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Radio World

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1/-

VOL. 10 ..... NO. 3 AUGUST 15 1945

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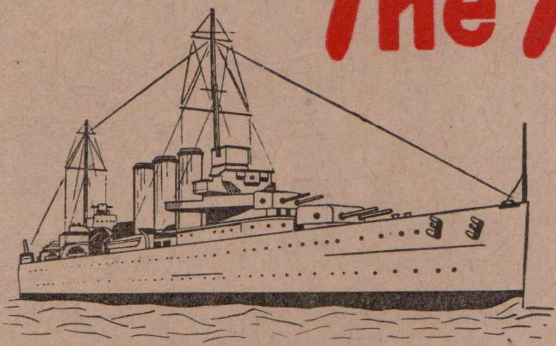

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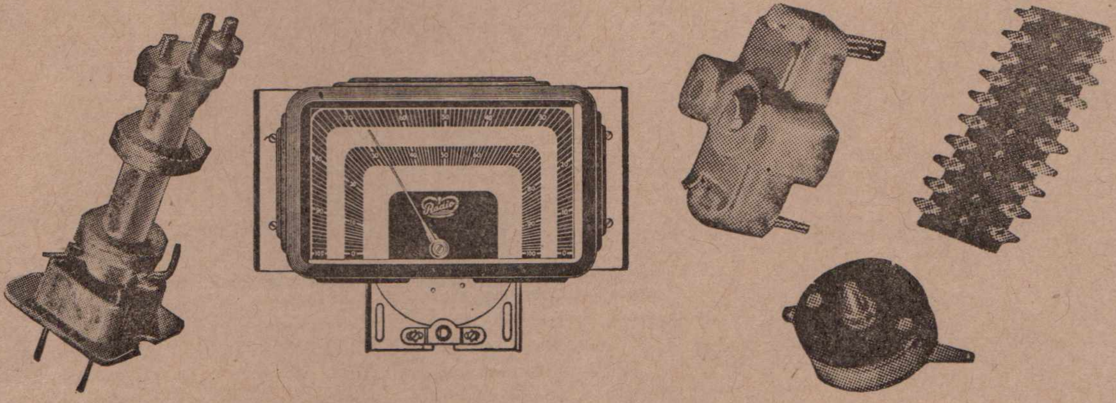

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Vol. 10 AUGUST, 1945 No. 3

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EDITORIAL

It is unfortunate that censorship has made it necessary to suppress the telling of the wonderful tale of what radio and radar have done to ensure victory, to save lives and to make the winning of the war so much more pleasant than would otherwise have been the case.

I recently encountered (and I don't mean met) a National Service Officer who really thought that the only use for radio in the forward areas was to provide the troops with light entertainment! There was a man who held the destiny of hundreds in the palm of his hand, yet knew nothing of the achievements of electronics.

Needless to add, when I left him he had an impression that there was something more to radio than horror serials. I hope that I did not reveal any of the "Confidential" and "Top Secret" angles on the latest methods of gun aiming, shell velocity measuring, and so on.

I feel that it is the duty of every one of our readers to do what he can to spread the gospel about radio and radar, even if he can only go as far as to tell what has already been released in our recent articles on radar and the vital part it played in the Battle of Britain.

There is so much about radio that is not worthy. Many of the abuses of broadcasting must make the radio pioneers squirm in their graves, but at least radio's part in the fight for freedom is something worth while for the poets to write about.

Let's all do our part and make the most of it. It is a fine topic for conversation with your friends and customers.

A. G. HULL.

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.

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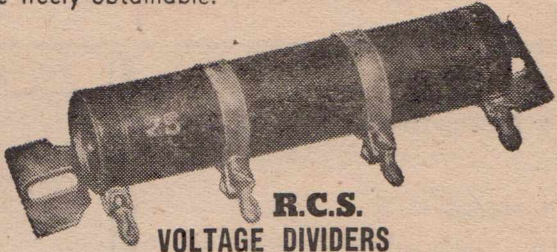


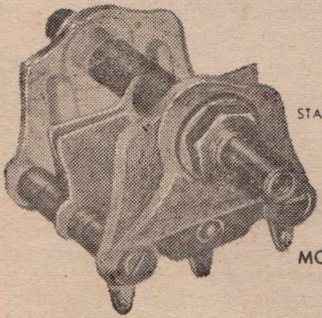
R.C.S. VOLTAGE DIVIDERS

R.C.S. Voltage Dividers are wound with 42 BMS Oxidised Nichrome wire, guaranteed best performance.

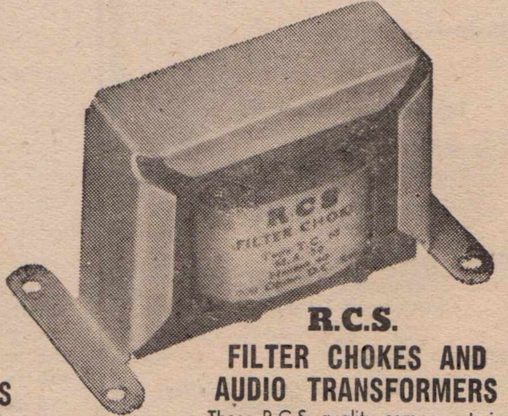
VD.25. 15000 Ohm. VD.28. 25000 Ohm.

R.C.S. STAR AND M/C CONDENSERS

R.C.S. Midget condensers feature Trolitul end plates and are available in single and double bearing types.



		Max. Cap. MMFD.	Min. Cap. MMFD.	Plates
STAR	CV34	10	3	2
	CV35	15	3	3
	CV36	25	3.5	4
	CV37	35	4	5
	CV38	50	4	7
	CV39	70	5	9
	CV40	100	6	14
MC	CV41	10	3	2
	CV42	15	3	3
	CV43	25	3.5	4
	CV44	35	4	5
	CV45	50	4	7
	CV46	70	5	9
	CV47	100	6	14



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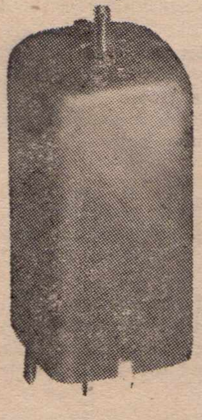
TC70. H.T. Vibrator Chokes



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R.C.S. I.F. Transformers are of registered design, are permeability tuned and feature the exclusive R.C.S. Trolitul base, with special condenser pockets. Coils are wound with 7/41 Litz wire.

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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.

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

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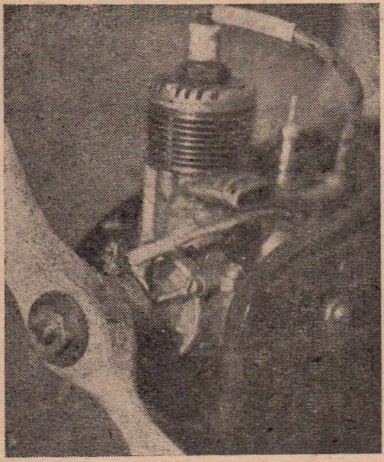
R.C.S. RADIO PTY. LTD.

174 CANTERBURY ROAD, CANTERBURY.

RADIO FOR MODEL PLANES

A FAVOURITE hobby in post-war years should be the flying of radio-controlled model aeroplanes. The making and flying of model aeroplanes is in itself good sport, especially contest flying, but the addition of radio control should be an added interest. Possibly some of our readers are not up-to-date on their model aero technique and think along the lines of models which fly under the power obtained from twisting rubber bands. Nowadays the modern model aeroplane has a "real" petrol motor, weighing four or five ounces, with a piston displacement of from a quarter to half a cubic inch, but 7,000 revolutions per minute and a bark like a racing motor-bike.

These little motors were brought to a high degree of reliability in America in 1939 and 1940. Previously they had been a trifle erratic at starting and in their behaviour in general, but constant attention to detail eventually produced motors which were really satisfactory in every way. Motors have been made in Australia, too, with varying degrees of success, and about three different types are at present available at prices under £10 each. The smallest, but most expensive of these is a job with a displacement of just under a quarter cubic inch, weighing just over 5 ounces, and is a reliable starter and performer in every way. It is built by an experienced flier who was prominent in the contests conducted by the Model Aeronautical Association before the war.



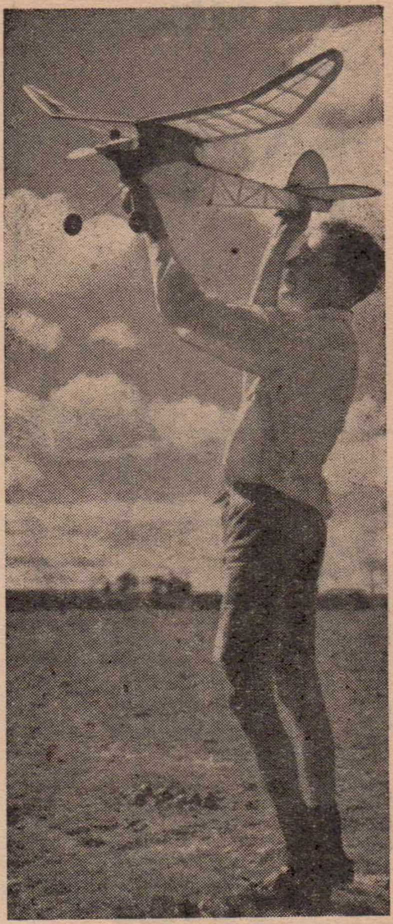
A Sydney-made motor weighing 5 ounces. Piston displacement is less than a quarter of a cubic inch.

Without radio control the flying of the model is largely under the influence of the prevailing wind. The model is adjusted to climb in circles under power and then the ignition is cut automatically by a timing device. With the motor shut off the model then glides like an eagle, soaring in circles and slowly descending. However, it drifts away from the point at which it was launched at about the same speed as the prevailing wind. Consequently, the model flier has to wait for calm weather, or else indulge in energetic cross-country running. With radio control it becomes possible to direct the model, head it into the wind if necessary and eventually bring it back to land at the spot from which it ascended.

Done in America

Radio-controlled planes were operated to quite a big extent in America just prior to the war, special contests for models of this type being held at the National Championships in 1940 and 1941. Prominent American radio "hams" entered models with planes fitted with radio receivers weighing, complete with batteries, under three pounds.

Before suitable petrol motors were available, the late Ross Hull did considerable work on radio-controlled gliders, and he experimented with a large model glider with a wing span of twelve feet. This model glider was launched from the side of a hill near Hartford in Connecticut and then brought under radio control so that it could be circled to take advantage of any rising currents of air which were available.



Trevor Evans, of Bathurst, is a keen model flyer and radio enthusiast. He operated VK2NS before the war.

(Continued on page 29)

Holder of the Australasian National Championship for petrol-powered models, built and flown by A. G. Hull.

ELIMINATING HUM

THE problem of hum reduction or elimination is one that has constantly been kept in mind by the writer and has been the subject of much experimenting.

At the outset it was decided that the best possible musical performance from a radiogram would call for a simple tuner with push-pull triode output. Such an outfit has now been in constant use for many years.

By
A. J. BARNES
87 Murriverie Road
North Bondi

Irreducible Minimum

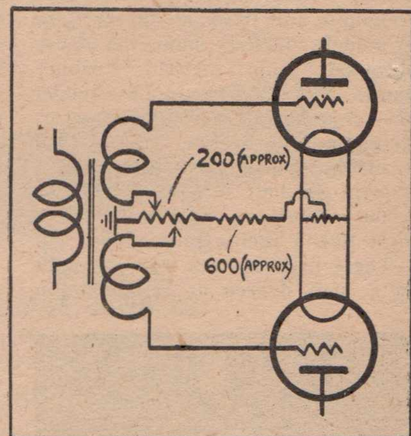
The circuit has basically remained unchanged during this time, but nevertheless many hours of work and much thought have been expended with the elimination of hum in view. The result is that we have an outfit capable of tremendous volume and excellent reproduction, with a residual hum level discernible only if one's face is turned sideways and held inside the speaker cone. This seems to be the irreducible minimum. Some enthusiasts may consider that I am over particular in this regard, but it should be kept in mind that the outfit is used as an all-purpose entertainment unit and one cannot very well enjoy a radio play, for instance, if it is accompanied by a steady and irritating buzz.

Single Chassis

The chassis of my radiogram when originally built consisted of a large cadmium-plated steel tray, which carried tuner, amplifier and power pack. Whilst in this stage many interesting points in connection with the reduction of hum were noted.

Beyond a certain point, no additional filtering or de-coupling would reduce hum. The first successful move consisted of temporarily lengthening the leads to the audio driver transformer and turning it about. It was found that a certain position gave a marked reduction in hum. The transformer in this position was standing on the corner of one mounting foot, so a bracket was made to hold it in this unorthodox position.

After this we made a most unusual discovery. Hum was still apparent from the speaker even when completely disconnected from the chassis which had the rectifier valve removed! Now, there was no audible mechanical hum from the power transformer but we found that the speaker cone was reproducing as sound inaudible vibrations conducted through the solid inch timber cabinet from the power transformer.



We made extra heavy clamp brackets and bolts and brackets for the power transformer, which was then mechanically insulated from the chassis with rubber blocks and bushings. The speaker was also mounted on rubber blocks, by which time the hum level was low enough to satisfy most enthusiasts—but not this one!

Separate Chassis

The next step was a big one—a complete rebuild, with power supply separated completely from the tuner-amplifier. Non-magnetic material for the trays was decided upon, as this would eliminate any possibility of magnetic buzz or eddy currents. After much searching, an odd piece of aluminium was obtained for the trays. Incidentally, in order to keep the filament volts at their proper level, we had to make the leads between chassis from heavy auto-wiring cable with plug and socket especially chosen for

(Continued on page 29)

TRADE WITH AMERICA

Some thoughts on the prospects of post-war competition from imported radio equipment

DURING my visit to America I was anxious to find out the extent to which that country and Australia could trade with each other. It seemed to me that this was an important question from the viewpoint of Australian manufacturers, exporters and importers. Furthermore, it can strongly affect our trading arrangements within the British Empire

By
A. G. WARNER
Electronic Industries Ltd.
Melbourne

and, in particular, with England, because a reduction in our purchases from America would probably increase our purchases from England and Europe.

Accordingly, I made enquiries in many directions and from these enquiries I obtained a number of facts which have led me to the conclusion that the amount of trade between Australia and America—both exporting and importing—will not be increased over pre-war standards or be great.

American Purchases

First, I enquired as to the possibility of America purchasing large quantities of Australian exports. It is obvious that America is a large country having cold northern boundaries and semi-tropical southern boundaries. Within this area, America is able to produce practically every form of primary product. There are a few exceptions—tea, rubber, coffee, etc.—but even these articles are obtained from countries closely associated with America, such as the Philippines and Cuba, and are not produced in Australia.

When you examine the list of primary products which Australia grows or produces, you find that America has every one of them in some degree. Wool, wheat, butter, eggs, etc., are all grown in America. In addition, America also produces most of the metals produced in Australia.

Political Influences

The primary producers form a strong political body. They appear to stick very firmly and rigidly together. All of them resent any attack upon the individual product of any one of them. They have secured high protective tariffs or, alternatively, restrictive laws which prevent Australian exports finding a market within America; for example, the import of fruit is prohibited into America on the grounds that it may be diseased.

In spite of the fact that American Congress has recently been persuaded to hand over to the State Department of Commerce the right to make trade treaties, which implies the lowering of duties on primary products, I still feel that, since America does not need our products and since a large percentage of her community, i.e., the primary producers, does not want them to be purchased, that the State Department will remain "ham-strung" in its efforts to encourage American import of our products. The Act empowering the Department of Commerce to handle international trade treaties makes it encumbent upon the State Department to seek the advice of the Department of Agriculture and other similar bodies. It appears that the authority given to the State Department was given with qualifications.

I did find that the average American citizen realised that, theoretically, they could not hope to expand their export market unless they were prepared to buy from overseas countries. Theoretically, America is in favour of buying overseas goods in order to expand international trade; when, however, you discuss with any American producer of any

Mr. A. G. WARNER

possible import into America, he is strongly of the opinion that something should be imported but not what he is producing, and there is a strong political body which supports him in his attitude. In simple language, the average American thinks importing is a good idea as long as it does not hurt his particular industry.

Farm Employment

It has to be realised that if America did break down her tariff and other restrictions which prevent the importation of Australian primary products and that of other countries, it might have some disruptive effects upon the employment amongst farm labourers and upon the value of agricultural land within America. Immediately this fact became evident or even slightly evident, I feel that such an uproar would arise that the imports into America would immediately be restricted by the application of political pressure.

Assume for the time being that my views on Australian export to the United States are substantially correct. There then comes the question: What can we buy from America and how? Firstly, Australia needs dollars in order to buy American goods with dollars. Where can Australia obtain these dollars?

(Continued on next page)

AMERICA

(Continued)

There are two possible sources:

(1) Obtain the dollars from our own exports; or

(2) Buy the dollars in the world exchange markets.

Substantially, I think we may ignore (1) because I do not think we can export to America. If, then, we go into the world's market seeking dollars, I believe we will find that most other countries will also be buyers. In other words, since America does not need many goods, the world is and will remain dollar hungry.

Dollar Shortage

Apart from the trading conditions which will create and continue to create a dollar shortage, America starts her post-war trading with the handicap of an existing world shortage of dollars. This is created by war and other debts to America. Insofar as the war debts are concerned, it is of great importance in the international trading picture that they should be spread over many, many years. If payments of these war debts is called for over a short period, it will act as an overwhelming breaking power upon America's ability to export and it will alone be sufficient to wreck the possible American export business, except in the case of two or three South American countries and Spain and Sweden, who are not in the position of dollar debtors because of America's temporary wartime purchase of goods and services.

Inflation in America

In addition to the fact that we cannot obtain dollars, there are reasons why countries such as England, Italy, Germany, Russia and possibly Japan will, in due course, be better markets from which we can obtain goods. America has gone through a period of inflation. She has not, since 1935, balanced her budget. The difference between the taxes and the expenditure has been found by the expedients of expanding credit and by local loans. The continuously increasing American loan and interest indebtedness to her own people is constantly raising her annual budget expenses. Added to this, there has been an increase in war expenditure and there will be an increasing expenditure due to the aftermath of war—example: repatriation, pensions, rehabilitation, etc. America, therefore, must meet a continuously rising bill of fixed charges. The combination of loans and the increase of credit has caused the American dollar to be deflated in value, or, in other words, the cost of goods has been inflated.

Rising Prices

Apart from any questions of theory about this matter, the rising prices are a self-evident fact. It is my opinion and that of many banking authorities in America, that the Australian pound will buy, in Australia, as much as $9 will buy in America, particularly if the price comparison is made upon the simple things of life such as food, clothing and rent.

