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THE AUSTRALASIAN

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EDITORIAL

The subject of television is still a sore one with the radio traders.

Talk of television is having a devastating effect on radio sales.

Yet a prominent radio concern recently made a wild publicity splurge on television, apparently just for some obscure political reason.

The so-called "television" was actually the sending of an image over a line, and not true television. It was accompanied by the grossest exaggeration, and claims that it was the first television in Australia. With a complete disregard of truth in advertising, these claims were made by people who should have well remembered the similar "television" demonstrations which were given in Australia more than ten years ago One such demonstration was given by the W.I.A. boys at their exhibition in the Assembly Hall, Margaret Street, Sydney, in 1936.

Television will come, eventually. It will cost a lot of money. It will be most disappointing from many angles. Special events will have their appeal, but long periods of peering into a small screen will give you a pain in the neck, in every sense of that expression.

Television will never replace radio broadcasting as we know it to-day, or the cinema, either. It will not make present broadcast receivers obsolete.

Most of our readers are recognised as authorities on radio matters by their many friends and business associates. I do hope that they will do their best to pacify the public and avert a television panic.

—A. G. HULL.

Measuring A.C. Current

As you already know, there are plenty of instruments on the market for the measuring of both voltage and current for d.c., but when it comes to a.c., they measure only voltage. From time to time, we have had many enquiries from repair men who want to check the current drain of an electric toaster, for example. A new element has been fitted, and there is doubt as to whether it is the correct type. Every attempt to measure the current drawn by this piece of equipment has been futile with the usual radio-type multi-tester.

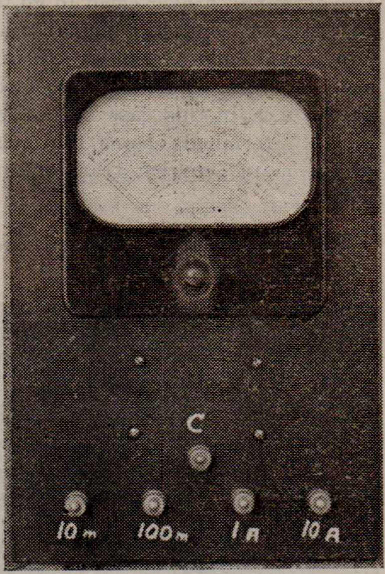
Here is a piece of test equipment for the measuring of current drawn by equipment operating from alternating current.

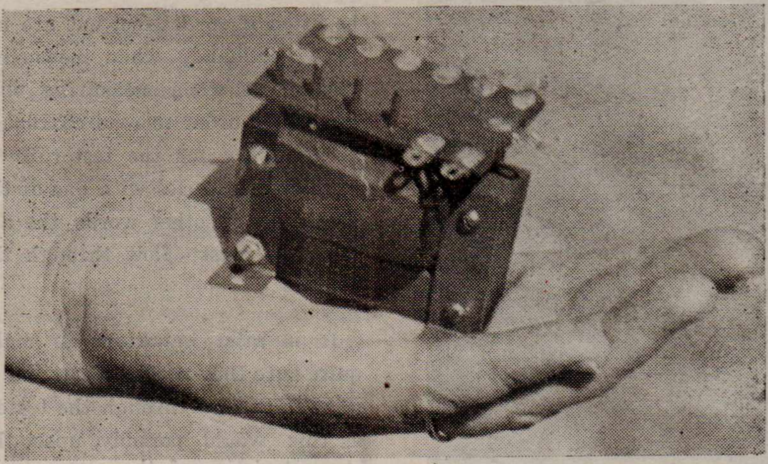
MAIN requirements are (1) an 0 to 1 milliameter, (2) the usual type of meter rectifier, and (3) a current transformer.

Dealing with these items you will immediately realize that the meter and rectifier presents no problem, these being readily available, in a number of types, brands, styles and prices.

The current transformer is a new release by the Trimax Transformer people, being specially designed and built for this purpose. It is listed as type TC2 at a price of 80/-.

The current transformer is a special style of auto transformer, with the meter across the whole winding and tappings which are taken out to provide various ranges of current, with full-scale meter readings of from 2.5 milliamperes to 10 amperes, in 12 steps. When building up this piece of test equipment there is no need to use all the tappings, and those which are likely to suit your particular purpose can be selected.





Just a handful—the Current Transformer.

The Current Transformer

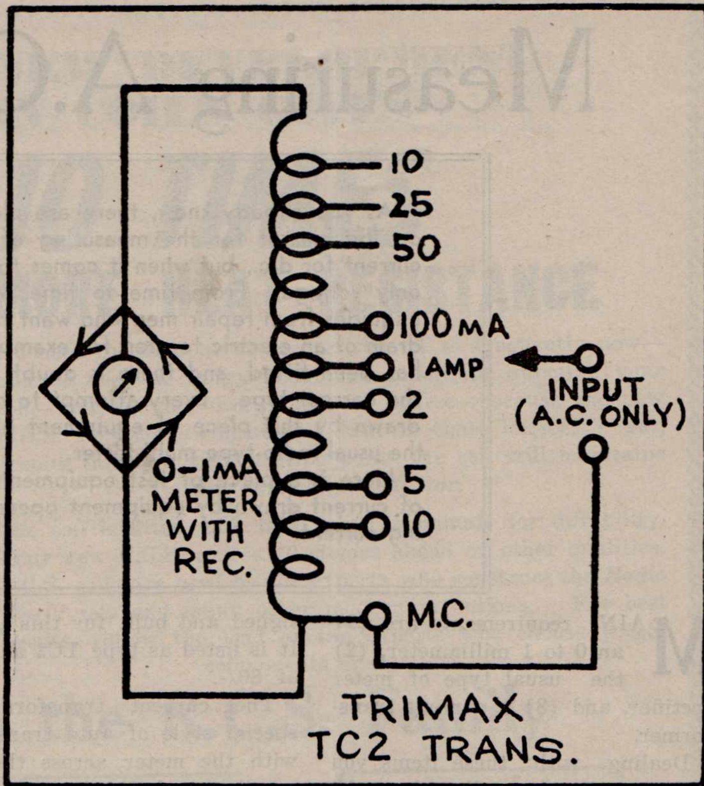
The Trimax TC2 current transformer is a compact little unit, measuring about 2 in. x 2 in. x 2½ in., with mounting lugs which are

(Continued on next page)

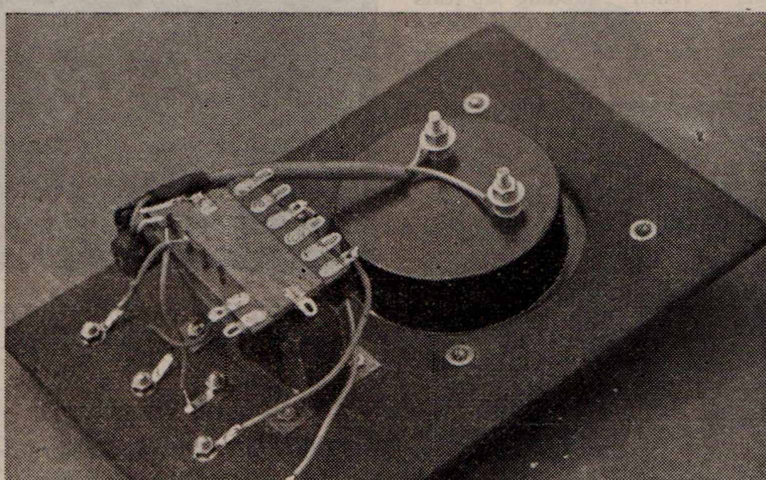
reversible. The tappings are brought out to terminals on a terminal board.

One terminal is marked "M" for meter. Another is "MC," being the common terminal for the other side of the meter, and the scale tappings. When we speak of meter we refer to the meter rectifier unit, of course.

If you get a rectifier which is not clearly marked the following hints may guide you to an understanding of its connections. The usual way of arranging the leads from a meter rectified is to have a red lead to go to the meter's positive terminal, a black lead to go to the meter's negative terminal, and two other leads of similar colour, such as white, which are connected to the a.c., in this case to the M and MC terminals, being the ends of the main current transformer winding.



The actual construction of the tester can be left to your own design, so long as you can accommodate the three main items as listed above. Ordinary terminals can be arranged in a row if you want the simplest method, or you can fit a rotary switch to select the ranges. Leads with prods can be fitted if so desired, but are not really so handy when measuring current as when measuring voltages. In order to read current it is necessary for the tester to be connected in series with one of the a.c. leads; in other words, the a.c. current must flow through the tester.



It is most important to make quite sure that no direct current is allowed to flow through the tester, as this would, possibly, upset the characteristics of the core. If

(Continued on page 14)

New-Style Direct Coupling

As announced in the "stop press" paragraph in last month's issue, there has been quite a bit of excitement in our laboratory at the development of direct-coupled circuits along the lines suggested by a Melbourne Technical School student who was down at Mornington for his Christmas holidays.

MAIN difference in these direct-coupled circuits is the use of two separate power supplies, these power supplies having their negatives at different potentials in regard to earth.

Now, in the circuit given in last month's issue, as originally suggested by Mark Atyeo, bias for the output valves was obtained in true direct-coupled style by keeping the cathode or heater circuit of the output valves at a positive potential in respect to the direct-coupled plate and grid circuit. In this particular circuit the drop in the plate feed resistors was taken into account and a suitable voltage for the cathodes then picked off a voltage divider across the first power supply.

By

A. G. HULL

This worked fine, and after a few parasitics had been ironed out of the original amplifier it gave excellent performance. But when thinking over the job one evening, your Editor got a rare brain wave, and realised that there was no real reason why the old inter-locking bias arrangements need be used with this new circuit, with its twin power supplies. Since it is possible to isolate the two power supplies it becomes a fairly simple matter to use the ordinary type of self-bias resistor for the output valves and then fit grid resistors to maintain the direct-coupled plates and grids at a static potential equal to the negative side of the second power supply.

This new idea was tried and proved a wonderful success. The full operation of the scheme has not been thoroughly investigated from a theoretical point of view, but practical results speak for themselves. The reproduction has something which just can't be obtained from ordinary resistance-capacity coupled amplifiers. Those who already have the finest of ordinary push-pull amplifiers have heard this job and readily admit that it has "it." Of course, all gramophone amplifiers are limited by the quality of the recordings, but some of the new M.G.M. series appear to have some pretty brilliant recording which comes out well. The Jazzart record of "Sweet Lorraine" also has some technical features which make it show up on the new amplifier. The band does not appear to have had

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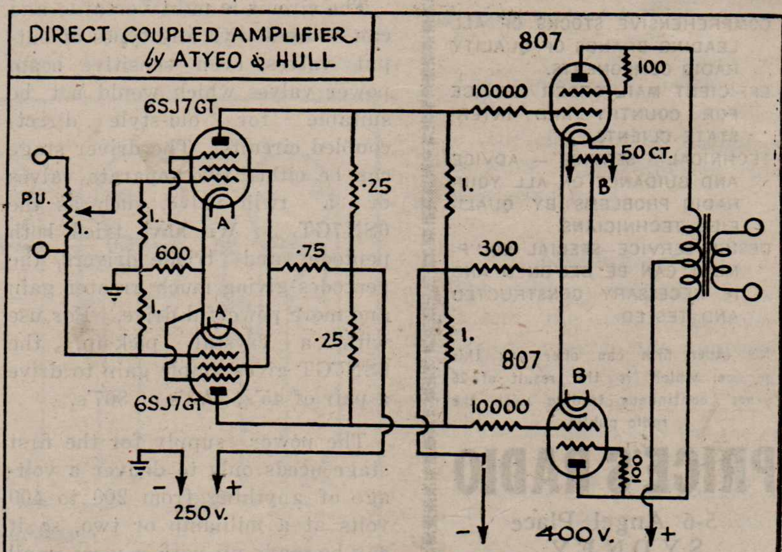

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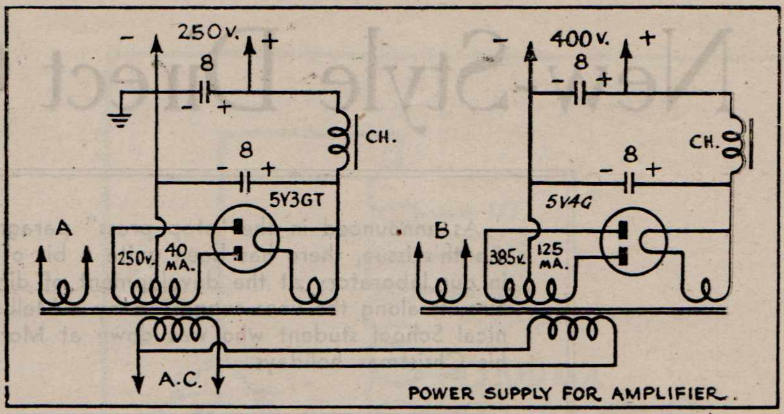
enough rehearsal, and so the record is not recommended on account of its music, but the quality of the instruments reproduces quite well on this new amplifier.

Those who want to ponder on the theoretical possibilities will find plenty of scope for deep thinking. Bias on the output valves is quite automatic and, therefore, does not have any of the disadvantages of the old-style direct-coupled circuits in this regard. When the amplifier is first switched on there is no lack of bias on the output valves, as with some types of direct-couplers.

For static considerations, the negative side of the second power supply is at the same potential as



POWER SUPPLY FOR AMPLIFIER.

the direct-coupled plate-to-grid circuit, since it is actually coupled to that circuit by grid resistors through which no current flows. But what happens when the amplifier is in operation, especially if there is any tendency to unbalance in the first stage, would take a fair bit of working out. It does seem, however, that there would be a degenerative effect which would tend to correct any unbalance. Likewise, any overloading of the final stage will be reflected back to stabilise the drivers. Practical work with the circuit make it unnecessary to delve too deeply into these points.

The circuit is most versatile and can be used with any types of output valves, even sensitive beam power valves which would not be suitable for old-style direct-coupled circuits. The driver stage can be either two separate valves or a twin valve, such as the 6SN7GT. We have tried both pentode and triode drivers, the pentodes giving much greater gain and more powerful drive. For use with a crystal pick-up, the 6SN7GT gives ample gain to drive a pair of 45's, 2A3's or 807's.

The power supply for the first stage needs only to deliver a voltage of anything from 200 to 400 volts at a milliamp or two, so it can be made up with a very small transformer and choke. We have used a little 40 milliamp 225 volt transformer which does the job well, with a little Rola choke and a pair of 8 mfd. electrolytics. The total cost of this small power supply is only a matter of a pound or two; little enough to pay for the remarkable performance which is obtained with direct-coupling. For the second power supply a 385 volt at 125 ma. transformer will give ample power for a pair of 807's in their triode connections, with a main bias resistor of 300 to 400 ohms. They will then deliver about 12 to 15 watts of undistorted output. If you feed this into a good 12-in. speaker you will get ample volume for domestic purposes. Possibly your neighbours will tell you that it is too much.

Our experiments have been carried out with a crystal pick-up and a centre-tapped input straight from this pick-up, as shown on the circuit, which is the simplest form. But the amplifier is also quite suitable for use with a primary amplifier, pre-amplifiers and so on. Along the lines of the Williamson, it is quite simple to drive the two grids of a 6SN7GT from another 6SN7GT as a direct-coupled phase-changer, with or without inverse feedback. In our brief experiments the use of inverse feedback does not seem to be of any great advantage.

A Simple Multimeter

A few months ago I decided to build myself a small multimeter for portable use. My workbench unit was rather large for portable use, having separate meters for voltage and current measurement. The meter (0-1 ma.) in the big job was by no means new, and had received some rough treatment on one or two occasions, so I decided to replace it with a new 4" meter, and to use the old one, a 3" round type, for the small unit.

All the remaining parts, except the test prods and resistances, came out of the junk box.

After a bit of juggling the circuit shown in fig. 1 was decided on. This was mainly determined by two switches available—

Two single pole, four position (S1 and S3)

One single pole, three position (S2)

One double pole, double throw toggle (S4).

With some rearrangement of the switches S1 and S3 could be combined into a double pole unit. The circuit would not require amendment.

To make the circuit clearer separate circuits are shown for each function of the multimeter. The assembly wiring diagram (fig. 2) shows the wiring from underneath.

By
W. S. LONDEY
8a. Barkly St., Sale, Victoria

Voltmeter

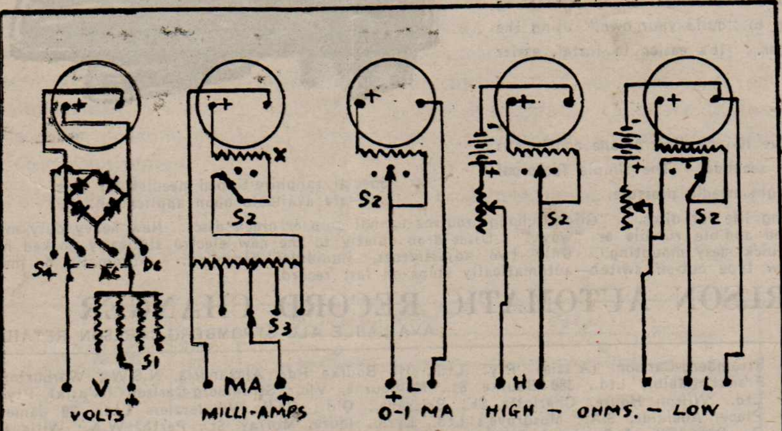
The voltmeter section is quite straightforward, being arranged to read both AC and DC. The meter had already been fitted with a rectifier. This was procured as a separate unit, bolted to the bakelite back of the meter, and two extra terminals fitted for AC. The DC side of the rectifier was left permanently connected across the meter, as its resistance to reverse current was too high to affect the meter reading. The DPDT switch (S4) simply changes from the DC terminals of the meter to the input of the rectifier. The toggle switch gives a definite indication of AC or DC setting.

