RADIO TELEVISION AND HOBBIES

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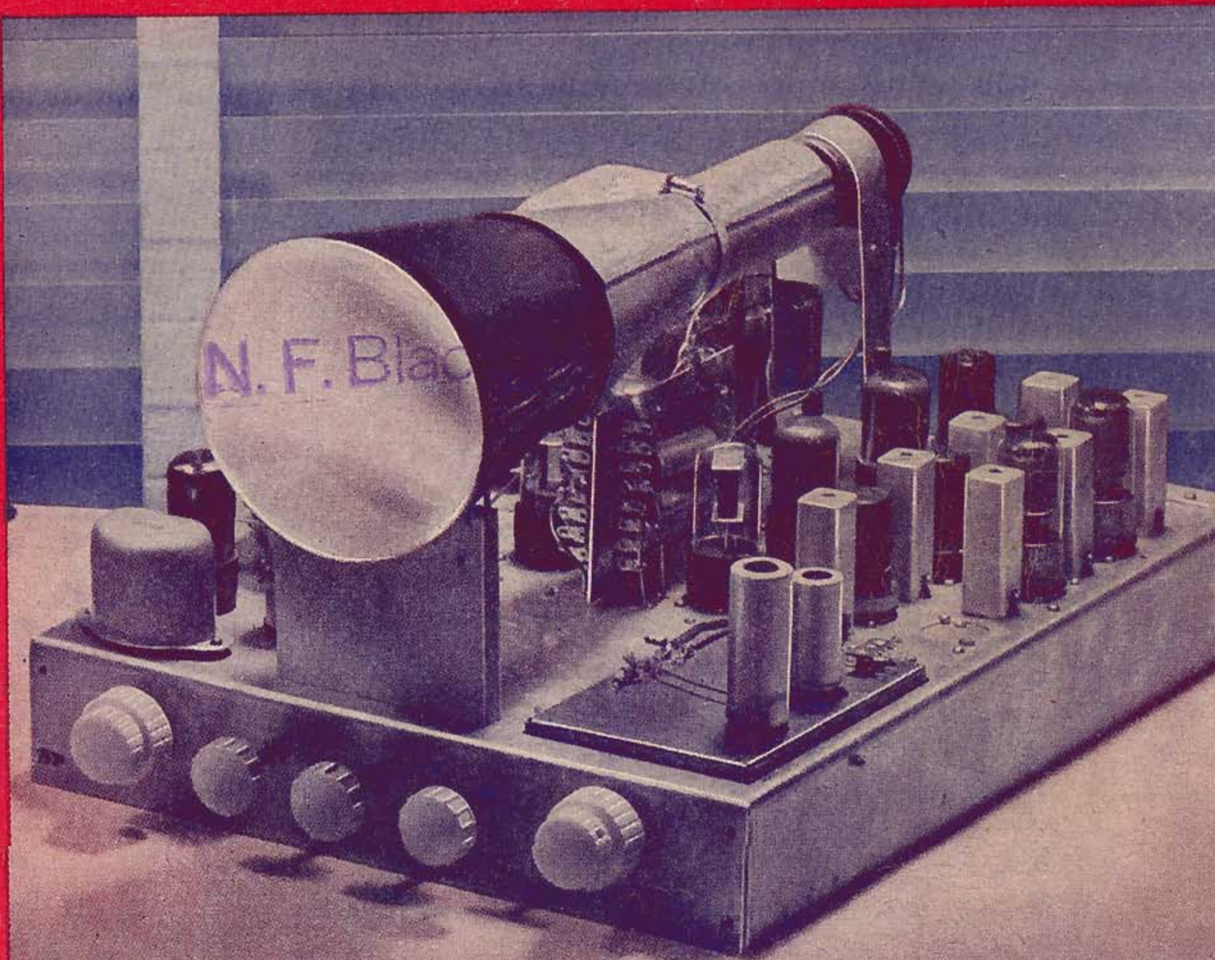

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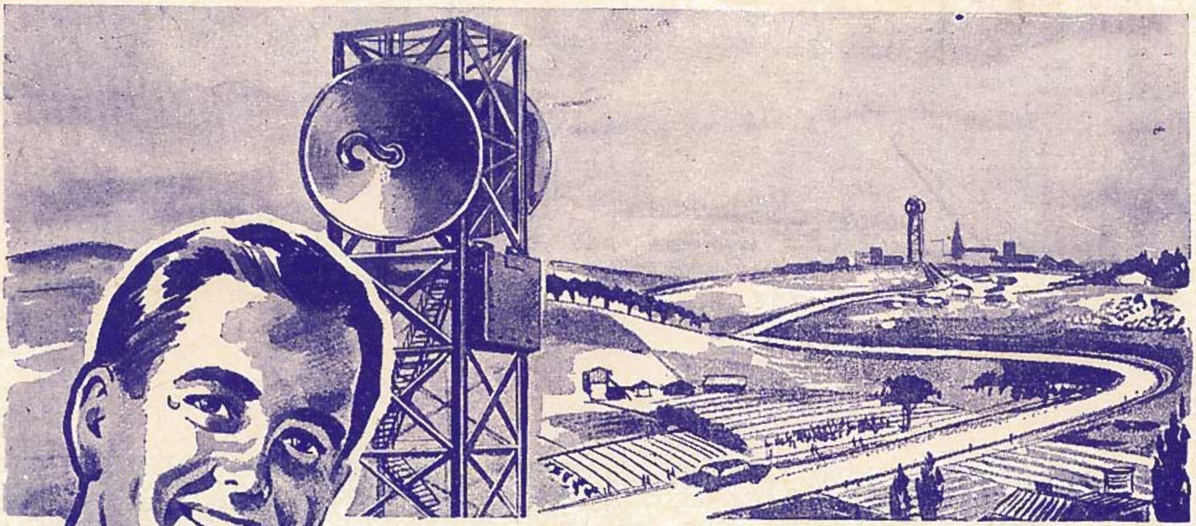

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EDITORIAL

MORE and more are we beginning to realise that Australian TV stations must rely heavily on film entertainment for their programs.

In this their experience is not greatly different from anywhere else in the world. It just isn't possible to have live artists in view all the time, or even for a major portion of the time.

In Australia our live shows have been largely audience participation sessions, children's programs, and a few quiz or panel shows.

But even programs of this type have found themselves on film, because it is often more convenient to do it that way.

It is paradoxical, therefore, that the medium which, above all others, is able to deal with events as they happen, should become possibly the largest single consumer of films.

There isn't fundamentally anything wrong with films, and there is much right with them. In this country, at least, we simply cannot assemble the quantity or quality of performers to equal those of the film producers.

It's a grand thing to encourage and foster the growth of local talent, but if this talent hopes to make a case for its survival, it must produce results at least comparable with those elsewhere.

And this isn't an easy task.

So far, imported film sessions have been of a reasonably good standard. I haven't seen any evidence that the community has suffered morally or in any other way by the high proportion of crime films. Many of these are quite entertaining. The greatest danger as I see it is that the viewer might become bored with so many.

There are plenty of film shows of poorer quality than those we see now.

We must be very sure that extra dollars for extra films will not mean their importation.

Frankly, I don't believe it will.

It is more probable that we will see more feature films, even if some of them are a bit old. Some of the best shows I have seen lately have been programmed between 9.30 and 11 p.m., by which time live-artist shows might reasonably be expected to have been and gone.

And, as we get more stations, so film costs can be shared.

In a country as big and sparsely populated as ours, close co-operation between TV station operators is the only real way to ensure value for our money.

John Moyle

RADIO TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE
S.M.I.R.E. (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS
M.I.R.E. (Aust.)

MAURICE FINDLAY
A.S.T.C.

PHILIP WATSON
A.M.I.R.E. (Aust.)

W. YASHIN

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OUR COVER PICTURE

A photograph of our 5-inch TV receiver taken during its development. The first part of the article describing its construction appears in this issue — more next month.

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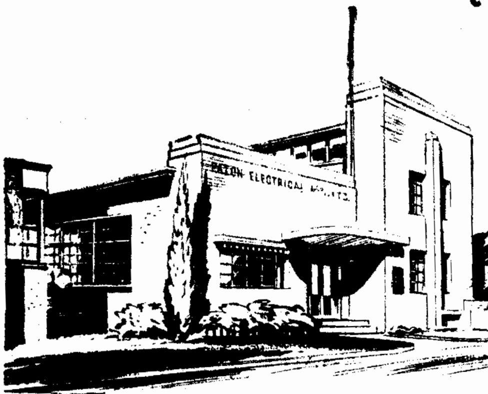

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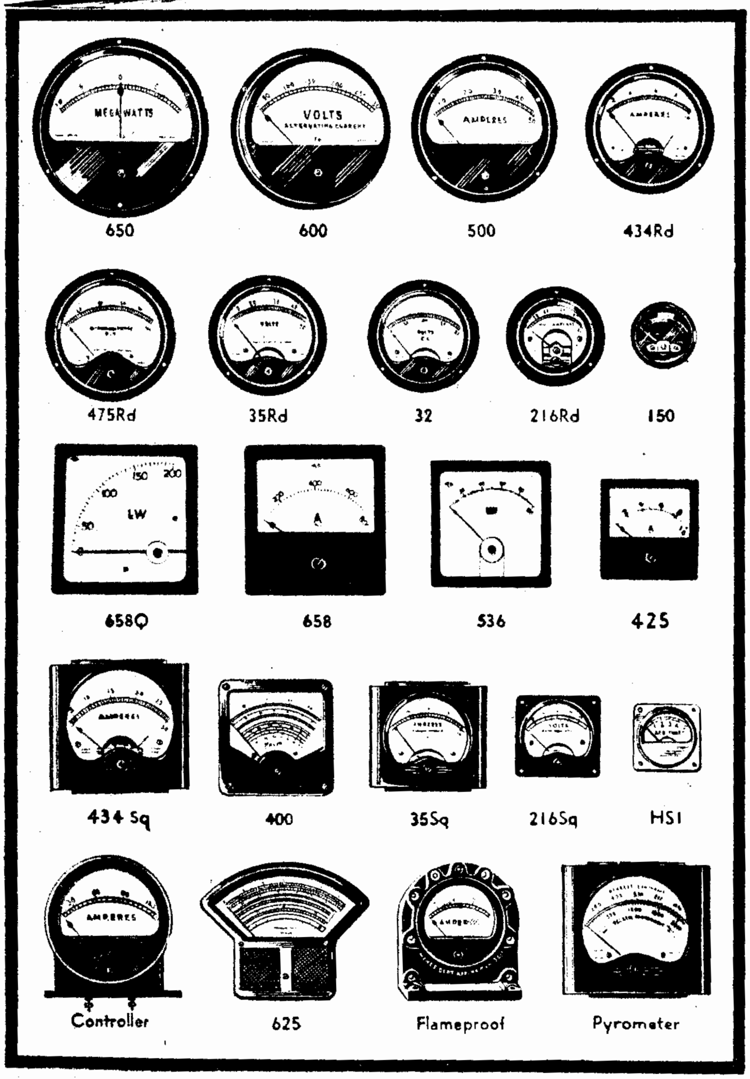

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SCIENTIST FISHES FOR HOT GOLD

RADIO-ACTIVE PARTICLES CHECK RIVER FLOW—Scientific fishing for "atomic" gold particles nets a big haul of information for Standard Oil of California's subsidiary, California Research Corporation. The effects of radio-active gold dropped into the American river a mile upstream are shown being measured by a geiger counter on the end of a fishing line to determine the flow of water which will give information vital in irrigation and land reclamation work. The scene above is at Sutter's Mill where gold was first discovered in 1849.

The Radio Scene 1957

Australia is facing the beginning of a new era in its radio history, one which seems certain to bring about essential and vital changes. These changes are so fundamental that, within a few years, the listening and looking habits of our people will be revolutionised. This is the kind of statement which is easy to make, and is, in part or in whole, being made in many places. But I think this is a good time to examine the position as I see it, and to assess, if possible, what such changes are likely to mean to the broadcasting world.

- **MORE AND MORE TV**
- **LESS AND LESS RADIO**
- **FM BROADCAST STATIONS**
- **MORE NETWORKS**

by **The Editor**

THE thing which has triggered off these changes is, of course, TV. But even without it, I think we were heading for some form of regrouping in the world of broadcasting. There isn't much profit in pursuing this thought now, because TV has so greatly modified anything which might have occurred as to completely dominate the situation.

During our next periods of development, which might be considered on a short term basis to be five years, and on a long term basis as ten years, we can expect a number of things to happen.

DOMINATION OF TV

Few people now have any doubt that TV will within the first period become a dominating influence in our lives. And by that I mean it will affect us, not only more than radio ever did, but more than any other single medium we have known to date.

As a complementary movement to the growing power of TV we must see the decline in the power of radio broadcasting. Not only has this decline been experienced overseas wherever TV has gained ground, but it is an automatic result born of the fact that we can't do two things at once where TV is concerned.

The fundamental thought we cannot escape is that all entertainment and recreation is based on competition for our spare time. Radio was a fairly accommodating thing where this was concerned. We could listen to it with both ears; we could read our newspapers and magazines while it was playing in the background; we could even carry on a conversation against it.

But no one has yet succeeded in doing anything with TV except give it his whole attention. It is fascinating, demanding, all consuming. In the competition for our time, there is virtually no answer to it. We must either take it or leave it alone. And few people, once exposed, have exhibited enough strength of mind to do that.

This competition for time will, of course, offset anything we would have done while looking at TV, such as reading books and magazines. All competitors of TV must, therefore, reconsider their position, and adapt themselves to our changing world of leisure.

The impact of the visual is probably the most potent of all appeals to our imagination. We see this borne out by the picture magazines, the cinema itself, in modern visual education, in the use of colour and form in our everyday life. It is hard to conceive a state of affairs where an audience would sooner hear the broadcast description of a football match than watch it happening on a screen.

In plain fact, while we are watching TV, we won't be listening to a broadcast station.

This inevitable eclipse of our present broadcast system as the major radio influence is not easy for many people to admit.

They point out that, while TV has made big progress in various parts of the world, radio sets are still made and sold in large numbers.

There are two comments one could make about this.

Firstly, TV, despite its enormous strides, is still in a state of intensive development. The pace is quickening every day, so much so that it is beyond the capacity of the average economy to keep up with it.

In the U.S.A., where TV is more highly organised than anywhere else, the era of first-set sales has long passed. TV sets are now being made big enough to rival home movies, and small enough to carry about as portables. Soon they will be available in self-powered form, and it is quite certain that they will become smaller and less complicated. More and more they will cut into the field still left to broadcasting.

Secondly, on a world basis, TV has only scratched the surface of the available market. In England there are something like 6 million receivers, and in the whole of Europe, probably not more than about 4 million.

ALWAYS RADIO LISTENERS

When the potential of users has been reasonably exploited, the number of sets concerned will make these figures look like chicken feed.

I do not mean by this that eventually everybody will use TV and nobody will listen to radio. But I think the implication that broadcasting's domination of the air has ended is so clear that it would be extremely foolish not to meet it.

Despite the comparatively few Australian TV sets now in use as against the total of radio sets, we have already seen several perfect examples of the transferred allegiance of the public from one medium to another.

Radio has starred a number of personalities for many years—Jack Davey and Bob Dyer are two instances. I don't know what mental picture most people had of Jack Davey before TV, but everybody had one. They built it up from his voice and his projected personality.

Most people, when they saw Davey and Dyer in the flesh, were puzzled, disappointed and even disillusioned. This reaction was only partly due to the success or otherwise achieved by these two men, who, like everybody else, improved with experience.

It was mainly a matter of a shattered illusion which had to be born anew.

Now every TV listener has a new picture, a TV picture, of Davey and Dyer, one which lives so vividly as to make the voice alone unsatisfying.

I well remember coming home one evening to hear the voice of Davey in the living-room. Unconsciously I looked around for the TV screen, which was missing.

I heard the voice, but Davey wasn't there.

There are probably good reasons why TV and radio stations find it necessary to double on their shows. But in doing so, they have underlined unmistakably the difference between sight and sound.

They have allowed every TV viewer to see for himself the difference between the substance and the shadow.

During the short term period I have mentioned, there isn't any doubt that both TV and radio will recreate their own worlds.

But if ever the time arrives when it is just as easy to send and receive a picture as it is to broadcast the sound only, and this may well come in the long term period, the position will be different.

It may no longer be profitable to operate radio stations as we know them, except perhaps on a minor scale.

This I freely admit, is mostly conjecture, but I believe the thought is in the minds of every radio executive who is facing up to the future

HOW MUCH ADVERTISING?

It is extremely difficult to visualise far ahead the ability of Australian listeners and viewers to support financially a large radio system. So much depends on how successfully station operators can present their wares, and how our general standard of living will react to the expansion which will go on. But it is certain that finance will pay a vital part, not only in the commercial field, but in the allocation of licence fees as well.

How much advertising revenue can Australia afford for commercial stations? This is a most important question and a most important answer, for on it will depend when, whether, and how such stations will survive.

It is probable that the total impact of radio and TV will increase the total sum which advertisers will spend on the air. But will this sum increase sufficiently to take care of all the present stations plus the array of new TV and broadcast stations we could have in the coming years?

I very much doubt it.

In Sydney, for instance, there are now six commercial radio stations. To these have been added two TV stations, and at some time in the future there will probably be more. If they are all spending to the limit, how can they pay their way?

Australia has more radio stations per head of population than any other country in the world. There are in round figures, 170 stations to serve 10 million people.

This has come about through an admirable desire to see that everyone in the country can receive a program. The A.B.C. has even used short wave programs to reach the outback which otherwise would have very poor service.

But it has loaded very heavily the resources which have to support those stations.

MAY BE FEWER STATIONS

Many of them just cannot afford to have large slices of their revenue and their audience attracted away by any medium, let alone TV.

And the cold fact is that, with so many listeners occupied at the TV screen, all these stations may not be justified.

I think, therefore, that, on a long term basis, we will end up with fewer stations than we have at present.

Just how can we hope to add many TV stations to the air—having started out we must do all we can to justify TV—and, ending up with perhaps a grand total of between 250 and 300, support them all?

It seems a simple elementary sum to me. Either we preserve our present broadcasting stations and limit our TV, or we develop TV as fast as we can and on as wide a front as possible, and face the inevitable consequence of broadcasting's decline.

If cost should ultimately prove to be the deciding factor, and it is in most things, then network operation would appear very encouraging. Networks operate at the present time, of course, but as facilities for communication throughout the country improve, it should be possible to develop them to a far greater extent.

This may call for some re-assessment of the Government attitude towards networks, and in the circumstances, this might well be a good thing.

I think the trend to fewer stations will be evident, in spite of our country's certain growth and potential in the meantime. How these two movements will be co-related should be one of the most interesting things to watch on the long term basis.

It may result in some merging of broadcasting interests and a curtailment of service.

THE FUTURE OF FM

In the meantime, there are important changes looming in the radio field which are very much a short term matter.

I refer particularly to the public hearings which are to be held during August on the granting of FM licences.

I have always held the view that, until TV has been absorbed, we wouldn't be in a position economically to consider FM. But events have moved quickly—we have experienced the passage of time in an accelerated form, and we must make some quick decisions about FM which are likely to be far-reaching.

FM was in the news about 10 years ago as an alternative to our crowded broadcast band. By FM I imply the use of VHF, for many of the benefits of FM are really due to the change to the higher frequencies, where there is more elbow room, and where wide-band transmissions can take place without interference. The absence of very long hops except under special conditions is another good thing about VHF, and allows band-sharing on a much safer basis than at present.

The appeal of FM to broadcast operators in those days wasn't very great. It meant extra expense with no great urgency to undertake it. Techniques were quite awkward and costly in the receiver field, and not nearly as much knowledge or experience existed as it does today.

In my reports from overseas last year, I told how Germany in particular had been forced to VHF and FM because of Allied limitations on its broadcast occupancy, and how it now had a network of hundreds of FM stations doing a fine job.

So effective were these in reducing the terrific interference problem in Europe that it took some time to realise that FM was doing much good on its own account, and giving not only comparable coverage over a primary area, but clearer and noise-free reception as well.

MODERN BROADCASTING METHOD

England is rapidly following suit, and covering the British Isles with VHF-FM programs which eventually seem certain to take over domestic programs.

People now know that simple and very cheap FM receivers can be made to outperform those using the broadcast band, even in mantel form.

And for the growing numbers who appreciate good reproduction of music, similar tuning methods applied to more complex audio systems will give superlative results.

FM, in fact, has now emerged as the modern method of supplying broadcast radio programs.

Its experience in the U.S.A. has been less fortunate, but I am inclined to believe that the radio industry, for its own reasons, did not encourage it as strenuously as it might have done. The investment in radio in that country is quite fabulous, and I do not think FM prospered slowly because it lacked merit.

But even in the U.S.A. it may yet be a force to be reckoned with.

Australia's FM position is unique. There have lately been strong pressures within the Broadcasting Control Board, and from outside as well, to get it under way. This pressure has, I think, been largely from engineers and technicians, and not primarily from station operators, who can see the costs in which they will inevitably be involved if it goes ahead.

And, for the reasons I have put forward, commercial stations are only too well aware of their difficulties, and the fight they have on their hands to preserve their positions.

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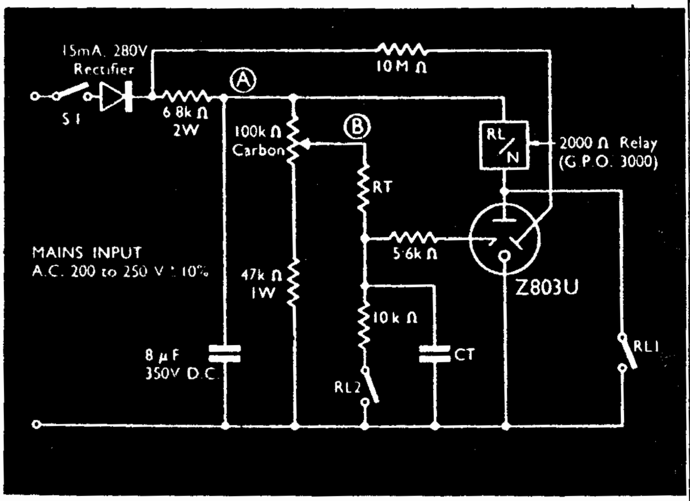

*The **Z803U** trigger tube can be used for a variety of timer, voltage control and general relay applications. It has an extremely stable trigger voltage over a very long operating life and offers the advantages of all Mullard cold cathode tubes — no heater supply requirements, no waiting for "warming-up" and good mechanical strength.*

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The 100kΩ preset potentiometer allows the timing circuit voltage to be set up so as to compensate both for component tolerances and for the value of the local supply voltage. The pre-firing voltage at point B will be about 170 volts.

