THE AUSTRALASIAN

Radio World

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

1/-

VOL. 10 ..... NO. 4 SEPTEMBER 15 1945

DESIGNED FOR REPLACEMENT

COMPONENTS BY "CROWN"

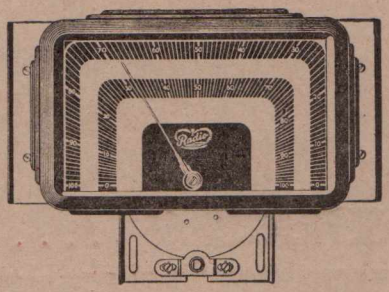


Fig. 1

Fig. 2

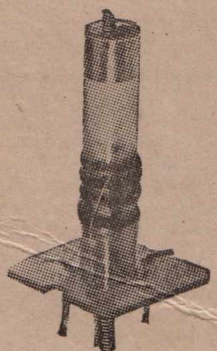


Fig. 3

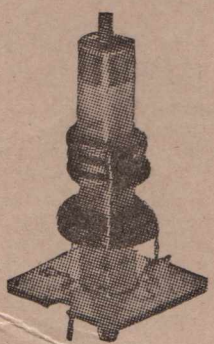


Fig. 4

"CROWN" Adjustable inductance "Permatune" Coils are designed to replace the Broadcast Band Coils in practically any receiver. When an Antenna, R.F. or Oscillator Coil requires replacement, use a "CROWN" Universal Adjustable Coil.

Universal "Permatune" Coils are, for replacement purposes, designed to have a variable inductance over a wide range. Each coil, when properly adjusted, will "track" accurately with the other coils in the receiver. The exact inductance of the old coil is easily matched with standard gang condensers by a very simple adjustment of the variable iron core.

Fig. 1. Universal Tuning Dial
Fig. 2. Universal Aerial Coil with Shield
Fig. 3. Universal OSC. Coil
Fig. 4. Universal R.F. Coil

If it's a "CROWN" Product it's reliable.

Crown

RADIO PRODUCTS PTY. LTD.

51-53 MURRAY STREET
PYRMONT — SYDNEY

Telephone MW2628 (2 Lines)

CR-11-45

THE AUSTRALASIAN
RADIO WORLD

Devoted entirely to Technical Radio

and incorporating

ALL-WAVE ALL-WORLD DX NEWS

Vol. 10. SEPTEMBER, 1945 No. 4.

★ **PROPRIETOR —**
A. G. HULL

★ **Manager —**
DUDLEY L. WALTER

★ **Secretary —**
Miss E. M. VINCENT

★ **Short-wave Editor —**
L. J. KEAST

For all Correspondence

★ **City Office —**
243 Elizabeth St., Sydney
Phone: MA 2325

★ **Office Hours —**
Weekdays: 10 a.m.-5 p.m.
Saturdays: 10 a.m.-12 noon

★ **Editorial Office —**
117 Reservoir Street, Sydney

★ **Victorian Advertising Representative—**
W. J. LEWIS,
20 Queen Street
Melbourne, C1
'Phone: MU 5154

★ **Subscription Rates —**

6 issues	5/3
12 issues	10/6
24 issues	£1

Post free to any address.

★ **Service Departments —**
Back Numbers, 1/- ea. post free
Reply-by-mail Queries, 1/- each

CONTENTS

EDITORIAL

You will be interested in Mr. Langford Smith's article in this issue in which he announces, on behalf of the Amalgamated Wireless Valve Company, the type numbers of the valves which are to be recommended as the standard or preferred-type valves for the immediate future. In his article Mr. Langford Smith gives a full explanation of the reasons behind the choice of these valves, giving the article added interest.

After reading the article you will doubtless agree that the policy adopted is sound and logical.

It is to be hoped, however, that the powers-that-be will appreciate that it is not reasonable to expect the local factories to produce every type of valve that the fertile mind can conceive, and make due allowance by making it easy for importers to land stocks of those particular valve types which cannot be produced locally on an economical basis. Valves such as the 6SN7GT and other twin types, for example, have many special applications and if the local experimenters are denied a chance to obtain small quantities of these valves it may tend to retard progress.

It almost looks as though we need two classifications for considering the importation of valves, giving preference to the types which are not locally-made. The locally-made valves are reasonably satisfactory and doubtless they can supply the need for all standard types.

Whilst on the subject of valves, we hope that a more legible branding of type numbers can be made, and that a handy abbreviation can be found for the mouthfuls like "6SN7GT." How about starting off a new run of serial numbers or letters, say, a single type letter, such as "A," "B," "C," etc., stamping it into the bakelite base and painting on a colour code as well?

A. G. HULL.

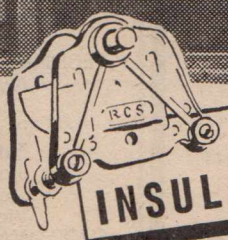
RCS Radio Parts and Components

. . . featuring Trolitul

● A view of the modern R.C.S. factory at Canterbury, N.S.W.

All over AUSTRALIA

—the name R.C.S. is recognised by both the trade and the amateur set constructor as being the trade mark of quality in precision-built radio parts and components. Contracts with a high defence priority naturally take precedence over civilian requirements at the present time, but the day is not far distant when a full range of both old and sensationally new chokes, transformers, coils and dials bearing this famous trade mark will again be freely obtainable.



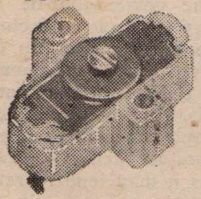
THE MIRACLE INSULATING PLASTIC

Trolitul — the semi-transparent, light-weight moulded insulating plastic — is exclusive to R.C.S. and wherever possible in the manufacture of R.C.S. quality radio parts and components you will find this modern miracle insulating material used as part of the basic construction. Sealing wires and connections into one solid damp-proof whole, the use of Trolitul guarantees longer life for all R.C.S. parts, maximum efficiency and the maintenance of factory-precision and accuracy for many years after its purchase by the customer.

R.C.S. TRIMMERS

R.C.S. Trimmers – Two-plate coil trimmers mounted on Trolitul base.

CG 15.



R.C.S. PADDERS

These padders are of a special high grade type. The plate is made of pure nickel and the base is R.C.S. Trolitul.

P 21.

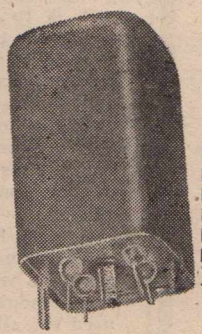
R.C.S. RESISTORS

R.C.S. Resistors wound with nichrome wire and are supplied complete with pigtails.

Ohms to 1500 Ohms
1" x ⅜" diam.

1500 Ohms to 10000 Ohms
2" x ⅜" diam.

C.T. Resistors
10 Ohms to 200 Ohms



R.C.S. COILS

R.C.S. Coils are specially wound on exclusive one-piece Trolitul formers with connecting lugs permanently moulded in.

F. Gang.	H. Gang.
E.282. Aerial Air Core	E.342. Aerial Air Core
E.283. R.F. Air Core	E.343. R.F. Air Core
E.284. Osc. Air Core	E.344. Osc. Air Core
E.279. Aerial Permature	E.345. Aerial Permature
E.280. R.F. Permature	E.346. R.F. Permature
E.281. Osc. Permature	E.347. Osc. Permature
T71. R.F. Reaction	T87. R.F. Reaction
T72. Reinertz	T81. Reinertz

R.C.S. RADIO PTY. LTD.

174 CANTERBURY ROAD, CANTERBURY.

STARTING IN THE RADIO BUSINESS

A FEW WORDS OF ADVICE FOR MEN BEING DISCHARGED FROM THE SERVICES

By

A. G. HULL

AMONG our subscribers we have thousands (and I don't mean hundreds) of men and women in the various branches of the armed forces. Now you are on the way home I want to offer you the usual congratulations on the job you did, a hearty welcome back to civvies and this little article on the subject of how to go about getting started up in the radio business.

Already hundreds have written for advice about the buying of radio businesses and I know that a big percentage of you have in mind that you would like to own your own snug little radio shop.

As you will soon find out, it is not quite as easy as might be imagined. You can't just wander down to the nearest real estate agent and ask him to let you have a suitable shop with a nice dwelling attached, as you might have done in the pre-war days.

To rent a suitable shop in a good location is practically an impossibility. About your only hope is to watch the classified columns of the local papers, keeping your eye on the "Businesses for Sale" column and dashing after the first advertisement you notice where someone is "prepared to sell the fittings" of a shop. In practice this means (in spite of any laws to the contrary) that the tenant of a shop will sell the key for a hundred pounds or so. Possibly the deal will be cloaked by a worn-out linoleum being left on the floor, but it hardly makes it legal. It is a stinking state of affairs, but there doesn't seem to be any easy way out of it.

If you become discouraged at the prospect of being able to rent a shop to allow you to start from scratch you can always consider buying out an established business on a walk-in walk-out basis, paying (and I mean Paying) for the privilege.

Advertising Abbreviations

In order to understand the advertisements you need to know that "S.A.V." stands for "stock at valuation," that an "L.B.A." is a licensed business agent.

Unless specifically mentioned as "freehold" you will know that the business is carried on in a rented shop and that when you pay the price you buy the goodwill of the business, not the actual building itself.

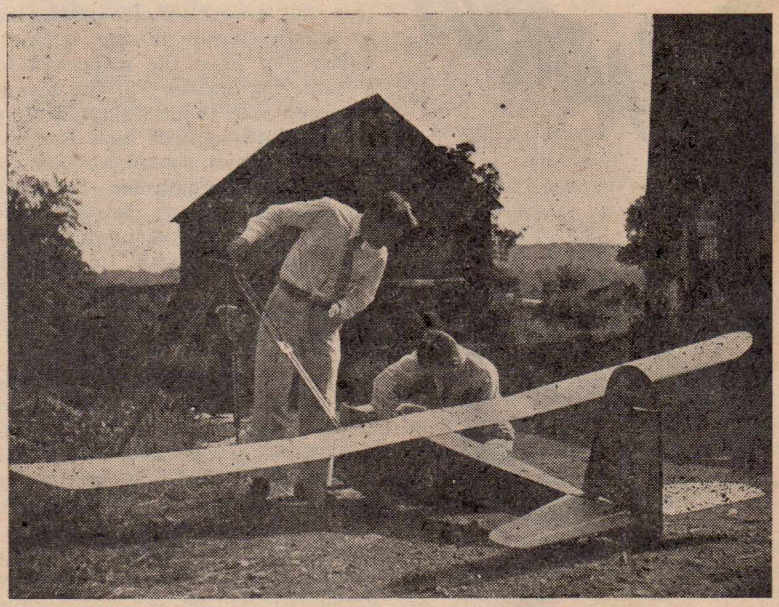
In the matter of a dwelling, it is accepted practice that in cases where a dwelling is attached you will have to exchange your present flat or house in order to get possession of the dwelling. Sometimes possession of the dwelling is available, but this is almost certain to be stressed in the advertisement if it is so.

Buying into an established business you will be required to pay a fairly heavy sum, probably between £500 and £1,000 for the goodwill of the business. To make sure that this good will is goodwill and not ill-will will call for a close study of the seller and his business methods.

A Point to Watch

The mere fact that he can show you a big box full of job cards of work done does not prove that these customers are not fleeced and seething with anger. If they are all happy with the work done, such a list of customers will be of great value when new sets are available. On the other hand, if the repairs have not been done carefully these irate customers may haunt you for many a day, expecting you to complete the work already paid for but not properly done. You can readily see that there is a terrific margin between the limits of negative and

(Continued on next page)



RADIO-CONTROLLED GLIDER

In last month's issue we mentioned the radio-controlled glider operated by the late Ross Hull. An enthusiastic reader has supplied the above photo of this glider. The photograph came from America some years ago.

STARTING UP

(Continued)

positive goodwill in the radio repair game and the utmost in perspicacity will be called for if you are to do the right thing.

Owing to the large number of people who will be looking for businesses, the sellers will probably be in a position to state the price and terms and adopt an attitude of "take it or leave it" and refuse to give particulars which are essential if the proper value of the business is to be assessed. I am afraid there is little advice that I can give under such circumstances except "Don't," but that is not much help to the person who is anxious to get settled in his own little shop.

A Lease Desirable

If the seller is a reasonable sort of person and will give you answers to your questions, I suggest that first of all you determine what is the position of the tenancy. Unless there is a written lease, you will always have a shadow of doubt hanging over you, for the landlord may suddenly decide that he needs the premises for someone else and give you a week's notice. If you have been paying rent by the week, then only a week's notice is required to legally terminate the tenancy, unless you have the safeguard of a lease. During the war the tenant has been able to sit tight and defy the landlord to shift him, but this state of affairs should not be accepted as a guarantee that the position will always be the same and that a lease is unnecessary. In a nutshell, if you want to establish a permanent business you should either own the freehold of the shop premises or else a lease in writing.

The situation of the premises is an important factor in the success of any business, but should be considered with due regard to the matter of rent. If you are to pay a big rent then you can expect to have a situation where a large number of people actually pass your windows. Before moving into any premises it will be well worth while to stand outside and count the passers-by, even for hours at a time and at different times of the day.

The handicap of a poorly-located shop can be largely overcome by spending a considerable amount of money on advertising, and so the amount to be paid in rent and advertising should be added together for consideration, rather than either item on its own.

The next question which is an acid test, but rather difficult to apply unless you are particularly tactful, is in reference to income tax returns. Ask the seller to produce his income tax receipts for the past four or five years and note if his face changes colour.

Probably the seller will tell you a long tale of how he has been dodging income tax or putting in false returns, and if he does so you will need to exercise special care. Remember the old proverb which says something about not trusting any man who has not a conscience in all things. In other words, if the seller is capable of trying to swindle the income tax collector he is also capable of trying to swindle you, too.

Value of Stock

In order to arrive at a sound value for the stock it is necessary to exercise foresight amounting to almost prophecy, because values are bound to alter in the near future and not necessarily in one direction. Notwithstanding the price-fixing regulations, quite a few radio dealers have been selling secondhand receivers at prices greatly exceeding their original price. Such a dealer may consider that his secondhand receivers are worth £30 each, even if they are the type of set which overloaded the dealers' stores as trade-ins a few years ago, coming into stock at a value of 30/- each. There is every possibility that those £30 sort of secondhand sets will again revert to a true value of 30/- very soon, and woe betide anyone who invests his savings in stock of that nature. On the other hand, recent trends in the prices of test equipment seem to indicate that a good valve and circuit tester is truly worth more today than its new price of five years ago, with little prospect of the value falling in the course of the next year or two.

Similarly, the value of compon-

(Continued on page 34)

STANDARD VALVE TYPES FOR 1945

EVER since the introduction of radio valves there has been a rapid succession of changes in design and there are no signs that the development has yet reached a stable condition. The period of the war has seen many developments in the radio field, and we have now reached the point where we must weigh up very carefully the pros and cons of all these developments with a view to peacetime applications.

Large countries such as the U.S.A. have advantages on the industrial side owing to their large-scale production and the consequent diversity of types. The position in Australia is different, and local manufacturers in all industries are restricted in their output and therefore also in the diversity which they can supply economically. In the case of radio receiving valves, the

By
F. LANGFORD-SMITH
(Amalgamated Wireless Valve Co. Pty. Ltd.)

total Australian market covers only perhaps two to three million per annum, while the minimum production necessary to give reasonably economical manufacture of any one type is round about 20,000 per annum. It is therefore necessary for Australian valve manufacturers to make a very careful analysis of the position to ensure that their forecasts are soundly based and that their types selected for local manufacture are those likely to continue for a number of years.

The system of using a "List of Preferred Tube Types" was first introduced in America by R.C.A., and has since been adopted by the American Joint Army-Navy and by the British Services. At a later stage the preferred types list was also introduced in Australia, and there seems to be no doubt that this system has come to stay, and to bring with it a number of benefits. The number of new types introduced overseas has been so great that there have been duplications and near-duplications in many instances, so that large numbers of valve types are quite unnecessary. Action was taken in U.S.A. by the War Production Board to cease manufacture of a large list of non-essential types, and somewhat similar action has been taken in England. There appears to be quite a good reason for believing that many of these types whose production has been suspended for the duration will never more come into production.

In one sense, Australia was in a better position to bring about standardisation of valve types during the early stages of the war than were either Great Britain or U.S.A.,

(Continued on next page)

VICTORIAN AMPLIFIER CONTEST

VICTORIAN AMPLIFIER CONTEST.

THE Australian DX Radio Club has just released details of the rules governing their annual contest for amplifiers. Last year's contest was a great success, as fully reported in our columns, and a great many of our readers will be interested in this year's event, which will be held about November 17. Entries, however, close on September 29, and so enthusiasts who wish to enter will need to get started on their jobs if they hope to be in the running.

GRADES.

The contest will be divided up into four grades, with Grade 1 open to all-comers with any type or power amplifier. Grade 2 is for amateur-built amplifiers only, but with no restriction on design, power or the components used. Grade 3 is for single-ended amplifiers, which must use only a standard radio output tube, and must be amateur-built. Grade 4 is restricted to financial members of the Australian DX Radio Club, but with no limits on design, power, etc.

DEFINITION OF AMATEUR.

For the purpose of the competition, the Australian DX Radio Club committee has defined an amateur in Grades 2 and 3 as being any person who is not employed in any capacity whatsoever in the Radio trade. Further, in order to eliminate any possibility of doubt, the executive committee of the Club has reserved the right to reject the entry of any person wishing to compete in the amateur grades.

THE JUDGING.

In spite of the criticism which was levelled at the judging after last year's contest, the general idea has not been altered for this latest event, three judges having been appointed to act as sole judges for the elimination heats and the final contest. The three judges appointed are J. Walsh of Trimax Transformers, H. Setford of the "Listener-In," and R. Buscombe of Velco Sound Systems.

ENTRIES.

An entry fee of 2/6 for each amplifier entered is to be charged, and this fee must accompany the application. Entries should be sent to the Honorary Secretary of the Australian DX Radio Club, Mr. Norman H. Groves, of 135 Burgundy Street, Heidelberg, N22, and must be in his hands on or before September 29, 1945.

1945 VALVES

(Continued)

since an "Australian-made list of Standard Valves" was already in existence for some years before the war. The local valve factories continued to manufacture throughout the whole of the war period almost identically the same types, with certain additions, as in the pre-war period. Australian owners of radio broadcast receivers were in a better position as regards the availability of valve types, than were their fellows in either Britain or U.S.A. The great majority of Australian-made broadcast receivers were already fitted with the standard range of Australian-made types, and therefore did not require to make any substitution of types when a replacement had to be made.

Future Valve Types.

The problem facing us at the present time is that of selecting valve types which will give the maximum degree of flexibility and widest field of application for the minimum number of types. The position is complicated owing to the various ranges and to the different types of construction which have been introduced during recent years. For example, there are, in Australia, three most popular ranges, namely:

1. The 1.4 volt Battery range.
2. The 2 volt Battery range.
3. The 6.3 volt A.C. range.

The 1.4 volt range is required for use both in portable sets and in home sets in country areas where accumulator charging is difficult. The 2 volt range is required for operation from 2, 4, or 6 volt accumulators, with either B batteries or vibrator-powered B supply. The 6.3 volt range is widely used in all receivers operated from A.C. mains.