Exchange Rates

At the present time when we exchange a pound for dollars, we only get $3.25. Consequently, apart from all other considerations, we have to pay nearly three times the value in order to buy American goods because the exchange value of our pound is only about one-third of its home buying value. So we have already two reasons why it is difficult to buy from America: (1) There is a shortage of dollars; (2) dollars are very expensive, and therefore American purchase prices are very high to the Australian buyers.

In addition to these facts, there is growing in America a strong Labour outlook which is insisting upon more money for less work. From a Labour point of view they may be fully justified. It is quite probable that a better distribution of wealth in America is overdue. However, as a matter of fact, a labour hour in America is expensive and looks like remaining expensive. This is another reason which makes for high prices in America.

The country, generally, appears to be involved in a fairly rapid spiral of increasing inflationary prices, followed by demands for increased wages, causing increased costs and increased prices and more demands for higher wages. Only a prophet could tell you if it will stop, when it will stop, and how far the reaction will be when the next slump occurs.

Production Costs

Such a deflationary effect may occur and create prices at which we can buy. In addition, it does appear that the American production per man hour in many industries is ahead of all other manufacturing countries in the world.

The "London Economist" has stated that the American man hour production is two and one-half times that of the British. Whilst I am loath to dispute with such a world authority, I must say that I do not believe this and I am aware that it certainly is not true of the ship-building industry, where England leads the world in the tonnage produced for a given number of labour hours. It may be that the "Economist," in making their valuations of man hour production, have used the present exchange rates which do not, to my mind, reflect true values but are merely an indication of the shortage of dollars and their high price measured in other currencies.

Incidentally, the Americans seem very anxious to maintain a merchant fleet for reasons of defence, pride, and a desire to engage in international trade. Few Americans appear to realise that the British merchant fleet did not create British international trade. They fail to realise that ships follow trade and not trade ships. When you ask the Americans what the ships are going to bring back to America after they have carried the exports away, there is never a satisfactory answer, and traffic may be somewhat expensive, when you suggest that one-way there appears to be no comeback.

The Bretton Woods Plan

There is no doubt that those Government officials responsible for fostering American international trade are fully alive to all these points. The Bretton Woods plan is an attempt by America and other nations to foster the very desirable international commerce and the American authorities realise that, because she has the biggest block of people (130 millions) living within one customs barrier and having the highest standard of living in the world, that she is the one nation with sufficient buying power and overseas exchange balances to start world trade in the post-war period.

American Sentiment

The Americans seem to have a sentimental and theoretical desire to assist the world in rehabilitation and, if they will use their power of investment overseas, they could decrease the world's dollar shortage. The Bretton Woods plan has been inaugurated to assist in this object. Nobody claims that the Bretton Woods plan is capable of alone achieving the desired results. The planners realise that to attain international trade a correction of exchange rates will have to be made and to do this a high standard of living is necessary—at least among the leading nations of the world, particularly in England and the United States, if only for the reason that they share one-quarter of the world's trade between them.

Initially, the Bretton Woods plan aims to stabilise exchange rates more closely to real values and to maintain these rates by temporary loans of exchange from an international fund. This indicates that stable, reasonable exchange rates, however, cannot be held against ad-

(Continued on page 25)

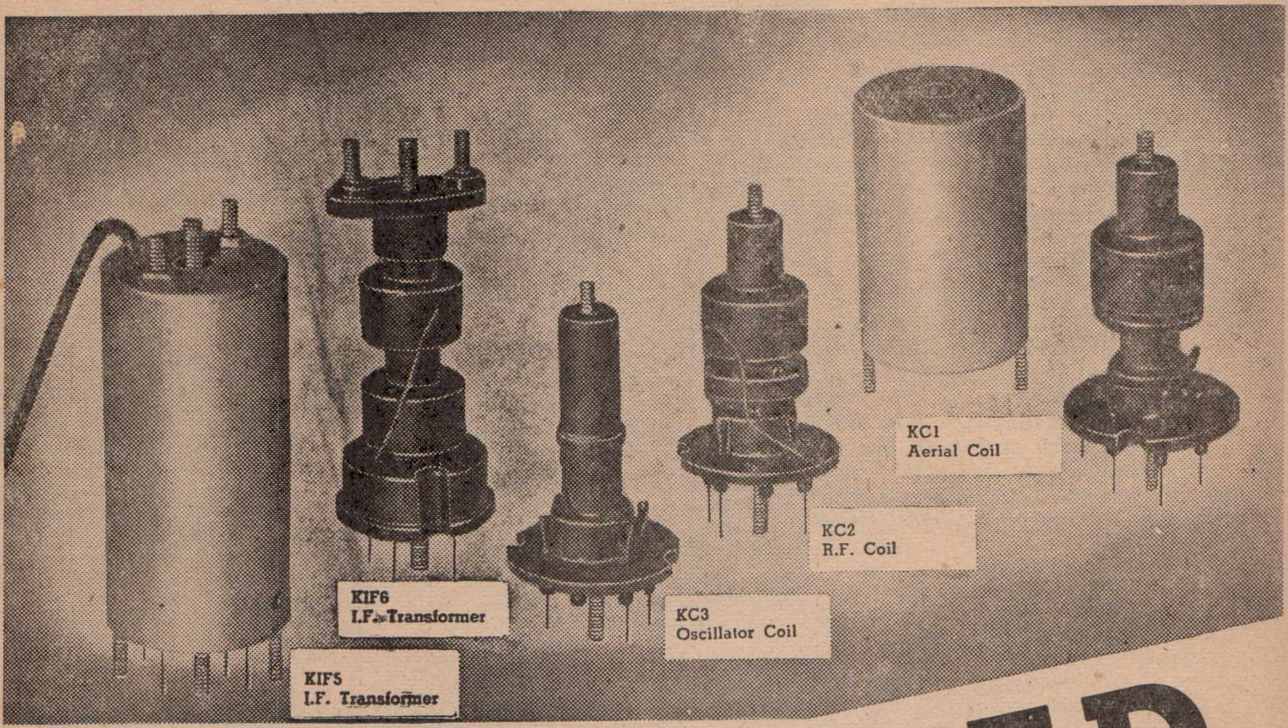
CLYDE BATTERIES

For greater convenience in office administration and distribution, the battery section of The Clyde Engineering Co. Ltd. will be conducted, as from 1st July, in the name of its subsidiary company, "Clyde Batteries Pty. Ltd."

The new company has taken over the entire plant, manufacturing and distribution of these favourably-known batteries at the Clyde Works, Granville, N.S.W. Mr. J. Roberts will continue as Battery Sales Manager for Australia.

Mr. James Pincott, who is in charge of battery production, will proceed shortly on an extended business tour on behalf of the new company. His itinerary will include the United States and Canada, and will extend over some months.

25 KEEN DISTRIBUTORS "MEAN BUSINESS"



PERMACLAD

Obviously our "Permaclad" Defence commitments come first, but we are doing all that is humanly possible to assist Radio Servicemen with essential replacement components.

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KR553

MAKING PAPER CONDENSERS

A RADIO serviceman or engineer can only hope to fully grasp his work after he has made a thorough study of both the theoretical and practical angles of the science. Even then it might be said that radiomen are born to the job. It is certain that some people adapt themselves to radio work a lot better than others. Some triers simply lack the necessary amount of imagination to handle the little radio impulses which dance through the receiver without being seen. With most mechanical devices you have something tangible to work on. With a motor engine you can actually see and handle the piston which moves up and down in the cylinder. You can feel the wear in bearings, but you can't see the electrons in a radio tube. Yes, we'd say that one of the principal requirements of a good radioman is a well-developed imagination. Next in line comes another vital requirement: a good sense of humour or perhaps you would call it a well-controlled temper! But that is another story.

By

A. G. HULL

What we started out to say was that, in addition to theory and practice, it is highly desirable to know the inside story of the various components used in radio assemblies. Here is just such an inside story, dealing with the manufacture of paper-dielectric capacitors. Apart from a few top-ranking radio engineers in the condenser factories, it is surprising how little is known about condenser construction by the average radio serviceman or engineer.

A Troublesome Component

As every serviceman knows, the paper condenser is a frequent cause of breakdowns in radio receivers. Radio servicemen have expressed the opinion that more than a million paper condensers are required in Australia each year for repairs and maintenance alone.

The usual culprit is the .1 microfarad condenser fitted across the main high tension supply in parallel with the second filter condenser.

To some it seems rather superfluous to have a paper condenser at this spot in the circuit, and often enough the broken-down condenser can be cut out of the set with a pair of pliers and the receiver will then operate quite normally. Fitting the condenser is good practice, however, as the characteristics of the electrolytic filter condenser are far from ideal when it comes to by-passing r.f. energy. Sometimes it is possible to do without the paper condenser, but often enough its omission will result in uncontrollable instability.

Breakdown Causes

The reason for the frequent breakdown of the condenser used is another story in itself. Sometimes it is simply due to using a 400-volt condenser. Normally the voltage across the condenser is only 275 volts, and at a glance it might seem that a 400-volt rating gives ample reserve, but practical results indicate otherwise. The condenser is subjected to r.f. and audio peaks in operation, and for the first half minute after the set is switched on it will get the full 385 volts high tension, plus any peaking which occurs due to the regulation of the transformer and rectifier. At normal load the output of the rectifier is designed to be 385 volts, but at practically no load there is every chance that the transformer will deliver up to 450 volts of alternating current, and the rectifier, working on the peaks of this a.c. will deliver an actual 500 volts of direct current.

To be on the safe side the replacement condenser should have a working voltage rating of 600 volts.

Even so, the peak voltage is not the only factor in condenser breakdown. A good 400-volt condenser when new and in perfect condition should stand a short pressure of 1,000 volts without difficulty. The trouble really starts when moisture has found its way into the inside of the condenser; acidity in the impregnant has eaten a hole through the paper, or one of a dozen forms of electrolosis has got to work to impair the ability of the condenser to withstand voltage.

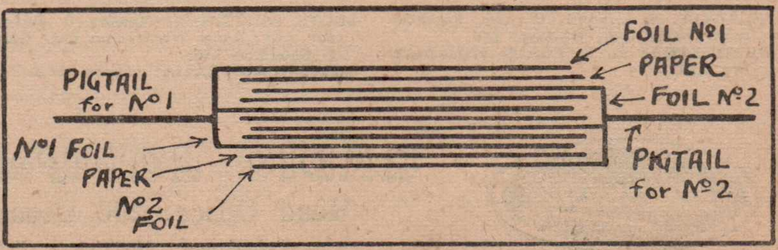
The main objective of the condenser manufacturer is to make the best possible condenser and then seal it up in such a way that the outside atmospheric conditions cannot get inside to do their foul work. The history of the various cans and casings which have been used from time to time is in itself quite interesting.

The Cans

Many years before radio broadcasting had brought us the joys (?) of serials and quiz contests, the paper condenser was widely used in telephone and electrical applications. Its construction was usually arranged with the roll of foil and paper set in a tin can full of bitumen compound. In such a guise it was quite cheap to manufacture and withstood climatic conditions remarkably well. Many hold the opinion today that the modern condensers have little, if any, advantage over the old telephone condenser.

In the early days of radio a somewhat similar type of condenser was popular, with a slight variation in the form of English T.C.C. and

(Continued on page 13)



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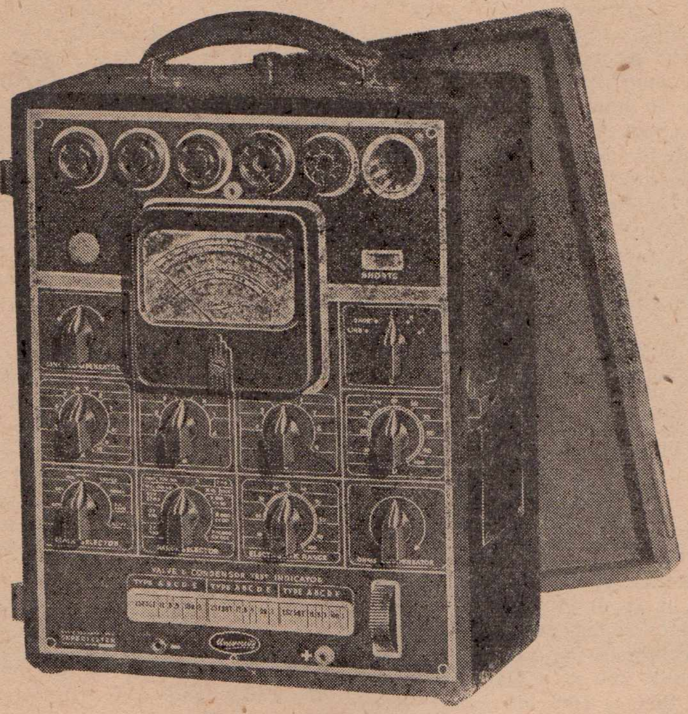

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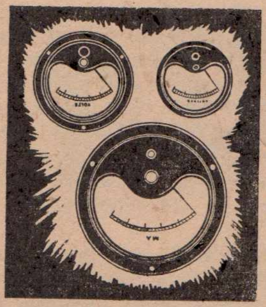

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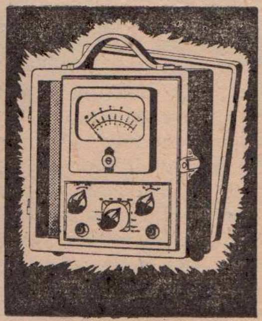

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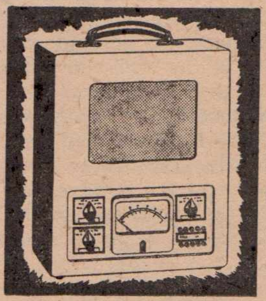

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PAPER CONDENSERS

(Continued)

Ferranti condensers made up in a moulded bakelite case, with terminals at the top and the unit pushed in from the bottom, packed in with some sort of pitch.

Often enough these condensers were designed to stand up to 200 or 250 volts; sometimes branded with a comparatively irrelevant peak test voltage such as 2,000 volts; sometimes not branded with any voltage rating at all. Small wonder, then, that when we started to build powerful a.c. operated receivers we ran into plenty of condenser trouble. Then came direct-coupled circuits with normal voltages of 475 to 750 volts and peaks considerably beyond. The mortality amongst condensers was terrific until somebody woke up to the matter of voltage ratings. During the turmoil the German "Hydra" brand condensers gained a wonderful reputation for themselves, being clearly branded with a definite working voltage and standing up to that voltage without alibis or apologies.

Comes the Electrolytic

With the passing of time and the passing of direct-coupled circuits and so on, so passed out the tinned can condensers so far as radio sets were concerned. The 4-microfarad filter condensers were swept aside by the introduction of wet electrolytic condensers, a step which is often regretted to this day. There are still plenty of enthusiasts who insist on paper filter condensers for their high-quality amplifiers, and many engineers who feel that the day will come when the paper condenser will regain the market at present so fully in the grip of various types of dry and semi-dry electrolytics which often lack the advantage which was such a vital factor in the triumph of the wet electrolytic over the original paper filter condensers.

Self-healing

The wet electrolytic had a remarkable advantage in that it did not "break down" like the paper condenser. If overloaded with excessive voltage it simply leaked a little current through, but as soon as the overload was removed the condenser returned to normal. If the overload was very heavy and maintained for a long period the condenser might hiss a little, overheat and even spew a little of its electrolyte out through the rubber vent at the top, but it seldom broke down with that degree of definiteness which means that the rectifier burns out and possibly the transformer as well!

Tubular Condensers

At about the same time as the paper filter condenser was displaced from the market by the electrolytic condenser, the paper bypass condenser of the tin can variety was displaced by the tubular or cartridge-type condenser. The difference was mainly on the outside, the same roll of foil and tissue being fitted inside, but with a cardboard cylinder and a pair of "pigtail" wires for terminals. To the set manufacturer the tubular was a great time saver, and time is money in the radio business. It could be soldered straight into position, hanging by its pigtails, saving hookup wire, and the drilling of mounting holes. Later it was found to be good practice to arrange some other form of support for the tubular condenser, or to solder it on to a terminal strip with short pigtails, but in the meantime the tin-can condenser had faded into oblivion so far as the radio manufacturer was concerned.

Moulded Cases

The cardboard cylinder held sway for a long time, but of recent years there has been a tendency to replace it with the moulded type, a low-melting type of resin-baked moulding compound being placed around the coil of paper and foil by an injection moulding or simply by dipping in a pot of molten compound and then squeezing into shape in a suitable die. The unit is then either put in a paper wrapper to show the brand and ratings or else these are printed directly on to the moulding compound in ink.

Such condensers have a couple of minor drawbacks. Sometimes the moulding is so brittle that to drop a condenser on the floor will cause the moulding to shatter. Sometimes the melting point is so low that the moulding will soften on a hot day, especially up north. There is also considerable trouble to get the compound to stick to the pigtail wire in order to avoid moisture creeping up the wire and getting into the vital spots. The moulding compound itself is waterproof enough for all practical purposes and a well-made moulded condenser can be depended upon to give reasonable service under most conditions.

Hermetically-sealed Condensers

Future development appears to lie along the line of producing sealed condensers which are absolutely water-tight and moisture-proof to the highest degree. Several different ways of sealing are being tried. One way is to use a glass envelope, having the drawback that it is even more brittle than the moulding, and stands a fair chance of getting broken even without dropping it on the floor! Then there are ways of using ceramic tubing with metal ends soldered to the ceramic. Alternatively the cylinder can be metal and the ends made of ceramic with insetted terminals. Soldering of metal to ceramic is achieved by depositing a metal coating on the ceramic by an electrolytic process, but it is doubtful whether it can be considered as really practical in a business way. Such condensers are expensive to make, heavy in weight and do not seem to be an ideal solution to the problem.

Still another method is to take an ordinary cartridge-type condenser, solder metal caps to the pigtails where they enter the cardboard and then fit the whole unit in a rubber sleeve.

Internal Construction

If you don't know what the inside of a tubular condenser looks like, you should certainly get a broken-down one out of the junk box and open it up.

Inside you will find the two condenser plates consist of rolls of tinfoil or aluminium foil, separated from each other by three or four thicknesses of waxed paper. One piece of foil overlaps the paper on one end. The other foil overlaps at the other end. The pigtails connect to the overlapping edges.

The Foil

There are two main types of foil used—tinfoil, consisting of an alloy of tin and lead, and aluminium foil. Both are made in thicknesses of

(Continued on next page)

PAPER CONDENSERS

(Continued)

about a quarter of a thousandth of an inch, as used in normal by-pass condensers. Price, per pound, is slightly higher for the aluminium foil, but when you consider that it is area, not weight, that counts in making the condenser you will find that the aluminium foil is much cheaper. It presents a problem, however. This is in regard to soldering the tinned copper pigtail to the aluminium. It is not easy to make a good joint. A faulty joint can cause intermittent contact, and condensers with this trouble are often at the root of the serviceman's nightmare—the set which comes and goes, and the irate customer who comes and goes with the set. Specially-designed soldering machines with wiping blades of dural, instead of a copper "iron," are used to try and overcome the difficulty, but in the long run it is often the moulding compound which holds the pigtail to the foil.