The values of RT and CT will be set by the required time interval T′, and can be determined from the fact that $T' = 1.6\ RT.CT$.

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The fact remains that public hearings are to commence, and will probably be completed by the time this issue appears. I have therefore no means of knowing what will transpire.

But I must believe that, at these hearings, many people will come forward offering to commence FM services if licences are granted. The Broadcasting Act was recently amended to allow commercial stations to use FM, and one cannot doubt that there will be applications.

The present licence-holders are faced with a serious quandary. Broadcasting is their business; many of them have spent half a lifetime on the air. If anyone offers FM services, they cannot afford to be out of it.

To decline the opportunity would be almost an automatic admission that they were refusing the fight.

DUPLICATE AM-FM CHANNELS

I am more inclined to think that many of them will hold their breaths and take the positive view — that they should be given priority in licence allocation, and permitted to run duplicate channels on FM and AM.

Now to install a 20 kw FM transmitter and its aerial system is not likely to leave much change out of £50,000. This is a big investment for an organisation whose natural tendency would be to husband resources, and not outlay more capital when the outlook is fraught with so much difficulty.

But if it is not done, it seems certain that new operators will be added to the broadcasting scene, all competitors for revenue which is due to be strained to the limit with each passing month.

It is doubtful whether any one man has enough knowledge of what goes on to say with accuracy what the outcome will be. But I will be most surprised if, in the FM stakes, there are no starters.

Many people quote the modest number of listeners to the P.M.G. experimental stations as evidence that the public isn't keen on FM.

ADVANTAGES OF FM

The truth is that these stations have always been publicised, when there has been any publicity at all, as experimental, and rumours have always been in circulation about their precarious future. Nor have they been able to broadcast any of the most popular listening sessions of the day.

Their coverage, too, has in many cases been most impressive.

As a guide to the success likely to follow a properly promoted campaign to sell FM, therefore, I don't think they can supply any reliable evidence of non popularity.

On the other hand the long music sessions presented by the TV stations, during which time they were virtually FM broadcast stations, have been well received in all quarters as entertainment. On a good set, they have sounded really fine.

Has the public anything to gain from the use of FM?

Undoubtedly it has. Properly sited stations can give better initial coverage with cleaner, quieter sound than their present counterparts. Shadow effects will deny a few badly situated people the best reception, but there are probably larger numbers at present whose radio is ruined by electrical noises.

The vast majority will benefit.

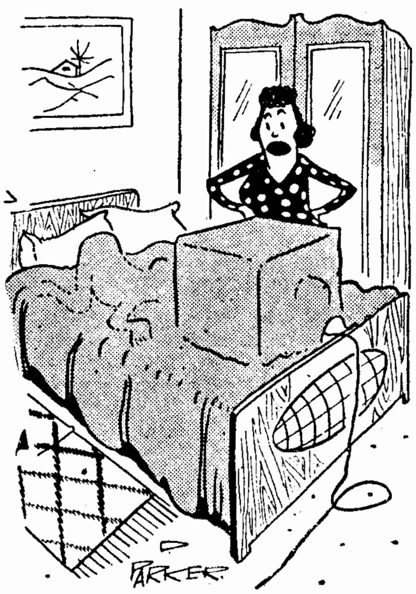
The radio manufacturers would be presented with a new field for exploitation, although it is probable that many of them would groan audibly at the added strain following their TV efforts.

But I cannot see how a new market for equipment, properly exploited, can fail to stimulate a vigorous industry.

And, after all, it isn't so hard nowadays to convince people that FM sound is good. One of the most noticeable reactions to TV concerns its better sound. Few users fail to notice how much better it is than their radio receivers.

And yet the FM standards allow for appreciably better results than those of the TV stations.

All things considered, therefore, how



"Why can't you just read in bed?"

can the broadcasting interests turn their backs on FM for very long? Only if there is a united decision not to do so, on the grounds that broadcasting cannot afford it.

But in so doing, I feel that a vital new field of appeal to the public would be passed over, and at most it would merely delay the inevitable.

In summing up the radio angle of my story, is there any future for broadcasting against the rather depressing picture I have painted?

SPECIAL BROADCASTING FIELDS

Of course there is. My very loose estimate of a five-year short term refers to a period during which TV stations won't be on the air all the time, nor able seriously to attack the huge portable radio field, or the ever-growing car radio field.

This latter alone can be a very big item. I gained the impression that, in the U.S.A, a very large proportion of the populace at any one time was driving its motor cars from point A to point B, and practically all of them were listening to radio.

Australia is well up on the list of the world's car owners. Plenty of them have as yet no radios.

Nor can I ever imagine a household for far into the future where at least one and probably two radio sets were not in use.

Just look at the enormous interest in hi-fi, an interest which continues to grow. It's not confined to the classical lovers, either. A decent FM set, which need not be expensive, and which could easily play through a high-quality amplifying system, would electrify those who imagine that this kind of sound can be heard only from their own pick-ups.

My point is that radio broadcasting is facing a complete re-orientation of its existence, and it will fail only if it does not face up to what this involves.

And after this period of re-orientation has taken place, with all its casualties and opportunities, it should be possible to make for itself a permanent place, although it must now live with a powerful competitor —and colleague if you like—which is destined to take over many of the important matters of which, up to date, it has been the sole owner. This is the real crux of my remarks.

This I believe!

And what of TV?

Obviously it will grow, and by all past standards it is streaking ahead. It has not achieved the astronomic figures some optimists foretold, but it certainly hasn't crawled. In less than one year's operation it has issued over 100,000 sets. When in France last year I found that there were an estimated 250,000 sets in use there, and France commenced its TV nearly as far back as England.

AUSTRALIA'S FAST GROWTH

At this rate, Australia is the fastest-growing TV country in the world. And it won't look back.

I can't believe that TV sets will get any cheaper. Labour costs alone will keep up prices, as will distribution costs and the heavy Government cut out of the price tag. We won't be satisfied until we have a full range of models, and a multiplicity of designs, although completely inevitable, won't cut expenses.

But quality has improved very greatly of recent months. You can now see really good 21in receivers in every store, whereas some of the earliest efforts discounted the large-screen advantages with lamentable performance. You won't see any better sets anywhere than you will in our radio stores.

PROGRAMME APPEAL

One reason TV is going ahead is that the programs for the most part make the viewer part of the proceedings. This is a unique characteristic of Australian radio, not precisely paralleled anywhere in the world.

Our duplicate Government and commercial system is largely responsible for this. If it allows the A.B.C. to pursue a somewhat aloof path, it has encouraged the commercials to really let down their hair. In every country where I have seen purely Government-controlled programs, I have seen good technique, but a lack of human interest.

If I can offer criticism to the A.B.C., it would be that it is still awkwardly self-conscious in its efforts to become an integral part of its audience.

There is still a tendency to imply that the programs will go on anyhow, whether you watch them or not. By contrast, some of the commercials are too free and easy.

I am trying to give out the idea that

(Continued on Page 105)

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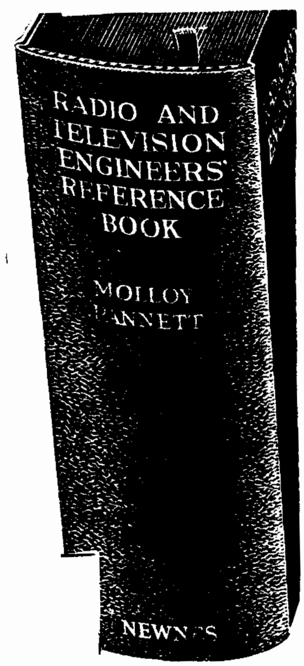

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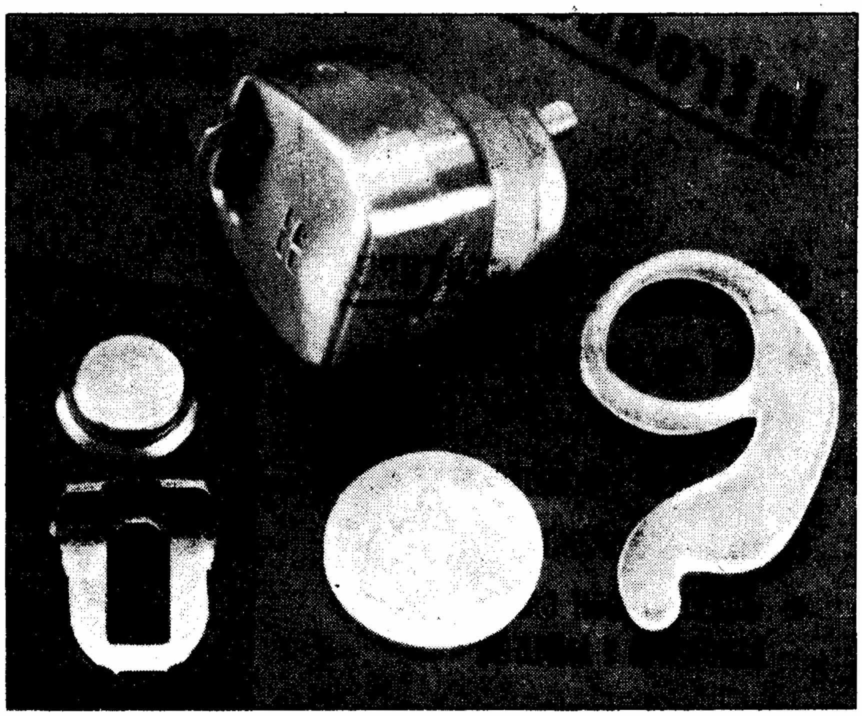
RTRB

A MASTERPIECE IN MINIATURE

The provision of a hearing aid which is inconspicuous, comfortable and economical, as well as efficient, has always presented a challenge to the electronics industry. A recent development by the Sonotone Corporation of America of a completely self-contained "in the ear" aid must be regarded as a major contribution to this problem.



The new hearing aid with its accessories, compared in size with a threepenny piece. The microphone is behind the four small cut-outs on the face of the instrument, with the receiver at the rear. At left is the battery and battery slide (it fits in the opening beneath the microphone) and at the right the soft plastic retainer which holds the unit in the ear.

THE new aid—which is now available in Australia—can only be described as a masterpiece of miniaturisation, even by our present standards. Within a space comparable with that of a conventional earpiece alone Sonotone engineers have managed to pack a complete 3-stage transistor amplifier, a microphone, an earphone, and a battery to operate the whole thing.

MEASUREMENTS

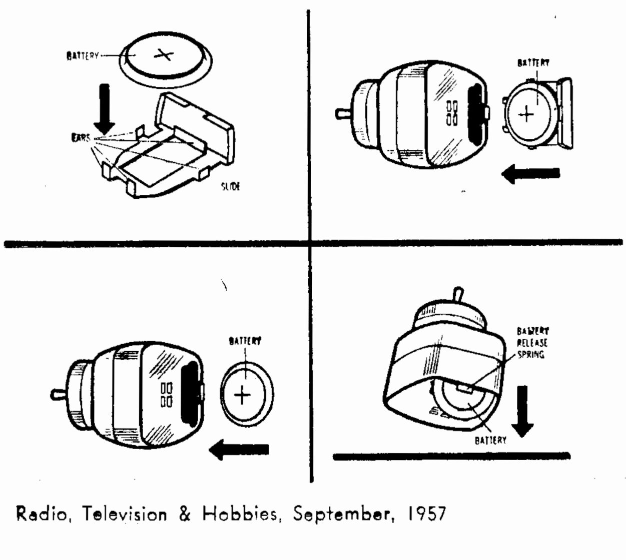
More precisely, the unit is housed in a stainless steel case measuring three-quarters of an inch square by half an inch thick, and weighing half an ounce. This light weight enables it to be held in the ear by means of a soft plastic retainer which slips into the natural folds of the ear. No external wires or fittings of any kind are required.

The unit has a maximum gain of 30 db; a figure which the makers claim is sufficient to accommodate the hearing loss experienced by approximately 40 per cent. of hearing-aid users. There is no volume control as such, but a pre-set control enables the unit to be adjusted for gains of 30 db, 24 db, or 16 db as required. Experience has shown that this range is adequate in practically all cases.

The battery is a single mercury cell, slightly less than half an inch in diameter and approximately one-eighth inch thick. It generates 1.3 volts and will drive the tiny amplifier for 50 hours. Replacement cost of the cell is 3/6, which, in addition to the convenience provided, is still a lower running cost than that of many older type aids.

FEEDBACK PROBLEM

The close proximity of the microphone to the earphone immediately suggests the possibility of acoustic feedback if the gain is made high enough. This is overcome largely by the use of carefully made and well-fitting earmoulds to trap the sound effectively inside the ear passage. It may also account for the gain being limited to 30 db, though further research may enable this figure to be improved.



These drawings give an excellent idea of the unit as well as the manner in which the battery is inserted. Top left is the battery and its slide with the manner of inserting shown on the right. The two bottom diagrams show how the battery may be fitted without the slide if preferred.

Quite apart from the psychological advantage of being inconspicuous, the new design has a number of more practical advantages. One is that the microphone is placed in the most logical position—right at the ear itself. This places it more favourably for speech pickup than on the chest, eliminates clothing noise, and provides a measure of directivity which can be controlled by the position of the head.

Most important, however, is the fact that, for the first time, a binaural hearing aid becomes a practical possibility. This has long been advocated by progressive authorities on deafness, who realised that the user's inability to distinguish between wanted and unwanted sounds was a major limitation in the successful use of hearing aids.

TIME AND PHASE

This inability stems from the fact that, with normal hearing, we use the time delay and phase difference which exists between sounds reaching our two ears to place the direction from which the sound reaches us. This enables us to differentiate between wanted and unwanted sounds.

The new aid enables a deaf person to approach this condition by using a unit in each ear, and extensive experiments are now being conducted to determine just how much benefit various

(Continued on Page 105)

MAN MADE—HARDER THAN DIAMOND

Proudly displayed to reporters some weeks ago were a few specks of what may be the hardest substance in the world—cubic boron nitride, or borazon (from boron and azo, which refers to nitrogen) for short. Through a magnifying lens, viewers saw rocklike particles of mixed tints: white, yellow, red, brown, grey, black. Only a few grams of the man-made material, a fraction of an ounce, exist to date. But if it can be mass-produced, at reasonable cost, it will work wonders in industry.

FOR borazon is called "certainly as hard as diamond, probably a little harder," by Dr. C. G. Suits, General Electric Company's director of research. Both to scientists and toolmakers, that claim makes astounding news.

Unchallenged until now, the diamond has been the king of all hard substances. That's why costly and "strategic" indus-

"Lapping test" clinches the proof that borazon is as hard as diamond. It compares rate at which borazon and diamond dust, on revolving wheel, grind away a measured diamond on arm above.

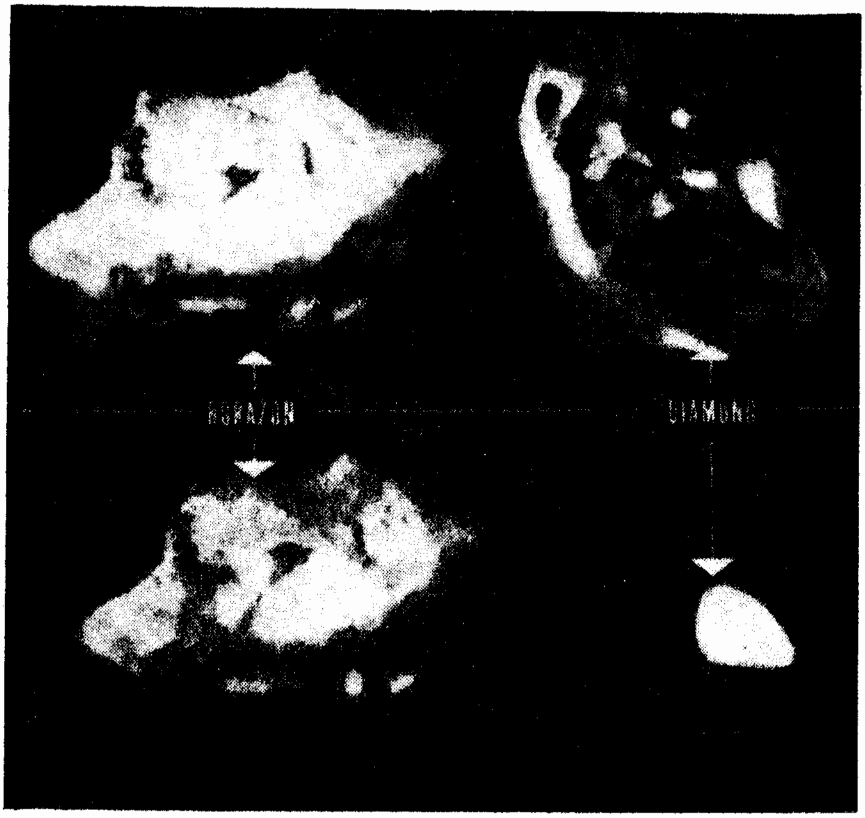
trial diamonds, imported literally by the ton from Africa and Brazil, are set in the tips of the tools that cut and shape the hardest modern alloys.

Nothing even approaching the diamond in hardness has been known before. In fact, scientific arguments have been offered in print, "proving" that nothing else could possibly be as hard as a diamond. Now Dr. Robert H. Wentorf jun., young G.E. physical chemist and creator of borazon, has accomplished the "impossible" by making such a substance.

EQUAL HARDNESS

Simplest evidence of his feat is the familiar scratch test for hardness. Traditionally, "only a diamond can scratch a diamond." But borazon and diamonds scratch each other, showing their hardness to be practically equal.

To measure more precisely the relative hardness of two substances at the very top of the scale, a "lapping" test compares the rates at which borazon and diamond dust can grind away a measured diamond. By a narrow margin, borazon appears superior in hardness.



Superior heat resistance of borazon, hard as diamond, is shown in highly magnified photos. In top view, borazon and diamond are placed on platinum ribbon, electrically heated to 2,000 degrees F. Lower view, $2\frac{1}{2}$ minutes later, shows diamond burning up. The borazon remains intact.

Far greater is borazon's superiority over diamonds in resistance to heat. For industrial tools, which get hot in use, this is a big advantage. Borazon should permit faster production without risk of damaging valuable tools.

SAME FORMULA

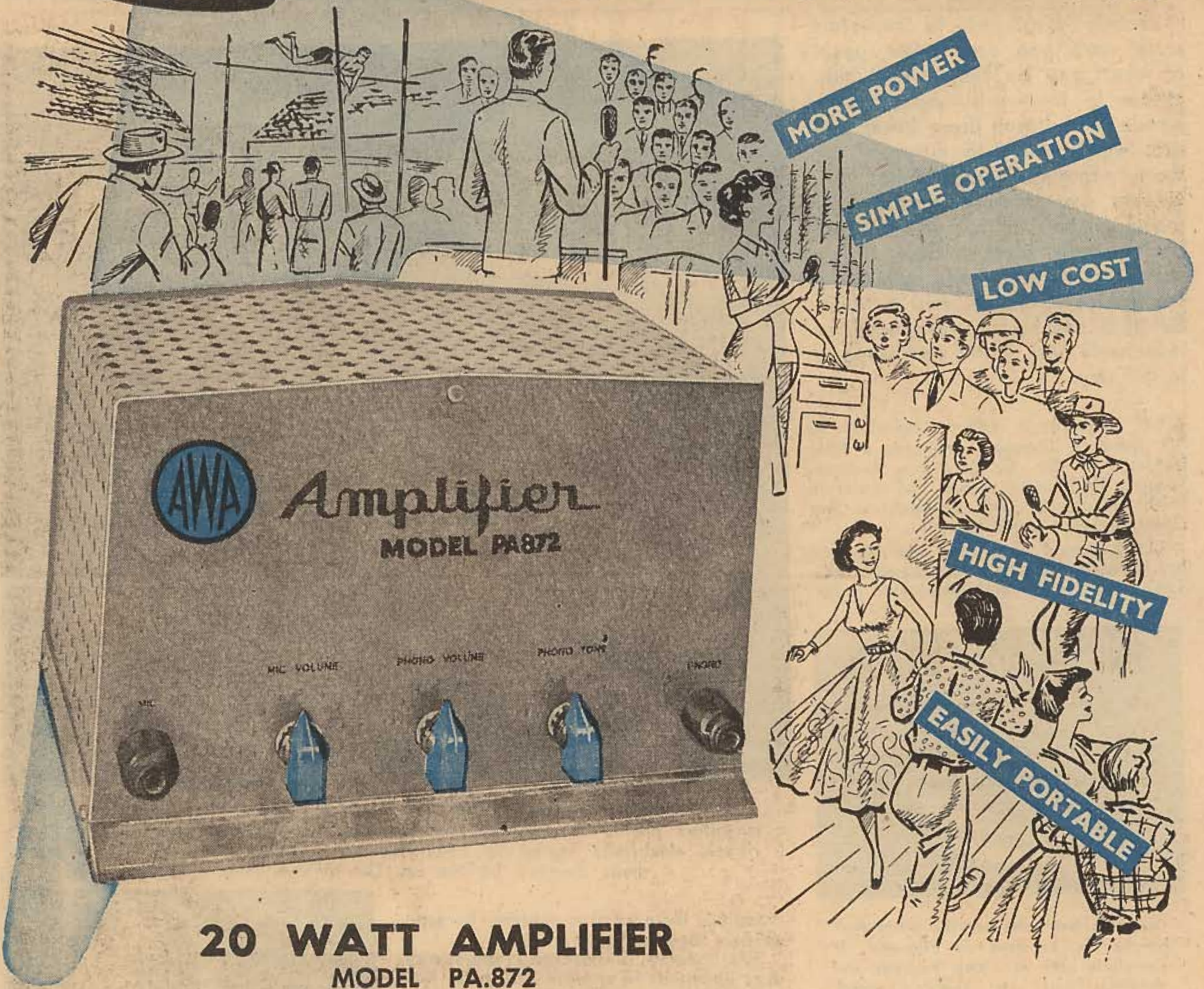
Just as hard diamond and soft graphite both are carbon, so hard borazon and the ordinary soft and white form of boron nitride have the same chemical formula, BN. Each is a solid compound of boron and nitrogen, the two elements that straddle carbon in the chemist's periodic table; and what makes all the difference is their crystal form.