It seems that U.S.A. has dropped the use of the 2 volt range in favour of either the 1.4 volt or 6.3 volt range, and an analysis was therefore made of the Australian market in order to see whether we could not follow the American trend in this instance.

The result of the analysis indicated overwhelmingly that there was an extremely strong demand for the 2 volt range in Australia and that this could not be met by

either the 1.4 volt or the 6.3 volt range. We were therefore left with three ranges to be adequately covered by valve types. In the 1.4 volt range we had a choice between the GT types at present being manufactured, and the miniature types now being widely used in U.S.A.

From an examination of the valve performance, characteristics, and dimensions, it was concluded that the 1.4 volt miniatures could do all that the GT valves could do and, in addition, they could be used in small portable sets such as personal portables. This miniature construction was therefore adopted and the valve types 1R5 converter, 1S5 second detector, 1T4 R.F. and I.F. amplifier, 1S4 power amplifier for sets using 67.5 volt B batteries and 3Q4 power amplifier for sets using 90 volt B batteries, were selected for local manufacture.

The 2 volt range is not intended for use in very small receivers, so that in this case there would be no disadvantage in making the valves smaller. So far as the characteristics are concerned, a careful examination revealed that only one type was capable of appreciable improvement, this being the converter type 1C7-G. It was decided to commence the development of a new 2 volt converter valve on the same lines as the 1R5 and 6SA7 pentagrids. This construction has the advantage of providing a high oscillator trans-conductance with high conversion conductance and other good features, particularly on short-wave operation. I am pleased to be able to say that the preliminary development has now proceeded far enough to indicate that there is no doubt that the new 2 volt converter valve will be a most valuable addition to the range. The remaining types will be continued as in the pre-war period, namely, 1K7-G second detector, 1M5-G R.F. and I.F. amplifier, 1L5-G power pentode, 1H4-G triode driver and 1J6-G class B power amplifier.

NOTE—

a circuit to use the new miniature valves appears on page 15 of this issue.

THE 1945 VALVE TYPES

MINIATURES—1.4-volt battery-operated, 1T4 r.f. amplifier, 1R5 converter, 1S5 detector, 1S4 power valve.

BATTERY—2-volt filaments. 1M5G r.f. amplifier, 1K7G detector, 1L5G power pentode and a new converter yet to be given a type number.

A.C. RANGE—6.3-volt heaters. 6SB7GT converter, 6SK7GT r.f. amplifier, detector, 6V6GT power pentode and 5Y3GT rectifier.

Australians Sent Overseas.

The 6.3 volt A.C. range presented the most difficult problem owing to the wide diversity of characteristics and constructions. . Three different types of construction were given careful consideration, and two of the Company's officers were sent overseas to gain further information on the merits of the various constructions and on their manufacturing technique. The first conclusion reached was that top caps were undesirable. This reduced the choice of construction to one of the following:—

1. Single-ended GT.
2. The Lock-in construction.
3. The miniature construction.

The single-ended GT construction has a number of valuable features, among which is the very important one that it uses the standard octal socket. It can also be manufactured on standard machines so that production can be commenced with a minimum delay. The electrical characteristics and performance are at least as good as those of equivalent types in either of the other two constructions. The size is almost the same as that of the lock-in construction and, in fact, the same size of bulb is used in both.

Not Loctal Bases

The lock-in construction has some very good features, among which is that with any quantity production it would probably be cheaper to produce than the single-ended GT. Against this it would suffer the disadvantages introduced by a different type of base and socket. Popular opinion appears to be opposed to the use of two different types of socket and two different valve constructions in the one set, and we would therefore be forced to duplicate, in the lock-in construction, types such as the 6V6-GT power amplifier, 5Y3-GT and 6X5-GT rectifiers. This would be wasteful both to the valve manufacturers and to the community since it would mean the introduction of three new types which conferred no benefits. There was also the doubt as to whether the lock-in construction would prove of lasting popularity owing to the introduction of the miniature types.

After weighing up all these features, it was decided to drop the lock-in construction from the immediate future programme for local manufacture.

Miniatures Not for Australia.

The A.C. miniature types have been widely used during the war and appear to have an important future ahead of them. They are physically suitable for equipment having very large numbers of valves and in which space is an important factor. These conditions do not apply to the ordinary A.C. receiver in Australia, which is, and appears likely to continue, mounted on a reasonably large chassis and is not cramped for space.

Miniature valves on such a chassis appear rather out of place, and

(Continued on next page)

1945 VALVES

(Continued)

there appears to be no present evidence that the American manufacturers are proposing to use miniature valves throughout their large console receivers. Miniature A.C. valves are likely to be used in America in small mantel model AC/DC sets in which space is an important factor; these form a comparatively small part of the Australian demand.

Owing to the use of higher mains voltages and in the doubling of the heat dissipation in a receiver it is not practicable to design equivalent sets for Australian conditions. The use of transformers is generally adopted in Australia, except for D.C. power supply, in which case a special D.C. receiver is used.

Small Glass "Bulbs"

The single-ended GT range is small enough to enable the 4 or 5 valve A.C. set to be constructed in a reasonably sized bakelite cabinet which should be better in performance than the extremely small American AC/DC sets, which suffer in both tone and power output from their too-limited dimensions. At the same time, the fact was appreciated that miniature valves (or a possible development from them) are likely to have an increasing market for use in special applications such as frequency modulation and television.

Miniature valves are likely to be used in the R.F. oscillator, and converter positions in such equipment, where their special advantages provide superior performance over larger valves. For the other positions in such equipments they offer no advantages other than small size.

For Big Amplifiers

It seems likely that large valves will continue to be used, at any rate, in the power amplifier and rectifier positions of all but the smallest sets, since the miniature valves are seriously limited in both power output and rectifier output. It is also likely that the life of the miniature valves will be shorter than that of corresponding large valves, and this will be particularly marked in the case of power amplifiers and rectifiers.

The stage of development of the miniature valve is still too early to make any definite pronouncement regarding its final performance, and the wisest plan for Australia appears to be to keep an open mind on the question and to profit by any overseas experience.

In order to enable developmental work to be carried out with miniature valves it was decided to manufacture two high-slope R.F. pentodes in this construction, one having sharp cut-off and the other a super-control characteristic.

Both these types are at present in the developmental stage in U.S.A., so that it is not possible to give their commercial type numbers at the present time, but they have advantages over their prototypes which led to their adoption. Having decided on the manufacture of two miniature A.C. valves, we then had the choice of single-ended GT types to cover the ordinary Broadcast Receiver range. The following types were selected:—6SB7-GT converter (a high-slope version of 6SA7-GT), 6SJ7-GT, 6SK7-GT, 6SF7-GT diode-super-control R.F. pentode, and 6CQ7-GT, together with the present types 6V6-GT, 6X5-GT and 5Y3-GT, the latter being a GT version of the 5Y3-G, which it will supersede and replace. This range provides improved characteristics in the first four types mentioned over their present near-equivalents, being particularly marked in the converter valve. Type 6SF7-GT has a trans-conductance of 2,000 micromhos, which is identical to that of 6SK7-GT, and the former may therefore be used as a very efficient I.F. amplifier valve and diode detector in four valve sets.

For large amplifiers there will also be type 5R4-GY, which gives an output current of 250 ma. with a peak inverse voltage of 2,100 volts.

Summary.

It will be seen that the plan for the immediate future covers five new 1.4 volt miniature valves, one new 2 volt valve, five new single-ended GT valves for the A.C. range, together with three existing valves in the GT range and a large rectifier. In the A.C. miniature range there are two types as a first step in this direction.

These valves will not only cover practically all the requirements of Broadcast Receivers, but the types selected are, in almost every case, on the R.C.A. Preferred Types List for post-war, and also on the American Joint Army-Navy List. There are, therefore, very good reasons for their selection, and it is my desire to convince Australian Receiver Manufacturers that the selection has been made for their benefit. The selection of types has not been arbitrary, but has been made scientifically, and consequently I feel that it is wise to put the whole situation clearly and frankly so that the reasons for the selection may be fully understood and appreciated.

Book Review

THE 1945 HANDBOOK

Copies of the 1945 edition of the American Radio Relay League's annual publication, "The Radio Amateur's Handbook," are now becoming available. It contains some 512 pages with 1,278 illustrations, 133 charts and tables, and 240 basic formulæ covering almost every aspect of radio communication.

A considerable quantity of new material is included, particularly in those sections devoted to the very high frequencies. For example, the chapter on the theory and operation of valves contains a description of the Klystron velocity-modulated valve and the magnetron, which are used for the generation of RF oscillations up to and even beyond 30,000 Mc/s (1 cm). It is anticipated that when amateur licences are restored in America frequency allocations will be made in these regions of the radio spectrum.

The expansion in the quantity, and quality, of the material on UHF practice and theory is in part due to the many American amateurs now enrolled in the WERS (War Emergency Reserve Service) for which a large amount of 2½- and 1¼-metre mobile radio equipment is required. Much of this gear is home-made.

There is a number of new pieces of test equipment, again largely of the UHF kind. Mention should also be made of a very ambitious 12-valve communications set covering 1.75 Mc/s to 30 Mc/s and embodying a crystal IF filter, noise limiter, signal strength meter and many other up-to-date refinements. Full constructional details, including coil winding data, are given.

AN ANSWER TO THE CATHODE FOLLOWER

SOME time ago the cathode follower output stage made its appearance, and circuits employing this arrangement were featured in The Australasian Radio World. Striking performance was claimed for this type of circuit. The following features, in relative order, are mainly responsible for such outstanding results:—

(1) The output impedance is extremely low compared with the load impedance, giving improved loudspeaker damping, better transient response, and wider frequency range (for a given output transformer.

(2) A considerable reduction in output stage distortion results from the use of 100 per cent. negative feedback, so much so, that a certain degree of overdriving may occur in the final stage before the distortion becomes intolerable (distortion is reduced by a factor of approximately $\frac{1}{4}$). This gives the effect of apparently greater power output.

(3) An increase in high frequency response due to a reduction of miller effect capacity loading the driver stage.

In the case of a single-ended 2A3, the normal output impedance as a plate loaded amplifier is 800 ohms, or approximately one-third of the normal load impedance of 2,500 ohms. In the cathode loaded circuit the output impedance is only 154 ohms, which is less than one-sixteenth of the load impedance. Thus it may be expected to obtain results with an output transformer of moderate performance, which would compare with those obtainable with a really good job, and correspondingly improved performance should be obtained with a really good output transformer.

Disadvantages of the Cathode Follower Amplifier.

Like most things, the cathode follower output stage has certain disadvantages, chief of which is undoubtedly the high input voltage required to fully drive the output stage. Since the gain in the case of a 2A3 cathode follower output stage is about 93 per cent., it follows that the driver stage must supply a voltage swing on the grid about 7 per cent. greater than normally occurs at the plate of the output stage. This fact practically necessitates the use of transformer coupling between the driver and output stages.

Using a Direct Coupled Amplifier.

Since the good points of the cathode follower amplifier are derived from the degree of negative feedback employed, the writer reasoned that equally good results could be achieved if the same amount of feedback were employed in some other way. The advantages in favour of feeding back from voice coil to driver stage are considerable, provided there is no tendency to oscillate due to phase

By

263312, S./Ldr. H. W. HOLDWAY,

Radar School,

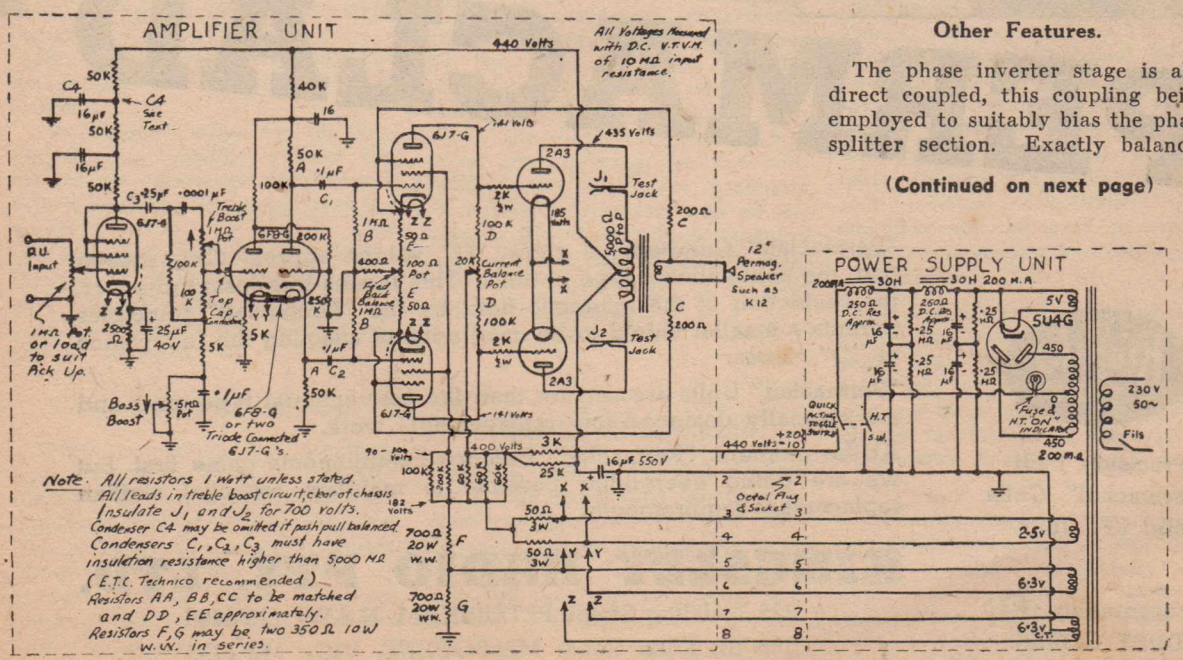
R.A.A.F. Station,

Maryborough,

Queensland.

changes occurring outside the desired range of operating frequencies (as is always possible where considerable negative feedback is employed).

This method was employed in the amplifier described in this article, and the major portion of the feedback loop was made aperiodic at low frequencies by employing direct coupling. At the same time, a further improvement in bass response results from the use of direct coupling.



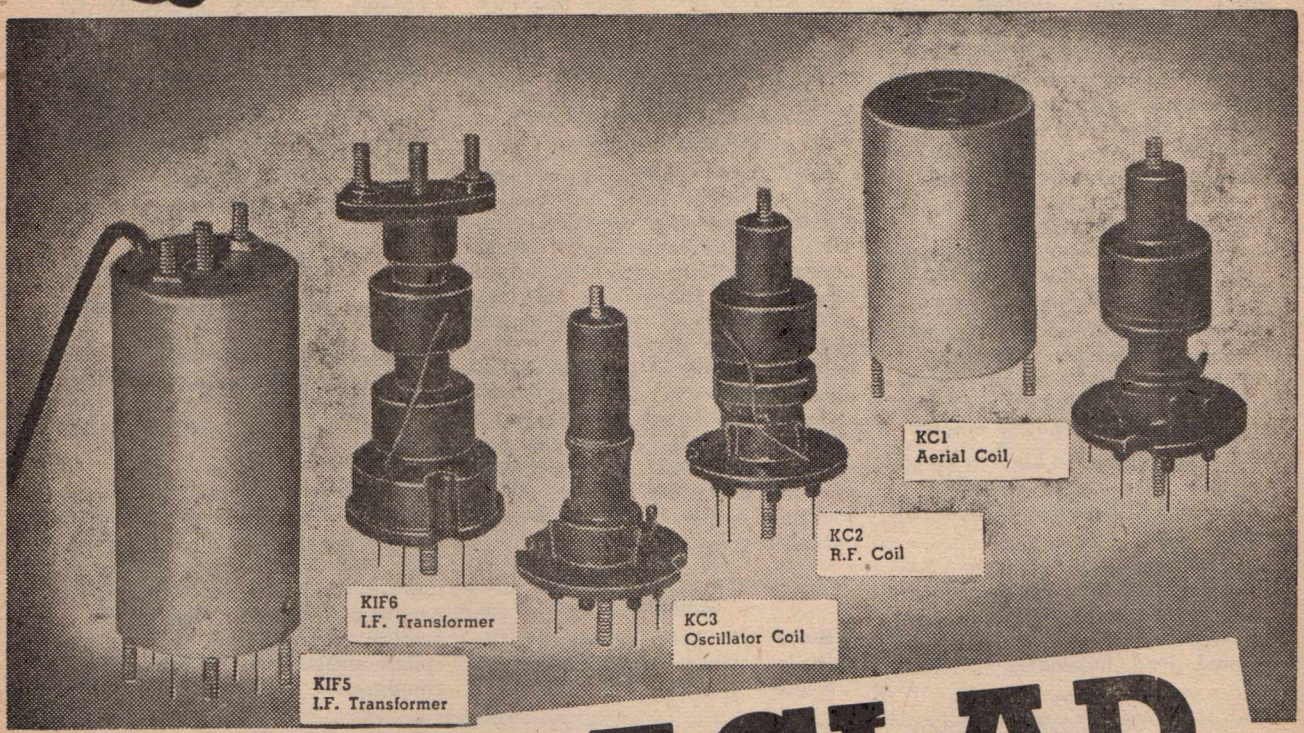
Other Features.

The phase inverter stage is also direct coupled, this coupling being employed to suitably bias the phase splitter section. Exactly balanced

(Continued on next page)

"Q"

VALUES APPROX. 33% GREATER THAN CONVENTIONAL TYPE UNITS



PERMACLAD

"Permaclad" Components show "Q" values approx. 33% greater than the conventional type of units. This means less loss; moreover, the restriction of the magnetic field by the "Permaclad" principles permits a smaller shield to be used without affecting the inductance or "Q" values.

"Permaclad" Units are smaller than the conventional type units and are specially designed for "replacement" work.

At the moment, "Permaclad" Defence commitments come first, but we are doing everything possible to maintain essential civilian replacement requirements.

Kingsley RADIO

Precision built "Permaclad" Coils and I.F. Units.

Incorporating KRN DUST CORES.

KINGSLEY RADIO PTY. LTD.

225 Trafalgar Street, PETERSHAM, N.S.W. LM 4466
380 St. Kilda Road, MELBOURNE, VIC. MX 1159

KR 552

AN ANSWER

(Continued)

push-pull output is obtainable from this stage if the plate and cathode resistors (AA in Figure 1) are matched, and also the following grid resistors (BB).

The overall gain from the input to the phase inverter to the output is such that any normal magnetic or crystal pick-up will fully drive the amplifier.

To provide compensation for deficiencies in pick-up, records and speaker, it was decided by the writer to incorporate, in addition, a tone control stage. The tone control stage shown in Figure 1 contributes no gain to the amplifier when set for level response, but bass or treble accentuation may be achieved by adjustment of the controls. In this respect it differs from many tone controls which work on the principle of bass or treble cut.

Advantages Claimed.

Summarised, the advantages claimed for this amplifier are:—

(1) Output impedance designed to correspond with that of a corresponding cathode loaded output stage, with similar degree of reduction in distortion.

(2) A feedback loop embracing the output transformer, driver and output stages, thus tending to remove distortions occurring within the loop.

(3 An improvement in bass response due to the use of direct coupling.

(4) Adequate drive for the output stage is possible without the use of an interstage transformer (direct coupling being employed instead).

(5) Balanced push-pull ensured by the use of a phase splitter stage with properly matched resistors.

(6) An efficient tone control circuit is employed.

Precautions to be Observed.

