at 5 am
XECC	Puebla	6.19	48.47	From 3—5 pm
WGEA	Schenectady	6.19	48.47	3.15—5.10 pm
LRM	Mendoza	6.18	48.51	9.30—2 pm
GRO	London	6.18	48.54	6—11.45 am; 3.40—8.45 pm
WCBX	New York	6.17	48.62	6.18—8 pm; News 7.18 pm
—	Antananarivo	6.16 N	48.62	2—3 am
HER-3	Berne	6.16 F	48.66	See 47.28 metres
HJCD	Bogota	6.16	48.70	Around 3 pm
CBRX	Vancouver	6.16	48.70	12.30 am—5.30 pm
CS2WD	Lisbon	6.15	48.74	6.30—9 am
EQB	Teheran	6.15	48.74	3—6 am; News 3.45 and 6.15 am
GRW	London	6.14 N	48.86	Schedule unknown.
WBOS	Boston	6.14	48.86	7.—9 pm
CXA4	Montevideo	6.12	48.98	Around 3 pm
GWA	London	6.12	48.98	7 am—1 pam; 2.45—7.30 pm
HP5H	Panama City	6.12	48.99	10 am—3 pm
YV3RN	B'quisimeto	6.12	49.02	Around 2.30 pm
XGOY ..	Chunking	6.12	49.02	10.35 pm—3.30 am
XEUZ	Mexico	6.11	49.02	Around 3—4 pm
WKTS	New York	6.12	49.02	5—7 pm
GSL	London	6.11 S	49.10	1—3.45 pm.
CBFW	Montreal	6.09	49.25	10.30 pm—2.30 pm
ZNS-2	Nasau	6.09	49.25	12—12.15 pm; 4.45—5.15 am
VQ7LO,	Nairobi	6.08 F	49.32	3—6 am; News 3.15 am.
WLWK	Cincinnati	6.08 S	49.34	11.30 am—3 pm; 3.15—7.30 pm
CKFX	Vancouver	6.08	49.34	12.30 pm—5.30 pm
CFRX	Toronto	6.07	49.42	10 pm—4.30 pm
—	Moscow		49.42	7.30—8.30 pm
GRR	London	6.07	49.42	4.45 am—1 pm; 2.45—6.45 pm
SBO	Stockholm	6.06	49.46	Try around 8.30 am
WCDA	New York	6.06	49.50	10.30 am—5 pm
GSA	London	6.05	49.59	9.45—11.45 am; 2.45—7.30 pm News 6.30 pm
XETW	Tampico	6.04	49.66	11 pm—5 pm
WRUW	Boston	6.04	49.66	3.15—7 pm
HP5B	Panama City	6.03	49.73	10 am—2 pm; 2.30 am—5 am
—	Moscow	6.03	49.73	10.40—11.19 pm
CJCX	Sydney (Nova Scotia)	6.01	49.92	10 pm—5.30 am; 9 am—2 pm
VUD-3	Delhi	6.01	49.92	11.25—12.a5 pm
GRB	London	6.01	49.92	9.45—11.45 am; 2.45—7.30 pm
ZRH	Joh'burg	6.00	49.95	2.—8 am
CFCX	Montreal	6.00	49.96	11 pm—2.15 pm
HP5	Colon	6.00	49.96	11 pm—5 am; 9 am—3 pm
ZOY	Accra	6.00	49.96	9.30—10.15 pm; 3.15—6.15 am News 6 am
XEBT	Mexico City	6.00	50.00	2 am—4.30 pm
WKRD	New York	5.98	50.12	3.45—7.30 pm
VONH	St. John's	5.97	50.25	11.30 pm—5.30 am; 8—1235 pm; News 8.30 am
HVJ	Vatican City	5.96	50.26	5.30—7.45 am
ZRD	Durban	5.94	50.47	10.30—11.10 pm; 2—8 am
—	Khabarovsk	5.93	50.54	9 pm—1 am
—	Moscow	5.89	50.90	8 pm—7 am
—	Lisbon	5.85	51.19	4.45—8 am
VUB-2	Bombay	4.88	61.48	12—12.15 pm; 1 am 1.15 am; News Midnight
VUC-2	Calcutta	4.84	61.98	11—11.10 pm; midnight—12.10 pm; 1 am—2 am.
WWV	Washington	5.00 N	60.00	See 300 metres.
VUC—	Colombo	4.90 N	61.2	10.30 pm—3.20 am. News midnight and 2 am.