As in graphite, the atoms of ordinary boron nitride's "hexagonal" crystals form loosely joined layers, sliding easily upon each other. As in diamonds, atoms that make up borazon's "cubic" crystals are locked together in a tight, compacted block.

Unlike the diamond, borazon doesn't exist in nature. So Dr. Wentorf didn't know, when he began, if it could be made at all. Just how he did is still his firm's trade secret. But General Electric reveals that the method uses a temperature of 3,000 degrees F. and a pressure of about a million pounds to the square inch.

Dr. Robert H. Wentorf Jr., 30-year-old GE physical chemist who accomplished what theorists had called "impossible," examines a few grains of the diamond-hard borazon he created.

AWA FOREMOST IN SOUND



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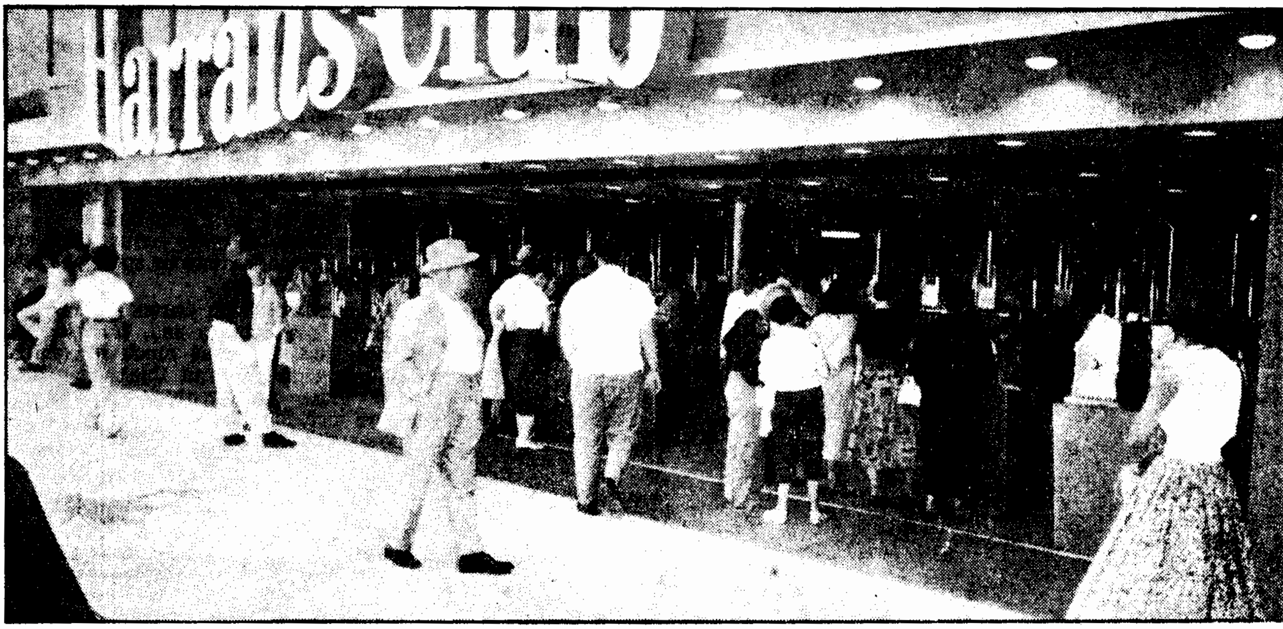
THIS BUILDING HAS DOOR OF AIR



UNIQUE AIR CURTAIN

This building in Reno, Nevada, has no door in the normal sense, despite the thousands of dollars which were spent on it. Yet it keeps out the weather, winter or summer.

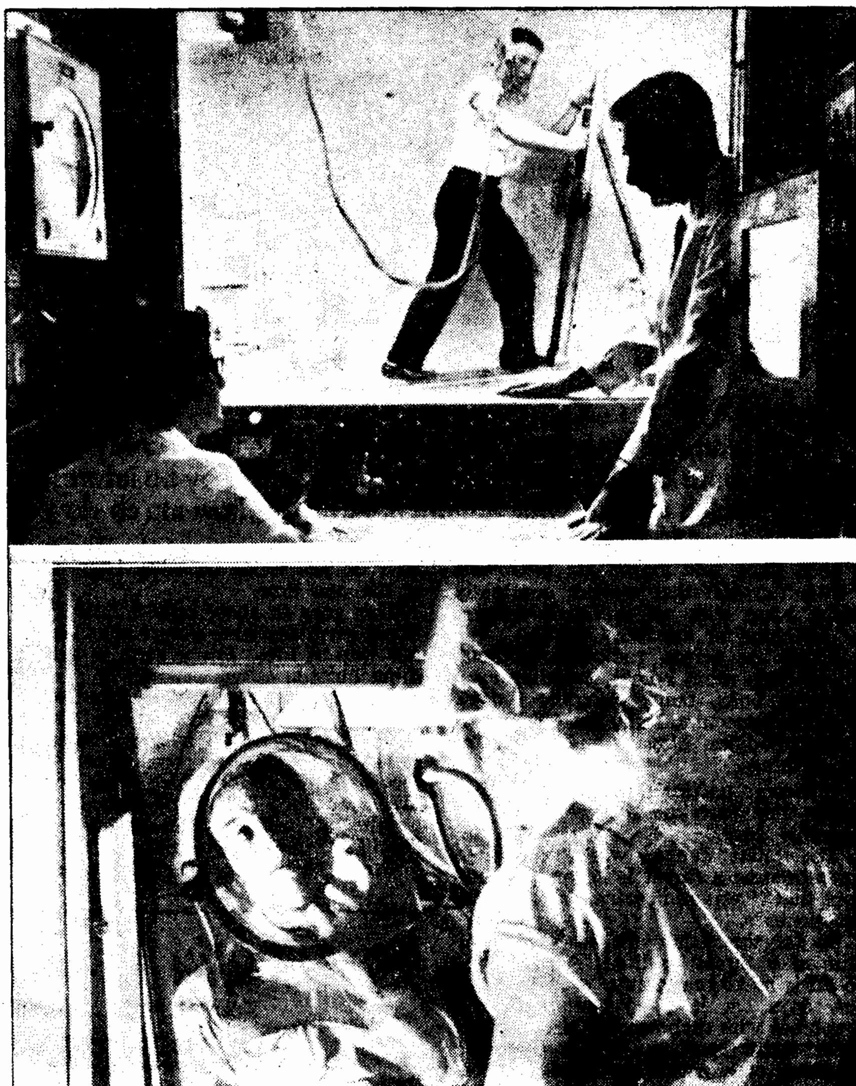
THE door is replaced by a 41ft long air curtain estimated as having cost over one thousand dollars per foot.

A wide jet of air comes through the vents above the entrance, and is drawn out through the grating over which all who enter must pass. The building is air-conditioned, and the curtain isolates the interior from the outside air.

It automatically adjusts itself to temperature, air pressure and wind velocity, keeps out stray insects and discourages stray dogs from entering.

A conventional door is not required, because Harrah's club is open day and night.

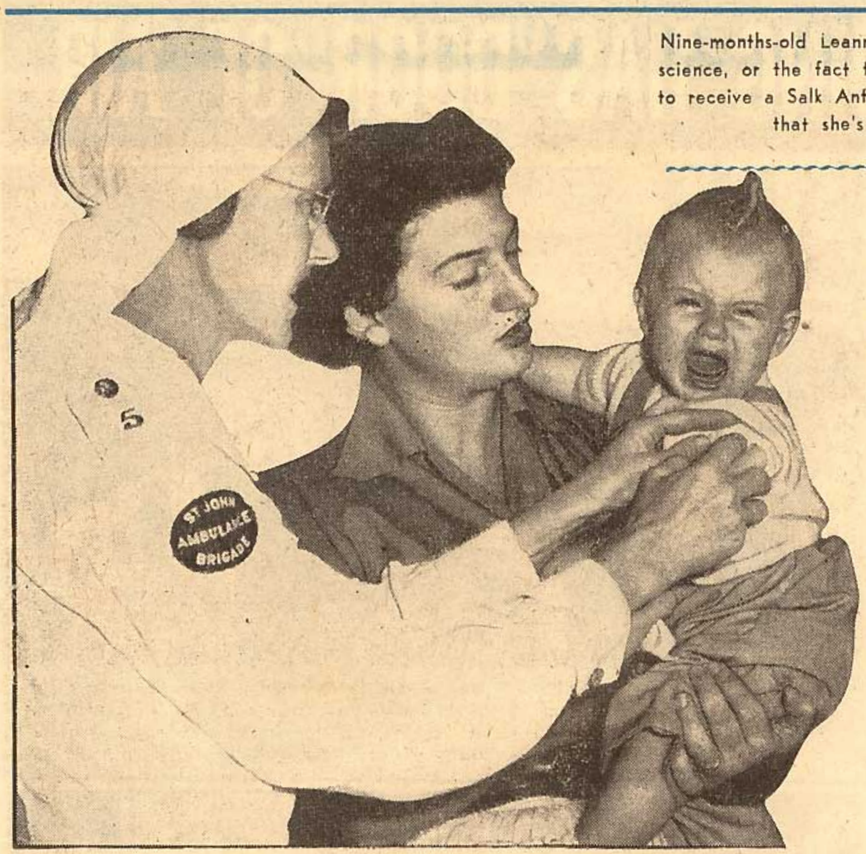
The owners find that more people will enter the premises when there is no need to use a normal doorway.



LIFE IN A FISH BOWL

THIS volunteer for research at the National Institute of Health, Minnesota, is undergoing constant observation for 24 hour periods in a metabolic chamber. In his private fishbowl, he wears a plastic helmet at all times, even when eating and sleeping during the tests. The helmet catches his expired air which is analysed for correlation with other tests.

Top picture shows him exercising on a treadmill while scientists watch. Bottom picture shows him shaving under his helmet.



Nine-months-old Leann Warbrook isn't the least bit interested in science, or the fact that she was the millionth child in N.S.W. to receive a Salk Anti-poliomyelitis vaccination. She only knows that she's scared, and the needle hurts!

A Virus is to Blame For This, Sonny!

Have you had an attack lately of Asian flu? Or a cold? Or poliomyelitis? Or perhaps you've had a bout of boils? If such is the case, you may be interested to read about the little "wogs" which caused your affliction. After all, how much do you know about such things?

by Calvin Walters

ONE thing that makes life interesting is the fact that we are constantly being beset with all kinds of dangers of one kind or another.

There are germs, radioactive fallout, scares from atom bombs, speeding cars, lightning bolts, faulty electrical fittings, taxation inspectors, leaky gas pipes, politicians, bodgies, blondes and a host of other things.

If it were not for these we would not be on the alert and life would be unbearably easy.

The latest danger which seems to have become a threat is Asian flu. Before that it was radioactive fallout from atomic tests.

So far the Asian flu has not constituted a threat to life. All it seems to do is make one pretty "groggy" for a few days but it is so contagious and it spreads with such rapidity that it could quite easily upset the whole economic structure of a nation by causing thousands of people to be away from work at the one time.

This goes to show how a little thing *like a germ* can have a vast influence on our way of life. For a germ is a little thing indeed.

How tiny it is can be deduced when we consider that a germ of the disease Typhoid fever is one twelve thousandth of an inch long by one twenty five thousandth of an inch thick. It is shaped like a rod and, like all rod-shaped germs is called a "bacillus" from the latin word "bacillum" meaning a rod or staff.

Other germs are spherical in shape and are called "cocci" (pronounced "cock-eye" but having nothing to do with a defect of vision pronounced the same way). The germ which causes boils is a coccus (the singular of cocci). If a man has a boil you wouldn't say he has a cocci, for you would be misunderstood if his eyes looked all right. You would just say he has a boil.

Then there are other germs which are shaped like corkscrews or springs. These are called "spirilla".

The fellow which causes ordinary influenza is a bacillus and, for his size, causes just about as much discomfort as any germ you can think of. It is just under one twenty-five thousandth of an inch long and less than one fifty-thousandth of an inch thick.

NOT VERY LARGE!

Harking back to the typhoid bacillus, you can get some idea of size if you could catch a number of them and lay them end to end alongside a safety match. You would require about thirty-seven thousand of them to span the length of the match and three thousand to span the width with their longer dimensions parallel.

When it comes to weighing a bacillus then, of course, we get down to minute measurements. Somebody has taken the trouble to calculate the weight of a typhoid bacillus and has found that fifteen millions of millions of them would weigh one ounce.

There are other smaller "germs" which have been named viruses and these are much smaller again than the influenza bacillus. It has not yet been established with certainty just what a virus consists of. It is known to cause terrible afflictions and can be isolated from other germs. It has, however, very different characteristics from ordinary germs and is thought to consist of some kind of protein matter.

Most of us know that germs multiply by division. First we have one germ. This divides in the middle and makes two germs. These divide in the middle and make four germs and so on. The mathematics which can be brought into this are fantastic.

Say we start with one germ and that it divides in two every fifteen minutes, which is average. So at the end of fifteen minutes we have two microbes. In thirty minutes we have four. In 45 minutes we have eight and in an hour sixteen. At the end of two hours we have a tribe of 256 microbes, whilst in three hours time we have more than four thousand. In four hours we have more than sixty four thousand so that in 24 hours there are ninety-six generations of microbes each of fifteen minutes duration.

Now for the full works. If you like calculating such things it will be found that the number of microbes which will develop from a single germ in 24 hours is 8 x 10 to the 28th which comes out to 78,700,000,000,000,000,000,000,000,000.

Now that is a sizeable number and needless to say if these got into you you would be "deader 'n dead" in no time at all.

Fortunately for us this theoretical number is never realised. Something always comes up to stop it just as something always comes up to stop a punter at the races from doubling up all the time on his bets in order to recoup his losses. Very often this is shortage of money or the wife or a pistol or overdose of sleeping tablets.

LIMITING EFFECTS

After multiplication has taken place for a time, the microbe sets about trying to defeat itself as it were. It creates by-products which, while incidental to its growth, are inimical to its multiplication.

Then again such large numbers of microbes must have plenty of "tucker" and there comes a time when there is not enough to go round. Other microbes, too, come into competition and a sort of a war goes on.

Of course our bodies are not inactive either during this uproar inside us, when we become infected. Our blood stream immediately takes action and puts up a defensive. The white cells of our blood stream has a vast appetite for germs and immediately one enters and settles in any spot large numbers of these cells called "phagocytes" are sent to the spot to try and devour the invader.

If the phagocytes do their job properly, the germ is defeated but, if the germ gets the upper hand, then things are bad and we get sick.

We then send for the doctor and he gives us one of the "wonder drugs" and most likely this settles the microbes and we get well again.

CAUSES INFLAMMATION

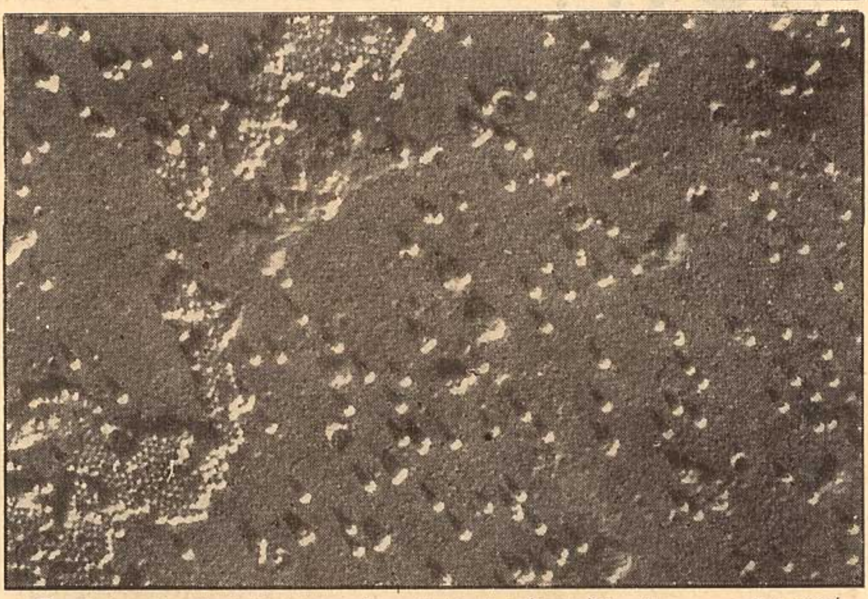
This war which goes on inside us between the germ and the phagocytes of the blood is often evidenced by a swelling and redness of the "battlefield." This is particularly noticeable around a boil or infected wound. It signifies a vicious battle going on and is caused by the large number of phagocytes which congregate around the site of the trouble.

Sometimes the microbes, which cause us to be ill, leave behind them certain substances which prevent their kind ever again getting a hold on us. It might be more correct to say that the microbe causes our bodies to generate protective substances against a further invasion of the same kind of microbe.

When this happens we are what is called "immune" to that particular disease.

Strangely enough this immunity is not conferred upon us by all germs. It is acquired for such disease as measles. whooping cough, scarlet fever, poliomyelitis, mumps and a few others. Sometimes we are naturally immune, that is, for some reason, we cannot "catch" one of these disease although, to our knowledge, we have never had it.

FIRST PICTURE OF POLIO VIRUS



The first authenticated picture of an isolated poliomyelitis virus, one of several photographs shown before the Electron Microscope Society of America gathering at Pocono Manor, Pennsylvania. The oval objects, in clusters and singly, are the virus, magnified 77,000 times. Indentations and larger swollen spots are on the surface of the background materials

The words "to our knowledge" are significant in this case for we never know, when we feel out of sorts, that we may have a very, very mild attack of one of these diseases, and thus become immune to them.

It has been suggested that the incidence of epidemics of poliomyelitis has been effected this way. During epidemics many young people suffer very mild attacks of the disease. These are characterised by pains in the limbs and fever, both of a mild nature. These symptoms, a mild attack of polio, quickly pass and are sufficient to immunise those who have suffered them.

This reduces the severity of the epidemic for a few years, during which

Assistants at the Commonwealth Serum Laboratories, Melbourne, drilling holes in eggs for the production of influenza vaccine. The vaccine is prepared from a virus taken from influenza patients in Singapore and injected into a partly incubated egg.

period a new generation of non-immunised children arrives and epidemics take on a more severe character.

Germs which cause most diseases are known as "pathogenic germs". They may be pathogenic bacilli or pathogenic cocci but are generally known as "pathogenic bacteria."

Like all germs they require a living host in order to perpetuate themselves by multiplication as described earlier.

Pathogenic bacteria usually force entrance to the human body by means of the digestive or respiratory passages.

In order to give an idea of how easy it is for one of these criminals to carry out his or her insidious work, the typhoid bacillus is a good example of a germ which enters through the digestive tract.

These bacteria usually come from milk, water, food, flies or fingers which have been infected somehow from a case of typhoid fever.

VULNERABLE PATCHES

Inside the small intestine of the human body there are peculiar patches of tissue called "Peyer's patches" which have a peculiar vulnerability to attacks by the typhoid baccilus. Why this is so is a bit of a mystery because, like the whole of the wall of the intestine, these Peyer's patches offer strong resistance to the penetration of the ordinary bacteria found in the intestines.

However, after repeated onslaughts the typhoid bacteria, for some reason, manage to penetrate these patches while they fail to penetrate elsewhere.

Having broken through the patches the bacillus enters the bloodstream where the processes described earlier begin to operate.

If the body defences succeed against the invasion, the patient gets well and his bloodstream is well fortified to defend itself against further invasion for it is rare that the patient becomes infected a second time.

However, even while the body is preparing itself against the invader, the latter is taking steps to carry out an offensive in another victim. It is multiplying in the first victim, escaping from the ulcerated Peyer's patches and maybe the gall bladder, and passes to the outside world to be carried about in the same manner as previously, namely through infected milk, water and so on.

TYPHOID EPIDEMIC

Thus a typhoid epidemic can run like wildfire through a whole community in a very short while. Thanks to modern sanitation and organisation on the part of authorities, typhoid epidemics are rare. They sometimes occur as an aftermath of earthquakes, floods, hurricanes and other disasters where sanitation has been destroyed or disrupted.

Influenza, including the latest Asiatic type, pneumonia, bronchitis, tuberculosis and a host of other diseases enter the system through the respiratory tract.

The respiratory tract is a vast system of channels which start at the mouth and nose down through the windpipe and into the lungs through a system of channels which constantly narrow and branch to a series of tubes called bronchi. They terminate in thousands of fine tubes which supply and remove the air from small sacs called "alveoli."

FULL-SCALE WAR ON POLIO VIRUS

Used polio needles by the thousand come back to Red Cross Blood Transfusion Headquarters to be checked and sharpened ready for recharging and re-issue. Authorities claim that Australia has virtually beaten the polio threat and leads the world in so doing.

It has been estimated that the combined area of the latter is about 90 square yards.

Down from the outside of these passages the inside wall of the tubes are provided with short hair-like protruberances called "cilia." These move in a rhythmic manner but in such a way that there is a thrust upwards and outwards towards the mouth. It is like a man rowing a boat. The end of the stroke is the one which propels the boat whilst the back stroke has no force.

The purpose of the movement of the "cilia" is to throw out any solid particles which may enter the respiratory passages. Bacteria are thus normally kept out of the lungs.

Under certain conditions the cilia become sluggish, if not actually paralysed. Cold is one of these conditions. If the body becomes chilled the cilia cease to do their job and bacteria can enter the lungs.

GETTING A CHILL

It follows that, when the body is chilled, its resistance is low and it cannot put up the fight against the invader necessary for it to overcome the infection. We then "catch a cold" which may develop into bronchitis, pneumonia, tuberculosis and so on.

It is from here that we enter the matter of "droplet infection." We hear so much about this. We are warned to cover our mouths when we cough or sneeze so that we won't infect the air and so pass on the disease to others.

One sneeze or cough is enough to spread infectious germs over a very large area. This has been proved by a crucial experiment.