When connecting the feedback lines between the voice coil through the 200 ohm resistors to the cathode circuit, correct phasing is required. This is easily found, since correct phasing reduces the gain of the amplifier, whilst with incorrect phasing the amplifier generates audio oscillations.

When this amplifier was first constructed, some difficulty was experienced in getting it to behave as it should. The trouble was finally traced to a slight leakage in the coupling condensers (C1 and C2 in Figure 1). On test, the leakage resistance was found to be of the order of 200 megohms, which was quite sufficient to put about ½-volt positive on one grid and one-tenth volt positive on the other. This unbalanced the amplifier and a relaxation oscillation resulted, with considerable plate current swings in the output stage. The coupling condensers were replaced with condensers having a leakage resistance higher than 5,000 megohms, and the trouble was cleared up. Of various condensers tried, the most satisfactory appeared to be a type with the trade name "Tecnico" (by E.T.C.) with a kind of cream-coloured sealing wax covering.

It was soon discovered that low frequency motorboating could occur when the bass boost control was turned fully up.

This was eliminated by using a two-stage decoupling network in the plate supply of the tone control stage. It was also discovered that the effect could be eliminated with the use of only a single stage of decoupling, if the feedback balance control was adjusted for correct balance. In this condition the tone control stage could be adequately decoupled with a 100 K. resistor and a single 16 microfarad condenser. The two stages of decoupling have been shown in Figure 1, in case it is regarded otherwise as being too critical a circuit.

It is desirable that both the output valves be operated at about the same current drain (although this is not highly critical, since these operate in Class A push-pull). To facilitate rapid checks, a couple of short-circuited 'phone jacks were wired into the output plate circuits, as shown in Figure 1. The balance can be quickly checked by plugging an 0-100 m.a. meter into each position, an adjustment being made by means of the balance potentiometer in the plate circuit of the 617-G drivers.

Results Obtained.

The amplifier was operated in conjunction with an H.M.V. High Fidelity Magnetic Pick-Up with built-in volume control, and the output taken to a Rola K12 Permag speaker, mounted on a 4 ft. square caneite baffle. Results were remarkably good, especially the rendering of bass and transients. The tone control functioned quite smoothly and appeared to provide adequate compensation for normal purposes.

As the power supply was built on a separate chassis, and good filtering was provided, the resulting hum level was very low and good dynamic range obtained. A separate chassis for the power supply is recommended for the best possible results.

No other amplifier was available for comparison, and no attempt is made to claim superiority over other 7 watt amplifiers. However, the writer is sure that anyone who cares to build this amplifier will be well satisfied with its performance.

BATS USING RADAR?

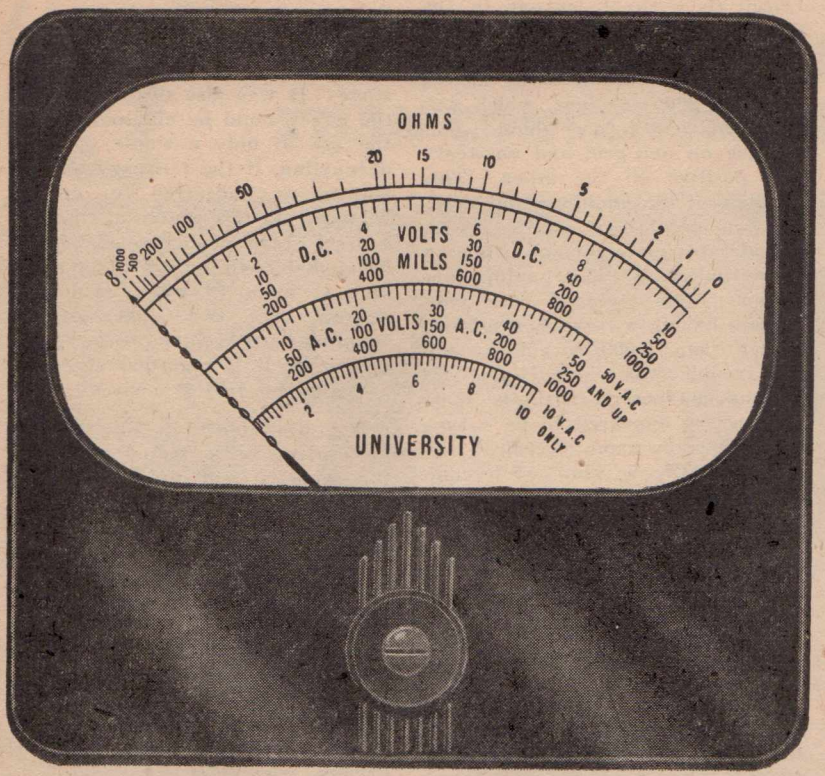
According to a contributor in "Radio-Craft" (U.S.A.), bats use radar! Bats were set free in a room in which a supersonic detector was located. These flying bats produced a constant stream of short cries in which frequencies around 45,000 cycles were most intense. When the ears were plugged the cries continued much as before, but the bat could not avoid obstacles such as a barrier of steel wire. Many of them crashed into the wall. When the mouth of the bat was taped shut, leaving the ears untouched, the cries were gradually diminished in intensity and all the animals floundered about, bumping into whatever lay ahead of them and behaving exactly as if their ears were plugged.

* * *

PATENTS IN AMERICA.

It has been announced in New York that the Philips Company in America will, after July 1st, issue its own patent licences direct to manufacturers. Hitherto, sub-licensing under the 700 Philips U.S. patents has been done by large American companies, mainly by R.C.A.

★CONSISTENT ACCURACY



★

When you Employ

A "UNIVERSITY" Meter

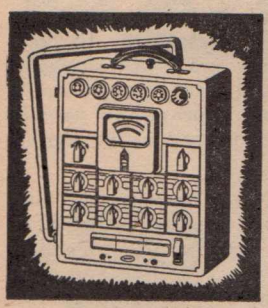
there is a Meter

to suit ALL YOUR

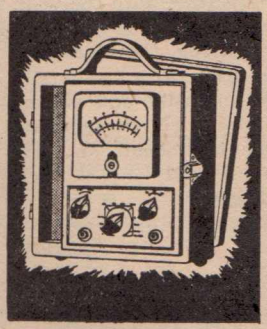
REQUIREMENTS

All types of meters are available including voltmeters, ammeters, microammeters, etc., etc. Most popular are the milliamp meters which can be supplied with multi-scales. A complete range of sizes is available — 2-in., 3-in., 4-in., and 5-in. Send today for leaflets fully describing all types of "University" meters.

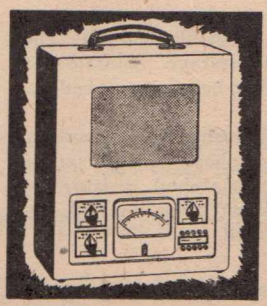
This instrument has been used with striking success by all branches of the fighting forces. Now it is becoming increasingly available to help make your civil radio job easier and more profitable.



The "University" Supertester is a most versatile Valve and Circuit Tester, featuring the extraordinary valve and condenser roller test chart — entirely new to Australia. Does many jobs well.



The "University" M.V.A. is an all purpose Multimeter giving complete AC-DC measurements, together with output meter ranges. Suitable for either bench use or as a portable.



The "University" Universal Speaker and Output Meter makes set testing quick and easy. No power connections required, you just plug the instrument into any type speaker socket.

DISTRIBUTORS:

VICTORIA: A. J. Veall Pty. Ltd.; Replacement Parts Pty. Ltd.; Hartleys Ltd.
QUEENSLAND: A. E. Harrold; Homecrafts Pty. Ltd.
SOUTH AUSTRALIA: Newton & McLaren Pty. Ltd.; Radio Wholesalers Ltd.; Gerard & Goodman Ltd.
WESTERN AUSTRALIA: Atkins (W.A.) Ltd.
TASMANIA: W. & G. Genders Pty. Ltd.
N.S.W.: All leading Radio and Electrical Distributors.
VICTORIAN AGENT: J. H. Magrath Pty. Ltd.

University

RADIO EQUIPMENT PTY. LTD.

Head Office: 206 Broadway, SYDNEY, N.S.W.

Telephones: M6391-2. Telegrams: "RAQUIP," Sydney.

RE.947.

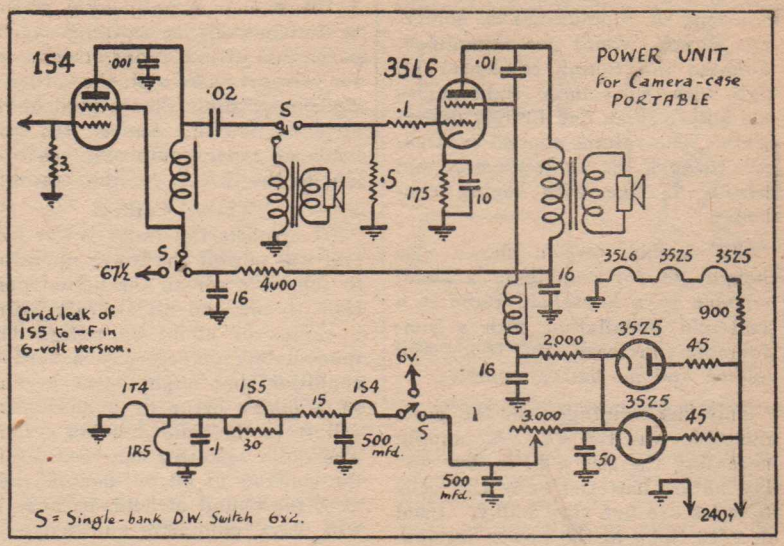
A CAMERA CASE PORTABLE

YOU may remember me from my entry in your battery circuit contest back in 1941.

I have been in the Army some years, but usually manage to secure a copy of the current issue of "Radio World."

I am now signal supply officer in an Allied organisation, and have a very fine test bench set up, and in my few spare moments have

By
NX90434
W.O.II. BROWN, R.
A.I.B. Staging Camp
Indooroopilly
Brisbane



knocked up a few rough midgets with tubes and accessories not yet available on the open market. Actually you may know just as much about them as I do, but I have not noticed any articles published.

The possibilities of camera-size portable radios has always intrigued me, and no doubt there shall be a fair demand for this type of article (radio, I mean) after the war.

The one I am using at the present measures about 7 ins. x 6 ins. x 4½ ins. overall, with batteries of quite reasonable capacity, and when it is remembered that timber of cabinet (which I covered in leatherette quite simply and cheaply) adds 1 inch all round to actual size of set, is not too bad. Speaker is 4-inch 9-oz. permag, and H.T. 45 to 67½ volts.

Output rated is only about 65 milliwatts, but is quite pleasant in a room or car, and when hooked to a 8/42 permag is really amazing. Weight is about 3 lbs.

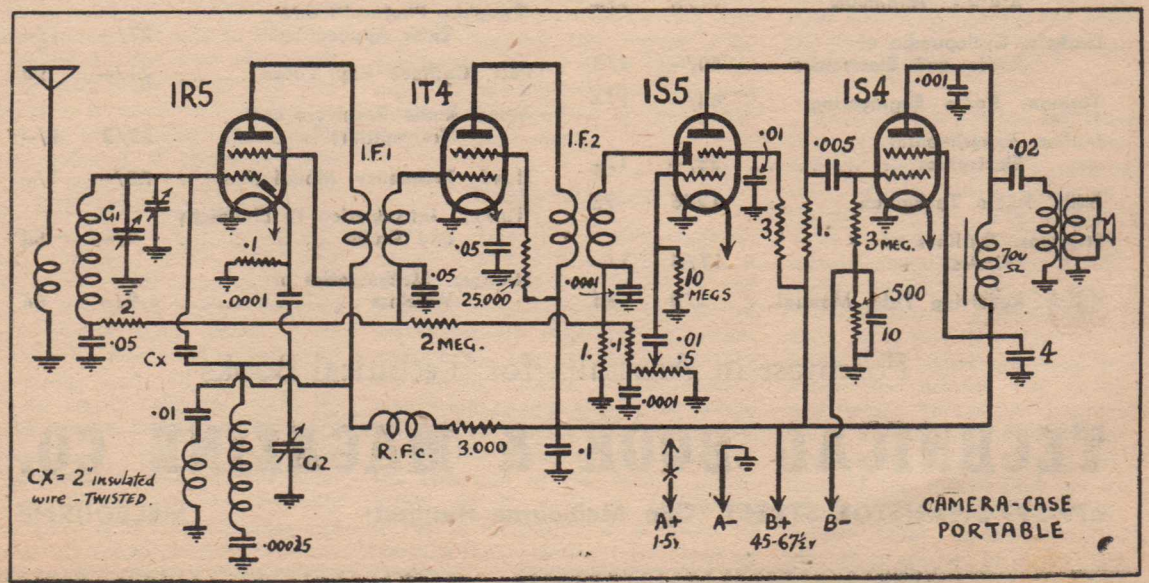
The oscillator valve 1R5 is a slight departure from older types, but coils with ticklers designed for 1A7 valves work O.K.

I used the loading choke on audio output reaction because of the very small input transformers available from speaker—microphone assemblies in walkie-talkie type transceivers in field case, but midget speaker transformer is even better.

Results are really amazing at outputs in the region of 100 milliwatts. Secondary is designed for onice coils of about 3 ohms.

I used a base 6 ins. x 1¾ ins. x 1½ ins. deep, and a back plate 6 ins.

(Continued on next page)



PORTABLE

(Continued)

x 5 ins., all of plated tin, so that mounting of components by soldering direct would be simplified. Mounted the tuning condenser up high, with two coils at right angles and one IF lying flat directly underneath. The volume control (switch-pot through the chassis below and directly in line with tuning condenser.

The second version shown was thought of for combining a small portable to a household radio is a semi-field installation with a considerable increase in tone and volume and no battery worries.

Only disadvantagge on the portable side was the 6V. "A" supply increasing the size a little, but 6V. day lantern batteries or 4-"U2" cells in series are not very bulky. Used an 8/42 Spka in the power version.

On power version pentode audio stage is no doubt bad policy in design, but output is so small it works reasonably well.

RADAR ADDS SAFETY TO AIRPORTS

The C.A.A. experimental station at Indianapolis is working on the perfection of two radar devices, one for airport use and the other a collision-warning device used in the airplane itself. Almost ten carloads of radar equipment has been lent to the C.A.A. for this research.

Tower Control

At airports the radar tower control will permit the tower operators to see on a screen the actual position of any and all aircraft within a radius of about 25 miles. This immediately detects any hazardous condition that might occur because of a pilot's error or a mechanical failure in the radio landing system. The radar operator can then adjust the controls of all out-bound traffic at a fog-bound airfield, because he will have complete knowledge of the exact position of all planes. The only way in which this can be done to-day is for a ground operator to determine the position of planes near his field by position reports radioed in by pilots. Only one such report can be handled at a time, and the distance estimates are not always accurate.

The collision-warning device is mounted right on the instrument panel of the plane. Here the radar screen will be of immense value. It will report to the pilot his own position in the air relative to other planes, as well as obstacles in his path such as radio towers, beacons, water towers, and other objects that may be hidden from actual eyesight.

Keeping Distance

With radar instruments, pilots will find it easy to maintain proper distances from other aircraft while climbing to their assigned altitudes, or descending to an airport for landing. The complete landing approach will be handled by the pilot while the control tower acts as a monitoring agent through its radar screen. This will speed up landing and take-offs in thick weather.

GETTING THE BEST FROM A PICK-UP

I HAVE read Mr. Straede's excellent articles about pick-ups, and I have read many others on the same subject. They all discuss in more or less thorough fashion the length, weight, support and resonances of the armature reed, damping, depoling, bass boosting, and so on. But there are two points—vital points—which seem to

By
P. STEVENS
3 "Westdale"
Fletchers Avenue
Bondi.

have always been the Cinderella in these discussions:—

(1) Seen from the front, the needle at rest must always form a right angle with the record surface (Figure 1A.

(2) The needle must not be allowed to vibrate in any other direction but in a right angle to the direction of the sound groove..

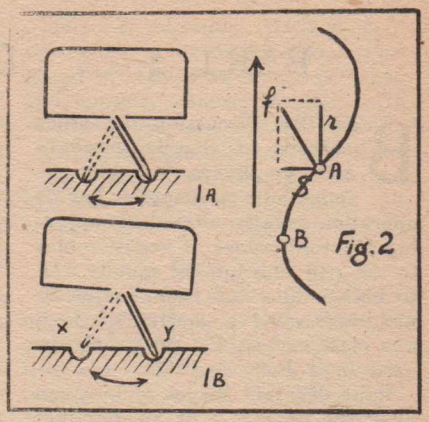
One glance at Fig. 1B will show you the effect if Rule 1 has been neglected. While in 1A the needle is at any time firmly wedged between the flanks of the groove, 1B tells us quite a different story: here the needle angle is less than 90 degrees. While the needle is being forced to point y by the wavy form of the groove, it tends to dig into the record or else lifts the whole pick-up head; while on the way over to point X it rises more and more out of the groove till it reaches its highest point at X. Very low frequencies, however, will allow the whole pick-up to fall down on to the record instead, only to be propelled upwards again when the needle moves back to point y. The result of the needle leaving the firm bottom of the sound groove every half cycle or else playing ball with the pick-up head (on low frequencies) is terrific record wear, increased chatter and harsh, distorted reproduction. Just try and loosen the mounting screws of your pick-up and tilt it a bit to one side whilst playing a loud record, and you can thoroughly convince yourself of the effect!

I have found that at least 20 per cent. of the record players I have examined were suffering from this particular complaint in varying degrees. Often the turntable is not level by uneven tightening of the rubber-cushioned motor mounting screws; or there is a bit of play in the back hinge of a bent pick-up arm and the weight of its overhanging portion behind the head makes the needle lean outwards. If you happen to have one of those notorious swivel-headed P.U.'s (where you turn the head 180 degrees round the axis of the arm to insert the needle) and the locking mechanism of the head is worn, you can put the needle down at almost any desirable or undesirable angle!

The second point is more interesting to the designer of pick-ups than to the attending service man. Practically every kind of pivoting commonly used by makers allows the armature and needle to vibrate only in a rectangular direction to the sound groove. Whether it is the knife edge, torsion rod, or compressed rubber sleeve pivoting, they all serve the purpose. But I recently read an article on a home-made needle armature pick-up which incorporates a thick-walled rubber tube inside the coil to hold the needle. In this case the vibrating needle would not only move from left to right, but would probably make something like the movement of a stirring teaspoon in a cup. Have a look at Fig. 2, and you will understand the reason why. Inside the rubber tube the needle can just as easily vibrate back and forth in the direction of the groove than left and right.

Needle Vibration

If we draw the vestor diagram, we see that the force f in point A can be substituted by 2 vectors, one (r) in the direction of the record movement, the other (s) in a right angle to it. s is the one that makes the needle vibrate in the desired way, while r tends to pull the needle forward in varying degrees according to the angle of the groove to the direction of the record movement. In A, r is at maximum, in B it is zero. It is easy to imagine the distortion introduced by this backward and forward movement if it is not eliminated by proper pivoting of the armature. But this is not all. As the needle rests at an angle of about 60 degrees on the record surface, every forward movement is accompanied by an upward movement, which tends to lift the needle out of the groove. Loud notes will therefore be marred by a rattling and crackling caused by the needle jumping out of the groove and plunging in again. Because of the low resonance point of the rubber block, the needle will, of course, not be able to follow every recorded sound wave with this undesired longitudinal vibration, but it will jump back and forth as the drag on the tip changes with frequency and amplitude, especially when soft music is suddenly followed by a loud and deep passage or bang on the drum, or similar noisy interruptions of low frequency.



