THE AUSTRALASIAN

Radio World

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VOL. 9 ..... NO. 2 JULY 15 1944

★ **Three novel receivers featured in prize-winning contest essay.**

★ **Jungle broadcasting station is operated by members of R.A.A.F.**

★ **Story of how an amateur built big communications receiver.**

★ **Details of a simple voltmeter with sensitivity and range.**

Price 1/-

THE AUSTRALASIAN
RADIO WORLD

Devoted entirely to Technical Radio

and incorporating

ALL-WAVE ALL-WORLD DX NEWS

Vol. 9 JULY, 1944 No. 2

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CONTENTS

CONSTRUCTIONAL—
Simple Vacuum Voltmeter 7
Home Built Communications Set 14

TECHNICAL—
R.A.A.F. Jungle Broadcaster 5
Winning Essay 8
Design Considerations for Amplifiers 10
Finer Points About Pick-ups 19
Distortion—Its Cause and Cure 20

SHORTWAVE REVIEW—
Notes From My Diary 23
New Stations 23
Short Wave Notes and Observations 24

THE SERVICE PAGES—
Answers 26

EDITORIAL

With the invasion going well and the war news very bright at the moment of writing, it is perhaps natural to find that thoughts are turning more and more to the post-war problems and prospects.

All over the world there will be huge stores of war material to be disposed, and the old parable of the "ill-wind" may be repeated.

Here in Australia it has been estimated that when the war finishes there will be radio components in store to the value of about ten million pounds.

Amongst these parts will be lots of transmitting valves, condensers and other parts which will not be suitable for use in broadcast receivers. They will be a wonderful windfall for those who operate experimental transmitters.

There will be great stocks of components suitable for use in building the thousands upon thousands of receivers which will be required to satisfy the overdue demands of the ordinary listeners, and the whole of the radio trade will need to handle things carefully to ensure that these parts are put to good use without upsetting factory production or affecting normal trading.

Some radio traders are apprehensive about the possible effects of the release of war surplus stocks, but others are quite confident that the matter can be easily handled by the trade, in close co-operation with the technical press, bringing about a boom in technical radio, with all-round benefits to the radio trade as a whole.

—A. G. HULL.

R.A.A.F. OPERATES JUNGLE BROADCASTER

SOMEWHERE in the jungles of New Guinea, near Milne Bay, there is a small studio in a native-built grass hut. A cheery Australian voice emanates from here, travels along two miles of precarious landline through dense jungle growth and is transmitted, to be picked up by receivers in warships, tankers, Douglas transports, patrol aircraft, hospital wards, and outlying Units. Thousands of Australian and American servicemen are its listening public. The voice says:

"This is R.A.A.F. Radio—the Voice of the Islands. We now bring you—"

Music of all kinds—light entertainment—news and sport.

Music For the Men

The accent is on music, for that's what men like to listen to most of all, especially men with time on their hands, who must spend weeks and months doing tedious and necessary jobs of war in these tropical outposts. To these men, R.A.A.F. Radio has become a great factor in keeping morale high, as the studio's ever-increasing fan-mail testifies.

Many units, previously supplied with small receivers by Comforts Funds and other sources, were unable to pick up Australian stations satisfactorily. R.A.A.F. Radio was able to bring these sets into proper use and to bring into the boring lives of thousands of servicemen a constant source of good entertainment.

R.A.A.F. Radio's beginning was a hazardous one. From the outset, the undertaking was fraught with obstacles. A small committee was formed to operate the station, like the board of management of any company—very like that of a country broadcasting station.

"Business manager" was the Squadron Leader H. W. Shirley, who has had many years of experience in Melbourne and Sydney since the early days of broadcasting.

Welfare Officer, Flying Officer F. Lasslett, formerly principal of the Gilbert and Sullivan Opera Company in Melbourne, took charge of "live artist" programmes.

Flying Officer Ralph Turner bore the biggest initial burden as chief technical engineer.

Formerly a "ham", conducting his own amateur radio station in Adelaide, Station VK5RT, Turner had the necessary experience to overcome innumerable technical problems.

Flying-Officer B. A. Clark, former New South Wales grazier, became right-hand man to Squadron-Leader Shirley on the business side, to handle the hundred-and-one details of organisation and management.

The station's initial transmitter, years old, bore no resemblance to any modern set and had to be completely rebuilt and adapted for broadcasting. The unit set-up demanded that the transmitter should be two miles from the studio—two miles through dense jungle growth. The only wire available was ordinary twisted telephone cable. It had to be strung through the dense growth of trees, creepers and foliage.

Difficulties Overcome

Once the lines were strung from studio to aerials, the jungle station's troubles weren't over. American engineers were still making roads through the jungle. Bulldozers showed painful lack of respect for the precious wires.

Once the wires were shot down.

But eventually the difficulties were overcome by the telephone mechanics, who laid a second set of wires, independent of the other.

Gradually, the broadcast studio and transmitter took shape. Bits and pieces were scrounged from neighbouring units. U.S. units were interested, too, and gave odds and ends of equipment.

Transformers had to be designed and hand-wound, then re-designed to overcome the effect of humidity. Gum trees 85 feet high were ear-marked for the aerials. But they were too high. The natives refused to climb them, so a wireless-mechanic, Sergeant Hugh Wallace, of Brisbane, did the job.

At last, on January 26, this year, R.A.A.F. Radio—"The Voice of the Islands"—went on the air.

The first two months were, in effect, a testing period. R.A.A.F. Radio gave only a 60-watt coverage and began with only a limited supply of records. Turntables, supplied by the Australian Comforts Fund, were adapted for studio use, a neat studio, accoustically correct and neatly set out, was built inside a grass hut.

Auditions had been made, and among R.A.A.F. personnel likely voices and talent were found.

A strong team of announcers was found as the result of these auditions.

The R.A.A.F. Broadcaster operates on a frequency of 1,250 k.c. and can be logged in Melbourne on a good DX set.

It included Corporal John Greathead, formerly of 2GZ Orange, 2KA Katoomba and 4BU Bundaberg; L.A.C. John West, of Concord, N.S.W., formerly A.B.C. announcer on 2FC and 2BL; L.A.C. F. E. ("Shep") Sheppard, of Brisbane, ex-A.B.C. announcer and regional officer for Townsville and Atherton; F/O. Ron Petty, of Middle Brighton, Vic., a former amateur announcer; W/O. Bailey, of Adelaide, a former amateur theatre player; and two assistant announcers, L.A.C. A. J. Fehlberg, of Yorktown, S.A., and L.A.C. K. Lyons, of Bundanoon, N.S.W.; F/O. John Eldon, of Melbourne, a follower of the little-theatre movement, and a keen collector of gramaphone recordings, took charge of recorded programmes and announcing.

Sporting editor and announcer was F/Sgt. J. R. Page, of Flemington, Vic., formerly of the staff of the former official R.A.A.F. newspaper, "Air Force News," and before enlistment an employee of "Truth". Assistant sporting editor was Sgt. W. Hamdorf, of Port Pirie, S.A., formerly of the "Recorder."

To assist F/O. Turner, two wireless-mechanics joined the station staff as assistant engineers. They were Cpl. R. Williams, of Cairns, Q., and L.A.C. B. Stockwell, both electrical and radio technicians in civilian life.

To-day, R.A.A.F. Radio is a going concern. Its new transmitter, constructed along modern lines, giving greater fidelity and greater range, has an output of 250 watts. Thanks to the generous co-operation of the A.B.C. and the Federation of Australian Broadcast Stations, its programmes are wide and varied. Two new turntables have been supplied by the Aus-

(Continued on next page)

VICTORIAN AMPLIFIER CHAMPIONSHIP

As announced in last month's issue, the Australian DX Radio Club, in conjunction with the Melbourne "Listener-In", will conduct an Amplifier Championship, commencing shortly, and with the final night some time in October.

Further details will be given in next month's issue, but those interested should get in touch immediately with the Honorary Secretary, Norman H. Groves, of 135 Burgundy Street, Heidelberg, phone number JL 1055.

Prizes will be awarded in three classes, so that amateur amplifier enthusiasts will be adequately catered for, as well as the topnotchers.

JUNGLE BROADCASTER

(Continued)

tralian Comforts Fund. Its studio even has a felt floor-covering now.

Relayed Programmes

Highlights of its programmes are Out of the Bag, Dick Bentley's Show, Victory Show, Spotlight, Shoulder to Shoulder, Comrades in Arms, You Shall Have Music, Road-house, Witches Tales, One Night Stand, Bob Hope, Fred Allen's Show, Command Performance, and Front-line Theatre.

Each Sunday night, a padre from one of the units in the area conducts an undenominational service, with sacred music, entitled Jungle Cathedral.

For the patients of Australian and U.S. hospital wards, regular sessions of popular request numbers are broadcast. Other musical sessions include Know Your Artists, These Were Hits, Listen to the Band and You A For It.

Sports programmes have a wide appeal.

Each Friday evening, the station broadcasts a half-hour's sports resume by Cyril Angles, of 2UW. This recording is flown from the mainland the previous day.

On Sunday at mid-day, recorded descriptions of all Sydney's leading races are broadcast. The recordings are made in Moresby by A.B.C. Station 9PA and flown to Milne Bay. At midday Saturday, sporting editor, Raymond Page conducts his "Page of Sport." There are other highly appreciated sports programmes covering results of all the sports.

As would be expected in these areas, good news broadcasts are a "must." Morning, mid-day and evening news sessions are regularly taken from the A.B.C., on relay. B.B.C., Austra and American News services are re-layed each eveni

In addition, there is the R.A.A.F. Radio Service Bureau, which ad tises all the local entertainments, ture programmes, sporting fixtures.

To simplify the designation of sites in the What's On Programmes, all the locations for mobile and camp movies have been named after theatres in every Australian capital. They include the State, Majestic, Metro, Regent, Civic, Liberty (and the Boomerang, the only one that wasn't changed).

The work of the staff of this R.A.A.F. Radio station is purely honorary and spare-time. The men who run it and work to bring greatly needed entertainment to the troops in New Guinea do it because they like doing it.

Perhaps, soon, as the war moves on towards Japan, the station will have to move on, too, and the work of initial establishment will have to begin all over again. In any case, R.A.A.F. RADIO has already done a worthwhile job.

A SIMPLE VACUUM-TUBE VOLTMETER

Details of an exceedingly simple device for reading A.C. Volts from .1 to 700. Sensitivity upwards of 300,000 ohms per volt.

By

J. W. STRAEDE, B.Sc.

7 Adeline Street, Preston, Vic.

EVERY radio serviceman knows how difficult it is to measure the minute A.C. signal voltages existing between the grid of a valve and the chassis. Even if a good quality 20,000 ohm-per-volt meter is used, only a slight indication is obtained, because the impedance of the meter acts as a shunt across the grid impedance, thus changing the constants of the circuit and altering (usually reducing) the value of the signal voltage.

High Impedance Possible

By isolating the meter with a vacuum tube amplifier, the impedance of the "voltmeter-cum-amplifier" testing device can be made quite high, several megohms in fact. At the same time, a diode rectifier may be employed to rectify the amplified signal voltage, thus enabling an ordinary D.C. moving coil meter to be used. The greater the amplification of the first valve the greater the sensitivity of the vacuum-tube-voltmeter. Sounds good, doesn't it?

But there are SNAGS—together with ways of overcoming them. The biggest problem facing the designer of a V.T.V.M. is as follows: All tubes of one type are not the same, in fact, they may differ in emission by as much as 30 per cent. Again tubes vary in anode resistance (and consequently in effective amplification) throughout their life. Besides these factors, mains voltages vary, so our amplifier tube will have rather a varying amplification! This means that our meter scales will be somewhat unreliable. There are ways out of this trouble. The zero end of the scale can be reset by varying a "fixed" D.C. voltage applied to the meter the sensitivity can be made adjustable and the V.T.V.M. can be checked against a built in A.C. voltmeter on a low value of mains-derived voltage (using the filament voltage of the valve, say). All these adjustments lead to complication and expense, besides making the instrument awkward to use and very bulky.

Negative Feedback Used

Is there no way out of the difficulty? Is there no device that keeps amplification constant when tubes vary? Yes—there's negative feedback and that's what we are using in this circuit. The tube we selected, a 6B6G or its six-pin equivalent the 75, has an amplification factor of about 100, but the gain in our circuit is only a little more than 7, this being due partly to the low value of anode load and partly to the negative feedback obtained in the simplest possible way by an unbypassed cathode resistor. A value of 2,500 ohms is given for this resistor, but slightly higher sensitivity together with a slight loss of feedback and a reduction in tube life is obtained with a value of 2,000 ohms.

The diode section of the tube has practically constant characteristics and need not be worried about—almost all voltage diodes (i.e., diodes apart from power rectifiers), both A.C. and battery-operated have practically identical characteristics, especially at low current drains.

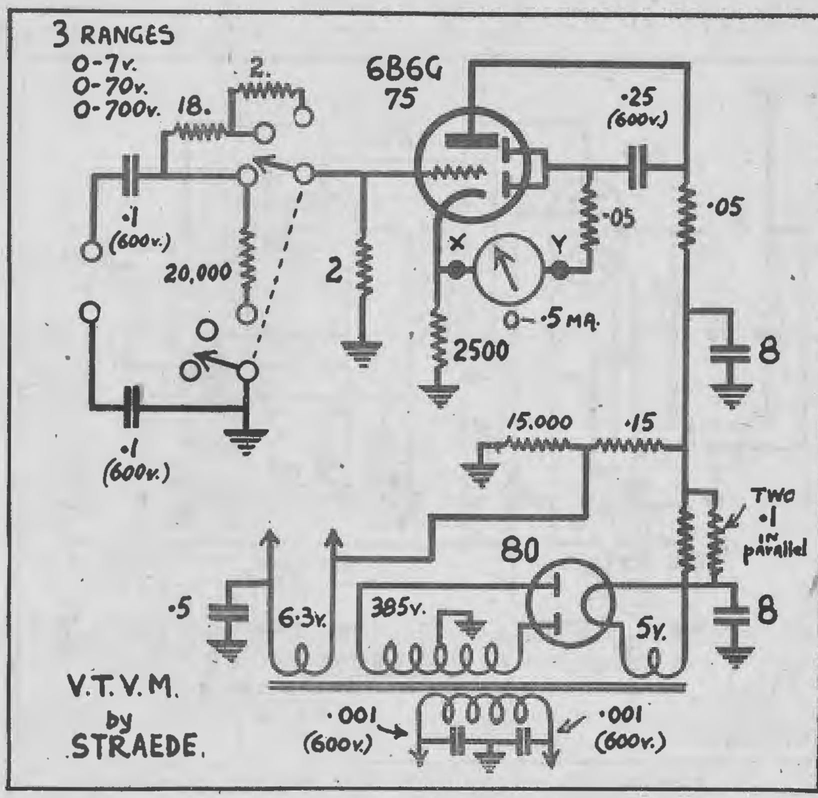
After rectification the voltage is measured by a 0 to .5 milliammeter connected as a voltmeter by means of a series resistor. A 0-1 meter may be used, but it may be found that the pointer will not go full scale, or, if it does, the scale is far from linear past the .5 mark. Even with a 0-.5 meter, the scale will depart from the linear at the ends, but this is unavoidable. The majority will, however, be linear, i.e., the markings will be evenly spaced. The departure from linearity at the low end is due to the diode characteristic being curved at low voltages while the departure at the upper end is due to "overloading" of the amplifier section of the valve on large grid swings.