Condenser Tissue

The tissue paper is also very thin, usually between a quarter of a thousandth of an inch and half a thousandth. Several layers of paper are used so that if there are any minute pinholes in the paper they are not likely to occur on top of each other. Two papers are used for condensers with a 200-volt rating, three for condensers of 400 volts and four for 600 volts. Of course, different manufacturers have their own ideas. Some prefer four papers of .0003 thick, rather than 3 papers each .0004 thick, and claim that, although the thickness of paper remains the same the effective voltage rating is better. The capacity of the condenser is influenced by the distance between the plates, together with other factors; so that a condenser with a 600-volt rating needs a lot more area of foil than a 400-volt condenser with its foils closer together, other things being equal.

Another factor in the size of the finished winding of the condenser for any given capacity is the dielectric constant of the impregnant used to "wax" the paper, this being done after the papers and foils have been wound. Popularly known as "K" in formulae, the dielectric constant governs the capacity for a given area and distance between condenser plates. If you have air between the plates the capacity may be 1 microfarad. With the same area and spacing but mica between the plates instead of air, the capacity might be about 6 or 7 microfarads. This means that the dielectric constant of mica must be about 6 or 7. Consequently, for the cheapest and smallest paper condensers it would appear best to use an impregnant with the highest possible dielectric constant. In practice this is found as a reason for the popularity of chlorinated napthalene, a synthetic wax available under the trade name of "Halowax." This wax was used in a lot of the Solar condensers which were imported from America a few years ago, and servicemen will know that peculiar smell which the wax gives off when heated with the soldering iron. In big quantities that smell might prove dangerous, as boiling chlorinated napthalene can give off free chlorine, which is anything but healthy!

Another factor must be considered with the impregnant. This is the matter of voltage breakdown.. Not all impregnants have the same insulation factor and the breakdown voltage rating for a condenser with three papers of .0004 will vary quite a bit according to the impregnant used. Thus the manufacturer of condensers is faced with quite a mathematical problem when he is trying to work out whether it would pay to use an impregnant with a dielectric constant of 2 and a certain insulation resistance, or to use a wax with a "K" of 4, but a lower insulation factor.

Effects of Temperature

Another important consideration in the choice of the impregnant is its characteristics in regard to temperature, especially in relation to the moulding compound used for the outside casing. For example, to use an impregnant which boils at 70 degrees centigrade and then try to mould a case around it with a moulding compound at a temperature of 125 degrees centigrade is simply looking for trouble. When the heat from the moulding compound boils the impregnant, the boiling wax is going to try very hard to force an outlet through the casing.

Drying the Paper

The eventual service life of the condenser is greatly influenced by the degree of dryness which can be achieved in drying out the paper before it is impregnated, as well as by keeping moisture out afterwards. To get paper really dry is not as easy as it sounds and the big condenser factories go to a lot of trouble to dry the condenser winding under a vacuum, in a steam-heated pot maintained at around boiling temperature. With a powerful vacuum pump on the job the inside pressure is reduced as far as possible, making the drying process quicker and more thorough.

Acidity of the Impregnant

Needless to add, the impregnant must be free from acid of any kind, and must be in close contact with the paper and foil for a long time, yet must not cause any corrosion of any kind. In this regard a popular impregnant is the common yellow petroleum jelly, but its dielectric constant is not nearly as high as Halowax. Of course, the makers of Halowax claim that it is quite neutral and cannot cause corrosion, but from time to time we see suggestions for the use of other chemicals, such as anthraquinone, to be added to chlorinated naphthalene, and where there is smoke there is often fire!

Thermal Effects

Specifications covering the supply of condensers have been drawn up from time to time by various organisations buying large quantities of condensers and sometimes they bring up the subject of maintaining constant capacity under varying temperatures, even from such extremes as down to minus 55 degrees centigrade, and up to 85 degrees. To meet these requirements

(Continued on page 17)

SMALL HINTS FOR BIG EFFECTS

HERE are a few tips for the radio designer, small hints that might, however, have a big effect on the performance of the finished product.

First, about biassing: The diagram in Fig. 1 shows how easily we can obtain all the biases and A.V.C. delay voltage for a standard 4-valver with a single back biassing resistor. The only condition is that the out-

By
PAUL STEVENS
21 Fletcher's Avenue
Bondi

put valve be an EL3, which, however, is the natural choice for such a set in any case. The resistors A, B and C (Fig. 1) form a voltage divider network, breaking down the original 6-volt back bias necessary for the EL3 to –4.5 volts at point X (which is the delay voltage for the A.V.C. diode) and to –3 volts at point Y, from where the converter and I.F. valves get their bias. Resistor A (2 megs.) at the same time cuts the A.V.C. voltage down to two-thirds of its full value, which is a big advantage for such a small set, especially on weak stations. For the same reason should the A.V.C. diode be fed from the secondary of the second I.F. transformer.

Compensating Bias

There is, however, another angle on back biassing for output valves, this time from the attending serviceman's point of view. The back bias voltage is created by the B current of the whole set flowing through a resistor. In a big set the output valve current forms only about 50 per cent of the total and as soon as that valve gets a bit old and starts losing its emission, it gets badly overbiased and distorts. This is especially true of the 52 valve with its peculiar slow emitting cathode that reaches its maximum efficiency only after a minute or two and never shows more than 70-80 per cent when in good nick, mostly, however, much less. In big sets the output valve should therefore always be self-biased, whereby the bias voltage adjusts itself automatically to the state of the valve and some valves of only 25-30 per cent still give a clear, distortion-free reception on normal volume levels; the volume control will have to be turned up a little, of course. (Yes, I know: Worn-out valves should be replaced; but are they always obtainable and is the customer always willing or able to pay for them, when he is only waiting till the war is over to buy a new set? I have fixed many receivers by changing their output valves over to self bias!)

Increasing Gain

And back to our 4-valver: A home-made set like this usually has not got ample power reserves; even weak "locals" often do not come in too loudly with the volume control flat out. Commercial jobs, however, are usually more powerful. The secret lies in the especially designed closer coupled I.F. transformers, which give a big increase of gain at the cost of selectivity, which is not so important for local receivers. The I.F. transformers made available to the public by various coil manufacturers are mostly on a standard line for 5-valvers, which are not "hot" enough for the 4-valve job. Also the often recommended line of using two 2nd I.F. transformers for higher gain leads to many disappointments, as in most cases the only difference between "1st" and "2nd" I.F. transformers is the number on the wrapping carton. (The "1st" I.F.'s often have not even got grid leads soldered in!)

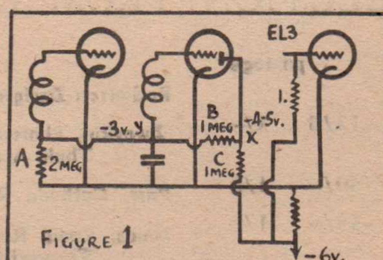

FIGURE 1

A novel arrangement of a voltage divider system for the back bias circuit.

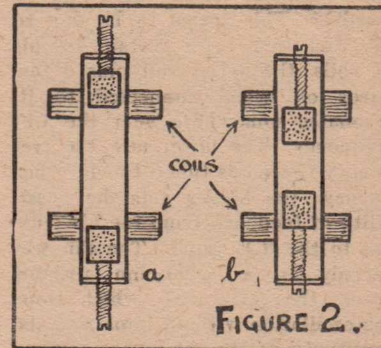

FIGURE 2.

Sections of intermediate coils showing how core adjustment can increase gain.

There is, however, a little trick in how to increase the gain considerably, provided you are using the standard permatune type. Just have a look at Fig. 2 (a) and (b). The coils are wound to resonate at a somewhat lower frequency than required with the cores full in. By gradually withdrawing the plugs the coils are being tuned in. Normally the coils are screwed outwards, as shown in Fig. 2 (a); but by screwing them in towards the centre (2, b) the same tuning can words, the closer to the I.F. frebe achieved, while at the same time the coupling between the coils is considerably increased by the plugs now forming a path for the magnetic lines of force for part of the space between the coils. The brass screws holding the plugs are then screwed in nearly as far as they will go and if they happen to be too short the I.F. frequency of the set will have to be lowered a few kc/s to bring the coils into tune. Sometimes best results might be obtained if only one core is screwed in, the other one remaining where it is.

Getting Stability

And again talking about those coils. Have you ever noticed that, when building a set highly efficient with full allowable voltage on the screws, and the right minimum bias for (R.F.), converter, and I.F. valves, and with all coils and I.F. transformers tuned in properly, you often get oscillation between the stations on the lower broadcast

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(Continued)

band (about from 2BL downwards)? This seems to be due to the fact that, with certain brands of coils, the aerial coil plus a few yards of aerial connected to it, resonates somewhere near the I.F. frequency. The lower now the frequency the set is tuned to—in other quency—the bigger gets the possibility of feedback from the I.F. output to the R.F. input. The simplest remedy is a 5,000-ohm resistor across the aerial coil, which stops the oscillation without impairing the sensitivity of the set to any noticeable extent.

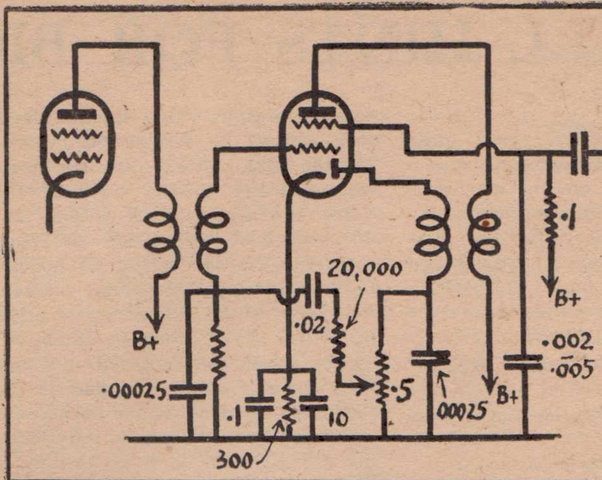


FIG. 3.

A variation of the usual reflex circuit in which the screen is used as plate for the audio amplifier.

Another Reflex Circuit

And here is a new variation of our good old standard reflex circuit (Fig. 3) which has a few advantages. Here the reflex valve (EBF2, 6G8G, etc.) works as a fully-powered I.F. amplifier, the screen grid of which is used as plate for the audio amplifier, which has a gain of about 20. The overall amplification of the whole arrangement might be slightly less than the conventional circuits (only triode audio amplification), but the big advantage is the shifting of the accent to a full unimpaired I.F. amplification, which brings about a reduction of the "minimum volume" effect and distortion and a general increase of the voltage handling capabilities of the valve. The only critical part is the by-passing of I.F. frequency from the screen grid without reducing the high note response too much. However, there is a well-known fact (seldom admitted by high-fidelity cranks) that 9 out of 10 people do not care at all for high notes, manifesting their dislike by turning the tone control to a more or less "mellow" position. So I decided to experiment, and I found that, according to taste, a .002 to .005 condenser gives a well-balanced tone to a mantle set with not too much bass response. As the impedance of even the smaller .002 condenser is less than 200 ohms for 460kc, which is ample, I left it at that. I should like to point out that this circuit is derived in principle from one of the latest models of a well-known Australian brand.

Trouble-free Service

And now a few hints on how to make a receiver give you the longest possible time of trouble-free service: First of all, buy only the best possible material, even if it costs you a few pennies more. A 1-watt resistor that goes "snap-crackle and pop" (with apologies to Kellogg's rice bubbles), if it is made to take that load, belongs in the garbage tin; the same applies to a 1,500-volt test, 400-volt working condenser that blows out on 200 volts. To make sure, always use banks of parallel or series resistors able to take 2 or 3 times the applied load, if no bigger suitable single resistors are available. Every condenser with more than 100 volts across should be of the 2,000-volt test type. If a condenser serves only as by-pass and not as hum filter as well, always put it between its "action station" and the point with less potential difference, be it chassis or B+. The by-pass condenser in the oscillator plate circuit of a converter, for instance, has to take 150-200 volts if connected to chassis, but only 50-100 volts if connected back to B+, which is therefore preferable. Put tone controls and speaker by-pass always between the speaker terminals and not to chassis or you are asking for trouble. And now the main point: Protect your set from the voltage surge between the moment after you switch it on and the rectifier (80, 5Y3G) heats up, to about six seconds later, when the rest of the valves are heated enough for the emission to set in! Most electrolytic and condenser breakdowns occur during this brief period when the voltage reaches 350 to 400 volts. That's why we should always and generally use only indirectly-heated rectifiers, which take as long as the other valves to get "alive," thus effectively preventing that deadly initial voltage surge.

Only the Best

And now, in connection with the last one, a final hint: **Only the latest and best is just good enough to be selected as our standard equipment!** If every radio man in this country would make this his slogan, Australia could easily get to be one of the most progressive radio countries in the world! As soon as a new valve, coil, electrolytic or other component has been developed, we should give it exhaustive tests and, if its superiority over its predecessor is proved, we should mercilessly discard the old and adopt the new! But I mean real, not phoney, progress! If we put the old 78 into a small glass envelope, fit an octal base, call the product 6K7G/6T and hail it as "the latest valve," that's just bluffiing! The same applies to, 6G7G-6DG 6Y7G-6C6, and many others. The 20-year-old "80" still haunts our modern sets as 5Y3G (its octal version), viciously blowing out condensers and electrolytics by its initial voltage surge (mentioned before). We discarded screen grid valves like 249 or 35 a long time ago; yet the 6A8G is still standard equipment in our sets, and what else is a pentagrid-converter like the 6A8G but a screen grid valve with an oscillator section in it? As for coils, we find that only now the superior "Permaclad" coil is making its appearance and soon other coil manufacturers will have to wake up out of their old smug complacency to adopt the new principle or lose the market! Yes, we all have to wake up! The old "what-was-good-enough - for - my-father-is-good-enough-for-me" mentality won't get us anywhere!

CONDENSERS

(Continued from page 14)

the most suitable impregnant would appear to be one of the mineral oils, but these again bring up the problem of having a comparatively low dielectric constant.

Acidity of the Operator

Elsewhere we mentioned the need for keeping acidity out of the impregnant and that also applies to the whole construction of the condenser. Great pains have to be taken to avoid perspiration from the winding machine operator getting on to the paper foil. Operators are tested regularly for acidity, as some people have considerably greater acidity in their perspiration. In some condenser factories every worker is checked for acidity with litmus paper each morning before starting work.

Dust on the paper can be dangerous to long life of the condenser and the ideal condenser factory has a winding room as dust-proof as possible, with an effective air-conditioning system.

Not Easy

From the above observations it will be seen that the manufacture of paper condensers is not easy. It takes a lot of intricate machinery to wind such thin tissue and foil without breaking it, a lot of expensive raw material and then the finished product has to sell for a few pence. Is it any wonder that most people prefer to earn the money to pay their income tax some simpler way?

THE S.O.S. COLUMN

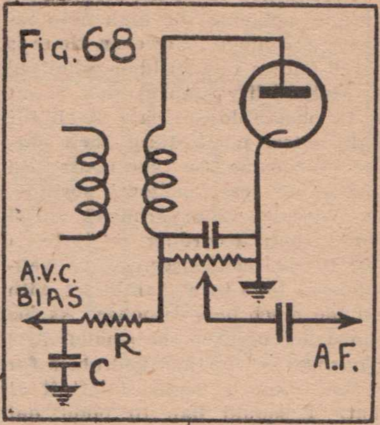
The following information has been sought by readers, but as we have been unable to assist, we are publishing them with an appeal to any readers who can help to let us have the data for publication:

V.D. (Bondi) wants the windings on the permags and data on the tone wheels used in the Hammond organ.

B.F. (Yarrawonga, Vic.) wants operating data and information on how to make the most of the following "Slade" equipment: type AD403 set analyser, type B304 oscillator, and type AC202 valve tester. He particularly wants to know how to test electrolytic condensers and the ranges of the oscillator.

A SHORT COURSE IN RADIO

PART 7 - - THE SUPERHETRODYNE



IF two different frequencies are introduced into the input of a valve (grid-cathode), in the output (plate-cathode) will appear, in addition to the two frequencies and their harmonics, the sum and difference of these two frequencies and with a suitably tuned circuit as the plate load, any one can be picked out and amplified.

If a receiver is tuned to 1,000kc/s and the oscillator to 1,456kc/s, their sum will be 2,456kc/s and difference 456kc/s, which in effect changes the frequency of the received signal from radio frequency to "intermediate" frequency.

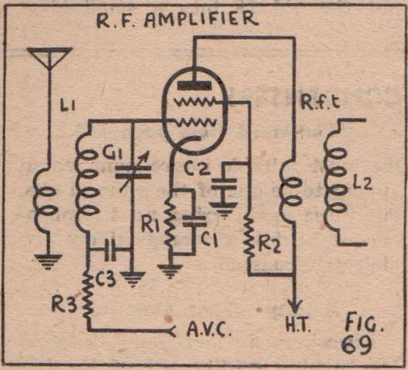
The I.F. Frequency

If the oscillator frequency is altered in step with the signal frequency, the difference between them will be constant, so no matter what frequency the receiver is tuned, the signal appearing across the plate load will always be the same frequency; in the above case, 456kc/s. So the following amplifiers are required to amplify and tune one frequency only, which is much easier to amplify and obtain a high degree of selectivity. Intermediate frequency transformers are capable of being designed with much greater efficiency than the ordinary tunable radio frequency transformers.

In the early days of superhets the intermediate frequency was produced by a rectification action on the received signal and the local oscillation and the valve performing this task was called the first detector. Now frequency changers do not use this method and are commonly known as a "converter" or "mixer."

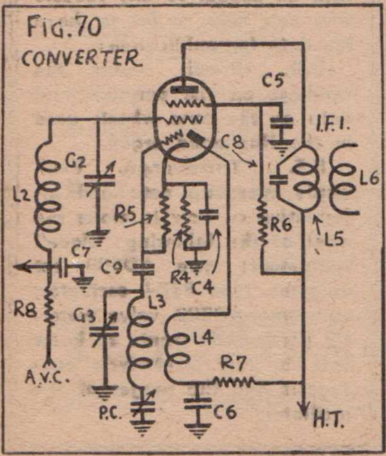
Suppressor Grids

The coupling between the signal and the oscillator frequencies should be kept to a minimum to avoid "interlocking," which means that the two frequencies tend to pull in step. To avoid this effect the oscillator output is introduced into the mixer by the suppressor grid of a R.F. pentode. The disadvantage of this system is that there is no screening between the suppressor and the plate. So another grid was introduced, an "injector grid," which is specially designed for the introduction of the oscillator voltage. The suppressor resumes its usual function.