There was a hidden reference to these facts in the article on the construction of such a pick-up in the January, 1944, issue of the "Radio World." The author told us at the end of the article that bad records sounded "really awful." It would be interesting to see these "bad records." I think that their main fault was that they contained a few of the abovementioned hurdles which his pick-up was unable to negotiate. Things are improved a bit by a certain "bias tension" on the needle caused by the friction drag of the record and the weight of the P.U., which "hardens" the rubber block against longitudinal vibrations enough to give a pleasant reproduction on easy passages.

THE THEORY BEHIND PROPER

PART 2 . . . DISTORTION

BEFORE discussing the other methods of coupling used in A.F. amplifiers, we will examine how an amplifier has its operation greatly altered by applying different values of negative bias to the grid; this applies equally well to both audio- and radio-frequency amplifiers. As a matter of fact, one class — class C — may only be used in a R.F. amplifier.

Four different values of bias can alter the operation of an amplifier to such an extent they have been defined and titled as: Class A, Class B, and Class C.

Class A.

A class A amplifier is defined as an amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific valve flows at all times. Fig. 4 shows the grid-voltage, plate-current characteristic curve of a valve, and it can be seen that between the points b and c the curve is substantially straight, and if the grid is biased to the centre of this straight portion (a) and the alternating signal applied to the grid is of such a magnitude that it will not cause the operating plate current to extend beyond the straight portion of the curve, nearly a perfect amplifier version of the alternating grid voltage will appear in the plate circuit. If the alternating grid voltage were too great, it would extend the plate current wave into the curved portion of the operating characteristic with a resulting flattening of the peaks of the plate current wave, which is introduction of distortion. Unfortunately, it is not possible to produce a valve that has a perfectly straight characteristic; thus it is impossible for the plate current fluctuations to be an exact enlargement of the grid voltage alternations, although with a properly designed class A amplifier it is very closely approached (Fig 5a). The efficiency of this type of amplifier is low, and cannot exceed 50 per cent; however, their ratio of power amplification is high.

It will be noticed that at no time is the grid allowed to become positive with respect to the cathode, as this would cause a small grid current to flow, which introduces complications such as causing considerable alteration of the wave form of the signal input, thus causing distortion.

Cost Considerations

Amplifiers operating in class A are used in A.F., R.F. and I.F. stages of radio receivers; the pre-amplifiers in modulators of transmitters, and in public address amplifiers. As the average value of the plate current remains constant, a power supply with relatively poor regulation may be tolerated, resulting in a saving in cost.

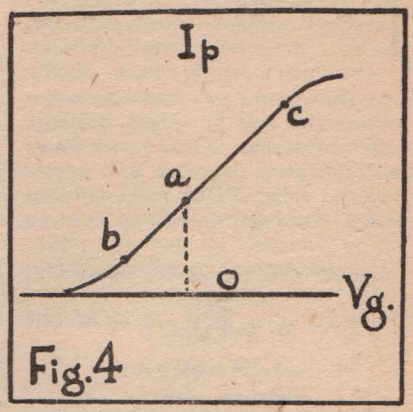


Fig.4

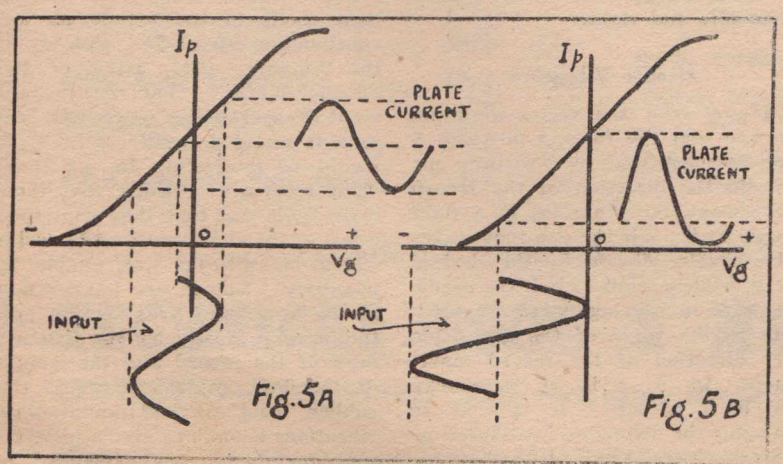
Class AB.

A class AB amplifier is one in which the grid bias and alternating grid voltages are such that plate current in a specific valve flows for appreciably more than half, but less than the entire electrical cycle when delivering maximum output. In practice the grid is biased about half-way between adjustment for class A and cut-off point, the exact position being determined by whether it is desired for there to be a grid current or not. If it is so biased that there is a grid current, it is known as class AB2; if not, class AB1—1 denotes no grid current, 2 denotes grid current.

With this class of amplification, push-pull is invariably used, each valve working on alternate parts of the A.C. cycle. The distortion developed by each valve will be cancelled if fed into a symmetrical output load, and the two plate current waves added will form practically a distortionless resultant wave-form.

If class AB2 is used, the valves of a necessity are fed from an input transformer, usually with a step-down ratio, having a low impedance secondary winding so no distortion will result when the grid current is flowing during the amplification of strong signals, and for the same reason the valve driving the AB2 stage must be capable of supplying small amounts of power.

Class AB amplifiers are more or less a compromise between class A and class B, and combine a portion of the advantages of both—its distortion is not as low as with class A,



AMPLIFIER DESIGN - - By CHARLES ASTON

yet its efficiency is higher; its efficiency is not as high as class B, but its distortion is lower.

Class B.

A class B amplifier is defined as an amplifier in which the grid bias is nearly equal to the cut-off value, so that the plate current is almost zero when no exciting grid voltage is applied and the plate current in a certain valve flows for approximately one-half of each cycle when an alternating grid voltage is applied.

With class B for audio amplification two valves are used in push-pull, and when combined in a balanced load connected in the plate circuits form an amplified version of the exciting grid signal. This type of push-pull amplifier will be considered in more detail later.

A class B amplifier may be used in R.F. service as a single valve. The reason for this will now be considered. Fig. 6 shows a tank circuit connected in the plate circuit of a valve operated as a class B amplifier. When the input signal drives the grid positive the valve will become conductive and the condenser will be charged until the maximum peak of the half cycle is reached. After this, the current flowing through the valve will diminish until it becomes non-conductive again. As soon as the current begins to diminish the condenser will discharge through the inductance in the direction of the heavy arrow, and due to the inductance the condenser will then become charged in the opposite direction, but by this time the grid is on the negative half of the cycle and the valve will be non-conductive. The condenser will now discharge through the inductance in the direction of the dotted arrow, providing the missing half of the cycle. This action is usually referred to as the "flywheel effect" of the tank circuit. It is obvious this effect can only take place if the output of the valve is feeding a resonant circuit, so it would not be possible to utilise it in audio frequency amplifiers for this reason.

Distortion Sometimes Wanted

Sometimes advantage is taken of this amplifier's ability to introduce distortion, as distortion is the introduction of frequencies in the output that were not present in the original input. If this input is a single frequency the output of the amplifier will consist of this frequency together with a range of harmonics the amplitudes of which are dependent on the characteristics of the valve. If two frequencies are fed into the amplifier input not only will their respective ranges of harmonics by in the output but also frequencies equal to their sum and difference taken in pairs. The plate load can be made to respond to any one of the frequencies to the exclusion of the others. Advantage is taken of this property in frequency-multiplying stages of transmitters.

Transmitters

Amplifiers operated in class B are used in the R.F. service when it is desired to provide a linear amplifier for the amplification of a modulated carrier.

Class B amplifiers are characterised by good efficiency, high power output with low distortion and a moderately high ratio of power amplification. It is particularly desirable class for the output stage of a battery-operated receiver for the reasons given and, as there is practically no flow of plate current when there is no grid exciting voltage which means considerable saving in battery, a very worthwhile feature.

As the plate current is continuously varying, in sympathy with the grid voltage, it is necessary that the voltage supply has particularly good regulation; if batteries, the problem is overcome. With an A.C. power pack the usual precautions for good regulation should be taken and mercury vapour rectifiers with their low internal resistance utilised.

Class B, similarly to class AB2, causes a grid current to flow and the same precautions should be taken to prevent distortion.

Class C

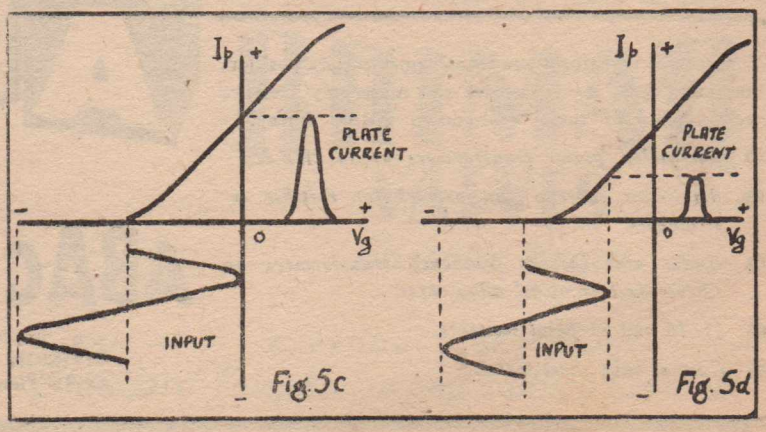
A class C operated amplifier may be regarded as an extreme form of class B but its grid is biased to at least one and a half times the value required to cut-off the plate current. It is defined as an amplifier in which the grid bias is appreciably beyond cut-off so that the plate current is zero when no alternating grid voltage is applied and the plate current that flows in a certain valve is restricted to appreciably less than one half of each cycle when an alternating grid voltage is applied.

Fig. 5d illustrates class C operation and the distortion introduced is too severe for its use as an audio frequency amplifier.

All the remarks made regarding class B as an R.F. amplifier apply equally to class C except that it may not be used as a linear amplifier.

The distortion caused by a class C amplifier is eliminated by the tank circuit in the output of the valve which is tuned sharply to the required output frequency and the other frequencies will not be developed across this tank circuit to any extent. The fly-wheel effect is previously described causes the circuit to oscillate when only plate

(Continued on next page)



(Continued)

current pulses of short duration flow in this type of amplifier.

Efficiencies as high as 75% are possible with this class and it has high power output but a relatively low ratio of power amplification.

When plate modulation is used in a transmitter, class C is invariably used as the modulated amplifiers not only because of their high efficiency but also as they reflect a pure resistive load into the modulator.

A class C operated valve amplifier may be used singly or as a pair in push-pull.

To summarise, class A is used when high efficiency may be sacrificed for faithful reproduction: class AB is used for better efficiency and higher output with the introduction of a small amount of distortion: class B is used as an audio frequency amplifier when maximum efficiency and output are required and a certain amount of distortion is tolerable; as an R.F. amplifier for linear amplification: class C is used for maximum efficiency in radio frequency amplification and where large outputs are necessary.

Choke-Capacity Coupling

The one disadvantage of resistance coupling was the high voltage that must be used to overcome the plate load resistance. This voltage drop may be avoided by replacing the resistance with a high inductance choke (up to 100 henries) which will have a low D.C. resistance but possessing considerable reactance to audio frequencies. The inductance of the choke is necessarily high to ensure good low-frequency response.

A typical choke-capacity coupled A.F. amplifier is shown in Fig. 7. The choke L has an iron core which should be constructed of high-grade laminated transformer steel.

The inductive reactance of a choke varies directly with the frequency that the output voltage will increase with the frequency. This effect may be reduced by increasing the resistance of the choke with regards to its reactance which will result in a reduction in the amplification of the stage. It should now be obvious that the higher the degree of amplification aimed at so the uniformity over the range of frequencies it is desired to amplify is reduced.

At Low A.F.

Unless the inductance of the choke is extremely high its reactance to low audio frequencies will be small and it will have a falling characteristic. If the resistance of the choke is increased in an attempt to overcome the effect, it results in a D.C. voltage drop and, as the choke is being used to avoid this, it would be unsatisfactory. The only satisfactory way to prevent the falling off of the low frequencies is to increase the inductance of the choke, unless great care is taken with its design other undesirable factors may develop, such as relatively high distributed capacity and core saturation caused by the flow of D.C. plate current.

The same consideration applys to the coupling condenser as in resistance coupling; it performs the same operation in both cases.

At Intermediate A.F.

At the middle audio frequency range the choke is equivalent to a

resistance of several megohms, which is in shunt with the grid-resistance, so the amplification obtained will nearly equal the amplification factor of the valve and will be considerably greater than that obtained with a pure resistive load, but, of course, cannot exceed the amplification factor of the valve.

At High A.F.

The shunting effect of the distributed capacities has the same results as in the resistance coupled amplifier and in addition is the distributed capacity of the choke and the manner in which high-u valves reflect the capacity increases the effect of these capacities, resulting in a shunting of the high audio frequencies; this is partially offset by the rising characteristics of the choke with the frequency.

General

The feature of this type of amplification is its ability to approach the amplification factor of the valve without the use of excessively high H.T. voltages but a suitable choke would cost many times the resistance it replaces and is not capable of the high and low frequency response of the latter. As a result choke coupling is not commonly used in modern practice, although its principle is employed in certain parallel feed systems.

Transformer Coupling

A circuit arrangement similar to that shown in Fig. 8 is used for transformer interstage coupling and has an advantage that is not possessed by either resistance or choke-coupled amplifiers, that is, its ability to produce a stage amplification that is several times higher than the amplification factor of the valve. Another feature of this type when used so that V2 draws very little or no grid current is that it offers an extremely high impedence by its primary winding to A.F. currents; this is due to the secondary winding being connected across an extremely high impedence (grid-cathode), which is reflected by the transformer action into the plate circuit. It is thus possible to obtain an amplification across the primary of the transformer closely approaching uEg.

The primary and secondary windings of the transformer are wound on a common iron core composed of a metal with a high permeability, which allows a much more compact unit than if ordinary transformer metals were used. It is most usual for the interstage transformer to have a step-up ratio which is the ratio of the number of secondary to primary turns, although where there is a flow of grid current a step-down type is used for special reasons, as shall be seen later.

It was shown that the A.F. voltage across the primary is nearly equal to uEg. The voltage developed across the secondary is therefore equal to N.uEg, where N is the transformation ratio; thus the gain of the stage is equal to uN. This in practice only holds true for a very limited range of the audio frequencies to be amplified.

At first glance it would appear that by using large step-up ratios very large voltage gains could be obtained, but various factors combine to prevent this, as shall be seen.

At Low A.F.

The primary winding of the transformer performs in a similar manner to the choke in a choke-coupled amplifier, but the reflected impedence assists in developing the low audio frequencies across it, although there is still a falling in the characteristic at these frequencies. If in an effort to increase the inductance of the primary winding by

(Continued on next page)

AMPLIFIERS

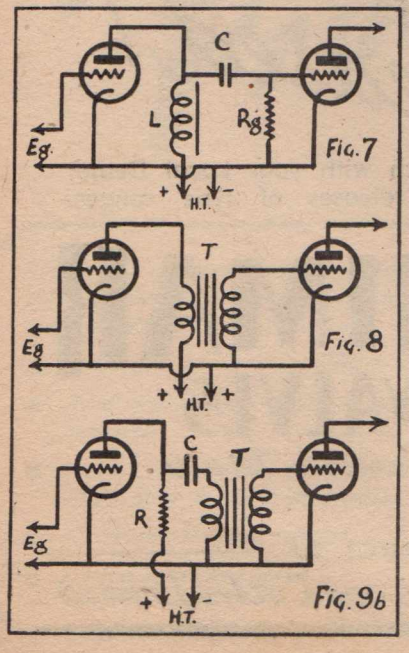
(Continued)

increasing its number of turns, the step-up ratio will suffer and the number of the turns of the secondary winding is definitely limited, so it cannot be increased to make up the reduction in turns ratio. It is, as a result, not usual to employ valves in this service with a plate resistance higher than about 20,000 ohms, which are used feeding transformer having a ratio lying between 1.5 and 4, which will have sufficiently high reactance in its primary that audio frequencies as low as 100 cycles per second will equal uN.

It is sometimes desired to operate the transformer from a valve having a comparatively high plate resistance. This is possible by having a transformer that has a high primary inductance and a low turns ratio. Such a transformer would not be liable to core saturation when used as a voltage amplifier owing to the low plate current requirements of such a valve. Core saturation is usually only encountered in a transformer—usually the speaker transformer—connected in the plate circuit of a single output valve as the condition is caused by too high a value of amp-turns.

At Intermediate A.F.

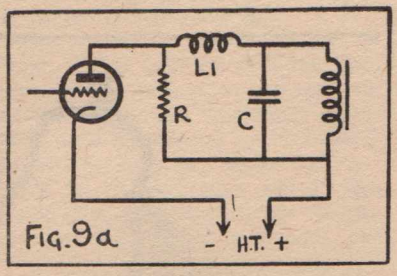
At the middle frequencies the amplification obtained is closely equal to uN. At this band of frequencies



resonance occurs between the primary L, and the distributed capacities C, as shown in the equivalent circuit Fig. 9a, acting as a rejector circuit offering maximum impedence to these frequencies. This is shunted by the resistance R, which represents the "iron losses" of the core (Eddy currents), which are small, so the value of R is high compared to the plate resistance of the valve. The ggreater portion of the output A.F. voltage will be developed across L.

At High A.F.

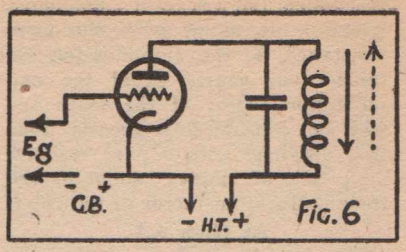
At the higher audio frequencies, say, above 5,000 cycles per second,



the distributed capacity including that of the transformer will have an increasing shunting effect on these frequencies. This is overcome to some extent by the series resonant circuit formed by the leakage inductance L1, and the stray capacities C, which at its resonant frequency will produce a hump in the upper frequency range. If this hump is too pronounced it will cause considerable frequency distortion, as amplification at the resonant frequency will considerably exceed that of other frequencies. If an excessive hump exists it may be overcome by shunting the secondary winding with a resistance which will flatten the amplification characteristic as well as stabilising the stage. If the shunt resistance is not less than $0.2N^2$ megohms (N is the turns ratio), there will be no serious reduction in amplification.

General

This type of coupling has the feature of being able to produce a stage of amplification that is several times the amplification factor of the valve with a substantially flat frequency characteristic especially in the more expensive types. This applies to pure class A amplifiers where there is no flow of grid current, as the amp turns would be



sufficient to cause core saturation, which introduces high harmonic distortion. The flow of grid current is equivalent to reducing the resistance connected across the secondary, thus reducing the reflected resistance in the primary. If the secondary is connected to a valve operating as class AB or B the transformer has a step down ratio with a low impedence secondary winding; cores of ample proportions are also necessary to prevent core saturation.

The use of special core materials makes a D.C. flowing through the windings undesirable, as it will result in a reduction of the effective inductance of the windings, with its undesirable effects. The manner in which this is overcome is shown in Fig. 9b, which is known as a "parallel fed" circuit. The H.T. is applied to the circuit through a resistance R and is prevented from flowing through the transformer by the coupling condenser C, which allows the audio frequencies to be applied to the primary winding of the transformer. An equivalent circuit is shown in Fig. and R in series with the H.T. shunts the A.F. circuit of C and L; it is therefore important that the resistance be high compared to the impedence of L C. There are several other ways of parallel feeding the circuit, each with its own particular advantages and disadvantages.