Shielding Essential

Because only a very small current flows, all resistors can be of ½ or 1 watt rating, the one-watt type being preferred on account of lower heating. Both the valves should be shielded, especially the duo-diode triode, to prevent hum pick up which would not only alter the meter reading but which would vary with A.C. polarity, etc.

The bottom of the chassis must be covered in for the same reason and if the unit is used anywhere near a

(Continued on page 18)



THREE INTERESTING CIRCUITS—

HERE is the essay which won first prize in the Utility Circuit Contest as announced in last month's issue:—

Dear Sir,

I would like to enter your "utility set" competition with the following three circuits. They all comply with my idea of a utility set, namely a set, small and inexpensive, though powerful enough to get all broadcasting stations of good programme value as far as the quality of the reception is concerned. Weak or distant stations, marred by static and fading are seldom patronised except by the DX enthusiast, and the same thing applies to overseas shortwave stations. The thrill of listening to the "truth" on Tokio or Berlin radio through a more or less dense cloud of interference will end together with the war, and as the continuous sideband fading on short waves makes the tone quality rather poor, a utility receiver should be built for broadcast only.

Three-valve Reflex

My first circuit is rather revolutionary, as it uses the EBLI as a reflex amplifier. This set is a direct successor of a 1-valve and rectifier set I built in 1937, shortly after the appearance of the EBLI on the market. It was a standard T.R.F. reflex, amplifier with two tuned circuits and it brought in all the Sydney stations with good volume and distortion free. Care had to be taken to stay well within the straight portion of the valve characteristic and I estimate that it got a distortion-free-to-the-ear ouput of 1½-2

By

PAUL STEVENS

"Westdale", Fletcher's Avenue, Bondi, N.S.W.

watts. Volume control was supplied by a 10,000 ohm potentiometer across the aerial coil. The selectivity of this 2-valver, with reaction, provided only by the very low grid-plate capacity of the EBLI, was not quite sufficient to separate the metropolitan stations completely, so I went on to the design of the 3-valve reflex superhet described here.

Fig. 1 shows the complete circuit with all particulars. For highest gain and selectivity, combined with low noise level, the EK2 followed by a high-gain I.F. transformer was the natural choice for a converter. The second I.F. transformer was air-cored with untuned primary to match the comparatively low plate resistance of the EBLI. I used one out of an old "Radiolette", back to front. Care had to be taken to keep the I.F. frequency out of the speaker, so I introduced a R.F. choke-condenser. Delayed A.V.C. for the EK2 could be incorporated in the circuit, but was omitted to simplify the set. The B plus voltage is near enough to 200 volts to connect the oscillator plate directly on ot it, thus saving another resistor and condenser. The power of this set is equal to any good 4-valve of standard design due to the high conductance of the EBLI, the current consumption low enough for a 40 Ma. power transformer.

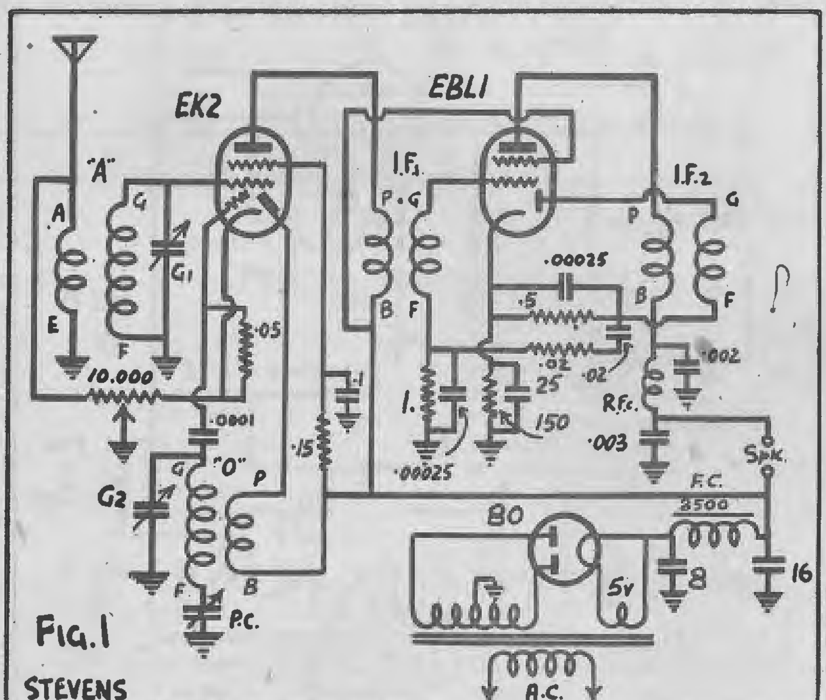
The second circuit is a more or less standard 4-valver with some special features to make the set simpler and therefore cheaper without reducing its power to any noticeable degree.

Continental-type Valves

The circuit is shown in fig. 2. All the valves except the rectifier are continental type, Australian-made valves, which, from the technical point of view, should be the only ones used, especially in a set with a low number of valves. Their characteristics are far superior to their American equivalents and nobody can deny that the team EK2 (EcH4), EBF2-EL3, gives better results than 6A86 (6J8G)-6G86,-6V6G, quite apart from the higher current consumption of the latter. Discussing one of our commercial 4-valve sets in the May, 1941, issue of the "Radio World" the editor stressed its high performance due to the use of the latest continental type, though Australian-made valves, together with high-gain I.F. transformers to fully utilise their advantages.

Low Voltages Used

The special features of our otherwise quite standard set are: (1) 200 V.B. voltage to omit dropping resistor and condenser for oscillator plate; (2) common screen resistor for EK2 and EBF2, putting 65-70 volts on their screens (continental valve charts specify EK2 screen voltage as 60-80 volts). Both (1) and (2) contribute to keep the B current drain within the scope of a 40 Ma. power transformer. (3) All cathodes to chassis. Common back bias resistor supplying all valves and A.V.C. delaying biasses. This is simply achieved by the introduction of a single resistor of 2 meg. ohms between the A.V.C. line and chassis. It provides a voltage divider network consisting of the two 1 megohm A.V.C. diode resistors and the

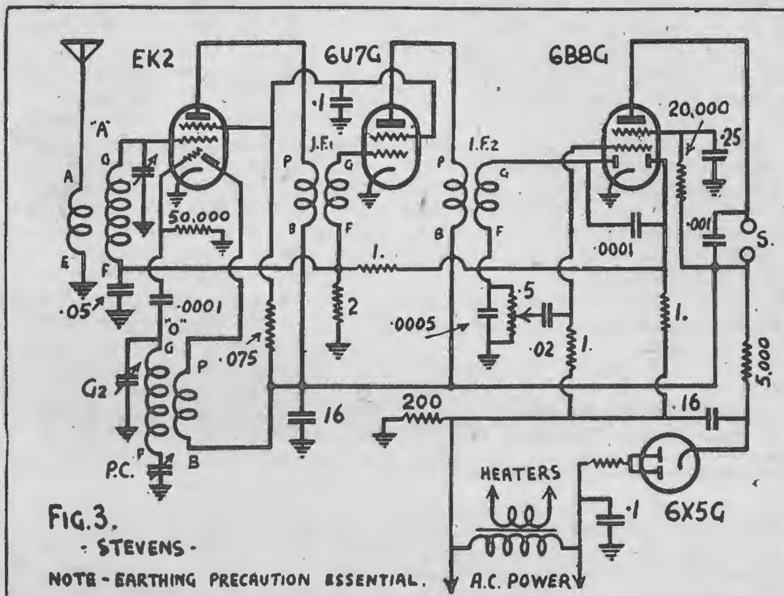


The interesting reflex superheterodyne using only three valves in all.

WINNING ESSAY IN OUR CONTEST

additional 2 megohms to chassis. The EL3 gets the full bias of about 5.5 volts. There is 4 volts delay on the A.V.C. diode and 2.5 volt bias on the A.V.C. line for EK2 and EBF2. The delay voltage of 4 volts is not quite sufficient for the directly driven EL3, but the fact that only two-thirds of the A.V.C. voltage reaches the valves, and feeding of the A.V.C. diode from the secondary of the I.F. transformer improves matters considerably.

The third circuit caters for those who consider a midget set the best solution for a utility radio. It does not take up much room wherever you put it and a built-in loop aerial makes it the ideal foolproof everyman's anywhere set.

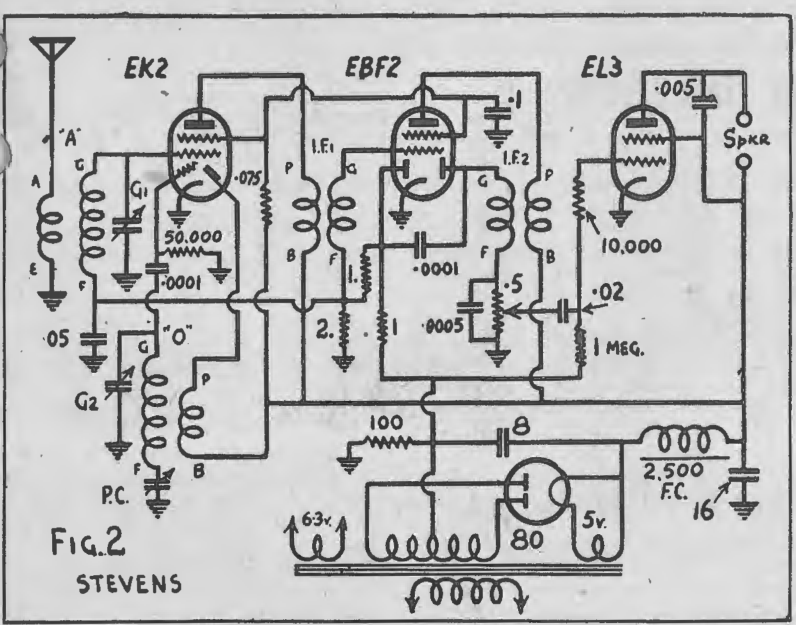


A suggested circuit, taking the power direct from the A.C. mains, a practice which is NOT recommended unless special earthing precautions are taken to avoid danger.

I worked out this circuit (fig. 3) only a few months ago, when I had to convert a 4-valve midget battery set into an A.C. set. There was no space for a transformer or extra rectifier. So I decided to build a 3-valve and rectifier receiver using EK2,-6U7G-6B8G-6X5G. The small per mag speaker had a transformer matched to 25,000 ohms, which is just the right value, for the 6B8G used as output valve. The B current drain of the whole affair is only about 20 Ma, so I used a 5000 ohm 2-watt resistor (2 10,000 ohms in parallel) instead of a choke and finished off with a B voltage of 170 volts. A 50,000 ohm screen resistor supplied 60 volts to the screens of both 6U7G and EK2. The screen of the 6B8G got 120 volts and the common back bias resistor provided 4 volt bias for the output valve. The EK2 and 6U7G got their 2 volts by the same method as in the previous circuit, namely a 2 megohm resistor from A.V.C. line to chassis. The set proved to be of remarkable sensitivity due to the high gain of the battery I.F. transformers and was in no way behind the standard 4 valves. Its output was, of course, limited to about 2 watts, quite ample for normal purposes.

I used a small filament transformer to heat the valves but the set could be easily built as an A.C.-D.C. set with 150 Ma. heater valves, which would be available again after the war. The heater resistor could then be stretched out and fitted, American fashion, inside the braiding of the asbestos protected power flex. The 25 watts absorbed by the resistor should not overheat the flex to any extent, especially when it is distributed over 3 to 4 yards of length.

—Paul Stevens,
"Westdale,"
Fletcher's Avenue,
Bondi.



High-gain four-valve circuit using continental-type Australian valves.

TIME MEASUREMENT

The accurate measurement of time intervals ranging from 1 millisecond to 1 second is made possible by an instrument known as the "Microtimer" which is made by R. K. Dundas, Ltd., The Airport, Portsmouth. The principle involves the charging of a condenser through a constant current circuit, the resultant voltage being measured by a D.C. valve voltmeter. Instruments for A.C. or battery operation are available.

DESIGN CONSIDERATIONS FOR AMPLIFIERS

AN announcement in last month's issue heralding the advent of an Amplifier Competition will probably have come in for a lot of discussion, even at this early stage.

The Australian R.D.X. Club is to be highly commended for its forethought in arousing such keen interest in a worthwhile hobby, as is the design and construction of high quality audio amplifiers for the reproduction of gramophone recordings, and high fidelity radio reception.

Many of our readers are fortunate enough to be able to design their own amplifiers and probably have at present achieved what they firmly consider the ultimate in high fidelity reproduction. But let us not forget those other readers who are groping in the dark, so to speak, asking themselves "What output power do I need?" "Will I use triodes or penthodes?" "Will I use resistance coupling or transformer coupling?" These, and a host of other problems, confront the average amplifier enthusiast so that for the benefit of our less technical readers, let us forget for the time being the finer points of the game and lend a helping hand.

By

CHARLES MUTTON

1 Plow Street, Thornbury, Vic.

Frequency Response

Before we consider output power we should firstly consider what we want to use the amplifier for, and having decided this, determine what frequency range is required to do the job. We will assume that at the moment most of our readers are interested in the reproduction of recorded music.

By the term frequency response we mean the degree of amplification which takes place as tones or notes of different pitch are fed through the amplifier, and subsequently reproduced through the speaker system.

The old adage "A chain is only as strong as its weakest link" can be well and truly applied to the design of amplifiers. On no account regard your amplifier apart from its associated equipment, ie., the pick up and the speaker. Failure due to disregarding this important point often results in disappointments.

Any enthusiast who after building an amplifier decides to pull all his good work to pieces because it lacks "highs" or "lows" or middle register, in most cases is confessing his lack of understanding of what is required in the matter of correction of these faults.

Of the three links in the chain, the amplifier itself will be the least troublesome in getting results as far as frequency response is concerned. Providing, of course, the tubes and the circuit are more or less of standard design.

The Speaker

In general the worst offender will be the speaker. The best of amplifiers will sound mediocre when connected to a poor speaker; so that the first important rule is, strive to use the best possible speaker which circumstances and finances permit. If one speaker will not do the job required, use two. In choosing a speaker, pick a reliable make, utilizing plenty of watts in the field coil (if a dynamic) and the larger the diameter of the voice coil the better, the same applies to the diameter of the cone. If a permanent magnet speaker is decided upon or on hand, use one which has a good sized magnet. One prominent speaker manufacturer turns out a speaker of the permanent magnet type, which provides the equivalent to 30 watts field excitation.

Cheaper speakers will, as a rule, reproduce reasonably well frequencies ranging from 100 cycles to approximately 5,000 cycles, below and above these limits the response falls off rapidly. The better class of speaker will reproduce satisfactorily frequencies from 50 cycles to 7,500 cycles. Better results still may be obtained by the use of one of several dual speaker kits which have been on the Australian market for some years, but which, unfortunately, are extremely hard to obtain. While on the subject of speakers, it might be well to mention that to get the ultimate performance from your speaker, try and spend a little extra and obtain a good size output transformer with plenty of iron in the core and lots of inductance in the primary. If you are fortunate enough to obtain the high fidelity type with a split primary winding and low leakage losses, quite a lot of design problems are solved for you.