Pentagrid Converters

It is possible to utilise this valve for the combined operation of oscillator and converter by the introduction of another grid, which is used as the oscillator plate. This type of valve is called the "pentagrid converter" because it possesses five grids. A suitable circuit for one of these valves is illustrated in Fig. 70; the cathode, oscillator grid and plate are connected to an ordinary feed-back oscillator circuit and the electron stream will be varied in accordance with these oscillations. It then passes on to the signal frequency section of the valve, which, in turn, will vary the electron stream in accordance with its own frequency. So the two frequencies are mixed together and the desired frequency may be picked up by the tuned plate load and passed on to the amplifiers.



Other Mixer Valves

The pentagrid converter is falling into disuse, as it suffers from several disadvantages, especially on the short-wave bands, as the mutual conductance of the oscillator section is rather low and oscillation is hard to maintain at the higher frequencies. There is a tendency to interlocking, as the shielding between the oscillator section and the signal grid is not perfect.

The triode-hexode and triode-heptode have superseded the pentagrid converter and, as their names imply, are two valves in the one envelope, the triode for the oscillator, and the hexode or heptode as the mixer, and are used in a similar manner to the separate oscillator and mixer valves. A circuit using one of these valves is shown in Fig. 75 and can be seen to be very similar to the pentagrid converter circuit.

Superhetrodyne Problems

The presence of an oscillator introduces certain troubles in this

FUNDAMENTALS - - By CHARLES ASTON

type of receiver and these will be now considered.

Images

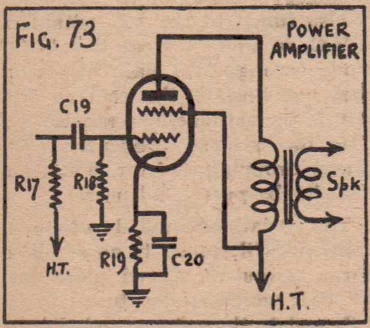
Frequency conversion introduces this type of interference and is due to the fact that there are two frequencies that will mix with the oscillator frequency, which will produce the same difference of (intermediate) frequency.

As an example of this interference, we will presume that the receiver is tuned to 11,500kc/s and that the intermediate frequency is 500kc/s, so that the oscillator will have to produce a frequency of 12,000kc/s. The difference is then 500kc/s. There is another signal with a frequency of 12,500kc/s also reaching the control grid of the mixer, and the difference between this and the oscillator frequency is also 500kc/s, so that the interfering signal will appear with the wanted one in the plate circuit.

Image interference troubles increase with the frequency of the incoming signals, as the percentage difference between the desired frequency and the image frequency decreases as the receiver is tuned to a higher frequency.

Need for R.F. Stage

With an intermediate frequency of around 450kc/s, image interference is very low for the broadcast band, but with the higher frequencies it is necessary to increase the selectivity of the receiver before the mixer valve. This may be done by the addition of a radio frequency amplifier ahead of the mixer stage, by using a higher intermediate frequency, say, 1,500kc/s, the degree of selectivity required before the mixer stage is reduced, as there would be 3,000kc/s separating the required signal from the one where the image originates.



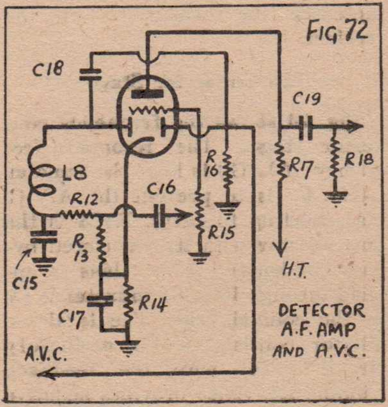
Background Noise

In the output of a superhet receiver may be heard a "hissing" noise which is caused by minute irregularities in the plate current of the mixer valve, and will be amplified by all the following stages. This hiss cannot be eliminated, but its effect may be reduced by increasing the signal to noise ratio with a R.F. amplifier ahead of the mixer, so that its output will contain a much larger proportion of signal than hiss.

It is obvious that increasing the gain after the mixer stage is practically useless, as the hiss will remain in the same ratio to the signal.

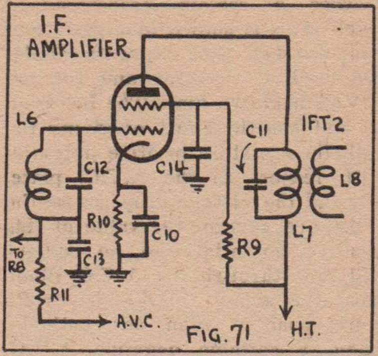
Automatic Volume Control

We are all aware that when radio signals are received over a distance



they are subject to fading. One moment the audio output may be loud and shortly after hardly audible. A system known as automatic volume control (A.V.C.) has been devised which tends to level out, in the receiver, these variations in carrier strength.

When a signal has been detected, we know that it still contains a large component of R.F. in addition to the A.F. currents. The amplitude of these R.F. currents is directly dependent on the strength of the received signal in the aerial. The A.V.C. voltage is obtained by using a diode to rectify the R.F. com-



ponent and arranged in such a manner that the voltage developed across a resistive load connected between the plate and cathode is negative to the cathode; the greater the R.F. amplitude the greater will be this negative voltage. If the grid circuits of the preceding variable mu valves are connected to this negative voltage, it will give them a bias that is negative to their cathodes. An increase in the negative grid bias of a variable mu valve will result in a reduction in amplification, so that, as the signal to the aerial increases, so the sensitivity of the receiver is reduced and, as the signal to the aerial falls away, so the sensitivity increases, and thus the resultant audio output is nearly constant for a wide variation of the input to the aerial.

Simple A.V.C.

Fig. 68 shows a circuit of a "simple A.V.C." system of the type just described; the resistor condenser combination, RC, is a filter to prevent the A.V.C. bias from varying with the modulation of the received carrier and if they were not included the negative bias would increase with the loud audio passages and decrease with the soft, which would smooth out the modulation of the carrier.

The disadvantage of the simple A.V.C. is that no matter how small the signal being received by the aerial, it will still cause a negative bias on the grids of the R.F. and I.F. valves, so their full gain will not be available when it is most needed. This may be overcome by arranging a delay so that a negative A.V.C. bias will be produced until the strength of the signal reaches a certain predetermined level. This is shown in Fig. 72 and can be seen that separate diodes are used as detector and for the A.V.C. negative bias. The inclusion of R14 has the effect of giving the cathode a certain positive potential with respect to the A.V.C. plate, P2, and the voltage drop across the resistance governs the value of this positive potential and no current will flow through the A.V.C. diode until the signal voltage drives P2 more positive than the cathode. Then, a suitable negative A.V.C. bias is produced.

With the "delayed" A.V.C. system it is necessary that the signal must have considerable amplification before being applied to this stage. It has the advantage over the simple type in that for varying inputs it will provide more uniform outputs.

A Receiver

Fig. 75 illustrates the circuit of a 5/6 valve superhetrodyne receiver of standard design. The operation of each valve and its component parts will be considered separately. As this will be more or less a summary of what we have already discussed, repetition is unavoidable.

The R.F. amplifier is shown in Fig. 69. The aerial is connected to earth through the primary of the "aerial coil," which is inductively coupled to the tuned circuit L1G1. C3 is of such a value that it has a negligible effect on the resonant frequency and is included in the circuit to prevent the A.V.C. bias shorting to earth. G_1 the tuning condenser, which is mechanically ganged to G2 and G3 in Fig. 70.

The frequency to which L1G1 is tuned is applied between the control grid and cathode of the radio frequency amplifying pentode valve.

R1 is the cathode bias resistor which makes the cathode positive to earth, thus making the grid negative to the cathode. C1 is for the purpose of allowing the R.F. currents to by-pass R1, thus giving them a low impedence path to the cathode.

The suppressor grid is connected directly to the cathode and is for the purpose of preventing secondary emission.

The screen grid is connected to the H.T. through the "screen dropping resistor" R2 and is of such a value that the voltage on the screen will be about equal to the potential of the electron stream at this point. C2 is the "screen-grid by-pass condenser" and keeps the screen at R.F. earth potential, thus acting as an electrostatic shield between the plate and grid, reducing their inter-electrode capacity, thus preventing feed-back from the output circuit to the input circuit.

The plate is connected to the H.T. through the primary of a radio frequency transformer which is inductively coupled to the tuned circuit L2G2.

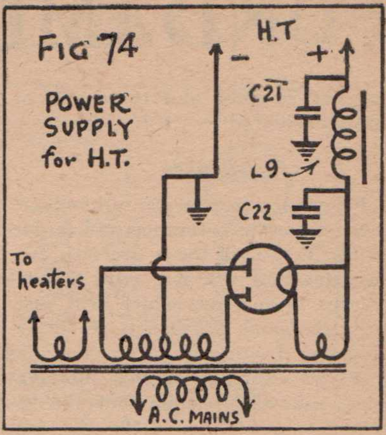
Signal-to-noise Ratio

The A.V.C. bias is applied to the grid through the resistors R11, R8 and R3 and through the inductance L1.

The R.F. stage increases the signal to noise ratio, reduces the possibility of image interference and increases the sensitivity of the receiver.

The Converter Stage

Fig. 70 shows the frequency converter stage. The resonant frequency of L2G2 is kept the same as L1G1. C7 is to prevent the A.V.C. bias shorting to earth. R4C4 is the bias resistor with its associated by-pass condenser. A.V.C. bias is applied through R11, R8 inductance L2 to the control grid. The local oscillator consists of the oscillatory circuit L3G3 with the feedback winding L4. C9R5 provides negative grid bias for the oscillator. The padder condenser, P.C., is for keeping the difference between the signal frequency and oscillator frequency constant over the whole tuning range. It may be done without by using different shaped plates in the condenser G3 to G1 and G2. If either of these precautions were not taken, the difference would vary over the tuning range and more so at the larger capacity settings. R7 is the "oscillator plate dropping resistor," and is required, as the voltage applied to this plate is usually considerably less than the H.T. supply: C6 is to by-pass to earth any oscillations that may be fed back in to the H.T. circuit.



After the frequency of the local oscillations have been impressed on the electron stream, it then comes under the influence of the control grid, to which is connected the tuned circuit L2G2, across which is developed the signal to which the receiver is tuned, which impresses its frequency variations on the electron stream, so that in the plate circuit will appear the sum and difference of these two frequencies to one of which the primary of the intermediate frequency transformer I.F.T.1 is tuned, which consists of a large inductance L5 tuned by the small capacity trimming condenser C8. R6 and C8 are the screen dropping resistor and by-pass condenser respectively.

Gang Trimmers

The three sections of the gang condenser, G1, G2 and G3 are all fitted with small capacity trimming condensers, so that variations in the condensers or tuning coils may be corrected.

The intermediate frequency amplifier is illustrated in Fig. 71. The control grid is connected to the secondary winding of I.F.T.1, which is also tuned to the I.F. with C12. A.V.C. is applied from the A.V.C. diode through R11 and this secondary winding to the control grid. R10 is the cathode bias resistor and C10 its by-pass condenser. The screep dropping resistor is R9, and C14 its by-pass condenser.

The variations applied to the control grid will appear in an amplified form across the tuned plate load L7 C11, which is also tuned to the I.F. and is the primary winding of

I.F.T.2; the H.T. is applied to the plate of the valve through this winding.

The diode-detector, A.V.C. diode and an A.F. triode amplifier are all contained in a single valve envelope in Fig. 72. We will consider the diode detector first. The signal is applied between the plate P1 and the cathode through the load resistance R12; the audio frequency variations are built up across this resistance and are picked off by the condenser C16, which is of such a value to offer a low impedence to A.F. currents and be a fairly high impedence to any of the R.F. component that may have escaped the filter C15 R13. These audio variations are then applied to the moving arm of the potentiometer, R15, and will develop a maximum value end remote from earth and a minimum when at the earthed end, and thus is an effective way of controlling the audio output of the receiver. The A.F. is applied to the grid of the triode section, which will cause plate current variations and will vary the voltage drop of the load resistor R17 so that an amplified version of the A.F. will appear across this resistor.

Delayed A.V.C.

The A.V.C. diode is connected to the signal voltage through the condenser C18 to P2, and the cathode; the A.V.C. voltage will appear across the resistor R16, which will have a delay voltage of a value depending on the value of R14. The A.V.C. voltage as taken from the resistor R16 still contains the audio component. This is filtered out by the resistance R11 and condenser C13. C17 is an audio by-pass condenser and should be of a larger value than these used in the high frequency stages.

Audio Amplifier

Returning to the audio voltage, C19 is of a similar value to C16 and should offer a low impedance to the whole audio range. The triode is a voltage amplifier as it is required to apply sufficient "swing" to the grid of the A.F. power amplifier.

The output pentode

Fig. 75 shows one of these pentode amplifiers that is required to supply A.F. power to the loud-speaker in its plate circuit and it is designed for this purpose rather than high voltage amplification. As a result, the plate draws a comparatively large current through the primary of the speaker transformer and the large variations in the grid voltages result in large current variations through this primary windings, which will be induced in the secondary winding and passed on to the loud-speaker, which reproduces them in the form of sound waves.

R10 is the bias resistor of the power amplifier valve and is required to carry a fairly heavy current; so a suitable wattage should be chosen. C20 should have a large value to offer a low impedence to the A.F. currents.

Rectifier Circuit

The power supply with its filter circuit is shown in Fig. 74 and can be seen to be a full-wave rectifier and its output is filtered by a "condenser-input" filter. As we know the output of the rectifier valve is pulsating, for a 50 c.p.s. supply, 100 times a second, and it is the purpose of the filter C22, L9 and C21 to smooth out these pulsations. Condenser C22 will charge up as the voltage is increasing, and when this applied voltage falls it will discharge into the load until the applied voltage rises, when it will once again be charged, and so the condenser acts as a kind of reservoir. The choke L9 will tend to oppose any change in the current flowing through it, and may consist of the field winding of the loud-speaker. Practically all the remaining ripple will be removed by condenser C21. The other secondary winding HH is for the valve heaters and is connected to them in parallel. The valves in this circuit all have the same heater voltage.

—— FINIS ——

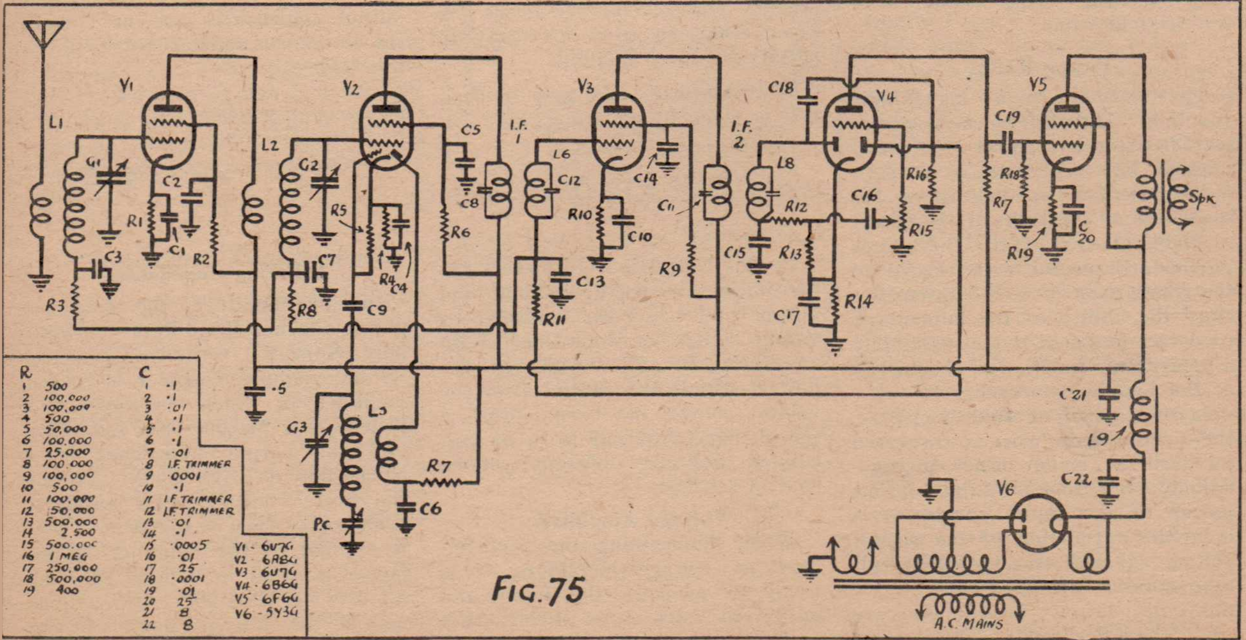


FIG. 75

DECIBEL -- A LOGARITHMIC FUNCTION

A DECIBEL is not a prehistoric monster, but the name of a power ratio unit which plays an important role in communication and sound engineering.

In the early stages of communication engineering, when the telephone was the only commercial system of voice transmission, engineers realised the necessity for establishing a unit to indicate the attenuation of signal between two given points on a transmission line. They decided that the attenuation introduced in one mile of standard telephone cable should be adopted as the unit, which was termed "a transmission unit," or "T.U." Later on, the name of this unit was changed to the "Bel," in memory of Dr. Alexander Graham Bell, who invented the telephone. The coming of wireless made it necessary for a smaller unit to be used, following which it was decided to adopt the unit "decibel," being one-tenth of the original value.

By

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Power Ratios

The decibel is a logarithmic function. The difference in power level bewteen two points on a transmission line expressed in decibels is represented by ten times the logarithm of the ratio of the power available at each point. The unit is particularly useful with regard to the comparison of sound intensities since the ability of the human ear to detect loudness is approximately a logarithmic function of the energy of the sounds concerned.

In the case of an audio amplifier, the overall gain can be expressed in decibels, being either a logarithmic function of the output power to the input power, or a logarithmic function of the output voltage squared over the input voltage squared, provided that the input and output impedances are equal. One decibel is approximately the change in power output required to make a just noticeable difference in sound intensity in reproducing equipment such as a loudspeaker. Thus, if a wireless receiver is operating with a certain output and the volume control is turned to such an extent that a just noticeable increase in volume is produced, the increase in power output under these circumstances will be in the vicinity of one decibel. Changes in the power output of such a receiver by a given ratio of initial to final power output, produce the same apparent change in volume, insofar as the ear is concerned, regardless of the actual power level.

The decibel is independent of frequency or distortion and is simply a power ratio whether or not the reproduction measured is pure or distorted. It is emphasised that the decibel is not a unit of power, or voltage, or current, but a ratio of power gain or loss in a circuit.

The Reference Level

All decibel measurements are quoted with regard to a reference point known as "zero db.," which, in practice, may be regarded as the threshold of hearing. Zero db. is generally taken as being six milliwatts of power present in a five hundred-ohm transmission line at a frequency of 1,000 cycles per second. Other reference levels are often used, so it is necessary to specify the level adopted.

Mathematically, the gain in decibels is given by equation (1)—

$$\text{db.} = 10 \log_{10} \frac{P_2}{P_1} \text{ ----(1)}$$

In this expression, P_1 and P_2 are the initial and final, or input and output powers of the amplifier or circuit under consideration. With amplifiers, P_1 and P_2 will be the power outputs before and after the volume control has been moved, if the change in output is to be calculated between different volume control settings.