Amplifier Distortion

Mention has been made of distortion being introduced by the amplifying valve of the components of the amplifying stage and, before proceeding further, an examination will be made of this distortion. For simplification, distortion has been divided into three main groups, each of which is common in practical amplifiers and may occur singly or as a combination.

Amplitude Distortion

This type of distortion causes the output of a valve to have a non-linear relation to its input. This dis-

tortion is due to the grid swing extending beyond the straight portion of the mutual characteristic curve or operating on its curved portion. In the output of such an operated valve will appear not only the original frequency but also a number of new ones which need not be harmonicly related to the original. Such distortion, if present to a sufficient degree, is distressing to the human ear.

If the valve is not operating on the straight portion of the curve, the bias is incorrect or there is an undesired bias being developed in the circuit. When the valve is being overloaded by the grid input the grid swings may pass into the curved portion of the characteristic with resultant generation of amplitude distortion.

Phase Distortion

In amplifiers phase distortion is the least troublesome, as it is nearly always of small proportions and is one the human ear does not perceive unless present to a relatively high degree. It occurs in amplifiers where reactances, either capacity or inductive, occur, which results in the phase relationship of the components of a wave to be altered.

Frequency Distortion

Frequency distortion, like phase distortion, is due to reactances being present in the circuit as they vary in their treatment of different frequencies, which increases with the band of frequencies to be amplified. This means that signals of the same amplitude of different frequencies will not be amplified equally. This type of distortion is of importance in radio- as well as audio-frequency amplifiers, as it may introduce distortion of the modulated wave form of the carrier.

A.F. Power Amplifier

The main purpose of a power amplifier is to provide large variations in the plate circuit of the valve for such purpose as driving a loudspeaker. It will be shown that the conditions for providing optimum voltage amplification are not those that will necessarily produce most desirable output.

To obtain a large amount of A.F. power in the load it is obvious the valve must be capable of handling large plate voltage swings or of producing large swings of plate current. The former method is used with tetrodes and pentodes owing to their high plate resistance, while triodes use the latter method with a conveniently high plate voltage and large swings in the plate current because of their comparatively low plate resistance. These large current requirements need a valve that is capable of conducting it, which means that a cathode capable of emitting sufficiently large quantities of electrons is required. The low plate resistance of the triode will permit a direct current to pass through the valve that is sufficiently large to handle big swings of signal currents before the plate current is cut off; a large signal input to the valve is required, as the amplification factor is low; to prevent the grid becoming positive on the positive peaks of the swings of the grid signal current, a sufficiently high negative bias is necessary.

Part 3 of this series should appear in next month's issue.)

COMPONENTS FOR AMATEURS

THE Radio Society of Great Britain has prepared a list of the radio components, valves and associated equipment which in its view will find a ready sale among constructors and experimenters, and particularly amateur transmitters, immediately experimental licences are reissued. No announcement has yet been made as to when amateur transmitting will recommence.

The publication of this list will be of great use to manufacturers. It is noted that the list includes some items which were introduced prior to the war, but which were not available at prices which compared favourably with those of foreign competitors.

The list includes A.V. transformers, such as Class B, microphone transformers, modulation and humbucking transformers, and sets of parts, together with interchangeable windings in a wide variety of gauges and turns. It is thought also that there will be a demand for the following items:—

Disc batteries for wiring into apparatus; butterfly circuits for V.H.F. work; small cathode-ray tubes for use in oscillographs and having high deflection sensitivity; swinging chokes; smoothing chokes of higher inductance; and chokes for cathode modulation circuits; fixed vacuum capacitators for high voltage and suitable for connection in banks; mica-blocking condensers; a full range of variable condensers; connectors; components for rotary beams; Faraday screens; crackle-finish paint; silver-plated copper tube; plastic sheet, rod and tube; coaxial cable; quartz crystals in enclosed holders; moving-coil head sets; I.F. amplifiers; a range of plug-in coils in 25 and 200 watt sizes with variable links; unbreakable low-loss transposition blocks and spacers; prefabricated masts; sectional steel masts; a full range of meters, microphones and morse keys; potentiometers, power supply systems and power transformers; all-British amateur bands communications type receivers and kits of parts; thyratrons; test apparatus; amateur television equipment; stabilisers and neon tubes; speakers, and a wide range of valves.

Constructors' Requirements.

This list is comprehensive and really catalogues most of the lines which were available before the war; thus it is a request for manufacturers not to desert the constructor, experimenter, and the transmitter, in order to cater for the completely assembled receiver and transmitter.

The constructor and transmitter market is a large one, and it can only exist if supplies of components are made available. It may seem to some manufacturers more attractive now that the war in Europe is over to make complete receivers rather than the parts, because of the great demand now existing owing to the lack of production during the last six years. That will, however, be a temporary boom, and if some of the component manufacturers desert the component market, other firms will step in and take their place.

—"Practical Wireless" (England).

PROBE ADAPTER FOR THE V.T.V.M.

By
263312
S/Ldr. H. W. HOLDAWAY
Radar School
R.A.A.F. Station
Maryborough, Q.

IN the linear V.T.V.M. described in the April issue of "The Australasian Radio World" the A.C. section is designed to cover audio frequencies only. It has the advantage that leads of reasonable length may be used, depending upon the frequency being used. The upper frequency limit is due to the shunting effects of stray lead and inter-electrode capacities and loading due to lead inductance. Capacity is the most important effect within this range.

To extend the operating range to higher frequencies, the test leads must be made of negligible length. This necessitates the use of probe type construction, so that the measuring valve may be placed right at the circuit being measured. For frequencies around 30 megacycles, loading due to transit time effects becomes important and it is essential to use one of the small acorn type valves. However, where it is desired only to cover to the limit of, say, the broadcast frequency, it is possible to employ more conventional valve types.

Reflex or Infinite Impedence Rectifier Circuit Employed

Where a high resistance D.C. vacuum tube voltmeter is available to measure the output from the rectifier, there are certain advantages to be derived from the use of a reflex rectifier. These advantages are as follows:

(a) Low loading effect on the circuit under test.
(b) A high degree of linearity over practically the whole range.
(c) A close approach to true peak reading (within limits).
(d) Bias control gives a useful zero adjustment.

To achieve these features it is necessary to use a cathode load resistor considerably greater than in normal detector practice. A value around 20 megohms is suitable, but more than this may be undesirable since the cathode resistor becomes the grid leak for the following D.C. vacuum tube voltmeter.

Valve Types

The most suitable valve type to employ is the 954 acorn pentode, wired as a triode for this application. The construction of a 954 lends itself particularly to probe type construction of the V.T.V.M. adaptor. If a 954 can be obtained, there should be no difficulty in covering a frequency range from 50 c/s to 30 Mc/s with substantially uniform calibration and without noticeable loading of the circuit under test.

However, since most readers will not be able to obtain one of the acorn tubes under present restrictions, the writer has also described alternative circuits in which more conventional tube types may be employed. A triode connected 6J7G or a 6J5G may be used in place of the triode connected 954, or, alternatively a 6B6G may be employed with some slight circuit changes. The latter type is the most suitable of the conventional types to use in this type of circuit, and gives higher sensitivity and, if anything, a closer approach to linearity. Satisfactory operation should be obtained up to 1.5 megacycles.

Circuit Details

The basic circuit is shown in Fig. 1 and the two alternative versions of the circuit in Figs. 2 and 3. The only changes are due to variations in the cut-off characteristics of the different valves.

It will be seen that the rectified output appearing at the cathode of the "infinite" impedence rectifier is measured directly with the linear D.C. vacuum tube voltmeter (from which the normal grid leak has been removed by setting the selector to INF.). The A.C. component of the rectified output is completely removed by the cathode condensers, C_1, C_2, which form an integral part of the circuit. C_1 is connected by short leads to the zero R.F. potential probe B, thus ensuring efficient operation at very high frequencies, while C_2 is a larger condenser to provide satisfactory filtering at 50 c/s. C_1 is of .0005 mica and C_2 a .25 mF paper condenser.

To prevent possible fluctuations of the triode plate at R.F. potential, the plate is connected by a short lead and a .0005 mF. mica condenser, C_3, to the zero R.F. potential probe B. Fluctuations at lower frequencies are automatically taken care of by the filter condenser in the 250-volt supply (in the linear V.T.V.M.).

The cathode resistor is built up of two resistors in parallel, one portion being connected to a negative voltage of – 1/10 volt approxi-

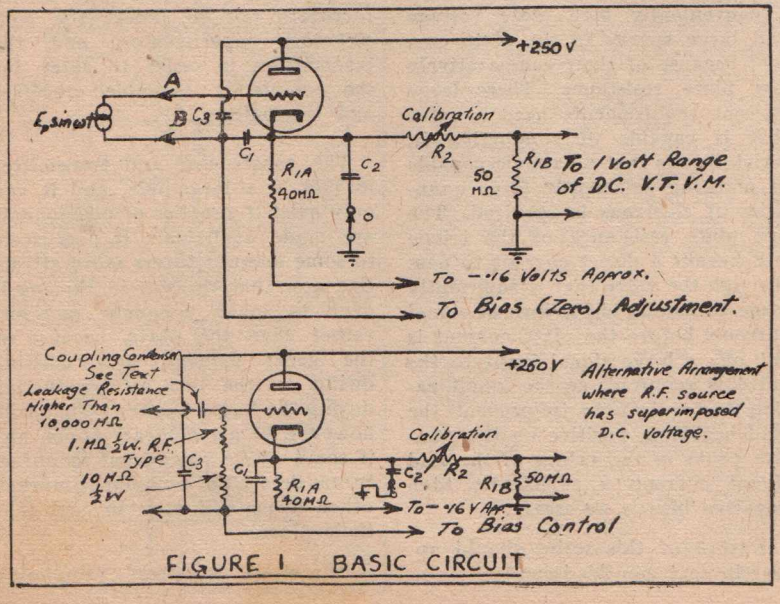


FIGURE 1 BASIC CIRCUIT

mately, thus ensuring that the valve is not completely cut off under normal zero input operating conditions, with the cathode at zero voltage, and no deflection on the D.C. V.T.V.M. This ensures a zero adjustment above and below zero, and leads to slightly improved operating conditions.

The current flowing, however, is extremely small and the bias required is for all intents and purposes the cut-off bias. For variations in the applied D.C. voltage to the grid, the valve will act as a cathode follower and very nearly the same voltage variation (more than 90%) will appear at the cathode so long as the bias does not exceed cut-off. The range of bias variation should not exceed ±2 volts, so as to allow for variations between valves and circuits, while still providing reasonably fine control. A smaller range of bias adjustment is permissible with a 6B6G and consequently a smoother control is possible. Zero adjustment should always be made on the 1-volt range, since this range is the most sensitive.

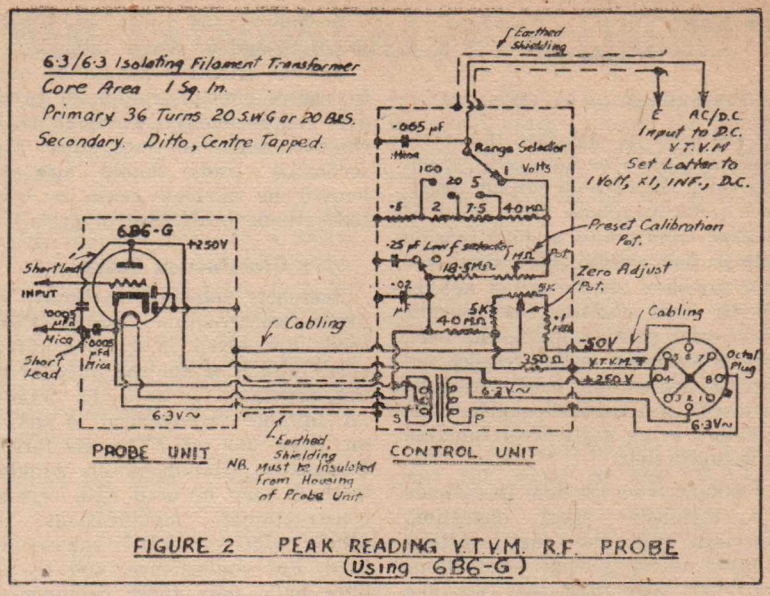


FIGURE 2 PEAK READING V.T.V.M. R.F. PROBE (Using 6B6-G)

Circuit Operation

For 1-volt R.M.S. input between the probes A and B, the D.C. voltage appearing at the cathode should be 1.38 in the case of the 6B6G and 1.31 volts in the case of a 6J5G or triode connected 6J7G or 954. The variable series resistor R_2 drops the voltage to 1 volt to be applied to the D.C. V.T.V.M. and thus provides a convenient sensitivity control, which is quite independent of the zero adjustment.

To attain true peak reading it is necessary to have a high value of the product Gm Rc. About 1,000 is the desirable value. In the region near cut-off a 6B6G has a transconductance of 50 microhms, and thus the cathode resistor should be about 20 megohms in effective value. It will be noticed that since Rc also serves as a grid leak for the D.C. V.T.V.M. the latter should be such as to have very low grid current. This is the case with the V.T.V.M. described in the April issue of "The Australasian Radio World," provided care was used in choosing a suitable 6F8G.

To keep frequency errors below 2%, the time constant in the cathode circuit should be about 5 seconds, for satisfactory operation down to 50 cycles per second. It will be found that the meter action is very sluggish, a feature common to peak reading voltmeters of the direct reading type. While this cannot be avoided for low frequency readings, a switch is provided to reduce the time constant to a reasonable figure for readings above 500 c/s.

During operation, the probe B is connected to a point of zero A.C. voltage in the set under test, whilst the point A will be connected to the "hot" end of a coil perhaps. The latter coil will provide the D.C. return for the grid circuit. Where this is not the case, such as measuring the R.F. potential appearing at the plate of a valve or where the coil is perhaps carrying direct current sufficient to produce a readable voltage drop, a grid leak should be inserted between A and B and a blocking condenser should be inserted in series with the grid leak. The grid leak should preferably consist of a ½-watt 1 megohm R.F. type resistor in series with a 10-megohm metallised ½-watt resistor. The coupling condenser used will depend upon the frequency, .05 mfd. to cover frequencies from 50 c/s. to 8 Kc/s. and .0002 mfd. to cover from 8 Kc/s. upwards. The latter should be of a physically small type for best results at radio frequencies.

When the A.C. voltage is applied, the grid point A will swing above and below the cut-off voltage to which B is connected. During positive swings the valve will conduct, charging up the cathode condensers C_1 and C_3. This charge will slowly leak away between conducting periods. In this way the charge on the condenser will build up until the voltage produced is only slightly less than would be obtained if the peak input voltage were applied as a D.C. voltage between B and A. To prevent too much charge leaking away between conducting periods the cathode circuit must have a time constant long in relation to the period of the applied wave. (It is desirable that less than 1% of the charge leak away at the lowest measuring frequency.

During conducting periods, the valve acts as a cathode follower and the condensers C_1 and C_2, are charged up from a source of output impedence 1/gm approximately. The steady final reading is reached when the charge acquired in the conducting period just equals the charge which leaks away between peaks. Difficulties occur since the voltage tending to charge the condensers is the relatively small difference between the maximum reading for peak D.C. input and the actual reading, whilst the condensers tend to be discharged by the full voltage appearing across the cathode resistor. The latter will be about a hundred times as great as the former. Another difficulty is that near the operating point (the peak of the sine wave) conduction will occur for less than 1/10th of a whole cycle. To meet these requirements the product gm Rc must be 1,000 as mentioned previously.

(Contined on next page)

V.T.V.M.

(Continued)

Precautions to be Observed

Care must be exercised if correct readings are to be obtained, especially since the cathode circuit resistance is 20 megohms. The effect of leakage from points at high tension voltage has already been discussed in a previous article and it applies equally here. Cabling between the probe and control units will need careful attention in this respect and the cathode circuit lead should be enclosed in shielded cable, the shielding being earthed to function as a guard ring.

Leakage from filament to cathode can seriously upset operation, especially on the high voltage ranges, unless special precautions are taken. The effect that can take place is that the filament will act as a cathode and the true cathode as the plate of a diode valve, when the cathode is driven positive with respect to the filament. To overcome this difficulty a small 1 to 1 transformer was made and mounted in the control unit to supply the filaments and the cathode lead conuected to a centre tap on the secondary. The details of this transformer (which may be easily hand wound on some old junk laminations) are as follows:

Core area: 1 sq. in.

Primary: 36 turns 20 S.W.G. or 20 B. and S.

Secondary: 36 turns 20 S.W.G. or 20 B. and S. centre tapped.

Special attention should be paid to ensure good insulation of primary and secondary windings from the core and from each other. The secondary leads should also be housed in shielded cable as with the cathode lead. (See diagram.)

Construction Details

Sketches showing methods of probe construction using acorn tubes are given in various references, and it is not the purpose of this article to go into the details. (A suitable arrangement is shown on page 259 of "The Radiotron Designer's Handbook.") Similar methods may be used with certain constructional modifications if 6B6G, 6J5G or 6J7G valves are used. For convenience, and to reduce bulk, only those components absolutely essential are housed within the probe. (See Figs. 2 and 3.)

From the probe leads are taken back to the control box which houses the range switch, zero adjustment and sensitivity adjustment. The latter should be a screwdriver adjustment, and should be sealed with sealing wax or shellac after calibration. Two sets of leads come away from the control box, the first a multiple cable ending in an octal socket for the power supply, and the second the lead to the D.C. V.T.V.M. input. Since the probe casing will not be at the same potential as the V.T.V.M. chassis and braiding, etc., the latter should be covered with some form of insulating cover such as Nylex tubing, to prevent the possibility of short circuits. The chassis of the V.T.V.M. should **not** be connected to the earth of the mains supply directly, but may be connected through a .1 mfd. condenser of high leakage resistance (better than 1,000 megohms). This is important, and no trouble will be experienced if previous circuits are followed exactly, but this point should be checked.

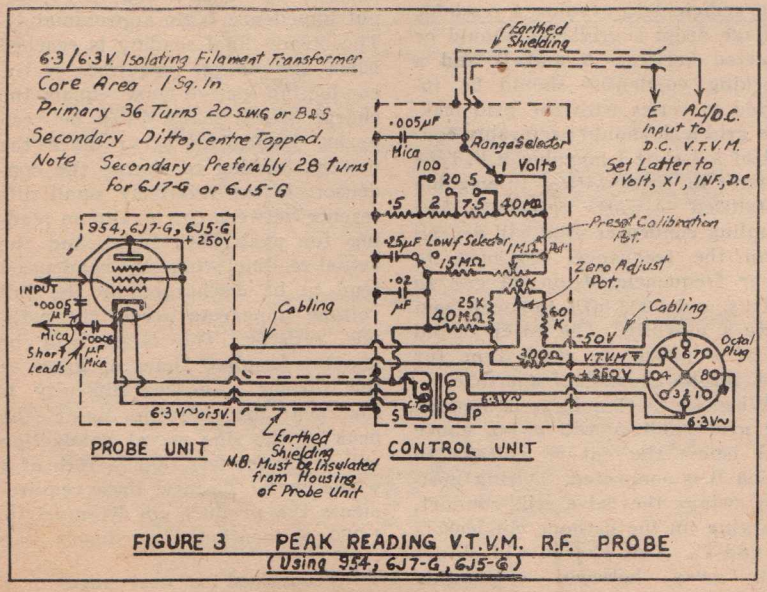


FIGURE 3 PEAK READING V.T.V.M. R.F. PROBE
(Using 954, 6J7-G, 6J5-G)

Setting Up Before Taking Readings.