Getting back to gramophone recordings and neglecting pick up amplifier and speaker temporarily, we are here restricted from the start. Speaking generally, recordings do not go lower than 50 cycles or higher than 7,000 cycles. For our purpose then it becames superfluous to design the frequency range of the amplifier any higher than 10,000 cycles or lower than 50 cycles, because we can't reproduce sounds which are non-existent. Having set our frequency range at 50 to 10,00 cycles we can now commence to think about the amplifier itself.

Types of Amplifiers

While admitting that by careful design it is possible to get excellent results from what is termed a single-ended amplifier, meaning an amplifier using one output valve, driven by a suitable driver, the results are in no way comparable to those obtained by using two similar valves in push pull. In most good quality amplifiers push

THE FINANCING OF TELEVISION

Television, someone remarked, is all set for the post-war period, but for television—meaning that the engineering and the price is right, but the problem of paying for the service until it becomes self-sustaining still remains.

Dr. E. F. W. Alexanderson, of the General Electric Co., has pointed out that the radio relays necessary for the network of television stations after the war may also have important uses in the aviation and communications industry, thus justifying the installation expense. Said Dr. Alexanderson:

"There may be some doubt whether the television industry alone can support extensive television relay chains. We must then keep in mind that such radio highways may be used for many other purposes.

"They may be used for a radio mail service so that a letter dropped in any post office will be flashed in facsimile and ready to deliver to any part of the country within a few minutes.

"The radio chains will constitute trunk lines of telephone and telegraph communication with greater capacity than all the wire lines in existence.

"The physical plant of the radio chains may serve as highways for the traffic in the air whereby all the information needed for safe public and private flying is given to the aviators.

"The all-around usefulness of radio relays is therefore apparent because they will serve the television and the communication industries at the same time.

"When we once establish this radio service it will no longer be a question of cost. We will not be able to get along without it any more than we can get along without the railroads."

pull output is synonomous with high fidelity reproduction. It is with the push pull type of amplifier that we are mainly concerned.

The basic types of amplifiers are as follows:—Class A, Class AB, Class B and Class C. The last named only finds use in transmitting circuits, and, in consequence, may be discarded.

Class A—Triodes

In a class A amplifier grid current does not flow during any part of the cycle of the input signal. In checking this condition it is necessary to check for plate current variation when varying the input signal from zero to full output. For correst Class A operation, the plate current should remain constant, regardless of the magnitude of the signal. Class A amplifiers deliver large amounts of power to the speaker, and are better than any other type for full fidelity. However, they suffer from low efficiency and low power sensitivity, but the distortion factor is low.

Class A—Pentodes

Pentodes can be operated as Class A amplifiers with greater power sensitivity, but suffer from high harmonic distortion. Beam power tubes such as the 6V6, 6L6, have better efficiencies and sensitivity than even the pentode, but the harmonic distortion is much greater than the pentode.

Class A—Parallel Operation

Class A power amplifiers are connected sometimes in parallel which will provide twice the output of a single tube, but such a scheme is not practical because of the excessive plate current of the two tubes which would cause saturation of the core in the output transformer, which in turn causes an excessive decrease in inductance attended by poor low frequency response. This disadvantage is overcome by push pull operation.

Class A—Push Pull

The main advantages to be gained from push pull operation are as follows:—

(1) Even order harmonics are cancelled causing a big reduction in harmonic distortion.

(2) Reduces expensive filtering systems by reason of the fact that hum in the output stages cancels out.

(3) Reduces second harmonic distortion and increases the power output with better fidelity.

All the above remarks apply in the main to output stages, but can also apply in most cases to voltage amplifiers which precede to output stage.

Class A—Voltage Amplifiers

The chief object of a Class A voltage amplifier is to combine a high voltage gain with a linear frequency response, the latter being purely a matter of design applied in the correct manner in the selection of output and input resistance loads and the coupling condensor. Modern design in voltage amplifiers favours sharp cutoff pentodes such as a 6J7, 6C6, 57, 77, etc. When resistance coupling is used with this type of tube the frequency response is remarkably good and is adequate for most purposes and much better than can normally be obtained from triodes of the 56, 76, 6F5, 6C5 type. The main reason for this being the relatively large input capacity of the triode restricts the high frequency response. Pentodes are also more economical, as usually it would take four stages of triode amplification to equal the voltage gain of two pentode stages. Each, however, have their special applications.

Class AB

Class AB operation is split up into two types, AB1 and AB2. In AB1 operation the bias is raised above that required for Class A, and in consequence it is permissable to increase the plate and screen voltages without exceeding the valve manufacturer's ratings for the internal dissapation. We then have increased our efficiency, and, as a result, we get greater output power; e.g., two 6V6G tubes in Class A push pull will deliver 9 watts audio power, in Class AB1 they will deliver 13 watts, amounting to an increase of 4 watts.

(Continued on next page)

AMPLIFIERS

(Continued)

The voltage amplifier preceding an output stage working under AB1 conditions, is not called upon to deliver any power into the grid circuits, in other words, grid current does not flow during any portion of the input cycle, so that the standard type of voltage amplifier will suffice ahead of two tubes working Class AB1.

Class AB2

In Class AB2 operation grid current is allowed flow during portion of the input cycle, in which case there is loss of power, which must be supplied by the preceding driver valve. In other words the driver valve in a Class AB2 system must furnish power rather than voltage, this power varies with different conditions which are governed by whatever types of valves are selected. In order to get the best results out of AB2 operation, strict attention to power supply regulation, such as choke input filter system, fixed bias supply, low voltage drop rectifiers such as the type 83, and well regulated screen grid supply must be used. Plate power efficiencies are high but AB2 power amplifiers seldom if ever are capable of giving the fidelity of tone from those using Class A. Their chief use is in big public address installations.

Class B Operation

The Class B amplifier operates on the principle that the plate current is cut off for a larger portion of the negative grid swing, high plate efficiencies are also obtained from this system but it suffers badly from distortion at low volume. Class B amplifier tubes operate at zero grid bias, which means that on the positive half cycle of the input signal the grid current reaches high proportions necessitating the same type of driver tube as is used in AB2 operation. The same power supply requirements also apply. Of latter years the Class B system has fallen into disrepute in favour of other systems, and mainly finds its application in modulators for transmitters.

Having discussed various types of amplifiers, their advantages and disadvantages, the old question will crop up. Which are best for really good high fidelity results? Pentodes, Beam Power tubes or triodes! More controversies have occurred over this question than any other that was ever asked. But looking at this question from all angles it becomes rather futile to even try and answer it with any satisfaction. The most logical answer is that they each have their applications. It is obvious, that to use four power triodes in push pull parallel to get 30 watts of audio power when the same result could be obtained with less expense by using two beam power tubes with much higher power sensitivity, would amount to stupidity. Beam tubes and pentodes lend themselves much more to public address systems requiring quantity rather than quality.

While it is perfectly true that good quality may be obtained from pentodes by using corrective measures in the shape of inverse feedback in one of its various guises, and is certainly essential when using beam power tubes, we merely come to the old brick wall when it can be pointed out the same results could be duplicated by using triodes without resorting to any corrective measures.

By following the lead of two world famous firms, i.e., Western Electric and The Bell Telephone Co., who cidentally have done more for art of audio sound reproduction than anyone else for the past decade, we can't go wrong by using push pull triodes if we want perfection in reproducing recorded music.

Types of Coupling Resistance Capacity

There are a number of ways of coupling tubes together, each one having its own advantages and disadvantages. With resistance capacity coupling perhaps holding pride of place, because of its extremely wide frequency response, economy, simplicity and comparative freedom from induced hum. By judicious use of various combinations of resistance and capacity it is possible to alter the characteristics of the amplifier to suit one's needs. This type of coupling suits equally triodes or pentodes.

Impedance Coupling

Impedance coupling usually takes the form of an iron-cored choke with ductance values ranging anything fr 100 to 300 henries, which is used in place of the usual plate load resistor in resistance capacity coupling. However, its uses are limited and really serves no useful purpose in these enlightened days. This type of coupling has one advantage in that very little voltage drop takes place in the plate circuit and practically the total supply voltage is applied to the plate of the tube resulting in plenty of gain. Its use, however, in latter years has gone into decline.

Transformer Coupling

Transformer coupling particularly applied to push pull operation has quite a lot to commend it and, in the writer's opinion, is much to be preferred to a resistance coupled phase changer for the purpose of supplying a signal 180 degrees out of phase to push pull grids. As in most things, however, there is a proviso and a most important one. An interstage coupling transformer which will transfer faithfully a band of audio frequencies ranging from 30 cycles to 10,000 cycles, with a variation of not more than one or two decibels, must be beyond reproach and cannot be bought with impunity. A word of advice here would not go amiss. Unless you are able to buy a coupling transformer with a split primary winding, split secondary winding permalloy or mu-metal core, of a very reliable make, cast all thoughts of transformer coupling away and stick to resistance capacity coupling. There is nothing worse than an amplifier using transformer coupling in which the design of the transformer leaves much to be desired. On the other hand a well designed transformer coupled amplifier leaves very little to be desired as regards the ultimate in amplifier performance. The transient response is far in advance of the best resistance capacity job. Sounds like handclapping, bells, sibilants, cymbals and percussion instruments are particularly good.

DIRECT COUPLER

Those who are keen on direct-coupled circuits will be greatly interested in Mr. Mutton's promise of a new direct-coupler, as mentioned in this article.

Direct Coupling

A system of coupling, called the Loften White method, of connecting the plate of the preceding valve direct to the grid of the following valve is termed direct coupling. On first thoughts it would be imagined that a high positive voltage applied from the preceding plate to the following grid would upset things, but due to the peculiar voltage distribution of this system the valves concerned work normally. By imagining a positive voltage of 150 V. on the driver plate, which is also applied to the following power valve, which we'll assume to need a normal grid bias of 12 volts. If by inserting a higher resistance than that required for normal cathode bias, we raise the voltage at the cathode to 162 volts positive, then the effective grid bias from grid to cathode will be 12 volts, which is the correct bias.

In the early days poor component parts did not help to advance the direct coupled amplifier in popularity. The main disadvantage being the extremely high voltages needed to maintain the correct potentials peculiar to direct coupled circuits. However in these days of indirectly heated rectifiers, better filter condensers and modern valves some extraordinary claims are made for the modern direct coupled amplifier circuits.

There is no doubt whatever that direct coupling correctly applied offers more advantages than any other type of coupling. It is possible to design a direct coupled power amplifier using not one single by-pass condenser, other

(Continued on page 26)

A HOME-BUILT COMMUNICATIONS SET

ONCE upon a time all ham receivers were home-made. No problem was involved in deciding what tubes to use; either you had a storage battery and used 201s or you had a UV-199 with three dry cells and a 30-ohm rheostat. The first chassis was a cigar box, with the top as the panel. After trying the two or three circuits which were known at the time, the ham ended up with the "Schnell tuner"—a regenerative detector and one-step audio. Signal-strength reports were given as audible so many feet from the 'phones.

Dead spots on the dial plagued the ham and caused him to wiggle the regeneration condenser back and forth like mad, but this bug was small potatoes compared with the trials and tribulations encountered in the construction of a modern receiver. Nowadays most hams who are smart buy themselves the best set they can afford and let it go at that. However, there are dopes like myself who still try to build receivers because we feel there is more to ham radio than the mere operation of "boughten" gear.

The design of the receiver shown in the photographs was started in 1939. The chassis and panel were made up and the parts all were bought at that time. Then, before construction could get under way, I moved half-way across the continent, and worse yet, got myself married to a YL unfamiliar with ham radio. Woe was she! No sooner had she become resigned to living in an apartment which (as she describes it) "looks like a cyclone struck it after you walk through it once" than I broke out on the kitchen table with thousands of little parts and wires. She swore the receiver would never make a single squawk; at least, she hoped it wouldn't. A situation of this kind requires extreme diplomacy, and if you can get over this hurdle the rest is easy by comparison.

Features

Before laying out the circuit I made a list of the features I thought ought to be included. As you will see, the list contains practically everything except perhaps dual diversity.

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(1) General-coverage and ham-band tuning ranges from 1.7 to 30 Mc.

(2) Full-dial bandspread for the 3.5-, 7- and 14-Mc. bands.

(3) Two r.f. stages, giving high gain ahead of the mixer.

(4) Two i.f. stages, giving good selectivity without the crystal and ample gain for proper A.V.C. action.

(5) Crystal filter with variable-selectivity and rejection controls on panel.

(6) Noise silencer with threshold adjustment on panel.

(7) Signal meter.

(8) A.V.C. with cut-out switch on panel.

(9) Beat oscillator with cut-out switch and beat-note adjustment on panel.

(10) Separate r.f. and audio gain controls.

(11) Knob on panel for tuning r.f. trimmers off resonance in severe Q.R.M.

(12) Plug-in coils for low losses.

(13) Stand-by switch in "B" + so power supply may be used externally during transmission.

(14) External stand-by switch leads so receiver can be cut off by transmitter relays if desired.

(15) Headphone jack.

(16) Externally mounted speaker.

(17) Doublet antenna input connections.

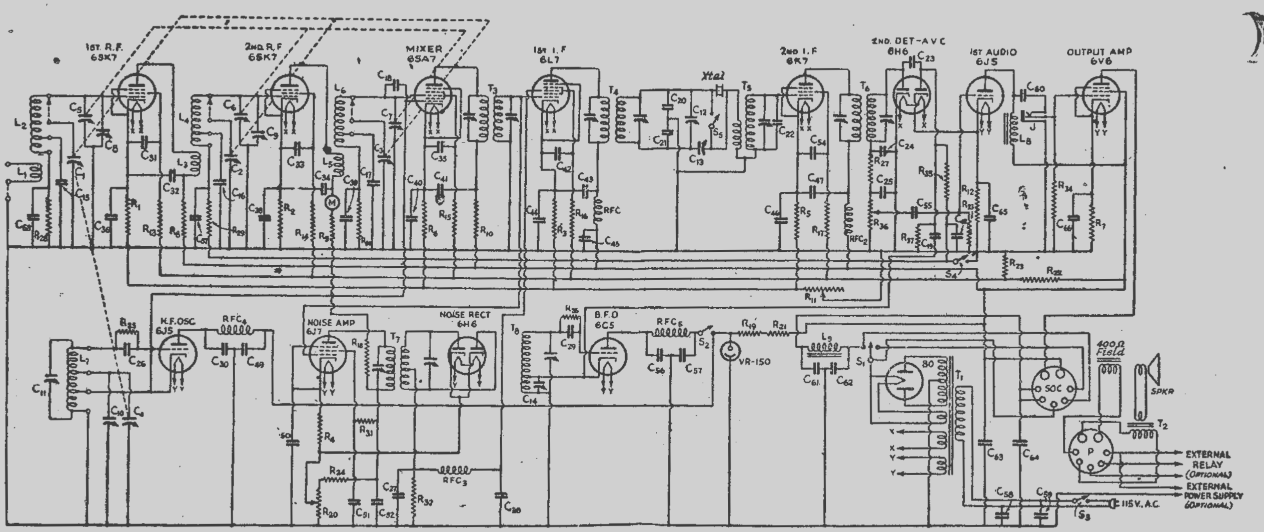
(18) Complete shielding, to minimize stray r.f. pick-up.

(19) Strong chassis construction.

(20) Last, but not least, a ha[nd]wheel big enough for accurate tun[ing] and with a low-enough gear ratio so the knob does not have to be spun a half-dozen times to get across the band.