SPEEDY QUERY SERVICE

Conducted under the personal supervision of A. G. HULL

J.W. (Newcastles) writes: "I have been trying to get hold of the constructional details of a multi-range meter, to enable me to make use of my 0-10 mA. meter, but all the designs I have come across make use of a meter having a maximum scale reading of 0-1 mA. Is there some special reason for this, and does it mean that my meter is not suitable for a multi-range instrument?"

A.—In a multi-range meter, the voltage measurements are obtained by inserting suitable resistors in series with the applied voltage and the mA. meter. In other wards, the meter indicates the current produced by the voltage and the resistor. Therefore, if, for example, a voltage of one volt is passed through a resistor of 1,000 ohms, the current would be 1 mA. If it was desired to measure 100 volts, a resistor of 100,000 ohms would have to be used, and for 200 volts a 200,000 ohm resistor, and so forth. This means that for a full-scale reading of the meter, a current of 1 mA is flowing. If your meter was used a full-scale deflection would represent a current reading of 10 mA.—the resistor values would, of course, be different from those given above—but the very fact that 10 mA.s was flowing in the meter circuit would produce misleading readings when voltage measurements were being taken, owing to the current drain imposed on the circuit under consideration, especially if high voltages were being measured.

●

C.T. (Bathurst) writes: "I am thinking of constructing a crystal receiver, but before purchasing the parts and devoting the time necessary to its making, I wish to ask you if you can give a guarantee regarding the range of reception ot the crystol receivers mentioned in your magazine.

A.—While all the designs of the crystal receivers given are efficient, we are afraid that you are asking rather too much by requesting a definite guarantee regarding their effective range of reception. In the early days, one used to think of 10 or 15 miles as being a reasonoble range for the reception of telephony, but nowadays, with the modern high-powered transmitters, this distance is, of course, greatly increased. With a crystal set so much depends on local conditions, the aerial system and even the crystal detector, but when these factors ore satisfactory, a distance of 50 miles would be quite feasible although, naturally, the closer one is to the station the more powerful the results.

●

J.R. (Pokeno, N.Z.) notes that the usual bios resistor for push-pull 2A3 type valves is 750 ohms, yet the Radiotron circuit D71 uses only 375 ohms.

A.—Yes, there are two ratings for the 2A3. The normal rating is with 250 volts on the plate, 40 bias and a current of 60 mills. But for push-pull operation it is permissible to step them up to 300 on the plate, with 60 bias and a current of 40 milliamps each. But it is also permissible to use them in push-pull in the original rating, with 250 plate volts, 120 mills for the two plotes, and a bias of 40 volts, obtained by using a resistance of 375 ohms. In this condition they need less signal input, but give lower maximum power output.

The armature-type pick-ups of some years ago were O.K. as regards frequency response ond record wear, but had extremely low signal output, so that high gain was required in the audio amplifier, with consequent trouble as regards hum and distortion unless great care was taken in the design and construction. One of the advantages of the crystal pick-ups ore their volts of signal. The infinite box baffle must offer peak loadings at exactly the same frequency as the resonance of the speaker, which is the main reason why the majority of them are such dismal failures. Normally the box is kept airtight. but in some designs allowance is made for a vent hole, but only experiment will prove what is necessary in your particular case to match up your speaker and baffle. We suggest that you lower your bias resistor until plate current is high enough to give rated energising for the field.

●

C.T.J. (Williamstown, Vic.) wants to know whether back numbers are still available.

A.—Yes, we have fair stocks of most back numbers, which are available at 1/- each, post free.

We have in mind to carry out your suggestion to publish an index to these back numbers as they contain a lot of good technical data which is hard to get in these days of paper rationing and restricted imports of overseas magazines.

ALIGNING INTERMEDIATES

When aligning the trimmers of intermediate transformers it is not good practice to use the steel blade of a screwdriver. This point is especially important when the transformers are of the iron-cored type.

A good type of aligning tool can be made from a piece of bakelite rod or erinoid, filing a flat of suitable shape on the end. A strip of bakelite cut from an old-style radio panel is quite good.

Care is needed to use the tool only when the screws move freely, a screwdriver being first applied to make sure that no great amount of force is necessary.

Another solution to the problem is to make up a tool with a very short blade mounted in a piece of bakelite, and this blade should be made of brass, not steel.

Fairly effective, although not ideal is a screwdriver made up from a brass rod with a wooden handle.

TESTING

(Continued from page 19)

leak due to the fact that grid current does not flow — the bias is merely a potential applied to the grid.