The setting up procedure is as follows:—

(1) Switch on the V.T.V.M. with probe connected, and allow a few minutes to settle down before using.

(2) Set the D.C. V.T.V.M. to 1 volt, x 1, infinite, input resistance and D.C., and short out the input and earth terminals.

(3 Adjust the zero on the D.C. V.T.V.M. This will remain very steady once the equipment is fully warmed up.

(4) Unshort the input, connect the leads from the control box to the input, and place a short between probes A and B of the probe unit.

(5) Adjust the zero control on the control unit. The equipment is now ready for calibration, or for taking readings once it has been calibrated.

(6) Select the range switch on the control unit to suit the voltage being measured. If the latter is unknown, always use the 100 volt range first, then the 20, 5, and finally the 1 volt range. Remove the short between A and B before taking readings.

Calibration.

The meter may be calibrated against any reliable meter of known calibration.. If the resistors comprising the range selector of the control unit have been carefully measured and are accurate to within ½% or better, it should not be essential to check all three ranges, although to be on the safe side this is desirable. The sensitivity or

calibration control should be adjusted (adding series resistance if necessary) until correct calibration is obtained at or near full scale on the 100 volt range. Calibration curves may now be made for all ranges, and the range selector resistors adjusted if necessary. It will be found that calibration is very linear down to one-tenth volt on all ranges.

For the purpose of calibration it is very desirable that the calibrating source be of reasonably pure sine waveform. If, however, the probe voltmeter is calibrated against a meter of the peak reading type (preferably a slide back voltmeter), moderate departures from pure sine waveform may be tolerated, so long as positive and negative half cycles are symmetrical.

Use as a D.C. Voltmeter of Very High Input Resistance.

The probe unit may also be used as a D.C. voltmeter on all ranges up to and including the 100 volt range if fresh calibration curves are prepared. The D.C. source must be free from superimposed A.C. components or the meter will indicate only the positive peak of the voltage, due to the inherent rectifying action. A.C. components may be removed by a 2 megohm resistor and a .05uF condenser acting as a filter with the resistance on the input side and the condenser between grid and ground (the condenser should have a leakage resistance of better than 10,000 megohms).

Fresh calibration curves will be required for all ranges, the maximum voltage covered being approximately 140 volts on the 100 volt range. In this service the unit will function as a voltmeter of input resistance considerably higher than that of the original D.C. V.T.V.M., with linear calibration on all ranges.

To prevent sluggishness, the .25 uF condenser in the cathode circuit may be filtered out, and also if desired the .02 uF condenser may be disconnected.

Conclusion.

This is the concluding article of this series. The linear V.T.V.M. with the two adaptor units will be found to fill a very useful place on the test bench, on account of the wide variety of tasks it can undertake.

NEW CATHODE-FOLLOWER CIRCUIT

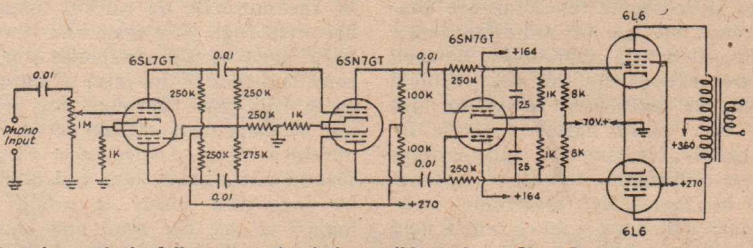
From the June issue of the American "Q.S.T." comes a circuit of great interest to amplifier enthusiasts.

By a clever application of the cathode follower principle, a 6SN7-GT type valve is used to replace the normal type of class B audio transformer, so that it becomes possible to have a resistance-capacity coupled amplifier, yet operating as Class B, and a pair of 6L6 valves delivering 47 watts of peerless audio quality.

Unlike the class B audio transformer which has a step-down ratio, the valve which replaces the transformer gives almost unity gain and frequency response far beyond that possible with even the best of audio transformers.

Unfortunately, the valve types specified are not likely to be readily available in Australia, and so it would appear likely that a pair of conventional valves will be needed. Even so, the circuit offers almost unlimited possibilities.

Space will not permit us to reprint the whole of the "Q.S.T." article, which covers the subject of cathode followers to great length, about nine pages in fact. Those interested in amplifier design are strongly advised to make a point of borrowing a copy of "Q.S.T." to study the article for themselves.



By using cathode follower practice it is possible to have Class B operation without an audio transformer, as in this circuit just received from U.S.A.

MANY CIVILIAN USES FOR RADAR.

For peacetime use the radar idea will find applications which are not even dreamt of to-day. First and most important, saving human life through prevention of collisions is probably the most urgent need. Radar on locomotives will prevent not only head-on collision, but rear-end collisions with other trains as well. Fog, thick weather and darkness, whether at night or in tunnels, do not interfere with radar. What is true of trains is equally true for airplanes, which no longer will collide with other planes in flight, nor run into mountains at great loss of life, as at present. Ships at sea will not collide either with other ships, nor will they run into icebergs or other obstacles, including uncharted, newly-made volcanic islands. Automobiles can be made practically collision-proof because radar will stop head-on and rear-end auto collisions. A driver who has gone to sleep will not crash into another car, if his own car has been made collision-proof by means of radar instrumentalities. It is possible, even with the driver asleep, to brake his car automatically by a radar system in order to prevent crashes. These are only a few and the most obvious uses of radar, and any technician can let his imagination run wild if he wishes to think up new applications in the radar principle. Anything that moves anywhere may be radar equipped for safety or other purposes if found necessary. This also suggests many industrial uses in factories, plants, mines, etc., where radar not only will save untold lives and accidents, but also will speed up work.—"Radio-Craft."

As soon as the conditions permit the re-opening of the "Radio World" laboratory, it is expected that further work will be done on this circuit to see the possibilities of adapting it to suit available valve types.

FUTURE APPLICATIONS OF RADIO

SOME TOPICAL COMMENTS BY A CASUAL OBSERVER

SO vast have been the strides made in radio developments during the war that it would be a bold—or foolish—man who would attempt to prophesy the state of the science in ten years' time. Some changes are certain, however: for example, frequency modulation will undoubtedly be adopted for some types of broadcast; television will be available in better and cheaper form than hitherto—but it is by no means sure that the transmission and reception systems will change in the near future, excepting in so far as colour and stereoscopic television are concerned; the use of radio-frequency emanation will undoubtedly be used more extensively in the medical field for diathermy treatment and as the "radio knife" for use by surgeons; centimetre, and perhaps even millimetre, technique appears to be inevitable; electronic techniques will have a much wider field of utility in industry, where photo-electric devices will play an important part, especially in the packaging and inspection departments.

Railway Telephones.

Those are just a few of the directions in which radio will tend to extend. In addition, one can be quite sure that the installation of radio receivers for normal entertainment will become customary for long-distance railway trains. Such trains will probably carry transmitters as well, so that passengers can despatch telegrams—and probably even "telephone" while in transit.

One branch of radio which has grown probably more than any other during the war years is that known as radar. Although it has been in use since 1939, the need for secrecy has prevented the general public from knowing very much about it. Even now, only a very slight amount of information has been publicly released. We do know, however, for the newspapers have told us—though often in inaccurate and unnecessarily flamboyant terms—that radar is employed for providing navigational assistance to air crews and ships' officers. We know also that it can act as a detector of submarines and surface ships as well as of aircraft which are well beyond the visual range or hidden by fog. By means of other radar devices the bombardier of an aircraft can drop bombs accurately on to a target which is completely invisible to him.

Seeing in Fog.

Because these things are known it has become a popular pastime to debate the possibilities of one or other of these radar devices, or of modifications of them, as the "eyes" of the motorist or railway engine driver in fog. The man who "swallows" some of the newspaper stories considers that if the pilot of an aircraft can "see" through fog with one of these instruments—if he can obtain a clear picture of a target several miles below him and hidden by fog—then surely it would be logical to see the road and traffic a few hundred yards ahead of the motorist.

It will be helpful to consider in very simple terms the action of some of these radar devices; let it be clearly understood that the explanation will not be complete because details are still covered by the Official Secrets Act. The fundamental idea is that a pulse transmission is sent out in the form of a very narrow beam and is made to "scan" the targget or other area. On striking different objects and surfaces the transmitted pulses are reflected in different ways, so that if we present the reflected signals on a cathode-ray tube we have, in effect, a picture. The general process, it will be seen, is analogous to that used in television, except that in that case it is a beam of light which is transmitted and reflected on to the lens of the television camera.

The radar picture obtained, however, could scarcely be said to resemble a cinematograph picture, and a certain amount of expert "interpretation" is required. It is certain that the average motorist would not feel competent to drive "blind" with such a device as this. Nor would the road be a safe place if drivers were abroad and driving in this way!

A Popular Fallacy.

Even if the difficulties of presentation could be overcome—and it is doubtful whether they could for very many years—there are many other reasons which would preclude the use of radar fog-driving aids in private cars. A suitable piece of equipment would probably cost at least £300, even if quantity produced. It would be expected to weigh, say, 250 lbs., and it would require power up to, perhaps, 1 horse-power, whilst occupying several cubic feet of space. Consider these facts in relation to a popular 10 horse-power car costing £200, weighing under 2,000 lbs., and having a "family" saloon body!

No, it will not do. Those who anticipate the early abolition of difficult fog driving must think again.

Alternative Possibilities.

But even if the scheme were possible and practicable, it would appear that there are many simpler and less expensive methods of achieving the same result. The use of the now familiar "cat's eyes" down the centre and along the verges of all roads would be more economical in the long run. If we are to use radio devices to increase the safety of fog driving there should be distinct possibilities in the way of laying iron rods in the road surfaces and using a device similar to the sapper's mine detector in the road vehicle. It might, in fact, be possible to introduce a modification into the standard car-radio receiver so that the set could also provide "navigational" aid.

Another possibility might lie in the direction of running a series of cables under the road surface and passing R.F. or A.F. through them. With single-track roads different cables would be keyed with "coded" dots or dashes or with different tones. A search coil fitted to the car and connected to a receiver and loud-speaker would complete the chain. In the case of double-track roads a different system of coding would be necessary so that the driver would know that he was on the correct side.

An alternative may be to lay cables in three lines, one on each

side of the road and one down the centre, keying the side cables with "A's" (. — in Morse) and the centre one with "N's" (— .). When the car was exactly midway between a pair of cables the driver would hear a steady note, whereas if it were nearer to one of the cables, the driver would hear a steady note with one of the letters superimposed.

Radar Signalling for Railways.

When one considers the possibilities of radar on railway the position is somewhat different, and a far better case can be made in favour of radar. But it does seem that there are many simpler devices which would serve an equally useful purpose. For example, a photo-cell could be placed at one side of the track, with a source of infra-red at the other, so arranged that the infra-red beam was cut whenever a train passed. The photo-cell could be made to actuate a relay which would modify the output from a transmitter. The photo-cells would be placed in the various sections of the track in the same way that visual signalling devices are placed, and any train approaching any section would pick up on its receiver a certain form of signal; this would indicate whether or not the section was clear.

There is little doubt that radar navigational aids will be used on ships, where they will also be employed to give warning of other nearby shipping, of rocks or of shallows. In the same way radar will continue to be used in aircraft, primarily as an accurate guide to navigation, but also perhaps at a later date, should the air become congested in various areas, to give a warning of the proximity of other aircraft.

Beam Navigation.

It may, however, be found that the system of beam approach (previously known as blind approach and, before that, as Lorenz) will be a simpler and less expensive navigational aid. By means of beam approach, aircraft can be landed safely in conditions of very poor visibility, because the pilot merely flies his aircraft along a radio beam. Should he leave the centre of the beam he is warned by the production of warning dots or dashes (according to whether he is to the left or the right of the centre line) in his earphones. A corresponding system was in use in America before the war for normal point-to-point flying, and it was possible to fly on any recognised route simply by keeping "on the beam." It would appear that a similar system could very easily and conveniently be used for bringing ships into harbour in fog.

One big advantage of beam approach or track-guide navigation is that a relatively simple receiving system is all that is required in the craft. And even the fixed transmitter is of simple design and can be efficiently maintained by wireless mechanics after a short period of training.

Television Relays.

With regard to the future of television, one of the greatest difficulties will probably be that of relaying the transmission from a central station to the various sub-stations that will be necessary to give ample coverage even over this country. It will be remembered that it is necessary to use ultra-short waves, and that the transmission range of these is visual only. The method of relaying used for sound broadcasts—by means of land lines—is out of the question because of the extremely wide frequency band which has to be covered. Special cables can be made, but they are extremely expensive. In consequence, it might be found more satisfactory to employ radio links, beaming the transmission from one station on to another, which will re-transmit the received signals.

—"Practical Wireless" (England).

AMPLIFYING CRYSTAL CIRCUIT

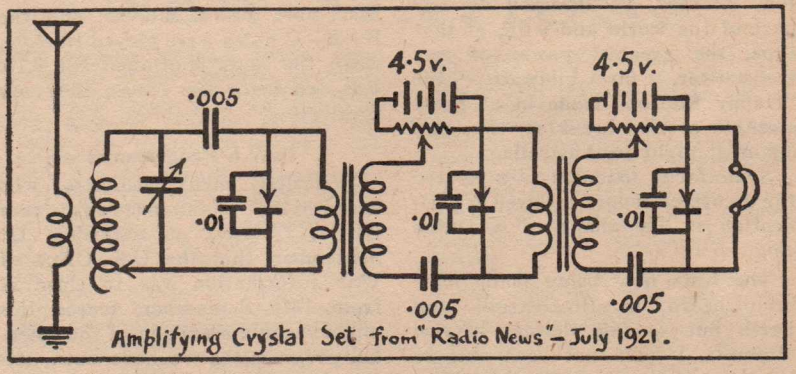
Radio enthusiasts still dream of a crystal set which will amplify signals, and it is a source of never-ending surprise to us just how many people write in every month asking why we don't concentrate on the design of a crystal set which will give good loud-speaker results—for preference, one which does not need a tuning condenser!

The humble crystal set has the wonderful advantage of not requiring a switch. It can be left in an operating condition for months on end, and yet never runs down the batteries or wastes the power. The drawback is the fact that sensitive headphones are necessary, a loud-speaker being impractical. Lack of selectivity is another drawback, the crystal detector loading the tuning circuit to a greater extent than a valve detector with regeneration.

A keen reader, E. W. Chambers, of 22 Martin Street, Heidelberg, Victoria, recently forwarded a circuit which he took from an old issue of an American radio magazine, and we reproduce this circuit purely as an item of interest and without any recommendation as to its practicability.

The circuit illustrates the early radio enthusiasts' efforts to produce a crystal circuit which would amplify the signal, but in so doing it has been found necessary to introduce batteries, so that switches become necessary and the most important advantage of the crystal set is immediately lost.

Whether the circuit will work or not is hard to say, but even if it did there is every reason to suspect that it would be a tough job keeping the crystal detectors in good nick when handling power!



Amplifying Crystal Set from "Radio News" — July 1921.

Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY

The "Happy Station"

News that the Philips Radio station PCJ, at Huizen, is back on the air is very interesting. Although at present only making tests, the announcer stated they would be on a regular schedule shortly. Evidently the reports which are invited will help to determine this.

A great number of DX-ers will remember this station quite justifiably called the "Happy Station" because of its bright programmes and its popular announcers, Eddy Startz and Bob Wybrands.

With the most remarkable directional aerial in the world, a beam aerial mast system on a railtrack so that the beam could, within a few minutes, be directed to any part of the world and with, at that time, the greatest power of any transmitter, 60 kilowatts, the "Happy Station" came in at great strength around breakfast time and again at night in Australia.

Some lucky listeners as a reward for a correct report received a verification in the shape of a Dutch clog.

The tests now being made have been heard in Invercargill and Perth but so far, despite several attempts, I have not been able to log them at the times at which they were reported. Maybe a new schedule or perhaps a different frequency is being tried.

Incidentally, the frequency of 9.59mc was, during the occupation of Holland, used by the Germans under the call, DXU-9.

"Here Isn't the News"

In all the years that I have been listening to London on short-wave I do not remember there ever being a break in the news excepting when one of the many transmitters may have failed temporarily, but that did not prevent it continuing without interruption. Imagine my surprise therefore, when listening to the 4 o'clock session through GRX, 9.69mc, on Monday, 27th August, to hear the announcer say, just after two minutes' news had been given, "I am afraid there will be a gap in the news until the next comes in." Then there was silence for the best part of a minute and the B—B—C notes were played till 4.04, when the news continued till 4.10. But, whatever the cause, they are forgiven.

O.W.I. Programmes

Doubtless many listeners who heard the announcement over KROJ, 17.77mc, on Saturday, 1st September, that the U.S. Office of War Information was to close as from 15th September, feared this might mean a cessation of the splendid programmes we have been getting from 'Frisco. However, on enquiry at the Headquarters of the U.S. Office of War Information in Sydney, I was told that as from 1st September all overseas activities of O.W.I. were transferred to a newly-created interim branch of the U.S. State Department, called the International Service. Until the 31st December of this year all the activities and offices previously maintained by O.W.I. will be contiued as before, by the I.I.S. Well, that is good news, as any curtailment of the splendid programmes from 'Frisco would have left a nasty gap in our overseas listening.

Walkie-Talkies

Shortly in the New Year America expects to see small home-type Walkie-Talkies with a range of about three miles. The Federal Communications Commission has set aside a high-frequency band, 460-470 megacycles, the same machines have been approved and a licence to own one will need a guarantee that it is to be used for personal use. A machine such as this should be of great help to Arthur Cushen, as it will enable him to keep in touch with his family when he is at the other end of his aerial.

SAYS WHO?

An excellent innovation under the title Programme Conference Period is the advance programme details for 24 hours ahead given over KNBA, 13.05, and KNBI, 15.15mc, each day at 4.05 p.m.—L.J.K.

Wally Young, of Adelaide, has been running around the Oceanic area, and provides some interesting notes as follows:

KU5Q, Guam, on 18.84m, good at 9.30 and 2.15 a.m., with 22.40m very good at 10 a.m. and 2.15 p.m., whilst at 11 p.m. Guam, on 32.30m, is heard well.

ZIJ, Okinawa, is generally heard around 10.30 a.m. and 9.30 p.m. on 19.32m, and SXS on 29.66m at 8.30 p.m.

PY-12, Manila, has been logged at 9 a.m. on 18.92m, and WVLC, on 32.25m, at 8.30 p.m.

•

Call-sign for Berne on 9.185mc, 32.66m, is HEF-4, according to "Universalite."

•

Dr. Gaden asks, "Who is it on 6.165mc—HHLM or HHBM?" According to the latest American advices, call is HHCM.

•

Arthur Cushen is hearing a stranger on about 10.975mc who opens at 7 a.m., leaving the air at 10 o'clock. Strength is good and "Arora" is used for signature tune for Portuguese news at 8 a.m. "Radio National ——" is the call. Can anyone supply missing particulars?