Circuit Details

The final circuit is shown in Fig. 1. The two r.f. stages are similar except that the first stage is not tied into the A.V.C. circuit. While the first tube runs at maximum gain all the time, a grid resistor inserted in the ground return protects the tube against strong r.f. fields. A.V.C. is applied only to the second r.f. tube and the mixer. This provides sufficient A.V.C. action while it also produces a greater deflection of the signal meter than would be obtained with more stages tied to the A.V.C. line. The manual r.f. gain control, R 11, controls all stages except the second r.f. stage. Since [the] only available meter for the sign[al] indicator had a 7-ma. movement, it



was placed in the plate lead of the second r.f. stage where it performs in a very satisfactory manner.

The 6SA7 proved better than a number of other types tried in the mixer position. It operates well with low injector-grid voltage from the oscillator and provides good gain. The small condenser, C 18, is a very necessary item. It is used to neutralise the space-charge coupling between the No. 1 grid and the signal grid.

The 6J5 h.f. oscillator and the Hartley circuit were selected after several other combinations had been tried. Although the cathode is operated above ground for r.f., no hum modulation was encountered after one filament lead was grounded at the socket. It was found important to have the plate of the oscillator by-passed to ground and isolated from the plate-supply line. C30, RFC4 and C49 take care of this requirement.

Tuning System

The four-section ganged tuning condenser consists of C1, C2, C3 and C4. For general coverage the tuning condensers in the r.f. and mixer stages are connected across the entire coil. C5, C6 and C7 are air trimmers ganged to one of the small controls along the lower part of the panel. Since the stray capacities in the mixer stage are slightly higher than in the r.f. stages, C8 and C9 were added to permit compensation. Two sets of coils are required to cover the frequencies between one amateur band and the next. This means quite a few coils, but it provides a good degree of band-spread for even the general-coverage ranges.

When bandspread tuning is desired, the main tuning condensers are tapped down on the coils of the r.f. and mixer stages by a switching system in the bottom of the coil form, as shown in the detail photograph and the sketch of Fig. 2. This connection would cause considerable non-linearity in calibration, with crowding at one end of the scale, were it not for the padder condensers C15, C16, C17 and C10. C10 is an air-insulated condenser which is mounted inside the oscillator shield compartment. After it is set initially to about 25 mfd., no further adjustment is required. The other condensers are mica units, especially selected for equal capacities.

I.F. Amplifier and Noise Silencer

The mixer output transformer feeds the grids of the first i.f. stage and the 6J7 noise-amplifier stage in parallel while the crystal filter is coupled to the output of the 6L7. This portion of the circuit, comprising the crystal filter and noise silencer, follows very closely Jim Lamb's original recommendations in QST and the ARRL Handbook. The 6J7 amplifies the noise and the 6H6 rectifies the noise and applies the d.c. impulse to the injector grid of the 6L7, cutting it off for the duration of the noise impulse. R20 provides the threshold adjustment.

As Lamb has pointed out, the noise silencer must work at a high level. The two r.f. stages serve the very useful purpose of getting the signal strength up before it is applied to the silencer circuits. A little more gain would not hurt in this part of the circuit, and the 6J7 might be replaced by an 1852 with better results.

Since the crystal filter follows the noise silencer, it is protected against noise transients which cause ringing. The absence of such trouble is quite noticeable in the operation of this receiver at high-selectivity settings, especially to one accustomed to a conventional crystal filter.

The 6H6 second detector is connected so that one section handles the audio signal while the other section supplies A.V.C. voltage. In this arrangement a bias of several volts is placed on the A.V.C. side, since the cathode of the 6H6 is returned to the 6J5 first audio cathode rather than to ground. Because the 6J5 cathode is above ground for D.C. no A.V.C. action is obtained until the signal level exceeds the bias. Thus A.V.C. action causes no reduction in sensitivity for weak signals. The delayed A.V.C. effect can be further manipulated by adjustment of the r.f. and audio gain controls.

The beat-oscillator circuit is similar to that used in the h.f. oscillator. It is operated at a fairly low level and the output to the diode detector is taken from the cathode. Thorough shielding of the lead to the 6H6 is important, since it is about 24 inches long. The tuning condenser, C14, is connected from cathode to ground to keep the r.f. voltage across it low and thus minimize pick up in neighbouring r.f. circuits. This connection makes it necessary to use the unusually large capacity of 140uu fd. to cover the desired frequency range. The amount of oscillator voltage fed into the detector is low enough so that good limiting of volume on c.w. signals is obtained, and the hiss level is low.

Audio System

Many manufactured sets have push-pull audio output stages which develop considerable power, although a fraction of a watt is plenty for good room volume on speech and c.w. The manufacturers build plenty of power capability into their receivers because we hams often erroneously judge a set on a dealer's shelf by the amount of noise coming from the speaker. Perhaps we think that, if a set will make the noise loud, it will probably make a weak signal loud.

Anyway, this practice was not followed in this receiver, because a lot of audio power is not needed in a ham station or in any place where the person listening is located near the speaker. In fact, it is desirable to have some sort of automatic limiting in the audio section to prevent occasional blasting which will drive the neighbours crazy without adding to the intelligibility of the signal. In this set a single output tube is used, and the output transformer feeding the 6-inch speaker is connected to furnish a higher than normal load resistance for the 6V6 plate circuit. Plenty of volume for ordinary use is available.

Power Supply

A 7-prong socket is placed at the rear of the chassis so that a plug may

(Continued next page)

PARTS LIST

C_1, C_2, C_3, C_4 — 50-μμfd. variable (ganged tuning condensers).
C_5, C_6, C_7 — 15-μμfd. variable (ganged r.f. and mixer trimmers).
C_8, C_9 — 15-μμfd. variable (stray-capacity equalizer).
C_{10} — 50-μμfd. variable air padder (see text).
C_{11} — Oscillator padder inside L_7 (see coil table).
C_{12} — 50-μμfd. variable (crystal selectivity control).
C_{13} — 15-μμfd. variable (rejection control).
C_{14} — 140-μμfd. variable (b.o. tuning control).
C_{15}, C_{16}, C_{17} — 25-μμfd. fixed mica padder.
C_{18} — Approximately 1 μμfd. (neutralizing condenser made from twisted insulated leads).
C_{19} — 10-μμfd. mica.
C_{20}, C_{21}, C_{22} — 50-μμfd. mica.
C_{23}, C_{24}, C_{25}, C_{26}, C_{27}, C_{28} — 100-μμfd. mica.
C_{29} — 0.001-μfd. mica.
C_{30}, C_{31}, C_{32}, C_{33}, C_{34} — 0.002-μfd. paper, 600 volts.
C_{35}, C_{36}, C_{37}, C_{38}, C_{39}, C_{40}, C_{41}, C_{42}, C_{43}, C_{44}, C_{45}, C_{46} C_{47}, C_{48}, C_{49}, C_{50}, C_{51} — 0.01-μfd. paper, 600 volts.
C_{52}, C_{53}, C_{54}, C_{55}, C_{56}, C_{57}, C_{58}, C_{59} — 0.1-μfd. paper, 600 volts.
C_{60}, C_{61}, C_{62}, C_{63} — 8-μfd. electrolytic, 450 volts.
C_{64}, C_{65} — 40-μfd. electrolytic, 25 volts.
R_1, R_2, R_3 — 250 ohms, 1 watt.
R_4, R_5 — 400 ohms, 1 watt.
R_6 — 500 ohms, 1 watt.
R_7 — 500 ohms, 10 watts, wire-wound.
R_8, R_9, R_{10} — 1000 ohms, 1 watt.
R_{11} — 1000-ohm r.f. gain control, wire-wound.
R_{12} — 1500 ohms, 1 watt.
R_{13}, R_{14}, R_{15}, R_{16}, R_{17}, R_{18} — 2000 ohms, 1 watt.
R_{19} — 5000 ohms, 10 watts, wire-wound.
R_{20} — 5000-ohm potentiometer (silencer gain control).
R_{21} — 7000 ohms, 10 watts, wire-wound.
R_{22} — 10,000 ohms, 10 watts, wire-wound.
R_{23} — 15,000 ohms, 10 watts, wire-wound.
R_{24} — 20,000 ohms, 1 watt.
R_{25}, R_{26}, R_{27} — 50,000 ohms, ½ watt.
R_{28}, R_{29}, R_{30}, R_{31}, R_{32} — 100,000 ohms, 1 watt.
R_{33}, R_{34} — 500,000 ohms, ½ watt.
R_{35} — 1 megohm, ½ watt.
R_{36} — 1-megohm audio gain control.
R_{37} — 2 megohms, ½ watt.
L_1, L_2, L_3, L_4, L_5, L_6, L_7 — See coil table.
L_8 — Audio coupling impedance (primary winding of audio transformer).
L_9 — Filter choke
T_1 — Power transformer
T_2 — Speaker output transformer, universal type.
T_3 — 465-kc. air-tuned i.f. transformer.
T_4 — 465-kc. i.f. transformer altered as described in text.
T_5 — 465-kc. b.f.o. unit (see text).
T_6 — 465-kc. diode input transformer.
T_7 — 465-kc. diode input transformer (see text).
T_c — 465-kc. b.f.o. unit.
RFC_1, RFC_2, RFC_3 — Approximately 11 mh. (replacement 175-kc. i.f. coil).
RFC_4, RFC_5 — 2.5-mh. r.f. choke.
S_1 — S.p.d.t. switch.
S_2, S_3, S_4 — S.p.s.t. switch.
S_5 — Crystal-filter switch (see text).
J — Double-circuit jack.
SOC — 7-prong socket on rear of chassis.
P — 7-prong plug for speaker cable and external leads.
M — Signal-strength meter (7-ma. movement).

COMMUNICATIONS SET

(Continued)

be inserted in it to provide leads to the speaker and to external controls. When the stand-by switch, S1, is in the "off" position, the d.c. power is thrown ot one of the socket leads and the receiver plate supply can be used to operate a small transmitter, crystal oscillator, or what have you. It will be necessary to provide a suitable external filter, however, since the "B" + lead is broken ahead of the filter. This power could be used to operate a battery D.C. relays to turn on the transmitter directly from the receiver panel. Conversely, external d.c. plate voltage can be supplied to the receiver through the leads on this socket, or an external control relay can be used to turn the receiver on and off.

The A.C. power lines are by-passed where they enter the chassis. The VR-150-30 stabilizes the plate voltage for both oscillators sufficiently so that no variation in beat note occurs with ordinary line-voltage changes.

Mechanical Details

Almost anyone can wire up a batch of parts according to a circuit diagram and produce something that will work electrically, but it takes a good craftsman to construct a mechanical job that won't fall apart. Not being a sheet metal expert, I located a willing ham who worked in a gadget factory and let him do the dirty work after laying out the chassis and panel.

The chassis was formed from 0.050-inch sheet steel. Reinforcing braces were spot welded in the corners and L-shaped strips were added along the bottom edges of the chassis for reinforcement and to form a shelf to which the bottom cover could be attached with sheet-metal screws. The cover plate was equipped with rubber mounting feet, one at each corner. The panel was formed from 0.062-inch sheet steel. A ½-inch edge wit a slight radial bend was formed alo the top. All holes were drilled fi and later everything was given a thick coat of baked-on crackle enamel.

The sides, back and cover are made of aluminium. Unlike the other parts, they were cut with tin shears and formed by hand in a vise. Their chief purpose is to assist in shielding the r.f. components, but they also add bracing between the panel and chassis. With the bottom cover fastened in place, the assembly is very rigid. It does not bend when picked up by one corner and the sides do not give under thumb pressure. When a stable signal is tuned in, it stays on the nose until the dial is turned. These considerations are very important in a receiver with high selectivity.

Good Shielding Essential

The shielding is good enough so that little but tube noise comes throu with no antenna connected, even wi both gain controls wide open. When the beat oscillator is turned on some of its harmonics can be located, b they are very weak. An additio shield on the beat-note adjusting co denser would probably eliminate this pick up, but its use is hardly worth bothering about.

The tuning control, built around an old National Velvet Vernier dial, is similar to the newer ACN model except that it is larger. The ACN would probably have been used had it been available at the time. The handwheel is a 4-inch valve-control knob; it won out over several other types which were tried on the set after it was completed. While it does not look much like a radio knob, it operates with gratifying ease. Many radio manufacturers seem to think that operators like to grasp a tiny knob between two fingers and gently twist it, debutante-like. Watch an operator sometime—yourself, for instance—and you will see that he tries to roll the knob like a ball on the inside of the right hand. The valve wheel is about the shape of an open hand and it just fits inside the four fingers; it is not for those who would steer a ship with a doughnut.

The general lay-out plan of the receiver is shown quite clearly in the photographs. The main essential is, of course, the close grouping of components in the high-frequency stages. All parts, especially those forming the various tuned circuits, should be mounted with good mechanical anchoring to prevent any slight movement which might cause a noticeable change in frequency.

Care should be exercised in lining up the units of the ganged condensers so that they will not spring when the shaft is turned. All r.f. wiring should be made as short as possible and kept well spaced from the chassis. Power wiring may be cabled and laid flat against the chassis wherever it is convenient to do so.

Coils

Although the coil table includes data for the 28- and 1.7 Mc. coils, the figures shown for these bands are only calculated and the coils have not yet been wound. Likewise, the calibration shown on the dial for these ranges was estimated. The data for the other coils, especially those requiring bandspread taps, were determined by calculation and checked by a frequency meter with the set in operation. The dial calibrations were made at 50-k.c. intervals and the 10-k.c. points for bandspread on 14, 7 and 3.5 Mc. were located by interpolation.

All of the coils in each set are wound to be as nearly identical as possible. The r.f. and mixer coils are then adjusted to exactly the same inductance by spacing the turns and heavily doping all but one or two turns at one end with clear nail polish. When the dope has set, a further adjustment may be made by moving the free turns on the end and then cementing them firmly in place. The inductance of the coils can be checked by interchanging two coils at a time in the r.f. stages. If there is a difference in inductance, the stray-capacity equalizers, C8 and C9, will have to be readjusted when the coils are interchanged. When the inductance of the three coils is adjusted correctly, it should be possible to place the coils in the three positions in any sequence without necessity for readjustment of any trimmer to restore resonance.

I.F. Transformers

The i.f. coupling transformers, which were already on hand, were modified to fit the circuits. About one-fourth of the turns were removed from the secondary of T4 and C20 and C21 were mounted inside the shield can. The primary and secondary windings were pushed a little closer together. T5 originally was a b.f.o. unit. The tickler winding was replaced with a 100-turn coil of No. 34 enamelled wire, which became the new primary. The two windings were placed close together for tight coupling. It was found that a 50 fd. fixed condenser, C22, had to be added to the secondary to hit resonance at 465 k.c. An auxiliary brass contact was added to C13, so that the crystal could be shorted out for straight operation. T6 is tuned by a mica trimmer, but since it drifts a little as the set warms up it could well be replaced with an air-insulated trimmer.

Tracking

With the minimum and stray capacities in each stage set at the same value, it is easy to secure good tracking of the r.f. circuits. It is necessary for them to track accurately, since the over-all selectivity of the three resonant r.f. circuits is high. If one of the circuits is detuned by moving a trimmer 2 or 3 fd. away from resonance, the signal meter will indicate a drop of several db. This makes the initial adjustment of the circuits very critical, but it insures that the r.f. portion will perform as intended.