There is a harmless microbe called Bacillus Prodigiosus which will grow prodigiously (hence the name) on many organic substances.

To carry out the experiment a small amount of this bacillus was taken into the mouth of the experimenter who stood at one end of a room. Scattered about the room at various places and levels were plates of sterile gelatin. Previous tests showed that the air contained none of the particular germs in question.

HE SNEEZED!

The experimenter now coughed, talked and sneezed. How he was induced to sneeze is not stated. However, he did.

After a few hours, spots of the Bacillus Prodigiosus were beginning to form on the gelatin plates 40ft from where the experimenter stood. All the plates in other parts of the room also grew the bacillus and in one case the bacilli were taken by a current of air through a hall and up several flights of stairs.

Swabbings taken from the noses and mouths of others in the room revealed the presence of this particular bacillus.

To prove the transmission of droplets from the mouth of a person during a cough or sneeze another method was used.

There is a chemical called phenolphthalein used in chemistry as an indicator for testing whether anything

(Continued on Page 105)

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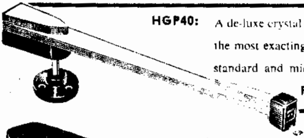

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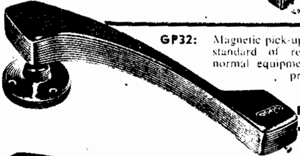

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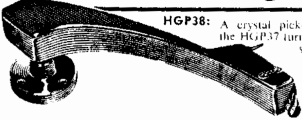

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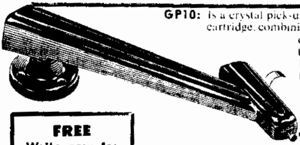

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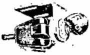

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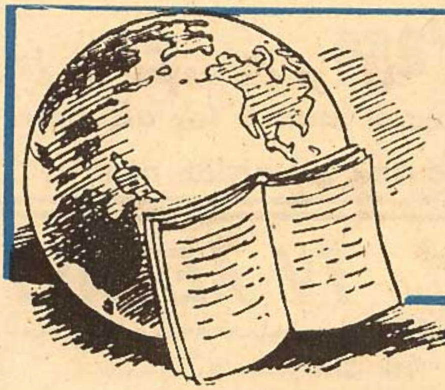

Technical Review

SPOT WOBBLE FOR BETTER DETAIL IN NEW TV TUBE

One defect of the conventional TV system is that the sharper the focus, the greater the danger of the line structure becoming visible at normal viewing distances. "Spot Wobble" was used to some extent in England some years ago, and is now being considered in America, whose 525 lines is the lowest definition system in the world after Britain's. This extract tells of a new approach to the problem.

If we could somehow blend the scanning lines together without sacrificing sharpness, that is, if we could increase the size of the picture without having the viewer move still farther back—we could find acceptance for larger picture tubes.

This may be done by spreading out the spot size in the vertical direction only, to fill in the conspicuous black areas between raster lines. Retaining the narrow spot width at the same time would avoid the sacrifice of any inherent detail. Accomplishing this general purpose by spot wobbling techniques has been known for years in the laboratory and is in actual use in some parts of the world.

WOBBLER TECHNIQUES

Some countries in Europe have TV transmission standards involving fewer lines in the raster than we use, with the result that the separation problem in respect to these lines is considerable when the attempt is made to use the 21-inch picture tubes that have become accepted here.

Wobbler circuits are used in some foreign receivers to overcome this problem. In essence, the wobbler is an oscillator whose output is used to deflect the scan lines so that, instead of tracing straight across the tube, these lines wriggle up and down in a sine-wave path. If a high wobbling frequency is used, the individual oscillations crowd together so that, instead of discreet cycles of oscillation, we get the impression of a thicker line.

Traditional means of obtaining spot wobble have involved considerable increase in the cost of the receiver, including the expense of an added winding around the neck of the picture tube, to which the wobble signal is applied. Also, there has been the problem of self-generated interference radiating from this coil.

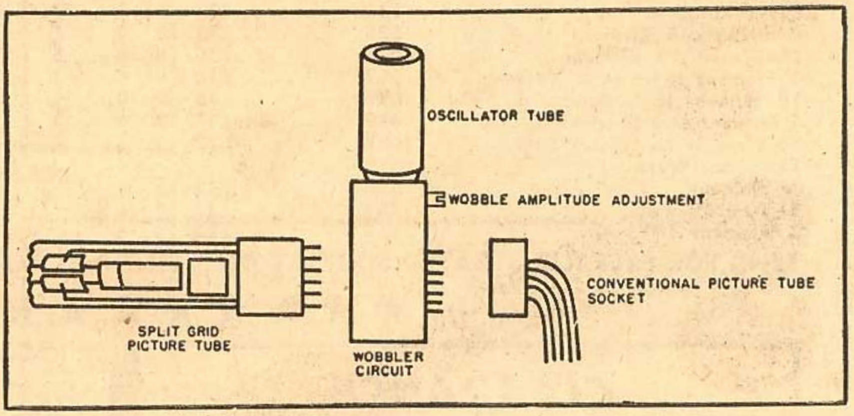

Fig. 3. The complete wobble oscillator circuit can be built on a plug-in sub-chassis to fit between the CRT and its socket. The socket provides voltages.

To overcome these drawbacks, engineers started out with the conventional low-voltage, electrostatic-focus picture tube, of which the 21AUP4 is an example.

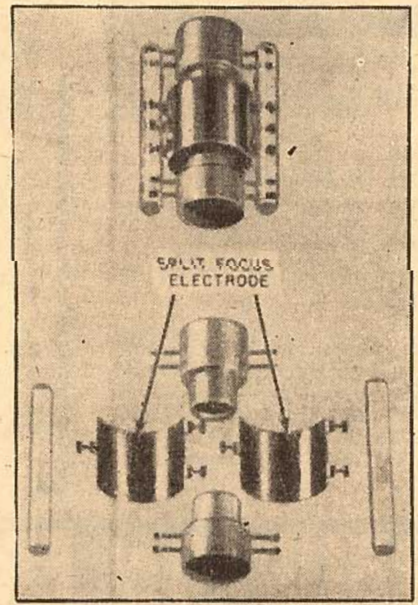

Fig 1. Exploded view of gun structure for conventional low-voltage electrostatic-focus picture tube, except that the focus electrode has been split into two parts, as shown, for the addition of an r.f. signal to produce scan wobbling.

Francis T. Thompson, of the Westinghouse research laboratories, suggested the use of a split focus grid as a simple method of setting up wobbling. The modified gun structure, developed by Eros Atti and J. A. Hall of the manufacturer's tube division, is shown in Fig. 1. As this exploded view shows, the cylindrical focus electrode has been split in two.

GUN STRUCTURE

In other respects, the gun structure is conventional. Separate leads are brought out from each half of the split electrode through the base of the CRT for application of the wobble signal.

Acting as a single unit, the two halves of the focus electrode continue to control focus in the conventional way. Acting separately, they form a push-pull pair to which the additional wobble signal is applied to swing the beam rapidly up and down.

The simple oscillator circuit of Fig. 2 was used to provide the wobble signal. While exact frequency is not critical, the circuit shown provided output at about 25Mc.

Since this is more than 1,500 times the scan frequency for each raster line, individual wobble cycles were not visible on the screen.

The coil in the tank circuit was wound in a form ¾-inch diameter. Eleven turns of closewound 17 gauge wire were used, with a centre tap for introduction of the normal focus voltage. Value of the potentiometer in the

(Continued on page 23)

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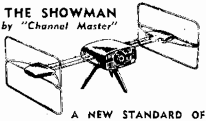

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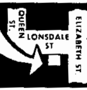

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RADIO COMPONENTS WORK AT 500 DEGREES CENTIGRADE

Steady progress is being made towards the product design stage of electronic subassembles capable of operating in the 500 degree C range. Although such assemblies are not as yet off-the-shelf items, specialised circuits for particular applications can and have been built. Resistance to both high temperature and nuclear radiation is demonstrated by the new components and subassembly approaches.

COMPONENTS are available now in America for the production of basic circuits such as amplifiers, multivibrators and clippers capable of operating satisfactorily at 500C. These components are in general prototypes of what will eventually follow.

It is certain that present designs will be refined and desirable that they be standardised. With time, the limitations and gaps will be filled. Perhaps it is significant that valves, which might seem to be the most difficult components to design for high temperature, are in fact the most highly developed at this time.

VALVES AT 500C

A number of valves capable of operation at 500C are in various development and pilot production stages for defence applications. These generally use titanium and a thermally matching ceramic in stacked co-planar construction. Connections may be made to the valves by socketing, by direct spot-welding or by brazing wires to the tube electrodes.

The new high-temperature valve line-up so far comprises a medium-mu triode, a high-mu triode, a defence applications UHF RF amplifier and a power triode with a 12.5 watt plate dissipation capacity. The specific external shape of these new valves is not yet finalised. It is expected that the final design will provide for multiple-point mounting directly to a printed wiring board. This construction will extend the inherent ruggedness of the valve to the sub-assembly.

RESISTORS

Resistors capable of operating at 500C are already available in sample quantities for experimental use. One type uses a resistive film deposited on the inside of a hollow ceramic tube. The resistor is sealed by using a metal-ceramic sealing technique at high temperature and low pressure. Resistor values above 1 megohm are available. Although new and improved resistive films are under development, the presently-available resistors exhibit a negative temperature coefficient which varies with resistor value much as in Figure 1.

A temperature coefficient of 0.06 pc/degree C is not uncommon for a 250K carbon film resistor, and this represents a 29 p.c. change in resistance for a temperature rise from 25C to 500C.

The effect on gain of such resistance changes can be reduced by using large amounts of feedback and this will surely be the technique used for the time being. Meanwhile, extensive efforts are being made to reduce the temperature coefficients of high value resistors.

Other research is being aimed at development of badly needed carbon film power resistors (about 10 watts), resistors in the 10 meg. range, high frequency resistors, precision resistors, variable resistors and potentiometers for operation at 500C.

At present, capacitors for the 500C range are in pilot production, based on a stacked mica design. This utilises 1-mill stainless steel electrodes, phlogopite mica splittings for the dielectric and stainless steel leads. The present case provides mechanical protection and mounting provisions, but not a hermetic seal.

Capacitors are available in sizes from 0.001 to 0.05 uF at a nominal 250V DC rating. Typical electrical characteristics are: 60 c/s power factor at room temperature 3 pc; 60 c/s power factor at 500C 40 pc; change in capacitance from room temperature to 500C, plus 33 pc to 60 c/s—as shown in Figure 2.

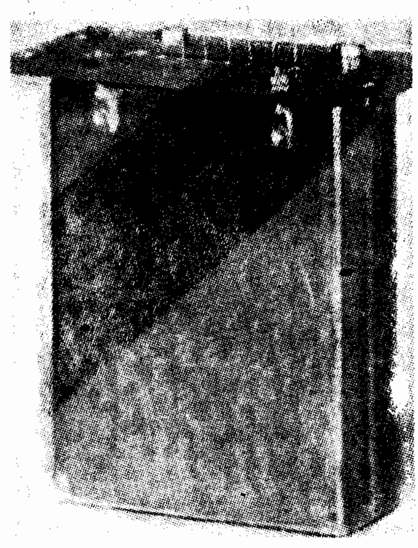
COUPLING CAPACITORS

For plate coupling and grid blocking applications, DC and low-frequency leakage resistance is a problem in high temperature capacitors. Essentially, the difficulty is one of keeping the plate supply voltage of one stage off the grid of the next.

Figure 3A illustrates the problem caused by leakage through the plate coupling capacitor. One way of getting around the problem is to use another capacitor resistor network as in Figure 3B. If the capacitors are not larger in the second case, low frequency response will be sacrificed.

Another need in the high-temperature capacitor line is for large-value high-voltage capacitors. Until one is developed, such basic units as DC power supplies will be difficult of achievement. The same capacitors are needed in screen bypass and cathode bypass applications. One special requirement here is resistance to nuclear radiation. In resistors and valves this is achieved naturally because of the nature of the materials used.

Frequency controlling and variable capacitors of any kind are also needed, although at first glance it would appear



Subassembly encapsulated in alumina sand has high resistance to shock, vibration and nuclear radiation along with 500 degree centigrade rating. Component leads are welded to wire terminals cemented into holes in ceramic chassis.

to offer less of a problem, particularly where air is used as the dielectric.

Few, if any, inductors are commercially available. Development engineers having need for inductors usually wind their own from silver or aluminium wire. Air cores have been used mostly, although certain magnetic materials and ferrites are useful at 500C. Although power and high-voltage transformers have not been produced, filament transformers using ceramic-insulated copper conductors and iron cores have been successfuly built and tested.

HOOKUP WIRE

Hook-up wire for high-temperature circuits should not be a problem for single uninsulated conductors. A ceramic-coated copper wire is useful in some applications.

Of every bit as much importance as component development is work in the area of sub-assembly designs. Besides standardisation of component cases, lead configuration and mounting provisions, this work includes development and design in four fields: Connection methods (component to component, component to chassis, chassis to cable, etc.); high-temperature printed wiring; suitable chassis or base materials; total sub-assembly mechanical design, including chassis, rack and shock mounting provisions, and simplified assembly and test techniques.

(Continued on Page 23)

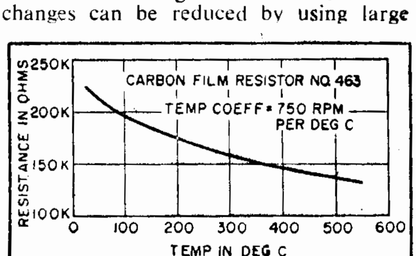


Figure 1. Effect of temperature on 225,000 ohm carbon film resistor.

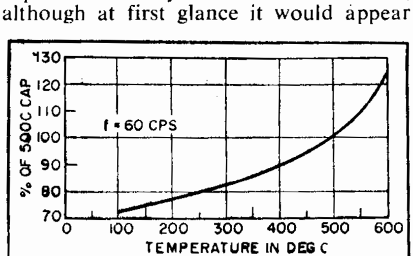


Figure 2. Effect of temperature on typical mica capacitor unit.

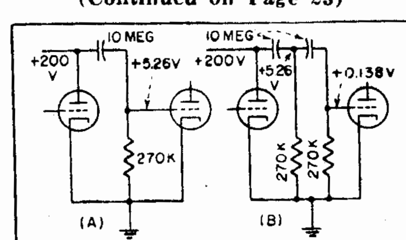


Figure 3. Two coupling capcitors decrease effect DC leakage on grid bias.

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(Continued from page 19)

plate circuit is not given because it will vary depending on the value of available "B+."

Plate power for the desired signal amplitude should be approximately 80 volts DC at 2 milliamperes. A nonlinear control, with resistance increasing rapidly as the adjustment is made away from the DC source, will afford the most convenient manipulation. If the "B+" source from which the plate voltage is derived is at about 130 volts DC, the control should be about 500,000 ohms in total resistance. In a nonlinear pot, 50,000 ohms, which should be the approximate value needed to provide the desired 80 volts, will then occur in the vicinity of the centre position.

In laboratory experiments with the split-grid tube, the receiver was adjusted as follows to demonstrate the effectiveness of the circuit: the wobble amplitude adjustment was turned off so that the picture tube could be operated just like a conventional CRT. Receiver focus was then adjusted for minimum spot size and sharpest definition.

The split-grid wobble deflection

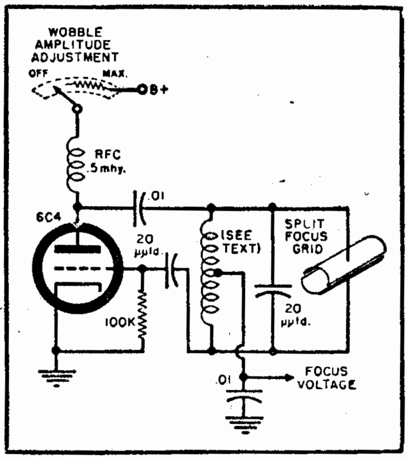

Fig 2. This single-stage wobbling oscillator, operating in the vicinity of 25 mc., uses one resistor, one resistive control, four capacitors, one standard choke, and one easily hand-wound coil on a plug-in subchassis.

method has several advantages over the system used in Europe, notably in Great Britain, where an auxiliary coil has to be wound around the neck of the picture tube.

The combination of the oscillator with the split grid results in a high "Q" which minimises the need for driving power and reduces oscillator harmonics. Such harmonics may cause interference patterns on some channels. Experimental evidence indicates that interference is not a serious problem when the split-grid method is used.

Also, high wobble frequencies are relatively easy to obtain because of the low capacitance between the two portions of the split grid and the fact that it thus does not do much to bring down the resonance of the oscillator tank circuit.

As already noted, if the wobble frequency is too low, the scanning lines will detract from the desired effect by permitting the individual cycles of oscillation to become visible. In addition, the cost of splitting the grid is small, in terms of production, as compared to the cost of using auxiliary deflection coils.

The wobble oscillator will be necessary in either case, but the drive requirement in the split-grid method is sufficiently lower so that some probable cost reduction in this circuit may also be realised.

When the split-grid tube becomes available, existing receivers can be adapted to the new technique quite simply. The experimental wobbler circuit was built on a plug-in subchassis, shown in Fig. 3, that was inserted between the base the CRT and the existing picture-tube socket. Filament and "B+" voltages for the oscillator are available at the latter socket. This construction minimises radiation by keeping RF leads short.

Production of split-grid picture tubes has not yet reached the commercial stage. One obstacle is the present association in the viewer's mind between clearly visible scanning lines and optimum focus.

A logical choice for its earliest use would seem to be sets with extra-large screen sizes for use in places of public assembly. If the system wins acceptance in this direction, it may well pave the way to home receivers with larger picture tubes than the ones currently accepted as providing images of quality from the normally observed living-room viewing distances.

—Radio and TV News.

HIGH TEMPERATURE RADIO PARTS

(Continued from Page 21)

For commercial system manufacturers or military weapons system manufacturers who require complete control or communication systems of proven reliability for operation at high ambients, the high-temperature component and subassembly art has not progressed to a point where it is directly usable. But simple devices must be built before complex ones, and the only way to achieve system operation at high ambients is to start by building useful and successful subassemblies.

The problem in connection development is to find a substitute for soldered joints. The desirability of 500 C printed wiring has resulted in evaluation of metallising techniques, mechanical strength, ease of making connections and simplicity of the process.

Work during the past year has led to subassembly configurations which are feasible for operation in high temperature and high nuclear radiation environments. In addition, one of the configurations is also suited to high shock and vibration conditions.

The first design resulting from subassembly research is an adaptation of conventional techniques to high-temperature requirements. A conventional sheet aluminium chassis can be used. In place of the conventional terminal strip made of phenolic laminate and tinned brass, a ceramic block is used. Nickel wire tie points are set into the ceramic and anchored with a high-temperature inorganic cement. Connections between components and the tie points on the ceramic block are made by spot welding. Another connection technique which has shown considerable promise is wire-wrapping.

MOUNTING

Most light components can be suspended between the tie points on the ceramic blocks by the strength of their own leads. This method would be used for resistors and some light capacitors. For heavier components, such as stacked mica capacitors, the electrical connection and mechanical mounting are separated. Larger capacitors can be bolted or riveted directly to the chassis.

If bolt and nut construction is used, the nuts may be drawn up loosely to allow for thermal expansion, then held in place with a drop of Saureisen cement. Another method is to utilise high-temperature spring lock washers made of Inconel X and draw the nut up tight against the washer.

A novel method is employed for mounting valves of the metal-ceramic type. Using a special welding fixture, lead wires about two inches long are welded across the valve electrodes. Next the valve is placed on a grooved ceramic mounting block with nickel tie points suitably located on the block.

By bending the tie point wires in toward the valve and spot-welding to the wire straddling the valve while the tie-point wires are under a flexural stress, a resilient harness is formed which serves as both the electrical connection to the valve and as a mechanical restraint.

ALTERNATIVE POSITIONS

The ceramic valve blocks can be mounted either above or below the top surface of the chassis. External connections for filament and plate power, signal input and signal output can be made by spot-welding wires directly to the appropriate tie points. Where necessary, woven glass tubing may be used to insulate one wire from another.

One advantage of the spot-welding connection technique is the extreme ease with which connections can be made and remade. Spot welding works best on materials of moderately high resistivity and most of the lead materials for high-temperature components now being developed fall into this category. Nickel lead wires spot-weld most easily. Even copper wires, if they are nickel-plated, spot-weld satisfactorily.

The second high-temperature subassembly design, based on a modular approach, is intended for high shock and vibration levels. The base plate is a moulded or fabricated ceramic base plate into which a number of nickel tie points are fitted, cemented with inorganic Saureisen cement. The tie points are set along the two longer edges of the base plate at incremental distances corresponding to the minimum spacing between small components. At the present time, this is on a 0.200-inch grid system.

The nickel tie points extend all the way through the ceramic base plate. Again, components including valves can be assembled and spot-welded on one side of the base plate. On the other side additional components can be placed, or overhead or printed wiring connections can be made to the input and output terminals at the end of the base plate.

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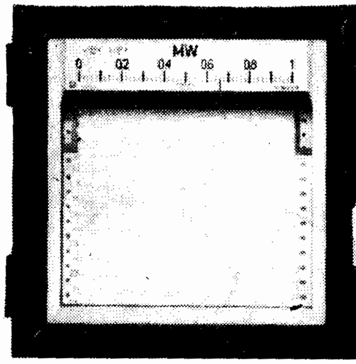

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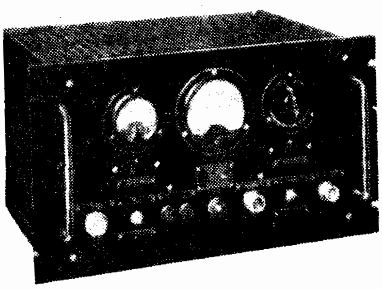

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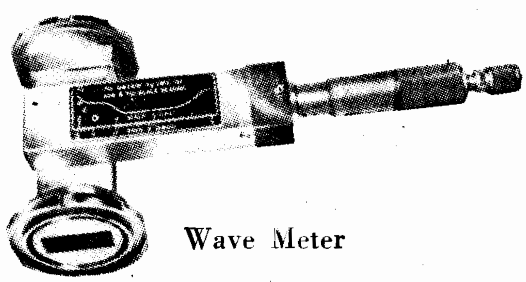

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NEWS AND VIEWS OF THE MONTH

Aust.-U.S. probe stardust

AUSTRALIAN and American scientists were jointly investigating an Australian theory that dust from shooting stars might cause hurricanes, said Mr. Heffernan, senior technical officer of the C.S.I.R.O. Radio-physics Division, on his return from the U.S.