•

The Shortwave League of West Australia is publishing monthly a very fine guide to shortwave listeners under the title of "Radio Listening Post." This 7-page mimeographed organ is for members of the league, and the guiding hand of the publication is Roy Matthews, P.O. Box P1179, Perth, W.A.

•

Mr. Rex Gillett advises address for Palestine reports is: Capt. Dean, C/- Near East Arab Broadcasting Service, Jaffa, Palestine.

•

Readers of these pages will remember Phil Byard, now W/O P. J. Byard, R.A.A.F., who, until joining up, was a regular contributor from Launceston. Is back in the right little tight little island enjoying leave. Maybe as things now are, he will be one of the lucky ones and stay home, when I feel sure, he will quickly replace any worn-out valves, and listen-in as he was wont to do and with very good results.

S/Sgt. R. K. Clack, writing from Labuan Island, says, interalia, "All our news advised that Sydney went delirious with joy at the news of peace, and I suppose the celebrations were quite fitting to such an extremely important occasion. Up here the manifestation of joy we felt took on a different aspect. The predominant feeling is one of thankful relief rather than joy."

Ray then goes on to list a lot of the stations heard which will be found credited to him under "The Month's Loggings," but one item worthy of mention here is: "No. 1 in rating for interest is the new VLA-6 on 15.20mc, which I heard during its first transmission period on August 14th. The signal up here was R5-6 at best so far and during the 7-8.15 p.m. session for the North is way behind VLG-10 in strength. One hundred kilowatts of power, it seems, does not necessarily mean a proportionate increase in signal strength."

•

Not only has peace in the Pacific brought changes in schedules and frequencies but programme material has been, as can be expected, repatterned. The other Monday night, expecting at 6 p.m. to hear "What the American Commentators Say" over KWIX, 11.87mc, I found they were introducing a round-up of what the American commentators had said during the last week. Was quite a good and interesting session. At 6.15 this was followed by "The Week's Activities at the Nation's Capital." Here was another 15 minutes of events that will go down in history.—L.J.K.

NEW STATIONS

CKCX, Sackville, 15.19mc, 19.75m: Here is another of the Canadian Broadcasting Corporation's outlets heard testing by Arthur Cushen from 8.45-9.30 p.m.

CKEX, Sackville, 11.90mc, 25.21m: Mr. Cushen also reports this one on a test between 6 and 8 a.m.

RADIO SOMALI, Hargeisa (Somaliland), 7.126mc, 42.10m: This is a new station reported by Rex Gillett, who says that, according to an announcement given by the station "is heard every night except Sunday." News is taken from the BBC at 1 a.m., but signal is generally weak. Address for reports is: Department of Information and Broadcasting, Government Headquarters, Hargesia, British Somaliland.

XGOY, Chungking, 11.995mc, 25.01m: This is, I think, a new frequency for "The Voice of China," heard at fair strength at 8 p.m.—L.J.K.

RADIO PALESTINE, Jaffa, 6.135mc, 48.90 m: Heard opening at 3 a.m. with an interval signal of 19 notes. Signal is good and the programme consists of Eastern type music and speech. Reported by Rex Gillett, Arthur Cushen and Leo Edel.

RADIO PALESTINE, Jaffa, 6.71mc, 44.71 m: Mr. Edel reports this outlet as audible at 1 a.m., although morse is troublesome. Many weeks ago Mr. Edel told me of this station, but he could not, at that time, state with any degree of certainty who it was. He also reports them in parallel with 6.79mc, 44.18m. An air-mail from Rex Gillett mentions these stations as in parallel with 48.90, but spoilt by morse.

PCJ, Hilversum, 9.59mc, 31.28m: Here is what Arthur Cushen says: "PCJ, Philips Radio Hilversum, Holland, again back on the air, very good signal, testing to 6 a.m., asking for reports to be sent to nearest Dutch Consul or Embassy. Announcer sounds like old pal Eddy Startz."

LRR, Rosario, 11.88mc, 25.24m: This Argentine station is not new, but I think this is the first time it has been reported out this way. Mr. Cushen says signal is good when testing to 4 p.m. He also mentions they carry CBS news at 8.30 a.m. According to latest advices from the "Universalite," schedule is: 7 a.m.-noon; 10 p.m.-3 a.m.; so perhaps they will—if tests O.K.—provide us with an afternoon shift.

XEOI, Mexico City, 6.015mc, 49.88m: Here is another that is not new but reported for first time in Australia, according to my records. Dr. Gaden says he is not sure of call-sign, but figures frequency is 6.015mc, so I am suggesting call is XEOI, as this fits in with schedule given in "Universalite," viz., 3-4 p.m.

VLW-7, Perth, 9.52mc, 31.51m: Here is a new outlet for Perth, and VLW-7 seems to have taken up running for VLW-3, as it is heard on VLW's schedule —8-11.45 a.m.; 8.30 p.m.-1.30 a.m. Signal is quite O.K., excepting at night, when CW upsets things.—L.J.K.

KCBR, 'Frisco, 15.27mc, 19.65m: The CBS have added this to their growing list. Broadcasts to Peoples of the Pacific and Far East from 9 a.m.-2.45 p.m. Strength right through is good.—L.J.K.

"A.E.S.," Milan, 6.125mc, 49.01m: "This is the 5th Army American Expeditionary Station in Milan" is the statement given over an announced frequency of 6.125 kc. Heard very well prior to closing at 7.30 a.m. The foregoing particulars are supplied by Rex Gillett, and N.Z. DXtra also reports this station as broadcasting programmes for Allied Forces in North Italy. News at 5 a.m. and usual AFRS features, some of which are relayed from "Radio Luxembourg." Strong signal but suffers heavy morse interference.

The Anti-Franco Radio Station mentioned in the Sydney Press the first week in August has been heard in Adelaide at 2.30 a.m. on 11.673mc, at 3.30 a.m. on 11.685mc and at 4.30 a.m. on 11.715 mc, in a 25-minute broadcast. Spanish was the only language used and seemed to be of a fiery nature. Each session concluded with a brief march.

GWT is the call-sign for London on 9.675 mc, 31.01m.

FZI, Brazzaville, 6.025mc, 49.81: This seems like a new outlet for French Equatorial Africa and is heard in parallel with 31.78m at 6.45 a.m.

(Continued on page 32, col. 3)

The MONTH'S LOGGINGS

OCEANIA

See complete list of Australian S/W stations elsewhere in this issue.

China

XGOY, Chungking 11.91mc, 25.18m
Very good signal from just before 8 p.m.—L.J.K. Is reported also audible from 9.30 a.m.

XGOY, Chungking 9.805mc, 30.58m
Opens nightly at 8.30 in parallel with 7.153mc, 41.96m. News at 9.30 and 11 o'clock.—L.J.K.

Radio Club, Macao (Portuguese China) 7.53mc, 39.85m
Has made a welcome reappearance after its long silence. Signal R7 from 8 p.m., but suffers from morse interference. News in English at 10.15 p.m. (Clack).

XGOY, Chungking 5.90mc, 50.85m
Heard occasionally late at night, but weakly owing to interference (Wally Young).

XGOY, Chungking 7.153mc, 41.96m
Very good from 8 p.m., when free of morse interference (Clack).

AFRICA

Belgian Congo

RNB, Leopoldville 17.775mc, 16.88m
Again opening at 8 p.m. (Matthews).

RNB, Leopoldville 9.785mc, 30.66m
Back here again—closes 4.15 p.m.; also on 9.75mc from 3.30 and badly heterodyned till KCBF closes at 4 p.m.—L.J.K.

OPL, Leopoldville 9.785mc, 30.66m
Good at 8 a.m. (Clack).

Egypt

JCKW, Cairo 7.22mc, 41.55m
Seems to have replaced JCJC. Heard at fine strength till sign off at 6 a.m. BBC news at 5 a.m. and then dance music till closing. Announces as JCKW, 41.55m (Cushen, Gillett).

Ethiopia

Radio Addis Ababa 9.62mc, 31.19m
Heard weakly on occasions at 2 a.m. with BBC news. Overlap from GWO spoils what would be a good signal (Gillett).

French Equatorial Africa

FZI, Brazzaville 17.53mc, 17.12m
Good at 4.15 p.m. (Young).

FZI, Brazzaville 12.12mc, 24.75m
Think this is the one I am hearing in the afternoon—Brazzaville mentioned quite often (Gaden). Fair signal some nights around 9.30 (Clack).

FZI, Brazzaville 11.97mc, 25.06m
Opens with news at 3 p.m.—fair signal (Cushen).

FZI, Brazzaville 9.439mc, 31.78m:
Good signal at 8 a.m. (Clack).

Mozambique

CR7BD, Lourenco Marques, 15.38mc, 19.51m
Fairly good signal when closing at 4 p.m. with English announcement (Gillett).

Somaliland

Radio Somali 7.125mc, 42.10m
Fair at 1 a.m. in relay BBC news (Matthews). See "New Stations."

India

VUD- , Delhi 15.16mc, 19.79m
"The Voice of Britain" calling the Far East at 9.30 p.m.; also on 16.83m.—L.J.K.

SEAC, Ceylon 15.12mc, 19.84m
Not a good band at night, but signal fair in afternoon (Gaden). Good from 9 p.m. (Clack).

SEAC, Ceylon 11.81mc, 25.40m
Very strong signal from 8.30 p.m. (Clack). At 10.45 p.m., "This is SEAC, Ceylon, in the 25-metre band. Next news in English is at 21 hours I.S.T., that is 1 hour and 45 minutes from now." Signal R7 Q4.—L.J.K.

VUD- , Delhi 9.67mc, 31.02m
Opens at 10.30 p.m. with good signal.—L.J.K.

CENTRAL AMERICA

Costa Rica

TIPG, San Jose 9.615mc, 31.21m
Still heard weakly after lunch; better at night (Gaden). News in Spanish at 2 p.m., signs at 2.30 (Cushen).

El Salvador

HUB, San Salvador 4.794mc, 62.57m
Heard till closing at 2 p.m. with clock striking 10 (Cushen). (Arthur, your country is certainly unique as regards reception.—L.J.K.)

Guatemala

TGWA, Guatemala City .. 9.685mc, 30.98m
Only fair in the afternoon (Gaden).

Panama

HP5G, Panama City 11.78mc, 25.47m
Very weak in a.m.—heard a little better about 1 p.m. (Gaden).

HP5A, Panama City 11.696mc, 25.64m
Fair at 1 p.m. (Gaden).

HP5J, Panama City 9.607mc, 31.23m
Good at 11 a.m. (Cushen). This is the best Panama station at present. Only heard at 10 p.m. (Gaden).

U.S.A.

San Francisco unless otherwise mentioned.

KQJ 18.02mc, 16.64m
Heard at good strength at 10.35 a.m.—L.J.K.

KCBF 17.85mc, 16.81m
Good till closing at 1.45 p.m.—L.J.K.

KRHO, Honolulu 17.80mc, 16.85m
Good from 6-8 a.m.—L.J.K.

KNBA 17.78mc, 16.87m
Very nice signal at noon (Gaden).

KROJ 17.77mc, 16.88m
O.K. with news at dictation speed 6.15 a.m.—L.J.K.

KNBX 15.34mc, 19.56m
Better than KGEI in L/A service (Gaden). Excellent till closing at 3.05 p.m.—L.J.K.

KWID 15.29mc, 19.62m
Sundays at 2.30, Hit Parade—closes at 3 p.m. (Gaden, Clack).

KCBR 15.27mc, 19.65m
Heard closing at 2.45 p.m. (Gaden, Clack).

KRHO, Honolulu 15.25mc, 19.67m
Has been on for about an hour in the mornings—very poor (Gaden, Cushen).

KNBI 15.24mc, 19.69m
Even worse than KRHO of a morning (Gaden).

KGEX 15.21mc, 19.72m
Very good till closing at 1.15 p.m. (Gaden, Clack). (Is only just fair around 10 a.m. at my little shack—think beam has been bent farther north.—L.J.K.)

KNBI 15.15mc, 19.81m
Splendid signal from 11.20 a.m. (Gaden).

KNBA 13.05mc, 22.97m
Still good signal till closing at 4.45 p.m. and again from 5-6.45 (Gaden, Clack).

KWIX 11.87mc, 25.27m
Excellent from 5.30-6.30 p.m. in programme for New Zealand.—L.J.K. As good as anything heard, best of the 25-metre band (Gaden).

KCBA 11.77mc, 25.49m
From 9 a.m. in L/A service R7 (Clack).

KCBF 11.77mc, 25.49m
Very good signal 5-6.45 p.m. (Clack).

KROJ 11.74mc, 25.55m
Very good signal from 5 p.m. (Gaden).

KGEI 11.73mc, 25.58m
Now in the clear in the afternoons, GVV having politely withdrawn.—L.J.K. Very good, 5-6.30 p.m. (Clack).

KCBF 9.75mc, 30.77m
Is spoilt by RNB on about same frequency from 3.30 p.m. (Gaden). Good from 7 p.m. but suffers from morse (Clack).

KCBR 9.70mc, 30.93m
"The Voice of Britain calling from the U.S.A. at 9.15 p.m.—L.J.K.

KRHO, Honolulu 9.65mc, 31.09m
From 2-5 a.m.—good (Cushen).

KGEX 7.25mc, 41.38m
Probably the best station on the air at 10.45 p.m.—L.J.K.

Other than San Francisco

WRUW, Boston 15.35mc, 19.45m
American News Letter at 10 p.m. followed by French at 10.15 badly heterodyned by Delhi.—L.J.K.

WLWL, Cincinnati 15.25mc, 19.67m
Best of any 19-metre band at 10 a.m.—L.J.K.

WOOC, New York 15.19mc, 19.7m
Closes at 9.15 a.m. and says will re-open in 15 minutes on 7.82mc.—L.J.K.

WNBX, New York 14.56mc, 20.61m
Good signal in German at 9.45 p.m.—L.J.K.

WNRI, New York 13.05mc, 22.98m
In parallel with WNRX, 14.56mc, at 9.45 a.m. R7 Q4.—L.J.K.

WOOW, New York 11.87mc, 25.27m
News at 8 a.m., also on WCBN, 11.145 mc, and WOOC, 15.19mc. WOOW when closing at 9.15 says will re-open in 15 minutes on 11.145mc, 26.9m.—L.J.K.

WLWL, Cincinnati 11.81mc, 25.40m
AFRS programme at 10.30 a.m.—very good signal.—L J.K.

WLWL, Cincinnati 11.71mc, 25.62m
News at 10.30 p.m.

WRUW, Boston 9.70mc, 30.93m
Good at 11.30 a.m. (Cushen).

WNBI, New York 9.67mc, 31.02m
Good at 11.30 a.m. (Cushen). Splendid at 8.45 p.m.

WCBX, New York 9.59mc, 31.30m
Excellent at 7 p.m. with news (Matthews).

WBOS, New York 9.57mc, 31.35m
Opens 3 p.m.—not strong then; improves and is quite nice before 4 and is O.K. till KWID takes charge (Gaden).

WGEO, New York 9.53mc, 31.48m
As good as any Eastener in a.m. (Gaden).

WOOC, New York 7.82mc, 38.36m
Opens at 9.30 a.m.

WOOW, New York 7.82mc, 38.36m
Excellent at 7 p.m. with news (Matthews).

SOUTH AMERICA

Argentine

LRY-1, Buenos Aires 6.09mc, 49.25m
Best of the S.A.'s at present around 9 p.m. (Gaden).

Brazil

PRL-7, Rio de Janeiro 9.72mc, 30.86m
Heard at good strength at 8 a.m. (Cushen, Clack).

ZYC-8, Rio de Janiero 9.610mc, 31.22m
Heard till GRY opens at 9 a.m. (Cushen).

Colombia

HJCD, Bogota 6.16mc, 48.70m
Never much good (Gaden). (Can be heard occasionally through morse at 10.30 p.m.—L.J.K.)

NEW STATIONS

(Continued from page 31)

ZLN-4, Wellington, 9.876mc, 30.37m: I heard this station of the New Zealand Post and Telegraph Department testing on the afternoon and evening of 29th August. Signal when they closed at 5.30 was R7 Q4. On opening again at 7.45 signal was still good till closing at 7.28½, when announcer said, "Now ceasing transmission until 9.45 p.m. New Zealand Civil Time." However, I could not hear them if they did open again at 7.45, although there was a very weak carrier on this frequency. This station, which is one of several to be used as an international transmitter, will be a welcome addition to the evening laddies. —L.J.K.

Ecuador

HCJB, Quito .... 12.45mc, 24.08m Very good at 11.30 a.m. (Cushen). Good 7.30-8 a.m. and from 10 p.m. (Clack).

HCJB, Quito .... 9.958mc, 30.12m Fair at 10 a.m. (Matthews). Good at 11.30 a.m. (Cushen). Good when opening at 11 p.m. but could not hear them on 12.45mc.—L.J.K.

GREAT BRITAIN

BBC, London

GSV .... 17.81mc, 16.84m Excellent at 7 p.m. (Matthews). News at 11 p.m. R7 Q4.—L.J.K.

GVQ .... 17.73mc, 16.92m O.K. with news at 6 a.m.—L.J.K. Wow of a signal at 6.30 p.m. (Matthews).

GWR .... 15.30mc, 19.61m Excellent with news at 6 a.m.—L.J.K. Good from 10.30 p.m. (Clack).

GSF .... 15.14mc, 19.82m Very good in news at 11 p.m. (Clack, L.J.K.).

GWC .... 15.07mc, 19.91m Heard twice with skeds—does not last long (Gaden). (According to BBC advice is on from 8 p.m.-1.15 a.m. I hear them most nights at 9 p.m. in news with fair signal.—L.J.K.). Weak but audible from 9 p.m. (Clack).

GSD .... 11.75mc, 25.53m Audible almost round the clock.

GRG .... 11.68mc, 25.68m Good in newsreel at 9.30 a.m.—L.J.K.

GRX .... 9.69mc, 30.96m Very good at 11.30 a.m. in AFRS programme (Cushen). (Little zizzy at that hour, here.—L.J.K.)

GVZ .... 9.64mc, 31.12m Good in Spanish at 11.30 a.m. (Cushen, Clack).

GWO .... 9.625mc, 31.17m Very good at 11.30 a.m. (Cushen, Clack).

GSB .... 9.51mc, 31.55m This old warrior is perhaps as good as any of the BBC's (Gaden). Fair signal from 7.30 a.m. until it fades out by 10 (Clack).

GRI .... 9.41mc, 31.88m Terrific signal when giving news in French at 5 p.m.—closes at 5.30.—L.J.K.

U.S.S.R.

Moscow unless otherwise mentioned.

—— .... 12.99mc, 23.09m Very fine signal in Russian language at 9.30 p.m. (Edel).

—— .... 12.27mc, 24.47m Good at 11.30 a.m. (Cushen).

—— .... 11.87mc, 25.26m Opens at 2.30 p.m. with Kremlin bells—then Spanish. French at 3 o'clock. Splendid signal.—L.J.K.

—— .... 11.635mc, 25.80m Very good in Spanish till 3 p.m. and news in English at 9.40 p.m.—L.J.K.

—— .... 9.705mc, 30.92m Good in Spanish at 11.30 a.m. (Cushen). (This looks like a new frequency for Moscow.—L.J.K.)

—— .... 9.65mc, 31.09m Good at 11.30 a.m. (Cushen). Excellent up till 2 a.m. when KRHO swamps (Matthews).