The ranges are 5v, 20v, 100v, and 500v, both AC and DC. These are sufficient for all normal service work. The different ranges are selected by S1.

Milliammeter

The milliamp section only reads DC, and the test leads must be changed over to the appropriate sockets. The centre switch (S2) must also be turned to MA to connect the shunts across the meter.

A tapped type of shunt was used in preference to separate



CIRCUIT DIAGRAMS. FIG I.

(Continued on Next Page)

METER

(Continued)

shunts because it is simpler and more reliable for switching. This is because no switch contacts between meter and shunt carry large currents. Compare the two diagrams—fig. 3, I and II. The upper diagrams show the circuits of tapped and simple type shunts with the range switch. The lower diagrams show the equivalent circuits one range only), where R represents the switch resistance.

In II a bad switch contact would alter the shunt resistance and therefore the effect of the shunt.

To be used in this system the shunt switch would have to have a contact resistance which is negligible compared with ½ ohm—(less than .005 ohm), as a shunt for 200 MA would be about this value. In the case of the tapped type shunt (fig. 3, I) a bad switch contact would not affect the shunt meter resistance ratio. The only contacts in the circuit that could affect the accuracy carry only 1 MA in a 100 ohm circuit, switch S2.

The shunt resistance values are determined as follows (those who don't like arithmetic can skip this part):—

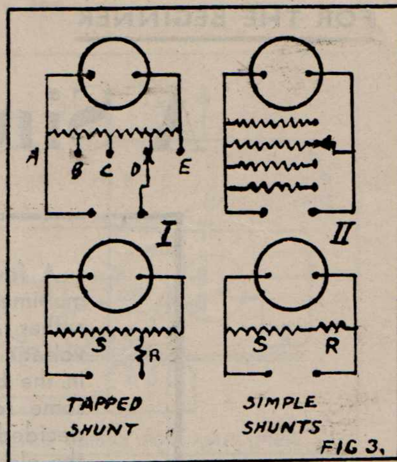
Meter resistance — 100 ohms. This is the resistance of the majority of meters, but, if the meter resistance is lower (as it was in my case) resistance X can be inserted as shown to make up the difference.

Ranges required—5, 20, 50, 200 MA. (I find these most useful for service work.)

Rule for all shunt calculations—
Meter resistance x meter current = Shunt res. x shunt cur.

100 x 1 (Shunt res. x (5-1).
Shunt resist. = 100
Shunt resist. = 100 = 25 ohms.
Total resistance A to E is 25 ohms.

In the case of tapped type shunts the ratio of tap resistance to that of the whole shunt is in-



versely as the current ratio.

Then—$\frac{AD}{AE} = \frac{5}{20}$

AD = ¼ AE
= ¼ 25
= 6.25 ohms

Therefore section DE must have a resistance of 18.75 ohms.

Similarly $\frac{AC}{AE} = \frac{5}{50}$

AC = 2.5 ohms

Therefore section CD must have a resistance of 3.75 ohms.

By similar calculations BC has a resistance of 1.875 ohms and AB a resistance of 0.625 ohms.

The proof (for those who are interested) is as follows:—

Let R1 be meter resistance.
R2 be resistance of whole shunt.
R3 be resistance from common to tap on shunt.
I1 be meter current.
I2 be meter current with shunt.
I3 be Maximum rating of tap.

At any tap the meter resistance becomes R1 † R2—R3.

Then I1 (R1 † R2—R3) = (I3—I1) R3.

But I1 R1 = (I2—I1) R2 (formula used for whole shunt)

Or I1 (R1 † R2) = I2, R2.

Therefore I2 R2 = I3 R3.

I2 = R3 (rule used above).

I3 R2

Caution—This rule only applies to tapped type shunts; simple shunts may be determined separate for each current.

Shunt resistances required:—

AB— 0.625 ohms.
BC— 1.875 „
CD— 3.75 „
DE—18.75 „

These resistances were made up of insulated eureka wire on a strip of bakelite fitted with solder lugs.

Although at first sight it would appear very difficult to make up an accurate resistance of 0.625 ohms it is possible to do so with ordinary equipment.

If four strands of 34 SWG eureka are used in parallel the resistance of each strand becomes 4 x 0.625 or 2.5 ohms, and that of the four strands in series, 10 ohms. This is easily measured accurately. Add 2 inches to the measured length, cut this piece into four equal parts and carefully tin exactly ¼ inch at each end of each piece. If no ohmmeter or bridge is available the wire tables give an accurate indication of the length required. No. 34 eureka has a resistance of 10.1 ohms per yard, so the length would be 35.6 inches, plus 2 inches, or each piece 9.4 inches long, with ¼ inch at each end tinned.

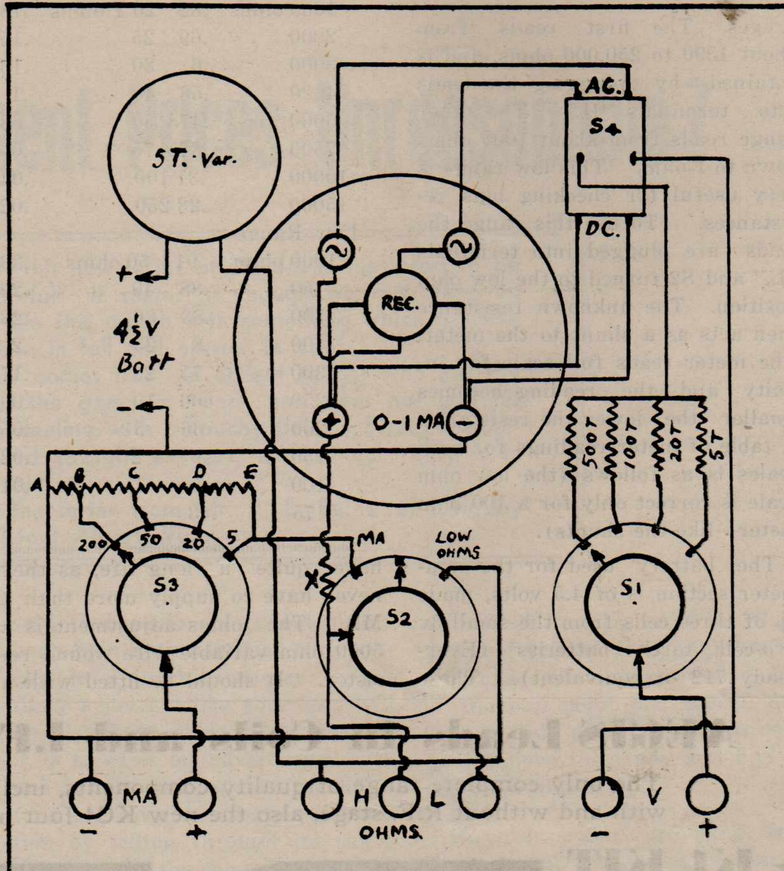


FIG 2.

Similarly, the next section, 1.875 ohms, can be made of two strands each 14 inches long, each end tinned.

The remaining two pieces need only be single strands, the lengths being 14 inches and 5 feet 7 inches respectively for 3.75 and 18.75 ohms.

Care should be taken to connect the shunts the correct way round —the end A of the lowest resistance section connects to the meter negative and to one lead socket, the other end E goes to S2.

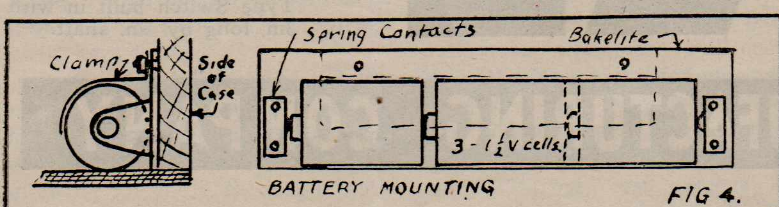


FIG 4.

Ohmmeter

The ohmmeter section has two

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METER

(Continued)

ranges. The first reads from about 1000 to 250,000 ohms, and is obtained by plugging the leads into terminals "H." The other range reads from about 1000 ohms down to 1 ohm. This low range is very useful for checking bias resistances. To use this range the leads are plugged into terminals "L," and S2 turned to the low ohm position. The unknown resistance then acts as a shunt to the meter. The meter reads full scale for infinity and the reading becomes smaller the lower the resistance. A table of meter readings for both scales is as follows (the low ohm scale is correct only for a 100 ohm meter—like the shunts).

High Range—			
1000 ohms	.82	20 T ohms	.18
2000	.69	25	.15
3000	.6	30	.13
4000	.53	40	.1
5000	.475	50	.08
7500	.375	75	.06
10000	.31	100	.04
15000	.23	250	.02
Low Range—			
1000 ohms	.91	50 ohms	.33
750	.88	40	.29
500	.83	30	.23
400	.8	25	.2
300	.75	20	.17
250	.66	10	.09
200	.66	5	.05
150	.5	2	.02
100	.5	1	.01
75	.43		

The battery used for the ohmmeter section is of 4.5 volts, made up of three cells from the small 3v two-cell torch batteries (Eveready 712 or equivalent). These have quite a long life, as they never have to supply more than 1 MA. The ohms adjustment is a 5000 ohm variable wire wound resistor. It should be fitted with a stop or mark to indicate when the battery voltage is below 4v. for low voltage causes high apparent resistance readings.

Fig. 4 shows how the battery unit is clamped into the case. Flexible leads run from the contact springs to the instrument.

The Case

The unit is mounted on a wooden case 6 inches x 7½ inches outside dimensions, and 2½ inches deep. The bakelite top carrying the parts is held in place by four screws, as it requires only infrequent removal to replace the batteries. The marking of the terminals and switches was as simple as possible. In this instance the letters and figures were stamped direct on the bakelite and the marks filled in with white ink. If desired a printed strip could be clamped under the row of banana sockets.

A few words of caution—when

(Continued)

ANSWER IN FULL

Are Component Prices Unreasonable?

> Although this new series of articles is supposed to be "answers in full" it seems as though we may tend to break the rule this month with something which is more like "question in full and answer in brief."
>
> The letter comes from an ardent reader who has the interests of the game at heart, and does not pull his punches in dealing with a touchy point. Straight questions demand straight answers, and so our reply is in the same vein.
>
> Here is the letter from Mr. R. L. Burns, of Kingsley Crescent, Mont Albert, Vic.:—

I set-up of the last few is- impressed with the new HAVE been pleased and sues, and am entirely sympathetic to your January editorial. However, one point should not be missed, in that I believe the radio trade and component manufacturers are very largely responsible for the disinterested conditions which obtain at the present time. After all, economic influences control a good deal of our lives, and a glance through the advertisements of components will soon convince one that radio is hardly in the "hobbies" class. In fact, many of my friends have informed me in recent times that they "have given radio away" for the simple and understandable reason that they cannot afford it. None of these are young fellows relying only on parental pocket money to keep them going, but are men with a considerable knowledge of the trade. A parent would need to be indulgent indeed to encourage radio as a hobby.

One is acutely aware of sharply rising costs everywhere, and a governmental tendency to grab the cream from everything. But, even allowing for these factors, I think it can be fairly and reasonably said that radio component prices have been maintained at a reasonable level in this country. One thing a journal like your own will one day have to decide is whether it is to exist on advertising revenue from component manufacturers or rely on a larger circulation by telling through its pages how to make the components themselves.

I also subscribe to *Wireless World*, and invariably read advertisements in all journals, and am always impressed by the difference in English prices and Australian for similar components, and this with the knowledge that present-day English prices are at least 100 per cent. greater than pre-war. I believe there is a big future in this country for the first component manufacturer who produces reasonably priced parts, and the revived hobbies interest will give the radio trade a lift no one will regret. Take a I.F. transformer or R.F., or oscillator coils as particularly bad examples. Pull one of these to pieces and it is immediately clear that there is not more than sixpence worth of material in the whole thing. If the total manufacturing cost exceeds 1/- per unit the manufacturer should go out of business, and yet these things retail at from eight to 14 shillings. It always reminds me of the ball point pen racket, and it is certainly not sound business, as I believe the trade will find in the days ahead.

However, enough grousing, and, as a constructive suggestion I would like to see more articles on simple, but efficient pieces of test gear. It is always a matter of surprise to me to see how many people try to do things in radio, often without means to measure even a voltage. I suggest that it is entirely within the scope of a journal devoted to technical radio to point out that any real progress in a technical field depends on the power to measure and check performance. It seems to me that the lack of appreciation of this fact is the greatest weakness in the make up of most radio men, and also the greatest brake on their own progress. Elaborate equipment is not necessary, but it is certainly necessary to have something to check the performance of sets and other equipment constructed. Australian versions

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PRICES

(Continued)

of equipment described in Scroggie's "Radio Laboratory Handbook" would be a good start.

I would also like to see an accurate and coherent description of how to use a modulated oscillator to correctly align a superhet receiver. I have never seen any article in any journal on this subject which entirely made sense to me, or did not require great chunks of imagination, or a sixth sense to comprehend. (See Paul Steven's effort, October, 1948, page 11.) I trust you will receive the above comments in the spirit in which they are given—for the future well being of radio.

Here is my reply:—First of all, I readily agree that prices of radio components are too dear, and that lower prices would mean greatly increased interest in the radio game. But there are some statements with which I cannot agree. Take for example, the figures given by Mr. Burns in regard to an intermediate transformer. These are not correct. I have made a point of checking with a manufacturer of coils and find that the materials in an intermediate transformer actually cost him 3/0½. Yes, three shillings and a half-penny, not 6d. It is not economical for a coil manufacturer to draw his own aluminium cans. The plant would cost a lot of money and then stand idle for days at a time. But to buy cans you have to pay the price. And, so on. The transformer for which the materials cost over 3/- is listed at 13/-, but we wouldn't go so far as to say that they sell for this amount. Nobody buys radio components at their list prices. Anybody with enough knowledge to know how to use intermediate transformers will surely know enough about the radio trade to patronize a "wholesaler."

There are plenty of good jokes in a Tivoli show, but nothing compared to the way the wholesale radio dealers "protect" the legitimate retailer, to use one of their favorite expressions. Many wholesalers will not use the advertising columns of *Radio World* for fear it will give the retailers the impression that they are encouraging the public to come and deal with them direct, instead of through the retailer, as would be ethical. Yet, in one of these wholesale places I recently noticed seven school boys in their school caps, buying liberally for cash at trade prices. Do you really believe that the wholesaler thought those school boys were in the radio trade? I am afraid his only thought was for the filling of his till.

It is logical for radio sets to carry solid discounts so that the retailer can make a living after home demonstrations, servicing sets and handling them. Radio components, especially those which need technical knowledge for their use, such as intermediate transformers, are never sold in a true retail fashion, and the trade is only fooling itself when it gives such components a high retail price and a long trade discount. The whole game would be far better off if spare parts for radios were sold on the same basis as spare parts for cars and motor cycles; with a discount of about 10 per cent.

All of which is to show you that although the nominal list price of the intermediate transformer may be 13/-, the nett return to the manufacturer will be considerably less than half this amount. Then he has to carry the full cost of expenses from development to advertising, including printed cartons, packing, delivery, and so on. With wages at their present level he will have to allow an amount of from 2d. to 2½d. per minute for every man he employs. The manufacturer does not reap bountiful profits from making coils. One of the largest coil factories recently went into liquidation. Others are barely struggling through. In fact, nobody reaps the vast difference between cost and price of intermediate transformers. The trade is simply fooling itself, and in so doing it frightens away thousands of would-be customers.

Using simple arithmetic anyone can add up that the cost of a receiver would be considerably more than its price if you took its various components at their nominal list price.

It is a great pity that the radio wholesalers can't get together to discuss more realistic ways of lowering retail prices, or eliminating them altogether, without discouraging the right sort of radio enthusiasts. Already the trade has agreed that all members of the Wireless Institute, whether actually licensed or not, should be entitled to trade discounts. Why not all amateur experimenters, whether members of the W.I.A. or not? And all amateur set-builders, too, of course.

With the rest of the letter we are mostly in agreement. The need for test equipment and a full knowledge of its use is fully appreciated.

With regard to using the modulated oscillator, the main reason for confusion seems to be that there are various ways of arriving at the same result. Some people prefer one way, others another.

Even coil manufacturers are not all in accord as to the best way to go about alignment, but you can rest assured that whichever way is recommended for any particular kit by any particular manufacturer is likely to prove correct for that kit. A lot depends on whether iron cores are fitted or not, also whether a fixed padder is used or a variable one. We recently built up some portables according to the article in the March, 1948, issue, following out the alignment instructions given in that article. It worked out to perfection with this particular set. The idea was to open the gang to about the normal position in which to expect to tune to 600 Kc. Then with the oscillator at this frequency, adjust the slug in the oscillator coil to bring signal up to maximum. Then swing down to 1400 Kc., set the gang at about the normal position, and adjust the oscillator gang trimmer to bring up signal to maximum.

This ensures that the oscillator tuning is correct, and this is the most important. The aerial tuning circuit is simply peaked at some convenient frequency, say, around 1200 kc.

This scheme, of course, would be quite unsuitable for use with coils not having iron cores, which goes to prove that you want correct alignment instructions for the coils you are using, rather than a general article on the subject.

However, we will see if the whole subject can be covered in a full article in the near future.