He said the scientists had used Australian developed equipment to investigate hurricane "Audrey," which struck the Texas coast and Louisiana on June 25 last, killing 500 people.

Mr. Heffernan worked for eight months with American scientists at the Florida Hurricane Research Station and also on atmospheric research at Pasedena (California).

He said the Australian equipment proved better for field work than the American laboratory-developed equipment.

The equipment processed air samples so that scientists could detect freezing nuclei.

Mr. Heffernan said the freezing nuclei had the same natural effect on clouds as silver iodide had in artificial rain-making experiments.

Scientists had detected the nuclei by condensation of super-frozen air, but had not yet discovered what they were.

American hurricane research teams are now investigating a theory by the C.S.I.R.O. Radio-physics Division chief (Dr. E. G. Bowen) that the particles are dust from comets which burn up in the earth's atmosphere.

Dr. Bowen said the scientists were testing this theory over the Caribbean Sea because they did not yet know what caused hurricanes.

★ ★ ★

Self-guided missile

U.S. jet fighters now carry guided missiles able to destroy 70 to 90 per cent of bombers which come within range.

This high rate is claimed by the Air Force for a new model of the Falcon missile which has a heat-seeking device that leads it to attacking aircraft.

The Air Force said the missile had knocked down a dozen Matador pilotless bombers in tests.

The Matadors were travelling near the speed of sound when destroyed.

The Matador is a missile designed to carry an atomic warhead several hundred miles.

The new Falcon senses invading planes at distances of more than five miles through infra-red radiation.

It differs from earlier models guided by their own radar.

Both types can be carried in fighters.

The radar-guided version can track down a target in any kind of weather.

The infra-red model is especially good against targets at low altitudes where radar can be avoided.

The Falcon missiles can be used in a new fighter which flies well over 1,000 miles an hour.

Australia tracks Satellite

THE eyes of the world will centre on the satellite as it travels at 18,000 m.p.h. circling the earth in 90 minutes.

The satellite will cross the Australian continent in six minutes.

Australia will play a major part in the experiment.

A £250,000 earth-satellite tracking and interrogating station is now being established at Woomera.

It will be the only satellite station outside the U.S. to be equipped with three major machines.

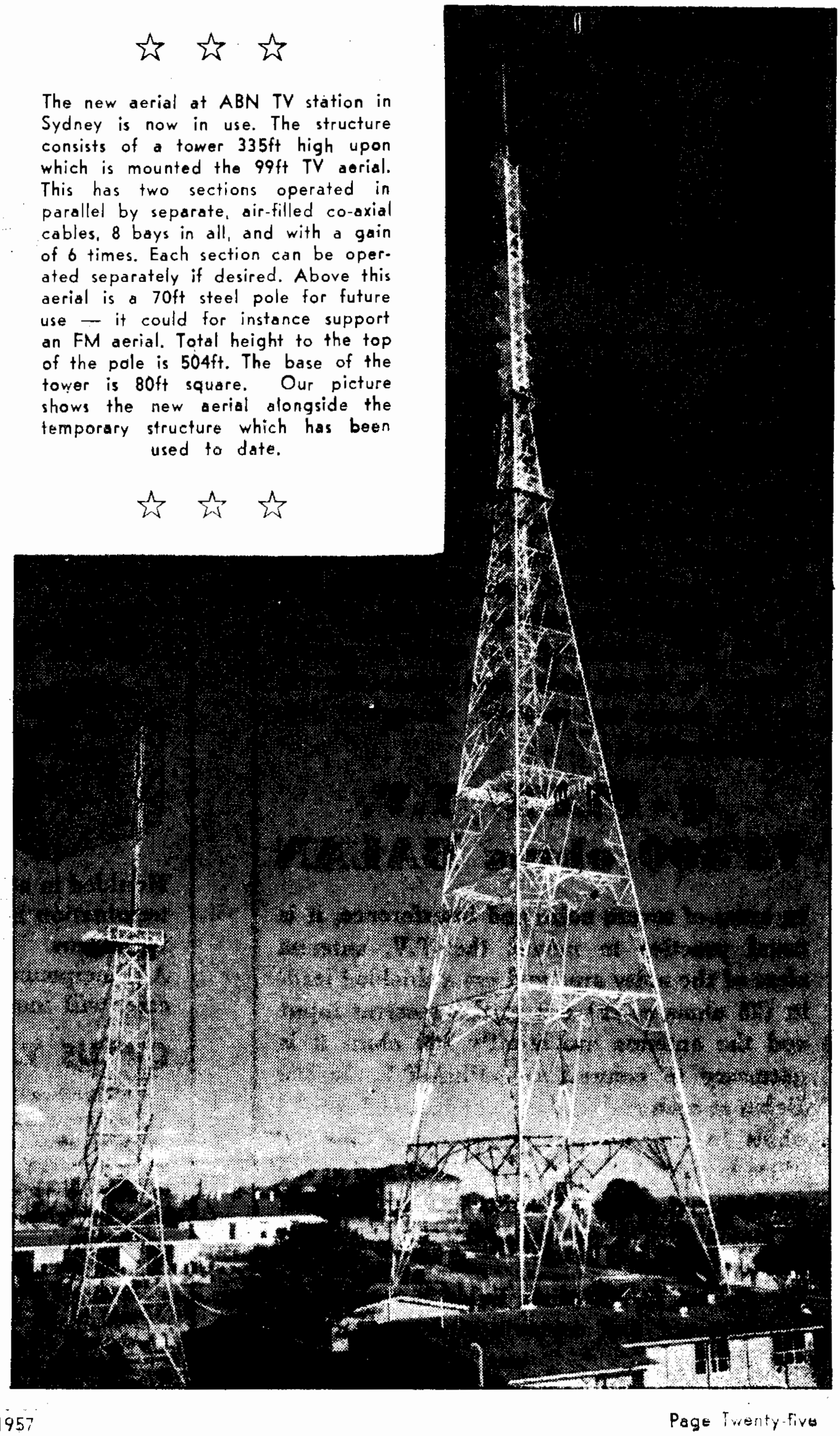
One machine is the satellite Telementry Interrogator and Recorder.

This machine uses three secret radio frequencies (like a safe opening combination lock) to interrogate the satellite

☆ ☆ ☆

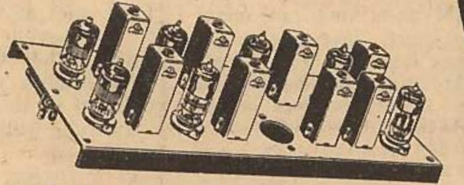
The new aerial at ABN TV station in Sydney is now in use. The structure consists of a tower 335ft high upon which is mounted the 99ft TV aerial. This has two sections operated in parallel by separate, air-filled co-axial cables, 8 bays in all, and with a gain of 6 times. Each section can be operated separately if desired. Above this aerial is a 70ft steel pole for future use — it could for instance support an FM aerial. Total height to the top of the pole is 504ft. The base of the tower is 80ft square. Our picture shows the new aerial alongside the temporary structure which has been used to date.

☆ ☆ ☆



"Q-PLUS" TV

Q-PLUS TV I.F. STRIP



NO TEST EQUIPMENT NECESSARY

The evcr popular Q-plus video and sound I.F. strip, wired, tested, aligned and sealed. Complete with all valves.

CONSUMER PRICE ONLY £19/19/-
PLUS SALES TAX £3/14/2

(4—6BC6's, 2—6AL5's and 1—6AU6) including spare 6AL5 diode as A.G.C. clamp. Full bandwidth 36.0-31.Mc. Simply connect tuner, audio and viedo output and power leads. That's all there is to it.

STOP PRESS!

T.V. KNOBS

Q-Plus are about to release a set of concentric TV Knobs to suit TV tuners and concentric controls. Make a Professional finish to your TV receiver!!

Available in various colours and with attractive anodised channel indicator plate. Channels 1-12.

Q-PLUS T.V. ATTENUATORS

Where signal strength is excessive causing picture overload, which can produce poor sync, distortion of picture, picture inversion (negative) or poor range of contrast, the insertion of a Q-Plus T.V. attenuator is required.

Q-Plus T.V. attenuators are made in attenuations of 6, 10 and 20db. Just connect directly to T.V. feeder and receiver. Complete with full instructions.

Q-PLUS T.V. 75/300 ohms BALAN

In areas of severe noise and interference, it is usual practice to mount the T.V. antenna clear of the noisy area and use a shielded lead-in (75 ohms co-ax) but as the receiver input and the antenna are usually 300 ohms it is necessary to connect a Q-Plus T.V. 75/300 Balan at each end. At the antenna end 300/75 ohms (a step down ratio to match the 300 ohms antenna to the 75 ohms line) and at the receiver end, a 75/300 ohms (a step up ratio to match the 75 ohms line to the 300 ohms receiver input).

The Q-Plus 75/300 ohms Balan is completely weatherproof and comes complete with full instructions.

Q-PLUS T.V. SET COUPLERS T.V. ATTENUATORS AND T.V. 75/300 ohm 'BALAN'

Moulded in attractive cream plastic with screw termination and supplied with plated mounting screws.

All components fully enclosed and sealed in case, will mount on wall, skirting board etc.

Q-PLUS T.V. SET COUPLER

Where two (or more) TV receivers are required to operate off the one antenna, a Q-Plus Set Coupler is required to corectly terminate the TV antenna and the TV receiver antenna input. Unless this is done, then serious mismatch could occur and could cause "ghosting" and other forms of loss of picture quality.

Each Q-Plus set coupler will operate two TV sets from the one TV antenna, for every extra two TV sets to be operated from the same antenna, just connect another Q-Plus TV Set Coupler to lead in. Complete with full instructions.

as it circles the earth at altitudes from 300 to 1,500 miles.

A huge Mini-track radar station will use eight radar aerials — arranged in a 500ft square — to project a fan-shaped radar beam through which the satellite will pass.

Scientists will be able to calculate with it the time of arrival of the satellite over any given ground point.

The information then will be relayed to the next station to enable the "little moon" to be under practically continuous observation.

Value of the equipment is more than £100,000.

★ ★ ★

Super space rocket

U.S. scientists will launch a rocket from a balloon platform 20 miles above the Pacific Ocean in an effort to set an altitude record.

Scientists expect the rocket to set an altitude record of "thousands of miles."

The official altitude record was 250 miles.

The launching of this rocket will be the first time scientists have attempted to fire a rocket from a platform suspended from a craft lighter than air.

The rocket is 23ft long and weighs 1900lb — rocket and balloon together weigh two tons.

The rocket has a four stage firing system and a thrust of 160,000lb in the first stage. The other three stages will take the rocket to a greater height than ever reached before, during which time it will travel at over 17,000 miles per hour.

The rocket will contain instruments to investigate atmospheric and space phenomena.

★ ★ ★

New record breaker

A NEW Navy plane being polished up on the development lines may leave the latest record-breaker a couple of States behind in any cross-country competition.

It is labelled F8U-3.

Indeed, the Crusader F8U-1, which flew from California to New York in three hours and 23 minutes wouldn't be worth racing against the F8U-3.

At last year's National Aircraft Show at Oklahoma City, the F8U-1, which missed by only nine minutes flying the 2,460 miles at the speed of sound, was clocked at 1,015.428 m.p.h. to win the Thompson trophy.

According to Pentagon sources, the F8U-3 is expected to fly at more than twice the speed of sound and sound travels at about 760 m.p.h.

It will also have more cruising range and will be able to operate at altitudes which a few years ago represented record heights for the rocket planes reaching them.

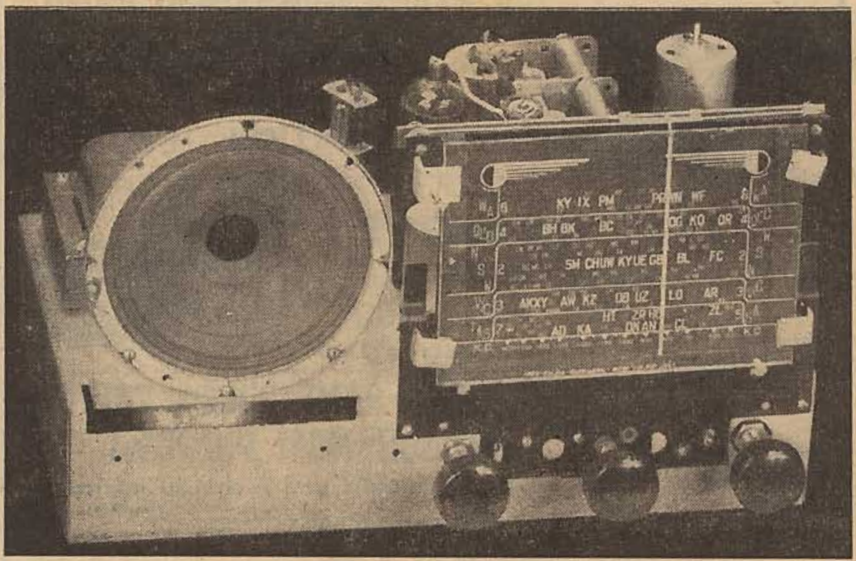
Powered by a Pratt and Whitney turbojet engine rated at 10,000lb thrust, the F8U-1 exceeded the speed of sound on its first flight in March, 1955.

★ ★ ★

Australian wind tunnel

AUSTRALIAN technicians have built a wind-tunnel capable of reproducing speeds up to 2.8 times the speed of sound or about 2,000 miles an hour.

Scientists at the Weapons Research Establishment at Salisbury (S.A.) will use the wind-tunnel for research and for experiments connected with high-speed aircraft and guided missiles.



This is the kind of receiver you can build from parts which are currently being offered cheaply by our advertisers. A home handyman should have no difficulty in making up a neat plywood cabinet to house the chassis, making it a very cheap proposition.

The Economy Five-Valve Receiver

Here's a set you can build for a fraction of the normal outlay, a set which is ideal for casual use around the home—in the kitchen, in the children's room, in the garage where Father does all the odd jobs. It takes advantage, in its design, of the many valves and components which are currently being offered cheaply by disposals dealers and others.

by *Wes Yashin*

THE idea of this set was born a couple of weeks back when browsing through the advertisements in the August issue. Among the various items of disposals equipment, having only a specialised appeal, were long lists of valves offering at very low prices.

Closer inspection brought to light coils and IF transformers, power transformers, speakers and other odd items which looked to be useable in a broadcast receiver, all at reduced prices.

Surely, we thought, there must be plenty of readers who would welcome an extra set around the home, especially if it didn't cost them very much. Couldn't all these parts provide the answer.

COILS, TRANSFORMERS

Suiting the thought to the deed, we had a look at some of the components. The coils and IF transformers were a little different physically from the branded lines which are normally sold over the counter, but they were well made, nevertheless.

The other lines were quite standard and, without inquiring into their history, we could only assume that they represented surplus items from production runs in one or other of the big factories.

The valves, for the most part, were new and in original cartons. To be sure, they were full-sized octal-based types but it's not so very long since valves of this size were regarded as standard. But could a set be built around the particular types offering?

One of the cheapest of them and the most plentiful is the 6AC7 and we toyed with the idea of using these valves in all stages, even to a couple of them as rectifiers. The resulting set would undoubtedly be novel but didn't appeal as being the most logical approach.

So we checked carefully through the valve lists and considered each stage on its merits. The result is the circuit opposite.

For the frequency changer, it would have been possible to use a 6AC7 in an autodyne circuit but we remembered how "cranky" this circuit could be with unsuitable valves and coils. We remembered also the problem there was with gain control, with only the IF stage to take the control bias.

Then what about two 6AC7s, one as a mixer and the other as an oscillator?

AWKWARD SCHEME

This would certainly have been practical but it would involve buying two valves and two sockets, then finding room for them on the chassis.

In the face of this, it seemed more logical to spend the money on a proper converter valve. These are not nearly as plentiful or as universal as 6AC7s, for example, but they can be bought for around ten shillings. Added to this is the fact that many constructors may have such a valve lying around—and it doesn't need to have peak emission to work on the broadcast band.

We specified a 6A8-G, which is probably the most popular example but a variety of other types will work under precisely the same circuit conditions. To mention a few, there is the 6A7, 6J8, 6K8, X61M, ECH3, ECH33, ECH35, 2A7 (the last having a 2.5 volt heater) and the 7A8, a "loctal" type requiring a special socket.

By dropping the oscillator plate and screen volts to 50 or 60, still other valves can be used, such as the EK2, EK32, CV1057 and VR57. One could hardly imagine a wider range of possibilities.

Next comes the IF amplifier. The aforementioned valve lists contain a variety of time-honoured variable-mu RF pentodes but most of them sell for about ten shillings and few of them are available in any large quantities. Surely we could use one of the "bargain" types?

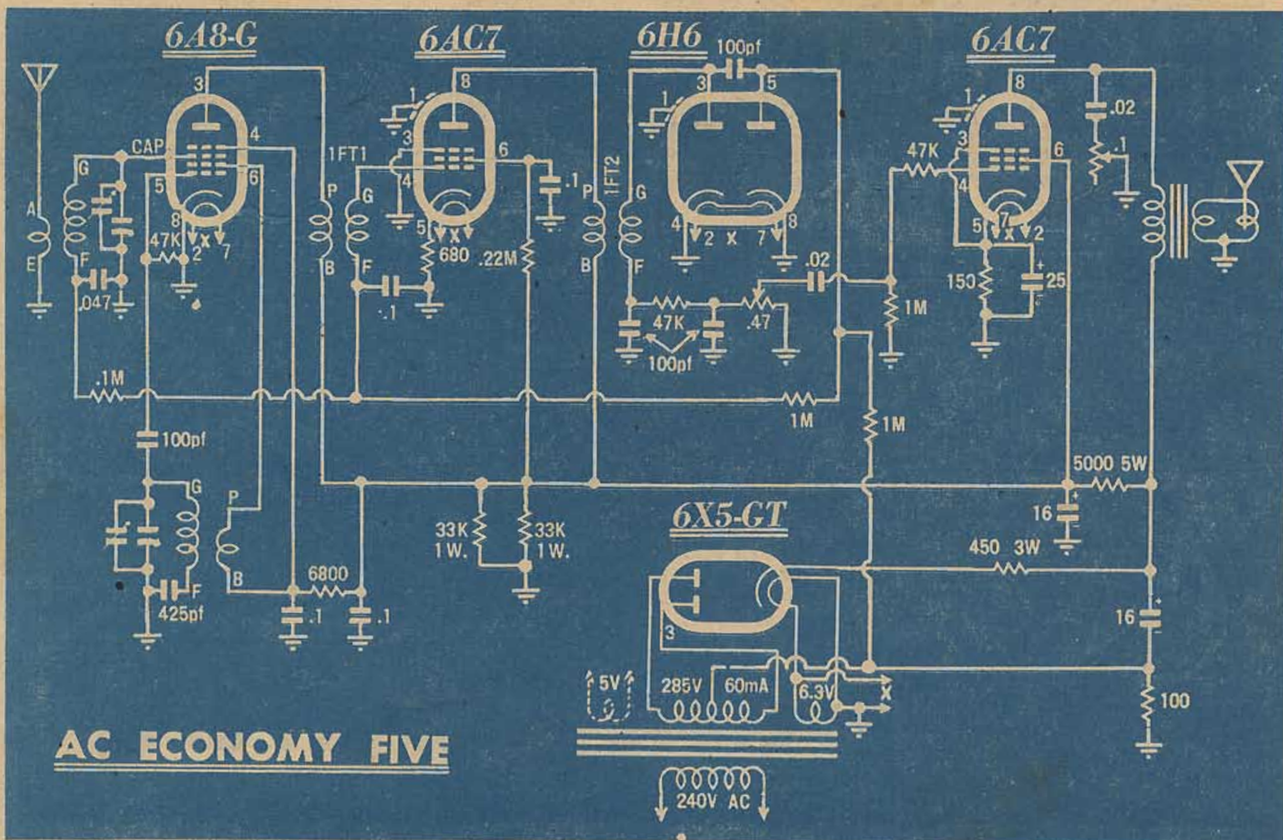
The EF50 was employed some years ago in one of our high-gain dual-wavers but it needs a special socket. The 6SH7 uses a standard socket but is not very amendable to variable-bias gain control.

ALL PRECAUTIONS!

Taking our technical courage into both hands, we ultimately selected and wired in a 6AC7, putting full AVC on the suppressor, part AVC on the grid, a series screen supply, and an unbypassed resistor in the cathode return to limit the gain.

This last provision proved to be a very necessary one and had to be increased to 680 ohms to secure IF stability. This value should not be regarded too critically, because it will depend on layout, wiring and the particular IF transformers selected. If you can make it smaller without the set bursting into oscillation, by all means do so. If it

CIRCUIT OF THE SET HAS SOME UNUSUAL FEATURES



Here is the complete circuit diagram. The valve types are all currently being offered at cut prices. The 6AC7 normally has too much gain to use in a 455Kc IF stage but is "tamed" by connecting an unbypassed resistor in its cathode circuit. Another 6AC7 as output valve makes all the noise you are likely to want from a "se cond set."

has to be made larger, that's all there is to it.

The big surprise had to do with the control characteristic. We finished up earthing the suppressor, putting full AVC on the grid and still failing to overload the set with over a volt of signal fed to the aerial terminal.

Still needing a diode detector, we felt that the obvious course was to use a 6H6, which is again available very readily and very cheaply. Its use avoids the problem of finding a composite diode-amplifier valve. A few of these latter are, in fact, among the valves currently being offered at cut prices but we gather that their numbers are not very great.

OUTPUT STAGE

The output stage called for a deal of consideration. The easy way would have been to specify a 6V6 but the end result would not only have been conventional but out of keeping with the basic idea of using the cheapest possible valves.

To cut a long story short, we managed to work in another 6AC7. With normal bias and 150 volts on the screen, it makes plenty of noise for a mantel set, feeding into a 5in speaker. Forgetting the niceties of matching, we merely fed it into an ordinary "pentode" transformer, as supplied with the speaker. We suggest you do likewise.