The main tuning condensers, C1, C2, C3 and C4 have a capacity range of about 2 to 50 fd. All of the other capacities in the resonant circuits, including tube-input capacities, trimmers, wiring and the distributed capacity of coils, total about 38 fd. The ratio of total minimum to maximum capacities throughout the tuning range is then about 2.2 to 1, and the frequency range covered is about 1.5 to 1. With the above ratios the spread of frequencies is not quite linear, but there is no noticeable crowding at the high-frequency end of the dial.

COIL TABLE

Band	Coil	Turns	Wire Size	Cathode Tap	B.S. Tap
1.7–2.4 Mc	L_2, L_4, L_6	60	26 d.c.c.	x	x
	L_1, L_3, L_5	8	28 enam.	x	x
	L_7	51	26 d.c.c.	6	47
2.7–4 Mc. or 3.5–4 Mc	L_2, L_4, L_6	42	22 d.c.c.	x	24
	L_1, L_3, L_5	8	28 enam.	x	x
	L_7	37	22 d.c.c.	5	20
3.4–4.8 Mc.	L_2, L_4, L_6	30	22 d.c.c.	x	x
	L_1, L_3, L_5	4	22 d.c.c.	x	x
	L_7	25	22 d.c.c.	4	x
4.8–7.2 Mc. or 7.0-7.3 Mc.	L_2, L_4, L_6	19	22 d.c.c.	x	6¾
	L_1, L_3, L_5	4	22 d.c.c.	x	x
	L_7	16	22 d.c.c.	3	5¾
7.0–10 Mc.	L_2, L_4, L_6	14	22 d.c.c.	x	x
	L_1, L_3, L_5	4	22 d.c.c.	x	x
	L_7	12½	22 d.c.c.	3	x
10–14.2 Mc. or 14.0–14.4 Mc.	L_2, L_4, L_6	10½	16 bare	x	4
	L_1, L_3, L_5	4	22 d.c.c.	x	x
	L_7	9¾	16 bare	2¾	3
22–30 Mc.	L_2, L_4, L_6	5	16 bare	x	x
	L_1, L_3, L_5	4	22 d.c.c.	x	x
	L_7	4½	16 bare	2	x

NOTE: All coils are close-wound on 1½-inch diameter forms except L_2, L_4, L_6 and L_7 for the 10- to 14.2-Mc. range, where the turns are spaced the diameter of the wire, and the same coils for the 22- to 30-Mc. range, where the turns are spaced to make the coil length 1½ inches. Taps are made the specified number of turns from the bottom or ground ends of the windings.

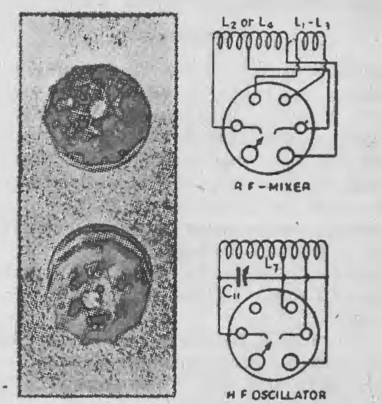


Fig. 2 — Pin connections for the r.f. and h.f.o. plug-in coils.
The bottom views of the coil forms in the photograph show the bandspread switching arrangement. The screw head completes the connection between either pair of pins, depending upon its position.

Final Refinements

The final circuit departs considerably from the one which was drawn up at the start. Innumerable bugs were encountered in getting the receiver finally to perform satisfactorily. When the adjustment of C18 is correct, there is no observable interaction between the oscillator and mixer tuning. Should there be any, it is a good idea to check the bias on the signal grid. It should be at least 5 volts. To insure that this voltage will be obtained, a 500-ohm cathode resistor is used in this stage. Grid current flows and upsets the whole stage if the cathode potential drops to below 5 volts above ground.

A parasitic oscillation in the mixer developed while the bandspread taps were being adjusted on the 7- and 14-Mc coils. Its exact cause was not determined, but it is not present when the coils are wound as shown in the coil table.

One of the 6J5 tubes I had lying around persisted in a parasitic oscillation, apparently of high audio frequency, which modulated the r.f. signal. This particular tube was a 6J5GT/G with a bakelite base. All other tubes, both glass and metal, worked without trouble. Nearly every other stage in the set developed some kind of parasitic oscillation at one time or another. Generous use of isolating

(Continued on next page)

COMMUNICATIONS SET

(Continued)

resistors and by-pass condensers in all screen and plate circuits was necessary.

During the adjustment of the crystal filter it was found that the rejection control allowed rejection of interference on one side of the desired signal but not on the other. It was necessary to add a little capacity, consisting of a pair of twisted wires across the crystal holder, to get the rejection slot to move to the other side of the signal.

Naturally, this receiver has not been used in actual communication. It will probably not get a thorough test of its full capabalities at handling QRM until ham radio comes back, since a ham band is about the only place where one can find twenty-five stations on every frequency! In listening to what the ether has to offer these days, its performance appears to be about as good as that of any receiver ever made available to hams and a sight better than many. The noise silencer is very effective in reducing or eliminating most of the noise floating around my apartment, and there is plenty. The crystal filter is effective in reducing noise, also, and it is broad enough at minimum selectivity to be useful on 'phone signals. When a signal generator is coupled to the input of the i.f. stage and output plotted against frequency, the curve obtained is very much like the sample curves given by Jim Lamb in his original description of the crystal filter.

The gain and image rejection in each r.f. stage have been checked roughly with a signal generator. The gain at 14 Mc. runs about 30 in each r.f. stage with the controls wide open and a v.c. off.

The signal-to-image ratio, measured by detuning the stage about 1000 k.c., is approximately 50 to 1. The mixer stage is not quite so good. For all practical purposes, the over-all image rejection is complete. This can be checked quite easily since at the high-frequency end of the dial the ganged r.f. and mixer trimmers have sufficient range to tune to the image frequency from the front of the panel. The capacity of the trimmers is decreased until the noise level rises in the speaker. With the trimmers lined up to the image, a strong signal is tuned in. Then when the trimmers are tuned back to normal setting the signal disappears, indicating rejection of images. This feature is particularly useful in rejecting images of shortwave b.c. stations operating near 15 Mc. when listening in the 14-Mc. band.

The sensitivity of the receiver could not be accurately checked with the equipment available. Mere listening, however, shows that the noise can be brought up to speaker level either with or without the antenna connected. With the antenna connected the tube noise is negligible in comparison to other noise and signals.

V.T.V.M.

(Continued from page 7)

broadcast station, very careful shielding must be used. A small condenser of 600 volt rating is connected between each side of the A.C. supply and the chassis to keep out R.F. from coming in via the mains.

If after connecting up the device, the meter has a small continuous reading with no voltage applied to the terminals of the V.T.V.M., this may be due to any one of three things: hum or R.F. pick-up (check by earthing the cap of the tube), a leaky .25 mfd. coupling condenser (check by removing), or a small emission of the diode at no voltage, or else at a voltage due to thermal effects in the circuit. If the last, then this small deflection can be ignored and just treated as zero when calibrating the instrument. Alternatively, the meter can be return to a tap on the 2,500 ohm bias resistor instead of to the cathode. If the latter, the tap must be fixed before calibrating the meter and the tap must then not be disturbed in anyway whatever.

Calibration can be done using 50-cycle/second alternating current and a standard A.C. voltmeter of good quality. A potentiometer, say, 10,000 ohms W.W., is connected across the 6-volt winding of a filament transformer. Both the V.T.V.M. and the A.C. voltmeter are connected in parallel to one end of the potentiometer and the moving tap.

For calibration on higher voltages, a 25,000 ohm voltage divider may be connected across the high-tension supply of an amplifier or radio set (i.e. the high-tension secondary wiring, not the D.C. supply).

Instead of building up the entire V.T.V.M. complete with moving-coil meter, a separate 2,000 ohm-per-v or 3,000 ohm-per-volt voltmeter m be used. The 50,000 ohm diode load resistor and meter are omitted, the output terminals for the voltmeter, going to the cathode and diode of the 6B6G tube. It is still necessary to calibrate the meter, although by varying the size of the anode load resistor it is possible you may get the voltmeter readings to correspond when using the 25 or 50 volt range. The addition of an extra .1 meg. resistor in parallel with the others, may help.

At present, parts are scarce and there is a possibility that it may be easier to procure a 2A6 (the $2\frac{1}{2}$ volt equivalent of the 75 and a $2\frac{1}{2}$ volt power transformer). Instead of using a built-in meter, an external meter can be connected to points X and Y (in the circuit diagram).

FINER POINTS ABOUT PICK-UPS

PICK-UPS may generally be divided into two main types the Magnetic and the Crystal. Due to bass below 250 to 400 cycles by designing the pick up in such a way that the pick up itself provides a boost at those frequencies which are compressed during the recording. The cheaper type of magnetic pick up generally accomplishes this by relying on

By

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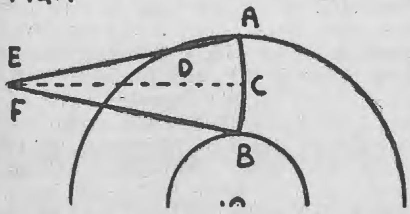
the mechanical resonance of the pick-up arm.

The crystal pick up constitutes what is essentually a capacity, and the impedance across it increases as the frequency decreases, and the voltage drop through it increases with the impedance. This accounts for the fact that the crystal pick up automatically is higher in output where the recording is lowest in output. The popularity of the crystal pick up is probably due to its much higher output over the magnetic type, and its ability to reproduce the higher register better than the latter.

It is not generally known by most enthusiasts, that different types of needles have an appreciable effect on the output voltage, as well as the frequency response. Technical data issued on the Shure Zephyr model 99B shows that the output voltage at 100 cycles using a full tone needle, and an input impedance of 1 megohm, is up 10 decibels. But by changing to the half tone needle, which is approximately one eighth of an inch longer, it produces a remarkable change, in that the output voltage then decreases — 17 decibels. In the first set of conditions the output of the pick up at 2,000 cycles is shown at 3.4 volts, in the second set of conditions the output is down to 2.3 volts. On the same set up by changing the input resistance from 1 megohm to 5 megohms we get a rise in output voltage from + 10 decibels to + 15 decibels. So we can see from just these simple facts that many factors enter into frequency response which starts from the input of the amplifier.

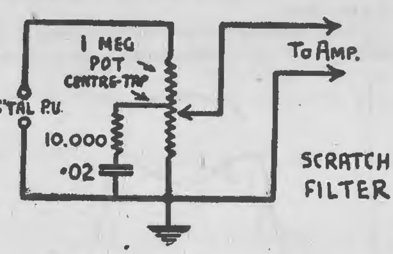
FIG. 1



What Is Required In A "Good" Pick Up

The qualifications of a good pick up are as follows: (1) Frequency Response, 50-10,000 cycles? Every 500 cycles over 5,000 costs in the region of £5 so from a cost point of view, most of us must bow to the inevitable. There is only one make of pick-up which has a flat frequency response over 50-10,000 cycles and it is not obtainable at present in Australia. Just in case you're interested it is the Microdyne, manufactured in America. Essentially a magnetic pick up, it works on a relay or trigger action. A small amount of motion is imparted to the armature by the needle, both being entirely independent of one another, this small motion is made to control large flux paths, with the result that the bulky armature of the usual type is eliminated. The elimination of the armature mass places its resonance point above audibility, which results in a pick-up free from objectionable resonances, reduction of needle point impedance and has an excellent transient response.

FIG. 2



However getting back to our original theme, it will be found that the average frequency response at the better type of pick ranges from 50 to 5,500 cycles which will be adequate for the purpose of reproducing recorded music. The cheaper types range from about 70 to 4,000 cycles.

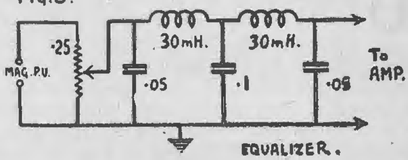
Needle Point Impedance

(2) Should be as low as possible.

Needle Pressure

Not more than 4 ozs., preferred weight 2½ to 3 ozs. It is also desirable that the pick up should have stability in performance under temperature changes, the magnetic type is superior in this respect to the crystal. As a rule crystal pick-ups show a marked change in frequency response and output at temperatures exceeding 90 degrees.

Fig. 3.



Tracking Problems

It will be readily understood that it is practically impossible to get perfect tracking from a pick-up arm when we consider that the cutter, when making the record, moves radially in a straight line, but the arm of the pick up must describe an arc of a circle no matter how slight. It then becomes an easy matter to see that correct placement of the pick up is essential. The acquisition of a pick up which uses either the bent arm principle or needle tilt method will help greatly to reduce the record wear and will minimise to a large degree the tracking error. By referring to fig. 1 the correct method of pick up placement will be seen. The little extra trouble will pay dividends in long record life and better reproduction.

From the spindle of the motor draw a line at right angles to the edge of the turntable. Now, taking the inner and outer circles of the start and finish of the record, describe an arc A to B on this line. Then bisect the arc at the mid-point, and from the mid-point project a line at right angles. Then from the inner and outer terminations of the arc project two more lines to form an isoceles triangle, and at the apex of the triangle mount the pick up.

It may be deemed necessary to be able to supress surface noise of records of different age and type. Fig. 2 shows the circuit for use with a crystal P.U. Fig. 3 shows a different arrangement for a magnetic P.U. Generally speaking the crystal pick up is more troublesome as to needle scratch, than the magnetic type.

Yet another pick up of the magnetic type is, in conclusion, perhaps worthy of mention and that is the oil damped pick up. In contrast to the usual run of magnetic types, this pick up, instead of utilising rubber tubing and a

(Continued on page 26)

DISTORTION — ITS CAUSE AND CURE

DISTORTION is perhaps best defined as the difference between that which is received by the microphone in the broadcasting or recording studio, and that which emanates from the producing loudspeaker or headphones. There are, however, several kinds of distortion which may be present in greater or lesser degree, and which do not appear to have any effect on the human ear. Thus the problem of "removing" distortion really consists of reducing the objectionable forms of distortion to such a level that they may be neglected.

This fine article, covering every aspect of distortion, is reprinted by special permission from "Practical Wireless" (England).

The principal forms of distortion may be classified under the following headings:

Frequency Distortion

The normal useful range of frequencies is from about 50-10,000 c/s. (though for high fidelity it is often taken as 15-15,000 c/s.), and, for perfect results, all should equally be reproduced. Frequency distortion implies that one particular frequency, or band of frequencies, is reproduced at a different level from the rest of the acoustic spectrum. There are two main types of frequency distortion. The first implies a lack of balance between the bass, middle and treble registers. This is not really objectionable—fortunately—but if there is a serious lack of bass, the reproduction sounds "tinny," while if the treble is weak—as it too often is in commercial sets—the reproduction is muffled, and consonants, particularly sibilants like "S," become indistinct.

The second type of frequency distortion may be termed "peaky," and can be really unpleasant. It may be likened to a piano in which some notes do not play at all, while others ring forth unpleasantly loud. As may be imagined, a scale played on such an instrument would sound rather erratic. This type of frequency distortion is not generally serious for speech, but for music it may be very conspicuous indeed, particularly with certain instruments such as violins.