Voltage Amplifiers

When determining the performance of voltage amplifiers, it is usual to measure the input and output in volts. It is obvious that such a measurement may be converted into a decibel ratio since the power existing in a circuit is equal to the voltage squared, divided by the impedence or the current squared, multiplied by the impedence. Therefore, the gain in db. in an amplifier where input and output voltages or currents only are known, can be represented by equations (2) or (3).

$$\text{db.} = 10 \log_{10} \frac{V_2^2}{V_1^2} = 20 \log_{10} \frac{V_2}{V_1} \text{ ----(2)}$$

Where V_1 and V_2 equal the input and output voltages respectively

or

$$\text{db} = 10 \log_{10} \frac{I_2^2}{I_1^2} = 20 \log_{10} \frac{I_2}{I_1} \text{ ----(3)}$$

Where I_1 and I_2 equal the input and output currents respectively.

Input Impedance

These formulae are only true when the input impedence of the amplifier is the same as the output load impedence. If these two impedences, Z_1 and Z_2, are different, the db change is represented by equation (4)—

$$\text{db} = 10 \log_{10} \frac{V_2^2 Z_1 \cos\theta_1}{V_1^2 Z_2 \cos\theta_2} = 20 \log_{10} \frac{V_2}{V_1} + 10 \log_{10} \frac{Z_1}{Z_2} + 10 \log_{10} \frac{\cos\theta_1}{\cos\theta_2} \text{ ----(4)}$$

where $\cos\theta_1$ and $\cos\theta_2$ are the power factors of the input and output impedances.

Alternatively, if the input and output powers are measured in terms of current and the input and output impedences are not equal, the db. gain is represented by equation (5)—

$$\text{db} = 10 \log_{10} \frac{I_2^2 Z_2 \cos\theta_2}{I_1^2 Z_1 \cos\theta_1} = 20 \log_{10} \frac{I_2}{I_1} + 10 \log_{10} \frac{Z_2}{Z_1} + 10 \log_{10} \frac{\cos\theta_2}{\cos\theta_1} \text{ -----(5)}$$

Differing Impedances

In valve amplifiers, the input impedence generally differs considerably from the output impedence. As an example, consider a typical amplifier in which the input impedene is a 500,000-ohm resistance and the output impedence is a 5,000-ohm resistive load. Assume the power output is 5 watts at 1,000 c.p.s. when a signal of 1 volt is applied to the amplifier. Since power is equal to voltage squared, divided by resistance, the voltage across the output load will be $\sqrt{5 \times 5{,}000} = 158$ volts. The db.

gain can therefore be calculated as shown in equation (6)—

$$\begin{aligned} db. &= 20 \log_{10} \frac{V_2}{V_1} + 10 \log_{10} \frac{Z_1}{Z_2} \\ &= 20 \log_{10} \frac{158}{1} + 10 \log_{10} \frac{500{,}000}{5{,}000} \\ &= 20 \log_{10} 158 + 10 \log_{10} 100 \\ &= 20 \times 2{\cdot}1987 + 10 \times 2{\cdot}000 \\ &= 63{\cdot}97 \text{ db} \text{ ------- } (6) \end{aligned}$$

Response Curves

If it is desired to draw an audio response curve for this amplifier, the power output must be measured at different frequencies between, say, 50 and 10,000 c.p.s., and calculations similar to that above, performed in each case to determine the db. gain at each frequency. The results can then be plotted against frequency on a curve which will indicate the overall response characteristics of the amplifier.

Relative Response

Reference to impedence may, if desired, be omitted when determining the gain or loss in decibels for the purpose of drawing response curves, as such curves are drawn merely to determine the relative response of the amplifier at different frequencies and, therefore, the actual gain at any particular frequency is of minor importance.

However, it must be realised that, although for some practical purposes, the gain or loss is calculated by using equation (2), this expression is not strictly correct if the input and output impedences are unequal.

Transformer Considerations

As a practical example, consider a hypothetical transformer in which the resistances of the primary and secondary windings are so small that they may be neglected; in which the ratio of the primary and secondary turns is 1 to 2 and in which, for the sake of simplicity, no losses occur and magnetising current is negligible. Suppose that the primary of this transformer is connected to an A.C. source of 1 volt and that a pure resistance R is connected across the secondary as a load. (See Diagram A.)

Using equation (2), the db. gain is calculated in equation (7)—

$$\begin{aligned} db. &= 20 \log_{10} \frac{2}{1} \\ &= 20 \times {\cdot}3010 \\ &= 6{\cdot}02 \text{ ------- } (7) \end{aligned}$$

Power Gain Impossible

This result is obviously ridiculous as it is impossible to obtain more power from a transformer than is fed into it.

Let us now use the complete formula (equation 4) to calculate the correct result. Firstly, it is

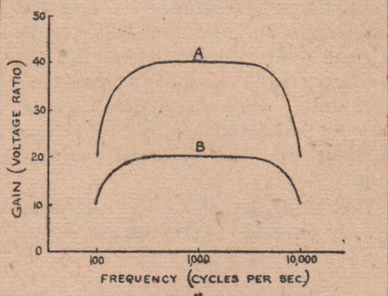


Fig. 1

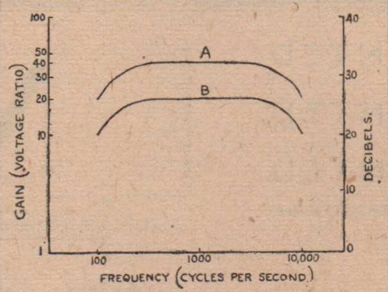


Fig. 2

noted that the input impedance, Z_1 in this case, is the resistance R reflected through the transformer to the primary and is thus R divided by the square of 2 since the primary to the secondary ratio is 1 to 2. Also the phase angles will be equal

$$\begin{aligned} db. &= 20 \log_{10} \frac{V_2}{V_1} + 10 \log_{10} \frac{Z_1}{Z_2} + 10 \log_{10} \frac{\cos \theta_1}{\cos \theta_2} \\ &= 20 \log_{10} \frac{2}{1} + 10 \log_{10} \frac{\frac{R}{4}}{R} + 10 \log_{10} \frac{\cos \theta_1}{\cos \theta_1} \\ &= 20 \log_{10} 2 + 10 \log_{10} \frac{1}{4} + 10 \log_{10} 1 \\ &= (20 \times {\cdot}3010) + (10 \times \bar{1}{\cdot}3979) + (10 \times 0) \\ &= 6{\cdot}02 + (-6{\cdot}02) + 0 \\ &= 0 \text{ --------------- } (8) \end{aligned}$$

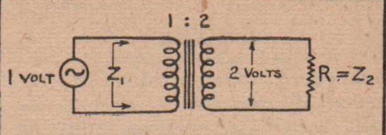


DIAGRAM A.

since the input and output impedences are purely resistive.

The real power gain in the transformer is shown to be zero db., which is unity, in equation (8). In practice, if the above calculation was applied to a real transformer, the answer would be negative (less than 0 db.), indicating a power loss owing to the losses within the transformer.

In relation to voltage amplifiers, one is probably accustomed to thinking of the overall amplification in terms of the ratio of output to input voltage and therefore wonders why it is necessary to introduce a more complicated unit of a logarithmic nature, such as the decibel, into calculations concerning the amplification of such an equipment. The advantage of the logarithmic unit becomes evident when one attempts to draw curves showing the relative gain of the amplifier throughout a range of frequencies such as those in the audio spectrum.

A Typical Case

Let us, for example, consider two typical Class "A" voltage amplifiers with equal input and output impedences. Having taken readings of the input voltage and output voltage at various frequencies in the audio spectrum, let us draw their response characteristics, graphing the gain in terms of voltage ratio against the response frequency in cycles per second. If the two amplifiers are electrically similar except that one is capable of producing greater amplification than the other, their characteristic curves may be those shown in Fig. 1. Observation of this diagram at a glance would indicate that the amplifier represented by curve "A" has greater overall amplification than that of curve "B" and also that the amplification represented by curve "A" is much more attenuated at the higher and lower frequencies than that of curve "B." In actual fact, however, both

(Continued on next page)

DECIBEL

(Continued)

these curves indicate identical frequency characteristics, as can be easily seen after a close study of Fig. 1. For example, with regard to curve "A," the ratio between the gain at 100 cycles and 1,000 cycles per second is 20 to 40, which equals 2. It will also be seen that the ratio of the gains at these two frequencies represented by curve "B" is 10 to 20, which again equals 2. Thus, both curves represent the same reponse characteristic.

Let us redraw these curves in such a manner that the gain is graphed against the frequency, the former also being plotted as a logarithmic function (refer Fig. 2). As the ordinate of this graph represents a logarithmic voltage ratio, it can be redrawn in dceibels (as shown on the right of Fig. 2), the decibel scale being uniform.

The ordinate may be calibrated in decibels by use of equation (2), or by use of the table shown in the text. It will be seen that 20 decibels is equal to a voltage ratio of 10 and 40 decibels is equal to a voltage ratio of 100, which corresponds with the calibration shown in Fig. 2.

The curves "A" and "B" of Fig. 1 have been redrawn, as shown in Fig. 2, and it will be observed that they not only indicate that amplifier "A" has greater amplification than amplifier "B" as before, but that both amplifiers have the same frequency response characteristic. Therefore, by using the logarithmic scales adopted in Fig. 2, one can see the actual frequency response characteristic at a glance.

Selecting Zero

Since the decibel scale in Fig. 2 is uniformly divided, zero may be selected as any point whatever on the scale. For instance, it may be convenient to renumber the scale so that o db. occurs where 30 db. is shown in Fig. 2 and thus the amplifier's characteristics would then be indicated as plus or minus so many db. with reference to this point.

The table in the text tabulates power, current and voltage ratios and their equivalent changes in db. This will be useful when it is desired to draw frequency response characteristic curves in relation to voltage and power changes in equipment. Some microphones and "pick-ups" are not capable of producing an output of 6 milliwatts (the generally accepted zero db. reference level), and therefore, in such cases, it is necessary to adopt some level less than zero db. when measuring their output.

If zero db. is regarded to be six milliwatts, minus 10 db. will be .6 milliwatts and minus 20 db. will be .06 milliwatts and so on.

If it is stated that an amplifier has an output of + 40 db. (0 db. =

6m.W.), this means that it has a certain ratio between 60 watts output and the accepted level of six milliwatts. This becomes apparent from the calculation shown as equation (9)—

$$
\begin{aligned}
db &= 10 \log_{10} \frac{P_2}{P_1} \\
&= 10 \log_{10} \frac{60 \text{ WATTS}}{6 \text{ MILLIWATTS}} \\
&= 10 \log_{10} \frac{60}{6 \times 10^{-3}} \\
&= 10 \log_{10} 10^4 \\
&= 10 \times 4.000 \\
&= 40 \quad \text{------------} (9)
\end{aligned}
$$

In a multi-stage amplifier, the power or voltage gains are multiplied together to obtain the overall gain, but if the individual gains are converted to db., they must be added together to obtain the result. Consider a two-stage amplifier in which the power gains of the first and second sections are 100 and 1,000 respectively, and in which the first section is matched to the second so that no power loss occurs in the coupling; then the overall power gain will be $100 \times 1{,}000 = 10^5$. If the gains are measured in decibels, however, they will be 20 db. and 30 db. and the overall gain will be the sum of these; i.e., 50 db.

A Practical Application

In considering a further practical application, take a carbon microphone with a rated power output of minus 20 db. and an amplifier which requires an input of zero db. (i.e., six milliwatts), to provide an output power of 60 watts, that is, + 40 db. For the amplifier to produce its full 60 watts power output, it is evident that the microphone will have insufficient output to drive it without the inclusion of an additional amplifier. This amplifier must obviously have an amplification of 20 db. to enable the full 60 watts output to be obtained.

It is pointed out that loss ratios measured in decibels are equal and opposite to gain ratios of the same magnitude. For example, if the output of an amplifier is increased from 1 to 6 watts, the db. gain calculated from equation (1) equals 7.782. If now the gain is reduced from 6 watts back to 1 watt, the db power loss is, again using equation (1), –7.782 db., which is the same figure with opposite sign as that obtained for the gain ratio.

Power, Current and Voltage Ratios (for equal impedences) and Their Equivalent Gain in Decibels

Decibels	Current or Voltage Ratio	Power Ratio
0	1.000	1.000
0.1	1.012	1.023
0.5	1.059	1.222
1	1.122	1.259
2	1.259	1.585
3.	1.413	1.995
4	1.585	2.512
5	1.778	3.162
6	1.995	3.981
7	2.239	5.012
8	2.512	6.310
9	2.818	7.943
10	3.162	10.00
11	3.55	12.6
12	3.98	15.9
13	4.47	20.0
14	5.01	25.1
15	5.62	31.6
16	6.31	39.8
17	7.08	50.1
18	7.94	63.1
19	8.91	79.4
20	10.00	100
30	31.6	10^3
40	100	10^4
50	316	10^5
60	1,000	10^6
70	3,160	10^7
80	10,000	10^8
90	31,600	10^9
100	100,000	10^{10}

AMERICA

(Continued from page 9)

verse natural economic conditions in any one country and that the fund can only assist by cushioning economic effects. Therefore, the fund has machinery for varying or re-arranging exchange rates by 10 per cent. Machinery is also contained in the plan whereby restrictions can be applied to a nation whose exports are excessive and whose currency is therefore in short supply. I think, however, it is important to realise that the Bretton Woods plan is merely a lubrication and is not the main machinery by which world trade must be powered.

The Five-Year Period

I am afraid that an examination of the immediate post-war situation forces one to the conclusion that for at least a short period—short in international commerce, say, five years—after the war, bi-lateral agreements will be necessary between nations in order to increase world trade immediately. Possibly we may have—in fact, we may need and England may need it more—a maintenance of the Ottawa agreement. It is obvious that England must import food in order to live. Australia can supply that food and we start off with an exchange rate which is not so unreal as that existing between Australia and America. England can only maintain her purchases of food from Australia if we can maintain our purchase of products from England, and these are two conditions upon which we can, without difficulty, commence our trade between England and Australia. There can be no one-way traffic in international trade over a long period.

By reading the various reports emanating from England and America, I am of the opinion that the British organisation for full employment, international trade, control of money, exchange rates, etc., is better organised than that of the American systems, which appear to be pulled in all directions by individual voting blocs, by more conservative laws, and the size of the country which is controlled under one political head.

THE THEORY BEHIND PROPER

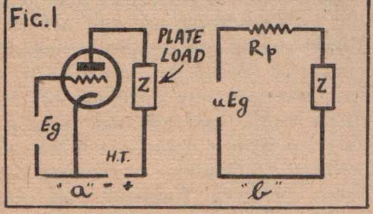
PART I . . . THE VALVE

THE ability of the valve to act as an amplifier is mainly due to the fact that a small change of grid circuit voltage will produce a comparatively large change of plate current and, as this control of the grid over the plate current is electrostatic, practically very little or no energy at all is supplied by the input circuit, so it is possible to produce large variations in power or voltage from an external source with a suitable valve.

Limiting Factors

The valve, in theory, is capable of amplifying frequencies of any value. However, losses due to leakage capacity and indutcance of the valve place a definite limit on its high frequency capabilities, and for micro-waves the velocity of the electron is also a limiting factor, requiring special designs for satisfactory results.

Essentially, radio- and audio-frequency amplifiers are the same, the only difference being the radio frequency amplifier has to amplify



The general case of the valve amplifier is illustrated by diagram "A," whilst "B" shows its equivalent circuit.

frequencies considerably higher than the other.

Amplifying valves used in radio usually consist of either the voltage or power amplifying types.

Voltage amplifying valves are used where the main consideration is maximum output voltage. The valve usually has a high amplification factor which is defined as the ratio of a small change in plate voltage, to the small change in grid voltage required to produce equivalent changes in plate current.

Power amplifying valves are used when it is desired to produce an output that is capable of supplying power to a load such as the stage of a transmitter that feeds the aerial; or in the audio range of a loud-speaker. As the power output rises rapidly with the plate voltage, it is desirable to operate them with as high a plate voltage as possible.

Audio Frequency Amplifiers

Audio frequency amplifiers will amplify frequencies that are audible to the human ear, which may be regarded to extend from 15 to 20,000 cycles per second, although the higher and lower sections of this band are imperceptible to the majority of people. This type of amplifier is known as a "wide band" amplifier and it is generally desirable that it is of the broadly resonant type. The frequency range of 19,985 cycles per second is a particularly wide band of audio frequencies, but in the radio frequency range a similar band width would be moderately narrow and to decide if an amplifier is of the wide or narrow band type it is necessary to compare it with the mid-frequency of the range.

We will now examine the general case of a valve amplifier as shown in Fig. 1(a). Across the input, grid-cathode, is connected a source of alternating voltage, Eg; the usual high-tension voltage is connected in the output circuit, plate-cathode, in series with an impedance Z known as the plate load. In examining the operation of this circuit the direct current potentials applied to the electrodes, although necessary for operation, may be disregarded when examining the properties of the circuit; by reducing Fig. 1(a) to essentials, the circuit shown in Fig. 1(b) will result.

All valves have plate resistance (plate resistance is defined as the ratio of a small change in plate voltage to the small change in plate current caused by it, the grid potential being kept constant), which is

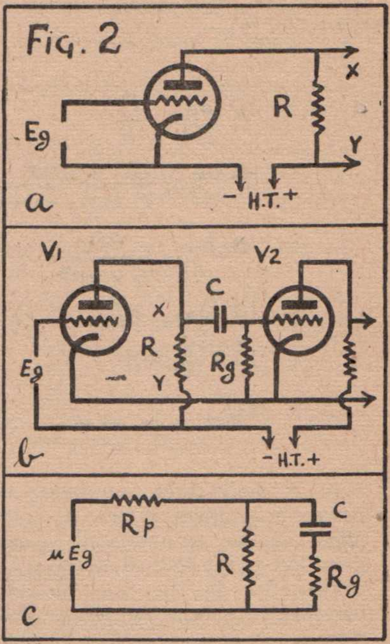


Fig. 2. "A" shows the resistance-loaded valve with output developed across X and Y. "B" shows resistance-capacity coupled valves and "C" shows why resistance Rg should be larger than the reactance of C.

represented by Rp. Van der Bijl has shown that the equivalent E.M.F. applied to the circuit is equal to uEg, where u is the amplification factor and Eg is the alternating signal input. In the ideal case, Rp would be zero, so all the output voltage would be applied across the load impedance Z. In practice the plate resistance is quite high and the applied voltage is divided across Z and Rp. Thus it is not possible for amplification of the stage to be as great as the amplification factor of the valve. The degree of amplification that does take place depends on the relative value of the load impedence to the plate resistance.