The same conditions apply when dealing with a battery receiver, and in this case the meter should be connected between the positive end of the bias battery and the tapping point employed, not to the grid of the valve. This is illustrated in Fig. 3.

Anode Current Totals.

A mistake is sometimes made when checking the total of individual valve anode current against the total current found by inserting the milliameter in the H.T.— lead. It is frequently found that the sum of the current is appreciably smaller than the single total reading. A search might then be made to find where leakage is taking place, but without result. This is because it has probably been overlooked that there is a potentiometer across the H.T. supply, used to feed the screening grids of the frequency-changer and I.F. valves, or to feed S.G. of the H.F. valve. A correction must be made by connecting a milliameter in series with the potentiometer to find exactly what current it is passing.

PARTS PRIORITIES

(Continued from page 5)

cour chairman; Messrs. B. J. H. Lutwyche, C. C. Gluskie, representing servicemen; Messrs. R. L. J. Sykes, A. G. Kirmsse, representing mechanics.

Southern Tasmania: Mr. A. C. Baxter, chairman; Messrs. E. L. Le Rossignol, C. A. Walch, representing servicemen; Messrs. A. C. Russell, E. R. Boss-Walker, representing mechanics.

Queensland: Mr. Colin Clark, Queensland Deputy Director of War Organisation of Industry, chairman; Messrs. C. G. Barton, K. H. McMahon, J. C. Grant and W. G. Duncan, representing servicemen. Messrs. J. H. Forrester, T. S. Milson, A. W. H. Gibson, and A. H. Dawson, representing mechanics.

Eimac gets another "E"

Mass production of a device that has always been hand made in a laboratory is an achievement in itself. But when the whole nation gives pause to *recognize outstanding excellence in this mass production* the achievement becomes all the more striking.

Such honors have been bestowed upon the Eimac organizations not once but twice. First to the San Bruno, California, plant (September 1942) and second, less than a year later, to a plant in Salt Lake City, Utah, that is little more than one year old.

Where does the credit go? . . . to the men and women at the Salt Lake City plant now for their recent triumph . . . and to the men and women of both plants always for their collective cooperation and hard work.

Follow the leaders to **Eimac** REG. U.S. PAT. OFF. **VALVES**

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Plants Located at: San Bruno, Calif., Salt Lake City, Utah

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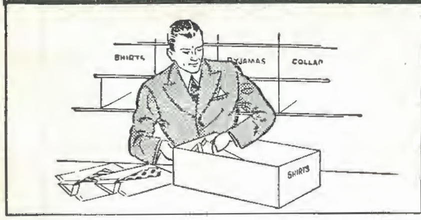
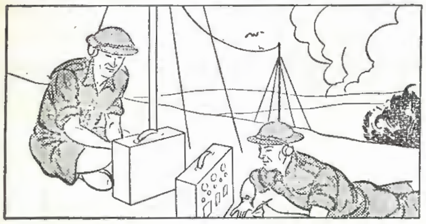
How John Stepped O



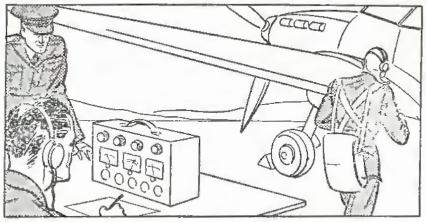
Not so very long ago, there was a young shop assistant named John, who wanted to do his best in the War effort. Being untrained, he did not know what do about it.

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.



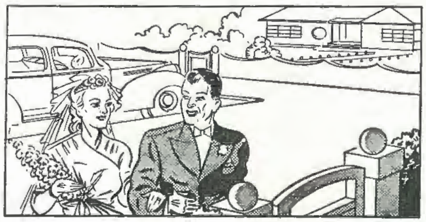
Had he wished at that time, he could have joined a Radio Unit in the Army at communications work, radio maintenance, or some other form of military radio work.



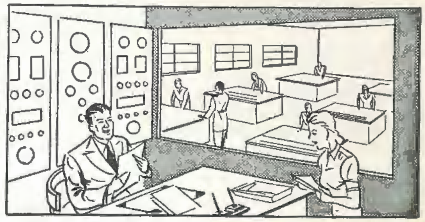
Or in the R.A.A.F. as a Radio Operator in air crew, or on the ground staff. Radio maintenance work, and radio location work, were also open to him.

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.

John stepped out of the rut, so can you. Men with some radio training are wanted urgently in Industry and all branches of the Fighting Forces. Learn Radio quickly and be equipped to help your country during this vital period. Peacetime will also find you ready to succeed in radio, to-day's fastest moving profession.

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