The power transformer has ratings similar to one offered by an advertiser and fits in nicely with a 6X5-GT, the only rectifier we could see in the valve lists. Resistance filtering is used, serving also to drop the final output voltage to 150 for the 6AC7 screen and for the earlier valves. Despite the lack of a filter choke, the hum level is virtually inaudible.

The power supply circuit could be amended in various ways to suit individual requirements or other parts. The important thing is to see that the 6AC7 plate is not run at more than 300 volts. Similarly, the screen should not exceed 150.

The two 33K resistors between this line and earth serve to stabilise the screen voltage against variations in current elsewhere through AVC action. Without these resistors, the voltage tended to rise alarmingly with signal, running up to nearly 190 volts. An overload of this order might easily be too much for a 6AC7.

PARTS LIST

- 1 Chassis, (old "Fireside Five")
- 1 USL/44 dial (to suit gang).
- 1 2-gang capacitor.
- 1 Aerial coil.
- 1 Oscillator coil.
- 2 455 Kc IF transformers.
- 1 285/60 power transformer.
- 1 5-inch speaker preferably with 10,000 ohm transformer.
- 5 Octal sockets.

VALVES

- 1 6A8-G, 1 6H6, 2 6AC7, 1 6X5-GT.

CAPACITORS

- 2 16 mfd 350 VW electrolytics.
- 1 25 mfd 40 VP electrolytic.
- 3 .1 mfd 400-volt paper.
- 2 .047 mfd 200-volt paper.
- 2 .02 mfd 400-volt paper.
- 4 100 pf mica or ceramic.
- 1 425 pf mica.
- 2 trimmers.

RESISTORS

- 3 1 meg ½ watt.
- 1 .22 meg ½ watt.
- ~~1 .1 meg ½ watt.~~
- 3 .047 meg ½ watt.
- 2 33K 1 watt.
- 1 680 ohm ½ watt.
- 1 100 ohm ½ watt.
- 1 6800 ohm 1 watt.
- 1 150 ohm 1 watt.
- 1 5000 ohm 5 watt.
- 1 450 ohm 3 watt.
- 1 .1 meg pot.
- 1 .5 meg pot.

SUNDRIES

1 8-lug strip, 1 5-lug strip, 1 4-lug strip, 1 3-lug strip, 3 2-lug strips, 2 terminals, dial lamps, 3 knobs, tinned copper wire, spaghetti, hookup wire, solder, nuts and bolts, shielded hookup wire, solder lugs.

To accommodate the set, we selected the old and popular "Fireside Five" chassis—the early version intended for octal-based valves. It mounts everything quite easily and can be accommodated in a cabinet of manageable proportions.

The one thing you should give careful thought to is the dial and tuning gang, which should be designed to work together. Unless you have something else on hand, it may be as well to buy a new dial like the USL44, making sure that the glass suits the gang.

CONSTRUCTIONAL DETAILS

Coming to the constructional side, you will observe the general layout from the reproduced photographs. A large variety of components may be adapted as there is adequate room.

In using up odd components care should be taken to orientate them correctly so as to ensure short leads for critical circuits. Should it be necessary to drill a new set of mounting holes, do so rather than have leads which are longer than necessary. In some cases it may be possible to rotate IF transformers and coils within the can to obtain the desired length of lead to individual lugs.

As a rule, coils and IF transformers are either colour-coded or coded in letters or figures. The codes used are fairly standard but, for the benefit of those not familiar with these systems, the interpretations are as follows:—

A green colour, the letter G or the figure 1 represents the grid terminal while black, F or 3 stand for the opposite end of the winding which may be either AVC or earth. Likewise, a blue colour, the letter G or the figure 4 represent the plate terminal, while red, B or 6 represent the opposite end of the winding which is the B plus terminal.

We used a 60 mA power transformer and it was necessary to make up a mounting plate as the cutout in the old "Fireside Five" chassis was intended for an 80 mA transformer. However, there is no reason why an 80 mA transformer should not be used if one happens to be on hand. Likewise an upright transformer would be suitable provided a mounting plate is used.

The dial we used is a type USL/44 and mounts directly without modifications. The drive spindle should be in the centre and, if not thus supplied, should be transferred.

SPEAKER MOUNTING

There is only sufficient room for a 5in speaker and this should be mounted on a bracket to extend past the chassis, flush with front panel of a cabinet. The speaker transformer is mounted under the chassis, using mounting bolts in common with the speaker bracket.

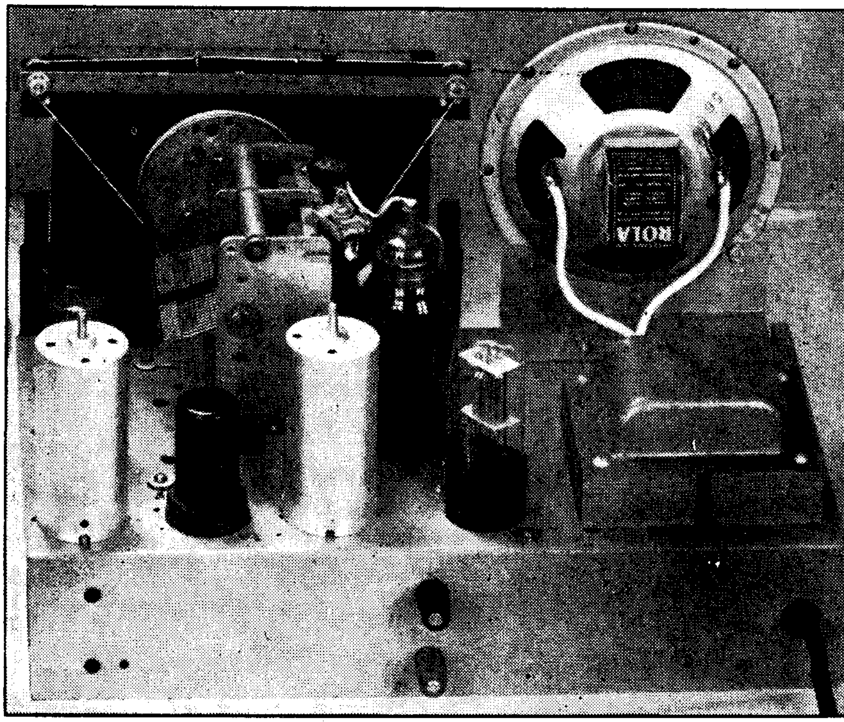
For the wiring runs we used spaghetti-covered tinned copper wire but ordinary hook-up wire would do equally well. Most of the wiring is point-to-point, a few tag strips being used to provide junction as well as support points for some of the components.

Looking over the rear edge at the under-chassis view, the output valve socket is in the top right-hand corner. A 2-lug strip is used as an anchor point for the grid stopper, the grid leak and the coupling capacitor, the other end of which is attached to the moving arm of the volume control.

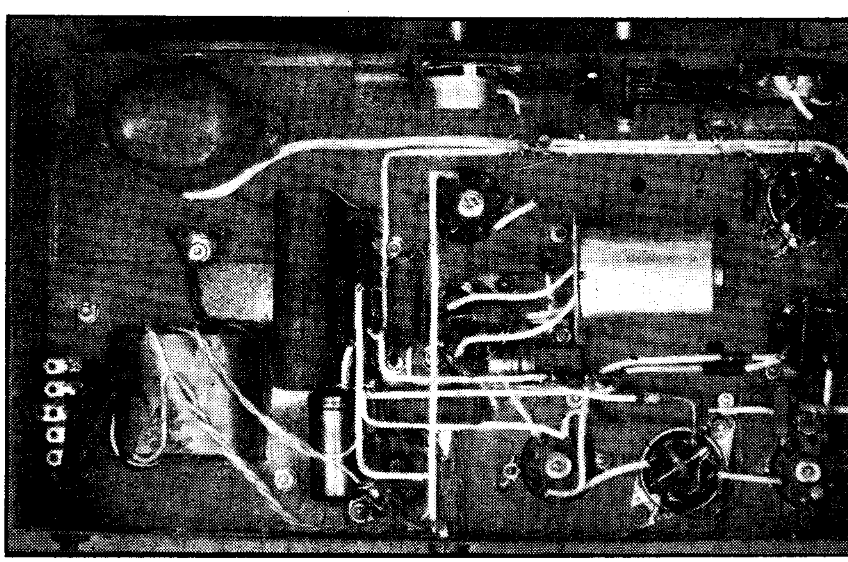
The next socket down toward the rear edge is that of the 6H6 detector and AVC diode. The socket should be so mounted that pins 3 and 5 are closest to the rear edge of the chassis. Pin 3 is the detector anode and connects to the grid terminal of the second IF transformer.

Coming to the second IF transformer in the corner between the 6H6 and the IF amplifier sockets, you will note the 2-lug strip, held by the transformer mounting bolt which supports one end of the diode filter resistor and its bypass. The other end of the diode filter resistor anchors directly to the AVC lug on the transformer while the remaining bypass connects between the AVC lug and an earth lug under the transformer mounting bolt.

A TOP VIEW OF THE CHASSIS



A rear view of the set showing the layout of the major components. Note the disposals-type valves and the large gang used. The power transformer, too, may vary considerably in size and shape.



An under-chassis view of the set showing the neatness of the layout. The bleed resistor consisting of two parallel units from the main HT line to earth was not wired when the photographs were taken. Reference regarding its position on the eight-lug strip is made in the text.

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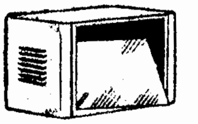

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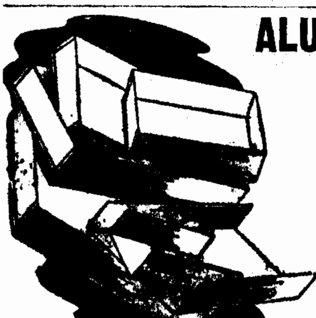

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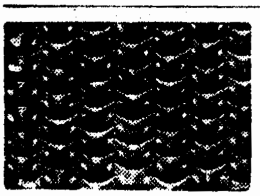

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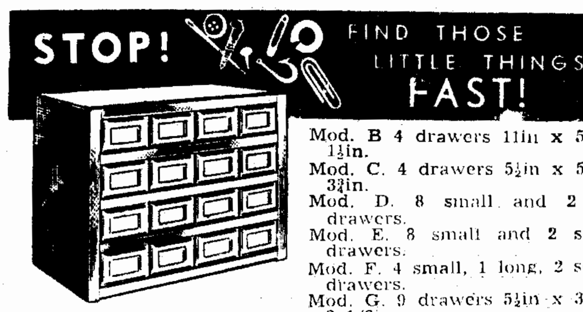

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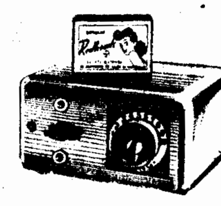

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EVERYTHING FOR THE RADIO AND ELECTRICAL EXPERIMENTOR

The transformer should be so orientated that the lead between the 6H6 plate and the grid pin is short. The lead between the plate of the 6AC7 and the plate pin should also be short.

The 6AC7 IF amplifier socket will have to be positioned so that pins 1 and 8 face the rear right-hand corner. Only three components terminate at this socket the bias resistor and the screen dropper with its bypass. The former is anchored between the cathode lug and an earthed lug while the last two are connected between the screen lug and two suitable points on the four-lug strip in front of the first IF transformer.

The first IF transformer should be mounted with the grid and AVC pins towards the rear edge of the chassis. The grid and plate lugs will then be directed toward the IF amplifier and converter sockets respectively.

SOCKET POSITIONS

Next in line with the first IF transformer is the rectifier socket followed by the converter socket. Looking at the latter you will observe that its orientation is such as to provide a short lead between the plate lug and the plate terminal on the IF transformer.

The oscillator coil is mounted on a bracket in a horizontal position with the pins facing the converter socket. This coil is positioned so that pins G and F are nearest the chassis, thus making it possible for a short direct lead to the gang through a hole in the chassis.

Next in line is the aerial coil and this is positioned so that the aerial and earth connections are nearest the front edge of the chassis, again allowing a short lead from the grid pin to the gang through a hole in the chassis.

The connection between the aerial lug on the coil and the terminal on the rear edge of the chassis is made by means of spaghetti-covered tinned copper wire. This lead should be made rigid and preshaped to clear the rest of the wiring.

Directly in front of the aerial coil on the front edge of the chassis is the tone control potentiometer. The capacitor in series with one end of the potentiometer and the plate of the output valve terminates on a two-lug strip directly beneath the potentiometer which also forms a junction for the plate and transformer leads.

An 8-lug mounting strip to the left of the converter socket supports most of the filter components, as well as providing anchor points for the back-bias resistor and the .1 meg AVC filter to the F pin of the aerial coil.

Rear to front, the lugs on this strip are as follows: Lug one is a junction point for the centre tap lead, the AVC return, the negative end of the second filter capacitor and one end of the back-bias resistor. Lug two is an earth lug and also acts as a support for the earthy ends of the back-bias resistor, the parallel bleed resistors from the main HT line and the AVC bypass from the F pin on the aerial coil.

Lug three is the junction point for the main HT line and supports one end of the second filter resistor, one end of the bleed resistors, the positive end of the second filter capacitor, one end of the .1 mfd bypass and several leads to remote HT points.

The fourth lug is not used, while lug five is a junction point for the lead between the cathode of the rectifier and the 450 ohm dropping resistor. Lug six is an AVC point from which a .1 meg resistor is wired to the AVC lug on the aerial coil.

Lug seven is an earth point while lug eight is another HT point. The last mentioned is a junction for both the resistors in the filter network, the positive end of the first filter capacitor, as well as being the take off point for the plate supply to the output valve.

A mounting strip to terminate the incoming AC and the transformer leads will complete the wiring.

DIAL LAMP SUPPLY

Should your transformer have a 5-volt winding, it may be used to supply the dial lamps, thus lengthening their life.

Once the wiring has been completed, check it thoroughly and then plug the valves in. Switch the set on but keep your hand on the switch in case you should observe any signs of distress. If all is well, the set should come to life and it should be possible to tune some stations even though these may not be correctly placed on the dial.

The following is a record of the main voltage and current readings for those wishing to check their receiver's performance against the prototype.

The HT after the first dropping resistor should not exceed 300 volts since the plate of the output valve is connected to this point of supply. In actual fact we measured 280 volts at this point while the reading after the second filter resistor was 158 volts which is also the output valve screen voltage.

The converter screen and the oscillator plate voltage reading was 100 volts. Bias voltage for the output valve should be 2.2 volts, and the cathode current 15mA while the total current drain should be about 37 mA. The readings given were taken with a standard 1000 opv. meter under no signal conditions.

For the

Radio TV Serviceman

GELOSO SIGNAL SHIFTER

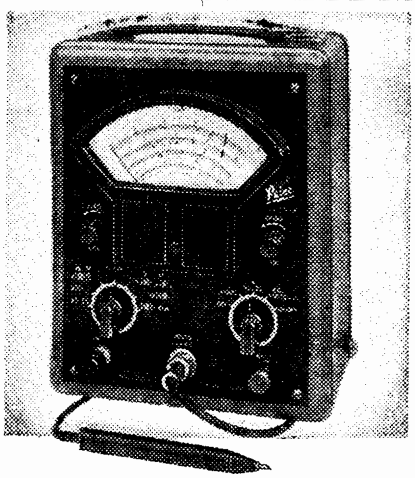
This V.F.O. M4/101 offers low cost, high stability 3.5-28 Mc R.F. generator that is accurately calibrated throughout each band and has simple band switching features.

- **No plug-in coils.**
- **Maximum Frequency Stability (plus or minus 200 cycles small bands)**
- **Complete with specially calibrated plastic dial.**
- **Power supply required 400v 32-54 mA.**
- **Valves used 6J5-GT, 6AU6, 6V6-GT.**

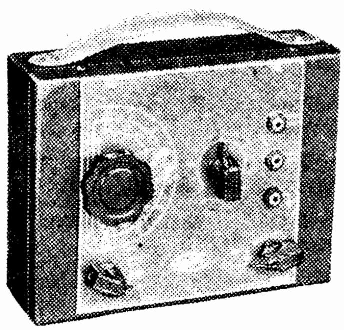
Price £10/4/9 inc. Sales Tax

Valves and power supply not supplied with this unit. M4/101 Pi-Coupler unit for use with above, £1/10/6.

University TVR-C3 is a small yet comprehensive Oscilloscope for bench or portable use. Ideal for TV, Radio and industrial requirements, and has all the features of larger instruments. Price £56.



The Paton TV-M. Vacuum Tube Volt-Ohm meter is a basic necessity for Television Service.
Features, A.C. volts R.M.S. and Peak to Peak, D.C. Volts, Resistance and Decibels. Comprehensive 42 ranged instrument. Price £49/17/6. High Voltage Probe to extend D.C. volts range to 30 K.V. £9/10/-. Crystal Diode Probe for H.F. measurements up to 400 Mc. £4/17/6.



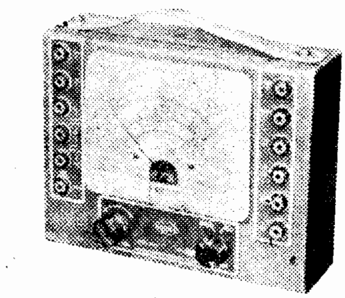
The OK.1. Oscillator comes in kit form with all constructional details necessary to assemble this unit. Covers all fundamental frequencies in average receiver, uses standard batteries and complete with instruction book. £12.

All prices plus 12½ per cent Sales Tax. Tax exemptions where applicable.

A fast, efficient repair service is now available on all your Radio, Electrical and TV testing instruments. Details upon request.

Informative Literature on all Paton and University products available on request.

Easy revised terms available on all instruments.



The Companion unit of OK.1. This Multimeter features AC/DC voltages to 1000, Current to 250 mA/Dc and Resistance up to 100,000 ohms. Large easy-to-read meter scale, and is available as a kit or assembled. All constructional details. Price £12.

Some of the other instruments available ex stock.

University T.S.T.2 valve and circuit tester, £58.

University T.V.T. valve Tester, £40.

University A.S.T. combining Signal Tracer and Vacuum Tube Voltmeter. Signal Tracer covers between 175 Kc-18 Mc. Price £60.

Paton O.M.2 4 range universal ohmmeter, £12/10/.

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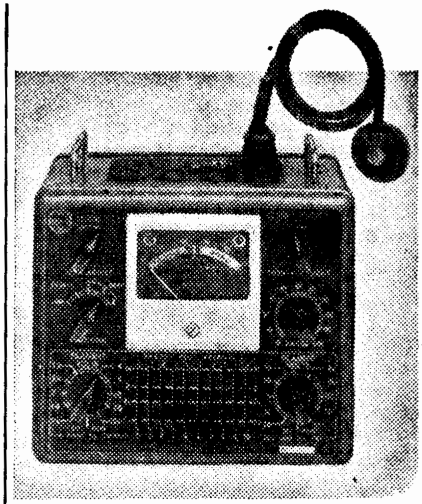
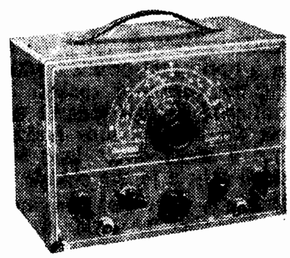
Paton M.42. A comprehensive 1000/v multimeter, £32/12/6.

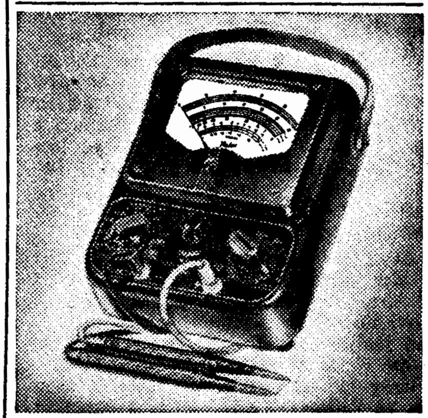
A modern Test Instrument Showroom will be opened during October, where a most comprehensive range of Radio, and TV instruments from leading makers will be on display. Watch October "R. and H"



The ET4.a. from Paton is portable, light and comprehensive, and features will enable it to test all Radio and TV Receiving Valves without the need for adaptors. £37/15/.



The YOA is ideal for Radio Service Work. Continuous coverage from 150 Kc-30 Mc in overlapping Bands. Improved attenuation system — spot frequency calibration of dial for speedy alignment by switching. 240v AC Power operated. Price £38.



A beautifully designed 1000 o/v 32 ranged Multimeter from Paton. It reads AC/DC volts to 1000, DC Current to 10A, AC Current and Decibels. Resistance to 1 megohm (int. batteries). Price £17/18/6.
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Accessories, carry case, shunts, current transformers and high voltage probe.

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A SIMPLE COURSE IN RADIO — 9

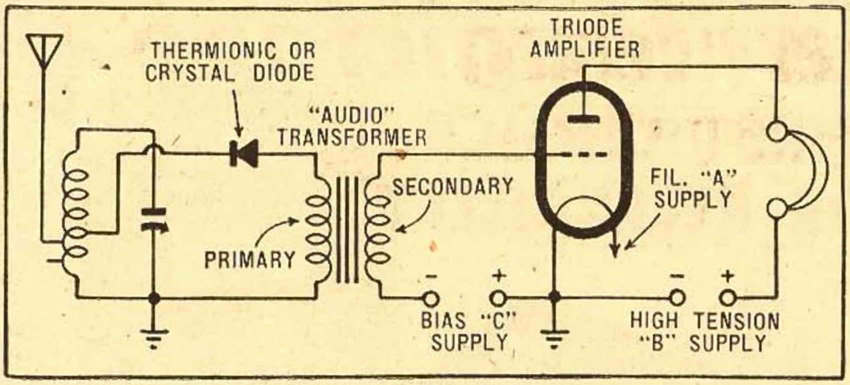

Figure 1: Here is the basic circuit for an amplified crystal set — a crystal detector coupled through an audio transformer to a single audio amplifier stage

Limitations of a crystal set. Amplified crystal sets and audio stages. Diode and triode valve detectors. Grid-leak detection. Reaction or regeneration. Two-stage receivers with transformer or resistance capacitance coupling. Three-stage receivers. Power output valves. Overload and gain control.