A.C. TESTER

(Continued)

this happened the current transformer would have to be returned to the makers for treatment.

Using the Tester

For general work with electric appliances the tester can be used to measure the current drawn by lamps, radiators, toasters, irons, stoves and such like items; the only limitation being the 10 ampere limit which might be exceeded with some of the larger electric cookers, those drawing over 2400 watts.

For radio work the tester can be used to check the current drawn by a.c.-operated valve heaters and filaments.

In all the above cases the tester will read off the current with a fair amount of accuracy, but with loads of an inductive type it is necessary to make allowance for possible error on account of the magnetising current. This would apply in the case of a power transformer, for one example. With a circuit in which there is inductive or capacitive reactance the power factor of the circuit would need to be taken into consideration.

A Precaution

If this tester is built up to operate with an external or plugged-in meter it is most necessary to take the precaution of avoiding every possibility of the tester being operated with current flowing in the current transformer, but without any meter in circuit. Whenever the meter is removed the "M" and "MC" terminals of the current transformer should be short-circuited.

TIME IS MONEY—WATCH IT!

SINCE "Radio World" is not a periodical with any political policy, it may be out of place to deal with the subjects of Communism versus Time Study, yet I feel that there are many struggling radio men who do not fully appreciate the significance of the old adage about time being money.

Personally, I have always found that happy workers do the most work, also that the workers who work the hardest are the happiest in the long run. Yet, over the past century there seems to have been a steady increase in wages and a shortening of working hours. I am not here to deplore this tendency, any more than I would waste time advocating a return to the horse-and-buggy days. All I want to have to do with the subject is to point out to radiomen that they should keep abreast of the times and remember always that time is money, more so to-day than ever before in history.

During the war the average suburban radio repair man enjoyed great prosperity. In spite of shortages of components he managed to keep the local sets in going order and was duly rewarded. To-day the credit rating on most radio shops is on the black list. Few of them are making any money out of radio repairs. Even the firms who have a big turnover in repairs cannot make them pay.

The only hope of making radio repairs a paying proposition is to keep a most watchful eye on the clock, marking down every minute spent on the job and then charging it out to the customer at not less than 10/- per hour. If you employ a man this basis will only barely work out. If you work for yourself alone you are at least entitled to make ordinary wages for your time.

To see the reason for 10/- per hour you have only to go into the facts. A good man will expect to earn not less than £10 per week; he will work (?) for 40 hours, but you'll be lucky if you can charge 30 hours of it to your customers.

Contributed by a successful Suburban Radio Dealer

His wages are £10, but you have to pay him for annual holidays, pay him when he is sick, pay a premium for his Workers' Compensation Insurance. By the time you consider the cost of wear and tear on your plant, your own time taken to make up the wages and supervise your man, and a dozen other minor items, you will find that you'll have to be careful to make anything out of 10/- per hour.

If you work for yourself and do not employ anybody, you should still remember that your time is worth at least 10/- per hour. Now let us see what this ten bob per hour means. First of all it means that to have a yarn with somebody about the merits and de-merits of the last shower of rain can run you into a debt of half a crown, which will have to be made up from somewhere. To fit a plug on the power cord of a receiver is only a few minutes' work, but you'll be doing it at a loss if you don't charge 1/- or 1/6 for the job. You'll be lucky if you can actually work for 50 minutes out of each hour, so your time is worth 2½d. per minute. If you are in the radio business a bit of time study may help you, but like most things, it is possible to overdo even time study. With radio repairs it is better to balance things up a bit. Make a point of charging for at least half an hour for all minor jobs, even if they take only five minutes. By this means you may be able to build up a bit of reserve time for use when you come across a job where you have to scratch around a bit to find the cause of the trouble, only to realise that if you were half the man you think you are you would have found it in five minutes instead of an hour.

We all do it at some time or other. It is hardly fair to charge all that time to the customer. Part of it should be charged up to "experience," but, to keep out of the red, it is better to build up a reserve fund from some of the easier and quicker jobs.

In addition to charging for time, all parts used in doing the job will need to be added, also running time or cartage. The full retail price of parts will only cover the cost of obtaining them. Remember the time you, or one of your employees, has to spend waiting at the wholesaler's counter when buying parts. Your margin will hardly cover this time if you consider it at 10/- per hour.

There is a certain amount of enmity between amateur and professional radio repair men. The enthusiastic amateur will fiddle

(Continued)

Cathode Coupling Again

Is It Worth While for Gramophone Amplifiers?

While cathode followers have found wide application in video amplifier design, and as impedance changing devices, little attention has been given to their use as power amplifiers in audio systems.

By

WM. DARRAGH

FOR applications involving reactive or variable loads, this type of amplifier is ideal. Typical of this type of load is the loud speaker, or the load presented by class B amplifier grids.

The most important characteristic of the cathode follower power amplifier is its practically perfect regulation. Of almost equal importance is it's extremely high damping factor. As a rule, the effective damping across the primary of the output transformer is approximately equal to the reciprocal of the grid-plate transconductance, and normally is in the order of a few hundred ohms.

Reduced harmonic distortion and greatly increased frequency response also result from the use of 100 per cent. feedback. The extended frequency response is very interesting in that it is possible to obtain an equal, or even superior frequency range with cheap audio transformers, than may be obtained with very expensive types in conventional circuits.

With all these advantages however, there is a catch, and that is the high driving voltages required. This is not too difficult a problem to overcome, fortunately, as audio transformers may be used freely. As all the output voltage is in the grid-cathode circuit, and therefore out of phase with the input voltage, the input voltage must exceed the output voltage for full audio output. This is another way of saying that the voltage gain of a cathode-coupled stage is always less than unity. At this unity, the power output is unaffected by the

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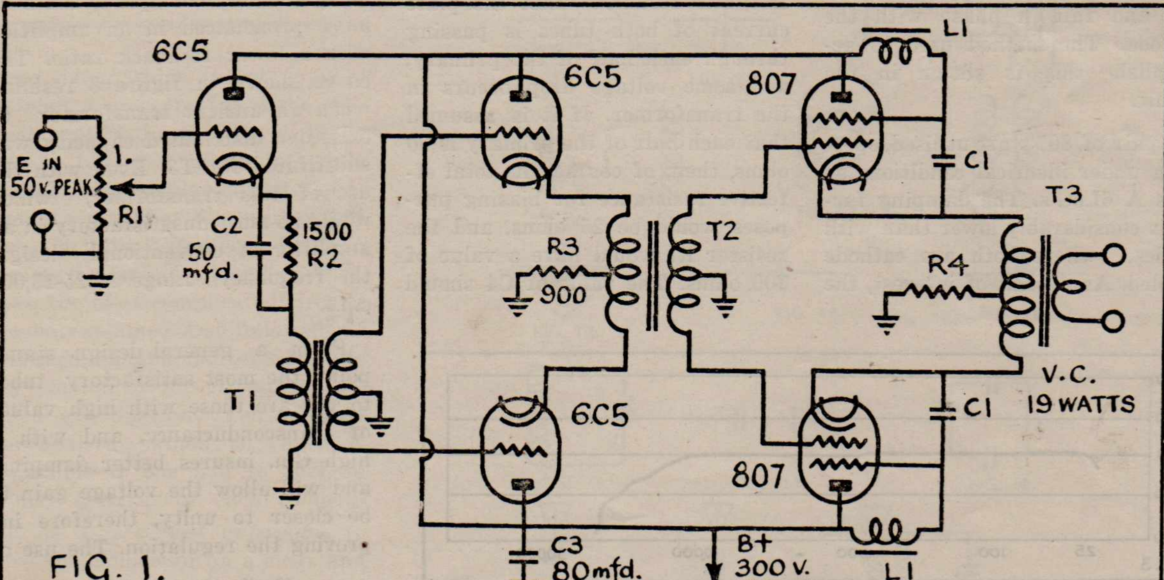

FIG. 1.

100 per cent. feedback. All that is necessary is to supply a larger grid swing.

Up to the present time, most articles have dealt with cathode-coupled triodes. This article is devoted to the use of beam tubes which, in this particular application, give superior results to triodes. Their use requires an additional provision to keep the cathode and screen at the same AC potential, so that true pentode operation may be obtained. In a conventional amplifier, the screen is bypassed to earth, as is usually the cathode. The screen is thus maintained at a constant D.C. potential above the cathode, but they are both at effective A.C. ground potential. The input signal then causes the plate voltage to vary in accordance with the input, while the cathode and screen voltages remain fixed. In the cathode follower, however, the plate voltage remains constant and the cathode rises and falls in accordance with the input signal. Thus, if true pentode operation with full output is to be obtained, the screen must be made to rise and fall in phase with the cathode. The method used to accomplish this is shown in the circuit.

A pair of 807's are utilised, operating under identical conditions as class A 6L6G's. The damping factor is considerably lower than with triodes, where both are cathode coupled. As a point of interest, the effective damping resistance of the 807's is 364 ohms.

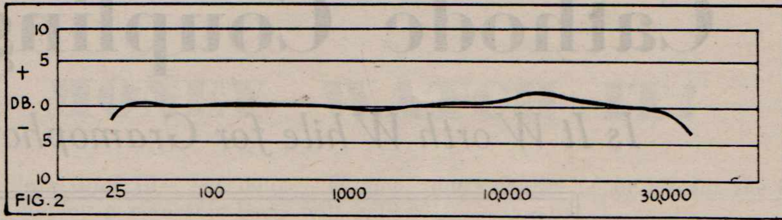

FIG. 2

In the case of a pair of 45's, damping resistance is 1200 odd ohms.

The values of the chokes L1 and the condenser C1 are not too critical, the principal requirement is that the reactance of the condenser be low, and of the choke high. A value of 16-24 mfd. for the condenser is satisfactory, and 30 or more henrys for the choke. This value of inductance should be readily obtainable in a small physical size, since the D.C. through each choke will be only 8 or 9 ma.

In selecting the bias resistor, R4, it is necessary to know the primary D.C. resistance of T3. The tube manual furnishes the information that a bias resistor of 125 ohms is required for the two tubes. But this assumed that the plate current of both tubes is passing through each half of the primary, and some voltage drop occurs in the transformer. If it is assumed that each half of the primary is 50 ohms, then, of course, the total effective resistance for biasing purposes would be 25 ohms, and the resistor RI would have a value of 100 ohms. The value of C4 should be very large to keep the plate to ground impedance low, 40 to 80 mfd. is satisfactory; actually, the higher the better.

Cathode coupling is used throughout to preserve the wide frequency response and minimise distortion. The total distortion is about one percent of a similar unit wired in a conventional manner. Figure 2 is the response curve of this amplifier. The transformers used were of the low-priced variety, and the response is down only 2 DB at 25 c.p.s. The treble limit taken at half power point is 33,000 c.p.s. This performance would be difficult to obtain, even with high quality transformers, in amplifiers of conventional design.

The 3 DB hump at 12,000 c.p.s. is due to resonance in the output transformer T3, and is not at all objectionable. This peak would be more pronounced in an amplifier with a lower feedback ratio. The curve shown in figure 3 resulted when an ancient transformer of excessive distributed capacity was substituted for T3. Even with the use of this transformer, which would be most unsatisfactory in an amplifier of conventional design, the frequency range is 25-13,000 c.p.s.

From a general design standpoint, the most satisfactory tubes to use are those with high values of transconductance, and with a high Gm. insures better damping, and will allow the voltage gain to be closer to unity, therefore improving the regulation. The use of

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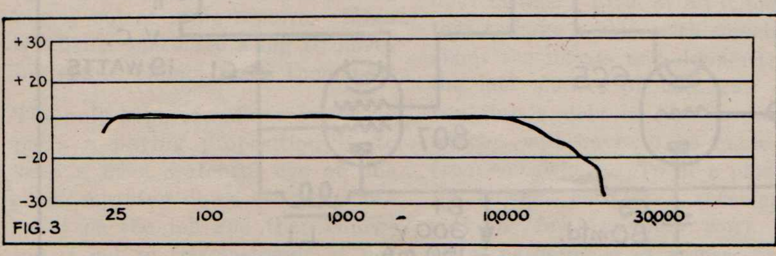

FIG. 3

HOW TO READ CIRCUIT SCHEMATICS

Once the principle and the symbols used in a theoretical or schematic diagram are understood — and it is really very simple — it is much easier to follow and far more reliable than any sketch which tries to show the actual components and connections.

By

G. W. BUTTERFIELD

" The Broadcaster "

Perth

Schematic radio diagrams can be considered as the shorthand of radio circuit design, and when properly understood they are by far the simplest and most accurate way of showing the various circuit components and their connections. Once one becomes accustomed to these signs, which is not so very difficult a procedure, it is the simplest matter in the world to be able to tell at a glance not only whether a particular circuit represents an amplifier or receiver, but also the min differences between one particular circuit and another. Even the most complicated circuits can be explained and followed, as it is such a simple matter to isolate any portion of the circuit for detailed examination and comparison. All this would be well-nigh impossible if one had to rely on clumsy sketches of each component, as it is almost impossible to show the connection in a clear and orderly manner by this method except in cases where only a few components are used. Even then, the schematic diagram is far more preferable to those who understand it.

In the following explanation it is not proposed to cover all the various signs in the electronic field. These would be too numerous for one article as they have, and are, being continually added to year by year due to the rapidly expanding and changing phases of the radio and associated electronic art. Only those mainly associated with receiver and amplifier design will be given, as these will be found ade-

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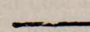
FIG. 1.

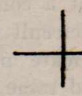
FIG. 2.


FIG. 3.

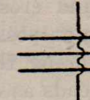
FIG. 4.

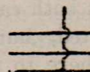
FIG. 5.

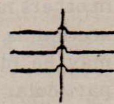
FIG. 6.


FIG. 7.

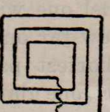
FIG. 8.


FIG. 9


FIG. 10.

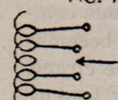
FIG. 11.

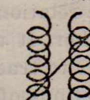
FIG. 12.

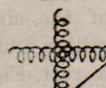
FIG. 13.


FIG. 14.


FIG. 15.

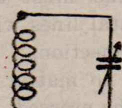
FIG. 16.

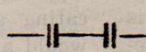
FIG. 17.

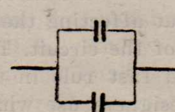
FIG. 18.


FIG. 19.


FIG. 20.

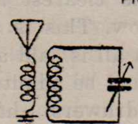
FIG. 21.

CIRCUITS

(Continued)

quate for most practical purposes.

We will begin with the simplest, yet most important part of any circuit—the connecting wire. A piece of wire connected between two or more points is always shown as a straight line (fig. 1).

This does not mean that the line will necessarily run directly to the point to which the connection has to be made; in fact, the opposite is quite frequently the case as the main purpose is to show clearly and unmistakably the point or points to which the wire, in its circuit, must be connected. Often, particularly in large and complicated designs, these lines may follow a round-about course to avoid cramming and crossing of other lines as much as possible. And the best way of doing this is to show all wires or leads as either vertical or horizontal lines running perfectly parallel one with the other, no matter how far one must divert from the shortest path to attain this. In fact, one glance at any circuit will show that this is carried out even in the relation of one component to another. It thus becomes a simple matter to trace the circuit route or connections of any lead by simply placing a ruler along any line representing the lead required. There are exceptions to this rule, of course, but these only apply where there is sufficient space available to show the more direct route without affecting the clarity of the rest of the circuit. There is no hard and fast rule in this regard and designers use what they consider will be the clearest and easiest way to follow. This is the main purpose when all is said and done, although it must be admitted that some circuit drawers have some queer notions in this regard.

Having made this point clear, I hope, the reader will now realise that the mass of lines he sees in some diagrams does not always mean that the circuit is particularly complicated as he will realise if he cares to follow them with a ruler as mentioned earlier.

This brings me to the second point of equal importance, which is the method of showing where a lead is intended to be connected and where not. Where two lines cross, as shown in fig. 2, it means that the leads should be connected, and where the lines are crossed with a loop, as in fig. 3, no connection is indicated. This is the old method and still widely used, but there is a modern tendency to dispense with the loop idea. In such cases a straight cross-over means no connection and a clearly-distinguished dot at the crossing point, indicates that a connection should be made. In circuit where a loop is shown to indicate no connection you may find some connection points shown by a dot at the crossing point, and in others none. In both cases a connection is indicated, ,but the dot may be placed there to indicate a particular terminal point. There are a few changes going on at the present time in order to make circuits more easy to follow. Therefore, if one is in any doubt at all as to the meaning intended, one should check up on some portion or connection of the circuit with which one is familiar and take this as a guide to the rest. Fig. 3 shows how a diagram would look where a vertical line must cross three other horizontal lines without indicating a connection. The same would apply no matter how many lines had to be crossed. Fig. 5 indicates a connection at the third horizontal line. Fig. 6 indicates no connection, the same as fig. 4 where horizontal lines are crossing the vertical. You see, it is all so very simple and once you have grasped the idea which should only take a few minutes, you are all set to trace any diagram once you are able to recognise the symbols for the various components.

The first of these is shown in fig. 7 and is found at the beginning of a receiver circuit usually shown in order from left to right. This represents the lead going to the aerial or aerial terminal of the set. Sometimes the horizontal line at the top is not included, but it will be pretty obvious what it is for, however it is shown. Where a frame aerial is to be used this is shown as in fig. 8 usually in portable receivers.