Resistance-Capacity Coupling

Fig. 2(a) shows a valve amplifier across the output of which is connected a resistance R and, as we have seen, there will be an amplified version of Eg across X-Y. If this is connected to the input of a proceeding valve, X to the grid, Y to the cathode, the signal output of valve 1 will be applied to the input of valve 2 but also will the full H.T. plate voltage of valve 1,

AMPLIFIER DESIGN - - By CHARLES ASTON

applying plenty of positive bias to the grid of valve 2, which is as good as any other way to ruin a valve.

Coupling Condensers

We are now faced with the problem of blocking the H.T. voltage from the grid of valve 2 and yet allowing the audio frequency voltage to be applied to it and as a condenser of suitable value will offer a very low impedance to A.F. currents, the obvious way to overcome the difficulty is by connecting a condenser between X and the grid of valve 2 as depicted in Fig. 2(b), where it will be noticed there is a resistance connected between the grid and cathode, and the necessity of this is shown in Fig. 2(c); it can be seen that C and Rg are connected in series with the signal voltage. If Rg was short-circuited, there would be no signal voltage drop across the input of the valve, as the grid and cathode would be at the same potential. So the whole of the signal would be developed across C. If the resistance of R is equivalent to several times the reactance of C, the greater portion of the signal voltage will be developed across R; thus across the input of the valve.

Suitable Values

The value of the component parts of a resistance-capacity coupled amplifier are not critical, but if optimum results are to be obtained, should be carefully chosen. The resistance, R, of V1, should be of infinite impedance if the full amplification of V1 is to be realised. Even if a resistance of this value could be produced, a H.T. supply with an infinitely high voltage would be required to supply V1 with any plate voltage at all. So that is ruled out. If R has a resistance equal to about three times the plate resistance, Rp, of V1, most satisfactory results will be obtained; increasing it beyond this value will not produce anything near an equivalent increase in effective amplification and, as the resistance is increased, so is the difficulty associated with supplying a sufficiently great H.T. to overcome the D.C. voltage drop across the resistance so as to supply the correct operating potential to the plate of V1.

Coupling Condenser

The coupling condenser C is of some consequence; if its capacity is too small, it will, at low audio frequencies, have a high reactance (capacity reactance varies inversely with frequency), which means that if the resistance of Rg is not sufficiently high, these low audio frequencies will be developed across the condenser and not the input of V2, and, in effect, are lost. We shall see late Rg cannot be increased beyond a certain value. It now appears that if the low audio frequencies are to be retained, the capacity of the condenser should be increased, but here another limitation is introduced, which is the time taken for the condenser to discharge through the high resistance Rg and is proportional to CRg. If this is too great, the condenser will be unable to discharge between the pulses of the high audio frequencies and, after an extra strong signal, what is called "grid blocking" will occur and the amplifier will distort badly for an appreciable period. Normal values of coupling condenser C will lie between .003 mfd. and .1 mfd. and vary to suit Rg.

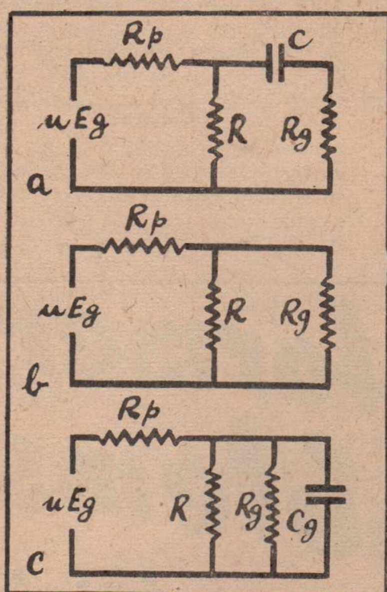


Fig. 3, showing the equivalent circuits of a resistance-capacity coupled amplifier at (a) low, (b) middle, (c) high frequencies.

Another point that must be watched is that the condenser should have extremely high direct current resistance, as otherwise a leakage current will flow from the plate H.T. circuit of V1 through C and Rg and the voltage drop across Rg would cause the grid of V2 to become positive—a very undesirable state of affairs. It is usual for the D.C. resistance of a condenser to decrease as the capacity is increased, which is another factor that limits the capacity of the coupling condenser C. Condensers with a high-grade dielectric, such as mica or the better class of paper, should be used in this service as their power factor (leakage)is low.

Grid Resistance, Rg

As shown previously, Rg should have a high resistance compared to the reactance of the coupling condenser C to all frequencies it is desired to amplify so they will be developed across the input of V2. A maximum value of Rg is set by the valve manufacturers and is usually shown in published data. It is usual for this maximum value to be employed to keep the capacity of C as small as possible without too much attenuation of the low frequencies developed.

At Low A.F.

The performance of a resistance-coupled amplifier at low audio-frequencies will now be examined and an equivalent circuit at these frequencies is shown in Fig. 3(a). The A.F. voltages developed across R, the load resistance, is supplied to the series circuit of the coupling condenser C and grid resistance Rg, and only the voltage drop across Rg is useful. That across C is completely wasted and, as said before, capacity reactance varies inversely with the frequency. So as the frequency is reduced, so the waste voltage developed across C is increased and the useful voltage across Rg will therefore be reduced;

(Continued on next page)

AMPLIFIERS

(Continued)

so the circuit will have a falling characteristic with a reduction in frequency.

At Intermediate A.F.

At intermediate, or middle, audio frequencies, the reactance of the coupling condenser is negligible; so an equivalent circuit, as shown in Fig. 3(b), is produced, and it can be seen that the grid resistance, Rg, shunts the plate load resistance R (and is another reason Rg should be as large as possible). Usually, Rg is several times the value of R and has very little shunting effect on the voltage developed across the load resistance R, so at these middle audio frequencies the circuit will have a straight characteristic and will amplify frequencies in this range equally.

At High A.F.

An equivalent circuit for the performance of a resistance-coupled amplifier at high audio frequencies is shown in Fig. 3(c) and at these frequencies the reactance of the coupling condenser C will be less than at middle frequencies; so, likewise, is disregarded. The capacity Cg is used to depict a shunt capacity that is composed of stray wiring capacities, the grid-cathode capacity of the valve and, if the valve has a high u, a large reflected capacity, which is proportional to the grid-plate capacity and the amplification factor of the valve. As the total of these capacities is increased, so its reactance is reduced, thus increasing the shunting effect of the higher frequencies which are by-passed instead of being applied to the input of the proceeding valve. The amplifier will have a falling characteristic at the high audio frequencies. The reader is referred to a comprehensive article on this section by Mr. Du Faur on page 27 of the February issue.

General

Resistance capacity coupling is an inexpensive method of providing practically uniform amplification of a wide range of frequencies. Although the gain per stage is low, the component parts are cheap, and several stages may have to be used in succession to obtain the required amplification. The only limiting factor is the inherent noise level introduced mainly by the valves. This type of coupling is now extensively used in all types of audio frequency amplifiers owing to the advantages just outlined, together with their light weight and compactness, and find special applications when a high impedance input is required, such as with a crystal or condenser microphone. This type of coupling is not desirable to induce pick-up such as hum, which is particularly desirable when power transformers are on the same chassis as the amplifier.

A possible disadvantage is the high voltage that is required to overcome the D.C. resistance of the plate load resistance, but this has been overcome to a main extent by modern valves which have high amplification factors and require only moderate plate voltages.

(To be continued in next month's issue.)

HUM

(Continued from page 6)

large contact area.

To all intents and purposes the amplifier was now without background hum and we had the opportunity to note that the broadcast engineers could do a little hum clearing-up themselves! It is really thrilling to turn up ten watts of good audio from a completely silent background!

Triode Valves

The only commonly available triode of reasonable output is, of course, the type 2A3. The writer has found these valves to be extremely "finicky." They vary in characteristics in themselves, whilst working and between one and another. They also seem susceptible to hum. We found that it was well-nigh impossible to find two tubes which would draw the same plate current and, as we had by now proved that the remaining trace of hum was coming from the push-pull output stage, we decided to bias each tube separately in order to balance their plate currents.

We were able to do this quite easily because the driver transformer was an "R.I. Varley"—a high-quality British job of comparatively ancient vintage. This transformer has the centres of the secondary windings brought to two separate terminals instead of the usual single terminal. It may be possible to separate these leads on other makes; if resistance coupling is used, then there is also no difficulty in biasing each tube separately. The cathode resistors must, however, each be heavily by-passed —a disadvantage avoided by our present arrangement as shown in the diagram. (Note.—the new "Trimax" audio transformers have separate secondary terminals.—Ed.)

Hum-bucking

This consists of a heavy potentiometer, which we had to make ourselves, as there is nothing like it obtainable through the usual channels.

A length of 30 gauge or near resistance wire was strung between fences and coated with shellac varnish. A saucerful of varnish was held under the wire as we walked along holding it in the varnish. This wire, now insulated sufficiently for the purpose, was then wound with close turns on a strip of one-sixteenth inch sheet fibre about one inch wide and six inches long. The resistance strip so formed was then clamped around a thick disc of wood and two contact arms, one each side, were fitted.

One arm only is fitted with a shaft and knob; the other is semi-fixed in a position which allows balancing of plate currents by moving the adjustable arm to either side of the semi-fixed contact point.

This hum-bucking arrangement works beautifully. In fact, when properly set, the main filter choke can be shorted out with no increase in hum!

MODEL AEROS

(Continued from page 5)

Ignition Interference

Frequency modulation will probably find favour for radio-control experiments owing to the way in which reception of f.m. signals can be had without interference trouble from the ignition system of the engine. The models fly with a spark obtained from a small ignition coil drawing primary current from a couple of torch cells. Naturally the spark is a very small one, but is sufficient to cause interference trouble with amplitude modulation reception.

Co-operation Needed

It is perhaps a little too much to expect to find anyone who has sufficient knowledge of both radio and flying to handle the whole task of building a suitable plane, as well as the radio equipment, and also the flying ability to operate a machine from a remote-control "joystick." It looks like a job for close co-operation between members of the Wireless Institute of Australia and the members of the Model Aeronautical Association.

Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY

Veri Good and Very Good

Whilst some shortwave listeners derive a lot of pleasure through obtaining veries for reports, S/Sgt. Ray Clack tells me he finds shortwave listening great for starting off the day brightly, and instances PRL-7, Rio de Janiero, on 9.72mc, as providing just the right class of dance music to do this, and before retiring at 10.30 p.m. he very often tunes to XEWW, Mexico City, 9.58 mc, for slumber music. Well, there is a new slant on DX-ing, and I guess that both these countries would be pleased to know they were affording comfort to a soldier who, although he does not disclose his destination, is, I figure, in a land where eiderdowns and cold, frosty mornings are unknown and mosquito nets and tropical heat the rule.

Incidentally, Ray's listening is now done on a vibrator-operated dual-waver, the portable set that he enthused about a little time ago having been lost, stolen or strayed. He says the new set is not so selective as the portable, but, with an antenna 40 feet long and 10 feet high, running east and west, results are fairly good.

And Another Ray From Sunshine

Going into the magazine section of a popular Sydney bookshop the other morning, who should I see at the radio end but none other than Ft./Lt. Ray Simpson. Down here from where wild men were sometimes wont to be, he grabbed the first few minutes he could to see "the latest" in circuits. Said he was receiving the dear old "A.R.W." regularly, although a little belatedly, and was amazed at the number of new stations being heard. He is just itching to get at those controls again and listen to what he would like to instead of what he has to.

Radio Silence

Have just returned from an eight-day spell in the Irrigation Area and think it is the longest period I have been away from the shortwave receiver since 1926. Although sorely tempted to just find out how conditions were in the wide open spaces, figured I was entitled to a complete rest, especially as, for the last $2\frac{1}{2}$ years, have averaged pretty nearly $17\frac{1}{2}$ hours a day at most concentrated listening.

SAYS WHO?

Arthur Cushen says he received a verification from CKKA, Sackville, 11.705mc, 25.63m. The C.B.C., in sending this, mentioned they would be adding a new transmitter in a few weeks on the higher frequency end of the 25-metre band. This will doubtless be CHOL. See "New Stations."

"Radio Unit Seac, heard recently with programmes for the Forces, has verified reception of their 19.64-metre outlet then in use. This is not to be confused with Headquarter's Radio South-east Asia Command. The following is an extract from the letter: "The 19-metre band (15.275mc) and 25-metre band (11.81mc) are now being used by Headquarters Radio South-east Asia Command for programmes in Eastern languages. We would like to know if you get our present frequencies as above. Our programmes are primarily for the Allied Forces in Burma and India and are beamed towards Calcutta, Mandalay and Rangoon." The schedule enclosed is as follows:

- 1130-1300 I.S.T. (4-5.30 p.m., Syd.), 15.22mc, 19.71m.
- 1430-1900 I.S.T. (7-11.30 p.m., Syd.), 15.22mc, 19.71m.
- 1930-2200 I.S.T. (midnight-2.30 a.m., Syd.), 11.83mc, 25.36m.

Address for reports is: Radio Unit, SEAC (Radio SEAC, Ceylon), 191 Turret Road, Colombo.—Gillett.

Apropos of above is an excerpt from S/Sgt. R. K. Clack's letter: "Here, incidentally, is a news item I copied from SEAC three days ago. It went as follows: 'One of the largest British radio stations in the world, larger than any commercial or service station outside England, forms part of the equipment of the British East Indies Fleet at its headquarters in Ceylon. Hidden away in the jungle, miles from the nearest town, more than twenty transmitters work 24 hours per day."

* * *

CROSLEY CHANGES

The Latin-American schedules shown in July issue stand. The following are alterations in European schedules:

WLWO, 17.80mc, 16.85m: 8 p.m.-6 a.m.
WLWO, 9.59mc, 31.3m: 6.15 a.m.-7.45 a.m.
WLWL-1, 11.81mc, 25.40m: and WLWL-2, 15.23mc, 19.7m: 8 p.m.-9.45 p.m. E.; N.A.
WLWL-1, 17.955mc, 16.70m, and WLWL-2, 15.23mc, 19.7m: 10 p.m.-10.45 p.m., S.A.; N.A.
WLWL-1, 17.955mc, 16.70m, and WLWL-2, 15.23mc, 19.7m: 11 a.m.-4.45 a.m. S.A.; C.A.
WLWL-1, 11.81m, 25.40mc, and WLWL-2, 15.23mc, 19.7m: 5 a.m.-11 a.m. S.A.; C.A.
WLWR, 15.25mc, 19.67m: 8 p.m.-7.45 a.m. N.A.
WLWR, 9.75mc, 30.77m: 8.15 a.m.-9.15 a.m. N.A.
WLWK, 11.71mc, 25.62m: 10.30 p.m.-7.30 a.m. E.

ADDITIONS TO DEPARTMENT OF INFORMATION SCHEDULE OF OVERSEAS TRANSMISSIONS.

VLG-7, Melbourne, 15.16mc, 19.79m, and VLC-4, Shepparton, 15.315mc, 19.59 m: Messages to P.O.W. beamed to Asia and Japan from 9.15-10.15 a.m.
VLC-4, Shepparton, 15.315mc, 19.59m: British Pacific Fleet programme, 2-3 p.m. (From 2.30 Sundays.)

'FRISCO NOTES

KWIX, 11.89mc, 25.23m: Now continues till 2.30 p.m. News at 2. News at dictation speed, 2.05 till closing at 2.30.—L.J.K.
KROJ, 17.76mc, 16.89m, and KGEX, 15.21mc, 19.72m: Now give sports' news at slow speed from 12.05-12.28 p.m.—L.J.K.
KWIX, in programme to The Peoples of New Zealand, from 5.30-6.30 p.m., has moved from 9.85mc to 11.87mc, 25.27m. At 5.45 gives news and at 6 p.m. "What American Commentators Say." For first and last fifteen minutes of programme are in parallel with KCBA, 9.75mc; KCBF, 11.77mc, and KGEX, 11.79mc.—L.J.K.
VUD-, Delhi, previously heard on 9.68 mc, is now being heard on 9.67mc, 31.02 m. Opens at 4.30 a.m. in company with 9.63mc, 31.15m.—Gillett.

B.B.C. PACIFIC SERVICE

As from 29th July, 3-7 p.m.:

To Australia

GRX, 9.69mc, 30.96m, and GRU, 12.04 m.c., 24.92m: 3-7 p.m.
GRM, 7.12mc, 42.13m: 3-5.45 p.m.
GSI, 15.26mc, 19.66m: 4.30-7 p.m.

To New Zealand and Pacific

GSN, 11.82mc, 25.38m, and GVZ, 9.64 mc, 31.12m: 3-7 p.m.
GRM, 7.12mc, 42.13m: 3-5.45 p.m.
GSI, 15.26mc, 19.66m: 4.30-7 p.m.
News: 4 p.m. and 6 p.m.
News Reel: 4.30 p.m.
Prog. Anncts.: 3.05 and 6.45 p.m.

B.B.C. EMPIRE SERVICE

As at 29th July. Black type indicates on beam favourable to Australia.

GRP, 17.87mc: 1.30-3 a.m.
GSP, 15.31mc: 7.45-9 a.m.
GSI, 15.26mc: 1.30-5 a.m.; 4.30-7 p.m.
GRV, 12.04mc: **3-7 p.m.**
GVY, 11.955mc: 4-7 a.m.
GSN, 11.82mc: 4-7 a.m.; 3-7 p.m.
GVW, 11.70mc: 1.30-7 a.m.
GRG, 11.68mc: 7.45-Noon.
GRH, 9.825mc: 7.45 a.m.-2.45 p.m.
GRX, 9.69mc: **3-7 p.m.**
GVZ, 9.64mc: 7.45 a.m.-2.45 p.m.; **3-7 p.m.**
GRY, 9.60mc: 3.45-7 a.m.
GSC, 9.58mc: 12.45-1.30 p.m.
GRJ, 7.32mc: 12.45-1.30 p.m.
GSU, 7.26mc: 7.45 a.m.-2.45 p.m.
GRM, 7.12mc: **3-5.45 p.m.**
GSL, 6.11mc: 12.45-2.45 p.m.
GRR, 6.07mc: 12.45-1.30 p.m.

African Service

News: 2, 4 and 6.45 a.m.
News Reel: 5.30 a.m.
Prog. Anncts: 1.45 a.m.

Pacific Service (see special section)

North America

News: 7.45, 8.45, 11 a.m.; 12.45 and 2.30 p.m.
News Reel: 9.30 a.m. and 1 p.m.
Prog. Anncts.: 7.15 a.m. and noon (10.15 a.m. Sun.-Fri.; 11.15 Sat.)