One, Two and Three-Valve Reaction Sets

Having learned from a crystal set certain basic facts about radio reception, we go on to discuss simple regenerative valve receivers of the type which have long been a favorite with small-set constructors. The emphasis in the articles is not so much on how to build such sets but on the ideas which lie behind such circuits.

A crystal set is a very useful and interesting device. It is simple to make, it costs nothing to operate and it demonstrates, in a practical way, many important radio-principles.

For all that, however, a crystal set has very serious limitations. The only energy available to it is the radio frequency energy picked up by the aerial and earth system from the desired transmitter. This is selected, demodulated and made available to the earphones as an audible signal.

LESS ENERGY

As the distance between receiver and transmitter is increased, the energy available becomes less and less until, at a distance which may be as little as 25 miles, the signal becomes inaudible. Only under very exceptional circumstances are the signals from a crystal set ever strong enough to operate a loudspeaker.

Yet another serious problem is that of poor selectivity, a crystal set often being unable to separate the wanted signal clearly from other strong signals in the receiving area.

In the face of such limitations, it is not surprising that engineers, very early, sought to improve the performance of crystal receivers or, alternatively, to supplant them altogether. Nor is it surprising that they have been relegated, in this modern age, to the role of a "beginner's set."

As you have probably guessed, the answer was found in a device we have already discussed — the radio valve. If you've forgotten this earlier article, we suggest you turn back to chapter 6, in the June, 1957, issue.

Strangely enough, the first valve receivers were no more ambitious in their performance than crystal sets — in fact there were plenty of early radio operators of the day who claimed that they were not as good.

These early valve receivers were just like crystal sets, in fact, except that they used a diode rectifier in place of the metallic crystal detector.

As we explained in the earlier article, diodes exhibit the same rectifying properties as a crystal, being able to pass current only in one direction. They make signals audible in the phones by the same process as explained last month for a crystal set.

The main advantage of the valve or THERMIONIC diode was that it needed no critical adjustment. This advantage was very real in a day when the surface of crystal diodes had to be probed with the "catswhisker" contact to discover a sensitive spot.

Against this, of course, the diode valve needed a filament battery, which was something of a nuisance. Hence the arguments of the day as to which was the better proposition.

The development of the triode valve settled such arguments, because it brought with it the ability to amplify the incoming signals. Instead of being utilised to operate the phones directly, the signals were applied to the grid to control plate current (see earlier article) flowing from a B-battery. The resultant and larger plate current excursions, dependent on the grid signal, produced much louder signals in the phones.

Figure 1 shows a type of receiver which was quite popular in its day — the combination of what is virtually a crystal or diode receiver and a triode amplifier STAGE. This type of receiver is often built, even nowadays, as a beginner's project.

The incoming signal is selected by the tuning circuit and applied to the detector. This latter may be either a metallic (i.e. crystal) type or a thermionic diode, which suppresses half the incoming carrier and delivers to its output circuit what we described, last month, as a series of unidirectional pulses proportional in strength at each instant to the modulated carrier.

Instead of being passed directly through the phones, to produce an audible sound, these pulses are passed through the PRIMARY winding of an AUDIO TRANSFORMER. Perhaps we should pause here to explain these terms, at least in brief.

The word "audio" comes from the Latin verb "to hear" and is used in radio to describe any circuit or component which handles signals at a frequency within or adjacent to the range of sound frequencies. Thus an AUDIO AMPLIFIER STAGE is one which amplifies signals at audio frequencies.

By the same token, an audio transformer is one which is designed to handle, or transfer, or couples signals at audio frequencies.

The principles of transformers generally have been discussed in an earlier chapter and obviously cannot be repeated here. An audio transformer is usually wound on a core made up from iron laminations. It normally has two windings, each comprising many thousands of turns of fine wire.

STEP-UP RATIO

The input signal is fed to the winding normally referred to as the PRIMARY, while signal is taken for the following grid circuit from the SECONDARY.

It is possible to secure a step-up in signal voltage from a transformer by winding more turns on the secondary than on the primary. Old-style transformers, which often come into the hands of experimenters, typically have a step-up ratio of 3½:1 or 5:1.

Now back to figure 1.

The signal currents from the diode detector flow through the primary winding of the transformer. Now the transformer is no more able to respond to individual uni-directional carrier pulses than the earphones referred to in the last chapter.

However, the current through the primary winding, and therefore the magnetic field it produces in the core, tends to merge into a pattern, which follows the rise and fall of the incoming carrier with modulation.

The changing magnetic field, due to current through the primary winding, induces current in the secondary winding and a corresponding signal voltage between its two ends.

SIGNAL TO GRID

These two ends are connected respectively to the grid and filament circuit of a triode amplifier valve and the audio voltage between them therefore constitutes a grid signal controlling the flow of electrons through the valve from filament to plate.

For the reasons explained in chapter 6, a bias voltage is normally provided to keep the grid slightly negative with respect to filament, the optimum bias depending on the type of valve and its other operating conditions. When the incoming signal carries the grid more negative than the standing bias, current through the valve is reduced. Conversely, when the signal makes the grid less negative, current through the valve is increased.

This ever-changing current, flowing from the High Tension or B-battery through the phones, in sympathy with the grid signal, produces much more output from the phones than could those available from the detector.

A simple receiver along the lines of figure 1 is capable of substantially better performance than an ordinary crystal set. Sound volume from nearby stations is increased. Range is effectively improved because signals which might otherwise be inaudible are amplified to listenable strength.

SELECTIVITY

Even the effective selectivity can be improved because amplification from the audio stage allows the tappings on the coil to be moved closer to the earthed end, than would otherwise be the case. Selectivity is improved as a result.

Still further improvement would be possible by providing two or even three audio stages after the crystal detector. In practice, however, this is seldom done because better overall performance can be obtained by following different circuit principles, at least for simple beginner's type receivers.

It involves, primarily, elimination of the crystal or diode detector and the substitution of a triode or one of the other multi-element valves already discussed.

Figure 2 shows the basic circuit for a triode detector. Its operation must be considered in two distinct steps.

Within the valve, the grid and filament constitute what is virtually a diode rectifier, even though the grid is a spiral of wire, intended to serve another function altogether. If the grid, at any instant, should become positive with respect to filament, electrons will flow to it, just as if it were a plate. The flow will cease immediately the grid becomes negative again.

Now in figure 2, the input signal selected by the tuned circuit is fed to the grid through a capacitor, shown as Cg. This kind of notation is often used, by the way, to facilitate discussion of electrical circuits. "Cg" is simply an abbreviation for "Capacitor, grid." In a typical detector circuit, its value would be from about 100 to 270pF.

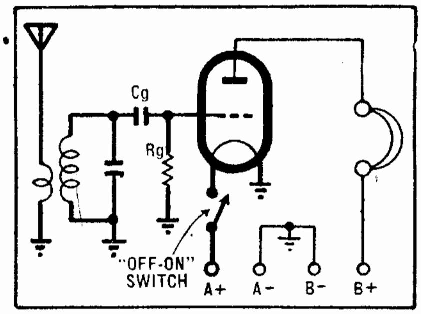

Figure 2: The basic circuit for a triode detector. The portion of the circuit drawn heavily and involving the grid is comparable in its operation to a diode or crystal detector.

Since there is no standing bias on the grid, it will be carried positive during each alternate half cycle of the input signal. Electrons will flow from filament to grid, thence back to earth through the grid return resistor Rg. This latter may typically have a value of between .27 and 2.7 megohms.

Now whenever current flows through a resistor, a voltage drop must appear across the resistor. This much will be evident from our earlier study of Ohm's Law. Since the voltage is caused by electrons (or negative charges) flowing to the grid, the voltage at the grid will obviously be negative with respect to earth.

This negative voltage is also present across the capacitor Cg, which has one end conected to grid and the other to earth. through the coil. By normal storage action, the capacitor therefore tends to acquire a charge, which is proportional to the voltage developed across Rg.

Without going into a lot of detail, it should be fairly obvious that a large input signal to the grid will cause heavier bursts of grid current to flow during the positive half cycles. As a result, considerable voltage will appear across Rg and as a charge stored by Cg.

With a small (or weak) input signal, the bursts of grid current will be of a lesser order, there will be less current through Rg and a smaller voltage across it and across Cg.

And here is the vital point. When the input signal varies in strength, with modulation, then obviously the voltage across Rg and Cg will vary in sympathy, increasing as the carrier amplitude rises, decreasing as it falls.

In other words, across those two components and therefore at the grid, a voltage is present which is negative in polarity and which varies in proportion to carrier amplitude. Thus, in its grid circuit, the triode provides a complete detecting action, changing the modulated RF input signal into a negative bias varying in sympathy with the original audio signal.

AMPLIFYING ACTION

This is the first half of the total action in the valve and involves those sections of figure 2 which are drawn in heavy outline. The second half involves the normal amplifying action of the triode. The varying negative voltage on the grid causes a corresponding variation in plate current through the phones, producing an amplified version of the original audio signal.

From the foregoing it will be obvious that operation of the detector depends on the presence of a grid capacitor and grid resistor (often called the "grid leak") and the absence of any initial bias. Because there is no initial grid bias, it is usual to operate a "GRID DETECTOR" with only a moderate plate voltage — 20 to 50 volts — so that it will not draw too much plate current with no input signal.

For all its technical interest, however, a grid detector as shown in figure 2, cannot boast any special order of performance. It is not markedly different, in fact, from the arrangement in figure 1 and the best that can be said is that it eliminates the need for a separate detector, the triode acting both as detector and amplifier.

That is not the end of the story, however. An addition to the circuit can make an enormous difference to the whole performance of a triode detector. It involves the use of REACTION or REGENERATION or POSITIVE FEEDBACK, terms which all mean much the same thing.

Figure 3 shows a triode detector incorporating what is probably the best known reaction circuit. Typical com-

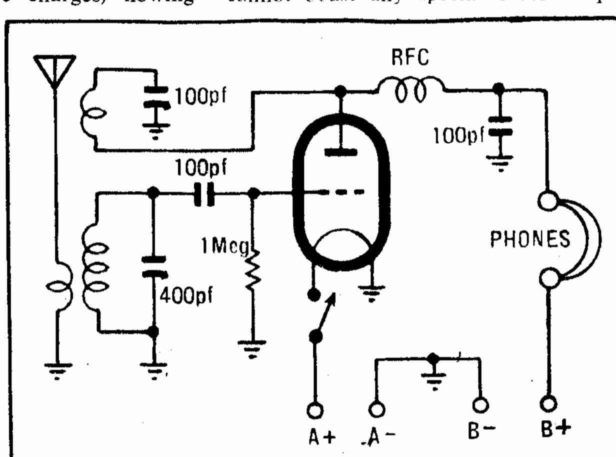

Figure 3: The addition of reaction or regeneration to the basic triode circuit shown in figure 2 makes an enormous difference to its performance. The reaction circuit shown is the most popular but there are many other possible circuit arrangements which achieve the same result. The function of the RF choke and bypass is explained in the text.

ponent values have been added for the sake of completeness.

It must be emphasised that this is not by any means the only possible arrangement for a one-valve receiver using reaction. It is popular and typical arrangement but it would be possible to produce a quite imposing article on the many circuits which have been evolved during the last thirty or forty years around regenerative detectors.

The tuning, detection and amplifying action are basically the same as for figure 2. However, advantage is taken of the fact that, over and above the detected audio voltage, there is present on the grid of a detector some of the original RF input signal. This is amplified and the signal at the plate contains the audio component, which operates the phones, plus an amplified RF signal.

When reaction is employed, this amplified RF signal is coupled back into the tuning coil in such a way that it adds to the signal energy already present. This involves placing a REACTION WINDING close to the tuned winding and so arranging the connections to it that the signals tend to add rather than to cancel.

Assume, for example, that there is a positive signal pulse at the grid, at a particular instant. This increases the plate current and causes a negative pulse at the plate. By impressing this pulse across the reaction winding and suitably arranging the connections, its phase can be reversed and coupled into the tuned winding as a positive signal.

This augments the original signal and produces a far greater total effect on the plate current than would the original signal alone.

MORE OUTPUT

The effect of feedback, therefore, is to make every positive signal excursion much more pronounced than it would normally be and every negative excursion likewise. The changes in signal level, due to modulation are made much more evident and therefore the audio signal delivered to the phones is greatly increased.

For a regenerative detector to operate correctly, it is most important that the amount of feedback be properly adjusted. If there is insufficient feedback from plate to grid, only limited benefit is obtained from the scheme. If there is too much feedback, the detector will oscillate of its own accord and begin to act as a generator of RF energy, exactly as described in the last chapter for a valve transmitter. (See figure 2, last month.)

To give the necessary control over reaction, it is customary to connect a small variable capacitor in series with the reaction winding. When this is fully meshed, maximum feedback current can flow from plate, through the reaction winding to earth. As the capacitor plates are opened, the impedance of the circuit rises and less feedback energy can flow through the coil.

When the reaction capacitor is set so that the detector is just below the point of active oscillation, the gain and selectivity of the detector and its tuning circuit is increased enormously. Used with an efficient aerial and earth, a one-valve reaction set can receive signals under favourable conditions from transmitters thousands of miles away.

The letters "RFC", in the circuit, stand for "radio frequency choke". This component, which is usually a honeycomb-wound coil, is inserted between the plate and the phones to ensure that RF energy at the plate is not bypassed to earth by capacitance of the phone cords. The RF is therefore retained for use by the reaction circuit.

At the same time, RF energy is undesirable in the phone cords, because it can radiate into space and back into the aerial tuning circuit, causing the reaction adjustment to be upset by random movement of the phone cords or even by the person wearing the phones.

The radio frequency choke is intended to prevent this trouble, its effect being augmented by the 100pF capacitor shown in the circuit. This bypasses any RF energy to ground which may still be present but it does not bypass the audio components, which have a much lower frequency than the RF carrier.

From the foregoing description, it might possibly be assumed that a one-valve set is all that should ever be necessary to receive radio signals but such is not the case.

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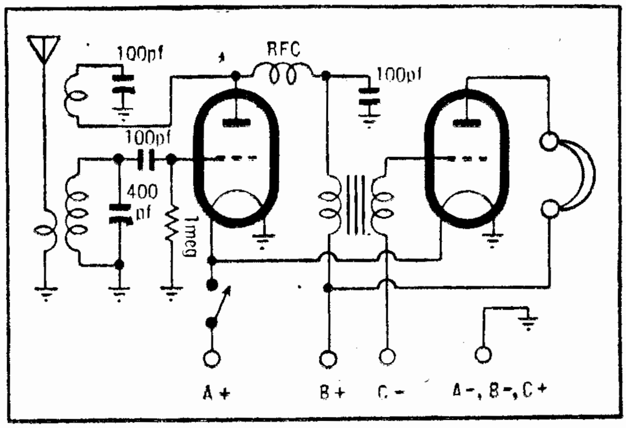
Figure 4: A two-stage receiver involving a regenerative detector and one transformer-coupled audio stage. Triode valves operate well into an audio transformer but not tetrodes or pentodes, which have a very high natural plate impedance.



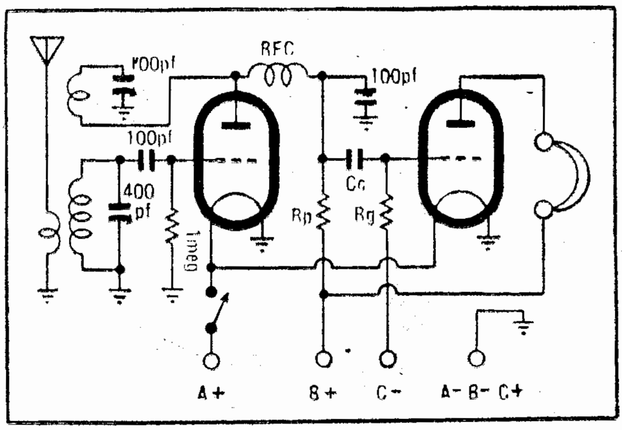


Figure 5: Another two-stage receiver, this time using resistance - capacitance coupling. Typical values would be 0.1meg. for the plate resistor, 1.0meg for the grid and .01mfd as coupling capacitor from plate to grid.

☆

Compared with a crystal receiver, a one-valve set has an enormous advantage in terms of SENSITIVITY and SELECTIVITY — terms which relate to its ability to pick up a wanted signal and separate it from other signals. For all that, however, its performance is still capable of substantial improvement.

For example, the signals heard in the phones from a distant station may be quite weak, requiring a good deal of concentration to follow them. The usefulness of the set can be increased greatly by adding an audio amplifier stage after the triode detector, exactly as already described in figure 1 for a crystal set.

This gives the basic circuit shown in figure 4.

The first valve is used as a regenerative detector but, instead of its output being fed directly to the phones, it is passed through an audio transformer and fed to the grid of a second valve, acting as an audio amplifier.

CLASS-A AMPLIFIER

It must amplify the signal without distortion and, referring back to the earlier chapter on valves, we may say that it has to operate as a "class A" amplifier, with a plate voltage and grid bias to suit the particular type of valve.

The amplified signals appearing in its plate circuit are then applied to the phones. Because of the extra amplification or GAIN, weak signals can be heard with less effort. Furthermore, the reaction control may not have to be set so critically to obtain adequate sound level, making operation and adjustment of the receiver that much easier.

The use of audio inter-stage transformers was commonplace many years ago, mainly because of the step-up they could give in the signal voltage. This supplemented, very usefully, the rather

ELECTRONIC A & R EQUIPMENT

TV NEWS

NOW! CHASSIS, POWER TRANSFORMER AND CHOKE FOR THE R.T. & H. T.V. RECEIVER!

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Mains Transformer

For the R. T. & H. 17" T.V. Receiver

MAINS TRANSFORMER DESIGN P.T. RECEIVER
Primary: 200, 230, 240V.
Secondary: 290-CT-290 V @ 275 mA.
Filament: 6.3V @ 9 Amps 5V @ 3A.

Horizontal mounting this transformer is designed for low radiation and in addition is fitted with a copper flux shorting shield to further reduce the external magnetic field. Colour coded leads. Height above chassis 3½in. Base size 4½in x 3¾in. Mounting centres 3¾in x 3in. Cut out 3 1/8in x 2 3/8in. Weight 11¾lb.

Filter Choke

DESIGN Z 1091. Inductance 1 Hy @ 275mA, D.C. D.C. Resistance 30 ohms. A strap clamp mounting with leads. Designed for low voltage drop. (Approximately 8 Volts at maximum current). Base size 4in x 2in. Mounting centres 3 9/16in. Height above chassis 2 9/16in. Weight 2lb.

T.V. Kit

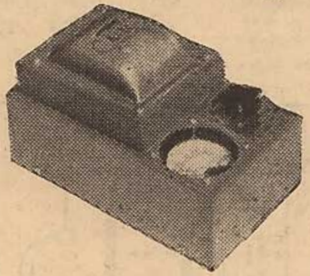
(Designed for use in T.V. circuit published by Philips Elect. Ind. Pty. Ltd.)

POWER TRANSFORMER: DESIGN P.T. 1790:
Primary: 200, 230, 240V 50 cps.
Secondary: 230-CT-230V @ 350mA.
Filaments: 2 x 6.3V @ 6 A.
Horizontal mounting. Fitted with copper flux shorting shield. Colour-coded, flexible leads. Height above chassis, 3½in. Base size 4¾in x 3¾in. Mounting centres 3¾in x 3 1/16in.

FRAME OUTPUT TRANSFORMER DESIGN O.1 2507: Designed to Philips' specifications. A strap clamp mounting, with colour-coded leads. Height above chassis 2 9/16in. Mounting centres 3 3/8in. Base area 3¾in x 2 3/16in.

POWER CHOKE. Design Z 1090: Inductance: 3 Hys @ 300mA. D.C. Resistance—50 ohms. An open clamp mounting (reversible) with leads.

T.V. Voltage Adjusters



AVAILABLE IN BOTH AUTO WOUND AND DOUBLE WOUND MODELS WITH OR WITHOUT 0-250v METER FITTED.

Designed primarily as aids to servicemen in installing and servicing television receivers these Voltage adjuster units are now being used in other applications such as correction of input voltages to Amateur transmitting and receiving gear, tape recorders, Hi-Fi audio equipment, etc., where the load imposed is within the capacity of the adjusters.

AUTO MODEL TYPE: A.T. 1215 (illustrated)

Input voltage (50 cycle A.C.) 190, 195, 200, 205, 210, 220, 230 or 240, adjustable by means of tapping switch. Input connector: Bakelite 3-wire type enabling any convenient length of mains cord to be used. Output voltage: 200 to 240 as selected internally. Output power: 300 V.A. (maximum output current 1.3 A.). Output voltage indicator 0-250V A.C. Meter (Optional). Output socket standard 3-pin flush type. Weight including meter 7½lb.

DOUBLE WOUND MODEL TYPE: P.T. 1832

Input voltage as for Auto model. Input connector as for Auto model. Output voltage: 200, 230, 240 as selected internally. Output power: 200 V.A. (Maximum output current 0.8 A.). Output voltage indicator as for Auto model. Output socket standard 3-pin flush type. Weight, including meter, 11lb.

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limited gain that was available from early valves.

As a component, however, audio transformers have always been rather bulky and expensive, prone to breakdown and liable to introduce distortion of one type and another. As a result, the growing tendency through the years has been to avoid them and to develop valves which are able to give adequate stage gain without the assistance of a transformer.

Figure 5 is similar to figure 4 except that resistance-capacitance coupling is used between the detector and audio amplifier stage. Some discussion relevant to the operation of this circuit appeared in Chapter 6 of this series, to do with valves.

A resistor, normally referred to as the PLATE LOAD resistor, is connected between plate and B-plus. With no input

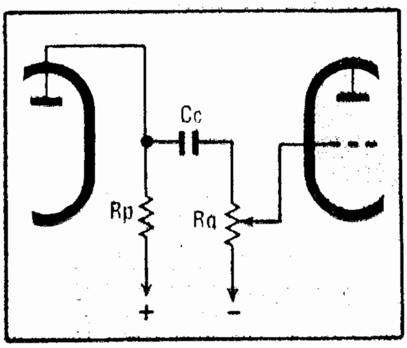


Figure 6: The most widely used and effective method of controlling volume is by a potentiometer in the grid circuit of an audio amplifier stage.

signal, a certain plate current flows through the resistor and produces a voltage drop across it. The plate, therefore assumes an initial potential with respect to earth, often equal to about half the B-plus supply voltage.