The group of diminishing horizontal lines shown at the bottom of the line (fig. 9) is always used to represent "earth." This may mean the chassis or common negative return, or, the actual earth terminal itself. As the whole circuit, or really groups of circuits, ultimately finish at one common point, which is the high tension negative, this commonly referred to as "earth" and is usually represented as a common rather thick base line in many circuit diagrams, and in actual practice is usually the metal chassis itself or a thick copper wire soldered at various points to the chassis in order to obtain maximum efficiency. This is the backbone, so to speak, upon which the rest of the circuit is built, and poor electrical connections of any lead finishing at this point can have very detrimental results. The chassis, or heavy copper wire, finishes at a terminal which can be connected to the earth proper, such as a water main pipe or other metal object in good electrical contact with the ground.

However, whether the true grounded earth connection is used or not, the common negative return either in the form of a heavy wire or the metal chassis, is generally referred to as earth or ground.

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Please send your remittance in 1½d. stamps or postal notes. Address: Australasian Radio World, Box 13, Mornington, Vic.

In some circuit diagrams, all lines terminating at "earth" are cut short and terminated with the sign (fig. 9) as shown instead of continuing to the one heavy base line, as previously mentioned. Regular "hams" have a habit of doing this as it cuts down the number of circuit lines considerably, thus allowing the much fewer remaining lines to be followed more easily. However, such a method lacks the professional touch. Perhaps that is why it is not used more frequently.

Fig. 10 represents a coil of wire commonly known as an inductance, and may indicate any type of coil whatever. Thus it is used to indicate aerial coils, grid coils, reaction coils, radio frequency chokes, oscillator coils or any other inductance where no iron core is used.

The purpose of the particular coil shown in any circuit is usually mentioned in the descriptive text and indicated by a key number with the letter L, which stands for inductance. Thus the first coil in a circuit, usually the aerial coupling, is generally marked L1; the second, which is usually the grid coil going to the grid of the first valve, L2, and so on throughout the circuit, so that although they are all shown the same as Fig. 10 one cannot make a mistake.

Fig. 11 indicates an R.F. inductance (coils such as just described are only used in portion of the circuit where radio-frequencies are to be dealt with), where a number of alternative connections (taps) can be made to the same coil. Fig. 12 indicates that two R.F. inductances are inductively coupled together; the arrow indicating further that the coupling is variable. In other words, two coils are in very close proximity to each other and the distance can be varied. Fig. 13 represents a different form of variable R.F. inductance known as a variometer. Both this type of coil and that just described in Fig. 12 are not seen in circuits very much these days, particularly the variometer, but it is just as well to be able to recognise them as they have still a certain amount of popularity in small sets suitable for beginners. The variometer consists of two coils, one rotated inside the other. In this way the value of inductance can be varied.

Coming to fig. 14, we here have the accepted symbol for the condenser, which can be seen dotted all over any circuit diagram. As shown, a capacity of fixed value is represented, but is cases where this must be a variable quantity, an arrow is shown, as in fig. 15. Sometimes this arrow is used in the form of a curve representing the moving plates, in which case instead of two parallel lines being used as in fig. 14, one of these lines is in the form of a curved arrow as mentioned. In such cases the curved section (moving plates) should be connected to the point shown rather than the opposite.

The most common function of the variable condenser is for tuning purposes, and it will therefore usually be seen connected across an inductance as in fig. 16. This commonly indicates either the R.F. or detector stage in the simpler type of "straight" receiver, or R.F. and oscillator tuned circuits of the more complicated superheterodyne. Fig. 17 indicates condensers connected in series and fig. 18 in parallel, whether fixed or variable, although only fixed are shown.

Fig's 19, 20 and 21 show typical instances of how the various symbols so far discussed would be shown to indicate a simple tuned circuit for a crystal set or one-valve receiver. The aerial lead (fig. 19) may be shown connected in series with a condenser to improve selectivity, or it may be shown connected directly through a coupling coil to earth, as in fig. 20. In the latter case, it is usual to have the tuned coil inductively coupled to the aerial coil as shown in fig. 21. If this coupling is intended to be variable an arrow would be shown, as previously mentioned in fig. 12. The actual complete tuned circuit, as shown in fig. 21, only needs a lead connected from the top of the

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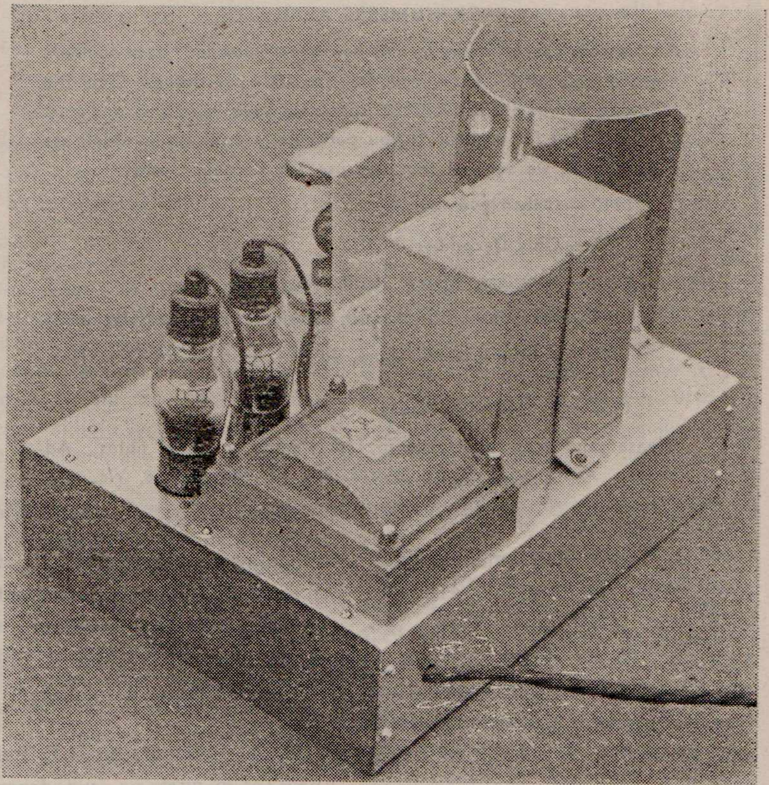
Photo Flash Outfit

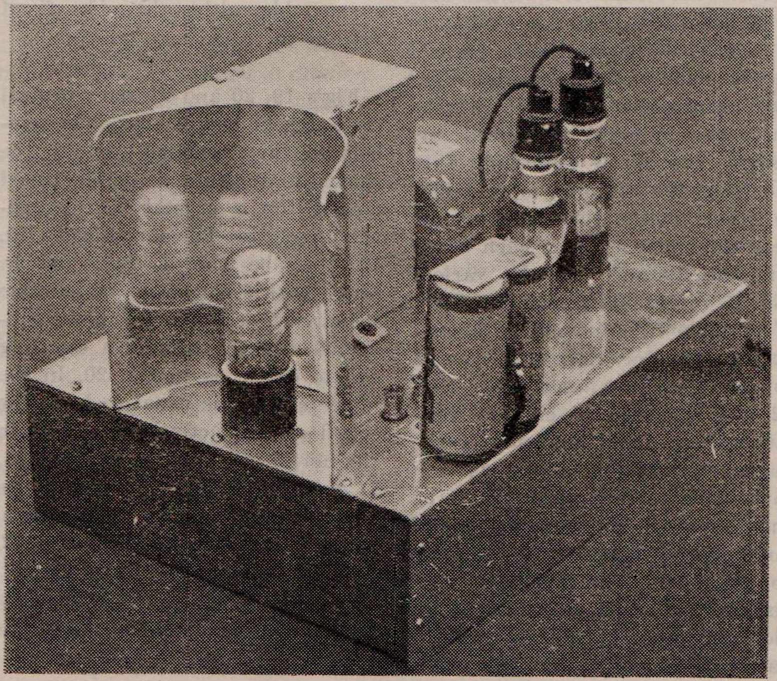
USING RADIO COMPONENTS



In response to many requests, here are some photographs of the photo. flash outfit which we mentioned in the January issue.

As will be seen, radio practice has been followed, with the main chassis folded up out of aluminium, with wooden ends for rigidity.

A special power transformer for the job, built by A. and R. Electronic Co. Pty. Ltd., can be seen alongside the two high-voltage rectifiers. Next is the big reservoir condenser, with a cycle lamp battery on the other side. Behind the battery are two terminals for the contact leads.



The Flash Tube

The flash tube is on the front of the base with a reflector behind it. If desired, the tube can be also used at the end of an extension lead, consisting of a four-pin plug and socket, with any desired length of three-core flex.

The outfit, which operates from a.c. power only, can be made up for a total cost of between £15 and £20.

Full details and circuit were in the January issue, still available from our Back Dates dept. at 1/-, post free.

WIDE-RANGE BRIDGE

One of the handiest pieces of test equipment for any radio enthusiast's work bench is a wide-range resistance-capacity bridge. It can be used for such jobs as comparing voice coil impedances of speakers, which are otherwise quite a problem.

The circuit consists of the usual bridge, fed by 50-cycle mains voltage, stepped down to 50 volts by replacing the 5-volt filament winding of the power transformer with

By H. M. WATSON
89 Botting Street, Albert Park
(S.A.)

one having ten times as many twins. This higher signal voltage greatly improves the sensitivity, as does the high-gain bridge amplifier. If there is insufficient room on the power transformer to take the increased number of turns an audio transformer may be used instead of this winding. It should be of a 5 to 1 ratio to give us something like the required 50 volts. In this case the terminals marked G and F would be connected across the mains and those marked P and B across the 2500 O.H.M. pot.

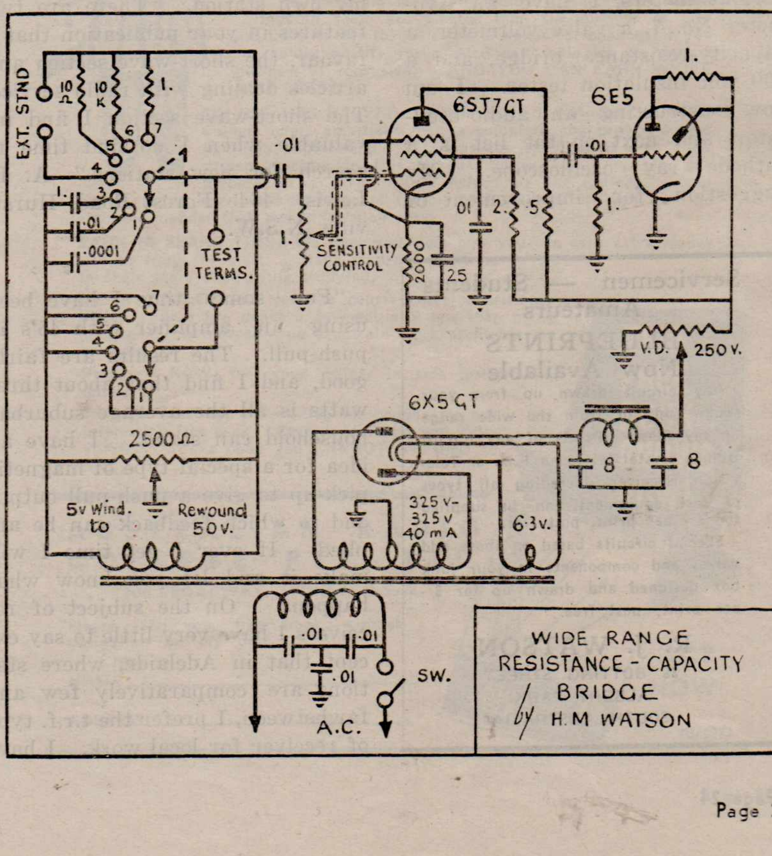
All earth connections of the 6S J7 should be anchored at the same spot on the chassis, and the lead to the sensitivity control shielded and kept as short as possible. The 6SJ7 itself should also be shielded.

Range and Calibration

The dial is calibrated with the switch in position 6, and graduations marked in and labelled with 1-1000th of the value of resistance used across the test terminals, such as .1 for 100 ohms, 20 for 20,000 ohms, etc. For this calibration it is best to use as many resistors between the value of 100 ohms and 10 megohms as possible. This range, when calibrated, will give us R x 1000, and as the resistor standards used in the 5th and 7th positions of the switch are 1-1000th of, and 100,000 times (respectively) that used for position 6, this same calibration will serve for all three resistance ranges if we multiply our dial reading accordingly. Thus:—

Switch position 5 = RX 1:
.1 ohm to 10,000 ohms.
Switch position 6 = 1000:
100 ohms to 10 meg ohms.
Switch position 7 = RX 100,000:
10,000 ohms to 1000 meg

(Continued on page 46)



AMONG OUR READERS

News and Notes from Subscribers about their Activities

I AM a chartered civil engineer with interest in radio dating back to 1916. As my hearing was less than 50 per cent. efficient I foresaw that a working knowledge of radio might be of assistance to me, and for over thirty years radio has been my hobby. My first set was one of the tuned-anode type, full of howls and whistles, and our greatest pleasure was listening to the many amateur broadcasters.

"My chief radio interests at present are high-grade tuner and amplifier, and in various pieces of test equipment. To date, besides various meters, I have an Avometer No. 7, a valve voltmeter, a capacity-resistance bridge, and a 500 volt insulation tester. I am now constructing an audio oscillator, and next on the list is a cathode ray oscilloscope. My suggestion for improvement of your magazine is to describe in considerably greater detail the application of test equipment, as many of your articles describe how to make the gear, but say very little about how to use it."—C. C. Halkyard, 288 Orrong Road, Caulfield, Vic.

* * *

"I have been interested in radio since 1936, mainly as a short-wave listener and an amateur serviceman. Then the war and my six years in the Army caused a gap in my hobby, but even so, my interest never waned, and the last two years of service saw me as a radio operator. At present I am doing a course in the tailoring line, and the study interferes a lot with my hobby, but I hope to one day join the ranks of "hams" and operate my own station. There are two features in your publication that I favour, the short-wave section and articles dealing with radio service. The short-wave section I find invaluable when I do find time to search for new stations."—A. E. Lewis, 464 Forest Road, Hurstville, N.S.W.

* * *

"For some time I have been using an amplifier with 45's in push-pull. The results are fairly good, and I find that about three watts is all the average suburban household can stand. I have an idea for a special type of magnetic pick-up to give a push-pull output and to which feedback can be applied. If ever I get time I will make it and let you know what happens. On the subject of receivers I have very little to say except that in Adelaide, where stations are comparatively few and far between, I prefer the t.r.f. type of receiver for local work. I have done a technical school course, and at present I am working in a power station. It is quite a contrast to measure power in thousands of kilowatts. There seems to be a certain friendliness about people connected with radio.

It is very noticeable in the *Radio World*, and I think it must be this which prompted me to write this rambling letter."—P. R. Sanderson, 3 Hexham Avenue, Myrtle Bank, South Australia.

* * *

"I wish to express my appreciation of the magazine and to state that, in my opinion, a real improvement is being shown. January issue, with its numerous circuit diagrams and a variety of practical articles, is just what the majority of readers are looking for in a radio mag."—Ernest G. Potts, 178 Denison Street, Hamilton, Newcastle, N.S.W.

Help Wanted

Can anyone help with base connections, characteristics, plate, screen, and grid voltages and suggested operating conditions for the type 631 PI strobotron tube? Replies to Box 13, Mornington, please.

Can any reader help Mr. T. Sutherland, of 128a Victoria Street, Footscray, Vic., who wants to get a tremolo or vibrator effect with the amplifier which he uses with a contact microphone, also an ordinary crystal microphone?

"I am employed by a country radio and electrical engineer. I am always interested in any articles on radio servicing and repair work. I have a back issue on strife encountered when installing car radios. I would like to see more articles on this subject."—J. F. Clewer, Box 86, Clare, S.A.

* * *

"I have been getting *Radio World* for the past eight years, and find it very helpful, so keep up the good work. I know that you are working under difficult conditions. I am a licensed amateur. It may interest you to know that I only buy your magazine and one other. I do not think that any of the American mags that we get in Australia are worth their price when compared with our own magazines in this country."—W. H. Ross, Ballangeich, Vic.

* * *

"I always await your publication eagerly. The articles on all aspects of audio systems interest me most, and the only improvement I can suggest is that you increase the space allotted to this subject, as it is surely an extremely popular one at the present. I have just left school, and have not much time for radio construction, but have just completed an amplifier of the Williamson type, which is now operating satisfactorily after considerable 'ironing out of bugs.' "—R. Curnow, 5 Kembla Street, Hawthorn, Vic.

* * *

"I would appreciate a comment by the Editor on circuits and view points published in the magazine by contributors who may be unknown to me. Whereas I pin my faith to the opinion of the Editor, I often feel sceptical about risking money and time on a theory which may not be sound. Congratulations on your work—may you keep it going."—Alfred T. Dean, 68 Cremorne Road, Cremorne, N.S.W.

"I am an instructor in applied science in a technical school, and have been interested in radio for nearly 20 years. I had seven years practical radio, parts making, service and laboratory work, but still like experimenting. One of the things I like best is to build a set from the ground up, wind and make parts I can. I won't try making intermediate transformers, as the coil winding is too difficult, and the spacing too critical. I think the best way to learn the principles of the superhet is to wind a set of coils and make them track. I like *Radio World* because you give a variety of opinions. After all, we can all learn something from someone else, as two heads are better than one."—W. S. Londey, 8a Barkly Street, Sale, Vic.

WITH PICK-UP TERMINALS

Simple Mantel Model Circuit

THE set described in this article was developed in response to a friend's request for a four-valve mantel with accommodation for pick-

By

A. M. GRIFFITHS

8 Holyrood Avenue

North Essendon

up input, and, ,though designed around particular valves, is not critical of valve types.