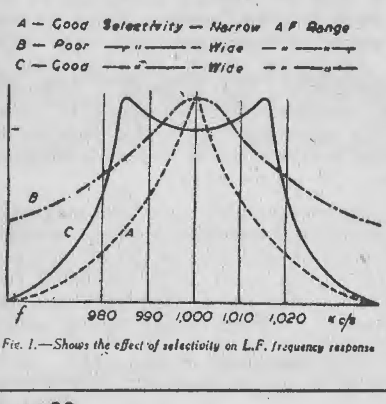


Fig. 1.—Shows the effect of selectivity on L.F. frequency response

Non-linear Distortion (Harmonics and Combination Tones)

A harmonic of a note is a frequency which is an exact multiple of the first, or fundamental, frequency. For instance, if we have a fundamental frequency of 100 c/s., its second harmonic (f x 2) is 200 c/s., its third harmonic (f x 3) is 300 c/s., it seventh harmonic (f x 7) is 700 c/s., and so on. It is these harmonics which give colour or "timbre" to a voice or instrument, and in themselves they are not generally unpleasant.

Combination tones are the result of passing two different frequencies through a non-linear apparatus such as a wrongly biased valve. If two frequencies, f1 and f2 of perhaps 400 and 360 c/s. respectively, are mixed. combination tones of f1 + f2, and f1 — f2 will be produced, i.e., 760 and 40 c/s. As, however, harmonics are also produced by a non-linear amplifier, we will have, in addition, harmonics of each of these four frequencies, and combination tones of the harmonics.

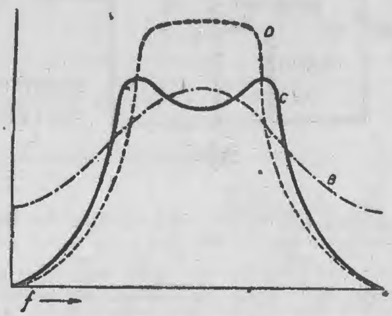


Fig. 2.—If suitable tuning circuits can combine B and C the square topped curve D will result.

Let us suppose the third is the predominant harmonic: We have fundamentals 400 and 360, combination tones 760 and 40 c/s., plus third harmonics of above: 1,200, 1,080, 2,280 and 120 c/s. Combination tones of harmonics: 3,360, 2,160, 3,480, 1,320, etc.

Clearly, the result will be very different from the two initial frequencies, and may be very unpleasant, as combination tones may be produced by any of the harmonics.

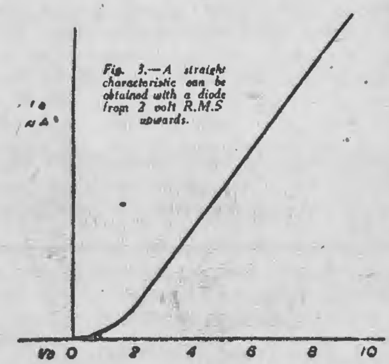


Fig. 3.—A straight characteristic can be obtained with a diode from 2 volt R.M.S upwards.

It would appear that it is not the harmonics themselves so much as the various combination tones produced by the harmonics, which are serious, and thus it is the higher order harmonics which produce the most unpleasant effects. In fact, it has been suggested that the percentage of a harmonic should be multiplied by its order to get the true value. For example, if the maximum permissible for second harmonic distortion is 5 per cent., the maximum for fourth harmonic is half this, i.e., 2.5 per cent.

Phase Distortion

The ear does not appear to be sensitive to phase distortion: if it were, music would sound different at varying distances from the source. It has, however, very serious effects on television.

Cross-modulation

This implies the unintentional modulation of one frequency by another. At R.F. the signal from one station may modulate that from another, in which case the cure is improved selectivity. With A.F. a sound of fairly high frequency may be modulated by one of lower frequency, a common example being a violin with organ accompaniment. As it most often occurs in the speaker, the best cure (should it be necessary) is to use separate high and low frequency speakers, with a dividing network.

Causes of Distortion in R.F. Amplifiers
Frequency Distortion

As mentioned earlier, if two frequencies are mixed, combination tones consisting of f1 — f2 and f1 + f2 occur. This holds, even if the two frequencies are of widely different values; even if one is R.F. and the other A.F. Thus, when an R.F. carrier wave of, say, 1,000 kc./s. (300 m.) is modulated by an A.F. signal of 10,000 c/s. or 10 kc./s., two other frequencies will be produced, i.e., 1,000 kc./s.—10 kc./s. (990 kc./s.) and 1,000 kc./s + 10 kc./s.

(1,010 kc./s.). Thus, in order to receive audio frequencies up to 10 kc./s. the set must receive not only 1,000 kc./s., but also 990 kc./s. and 1,010 kc./s. (Fig. 1). If the set has fairly good selectivity, as indicated by the dotted line "A", the higher audio frequencies will be almost entirely suppressed. You have probably come across sets—particularly superhets—where you had to tune them to the edge of a station to make speech clear.

One way, then, is to have very flat tuning ("B" Fig. 1), but a better method is to use band-pass coupling in which two very selective tuned circuits are coupled together. As the coupling is increased a double-humped resonance peak appears, as shown at "C", Figs. 1 and 2. This retains the steep sides of the individual circuits, but provides a broad, flat peak which will reproduce all audio frequencies. If this curve "C" is combined with curve "B" an almost square top "D" is obtained (Fig. 2). Thus, two selective circuits in band-pass, together with a fairly flat single circuit, are desirable.

Non-linear Distortion

This type of distortion is frequently found in the detector stage of a set, and, as its name implies, may be caused through operating on the curved portion of a valve characteristic. The anode bend detector almost inevitably causes distortion. The leaky grid detector is normally free of it, but a strong signal will move the operating point on to the curve, and distortion may be very serious.

The diode detector has a straight characteristic from about 2v. R.M.S. upwards, so, provided the signal does not fall below a certain level, this would not cause any trouble (Fig. [illegible]) If, however, the A.C. load on a diode is not substantially equal to the D.C. load, very serious non-linear distortion may take place. Various circuits have been evolved to overcome this, such as the use of two diodes in push-pull, but none has so far become popular. The diode is, nevertheless, much more satisfactory than the triode as a detector.

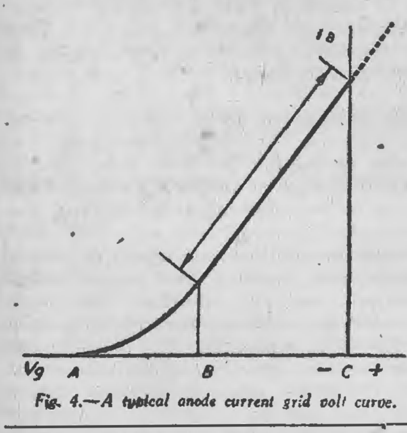


Fig. 4.—A typical anode current grid volt curve.

A.V.C.

Various forms of distortion may arise from the use of A.V.C. (or automatic volume control), and, generally speaking, it is not necessary or desirable for local stations, particularly if high fidelity is aimed at. Although some of the troubles outlined below may be removed, or reduced by careful design, the simple A.V.C. generally employed has many drawbacks.

If the time constant is too short, it may cause non-linear distortion, or at least serious attenuation, of the lower frequencies.

Transients, such as clashing of cymbals, or staccato chords, will be distorted.

A.V.C. is intended to minimise changes of volume due to fading, etc.; unfortunately it also "irons out" variations which are desirable, and increases background noise. It is only necessary to hear an orchestra with and without A.V.C. to realise the profound effect it has on the contrast and vitality of the music.

Frequency Distortion

Lack of high notes may be caused by excessive R.F. decoupling condensers in diode or triode detector circuits, or by too large a grid leak

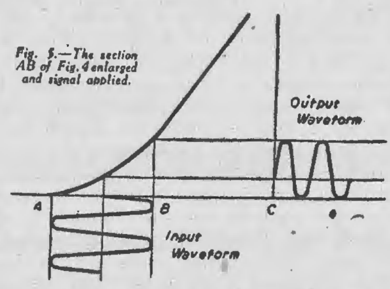


Fig. 5.—The section AB of Fig. 4 enlarged and signal applied.

which is shunted by the grid-cathode capacitance of the valve in R.C.C. circuits. Similarly a high anode/cathode capacitance in the preceding valve, especially if it is of the high-impedance type working into a high anode load, may cause losses. In R.C.C. circuits a large coupling condenser is often blamed for high-note loss. This is incorrect. A large coupling condenser reduces losses at the low-frequency end of the scale and provides an increased proportion of bass, which may make a lack of treble more noticeable, but to reduce the coupling is merely to make the reproduction thin at both ends.

Lack of bass may be caused, in R.C.C., by an inadequate coupling condenser, or by too low a grid leak value. In transformer-coupled circuits an inadequate primary inductance in the coupling transformer will cause bass losses. As the inductance of an iron-cored solenoid decreases with a heavy

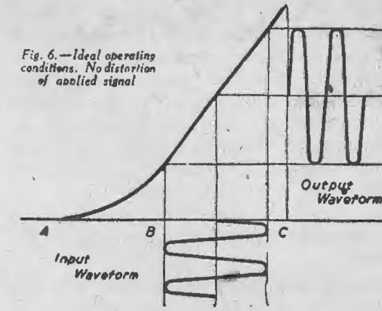


Fig. 6.—Ideal operating conditions. No distortion of applied signal

current flowing through it, an improvement may sometimes be effected by parallel-feeding the transformer. This, by removing from the primary the direct current which tends to cause saturation of the core, will increase the primary inductance. In choke-capacity-coupling, loss of bass may be experienced due to unsuitable design, or to saturation. The main advantage of this type of coupling is that, as the reactance of a choke rises with frequency, it may in some measure compensate for losses in the upper register, caused by the cutting of side-bands, as referred to earlier. It is not, however, to be recommended.

Loss of bass can also occur through inadequate decoupling of cathode bias resistors, causing negative current feedback at lower frequencies.

It might be mentioned in passing that, while negative feedback properly applied may do a great deal to level out the response curve of a set, and reduce distortion, if applied haphazardly it may have some altogether unexpected—and undesired—results.

"Peaky" Reproduction.

Due to the large number of turns close together on an A.F. choke or transformer, there is apt to be a fairly large "self-capacitance" between adjacent turns, and thus the winding really consists of an inductance and capacitance in parallel, which, of course, is a tuned circuit, having a resonant frequency. If this resonant frequency is within the audio range—as it frequently is—the amplification will be much greater at that frequency than at any other, and a "peak" will be produced. Hence all chokes and transformers, particularly of the cheaper variety, are liable to produce peaks, and should be avoided if possible.

Non-Linear Distortion

In connection with triode detectors we saw that operating on the curved part of a valve characteristic produces distortion. As this is a very fruitful source of trouble, we will consider the point rather more closely. Fig. 4 shows a typical valve characteristic curve. The point "A" is at "cut-off", i.e., zero anode current, AB is the curved portion, and BC the working

(Continued on next page)

portion, where "C" is zero grid bias.

Fig. 5 shows the part AB enlarged, and the effect of working on it. It will be seen that the waves are flattened at the bottom. Fig. 7 shows that this effect may also be produced by combining a fundamental with its second harmonic, hence this is known as "second harmonic distortion."

Fig. 6 shows the ideal, working on the straight portion, no distortion present.

Considering the result of working beyond "C" it will be understood that, if the grid is allowed to run positive, it will collect electrons like an anode, and hence current will flow in the grid circuit: It is difficult to show graphically, but it can readily be proved from a mathematical consideration of the conditions, that second harmonic distortion again occurs, this time of an inverse type (Fig. 8). The degree of distortion, however, depends on the D.C. resistance of the grid circuit, and if it is arranged that this resistance is very low, it is possible to avoid serious distortion. This fact is made use of in Class B2 and AB2 (push-pull) circuits. Normally, however, it is much safer to use only the section BC, i.e., biasing the valves so that its working point is in the middle of BC, this being the value of bias recommended by the makers.

Clearly, under ordinary conditions, very serious distortion will occur if the valve is overloaded, the signal spreading beyond "B" on the one side and beyond "C" on the other. The only remedy here is to reduce the signal, or use a larger valve.

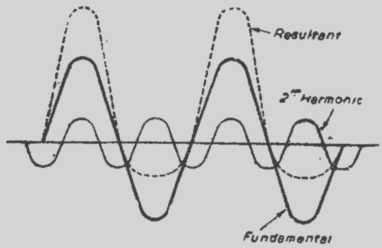


Fig. 7.—Combining a fundamental with its second harmonic produces the broken curve.

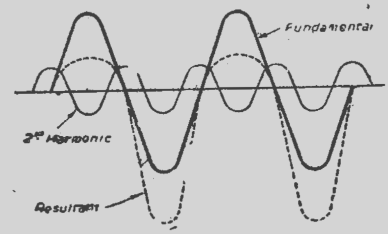


Fig. 8.—When grid current flows it can produce an inverse form of second harmonic distortion

Anode-bend distortion is due to excessive bias (assuming the valve is not overloaded). This may be caused by too large a bias resistor in a mains set, or excessive G.B. in a battery set. The former is less serious, as the increased bias reduces the anode curren which in turn reduces the bias volta dropped across the resistor. It ma also be caused by the application of a strong signal to a leaky grid detector.

Grid current distortion is caused by inadequate (negative) bias, no bias, or (accidentally) positive bias. This may be the result of too small a bias resistor in a mains set, or by faulty G.B. in a battery set. Again, the former is the less serious, as the change of anode current raises the bias developed across the resistor. A shorted or leaky cathode by-pass condenser may also cause trouble.

A fault which can have very serious results, and one which is sometimes overlooked, is that of a leaky coupling condenser in R.C.C. Consider the case of an Osram ML4 feeding an MKT4 in the conventional circuit shown in Fig. 9. With a bias resistance of 1,00 ohms, the ML4 passes 14 mA ano current at 250 v., and, as a common value of anode load is 20,000 ohms for this valve, the voltage at the anode will be about 150 v. The grid coupli condenser "C" is suspected, but, test. with a multimeter for shorting, appears to be in order. Treated with a megger it is found to have a D.C. or leakage resistance of about 1.0 megohm. This seems high but, as a result of it, a potential divider is formed, and a positive voltage of $150 \times \frac{0.25}{1.0 + 0.25}$ or 30 volts is applied to the grid. As a negative bias of only 13.5 volts is applied by the bias resistor, the valve has a positive bias of 16.5 volts! It need hardly be pointed out that this would cause very serious grid current distortion, and, in addition, the valve would pass excessive current, with very serious consequences. The moral is to use the best condensers available, preferably of the mica or oil-filled variety for this position.

AMERICAN SETS FOR BRITAIN

Owing to the shortage of broadcast receivers in England a large number are being imported from the United States.

An authoritative statement on the supply of imported receivers was issued by the Radio Manufacturers' Association on March 6th. It states that it is expected the work of testing the first 10,000 imported receivers and of making them suitable for the British market will shortly be completed, and so permit their distribution to the trade.

It is announced a further 20,000 sets will become available probably during the following three months.

These imported receivers will, it is understood, be followed later by the "standard" British-made set.

The imported sets, all of which are superhets, are of many types but, for the purpose of price regulation, have been classified into four groups by the Board of Trade.

Those in Group I are mediumwave five-valve sets (including rectifier) in bakelite cases and will cost £11/14/2.

Sets in Group II are similar to those in Group I but generally in wooden cabinets. A few sets in this group cover the medium- and short-wave bands. Price £13/10/-.

Group III includes six-valve medium-wave sets for AC/DC/battery operation and receivers similar to those in the first two groups but in superior cabinets. Price £15/5/10.