B.B.C. GENERAL OVERSEAS SERVICE (Including General Forces Programmes)

GSH, 21.47mc: 9 p.m.-1.45 a.m.
GVO, 18.08mc: 9 p.m.-1.15 a.m.; 2.45-3.45 a.m.
GSV, 17.81mc: **7 p.m.-1.45 a.m.**
GSG, 17.79mc: 2-5.15 a.m.
GVQ, 17.73m: 4.30-7 p.m.; **9 p.m.-1.15 a.m.;** 2.45-7 a.m.
GRA, 17.75mc: 10.30 p.m.-1.15 a.m.
GRD, 15.45: 1.45-5.15 a.m.
GSP, 15.31mc: 7-7.15 a.m.; 4-6 p.m.; 9.45-10 p.m.
GWR, 15.30mc: 3.45-7 p.m.; **8-9.15 p.m.;** 10 p.m.-5.15 a.m.; **5.30-7.45 a.m.**
GSO, 15.18mc: 3 p.m.-6.30 a.m.
GSF, 15.14mc: **2 p.m.-3.15 a.m.**
GWC, 15.07mc: **8 p.m.-1.15 a.m.**
GRF, 12.095mc: 4 p.m.-6.15 p.m.; 7-3.15 a.m.
GVX, 11.93mc: **3-7.45 p.m.;** 8-10 p.m.; **2.45-3.15 a.m.**
GVU, 11.77mc: **2-4.15 p.m.**
GSD, 11.75mc: 3-6 p.m.; 7 p.m.-2 p.m. (next day). (**From 6 a.m.-2 p.m.**).
GVW, 11.70mc: **2-4.15 p.m.**
GRG, 11.68mc: **midnight-1.15** a.m.; 3-5.15 a.m.
GRU, 9.915mc: 3.30-6.30 a.m.; 6.45-7.45 a.m.
GWP, 9.66mc: **2-2.45 p.m.;** 3- 5.45 p.m.
GRY, 9.60mc: **3-6 p.m.**
GSC, 9.58mc: **5.45 a.m.-12.15 p.m.**
GSB, 9.51mc: 3.30 a.m.-6 p.m. (**noon-6 p.m.**)
GRJ, 7.32mc: 9 a.m.-12.15 p.m.; 2-3 p.m.
GSW, 7.23mc: **1-5.45 p.m.**
GRS, 7.075mc: 2-6.30 p.m.; 1.30-8.30 a.m.
GRR, 6.07mc: **10 a.m.-1.30 p.m.**
News: 1, 3, 6 and 11 a.m.; 12.30, 2, 4, 5, 6, 9 and 11 p.m.
News Reel: 9.30 a.m. and midnight.
Prog. anncts: 7 a.m., 2.01 p.m., 5.59 p.m., 8.07 p.m., 9 (Sundays 8.15), 1.55 a.m.

NORTH AMERICAN SERVICE

GSU, 7260kc, 7.15 a.m.-2.45 p.m.
GRH, 9825kc, 7.15 a.m.-2.45 p.m.
GSL, 6110kc, noon-2.45 p.m.
GSP, 1531kc, 7.15 a.m.-9 a.m.
GVX, 11930kc, 7.15 a.m.-noon.
GVZ, 9640kc, 7.15 a.m.-2.45 p.m.
GRW, 6150kc, 12.15 p.m.-1.30 p.m.
GRJ, 7320kc, 12.15 p.m.-1.30 p.m.

EASTERN SERVICE

GSG, 17790kc, 9 p.m.-2 a.m.
GWD, 15420kc, 9 p.m.-2 a.m.
GRG, 11680kc, 11.30 p.m.-midnight.
GSF, 15140kc, 1 a.m.-1.15 a.m.
GSV, 17810kc, 1 a.m.-1.15 a.m.

MEDITERRANEAN AND NEAR EAST SERVICES

GRM, 7120kc, 2.15 p.m.-2.45 p.m.
GSC, 9580kc, 2 a.m.-3 a.m., 3.45 a.m.-6.30 a.m., 2.15 p.m.-3.30 p.m.
GWO, 9625kc, 7 p.m.-7.30 p.m.
GRG, 11680kc, 2.45 p.m.-3.30 p.m., 7 p.m.-7.45 p.m., 10.15 p.m.-10.30 p.m.
GRV, 12040kc, 2 a.m.-3 a.m.; 3.45 a.m.-4.15 a.m., 4.45 a.m.-5.15 a.m., 5.30 a.m.-6.30 a.m.
GSU, 7260kc, 2.45 p.m.-3.30 p.m.
GSP, 15310kc, 8.30 p.m.-9 p.m.
GRD, 15450kc, 8.30 p.m.-9 p.m.
GVO, 18080kc, 8.30 p.m.-8.45 p.m.
GWD, 15420kc, 3.45-4.15 a.m.
GRX, 9690kc, 5.30 a.m.-6.30 a.m.
GWO, 9625kc, 7.30 a.m.-7.45 a.m.
GSI, 15260kc, 8.15 p.m.-8.30 p.m.

LATIN AMERICAN SERVICES

GSP, 15310kc, midnight-12.15 a.m.
GRA, 17715kc, 1.30 a.m.-2.30 a.m.
GRQ, 18025kc, 1.30 a.m.-2.30 a.m.
GSN, 11820kc, 8 a.m.-8.15 a.m.
GWE, 15430kc, 8 a.m.-8.15 a.m.
GRR, 6070kc, noon-1.45 p.m.
GWO, 9625kc, 9 a.m.-1.30 p.m.
GWN, 7280kc, 9 a.m.-1.30 p.m.
GVW, 11700kc, 9 a.m.-1.30 p.m.
GRK, 7185kc, 9 a.m.-1.30 p.m.
GRY, 9600kc, 9 a.m.-1.30 p.m.
GRT, 7150kc, 8 a.m.-11.30 a.m.
GRU, 9915kc, 8 a.m.-11.30 a.m.
GRF, 12095kc, 8 a.m.-11.30 a.m.
GVU, 11770kc, 8 a.m.-11.30 a.m.
GRM, 7120kc, 8 a.m.-11.30 a.m.

B.B.C. EUROPEAN SERVICE

My copy of "London Calling," No. 300, not having arrived, I am indebted to Ted Whiting for the following particulars which show how much the European Service has been curtailed:

European Service

This service now takes the air between the following defined times: 2 p.m.-5.15 p.m., 8 p.m.-10.45 p.m., 1 a.m.-8.30 a.m.

GSE, 11860kc, 2.30 p.m.-4.45 p.m., 8 p.m.-10.45 p.m., 1.15 a.m.-7 a.m.
GRI, 9410kc, 2.30 p.m.-5.45 p.m.; 8 p.m.-8.15 p.m., 8.30 p.m.-10.45 p.m., 1.15 a.m.-8.30 a.m.
GRO, 6180kc, 2.30 p.m.-5.45 p.m., 7.30 a.m.-8.30 a.m.
GRT, 7150kc, 2.30 p.m.-3.45 p.m.; 4 p.m.-5 p.m.; 8 p.m.-10.30 p.m.; 1.15 a.m.-7 a.m.
GVU, 11770kc, 25.49m, 8 p.m.-8.15 p.m., 8.30 p.m.-10.45 p.m., 1.15-4.15 a.m.
GVY, 11955kc, 8 p.m.-10 p.m.
GWQ, 15110kc, 8 p.m.-10.45 p.m., 1.15 a.m.-7 a.m.
GWH, 11800kc, 4 p.m.-5 p.m., 8 p.m.-10.30 p.m., 1.15 a.m.-4.30 a.m.
GWJ, 9525kc, 2.30 p.m.-4.45 p.m., 8 p.m.-10.45 p.m., 1.15 a.m.-7 a.m.
GWL, 7205kc, 8 p.m.-8.15 p.m., 8.30 p.m.-10.45 p.m., 1.15 a.m.-7 a.m.
GWN, 7280kc, 2 p.m.-3.30 p.m., 4 p.m.-5.45 p.m., 8 p.m.-10 p.m., 1 a.m.-8.30 a.m.
GWO, 9625kc, 2 p.m.-3.30 p.m., 4 p.m.-5.45 p.m., 8 p.m.-10 p.m., 1 a.m.-8.30 a.m.
GWS, 6236kc, 2 p.m.-3.30 p.m., 4 p.m.-5.45 p.m.
?, 9675kc, 4 p.m.-5 p.m., 8 p.m.-10.30 p.m., 1.15 a.m.-7 a.m.

The MONTH'S LOGGINGS

OCEANIA

Fiji

VPD-2, Suva 6.13mc, 48.94m
Is being heard again in the mornings with news at dictation speed at 6 (Gillett).

Iwo Jima

KGIP 10.64mc, 28.20m
Calls KU5Q about 9.45 p.m. very often (Gillett).

Okinawa

See frequencies, etc., at foot of "New Stations."

GREAT BRITAIN

B.B.C., London. See also elsewhere special list of B.B.C. transmitters.

GSV 17.81mc, 16.84m
Good with news at 9 p.m. (Matthews).

GSF 15.14mc, 19.82m
Fair at 9 p.m.; better at 1 a.m. (Matthews, Edel).

GRF 12.095mc, 24.80m
Good all evenings and fair in afternoons (Matthews).

GRV 12.04mc, 24.92m
Good in Pacific Service (Matthews, Edel).

GRU 9.915mc, 30.26m
Excellent strength at 8 a.m. (Matthews).

GSC 9.58mc, 31.32m
Excellent until 11.30 a.m. (Matthews).

GWL 7.205mc, 41.64m
Heard in session to North America at 11 a.m. (Cushen).

AFRICA

Algeria

AFHQ, Algiers 11.765mc, 25.50m
"The Voice of America in North Africa" is heard closing at 5.15 a.m. with "S.S.B." (Gillett).

Belgian Congo

RNB, Leopoldville 9.785mc, 30.66m
Good strength at 10 a.m. (Matthews).

Ethiopia

Radio Addis Ababa 9.62mc, 31.19m
Heard at 2 a.m. in relay from B.B.C. Annoying overlap from GWO very often (Gillett).

French Equatorial Africa

FZI, Brazzaville 17.50mc, 17.143m
Good signal in the afternoons, but not up to the great form of their 25-metre band. No English (Gaden).

FZI, Brazzaville 15.595mc, 19.25m
Fair from 8.15 p.m. (Matthews). Very good here; only natural, as is beamed to Indo-China (Clack).

FZI, Brazzaville 11.97mc, 25.06m
Good until closing at 4.30 p.m. (Matthews).

FZI, Brazzaville 9.50mc

Kenya Colony

VQ7LO, Nairobi 10.73mc, 27.96m
Fair strength at 12.15 a.m. (Matthews).

VQ7LO, Nairobi 6.114mc, 49.07m
Is fairly good strength at 2.45 a.m. with programme of semi-classical music (Gillett).

Senegal

FGY, Dakar 11.715mc, 25.61m
See "New Stations."

CENTRAL AMERICA

Costa Rica

TIPG, San Jose 9.62mc, 31.20m
Fair to good at 10 p.m. (Matthews). At 10.30 puts in an R8 signal when free of morse interference. VLC-6 causes only slight annoyance (Clack).

Panama

HP5G, Panama City 11.78mc, 25.47m
Very good here, till signing at 2 p.m. Good after GVU signs (Cushen).

SOUTH AMERICA

Argentina

LRM, Mendoza 6.185mc, 48.51m
Weak and noisy at night (Gaden).

Brazil

PRL-7, Rio de Janiero 9.72mc, 30.86m
Fair signal at 8 a.m. (Matthews). At 8.30 a.m. the signal is at R8-9 for 30 minutes but then weakens, although audible till 11 o'clock. The programme of dance music heard at 7.30 is just the thing for starting off the day brightly. I also hear them at 8 p.m with a signal that remains R5-6 for nearly an hour, after which noise blots it out (Clack).

ZYC-8, Rio de Janiero 9.61mc, 31.22m
Some a.m.'s not bad after breakfast and near 2 p.m. (Gaden).

Chile

CE-615, Santiago 6.155mc, 48.78m
Signs at 2.05 p.m. No English heard (Cushen). Takes some getting at night weak and noisy band (Gaden).

Ecuador

HCJB, Quito 15.09mc, 19.87m
Fair at 7 a.m. (Young).

HCJB, Quito 12.445mc, 24.08m
Fair at 10 p.m.; better at 10.30 a.m (Matthews). (Just the reverse here.—L.J.K.)

HCJB, Quito 9.958mc, 30.12m
Fair around 10 a.m. (Matthews).

Peru

OAX-4T, Lima 11.80mc, 25.42m
"Radio National del Peru" heard at fair strength till 2 p.m. (Cushen).

OAX4G, Lima 6.33mc, 47.39m
Not a new station, but hasn't been heard here for many months. Signs at 3 p.m. with organ number. Announced OAX4B, OAX4G, Radio Lima. Signed with 4 chimes (Cushen). (This is very interesting as OAX4G was reported to have moved to 6.19mc. Last known schedule was 11 a.m.-1 p.m. daily and till 4 p.m. on Sundays.—L.J.K.)

U.S.A.

San Francisco unless otherwise mentioned

KCBF 17.85mc, 16.81m
Good for several hours after 11 a.m. (Matthews). (Good from opening at 7 o'clock. Has a spell of 5 minutes at 10.25 and from 10.30 till closing at 1.45 p.m. is very good. Both sessions are for Latin America and through United Network.—L.J.K.)

KRHO, Honolulu 17.80mc, 16.85m
Excellent all through the day (Matthews).

KNBA 17.78mc, 16.87m
The best 16-metre station (Gaden, Matthews).

KROJ 17.76mc, 16.89m
Good from opening at 11 a.m. (Matthews).

NEW STATIONS

OLR-3A, Prague, 9.55mc, 31.41m: Here is a good catch by Arthur Cushen. Heard from 5.30-6 a.m., announcing as "This is Prague calling our friends in Great Britain." Programme includes news commentary from Prague newspapers, and recordings. Leaves the air at 6 o'clock. (This station during the occupation by Germany had the call-sign of DHE-3A.—L.J.K.)

SPW, Warsaw, 13.635mc, 22.02m: Here is an old-timer—silent during German occupation—reported by Arthur Cushen. Heard opening at 11.45 a.m. a.m., but signal poor. (This frequency was taken by Germany for DZF, but not used.—L.J.K.)

——, Dakar, 9.92mc, 30.22m: Dr. Gaden reports this new outlet for Senegal. Heard around 6 p.m. Perhaps not as strong as their other transmitters but is less noisy. No English heard.

FGY, Dakar, 11.715mc, 25.61m: Here is another spot for Dakar, also reported by Dr. Gaden, who says: "Was surprised to hear 'Dakar' at 5.15 p.m.; there was little noise then in that area and signal was quite good; no English heard."

——, Delhi, 11.71mc, 25.62m: Announcing as on 25.62m, this new Delhi transmitter is heard nightly at 11.30. Reported by Rex Gillett.

RADIO NATIONAL ESPANA, Madrid, 7.37 mc, 40.71m: Wally Young reports hearing Madrid on this new frequency around 3 a.m.

KRHO, Honolulu, 15.25mc, 19.67m: Opens at 8.45 a.m. with fair signal until closing at 9.15. This session is beamed to China and the last 15 minutes may be Radiophoto.—L.J.K.

IAC, Coltano, 15.91mc, 18.85m: Another from Wally Young, of Adelaide. Heard around 6.15 p.m. and a new spot for Italy.

WCBX, New York, 9.59mc, 30.28m: "This is according to my records a new spot for this station. Is heard at fair strength around 6.30 p.m., carrying A.F.R.S. programmes. Closes at 7.45."—Rex Gillett.

Z1J, Okinawa—
15.52mc, 19.32m: Heard around 8.45 a.m., 2 p.m. and 9 p.m.
13.76mc, 21.80m: Heard around 10 a.m.
10.64mc, 28.20m: Heard around 6 a.m. and 9 p.m.
7.64mc, 39.25m: Heard around 10 p.m.

CHOL, Sackville, 115.72mc, 25.60m: This further outlet of the Canadian Broadcasting Corporation is heard opening at 7.15 a.m. Signal is only fair, with classical music till 7.30, when male announcer, in English, gave particulars of items played, and said, "This is the international station of the C.B.C., CHOL, on 25.60m. The following programme in French is for our French listeners." Female announcer then read items in French until 5 minutes later, when taken up by male announcer, also in French. At 8 a.m. station announcement by man in English, followed by music, with singing in French. Morse now spoilt signal, which was improving in strength. Left set for few minutes, but no sign of them at 8.50, so figure they closed at 8.45.—L.J.K.

KNBX 15.34mc, 19.56m
Quite good in a.m. in Latin America service (Gaden).

KGEX 15.21mc, 19.72m
Good signal at 12.30 p.m. (Matthews).

KNBI 15.15mc, 19.81m
Perhaps the best of all 'Friscos in 19-metre band (Gaden).

KNBA 13.05mc, 22.98m
A great success in all its sessions (Gaden).

KWIX 9.85mc, 30.44m
"The Daddy of 'Em All" after 5.30 p.m. (Gaden). (See "Says Who?"—L.J.K.)

KCBF 9.75mc, 30.77m
At 7 p.m. is rather better than KCBR (Gaden).

KRHO, Honolulu 9.65mc, 31.09m
Is fine strength from opening at 2 a.m. with news (Gillett).

KGEI 9.55mc, 31.41m
Excellent all night (Matthews). Good signal spoilt by station a few kc/s higher (Clack). (You are **right,** but the said station announces as a few kc/s lower.—L.J.K.)

KNBX 7.805mc, 38.43m
Good at night (Gaden).

CHINA

XGOY, Chungking 11.909mc, 25.19m
Have you heard the American Hour at 9 a.m.? The signal here is very good at that time (Clack).

XGOY, Chungking 9.805mc, 30.58m
News at 11 p.m. now (Matthews).

XGOY, Chungking 7.153mc, 41.96m
Very good at 11 p.m. (Clack).

INDIA

VUD-5, Delhi 17.84mc, 16.82m
News for people in Burma and the Far East at 1.30 p.m. Excellent signal.—L.J.K.

SEAC, Ceylon 15.275mc, 19.64m
Good from 7 p.m. here, with Forces programme (Clack).

SEAC, Ceylon 15.22mc, 19.71m
Transmission closes at 3 p.m. with R6 signal (Clack).

SEAC, Ceylon 11.810mc, 25.40m
Good all evening (Matthews). Dictation speed news at 7.30 p.m. is R Max. (Clack).

VUD-, Delhi 9.68mc, 30.99m
Apparently idle and A.I.R. is heard on 9.67mc, 31.02m, opening at 4.30 a.m.

VUD-4, Delhi 7.275mc, 41.24m
Is on the air from 10 a.m. for 30 minutes with an independent Forces programme of music. Signal is R7 (Clack).

U.S.A.

Other than 'Frisco

WNRE, New York 15.28mc, 19.63m
Fair on opening at 8.30 p.m. (Matthews).

WRUL, Boston 15.13mc, 19.83m
Opens strongly at 11.30 p.m. with programme in Spanish (Gillett).

WOOW, New York 11.87mc, 25.27m
Very good in morning (Gaden).

WRUL, Boston 11.73mc, 25.58m
Very good at 9 p.m.—L.J.K.

WOOW, New York 11.145mc, 26.92m
Very good after 9.30 a.m. (Gaden).