Wishing to avoid the added complexity of reflexing, or the application of a high output crystal pick-up directly to the grid of the output tube, a separate audio amplifier before the output tube was decided on, leaving one tube to deal with the R.F. end of things. T.R.F. circuits, with and without regeneration, were tried, but their overall performance could not compare with that of the superhet circuit shown which used only one I.F. transformer.

To consider the output end, dropping the screen voltage of the 6V6 to 100 volts lessens the cathode current to just under 20 mA, maximum output being an ample 1.5 watts. Total H.T. current is just on 30 mA, so that even a 30 mA power transformer is suitable; however, a 40 mA transformer would be cooler, and would allow a margin for alterations and dis-

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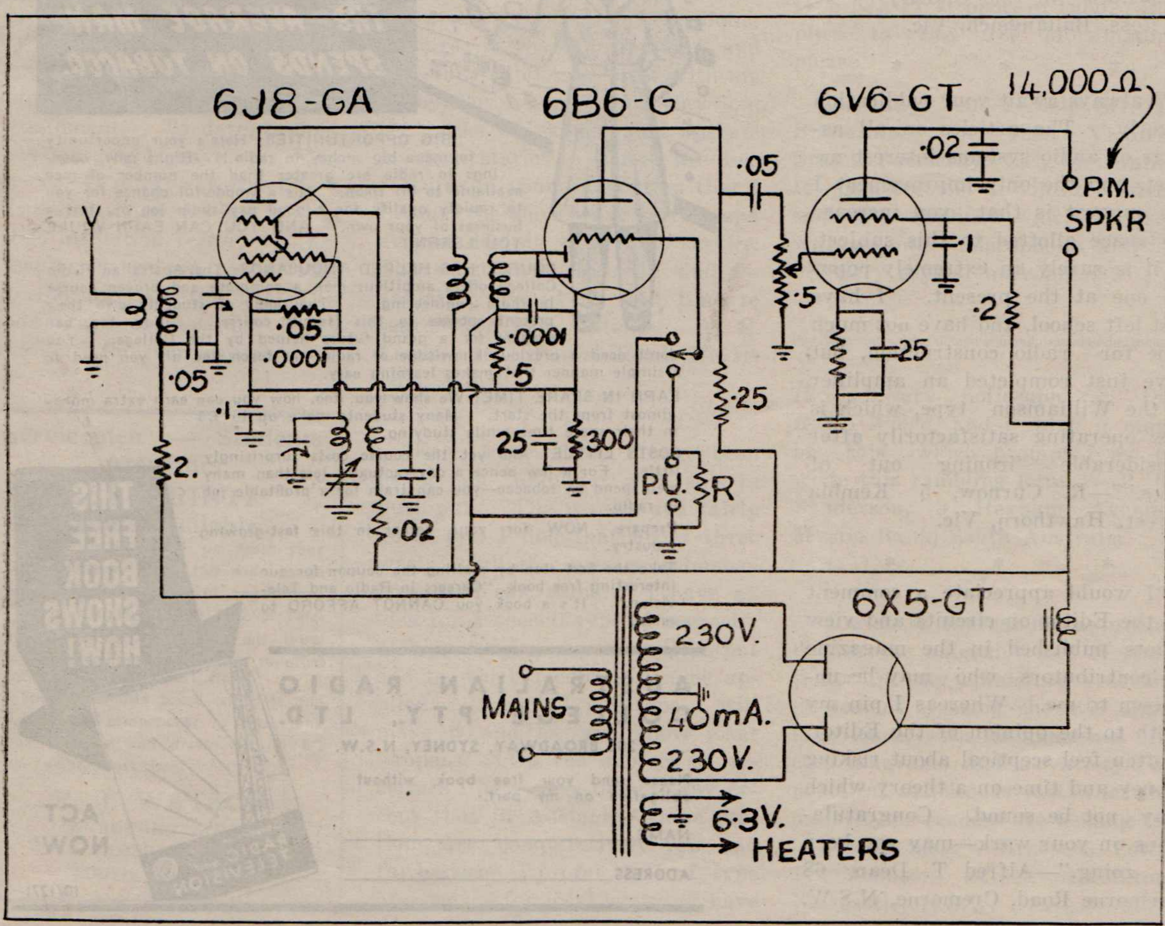

Introduction to "Ham-Gen."

As announced in last month's issue, our section for the amateur transmitter will be conducted by Mr. R. H. Cunningham (VK3ML). It will be devoted exclusively to furthering the interests of amateur radio. Here is Mr. Cunningham's introduction to the new section, which will be known as "Ham-Gen."

IN last month's issue A.G.H. placed a very nice panel in this magazine to the effect that I was to do something about a Ham section. The general idea sounded quite good to me, but as time drew on towards publication date I realised that the subject was far deeper than I originally thought. The question that has been worrying me is "what type of stuff to give the hams"? The field is a very broad one, and this question is hard to answer. However, I anticipate I'll find out what is needed very shortly after some very caustic comments, or otherwise, are received following receipt of this issue ! In the interim I have thought it best to divide the section into technical, operating and general notes on ham activities; so here's hoping that I can provide something interesting.

Well, that's not a bad start. There must be more than half a dozen "I's" in that opening paragraph, and one would think that this page was a VK3ML benefit ! It is very hard to discuss one's intentions without reference to the first person. After I get this first issue over and introduce myself you can forget who is doing the writing and just sail straight into the meat.

As far as journalism is concerned I regret to say that it is not one of my few accomplishments. Nevertheless, I stuck out being technical editor of the W.I.A. journal *Amateur Radio* for about five years before the war, and one must presume that we learn by experience. It was always my desire to journalise along the lines of A.G.H.'s late brother Ross, of QST fame. In my estimation Ross could write articles in such a way that just left all other technical editors cold. His great ability to write clearly, logically, and simply was recognised the world over. Even to-day it is hard to find authors who can express themselves simply so that the layman can understand what it is all about. I am sure that I learnt more from Ross Hull's articles than from any other writer (with all due respects to the "others"). In the early days of radio in Australia the Hull boys produced a paper called *Wireless Weekly*, which was a winner. It was just a "natural" for Ross to sit down at a typewriter with a bun in one hand and to punch the keys with the other. When he went over to the staff of QST it was a great loss to us, but, of course, his scope was greatly increased by the opportunities afforded him in the U.S.A.

Yes, this journalistic business must run in the family blood. A.G.H. has made a success of it, too. I am sure that he will have one more reader after I have finished my section—that'll be me, of course, because I must see what it looks like in print ! It is strange how many hams turn their thoughts towards mill punching at some time or other. One of the most successful in this direction is VK2JU with our contemporary journal *Radio and Hobbies*. Then again, VK2NO is a grand journalist. Good luck to you, Don.

Well, getting down to business, just what do the hams and would-be hams want in the way of technical and topical stuff? I suggest that it is an impossible question, not only to answer, but to deal with. Just take a look around the journals on the bookstalls in town. How many of them do you buy? . . . and why? You probably buy *Radio World*, *QST*, *Amateur Radio*, *Short Wave Magazine*, and several others. By the time you pay the bill you find that you have spent a small fortune on papers. Why? It is because you want some news from this paper, an article on an amplifier from that, and the latest dope on the Clapp oscillator from another.

Wouldn't it be great if ONE magazine gave you all this? I suppose we often ask why this is not done. I submit the answer is that it can't be done. If it were, you would have a paper inches

(Continued on page 42)

Receiver Aerial Matching

THE input impedance at the aerial terminals of a communications receiver is generally chosen to match into some standard feeder impedance.

feeder, a good match results, at least at the receiver end.

When an end-on aerial is employed, or when a feeder cable with a characteristic impedance different to that of the receiver

By
J. N. WALKER
Technical Dept.,
Stratton & Co. Ltd., Birmingham

input is used, things are not so simple, as a few examples will show.

Assume the receiver impedance is 400 ohms and a low impedance feeder cable of about 80 ohms is used between the aerial and the receiver. The ratio of the impedances is 5 to 1, which will result in a certain amount of mismatch and a consequent deterioration in performance. On average to strong signals, the falling off will not be serious, but the intelligibility of weak signals will be adversely affected.

With an end-on aerial, the degree of mismatch will vary greatly according to frequency. When the frequency is such that the length of the aerial represents an exact quarter-wave length, the end will show a low impedance—about 40 chms in an average case. On the other hand, when the aerial is an exact half-wavelength, the end impedance will be high—2000 ohms or more. At intermediate frequencies, the end impedance will vary between these extremes and, in the case of a long wire, the multiples of quarter and half-wavelengths and fractions thereof will further complicate matters. Only over relatively small bands of frequencies will the match be really good with a 400 ohm impedance, these points will occur when the aerial is slightly longer or slightly shorter than a quarter wavelength. Whatever the receiver impedance, it is not possible to ensure an accurate match over a wide range of frequencies, with an ordinary type of aerial. (It can be done commercially by using special aerial systems and untuned feeders.)

On amateur frequencies, the nearest one can get to obtaining a good match on each band is to use a Windom type of aerial, the latter, as usual, working either on the fundamental or harmonic nodes. For instance, an aerial 60 feet long, with the feeder tapped in about 11 feet from the centre, will give good results on the 28, 14 and 7 Ms/c bands. The single wire feeder possesses a medium impedance which will match quite well into the receiver.

An end-on half-wave aerial (or a multiple of half-waves) is actually about the worst one could use. The self-resonant properties of the aerial are largely nullified when the end, with its relatively high impedance, is connected to the receiver terminal.

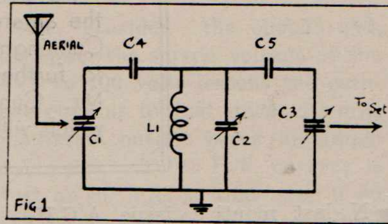

Fig 1

Construction of a Matching Unit

It is not a difficult matter to construct a small unit, with the aid of which correct matching can be maintained over a wide range of frequencies. In effect, this unit is a pre-selector, but one which does not require a valve, and therefore introduces no complications in the way of power supplies. It enables full advantage to be taken of the natural resonant properties of the aerial and ensures a correct match to the receiver at all times. Further, with a superheterodyne receiver, the additional tuned circuit reduces image interference, and, with any type of receiver, gives a measure of increased selectivity.

The circuit of the unit is shown in Fig. 1. Using the component values specified, any aerial up to 150 feet in length can be matched on any frequency higher than about 3.5 Mc/s. To be fully effective on frequencies lower than this, it is necessary to increase the value of C4 and C5 to about 20 pF. Conversely, at the higher frequencies—for instance, the 28 and 14 Mc/s amateur bands, some improvement will be obtained if C4 and C5 are reduced to 5 pF. Variable trimmers may therefore be used in place of fixed condensers for C4 and C5, where the interest lies over a wide range of frequencies.

The construction is straightforward and easy. Any convenient panel and chassis may be used. The differential condensers C1 and C3 should be mounted on insulated mounting brackets, since the spindles must not be earthed. One stator of each condenser is earthed—it is immaterial which—and the other stators connect to the tuned circuit, through C4 and C5. It is preferable to use standard Eddystone plug-in coils for L1, since the tuning range of each coil can be readily ascertained. Also, dials should be fitted to the variable condensers, so that the settings of various frequency bands or for different aerials can be logged for future reference. The dials fitted to C1 and C3 should indicate zero when the rotor sections are fully meshed with the earthed stators, corresponding to minimum coupling and low impedance.

Operation of the Unit

With the aerial connected directly to the receiver, first tune in a station on the selected frequency band. If an "S" meter is available to give a definite carrier strength indication, so much the better.

Then transfer the aerial to the appropriate stand-off insulator on the pre-selector unit and connect the receiver to the other insulator with a short length of wire. Plug in a suitable coil and tune C2 to resonance. Starting with C3 at zero, increase the dial reading in

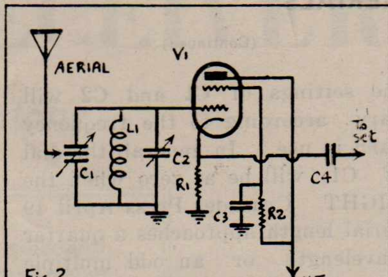

Fig.2.

small steps, retuning C2 each time (only a small movement will be necessary) until maximum strength results. The unit is now matched to the input impedance of the receiver.

Follow the same procedure with C1 (retuning with C2) until the aerial also is properly matched. Unless the match originally was good, a definite improvement will be noticeable. Thereafter there will be little need to touch C3, but

(Continued on Next Page)

AERIALS

(Continued)

the settings of C1 and C2 will vary according to the frequency band in use. In general, the dial of C1 will be at zero when the EIGHT Crusader Press April 49 aerial length approaches a quarter wavelength or an odd multiple thereof, and near maximum, when the aerial is a half wavelength or any multiple.

A Second Method

A second method of ensuring correct matching is shown in Fig. 2. This involves the use of a valve, but cuts out one variable adjustment and is, on the whole, somewhat better where it is desired to cover a wide range of frequencies. The first portion is practically identical with that of Fig. 1. The signal is fed into the grid of a pentode valve, which is used as a cathode follower, the output to the receiver being taken from the cathode *via* a condenser, to prevent the bias-cum-load resistor being short circuited.

Normally, a valve with a high mutual conductance is specified for cathode follower applications, in order to bring the output impedance down to a low value (70 to 100 ohms). In the present instance, this is not necessary, and it will, in fact, be better to use a valve such as the EF37, EF39, 6J7, etc., possessing a medium mutual conductance, and giving a close match to the receiver input impedance.

It will not be easy to adapt the circuit for use with a battery valve. An R.F. choke will be necessary in each leg of the filament, since the latter must be held above earth potential as regards R.F. At the same time, there will be no need for the R.F. chokes to be so efficient as when used in, for instance, an electron coupled oscillator circuit, and if the reader is prepared to wind two chokes, having reasonably high inductance combined with low resistance, reasonably good results should be obtained.

In the circuit of Fig. 2 the output impedance remains constant, irrespective of frequency, but it is still necessary, of course, to match the aerial to the tuned circuit by adjustment of C1. One feature of the cathode follower circuit is the very high input impedance which, in effect, will sharpen the tuning of the L1/C2 combination and give added selectivity. Admittedly, the valve itself will not provide any additional gain, but the improved matching and the increased selectivity will result in a definite improvement in the performance of a receiver with which the unit is used.

Components List (Fig. 1)

C1, 3—25 pF Differential. Cat. No. 719. (Eddystone.)

C2 —60 or 100 pF Single. Cat. No. 582 or 585. (Eddystone.)

C4, 5—10 pF Ceramic or Silvered Mica. (But see text.)

L1 —Coil to cover appropriate frequencies.

Miniature Stand-off Insulators for aerial and receiver connections.

Components List (Fig. 2)

C1, C2 and L1 as in Fig. 1.

C3, 4.—.01 uF (preferably mica).

R1. —470 ohms ½ watt.

R2. —47,000 ohms ½ watt.

V1. —EF37, EF39, 6J7, etc.

MEVER

Continued

not using the meter remove the leads, set volt and milliamp switches to the maximum range (this tends to reduce the chances of 250V. across the 5V. or 5MA ranges), and see that the switch S2 is in the centre position.

This unit, although possibly not as accurate as a commercial instrument, is quite accurate enough for service work. After all, there is a variation of 10 per cent. allowed on stock resistances (at least), and it generally takes a greater change than this to seriously affect a receiver's operation.

BRIDGE

Continued

can keep our dial measurements reading in the same direction by employing a two-bank switch, which reverses the potentiometer connections constituting one-half of the bridge circuit with relation to the other half, made up by the standard component and that across the test terminals.

The standard condensers used in our circuit give us the following:

Switch position 1 = C x 10:
1 mmfd. to .1 mfd.

Switch position 2 = CX 1000:
100 mmfd. to 10 mfd.

Switch position 3 = CX 100,000:
.01 mfd. to 1000 mfd.

Application

The component it is desired to measure is placed across the test terminals and the range switch rotated to its appropriate position. The calibrated dial is then rotated until the 6E5 null-indicator closes to a sharp line, the sensitivity control being advanced as balance is approached.

Faulty Components

Condensers with a high power factor or low "Q" will cause the eye to be blurred on each side, the width of the blurr increasing with power factor.

The eye will open at the left end of the dial setting for shorts, and at the right end for opens. Intermittent components will cause the eye to flicker.

T.R.F. "HAM" RECEIVER

Circuit Design from Eddystone

By exercising care in the selection of valves, coils and other components, it is possible to build a three-valve T.R.F. receiver, capable of an excellent performance on both the amateur bands and the short-wave broadcast bands. The present design is a typical example.

THE *Mullard* EF50 valve pos- mutual conductance and can sesses a high value of be made to work well in all three stages—R.F. amplifier, detector

By

J. N. WALKER

Stratton & Co.,

Birmingham, Eng.

and audio amplifier—of a T.R.F. receiver.

The coils are a new type recently introduced by Stratton Co. Ltd. and take up but little space, thereby lending themselves to a compact design. Yet, they possess high "Q" factors and are very efficient. Each coil has three windings (coupling, tuned circuit and reaction), and is therefore suitable for use in most positions in a receiver. One end of each winding is brought to a common earth pin, so that four pins suffice.

The three coils which cover 33 Mc/s (with a 140 pF tuning condenser) are wound on ribbed formers and have air cores. The remaining coils in the series are wound on a former fitted with an adjustable dust iron core, and are fully enclosed for extra protection. Types are made covering the medium and long wave broadcast bands, and, if desired, the receiver can be used for occasional broadcast reception.