Group IV comprises AC/DC/battery six-valve sets covering the medium- and short-wave bands. Some have push-button tuning. Price £17/1/8.

The majority of the sets for short-wave operation cover 16 to 50 metres, but a few 16 to 25 metres only.

The prices given include Purchase Tax.

REPAIRING PLIERS

As a help to the war effort, the R.C.A. Company of U.S.A. offers a hint on the salvaging of radio tools.

This suggestion covers a method of salvaging long nose pliers and side cutters, a large number of which are now impossible to purchase.

In normal production operations the serrations on pliers and the cutting edges of cutters become smooth and dull. These tools, formerly scrapped, are now re-serrated with a file on an anvil, using a hammer. The pliers are heated to red heat and serrated with a file.

The plier jaw is driven down on the file, then closed until the jaws are parallel. Following the air-cooling operation, it is re-heated to approximately 1400 degrees F., drawn at 400 degrees F. for approximately 15 minutes, then cleaned and polished.

Cutters are annealed and closed in to make jaws parallel (while hot), file-sharpened, heat-treated and drawn as above.

DOUBTING AMERICANS

Metal poles must be used in some parts of Australia because white ants completely devour wooden ones, according to Signal Corps men serving there. Doubting Americans set one wooden pole as a test, and on returning later found nothing but the glass insulators, wire, bolts, braces—and an empty hole! —From "Q.S.T." (U.S.A.)

Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY—

HELP WANTED

Rex Gillett of Adelaide writes:—

A Spanish speaking station on approximately 49.07 m. has been heard at 10.15 p.m. Can anyone help on this one?

(May be CP-2 La Poz Bolivia, who, on 6.11 m.c. are scheduled for that hour.—L.J.K.)

Dr. Gaden sends a poser:—

From 1.30 pm can hear a Latin-American on about 9.795 mc. At a guess I would say a three letter call, LXC, or E. Similar type to the Brazilian which can be heard when CE-960 ..ses. The "L" signal is better than ..se two. (Think this will be LSE, ..nte Grande, Argentina, who is reported by Wally Young of Adelaide as being heard at that hour—L.J.K.)

PEN-FRIEND WANTED

Mr. Arthur Wise, of Lower Montere, Nelson, New Zealand, would like a pen-pal of either sex, 21—22, keen on DX-ing. Will answer all letters.

FAIR COMMENT

One or two of the more venturesome reporters have taken me to task for incorrect call-signs as regards the final letter. Well, some day we will probably learn why the call was changed even after programme sheets had been prepared. I took the matter up with the office boy this morning and I thought his reply was most apt. He simply said, "Wouldn't it?"

WHERE DID THAT ONE GO TO?

A good station after 9.35 pm is .GOY on either 9.645 mc, or 7.171 mc, .. you will often find a reporter sending a story to one if not all of the networks in U.S.A. On Friday, June 16, heard Roy Porter give an eye-witness ..unt of the bombing of Japan by . Super Fortresses. The machine in which he travelled was twice hit, but got home O.K.

I was telling Mr. Edel about this and he said: "A few nights previously from the same station a reporter mentioned he had just paid 750 American dollars for an electric fan. That was equal to 30,000 Chinese dollars, or, shall we say, about £200 in good hard-to-get, or rather hold, Australian."

BACK NUMBERS

We wish to advise subscribers who require back numbers of Australasian Radio World, that, with the exception of January and February, we have no stocks of 1942 issues. We can supply the complete set of 1941 and 1940 with the exception of January, February, March and May. These numbers are on sale at 1/- each.

NEW STATIONS

VLC-4, Australia, 15.315 mc, 19.59 m: This new one mentioned under notes in June issue came into operation for two days following the Invasion of Normandy. Was used by General MacArthur's Headquarters for news to the Philippines at 9 am, noon and 3 pm.

Is now in general use from 3.10 till 3.40 pm with VLG-3 in programme for North America.

VLC-5, Australia, 9.54 mc, 31.45 m: This new and powerful transmitter commenced on June 12 was used from 1—1.45 am in session to West Coast of North America, for about 10 days and replaced on June 23 by VLC-6, 9.615 mc, 31.21 m.

VLI-6, Sydney, 9.59 mc., 31.28 m.: Has replaced VLG-3 and VLI-2 in programme to the British Isles at 4.55 and 7.30 pm. Excellent signal.

WKRX, New York, aprox. 11.65 mc, 25.75m: This note may be a little early, but WKRX was heard on June 9 from 8.45 till 10 pm carrying usual "V of A" programmes. Gave call every quater hour, but no frequency. Have not heard since.

VLC-6, Shepparton, 9.615 mc., 31.21 m: Used by Department of Information in broadcasts to North America (West Coast) from 1 till 1.45 am. Commenced on June 23.

HER-, Berne, 11.78 mc., 25.47 m.: Arthur Cushen advises this frequency is used in parallel with 6.34 mc at 6.55 am with "Swiss Spotlight". Signal is not as good as the latter.

XEKW, Morelia, Michocan, Mexico, 6.030 mc, 49.73 m: This is a new one submitted by Mr. Matthews, of Rivervale W.A. He heard same between 10 and 11 pm, but mentions signal only fair. A later letter from Mr. Lindsay Walker, of Perth, refers to this station. This is certainly a nice catch, as noise is always prevalent at that hour on the 49 metre band.

. . . ., Brazzaville, 9.705 mc., 30.92 m.: This new one from French Equatorial Africa is also reported by Messrs. Matthews and Walker. Heard with fair signal in French at 7.30 pm. Close at 8 pm.

ZFD, Hamilton, Bermuda, 10.335 mc., 29.03 m.: Here is another excellent catch, and by the South Australian veteran, Wally Young. Heard around 6 am. Right in a very bad morse channel for Sydney listeners but will doubtless get through one of these mornings.

WBOS, Boston, 7.25 mc., 41.38 m.: This outlet of The World Radio University has inadvertently been omitted from schedule list, but a letter from Arthur Cushen telling me he can follow their programme to South America from 1 pm till closing at 2 drew my attention to the oversight. They are beamed to Latin-America from 10.30 am till 2 pm.

GWR, London, 15.30 mc., 19.61 m.: This new BBC transmitter is not only the loudest of the 19 metre band around 7 am, but probably one of the best on the air at that time. Being beamed to South America from 2 till 3 am accounts for the splendid reception here.

RNB, Leopoldville, approx., 11.64 mc., 25.76 m.: Heard here from 3 till 3.45 pm and apparently accounts for their absence on 30.66 m. Signal at opening is fair, but rapidly improves to very good. Call sign may not actually be RNB, but continual reference to "Radio National Belge" suggests it as suitable till correct is made known.

LSE, Monte Grande, Argentina, 9.80 mc., 30.61 m.: Trust those South Australians to find the new South Americans. Wally Young reports hearing this around 1.30 pm.

(Continued on page 25)

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 no want to mutilate their copies can write out the details required.)

Shortwave Notes and Observations

OCEANIA

Australia

VLC-4, Australia, 15.315 mc., 19.59 m.: Heard on 7th and 8th June in 3 sessions, 9 am, Noon and 3 pm, directed to Philippines.

Since the 9th June has been in parallel with VLG-3, 25.62 m., beamed to North America from 3.10 till 3.40 pm.

VLG-6, Melbourne, 15.23 mc, 19.69 m.: Great at 3.20 pm (Cushen). (Has now been replaced by VLG-3, 25.62 and VLC-4, 19.59 m.—L.J.K.)

VLC-2, Australia, 9.68 mc, 30.99 m.: is heard daily 5.30—6.30 in Japanese, and from 7—8 pm in Philippine Hour. —L.J.K.

Coming in well up here (Gaden, Perkins). Very good signal (Bayley).

Very good in Jap. session, but strength much reduced in Philippine Hour (Cushen).

VLQ-3, Brisbane, 31.05 m.: Good till 5.15 pm (Cushen).

VYI-10, Sydney, 9.58 mc.: In use again to British Isles at 8 pm (Matthews).

At 5 pm suffers from WCRC (Cushen). (Station now used is VLI-6.—L.J.K.)

VLC-6, Shepparton, 9.615 mc, 31.21 m.: To North America from 1—1.45 am.—L.J.K.

VLC-5, Shepparton 9.45 mc, 31.45 m: Commenced on 12th June directed to North America, West from 1—1.45 am., but replaced by VLC-6, 9.615 mc., 31.21 m. on 23rd June.—L.J.K.

VLI-9, Sydney, 7.28 mc. 41.21 m.: Great at 7.30 pm (Cushen).

VLQ, Brisbane, 7.24 mc., 41.44 m.: Great programme at 6 am. with Crystal Thompson in "Reveille Round-up." (Cushen).

VLQ-2, Brisbane, 41.58 m.: Good at 5.30 pm (Cushen).

Fiji

VPD-2, Suva, 6.13 mc, 48.94 m: Very good on Sunday evening (Perkins).

New Caledonia

FK8AA, Noumea, 48.39 m. Very good from 7—8 pm (Perkins). Has a good service on Mondays from 7.30 till 8 pm. when N.Z. news is presented. (Cushen).

New Zealand

ZLT-7, Wellington, 44.68 m.: Weak here, suffers from Morse (Cushen).

(Strangely enough has been putting in a great signal over here lately.—L.J.K.)

Tahiti

FO8AA, Papeete, 6.89 mc., 42.98 m.: Heard Saturday at 2.30 pm with good signal. Have never had a reply from them (Cushen).

AFRICA

Algiers

Radio France, 24.75 m.: Heard at 4 pm (Young).

AFHQ, Algiers, 31.46 m.: Heard at 2 am (Matthews).

Belgian Congo

Leopoldville on 9.78 mc, is excellent when closing at 3.45 pm (Graham).

(Have now moved to 11.64 mc., 25.75 m. See New Stations.—L.J.K.)

Ethiopia.

Addis Ababa, 9.62 mc, 31.17 m: Still comes through at 2 am with BBC news followed by local news (Walker, Matthews).

French Equatorial Africa

Brazzaville, heard on 5th June, at 7.30 pm, on 9.705 mc., signal only fair (Matthews.)

FZI, 25.06 m. very fair at 3.30 pm. (Young).

Gold Coast

ZOY, Accra, 42.54 m. has news in English at 4 am—closes at 5 am. (Gillett).

Morocco

CNR-1, Rabat, 8.035 mc, 37.34 m.: Am hearing American transcriptions around 12.30 am and then Spanish. Quality only fair as morse often blankets the whole signal. Think it is CNR-1 but cannot be sure (Walker).

Mozambique

CR7BE, Lourenco Marques, 30.42 m.: Very good at 6.15 am (Young). Heard what I think was CR7BE at 8 am in English—seems to be on at this time on Sundays only (Matthews, Walker).

(Quite likely, as have moved from 9.88 to 9.86 mc, just recently and schedule is: 3—4 pm; 7.30—10 pm; 4.25—6.30 am.—L.J.K.)

Senegal

Radio Dakar, 9.91 mc, 30.28 m.: Heard in parallel with 11.41 mc from 4.45—7 am (Howe, "Universalite".)

South Africa

ZRD, Durban, 5.945 mc, 50.47 m.: Is R-4 with Radio News Reel at 5.30 am. (Gillett).

Heard a South African at 8 pm. Gives 6 pips on the hour—News in English at 9.15. Strength R-7, Q4-5. Annct. 31.23 m (Matthews).

Mr Walker, also of Perth, has heard the above and says all announcements are in English except news in Afrikaans at 9 pm. which is followed by news in English at 9.15. Strength fair. (This would appear at first blush to be ZRL, Capetown.—L.J.K.)

AMERICA—CENTRAL

Costa Rica

TIPG, San Jose, 31.20 m.: Very good at 11 pm (Young).

Guatemala

TGWA, Guatemala, 19.78 m.: Generally good on Monday mornings, but only just audible on June 12 (Gillett).

TGWA, 30.98 m.: Fair signal at 2.30 pm (Young). Can be heard sometimes at 1.30—L.J.K.

Nicaragua.

YNFP, Managua, 6.275 mc., 47.80 m.: Slogan "La Voz del Tropico." QRM's ZPA-1 (Howe, "Universalite")

AMERICA SOUTH

Argentine

LRR, Rosario, 11.88 mc, 25.25 m: Should be a good station in Australia, peak hours 7—9 pm (9—11 am Syd.) but has a long schedule. (Howe, "Universalite.").

Brazil

PRL-8, Rio de Janiero, 25.61 m: Has

been heard closing in English at 6.10 am with an R4 signal (Gillett).

Colombia

HJY, Bogota, 13.65 mc, 21.98 m.: Heard around 10.15 am (Gillett).

HJCD, Bogota, 48.70 m: Has been heard with news in Spanish at 10.30 pm at good strength (Gillett).

HJCX, Bogota, 49.85 m: Fairly good, despite niorse at 10.30 pm (Gillett).

PRL-7, Rio de Janiero, 9.72 mc, 30.86 m: Was excellent from 7.30 till 9 pm. on June 5 (Matthews, W.A.). (This was a new time for this laddie. —L.J.K.)

Heard PRL-7 at unusual hour of 8—9 pm. Signal only fair; mentions Radio Nacional and uses 12 chimes (Walker, W.A.).

Dutch Guiana

PZH, Paramaribo, 10.97 mc, 27.34 m: Very good on this new frequency from 10—11.40 am (Howe, "Universalite").

Ecuador

HCJB, Quito, 24.11 m. Terrific signal at 12.30 pm.—L.J.K.

Heard daily at R9 around 10.30 am. (Graham). The best South American heard here. Closes at 1.30 pm (Gillett, S.A.).

HCJB, Quito, 30.12 m. Very fair at 11 pm (Young).

Ecuador on both 24.11 and 30.12 m good here at 11 am (Matthews, W.A.). HC2ET, Guayaquil. 9.19 mc, 32.64 m: Has been heard at both 9.30 am and 2.45 pm at fair level. (Gillett).

HC1QRX, Quito, 5.972 mc, 50.23 m: Has been at fair strength about 10.15 pm (Gillett).

Uruguay

CXA-6 Montevideo 9.62 mc, 31.17 m: Was being heard at 10 am (Howe "Universalite").

THE EAST

XGOY, Chungking, 25.19 m: Fair signal at 10 af (Young). (Generally a woeful signal at night around 8 pm —L.J.K.).

XGOY, on 31.10 and 41.80 m often provide good entertainment after 9.35 pm, when News reporters talk to the various U.S.A. Networks, and signal is invariably good.—L.J.K.

INDIA

VUD-, Delhi, 19.55 m: This new Delhi heard at 3 pm; announcer says 19.54, but I think 19.55 m is nearer correct (Young).

VUD-3, Delhi, 19.62 m: Heard news very well at 4.30 pm (Hallett).

VUD- on 25.27 m. Heard at noon (Young).

At 11.45 am heard news read by a woman on 19.62, 25.27, 25.36, 31.15 and 31.28 metres. The 25.45 m. outlet seems to have been replaced by 25.36 m. (Walker).

At 1.30 pm Delhi is on 15.35, 15.29, 11.87, 11.89, 11.79, and 9.63 mc.

Found 11.79 and 15.29 the best. They also use 9.59, but I can't hear them for QRM (Graham).

GREAT BRITAIN

The BBC are warning listeners that events may mean alterations to scheduled programmes and advising that they tune at 3.05 pm daily for programme details.

GWR, 15.30 mc, 19.61 m: See "New Stations."