WNRA, New York 9.85mc, 30.44m
Good before breakfast (Gaden).

WRUW, Boston 9.70mc, 30.93m
Heard testing at 4.30 p.m. after transmission to Latin America signed. Were asking for reports (Cushen).

——, 9.69mc, 30.96m
American Forces Network beamed to China. Excellent at noon.—L.J.K.

WNBI, New York 9.67mc, 31.02m
Fairly good signal at night (Gaden).

WCBX, New York 9.59mc, 31.28m
Carries AFRS programmes until closing at 7.45 p.m. (Gillett).

WGEO, New York 9.53mc, 31.48m
Excellent around 7 a.m. (Gaden).

WOOC, New York 7.82mc, 38.36m
Very good in a.m. (Gaden).

WBOS, Boston 7.80mc, 38.44m
Very ordinary in a.m. (Gaden).

WGEX, New York 7.00mc, 42.86m
Can be heard amongst a lot of noise (Gaden).

U.S.S.R.

——, Moscow 12.06mc, 24.88m
1-1.30 a.m. Very good signal (Edel).

——, Moscow 9.715mc, 30.88m
Good strength at 8 a.m. (Matthews).

WEST INDIES

Cuba

COKG, Santiago 8.95mc, 33.48m
"Radio General Electric" signs at 2 p.m. Fair signal (Cushen).

Haiti

HHBM, Port-au-Prince 9.65mc, 31.06m
Some nights is not bad on opening soon after 9.30 p.m. (Gaden).

MISCELLANEOUS

***Carried over from July issue**

Azores

Emisora Nacional, Ponta Delgado 11.09mc, 27.05m
Good signals are being heard from this station about 4 a.m. (Gillett).

Canada

CHTA, Sackville 15.22mc, 19.71m
Only fair at 9 p.m. (Matthews). Closes some nights at 11 o'clock (Gillett).

***CKRX,** Winnipeg 11.72mc, 25.60m
Relays CKRC till 3 p.m. week days, and until 4 p.m. Sundays—interference from GVV—signs with National Anthem after 5 minutes of news (Cushen).

***CKXA,** Sackville 11.705mc, 25.63m
Still broadcasting till after 8 a.m., best after GVW signs (Cushen). Has been heard nicely up till 4 p.m. and again at night, rather better than when heard in a.m. (Gaden).

***CKRO,** Winnipeg 6.15mc, 48.78m
Same programme as CKRX but in the clear; gives also broadcast call (Cushen).

CFRX, Toronto 6.07mc, 49.42m
Heard through the Russian at 8 p.m. (Cushen, Gillett). Fair signal but noise and interference bad (Gaden).

***VE9AI,** Edmonton 6.005mc, 49.95m
Heard signing at 4 p.m. but covered with morse. News at 3 p.m. (Cushen).

Finland

OIX-4, Lahti 15.19mc, 19.75m
Classical music at 5.30 a.m. (Gillett).

***OIX-2,** Lahti 11.79mc, 25.43m
Has English session at 10.15 a.m.—signs at 10.55 (Cushen). (Quite a good signal here, too.—L.J.K.)

OIX-3, Lahti 11.775mc, 25.48m
Heard at 5.30 a.m. (Gillett).

France

***——,** Paris 15.92mc, 18.84m
"Shaef in Paris" has been logged at 8.45 a.m., calling the Blue Network in New York.

***——,** Paris 15.24mc, 19.69m
One of the best, opening at 1 p.m. on its old spot. Have not heard a word of English on any of their transmitters, probably due to not listening at the right time (Gaden).

***——,** Paris 15.09mc, 19.87m
Heard at about 3 p.m. (Gaden).

——, Paris 11.845mc, 25.33m
Excellent strength at 3 a.m. (Matthews).

——, Paris 11.73mc, 25.58m
Very good signal at 1.30 and 8.30 a.m. (Matthews). Opens at 7.15 with "Marseillaise."—L.J.K.

***——,** Paris 9.55mc, 31.41m
Heard around 3 p.m. (Gaden).

Italy

HVJ, Vatican City 9.66mc, 31.006m
Concludes an English broadcast at 4 a.m.—good signal (Gillett).

***"The Voice of Italy,"** Milan 6.40mc, 46.80m
Good strength with classical music till closing at 8 a.m. (Gaden). Good at 3.30 p.m. (Cushen).

Luxembourg

***Radio Luxembourg** 15.105mc, 19.86m
Is often good signal with B.B.C. News relay at 9.45 p.m.—also heard well at 6 a.m. (Gillett).

Radio Luxembourg 6.020mc, 49.83m
Good at 2.30 p.m. in English. Broadcasts till 4 p.m. in German, etc.—suffers by interference from "mystery" station on 6.025mc, opening at 2 o'clock and using 3 drum beat interval signal (Cushen). Has been very strong, closing at 7 a.m. (Gillett).

Mexico

***XEQQ,** Mexico City 9.68mc, 30.99m
Fair at 2.45 p.m., best there before GRX opens (Cushen).

***XERQ,** Mexico City 9.618mc, 31.21m
Back here after being on 9.59mc for a time. WLWO was too tough for them (Cushen).

XEWW, Mexico City 9.50mc, 31.58m
Good at 11 p.m. (Young, Matthews). Particularly good up my way—comes through at R8 from 10 p.m. here (11 p.m. Sydney) and this one frequently provides the musical entertainment I need before retiring, at 10.30 (Clack).

Poland

***Radio Lublin,** Warsaw 6.115mc, 49.05m
Commences a broadcast in French at 4.30 a.m. (Gillett). (An interval signal of chimes is used between various languages.—Edel.)

Spain

Radio National Espana, Madrid 9.375mc, 32.00m
This is a new spot for this Spanish station. Heard during early hours of morning until closing at 4.30—re-opens at 9 o'clock (Gaden, Gillett, Eden, Cushen, Lennie). (Excellent signal at 11.30 a.m. and till closing at noon.—L.J.K.)

Portugal

CSW-7, Lisbon 9.735mc, 30.82m
Good 10-11 a.m. (Matthews).

CSW-6, Lisbon 11.04mc, 27.17m
Good strength at 8.45 a.m. (Matthews).

Sweden

SDB-2, Stockholm 10.775mc, 27.83m
Very good from 1 a.m. (Edel, Matthews).

SBU, Stockholm .... 9.535mc, 31 .46m
Musical programme spoilt at 6 a.m. by Paris on the same frequency (Matthews).

Switzerland

HER-5, Berne 11.96mc, 25.08m
Heard closing at 7 a.m. Both French and Spanish used (Gillett). Excellent in Pacific Service—Tuesdays and Saturdays—closes at 4.30 p.m. (Matthews).

HEI-5, Berne 11.715mc, 25.61m
Very good at 1 a.m. (Matthews).

HEO-4, Berne 10.345mc, 29.00m
Good strength 5.20 a.m. in English; French at 5.30. Closed at 5.50 with English announcement (Gillett).

Yugoslavia

Radio Belgrade, Belgrade, 9.42mc, 31.85m
Opens at 1.15 a.m. with good signal (Edel).

Radio Belgrade, Belgrade, 6.10mc, 49.18m
Heard about 7.30 a.m. with varying signals. Male and female announcers (Gillett).

Speedy Query Service

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

W.G.H. (Albury) enquires about running cost of a set.

A.—There is no catch in it. A unit of power is 1,000 watts for one hour and if your set draws only 50 watts the cost of operation should be 20 hours per unit. The price of the power unit varies according to the supply, but doubtless you can get this from the electric power bill. Most radio sets draw well under a hundred watts, so ten hours per unit should be quite a safe basis for working on in your case.

* * *

F.A. (Adelaide) is having plenty of difficulty with a set which gives trouble in the form of intermittent fading.

A.—Yes, it would seem that you have tried every cure, but we suggest that one of the possibilities could be that the trouble is outside the set, for example, due to some peculiarity in the electric wiring system of the house, or even of the earthing of the tin roof through a drain pipe. This could give an absorption effect or a shielding of the indoor aerial. So we suggest taking the set to some friend's place and noting whether the trouble goes with the set or is left behind. Personally we like to tackle this type of job with the chassis upside down on a table and a meter across the high tension. If the voltage does not vary even a shiver with the fading, then we look for trouble such as by-passing of a screen, or the insulation of the aerial terminal, effectiveness of aerial connections, etc. Faults in valves or resistors are almost certain to show up as movement of the meter at the same time as the fading takes place.

* * *

W.E.R. (Port Pirie, S.A.) enquires about subscriptions.

A.—Yes, your local bookseller or newsagent should accept your yearly subscription at 10/6, but if there is any doubt about it you can send a postal note direct to our office. The issues are posted direct from Sydney in both cases. Alternatively, you can place an order with your newsagent for each month's issue, which he will hand over the counter at 1/- each.

J.M. (Collingwood) wants a high-voltage power supply for a cathode ray oscilloscope.

A.—Yes, it is quite a sound scheme to use an ordinary 385-volt radio-type power transformer as a half-wave supply, neglecting the centre-tap and earthing one of the 385 terminals, and applying the other to the plate of the rectifier. At a low current drain this should give you about 700 volts. Possibly not within the approval of the makers, but the humble 80 will often stand up to 700 volts at low drain. Use one plate at a time and you will have two lives to use up, anyway. Stick as close as possible to the rated filament voltage for the rectifier, as it is possible that either higher or lower can be harmful.

* * *

P.S.K. (Hamilton) is worried about loud-speaker matching.

A.—Correct matching is necessary for best results, but the subject is not nearly as critical as you may imagine. Unless you have a particularly keen ear, it is unlikely that you could tell the difference between results with a 5,000-ohm load and one of 7,000 ohms.

* * *

D.L.M. (Koonwarre) wants to know of a good circuit for a public address amplifier to deliver 15 watts of audio power and operate from ordinary dry batteries.

A.—Any ordinary 15-watt amplifier circuit can be operated from dry batteries, but it is not a sound proposition economically. You would need five or six batteries in series and then could expect a life of only a few hours. You can't get more power out of an amplifier than you put into it; in fact, you will be lucky if you get an efficiency of better than 75%. If you know your volts and amps you will be able to calculate what it is going to mean to drag 20 watts out of dry batteries. In practice, it is found that the reasonable limit in a straight battery amplifier is about three to five watts, obtained by using Class B or pentodes in push-pull. For bigger amplifiers the scheme is to use a couple of car batteries (accumulators) with a vibrator or rotary converter to get your high-tension supply.

T.P. (New Farm, Q.) notices that his set is only brilliant when operating at loud volume. The tone does not seem so good when turned down low.

A.—This is fairly normal and does not necessarily indicate that the volume control is faulty, unless the effect is so acute as to be especially noticeable. To obtain brilliance at low levels calls for a compensated amplifier of special characteristics. A lot of work in this direction is being done at present, but so far it has not reached the stage where we can tell you in so many simple words just how to alter your existing receiver to get this effect.

* * *

S.D. (Cronulla) enquires about the Institution of Radio Engineers.

A.—We suggest you get in touch with the I.R.E. secretary by sending him a letter at Box 3120, G.P.O., Sydney.

* * *

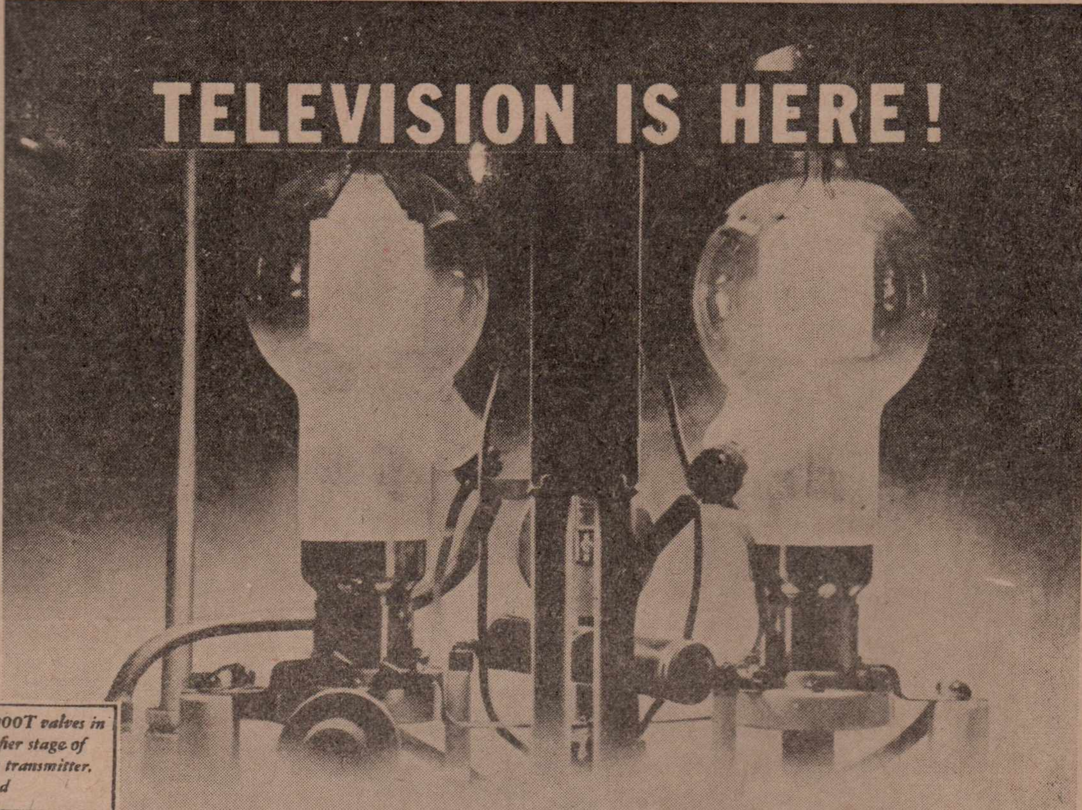
M.L. (Auburn, Vic.) is in trouble with a screen-grid valve.

A.—The initials B.V.A. stand for the British Valve Manufacturers Association, and do not denote a particular valve type. From your remark about the top terminal being a bakelite screw knob and not a metal cap, it is evident that the valve is one of the English type, and this top connection will be for the plate, not the grid, as with the American type cap. American valve types, with American-style connections, are made by British manufacturers, but this would appear to be one of the English-type valves with English-style connections.

* * *

R.A.H. (Dromana) is starting up in the radio repair business.

A.—To arrive at a suitable basis for charging you should have a job card for each set, putting down on this card the time spent on the job, listing the parts used and showing if the set was picked up or delivered. The charge is then made by allowing from 5/- to 7/6 per hour for time (according to your overhead), the value of the parts at retail price and a fee for transportation, either a fixed fee of 3/6 or 5/- each way, or so much per mile. The figures given are taken as between the usual limits, but you can suit yourself. Either way, you will find that you will need to keep on the move if you are to make a fortune.



Eimac 1000T valves in an amplifier stage of W6XAO transmitter, Hollywood

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Julia Lee Wright, noted Home Economics Director of "The Family Circle" magazine being interviewed, and telecast revealing tricks of her trade.

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Work on television station W6XAO (Commercial station KTSL) began in November 1930; and thirteen months later, Dec. 23, 1931, it was on the air on the ultra high frequencies, the first present day television to operate on schedule. Today the station occupies elaborate copper sheathed studios which stand 1700 feet above Hollywood with an antenna on a 300-foot tower.

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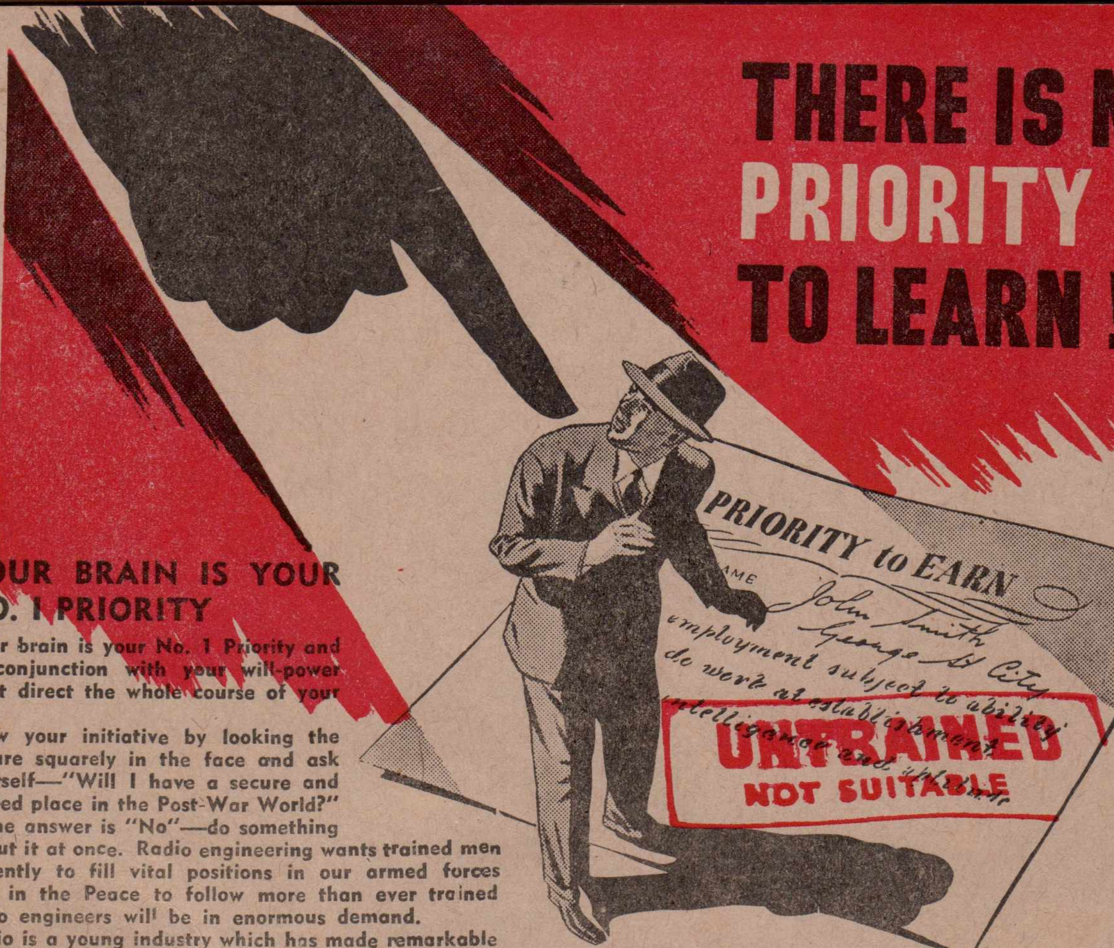

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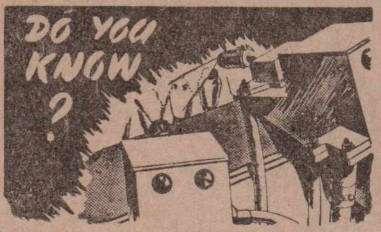

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