The tuning condensers have ceramic insulation, and again, being physically small, assist in the achievement of a compact lay-out, with short wiring.

It is primarily intended that the power supplies for the receiver be drawn from a small A.C. mains unit, but it may be noted that the consumption is sufficiently low to permit economical operation off batteries. The valve heaters draw 0.9 ampere at 6.3 volts. A 6 volt 20 ampere hour battery will therefore operate the receiver for up to 20 hours at a charge. The H.T. consumption is about 10 milliamperes—it varies slightly with adjustment of the gain control. The performance is quite good when

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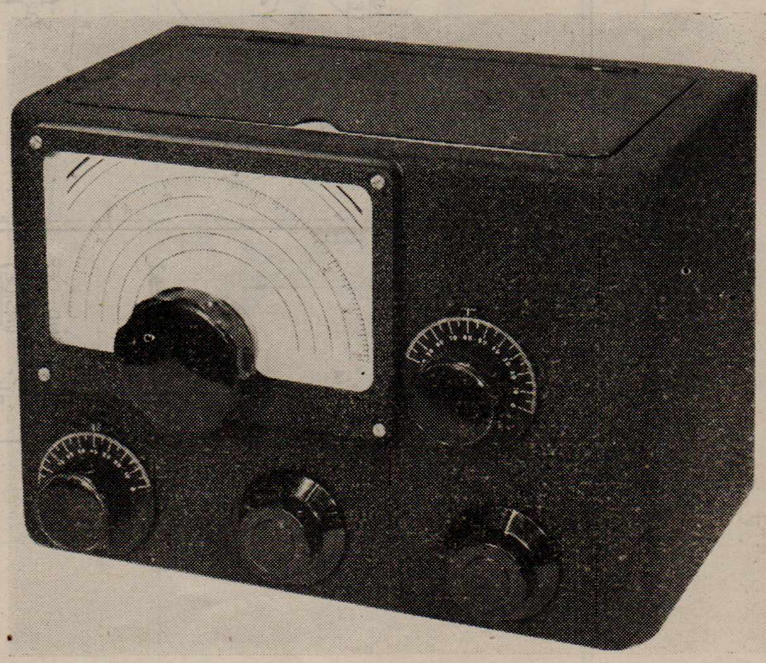
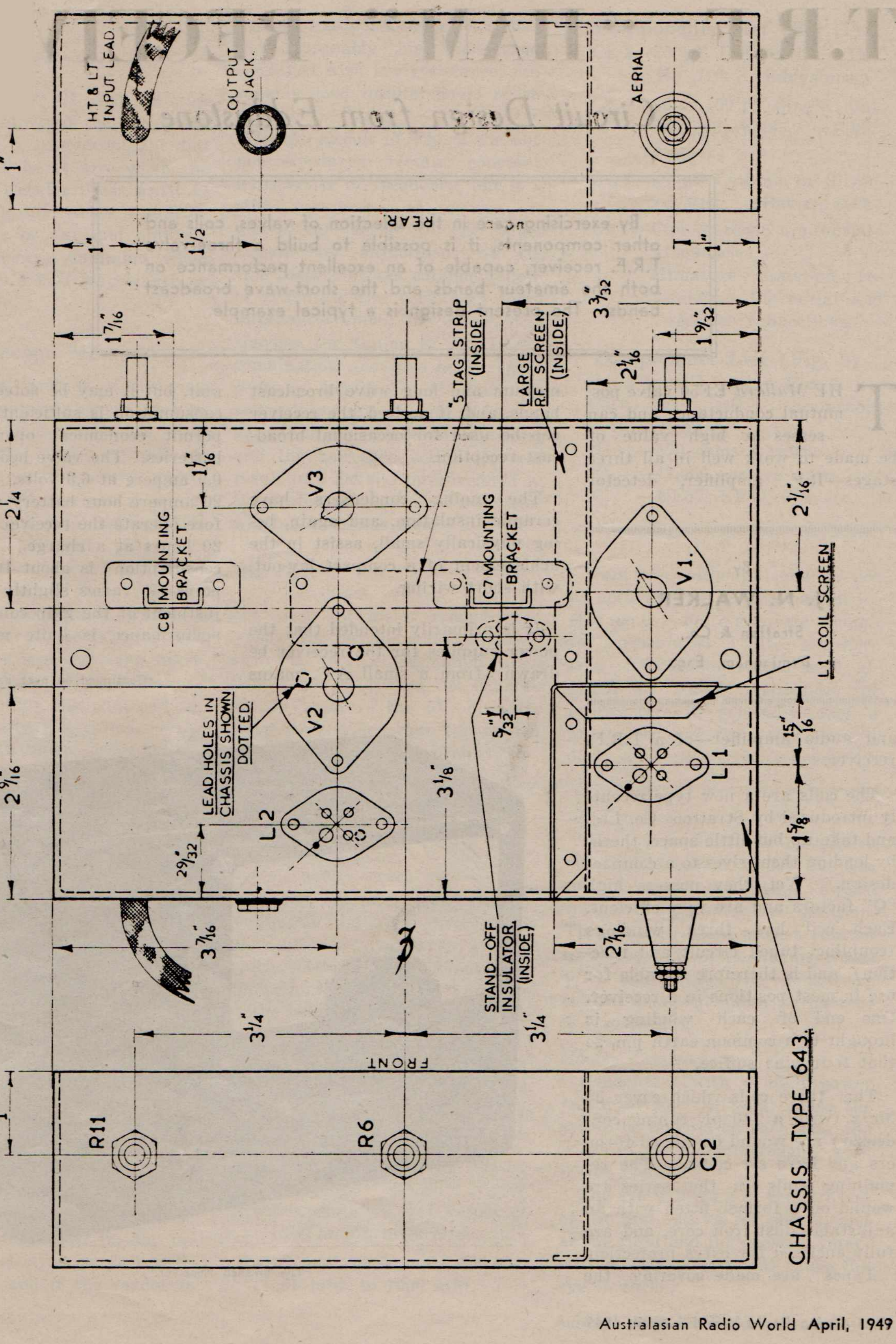


The finished Receiver.


HT & LT INPUT LEAD
OUTPUT JACK.
AERIAL
REAR
"5 TAG" STRIP (INSIDE)
LARGE RF SCREEN (INSIDE)
V3
V1.
V2
L1
L2
C8 MOUNTING BRACKET.
C7 MOUNTING BRACKET
L1 COIL SCREEN
LEAD HOLES IN CHASSIS SHOWN DOTTED.
STAND-OFF INSULATOR (INSIDE)
FRONT
R11
R6
C2
CHASSIS TYPE 643.

T.R.F.

(Continued)

using a 120 volt battery (with one slight modification noted later).

Discussion on the Circuit

The complete circuit diagram is given in Fig. 1. The first valve is a straight R.F. amplifier, the gain being varied by adjustment of the screen voltage. Regeneration becomes evident when R6 is well advanced. If, as happens with some of the coils, actual oscillation occurs, R6 must be backed off a little. This regeneration is considered an advantage rather than a disadvantage. It gives an increase in gain, but, more important, it also improves the selectivity.

The R.F. grid circuit tuning condenser is independently adjusted. Optimum results are thereby obtained and the construction simplified.

At first sight, R1 may appear superfluous. It is included to prevent the grid of V1 being deprived of bias whilst the coil is being changed. The high value specified has no deleterious effect on the performance.

The output of V1 is shunt-fed to the coupling winding on the detector grid coil. In parallel with the latter are two variable condensers. The larger can be used for general purpose tuning, for which reason a slow motion dial is fitted, or as a band-set condenser. The smaller bandspread condenser is coupled to the full vision dial. The amateur bands are well spread out (details are given later) and fine tuning is possible on any of the short wave broadcast bands.

The detector valve is triode connected. Used as a pentode, smooth reaction control becomes virtually impossible and no improvement in signal strength is obtained.

Rather a lot of resistors and condensers appear in the anode circuit of the detector valve, but they all serve useful functions. In the main, the additional decoupling is inserted to make very sure that no radio frequency voltages reach the grid of the EF50 audio amplifier. It may not perhaps be generally realised that many minor troubles with a T.R.F. set—for example, threshold howl, hand capacity effects and "ploppy" reaction—are frequently due to the audio valve amplifying R.F. voltages, these then being fed back to the earlier stages. The EF50 gives considerable gain, and it is particularly important to filter out R.F. voltages. The small resistors and condensers cost but little and are well worth including.

Shunt feeding to the anode of V2 is necessary, and R9 performs this function. R10 is the anode load. The combination of C12, R13, C14 and R15 forms a very effective low-pass filter.

The value of C13 is given as 0.5 uF, and this is the minimum value that should be employed, to prevent noise being audible when rotating the reaction control R11. This value can, with advantage, be increased, and a 2 or 4 uF electrolytic condensor (200 or more working volts), if obtainable, should be substituted.

A resistor is used as the anode load of the EF50 output stage, and the output is entirely adequate for all normal needs, when using telephones, or even with a small speaker. If it is intended to use a speaker regularly, a pentode output transformer, with a ratio of 60 to 1, should be substituted for R18. C18 and the telephone jack can remain, the low impedance winding on the transformer being taken to a terminal strip, for connection to the speaker. In this case, the value of R17 should be reduced to about 10,000 ohms. These modifications will, of course, increase the H.T. consumption.

No audio gain control has been

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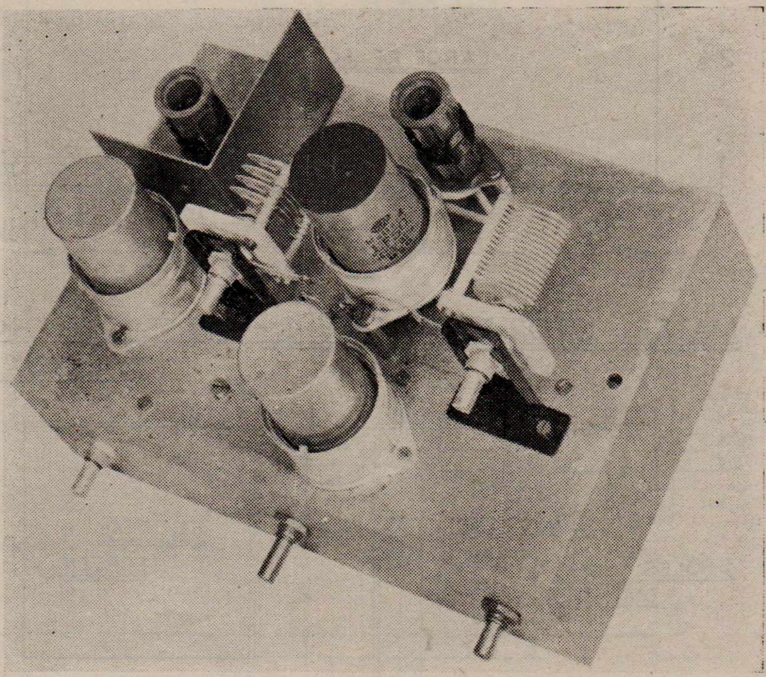


Top View of the Chassis.

T.R.F.

(Continued)

found necessary, as the R.F. gain control permits a wide range of signal strength adjustment.

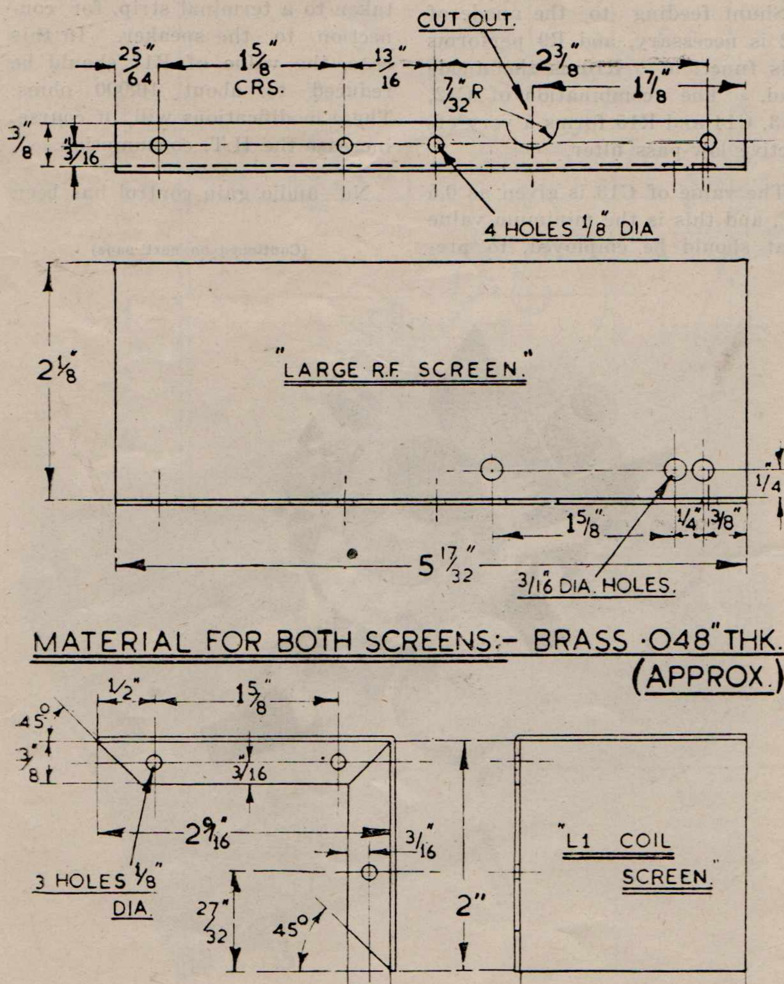
Points Regarding Frequency Coverage

As the coil data panel shows, coils are available covering frequencies from 33 Mc/s to 150 Kc/s. This is a wide range, and it is practically impossible to arrange the circuit constants to give optimum results over the entire possible coverage. The values recommended form a good compromise.

If the main interest lies in the higher frequencies—say, 7 Mc/s upwards—the value of C1 and C6 can well be reduced to 25 pF, and that of C10 to 100 pF. On the other hand, better results will be secured on medium and long wavelengths, if C1 and C6 are increased to 100 pF and an all wave type of choke (e.g., the Eddystone Cat. No. 1066) included in lieu of the 2.5 mH type specified.

Construction

The diecast aluminium chassis, on which the receiver is built, is easy to work, and, as comparatively large holes are required, the construction is fairly easy. Only two small screens are required, and they may be made of any metal available—brass or aluminium of about 18 gauge (.048-in. thick) is recommended. Details of the screens and of the holes in the chassis are given in Figs. 2 and 3.



EDDYSTONE COILS

Coil Type.	*Frequency Coverage.*
706/LB	33-15 Mc/s.
706/Y	16-6.7 Mc/s.
706/R	7.5-3.1 Mc/s.
706/W	3.3-1.35 Mc/s.
706/P	1.4 Mc/s.-720 Kc/s.
706/G	750-300 Kc/s.
706/BR	370-150 Kc/s.

The R.F. Stage

The R.F. stage is a compartment formed on three sides by the chassis walls and on the fourth by the screen. The latter is fitted close up to the valveholder, which must be fitted as indicated in Fig. 2, so that the length of anode lead actually in the R.F. compartment is very short. This compartment houses C1, C2, C3, C4, R1, and R2. Resistor R4 is soldered to the centre tag of the gain control potentiometer, as also is C5.

Condensers C3 and C4 are mounted across the valveholder in an upright position, to provide a measure of screening between the grid pin (No. 7) and the anode pin (No. 3). The screen above the chassis shields the coil from other parts of the receiver. The lead-through insulator, used as the aerial terminal, is fitted to the rear of the chassis and projects into the R.F. compartment. Alongside this insulator is a 4BA bolt for an earth connection.

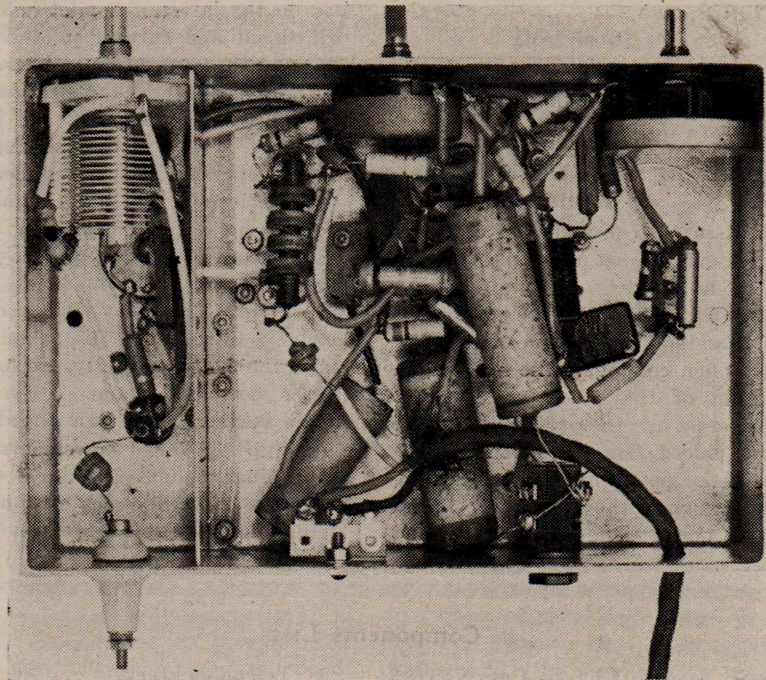
The Detector Stage

Coupling condenser C6 and the R.F. choke are supported, at the anode end, by a miniature stand-

(Continued)

off insulator. The other end of C6 goes direct (through a hole in the chassis) to the coil holder. The other end of the R.F. choke is held by a two-way tag strip, which also takes R3.