WEST INDIES

Cuba

COK, Havana .... 11.62mc, 25.83m Heard with fine signal at 9.30 a.m. (Gaden).

COCM, Havana .... 9.83mc, 30.51m Good strength 10 a.m. with announcements (Matthews).

COKG, Havana .... 8.955mc, 33.48m Good at 8.30 a.m. (Young).

Haiti

HH3W, Port-au-Prince .. 10.13mc, 29.62m Heard at 10 a.m. at good strength (Matthews).

HHCM, Port-au-Prince .. 6.163mc, 48.70m Reasonably good at 9.30 p.m. (Gaden).

HHCA, Port-au-Prince .. 4.60mc, 65.21m Heard at 1 p.m. (Cushen). (Mr. Cushen shows this as HHCW, but, believing it is a typographical error, I am listing it as HHCA, which is correct according to my records.—L.J.K.)

STOP PRESS

Radio Singapore, 9.555mc, 31.40m: Heard on 5th September at 8 p.m. with announcement, "British Military Administration calling from Singapore. We are broadcasting from the Cathay building." News was given, as also were several orchestral numbers. A little later an announcer, whose name sounded like James Moody or Mudie, was brought to the microphone and, before he gave a message, it was explained he had been a regular announcer over this same station previous to his three years as a war prisoner.

Signal strength was greater than when used as Radio Shonan, but is still very close to KGEI and requires careful tuning. The wavelength was given as 31.42, which is the same as the Japs have been announcing for a long time but Singapore is definitely on a HIGHER frequency than KGEI (9.55mc) and that is why I have shown it as 9.555mc, and not as 9.548mc. It was certainly most refreshiig to hear Singapore again. Prior to the war we heard them regularly on 9.69mc, 30.96m, under call of ZHP. I have a very nice card from the British Malay Broadcasting Corporation Ltd. for a report sent early in 1938.

JLU-2, Tokyo, 9.525mc, 31.51m: The Americans have been using this station for the last few nights, calling 'Frisco, but morse as well as the strong signal from VLW-7, 9.52mc, made listening very difficult.

MISCELLANEOUS

Canada

CHTA, Sackville .... 15.22mc, 19.71m At times as good as any on the 19-metre band at night (Gaden). Usually heard easily when opening at 9 p.m. Chimes are used as interval signal (Gillett).

CHOL, Sackville .... 11.72mc, 25.64m Good in a.m. till closing at 9 o'clock; best at 8 (Gaden). Beamed to Eurpoe from 6.15-9 a.m. Sometimes has news summary at 8 a.m. (Cushen, Gillett). Re-opens at 10 a.m., but not as good as a couple of hours earlier (Gaden).

CBFX, Montreal .... 9.63mc, 31.15m Have heard this call plainly at 6 p.m. (Gaden). (Is now putting in an excellent signal at 10.15 when morning devotion is given.—L.J.K.)

CKRB, Toronto .... 6.07mc, 49.42m Heard behind morse from 9.30-10.15 p.m.—L.J.K.

* * *

NEW SHEPPARTON TRANSMITTERS

VLA, 7.28mc, 41.21m; VLA-4, 11.77mc, 25.49m; VLA-6, 15.2mc, 19.74m.

These new and powerful transmitters used by Department of Information for overseas transmissions commenced operations on August 13th. Here are the schedules as at time of compiling these notes, August 29th:

VLA: 11.35 p.m.-midnight, to Bangkok in Thai; midnight-12.30 a.m., to Bangkok in English; 12.35-1 a.m., Forces in India in English; 2.15-2.45 a.m., Britain in English.

VLA-4: 8.30-8.45 a.m., to Tokyo in Japanese; 8.45-9 a.m., to Tokyo—relay of BBC news in English; 9-9.15 a.m., Dutch; 11.55 a.m.-12.45 p.m., to North America; 10-10.30 p.m., to Batavia in Malay; 10.30-11 p.m., to Shanghai and Singapore in English.

VLA-6: 1.15-2 p.m., to Forces, North Australia (to 2.30 Sundays); 2-3 p.m., British Pacific Fleet programme (from 2.30 Sundays); 3.10-3.45 p.m., to North America; 4.55-5.25 p.m., to Britain; 5.30-6.45 p.m., to Northern Asia in Japanese (to 6.30 Sundays); 7-8.15 p.m., to Asia in English (at 7.45 Dictation Speed News); 8.15-8.30 p.m., to Asia in Chinese; 8.30-8.50 p.m., to Asia in English; 8.50-9.15 p.m., to Batavia in Malay.

A complete list of Australian shortwave transmitters appears elsewhere in this issue.

——, **Moscow, 15.32mc, 19.58m:** Still a further outlet for the U.S.S.R. Heard opening at 9.45 p.m. on August 9th. A letter from Roy Matthews of Perth states he is hearing this one, too.

'FRISCO CHANGES

KCBR, 15.27mc, 19.64m: 2-5.15 a.m.; 6-8.45 a.m.; 9 a.m.-12.45 p.m.; 1-2.45 p.m.

KNBA, 7.56mc, 39.66m/KNBI, 9.49mc, 31.61m: 1-2 a.m.

KNBA, 13.05mc, 22.98m/KNBI, 15.24mc, 19.69m: 5.15-8.45 a.m.; 9-11.05 a.m.

KWID, 15.29mc, 19.62m: 2-4 a.m.

KWIX, 9.85mc, which was in parallel with KROJ from 7-8.45 p.m., has been withdrawn and is now on 7.23mc, beamed to China and Japan from 7-11.45 p.m., carrying same programme as KROJ and KGEI, the latter, as usual on 9.55mc, closing at 1.45 a.m.

'FRISCO NOTES

Beginning September 1st, KWIX will broadcast AFRS News and programmes to China and Japan on 7.23mc, 41.49m, from 7-11.45 p.m., according to an announcement heard over KNBA, 13.05mc, on August 29th.

KWID, 15.29mc, 19.62m: Heard closing at 3 p.m. but so far have not found opening time.

COMPLETE LIST OF AUSTRALIAN SHORTWAVE TRANSMITTERS ACTIVE AS AT AUGUST 29th, 1945

Compiled by L. J. Keast

VLC-4, Shepparton, 15.315mc, 19.59mc:

VLA-6, Shepparton, 15.2mc, 19.74m: 8.30-10.15 a.m.; 11.55 a.m.-12.45 p.m.; 1-3 p.m.; 3.10-3.45 p.m. 1.15-3 p.m.; 3.10-3.45 p.m.; 4.55-5.25 p.m.; 5.30-6.45 p.m.; 7-9.15 p.m.

VLG-7, Melbourne, 15.16mc, 19.79m: 6.45-8 a.m. (Sunday till 8.15 a.m.); 9.15-10.15 a.m.

VLR-3, Melbourne, 11.88mc, 25.25m: 7.20-10 a.m.; 11.45 a.m.-5.45 p.m. (Sundays 6.45 a.m.-5.45 p.m.)

VLG-5, Melbourne, 11.88mc, 25.25m: 2.15-2.45 a.m.

VLG-4, Melbourne, 11.84mc, 25.35m: 3.10-3.45 p.m.; 10 p.m.-midnight; 1-1.45 a.m.

VLC-7, Shepparton, 11.84mc, 25.35m: 4-4.40 p.m.

VLW-3, Perth, 11.83mc, 25.36m: 1.30-8.15 p.m.

VLA-4, Shepparton, 11.77mc, 25.49m: 8.30-9.15 a.m.; 11.55 a.m.-12.45 p.m.; 10-10.30 p.m.

VLG-10, Melbourne, 11.76mc, 25.51m: 6.10-6.55 p.m.; 7-9.45 p.m.

VLG-3, Melbourne, 11.71mc, 25.62m: 11.55 a.m.-12.45 p.m.; 1-2 p.m. (Sundays till 2.30); 4-4.40 p.m.; 4.55-5.25 p.m.; 5.30-5.55 p.m.

VLC-2, Shepparton, 9.68mc, 30.99m: 5.30-6.45 p.m. (to 6.30 p.m. Sundays); 2.15-2.45 a.m.

VLQ-3, Brisbane, 9.66mc, 31.06m: 11.45 a.m.-5.15 p.m.

VLC-6, Shepparton, 9.615mc, 31.2m: 7-9.45 p.m.; 11 p.m.-12.45 a.m.; 1-1.45 a.m.

VLG, Melbourne, 9.58mc, 31.32m: 12.15-12.30 a.m.; 12.35-12.45 a.m.

VLR, Melbourne, 9.58mc, 31.32m: 6-7.10 a.m.; 6-11.30 p.m.; (Saturdays midnight); 6 a.m.-11.30 p.m. Sundays.

VLC-5, Shepparton, 9.54mc, 31.45m: 10-10.45 p.m.

VLW-7, Perth, 9.52mc, 31.51m: Daily 8-11.45 a.m.; 8.30 p.m.-1.30 a.m.; Sundays 8.45-11.40 a.m. (Saturdays till 2 a.m. Sunday); Sundays 8.30 p.m.-1.30 a.m.

VLA, Shepparton, 7.28mc, 41.21m: 11.35 p.m.-12.30 a.m.; 12.35-1 a.m.; 2.15-2.45 am.

VLQ, Brisbane, 7.24mc, 41.44m: 6-10.10 a.m.

VLQ-2, Brisbane, 7.215mc, 41.58m: 5.30-11.30 p.m.

Speedy Query Service

(Conducted under the personal supervision of A. G. Hull)

C.G.C. (Geelong) sends an elaborate problem in Ohm's Law.

A.—Sorry, but we cannot possibly spare the time to go into this problem fully, as it would be doubtful whether any useful purpose could be achieved. It would seem that you have not fully grasped even the fundamentals and so we would have to start from scratch. For example, there would be no current in resistor number three and so there can be no voltage drop.

* * *

W.S. (Chatswood) enquires about the control of spare parts.

A.—Unfortunately it may be some time before this reply appears in print and so the answer may be out of date by the time you read it. At the moment of writing it would appear that gang condensers are the only controlled items and that set manufacture is permitted in those factories which were engaged on set production in 1938, 1939, etc. It seems fairly certain that it won't be long now before we are able to resume our articles on how to build sets.

B.L.N. (Wagga) enquires about test equipment.

A.—You can get a complete valve tester unit which can be operated either from a.c. power or from a car battery. This would appear to be the kind of thing for you to carry in your car. Write to Mr. Graham, of Radio Equipment Pty. Ltd., Cnr. City Road and Broadway, Sydney, for full details, prices, etc. Be sure to repeat your query in full when writing to Mr. Graham.

* * *

R.M.F. (A.I.F.) writes about the possibility of joining the technical staff of "Radio World."

A.—Arrangements for our reorganisation are now being considered and applications are invited from members of the forces who feel they can help. Those with journalistic experience, circuit-drawing ability or capable of handling the organisation of the advertising department are required for a start. If you can do all three classes of work you should be assured of a position.

REHABILITATION

(Continued from page 6)

ents such as tubular condensers is likely to hold or increase, rather than depreciate, as production costs are high today and prices only held in check by the price control regulations. An increase in price by twenty per cent would not be at all surprising.

Speaking of value, it is to be hoped that it is not necessary to stress the fallacy of the so-called "fixed black market prices" which have more or less governed transactions in controlled items, such as 50/- each for two-gang condensers. Let us hope that those bad days are gone forever.

The prospects for the radio trade are wonderfully bright at the moment, and a well-conducted radio repair and sales business can expect to make a lot of profit from set sales over the next three or four years and then settle down to a steady job maintaining the sets in use. The small radio retailer will not have the problems of the big factory owner on this account, for when sales are scarce the repair business carries on. This was proved during the war years when, although sets were not available for selling, the small radio dealers made excellent profits from maintenance work.

New Sets

At the moment it is not clear what the position will be in regard to the manufacture of radio sets for civilian use, but it is safe to follow a middle line of thought and reckon that things won't be as bad or as good or as sudden as the extremists think..

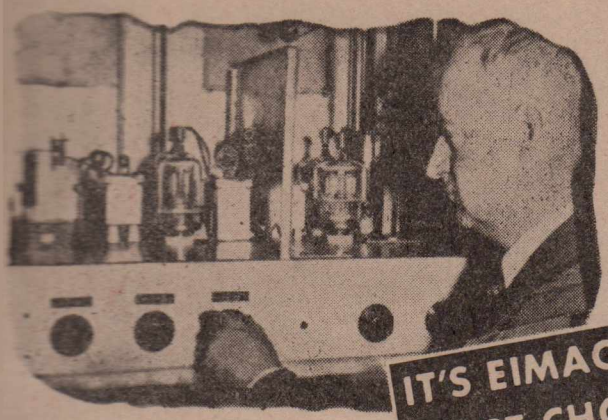
A group of set manufacturers have recently been talking about getting out 400,000 sets within the next twelve months, but I can't believe that it is possible. The factories have tremendous capacity for production, but they will have to depend on others for their components, and bottlenecks are almost certain to develop in certain lines. Any chain is only as strong as the weakest link and any run of production is only as good as the tightest bottleneck.

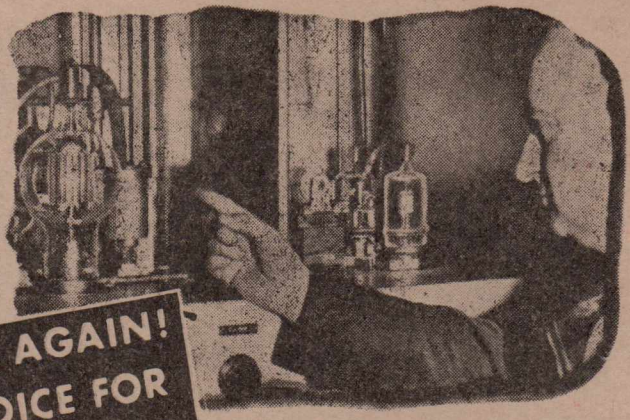
For example, let us consider loudspeakers. There are not many loudspeaker factories in Australia and we doubt whether they can hope to keep pace with requirements to the order of 400,000 units a year in addition to the number required for replacements and other uses. Another factor in the production of a large number of sets will be the matter of incentive, and its relation to income tax. Back of the conscious or sub-conscious mind of every component and set manufacturer is the thought that it is not a sound policy to run the plant to destruction trying to get record-breaking production and paying record-breaking income tax. How much nicer to tick along steadily, putting in plenty of time on the overhaul and maintenance of the plant, spreading the potential market over a number of years, making a comfortable profit and paying a comfortable amount of income tax.

It has been said that the present capacity of the radio trade is between eight and nine times what it was in pre-war years. It has been estimated that if all the radio factories swung over to the mass-production of receivers they could put two sets in every home and one into every motor car in the next twelve months. Then what would they do?

Some suggest that technical improvements, such as the introduction of television and frequency modulation can keep the market open indefinitely, but I think the above factors are likely to have the necessary steadying effect to avoid a boom and following depression.

(Another article on this subject is due in next months issue.)

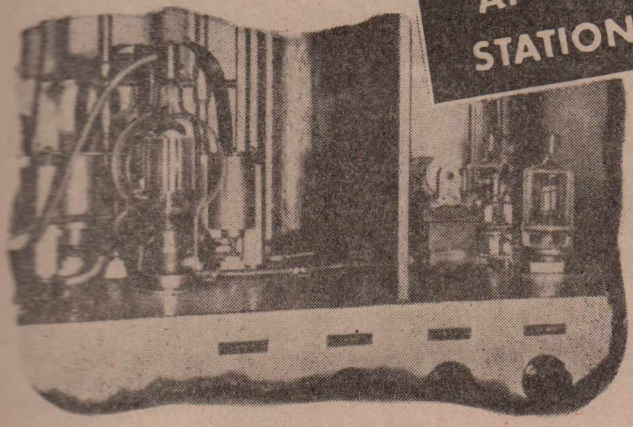


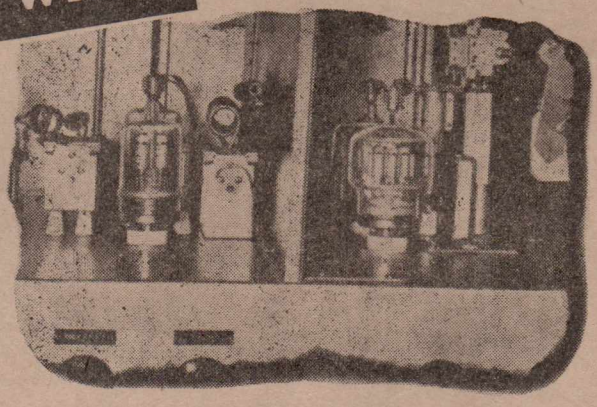


IT'S EIMAC AGAIN! FIRST CHOICE FOR THE KEY SOCKETS AT TELEVISION STATION WBKB

A. H. Brolly . . . Chief Engineer of Television Station WBKB, Chicago, adjusts the grid circuit of the Eimac 304-TL's in the Class B linear stage of the video transmitter.

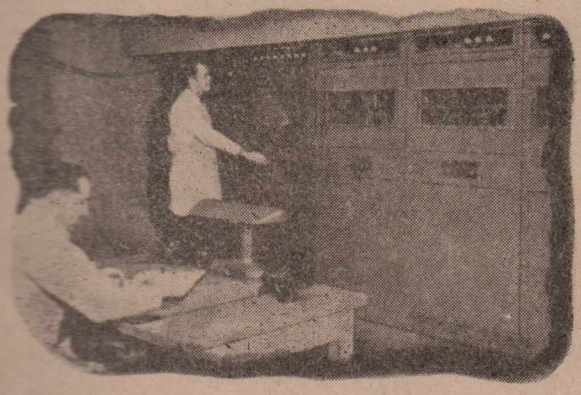
Mr. Brolly calls attention to the Eimac 1000-T's in the final stage of the Audio F.M Transmitter which operates at 65.75 megacycles. It is a very stable amplifier of good efficiency.





The video transmitter operates at 61.25 megacycles; peak power output is 4 KW which provides a television service throughout metropolitan Chicago and reaches suburbs out to 35 miles or more.

Eimac 152-T's are used in the modulated stage and 304-T's in the first Class B linear amplifier of the video transmitter.



Grid modulation is employed at WBKB and a broad band of frequencies must be passed in all stages following the modulated amplifier. Multiple-tuned resistance loaded coupling circuits are used between stages.

Performance, stability, dependability are good reasons why Eimac valves are to be found in the key sockets of the outstanding new developments in Electronics. Balaban & Katz, owners of television station WBKB of Chicago, offer potent confirmation of the fact that Eimac valves are first choice of leading Electronic Engineers the world over.

E. F. Cawthon and W. R. Brock are operating the station which has been broadcasting television programs with the present equipment since 1942 and began operation on a commercial schedule in October, 1943.

ELECTRONIC TELESIS—*fully illustrated. Send for a copy now. The Science of Electronics written in simple language. You'll find it of valuable assistance in explaining electronics to the layman. No obligation.*

FOLLOW THE LEADERS TO

Eimac REG U.S. PAT. OFF. **VALVES**

EITEL-McCULLOUGH, INC., 1032 San Mateo Ave., San Bruno, Calif.
Plants located at: San Bruno, California and Salt Lake City, Utah
Export Agents: Frazar & Hansen
301 Clay Street, San Francisco 11, California, U. S. A.

Printed by the Bridge Printery, 117 Reservoir St, Sydney, N.S.W., for the proprietor of the "Australasian Radio World," Elizabeth St., Sydney.