GVQ, 17.73 mc, 16.92 m: Withdrawn from Pacific Service on June 12 — L.J.K.

GVY, 25.09 m. French at 1.30 am (Edel).

GVX, 25.15 m: Excellent for Radio News Reel (N. American Edition) at 9.30 am—L.J.K.

GVU, 25.47 m: Excellent in afternoon around 4.30.

GVV, 25.58 m: At 10.45 pm German for Austria. At 11 pm U.S.A. calling Austria on 49, 41, 31 and 25 m bands. (Edel).

GRG, 25.68 m: Very good signal in early afternoon.—L.J.K.

GRX, 30.96 m: Good show on Sunday mornings from 10.30—11. "The Old Town Hall."—L.J.K.

GWW, 31.06 m, and GRX both in Polish at 1.45 am (Edel).

GWO, 31.17 m: Heard in Italian at 12.45 am and Hungarian at 1.15 am (Edel). Good in afternoon from around 3 pm—L.J.K.

. . . —, London, 9.52 mc, 31.51 m: Heard in later afternoon and again in morning carrying ABSIE programmes —L.J.K. Heard "V of A" station in Europe on this frequency from 4.30 pm till midnight (Cushen).

(This is the station mentioned by Mr. Gillett in May issue.—L.J.K.)

GRI, 9.41 mc, 31.88 m: Excellent programme of music with anouncements in Spanish at 11.45 am—L.J.K.

Mr. Edel has heard, on ocasions, in the afternoons, what he thinks may be a new BBC transmitter on approximately 6.03 mc, 49.73 m. He has noted Czechoslovakian at 4.10 and Polish at 4.20.

GRM, 42.13 m: Now continues till 7 pm in Pacific Service.—L.J.K.

GRC has changed frequency and is now on 288 kc., 104.2 m: Anyone hearing it? Sched. is 7.15 am till 2 pm.

U.S.S.R.

Moscow, on 19.54 m. has a good signal at 1 am and same programme is on 24.47, 24.65, 30.36, 30.43, 33.56, and 39.68 metres.

Leningrad, 25.79 m.: News in German at 9.30 and 11.30 pm (Edel).

Moscow, 31.65 m., Italian at 12.30 am and 41.83 Estonian at 1.30 am (Edel).

Radio Petropavlovsk, 6.07 mc, 49.42 m: This new Russian has a fine signal at 7.20 pm.—L.J.K.

RW 15 "Frunze", Khabarovsk, 50.54 m.: At 11.50 pm gives schedule for following day. Khabarovsk time is same as Sydney (Edel).

Heard Moscow, once, on 24.45 m. carrying same programme at 24.47 m (Gillett).

Mr. Young, the South Australian veteran, says: "Listen to Moscow's Big Ben on 39.68 m. striking 12 at 7 am —it's very nice." (Hea! hear! here too, Wally.—L.J.K.)

MISCELLANEOUS

Army Testing (location unknown) 38.27 m.: Heard at 2 pm, midnight and 3.30 am (Young).

British Mediterranean, 31.03 m: News in English at 2.45 am—Good sig. (Matthews, Hallet).

(See also remarks under Palestine. —L.J.K.)

Canada

CBFX, Montreal, 9.63 mc, 31.15 m: A hopeless job, here, to separate from VUD on same frequency. (Graham). (I still hear them occassionally, when there is a lull in VUD's speech.—L.J.K.)

Dr. Gaden writes: "Some luck with the Canadians on 48, 49 and 31 m. bands; last night (June 14) gave CBFX a turn soon after 10 o'clock. Ye Gods, lovely in news, then in Divine Service; call at 10.30 was perfect, then a bad slip with gradual weakening of sig. Until 10.30 there was NO interference."

CFRX, Toronto, 6.07 mc., 49.42 m.: Have been hearing the Rogers Station fairly well (Gaden).

CBRX, Vancouver, 6.165 mc, 48.70 m: is what anouncer says at 4.30 pm when closing. Poor signal as a rule, but can be heard some days (Gaden). Cannot find that "some day" down here.—L.J.K.

Rex Gillett, of Adelaide, has also been fortunate with the Canadians, he says, "Heard CBRX and CKRO (Winnipeg, 48.78 m.) in parallel at 6.30 pm with news flashes on Invasion Day and at 7.15 found CFCX, Montreal, 49.96 giving a flash.

Italy

ICA, Naples, 9.10 mc, 32.96 m: This Advance Headquarters contacts New York, 8.30—9 pm; 10.30—10.45 am (Howe, "Universalite").

NEW STATIONS

(Continued from page 23)

. . ., Berne, 9.185 mc, 32.66 m.: This is a new outlet for The Swiss Broadcasting Corporation, and was first heard on June 27. Announcer says is directed to New York from 11 am till 1 pm and is in parallel with 9.54 mc. Signal was a little better than the 31 m band but background noise was fairly high.—L.J.K.

KGEX, 'Frisco, 15.30 mc., 19.83 m.: A new call sign for the old Gen. Electric frequency. Heard also on June 27 when Test "A" was being conducted by The United Network. They were anxious to have reports on this transmission, noon till 2.45 pm, which was being conducted as a test till June 30, when further particulars would be made available. Signal is only fair when opening, but quickly improves to R9 Q5 which is maintained till closing—L.J.K.

KGEX, 'Frisco, 9.53 mc., 31.48 m.: Also heard on June 27 when call sign and frequency were given at 10.45 pm. Orchestra was followed by Eastern language, which was still in use when I pulled the big switch at midnight without learning anything of their schedule, etc.—L.J.K.

SPEEDY QUERY SERVICE

Conducted under the personal supervision of A. G. HULL

P.S. (Wollongong) enquires about converter valves.

A.—You can use the EK2G instead of the 6A8G, and it may give you even better performance, but you will have to make sure that you change the circuit around to allow correct voltages to be applied to the elements of the EK2G. If you put the full high tension on to the oscillator plate you will probably damage the valve. Surest check of the proper performance of the converter is to check the grid current and make sure that it is according to the makers recommendations.

●

C.A.L. (Bondi) enquires about cutting out the power transformer.

A.—It depends on what you mean by "does it work?" The scheme is sound enough in theory and you can rectify the mains directly and use the resultant d.c. for the high tension. But the danger lies in the fact that the other side of the power main has to be earthed to the set or otherwise connected to become high tension negative. Which is dandy until you get a case where the main you are "earthing" is actually 240 volts above or below the outside earth. Getting yourself between these two "earths" will give you the full 240 volts with lots of kick behind it, and you will get a nasty jolt or even worse. Of course if you have the whole set caged in a bakelite case with a back, and make your aerial and earth connections through small mica condensers the set may be safe enough in operation. It requires caution, however, when messing about with a chassis of this kind when not in the case.

PICK-UPS

(Continued from page 19)

rubber block as a damping medium, uses a special oil, which fills the pick up head, to almost full capacity. The needle is attached to a light diaphragm which in consequence of its great reduction in mass and better damping medium is capable of quite good quality and usually extends the frequency range appreciably over that of the ordinary type, but at the same time is rather costly and usually quite bulky in its physical dimensions.

One more point which sometimes is overlooked, and that is the advisability of mounting the motor board on sponge rubber blocks or alternatively the pick up itself. No trouble should then be experienced with the pick up setting up a resonant note in the reproducer due to the beat note of the turntable revolving.

H.E.P. (Hornsby) asks about aerials for crystal sets.

A.—The selection of a suitable aerial will be much more important for the crystal set than for the big superhet, as you will need maximum efficiency. There is no amplification in a crystal set so all the power you have to play with must be dragged down the lead-in. However there is a definite limit to the size you can use as otherwise there will be trouble with selectivity, especially in a location such as yours.

We hesitate to give you any hard and fast height or length and feel sure that the matter is one which offers plenty of scope for scientific experimenting. Try different lengths, heights and directions, keeping a log of results, and then decide for yourself which is best.

●

V.A. (Essendon, Vic.) is not getting proper power output from his amplifier.

A.—From your remarks we would make a wild guess that the speaker field is not being fully energized. It is not much use feeding ten watts of audio power into the voice coil if the field has only four or five watts in it. Unfortunately you have not given us a sketch of the circuit, but we know how hard it is to arrange to put plenty of watts into the field, enough into the output valves and still use only a medium-weight power transformer for the high tension supply.

●

W.A.B. (Glen Innes) complains of irregular delivery of his issues, which he obtains in a rather roundabout way.

A.—We can only suggest that you place a subscription order, either through your local newsagent or else direct with our Sydney office. You will then be quite sure of getting your issues regularly and promptly.

●

F.S.T. (Ballarat, Vic.) is interested in direct-coupled amplifiers.

A.—Direct-coupling simply won't lie down or stay decently buried. The latest revival seems to be in the hands of Charlie Mutton who has something really effective in operation. It seems to be so good that he talks of putting it in the Victorian Amplifier Championship. We hope to be able to publish some details of the circuit in an early issue.

●

A.P.D. (Toora) is having trouble to obtain "B" batteries.

A.—Sorry, but we have no source of supply for batteries and cannot help you in this matter. We can only suggest that you do your best to get yourself popular with the local dealer.

S.B. (Lidcombe) asks about radio induction heating.

A.—There was a most thorough article on the subject in the December issue of the General Electric Review (U.S.A.) but you may have some trouble in getting hold of a copy. Possibly the Sydney office of the A.G.E. Company will have it on file and let you take notes from it. We have in mind to reprint the article in an early issue but it runs to considerable length and we are a little doubtful about whether a large percentage of our readers are yet fully alive to the importance of this project. Considerable power is necessary; something in the region of about 15 kilowatts input being sometimes used. This power would rate quite big for even a broadcasting station in this country!

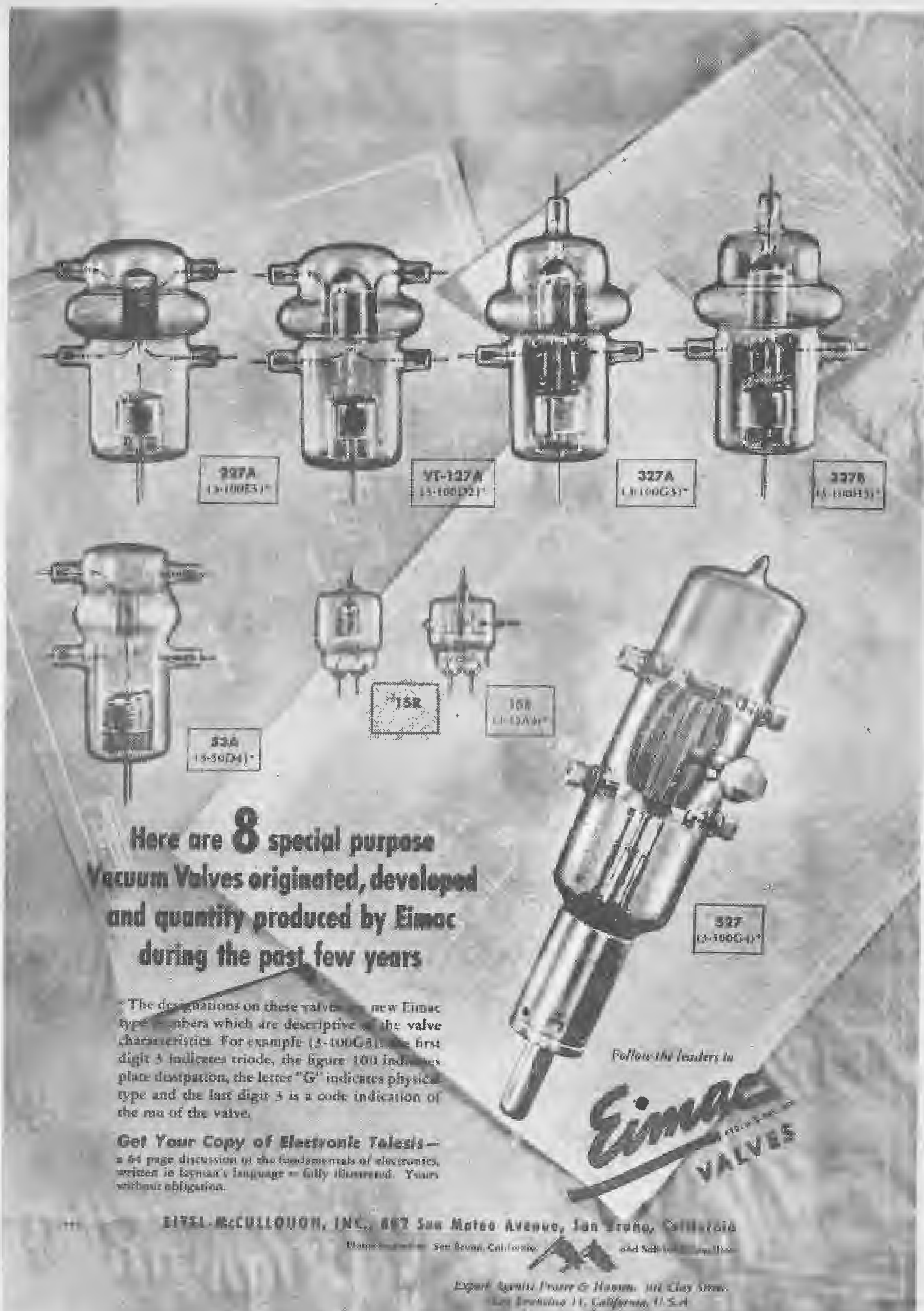
AMPLIFIERS

(Continued from page 13)

than the two used in the filter system, and half a dozen resistors, which possesses a flat frequency response from 1 cycle to 20,000, 10 watts output at 2 per cent. total distortion, and a hum level which is inaudible. However direct coupling is not a job to be attempted lightly, and unless one thoroughly understands voltage distribution, bleed current, and a good working knowledge of valve characteristics, plus a vacuum tube voltmeter, leave well alone. If any reader requires a circuit diagram of an excellent direct coupled amplifier the diagram will be featured in a forthcoming issue.

That just about sums up the main points regarding power amplifiers along with the "for" and "against" for each type and while only havir touched lightly on each type, at least . may be some guide to those readers who are, as we mentioned before, "groping in the dark."

We would like to assist readers wi their own little problems regarding amplifier design, circumstances permitting. And don't forget your entry in the A.R.D.X. Club Amplifier Contest.



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15R
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LET THE PRESENT DECIDE YOUR FUTURE NOW !

Whatever job you are engaged upon at the present time, whether it is in the Forces, or in the Factory, or in any of the many essential Services, keep the Future well before you. Remember, the war won't last forever and the Peace must find you prepared to take your place in the post-war world where competition will be very keen. Radio is a young industry which has shown remarkable progress in the past few years. The future possibilities of Radio are unlimited, and they spell security and prosperity for a man who is trained.

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Right now openings in Radio are greater than the number of men available to fill them. Here are three good reasons, moreover, why A.R.C. Radio Training must interest you so vitally. 1. You will enter today's most progressive industry. 2. You will be pulling your weight in the war effort. 3. You will have a splendid career ahead of you when the war is over.

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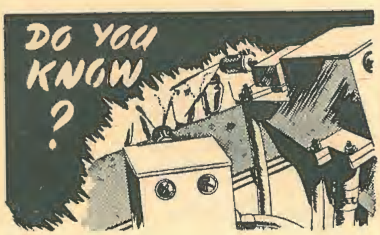

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