Several advantages obtain from mounting the detector valve and coil on pillars, well away from the chassis. Construction is simplified, leads are kept short and stray capacities are minimised. The pillars used for the coil holder are 1 in. long, and those for the valveholder 1 in. long. If any difficulty is found in purchasing suitable pillars, they can easily be made by sawing off lengths of small diameter tubing, the centre hole of which is large enough to take a 6BA bolt. Before permanently mounting, wires of appropriate length should be soldered to the coil holder sockets and all connections made to the valveholder, including the fitting of C9, C10, R8, and R9.

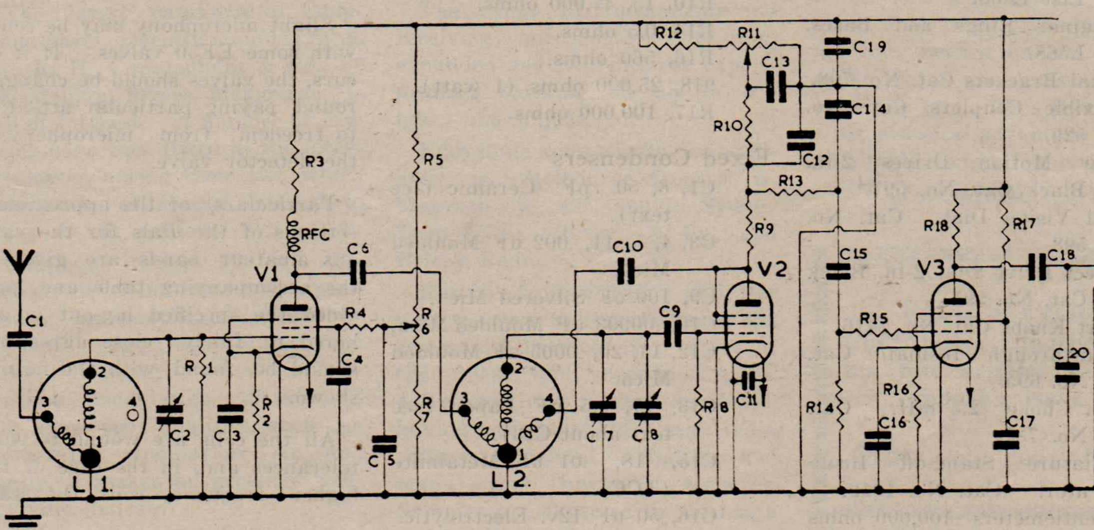


The Underside Wiring.

Tuning Condensers C7 and C8 are positioned with the spindle 1 inch above the chassis. The rotors are earthed, by the large tags provided, to a soldering tag fitted beneath the nearer fixing bolt of the V2 valveholder.

The audio stage is straightforward and calls for no particular comment, except perhaps to mention that the grid stopper (R15) is fitted very close up to tag 7 on the valveholder.

(Continued on Next Page)



T.R.F.

(Continued)

The power lead takes the form of a three-way cable, anchored to a three-way tag strip.

Fitting the Chassis to the Cabinet

Holes are provided in the chassis and cabinet to enable the two to be fitted together, a 2¾-in. length of 2BA screwed brass rod being required for the purpose.

When coming to the holes in the front of the cabinet, a smear of vaseline or other compound should be placed on the spindle of the centre potentiometer (R11), so that, when the chassis is pushed up against the panel, a mark is left on the latter. A pilot hole is drilled out and further pilot holes made at the appropriate distances to right and left of the first hole, for the spindles of C2 and R6. The pilot holes are then enlarged to ⅜-in. diameter, either by means of a punch or by drilling a number of small holes and filing clean.

The same procedure is followed for the two 13/16-in. holes required for the slow motion dial heads. Care should be taken to mark the holes correctly, at least in the horiontal plane. Errors in the vertical plane can be taken up by up and down movements of the tuning condensers.

A little difficulty may be found fitting the index to the dial on C2. A 6BA tapped hole is necessary, and, if a tap is not available, it will be as well to leave out the index, since accurate readings of this dial are not necessary. Set condenser C2 to full mesh before finally fixing the chassis inside the cabinet.

Operation

A well smoothed power unit delivering a voltage between 150 and 250 volts is suitable for the H.T. supply. As mentioned earlier, a 120 volt day battery may be used, in which case R12 should be omitted. No switch is included in the receiver itself, as it is assumed that one will form part of the power unit. If an H.T. battery is used, means should be provided for breaking either the positive or negative lead, to prevent the small drain through R5, 6 and 7 and R11, during periods when the set is idle.

Any type of aerial may be employed—good results have been obtained on a short length of wire, but, as with any other receiver, the better the aerial, the better the results. If a long aerial is used—that is, over 66 feet long—it may be desirable to reduce the size of the condenser C1 in series with the aerial coupling winding.

Slight microphony may be found with some EF50 valves. If it occurs, the valves should be changed. round, paying particular attention to freedom from microphony in the detector valve.

Particulars of the approximate settings of the dials for the various amateur bands are given in the accompanying table and, provided the specified lay-out is adhered to, fairly close agreement should be found with the figures shown.

All the coils are wound to close tolerances and, in the case of the higher frequency coils, the read-

(Continued on page 42)

Components List

1 Diecast Chassis Cat. No. 643.
1 Metal Cabinet Cat. No. 644.
2 Ceramic Microdensers 140 pF (C2, 8) Cat. No. 586.
1 Ceramic Microdensers 12.5 pF (C7), Cat. No. 580.
2 Coil Bases. Cat. No. 707. Coils as required (see panel) Cat. No. 706.
3 Valves type EF50.
3 Ceramic Valveholders B9G. List L500.
3 Retainer Rings and Bases. L568.
2 Metal Brackets Cat. No. 708.
2 Flexible Couplers Cat. No. 529.
2 Slow Motion Drives 2-in. Black Cat. No. 597.
1 Full Vision Dial. Cat. No. 598.
1 Direct Drive Dial 2-in. Black Cat. No. 595.
2 Skirt Knobs Cat. No. 2416.
1 Lead-through Insulator Cat. No. 695.
1 R.F. Choke 2.5 mH. Cat. No. 737.
1 Miniature Stand-off Insulator. Cat. No. 1019.
2 Potentiometers 100,000 ohms (R6, 11), type SG.
1 Telephone Jack.
5-way tag strip, insulating sleeving, etc.

Resistors

(All except R16 are ½ watt).
R1, 2 megohms.
R2, 220 ohms.
R3, 4, 7, 10,000 ohms.
R5, 12, 33,000 ohms.
R8, 4 megohms.
R9, 13, 22,000 ohms.
R10, 15, 47,000 ohms.
R14, 0.5 ohms.
R16, 560 ohms.
918, 25,000 ohms (1 watt).
R17, 100,000 ohms.

Fixed Condensers

C1, 6, 50 pF Ceramic (see text).
C3, 4, 5, 11, .002 uF Moulded Mica.
C9, 100 oF Silvered Mica.
C10, .00003 uF Moulded Mica.
C12, 14, 20, .0005 uF Moulded Mica.
C13, 17, 0.5 uF Paper (see text about C13).
C15, 18, .01 uF Metalmite (TCC).
C16, 50 uF 12v. Electrolytic.
C19, .01 uF Moulded Mica.

Converting That Prop Motor

MANY hams have purchased Douglas aircraft variable pitch prop motors for rotary beams and other uses. This very excellent motor is ideal for this purpose, because it will operate off 25 volts D.C. or A.C., and has a tremendously high reduction ratio, in the order of 3000 to 1, which permits the motor to develop high power and turn the heaviest beam mechanism with ease.

The motor, as it is received, carries a magnetic clutch, which must be removed for ham use. About an hour's work is all that is necessary to do this.

The technique of conversion is first to remove those two bolts holding a small plate into the throat of the gear box just below the mounting plate and withdraw the plate to which a small plug is integral. This plug operates stops in the gears and should be sawn off to keep the hole closed, but to miss engaging stops.

Next, the light metal cover should be withdrawn from the motor itself and the assembly on the extreme outboard end of the motor should be completely removed. This is a friction brake which is normally hard on and which can be released only magnetically at the expenditure of considerable current. The first step is to undo a little screw with a screw-driver which you will find holding a slip of metal to lock two turrets on the end of the motor casing. Without undoing the three bolts round the edges this end turret can be screwed right out. The composition disc which is held on to the motor shaft by the big sprocket can then be lifted out. The motor will then turn over, but it turns much more freely if the sprocket is removed from the shaft by undoing the turret nut on the end of the shaft and lifting the sprocket off. The bottom section of the brake can then be removed by taking off three nuts which you will see between the lower brake plate and the magnetically operated flexible plate.

With this gear removed the motor runs like a dream on about 25 volts A.C. The actual shaft power on the motor is surprisingly small—at that pressure very much less than a vacuum cleaner motor —but the torque on the output shaft is terrific and would turn a locomotive on a turntable. I don't quite know what the motor connections are, but, to my surprise, only three leads instead of the four needed on the standard series motor are necessary to reverse the job. This is, of course, a big practical advantage and only a simple single pole two-way switch is necessary for reversing.

Eddystone Catalogue

SINCE the earliest days of the radio the well-finished products from the English Eddystone factory have enjoyed unrivalled popularity with those radio enthusiasts who can afford the best.

The latest catalogue of Eddystone parts, recently supplied to us by R. H. Cunningham & Co., of 420 William Street, Melbourne, is full of interest. A number of new items have been listed in the latest catalogue, among them two which should be of special interest to many of our readers.

Catalogue number 678 is a modulation level indicator for experimental transmitters, that may be used as a phone monitor and field strength meter. It reads percentage modulation direct, and will show poor qualities, such as downwards modulation, etc., and finally, it makes an excellent neutralizing indicator.

Items numbers 709 and 717 in the new catalogue are 145 mcs. tuning assembly and beam aerial kits, respectively. They should be of considerable interest to Australian "hams," as no similar line has been offered before in Australia.

The range of transmitting and receiving microdensers has been expanded and will interest experimenters working on up to 500 mcs., and higher.

Eddystone components are available in Melbourne from J. H. Magrath & Co., and in Sydney from Geo. Brown & Co., and Price's Radio.

Rumour from England indicates that the new Eddystone model 680 communications receiver is one of the finest and most modern 15-valve receivers ever produced, having variable i.f. selectivity, voltage stabilized oscillators, and many other advanced features. Samples are expected in Australia shortly.

PAUL STEVENS
Contributes another of his fine articles in next month's issue.

Order your copy, Now !

Shortwave Review

CONDUCTED BY L. J. KEAST

ON account of the sale of this magazine in so many parts of Australia, new Zealand, the Pacific and overseas, kindly note all times are *Australian Eastern Standard Time.*

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ONE MAN BAND ARRIVES

Readers of these pages will remember in December issue I suggested HCJB, Quito, would send a pocket size harmonica to listeners in this country who sent in a correct report of their 16 metre band transmission. Sure enough, Allan W. Beattie, of New Lambton, received the bamboo mouth organ ("Rondador" for his report on 17.89 m.c.

((Well done, Allan. Yours is the first report I have heard, so maybe you beat the horses I tipped.—L.J.K.)

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WANT TO BE A FINANCIER ?

The World-wide Broadcasting Foundation in Boston are offering two free booklets for the asking. They are "How to Read a Financial Report" and "The Show That Never Ends." Simply write to Radio Station WRUL, 598 Madison Avenue, New York 22, U.S.A. These people before the war used to send out some beautifully illustrated booklets, and as far back as 1936 I received their publications monthly.

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SWISH ONE IS IT ?

There seems to be some confusion between the Swiss and Swedish broadcasting stations. That is, listeners are apparently not quite sure to whom they are listening. Perhaps this will clear things. The Swedish radio announces as follows: "This is Radio Sweden (the International Service of the Swedish Broadcasting Corporation)." From Berne the announcement is generally: "This is Switzerland Calling."

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WOULDN'T IT?

After a day's work in the garden it is seldom I feel much like spending the evening of Saturday at the receiver if it means intent listening, but knowing that the English Foreign Broadcast Section of Radio Indonesia in Batavia were putting on a special Quiz Contest for which prizes were to be given to listeners who successfully answered a short list of questions I got ready on Saturday, March 5, well ahead of the schedule (9 p.m. Sydney time), but QRM made it impossible for me to hear a sound, if the broadcast did take place, on either of the three transmitters, YDC, PLB-7 or YDB-3. It was just one of those nights, in my district anyway, when every type of noise that affects radio reception seemed to be at its top. Even the 'Frisco stations were only fair, and London was difficult. But as I have often said before, radio is like golf, no matter how bad the score, you figure you will be more fortunate "in the next round."

AND STILL THEY COME

Arthur Cushen, that tiger of the Shaky Isles, has now received his 1547th verification, which represents 116 countries. That certainly is a fine record, and most certainly a record for verified reports in Australasia.

During the war, when I was employed by the United States Office of War Information, and spent up to 17 hours a day listening in, I thought I had a great system of recording loggings, but I would love to see Arthur's "little Register."

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CHANGE IN CALL-SIGNS

Advice from Tokio brings news that all Japanese call-signs have been changed. Here is the new list:—

JKH (7.257), JKI (4.91), JKI-2 (9.655), relaying 1st network.

JKJ (7.285), JKM (4.93), JKM-2 (9.695), relaying 2nd network.

JBD (9.505), JBD-2 (9.56), JBD-3 (15.225), JBD-4 (15.235), Repatriates' n/w.

JKK (6.015), JKL (4.86), JKL-2 (9.605), relaying the AFRS network.

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NEW STATIONS

DZH-5, Manila 9.69 m.c. 30.96 met.:

Here is another addition to the Philippine stations using the slogan "Your Station of the Stars." Opens at 8 p.m., and can be heard at fair strength till 9 o'clock, when, owing to Singapore opening up on the same frequency the Philipino fades out.

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SAYS WHO?

Allan W. Beattie drops a short note on his short-wave loggings:—

"Dear Mr. Keast:

"Only a very short note, as my listening time has been very short over last few weeks. On the few occasions I have been able to get near the receiver it has usually been tuned to one of the 'locals,' YDC, HER5, VUD, D2H2, and so on.

"*Macassar* (*11.084*): Good from 8.10, in Dutch Forces programme, provided Morse is not too bad. Was asking, in English, for reports.

"*Monte Carlo* (*9.50*): Very nice signal at 5.45 p.m. one afternoon when VCI3 was temporarily off the air.

"*OTC2* (*9.76*): DX session (Thursdays 5.45 a.m.) comes in very nicely.

"*DZH5* (*9.69*): Good around 8.30 p.m..

"*DYH3* (*6.10*), *DZH4* (*6.005*), *DUH2* (*6.17*): Fair to good nightly.

"*DUH5* (*11.84*): Greatly improved nightly. On 15th each month at 9 p.m. broadcasts a fireside chat by President of Philippines.

"*TAP* (*9.465*): Very nice signal Monday, Friday, 7.30 a.m."

From Max Krumbeck, Lot 31, Turton Avenue, Belmore, N.S.W.

"Dear Mr. Keast:

"Just a copy of this month's loggings, which may be of help. Unfortunately, accountancy studies do not give me as much time as I would like. But, anyhow, here's the list:—

15.19—OIX4 Finland: Fair signal at 10 p.m., but unreadable due to VUD5.

9.369—R. Nacional D'Espana: Very good signal; also on 15.19 6.20 a.m. (English programme).

11.97—Brazzaville: Very good at 8 a.m., and also at 3.30 p.m.

17.83—VUD10 India: Fair only around 4.05 p.m.

17.78—HER7 Berne: Very good signal at 12.50 a.m.

11.78—Saigon: Good signal at 10 p.m.

9.505—JVW2 Japan: Fair signal 7 p.m. Poor readability and ORM.

17.85—Paris: Excellent signal 1 a.m.

11.715—Berne HE15: Fair only, due to ORM by VLG3; 1171 at 7.30 p.m.

11.084—Macassar: Good with Dutch Forces programme at 9.15 p.m.

17.63—Batavia: Excellent signal, 2.10 a.m.

Best wishes for now and good listening,

Sincerely,
Max Krumbeck."

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VERIFICATIONS

Arthur Cushen says: "Latest verifications here are from Munich (6.17 m.c.); CR6CF (8.09 m.c.); JKA (7.285 m.c.); JKG-2 (4.93 m.c.); WRUA (17.755 m.c.); LLK Hamburg (7.29 m.c.); Djockjakarta (5.03 m.c.); PLB-7, PLB-4, PMW; United Nations Geneva (6.675 m.c.); Denmark (15.165 m.c.); Moscow (11.63 m.c.); HCJB (17.89 m.c.); KGEI (9.70 m.c.); OAX6B, Radio Sario (9.745 m.c.); WNRX (11.89 m.c.); YDH (11.03 m.c.); YDP-2 (7.21 m.c.); Bukit Tinggi (7.45 m.c.); YDI-2, KRHO (15.13 m.c.).

Moscow was perhaps the best verification this month, although

(Continued on Next Page)

SHORT WAVES
(Continued)

Radio Sario, Manado, was first report from Australasia.

OAX6B, "Radio Landa," Arequipa, Peru, verified by post card with view of the city. The reverse side listed verification details, power 300 watts, and signature was Snr. M. Landa, owner.

United Nations, Geneva, verified by air mail from P. Janowski, radio officer. He states that the 4.30-4.50 a.m. English-French broadcast is the only transmission at present. Frequency is 6.675 m.c. The 18.45 m.c. station has been withdrawn. Power of existing transmitter is 7500 watts. They plan to increase transmissions when U.N. grant budget increase.

Lieut. A. J. Visschedijk, writing from Radio Saric, Menado, says: "Your statement is the second one we received from Australia. The first came from N.Z. on January 1. (I wonder if I can guess who sent it?) Power is about 800 watts output.

HCJB sent along the promised bamboo mouth organ ("Rondador") for the report on 17.89 m.c.

SHORTS

Radio Congo Belge is an official station of the Gouvernment General of Belgian Congo. There are programmes from several stations. Over OTM-1 (6.295 m.c.) for European listeners from 3-5 p.m., and 8-10 p.m.; also from M/N till 6 a.m.

OTM-2 (9.38 m.c.) from 3-5 p.m., and 8 p.m. till 6 a.m.

Station OTM-4 (11.72 m.c.) is on the air from 8.15 till 10 p.m. Languages used are French, Flemish and Portugeuse.

Transmissions for native listeners over OTH on 9.21 m.c. in French and various Congo tongues is on the air from 3.30-4.30 a.m., and on station OTC ("The International Good Will Station") operates as usual on 9.767 m.c.

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Canada is now broadcasting Swedish, Norwegian and Lanish programmes on 15.32 m.c. between 5 and 6 a.m.: "Sweden Calling."

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Kuala Lumpur (6.03 m.c.) is good at 11.15 p.m.

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XLRA (11.15 m.c.) has a good programme always at 8.30 p.m.

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Monaco has two 25 kw stations operating on 6.035 and 9.49 m.c.

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Radio Seac, Colombo, has programmes on Sundays for United Kingdom between 2.30 and 4.30 a.m.

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San Franciscan stations broadcasting the Armed Forces Radio Service programmes are as follows: KCBA (6.12 m.c., 49.02 met.), 11.15 a.m.-6.30 p.m., and 7 p.m.-m/n. KCBF (11.81 m.c., 25.40 met.), 11.15 a.m.-6.30 p.m. KCBF (9.65 m.c., 31.09 met.), 7 p.m.-12.30 a.m. KWIX (9.57 m.c., met. 1.15), 6.45 p.m.

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XGYA (Communist - controlled station) is heard on 7.99 m.c., 37.54 met. at 10.45 p.m.

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PLB-7, Batavia (11.08 m.c., 27.05 met.), gives an English session from 9-10 p.m.

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ETA, Addis Ababa (15.074 m.c., 19.9 met.), is good around midnight.

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CHNX, Halifax, Nova Scotia (6.13 m.c., 48.94 met.), operates daily 3 a.m. till 2.15 p.m., except Mondays, when transmitting times are: 5 a.m.-2.15 p.m. If you desire to send a report address it to: Miss Margaret Forrest, P.O. Box 400, Halifax, Nova Scotia.

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Radio Athens (Greece) (7.30 m.c., 41.16 met.), advises new schedule is: 2-7 a.m. (whilst on 9.607 m.c., 31.22 met.), 3.15-6.35 p.m.; 8-11 p.m., and on 15.345 m.c., 19.53 met., 8.30-9.30 a.m.

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Radio Club, Tenerife (Canary Islands) (7.267 m.c., 41.28 met.), has two transmissions: 10 p.m. till M/n., and 3.30-9 a.m.

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Radio Tetuan (Spanish Morocco) (6.067 m.c., 49.45 met.), 11.30 p.m.-1 a.m., 4.8 a.m.

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Radio Monte Carlo is being heard at 11 p.m. on 17.78 m.c., 16.87 met.

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If you are prepared to put up with a little bit of noise, several of the Indian stations are about after midnight in the 60 metre band. For instance, VUM-2 (4.92 m.c., 60.92 met.); VUB-2 (4.88 m.c., 61.47 met.), and VUC-2 (4.84 m.c., 61.98 met.).

Alan Beattie says:

A few recent loggings are:—

KNBA (6.06 m.c.). Now used for afternoon U.N. session. Very much better than 11.79 m.c.

WLWR (15.33 m.c.). Fairly good at 11 p.m. to Latin America.

HI2T (9.74 m.c.). Good around 10 p.m.

COBC (9.37 m.c.). Afternoons and around 10 p.m.

Guam (17,82 m.c.), and Guam (15.93 m.c.). Have heard these around 9 a.m. relaying WVTG and calling Navy Radio, San Francisco.

B.F.E.B.S. (11.88 m.c.). This channel is much better than 11.85 used to be.

Menado (approx. 9.72 m.c.). Good around 8.30 p.m.

Monte Carlo (11.80 m.c.). "Bringing Christ to the Nation," 6 p.m., Sundays.

XGOY (?) (9.46 m.c.). Lot of Morse over this chap in midnight news.

XGOY (7.10 m.c.). Fair nightly.

XGOA (7.47 m.c.). Fair nightly.

VUD (9.57 m.c.). Closes at 10.30 to Indonesia, I think.

XGOA (5.985 m.c.), XGOA (9.73 m.c.). News, 9.30 p.m.

* * *

Unfortunately, I cannot print the exceptionally fine list of loggings sent by Miss Dorothy Sanderson, but the following will be helpful, particularly to the many new-comers to this grand hobby of dx-ing.:

TGWA, Guatemala, 9.76 m.c. News in Spanish and good programme of music at 4.45 p.m. The same station, but on 15.17 m.c., at 7.30 a.m., is good also.

ZYK-3, Recife, Brazil, 9.56 m.c., has a fair signal at 6.30 a.m., when news in Spanish and music is heard.

PCJ, Hilversum, 21.48 m.c., at 8.45 p.m. give a talk followed by music.

SBP, Motala, 11.70 m.c. Very good at 11.15 p.m., when talk is usually given.

HEI-5, Berne, 11.71 m.c. Excellent at 5.15 p.m.

Leipzig, 9.73 m.c. News in German at 5.30 p.m.

OIX-4, Denmark, 15.19 m.c. Good programme at 11 p.m. They ask for reports.

PCJ, Hilversum, 15.22 m.c. News in English on Indonesian problems at 8 p.m.

HCJB, Quito, 15.11 m.c., at 9.30 p.m., usual talk and hymns.

HCJB, Quito, 12.45 m.c. Uncle John and the old family Bible session and hymns.

HP5A, Panama News in Spanish at 9.30. Good programme and signal.

COBC, Havana, 9.37 m.c. "Radio Progresso" is good at 9.45 p.m.

HH3W, Port-au-Prince, Haiti. CBS programme of French news and music at 10.15 p.m.

VP-4RD, Port-of-Spain, 9.62 m.c. At 8 p.m., "Church in the Wildwood" session.

CATHODE COUPLER

(Continued)

tubes with a low value of plate load simplifies the design, in that the required input voltage to the final grids will be lower for full power output. Transformer ratios of 1 to 3 or 1 to 4 are commonly used.

For full output of 19 watts, it is necessary to drive the 807 grids to the tune of 460 volts. If the input transformers are of 1-3 ratio, this will entail an input of 50 odd volts to the first 6C5. This may be obtained from a conventional resistance-coupled voltage amplifier, preferably with an unbypassed cathode resistor. It will be observed that the amplifier voltage gain is only a function of the input transformer set-up ratios, so that the extent of the input voltage depends only on this ratio. It is not necessary to use 6C5's, either 6J5's or 6N75s may be utilised.

TIME IS MONEY

(Continued)

around with a friend's set for three or four hours and be happy with a fee of 5/- or 10/-. This may be alright for the amateur who wants to gain experience with somebody else's set, but as soon as the enthusiastic radio man has the necessary knowledge to carry out repairs quickly and effectively he should make a point of charging a worthwhile amount for his time. Radio is an expensive hobby; practical knowledge is not obtained cheaply. So why be cheap?

CIRCUITS

(Continued)

secondary coil in series with a crystal unit and a pair of phones to the bottom of the coil to complete a good crystal circuit. Connected in a like manner to the grid of a valve with the plate of the latter connected in a series with an inductance to a source of H.T. voltage with the negative of the latter at "earth," it would provide a R.F. amplifier. With a small fixed condenser and resistance in parallel connected between the grid input and the coil you would have a simple one-valve receiver or detector. It is practically always in one of these capacities that you will find such a tuned circuit, besides that of the oscillatory circuit of the superheterodyne oscillator as previously mentioned.

The symbols so far described are mainly concerned with the R.F. or signal frequency of a receiver. There are quite a few more symbols yet to be described particularly as regards the low frequency section of the receiver, but as considerable space will be required for this—contrary to my original intention—it will have to be continued in our next issue.

Speedy Query Service

Conducted under the personal supervision of A. G. Hull

C.T.H. (Heidelberg) enquires about a kit of parts for a small mantel model.

A.—It is rather out of place for us to make a firm recommendation in these columns, but the offer by Magraths in last month's issue is something quite out of the box, and one which we would point out to you as a grand proposition. This is a kit for four-valve mantel model, complete with valves and moulded bakelite cabinet for ten guineas. We know that this set builds up into a fine little performer which will do all you want. Fitting the dial cord and one or two trifles may make you scratch your head for a minute or two, but you'll soon work them out. The finished set is in every way equal to the factory-built sets costing from 18 guineas to £25. The offer holds good only for the month of April, so you will need to rush it.

P.H. (Horsham) asks about a rotary converter.

A.—Yes, although the rotary converter was originally designed for 12-volt operation, you should be able to run it quite well from a 6-volt car-type accumulator. The output voltages will be halved, but this should suit you quite well, as 150 volts is quite enough for the early amplifier stages, and 250 right for the output stage. The current drain on the battery will depend on the current drain taken from the output of the converter. Limit to current you can draw will be the voltage drop on heavy load, or the heating up of the converter in operation. Output will need filtering for the early amplifier stages, but you might get away without filtering for the final.

HAM-GEN.

(Continued from page 27)

thick, and you would pay £'s for it. There is so much scope these days in the radio field that all spheres cannot be covered in any one journal, and hence the need for specialisation. *Radio World* serves a great number of readers here and abroad, and I'll bet they all have interests in common. My job is to develop the ham and would-be ham material. Therefore, I would be grateful if anybody who has read this far would drop me a line and make some suggestions as to the type of articles they would be interested in.

Later on I hope to produce such stuff as a course in radio for the A.O.P.C. aspirants. How would that be? For next month I have some good articles coming up. In Adelaide recently I saw one of the best V.F.O.'s in VK to-day. I have the circuit of it and all the dope on making it up. Secondly, I have been playing with the V.H.F.'s of late, and find that one of the most useful gadgets—and I'll say, one of the most indespensible, gadgets is a grid dip oscillator for locating the bands and for checking the frequency of a condenser inductance combination. My good friend Jerry Walker, G5JU, has sent me out an excellent article on how to build one of these devices. That will appear also next month.

It is hoped that this section will not only be technical, but also topical, and carry an atmosphere of personalities. I think it is very interesting to read how the other person lives and operates. To this end we would like some contributions in the form of Station Descriptions from readers.

BARGAIN CORNER

Advertisements for insertion in this column are accepted free of charge from readers who are direct subscribers or who have a regular order placed with a newsagent. Only one advertisement per issue is allowed to any subscriber. Maximum 16 words. When sending in your advertisement be sure to mention the name of the agent with whom you have your order placed, or your receipt number if you are a direct subscriber.

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FOR SALE: Two Type P26 ASV receivers, 6-EF50, £4½ each. Wavemeters to suit, £1 ea. Two Bendix 28 v. type MP10G, power units, 1050 v. at 400 ma., and 230 v. at 100 ma., never used, £5 ea. P. W. Butler, 1 Darley Road, Randwick, N.S.W.

FOR SALE: Valves 6 x 6K7, 2 x 6K8, 1 x 6B8, 1 x EF50, 1 x 807, 2 x 6V6, One Saxon 8" permag, one 4-gang tuning condenser, 3 x 465 Kc. i.f.'s, and sundry parts out of a No. 19 transceiver. All good. £7 the lot. M. R. Shaw, Christmas Hills, near Yarra Glen, Vic.

T.R.F.

(Continued from page 36)

ings on the dials of C2 and C8 will be similar, allowing for the effect of the bandspread condenser C7.

On the lower frequencies, the position of the dust core will affect the coverage of any given coil. To begin with, the core should be well down inside the former. If, with the tuning condenser at maximum, it is then found that the frequency is too low, the core can be brought nearer the top of the former.

The core of the R.F. coil is adjusted so that resonance occurs with identical dial readings of C2 and C8. The tuning range of C7 will be small on the lower frequencies, and tuning will normally be carried out with C8.

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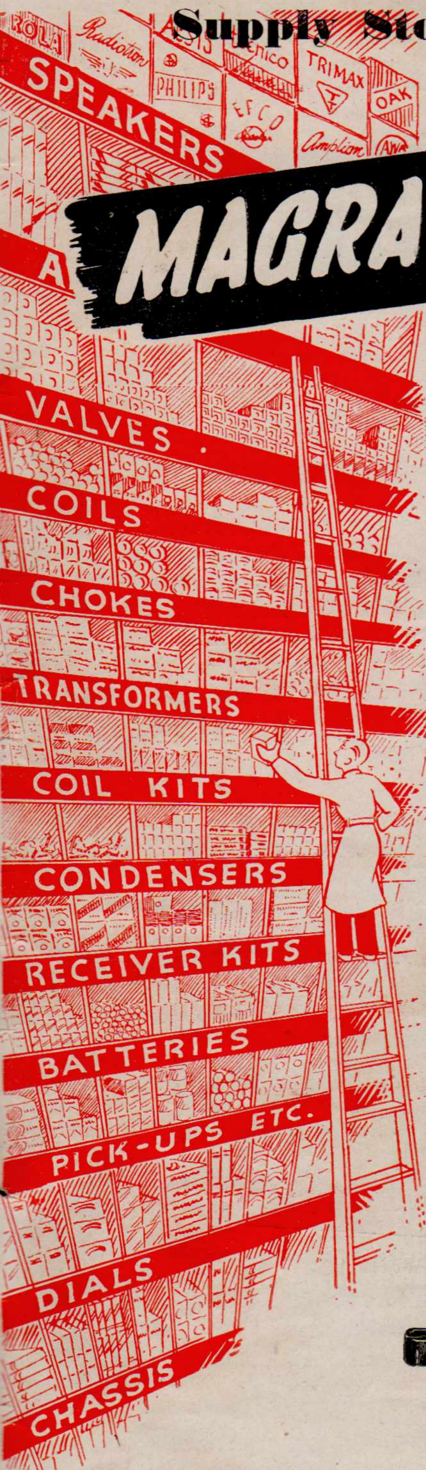

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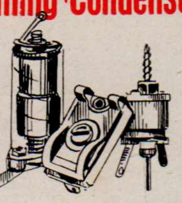

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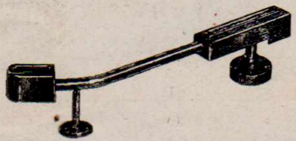

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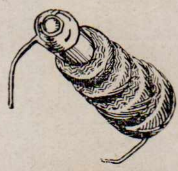

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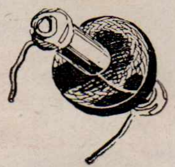

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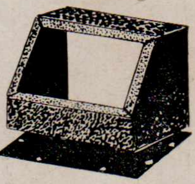

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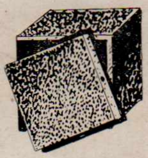

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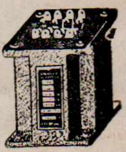

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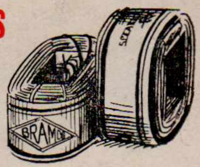

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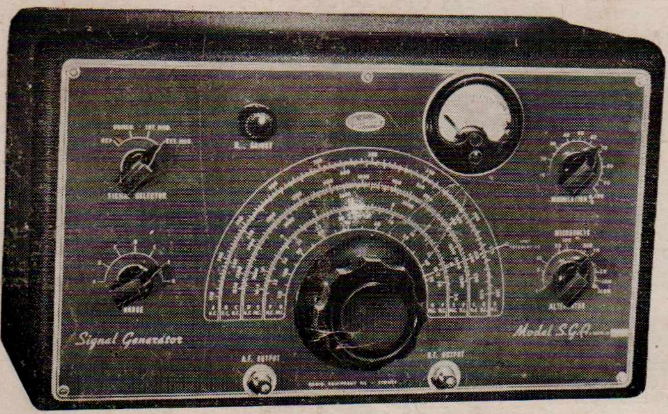

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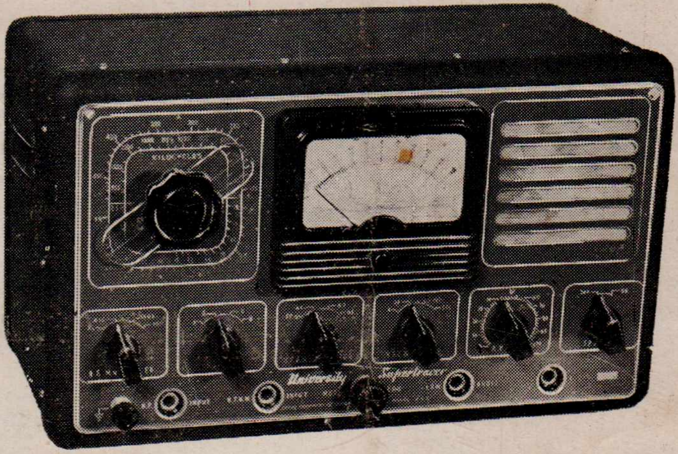

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