The following grid is returned through a resistor Rg to the bias source. Since there is no current flowing through this resistor, there is no voltage drop across it and the grid has the same initial potential as the bias source.

Between plate and grid is a COUPLING CAPACITOR (Cc). Since one end is connected to plate (a positive point) and the other end to grid (a negative point), the capacitor will acquire an initial charge equal to the difference between the two points.

SIZE OF CAPACITOR

The capacitor is always made large enough in respect to the two resistors so that it cannot alter its charge appreciably at an audio rate.

Now, when an audio component at the grid swings the plate current up and down, the voltage drop across the plate load resistor varies. As a result, the plate voltage itself varies at an audio rate.

Since the capacitor cannot alter its charge at an audio rate, it simply transfers the VARIATIONS in plate voltage to the following grid, the variations appearing at the grid and across the grid resistor as an alternating audio signal. The signal is then amplified by the second valve in the ordinary way.

In other words, the coupling capacitor transfers the signal from plate to grid but prevents the positive DC voltage on the plate from cancelling or upsetting the negative DC bias voltage on the grid.

Much more could be said about resistance-capacitance coupling, but the foregoing should convey the general principles involved.

Just as the addition of one audio stage to a detector makes for a more sensitive and versatile receiver, so can further improvement be obtained by using two audio stages, with either transformer or resistance-capacitance coupling. In point of fact, many domestic receivers in the early days of radio were designed around a detector and two audio stages.

USING A SPEAKER

In such a case, the amplification can be of such an order that the use of a speaker can be considered, rather than headphones. The convenience of a speaker is obvious but it does need to produce a great deal more sound output than phones, if it is to be heard properly.

This raises a special difficulty. If a speaker has to produce a lot more sound output or ACOUSTIC POWER, it has to be supplied with a lot more AUDIO POWER in the form of electrical energy.

If we can cut a lot of corners to make the point clear, we can say that most speakers and, of course, earphones operate by virtue of a changing flow of current through their windings. Therefore a lot of acoustic output requiring a lot of audio electrical power can also be thought of as requiring a large change of current flowing through the windings.

Now if a valve is to amplify without distortion, its plate current cannot swing beyond the limits of zero to twice the standing plate current. Therefore, if the last valve in a receiver is intended to draw only 1 milliamp of standing plate current, the maximum plate current change it can effect through phones or speaker is plus and minus 1 milliamp — that is from zero to 2 milliamps.

MORE CURRENT

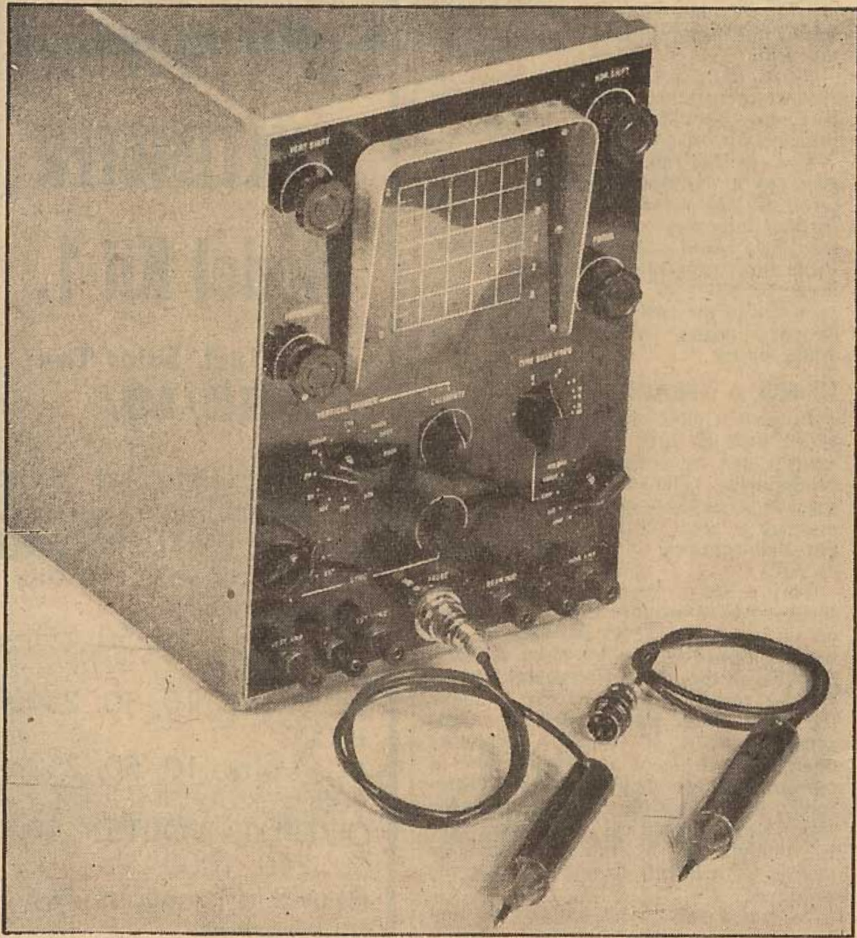
Such a change might be plenty for phones but it certainly would not be enough to produce much output from an ordinary speaker. To operate a speaker, therefore, it is necessary to use in the last stage of a receiver a valve which can draw a higher standing plate current. With a signal, the plate current can then swing through wider limits.

In point of fact, valve manufacturers have provided set designers with a whole variety of POWER OUTPUT or POWER AMPLIFIER valves, expressly designed for use in the final stages of receivers and amplifiers. They draw more plate current, of necessity, than other comparable amplifier valves and usually have a heavier filament or heater, to provide a more copious supply of electrons.

Throughout the discussion, also, we have assumed the use of triode valves. In actual fact, tetrode or pentode valves are frequently used as detectors or audio amplifiers, often giving higher gain or more efficient operation in particular circuits than comparable triodes.

It is beyond the province of this article to discuss the many possible circuit arrangements and, from the beginner's point of view, individual designs

(Continued on Page 79)



Two low loading probes complete the oscilloscope project. One is designed for low level signals and the other will handle up to 2,000 volts peak-to-peak.

Test Probes For Your Oscilloscope

The versatility of the Wide Band Oscilloscope described in the issues of Radio, Television and Hobbies of February, March and April, 1957, can be increased by the addition of low-loading, shielded test probes. This article discusses the problems of designing such probes and shows a simple and effective way of solving these problems.

by Maurice Findlay

Access to the vertical amplifier of the oscilloscope is ordinarily via a terminal on the front panel. In practical service work, the instrument would probably be mounted on a shelf above the test bench or on a mobile trolley. In either case, the length of lead between test point and instrument is not likely to be less than 18 inches.

INTO PANEL TERMINAL

It is interesting to analyse the position with regard to circuit loading when such a test lead is in contact.

From the circuit, some idea of the loading due to the instrument itself can be gained.

While it is always possible to quote the complex impedance for a particular frequency, our purpose will be served better by considering the resistive and capacitive components separately. At frequencies handled by the instrument, inductive components can reasonably be neglected.

Looking now at the input circuit of the vertical amplifier with the switch in the "500mV," "1V" or "2V" positions, the resistive component of the input impedance can clearly be seen to be near enough to 2.0 megohms.

Capacitive loading cannot be calculated so easily. Input capacitance of the valve, the switch, wiring, and the setting of the trimmer capacitor all affect the final result.

ESTIMATE OF LOADING

As you will remember from the setting-up procedure, trimmer capacitors are adjusted so that the total effective capacitance across each of the 1.0 meg. input resistors is equal. Experience shows that the capacitor across the upper 1.0 meg. resistor will normally be set at about 20 pF. With the two circuits in series, the capacitive loading seen looking into the network would be about 10 pF.

To this must be added stray capacitance between the input terminal and ground and that between the test lead and ground. The total could easily be up to 30 pF.

At 3 Mc/s the upper frequency the amplifiers handle without serious attenuation, the reactance of 30 pF is about 1,800 ohms. Compare this with the resistance component of 2.0 meg. and it becomes obvious that the loading is almost purely capacitive and that it will be very serious in high-frequency high-impedance circuits.

With the range switch set for the higher ranges similar remarks apply, except that the capacitive component is even higher and the resistance component a little over 1.0 meg., depending on the range.

There are many circuits in radio and TV receivers where loading of this order is not important, either because of low source impedance or low frequency components only being involved. In fact, test points are purposely chosen in order to enable service routines to be followed with instruments having specifications very similar to our own and without the aid of any special low-loading probes.

PERFORMANCE COMPARED

Most commercial oscilloscopes sold for television service work are designed to accept signals into a front panel terminal in the same way as ours and loading is of the same order.

However, by using special low-loading probes, investigations can be made at almost any point on the circuit, a most valuable facility when diagnosing unusual faults.

Yet another advantage of the low loading probe idea is that the additional "live" conductor can be confined to the inch or two making up the test probe. With a long lead between probe and instrument terminal, there is always the possibility of radiation from the lead getting back into low level circuits of the equipment under test and causing improper operation if not clear instability.

Let us now consider how to make a probe with the desired features. One type of probe makes use of the cathode follower amplifier.

THE CATHODE FOLLOWER

You are already familiar with this type of amplifier in the oscilloscope proper, where it is used in two places to provide a low impedance signal source. In the vertical amplifier it simplifies the switching circuits and in the time-base oscillator it provides a low impedance source for charging the capacitor of the Miller/transitron oscillator in order to reduce the flyback time.

This ability of the cathode follower to behave as a signal source with low internal impedance is extremely valuable in a probe. A shielded cable can be run between the probe and the oscilloscope proper without the capacitance between inner conductor and shield being prohibitive, provided suitable cable is chosen.

Typical cable suitable for the job would have a capacity of 30 pF per foot or less making the total shunt capacity of a suitable length probe cable of the order of 50 pF. At 3 Mc/s the capacitive reactance of the cable is about 1,100 ohms and, for low attenuation at this frequency, the output impedance of the cathode follower must be small compared with this.

Output impedance of a cathode follower stage depends on the type of valve employed, the load resistance and other conditions of operation. The valve itself is regarded as a generator with internal resistance—not a physical resistance but an equivalent which applies to small amplitude alternating current signals only.

OUTPUT RESISTANCE

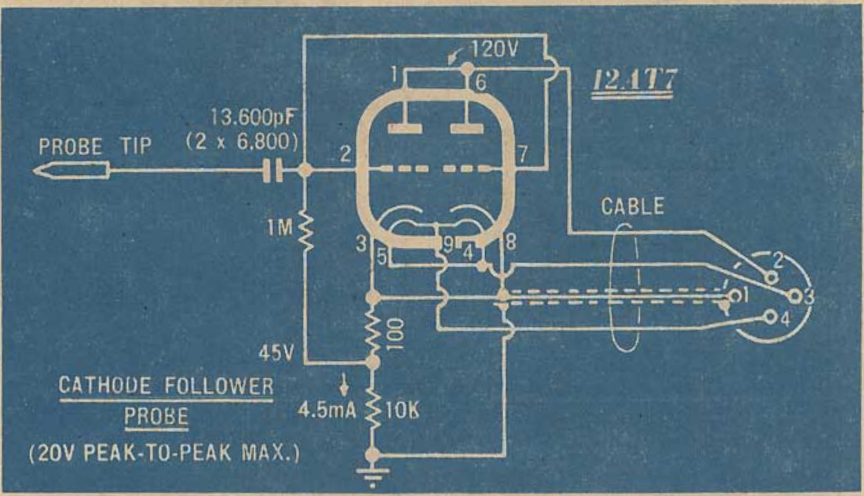
The valve equivalent source resistance may be calculated accurately but for most practical purposes is near enough to 1/gm where gm is the mutual conductance of the valve.

A figure for gm cannot be taken from the "typical characteristics" table of a valve data book since it depends on plate current. Graphs of gm plotted against plate current are available for most popular valves but the figure can be estimated from the plate family of characteristic curves.

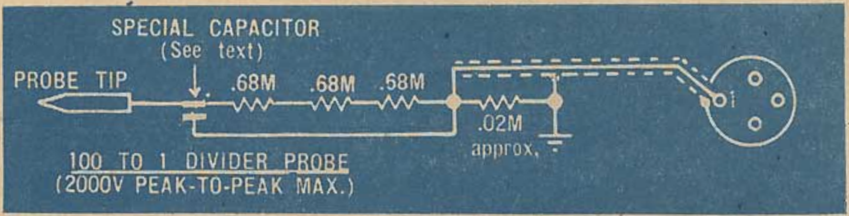
To give an idea of how the calculation works in practice we will find the output impedance of a 12AU7, two halves in parallel, plate current adjusted so that the gm of each section is 2 mA/V and with a 10,000 ohm load resistance.

The mutual conductance of the valve with the two sections in parallel is 4 mA/V so that the incremental output resistance of the valve is 250 ohms. The 10,000 ohm resistor in parallel with the output circuit can be neglected since the gm is not known, or required to be

CIRCUIT DIAGRAMS OF TEST PROBES



Low output impedance of cathode follower ensures that capacitance of connecting cable has small effect on high frequency signals. Probe has high input impedance.



Divider probe is able to handle high amplitude signals without distortion. Upper limit is due to insulation and resistor ratings.

known, with a high degree of accuracy.

Low as this is, it is obvious that some attenuation will result when a 3 Mc/s signal passes through the stage.

Unfortunately, the plate current for a gm of 2 mA/V per section for a 12AU7 is fairly high and it is better from the point of view of the overall design to choose a valve which has the required gm at as low a plate current as possible.

Type 12AT7 is a more expensive valve but is better than the 12AU7 by a factor of about 2 to 1. A fairly new high gm pentode which can be connected as a triode is the E180F. This is better than the two halves of the 12AT7 connected in parallel but not so much as to warrant the extra cost for our purpose.

Apart from output impedance, signal handling capability of the cathode follower deserves consideration. For operation in a probe it may simplify circuitry and mechanical details if the stage can be made to handle high signal levels.

THEORETICAL APPROACH

The undistorted output voltage which the valve can deliver may be determined by drawing a load line across the valve's plate family of characteristic curves in a manner similar to that for a normal plate-loaded amplifier. Limits are reached on the one hand at the zero bias curve and on the other at plate current cut-off. Note that this applies at low frequencies. We will see the effect at high frequencies in a moment.

Actually the cathode follower still operates with the valve grid positive with respect to the cathode but in this condition does not have the high input resistance we require.

Near plate current cut-off, the gm of the valve is low and the output resistance rises. Therefore, the actual maximum output voltage of the stage may be less than would first appear.

CAPACITIVE CURRENT

At frequencies high enough for the capacity across the output to have a reactance comparable with the load, the valve has to supply an appreciable additional current in order to charge this capacitance. For this reason also, the undistorted output voltage at high frequencies is less than at low frequencies.

An appreciation of the practical performance of a cathode follower with capacitive loading handling high amplitude, high frequency waves can be gained by applying a steep-sided high frequency square wave. (See photograph.)

Take the half cycle when the grid goes positive. The plate current increases and hence the voltage at the cathode, relative to earth, increases, following the grid. This part of the wave is handled well since, with the increased plate current, the gm of the valve increases and the output impedance of the valve decreases.

The position is not so happy when, at the end of the flat topped portion, the grid suddenly completes the negative excursion.

At first the cathode follows the grid but an appreciable time is taken to discharge the capacitance across the cathode circuit even through the low source resistance of the cathode follower. The acos

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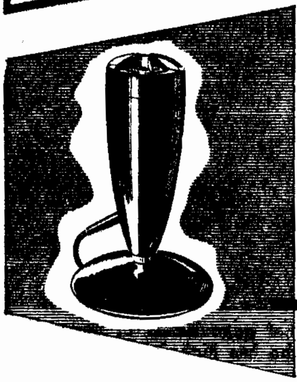

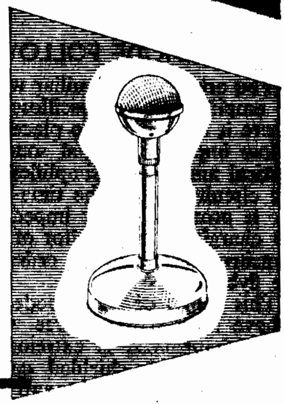

DESK or HAND MICROPHONE, MIC36

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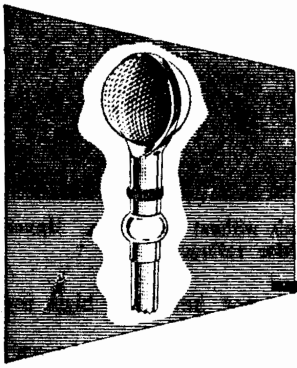

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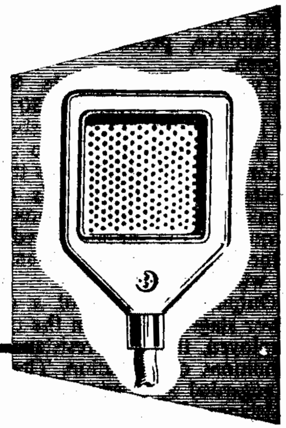

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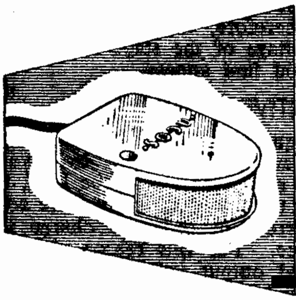

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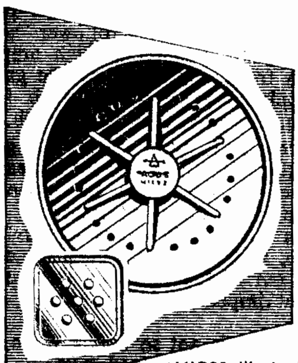

(MIC32 illustrated)
(MIC23 illustrated)

CRYSTAL MICROPHONE INSERTS

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position is then that the grid goes negative faster than the cathode and if the signal is of sufficient amplitude and the sides of the wave sufficiently steep, the plate current will be cut off altogether for a brief period.

When this happens, the cathode follower action is no longer present and, as far as the output circuit is concerned, we have only the charged capacitor with the load resistance in parallel with it. This resistance may be of the order of 10,000 ohms or 20,000 ohms compared with the few hundred ohms represented by the cathode follower, so that the capacitor takes a relatively long time to discharge. The effect of an extreme case of this phenomenon is clearly shown in the photograph taken from the screen of the oscilloscope.

UNLIKELY CASE

In order to emphasise the point we have deliberately taken an extreme case. High amplitude and high frequency components have to be combined for it to become serious within the range of interest to us. We can always use a divider type probe to handle the higher ranges efficiently, making the cathode follower a perfectly practical proposition for the lower voltage ranges.

In addition to a low output impedance, a cathode follower amplifier has a high input impedance, a very desirable feature. From the first glance at the circuit you may gather the impression that the input impedance of the stage is determined by the grid return resistor and the grid to cathode capacitance of the valve.

This is not the case since neither component returns to ground but rather to a point which is varying in potential, i.e., "following" the potential of the grid. If, in fact, the cathode were following the grid exactly the input impedance, disregarding stray resistive and capacitive components directly to earth, would be infinite.

INPUT IMPEDANCE

The more nearly the cathode follows the grid the higher the input impedance of the stage and best results are achieved by choosing a reasonably high value of load and a high gm valve. In practice, an increase in input impedance by a factor of from 5 to 10 times is generally realised. That is, if the grid return resistor is 1.0 megohm, the resistive component of the input impedance may be from 5 to 10 megohms. In some cases it is higher than this.

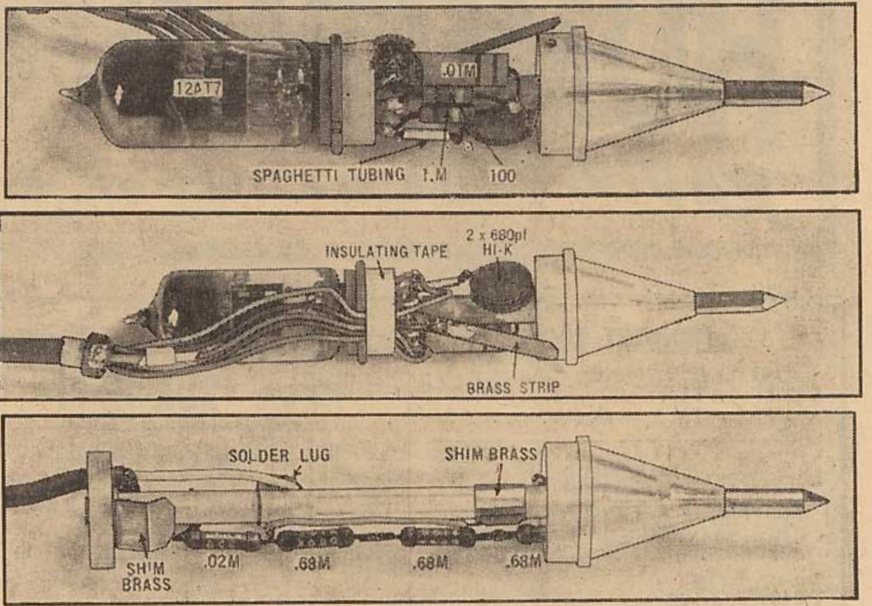
Input impedance and gain of the cathode follower stage are fairly closely related, as is obvious from the foregoing. Practical gain figures vary from about 0.8 up to 0.95 and above.

When the gain of the probe is around the 0.9 mark or better (as it is in our case), recalibration of the vertical amplifier will not normally to considered necessary. However, if particularly accurate measurements are required for a special reason, it would be a simple matter to add a separate calibration mark.

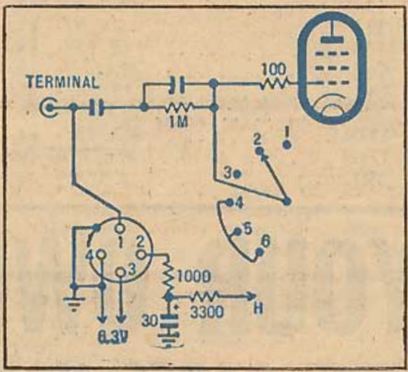
Before leaving the cathode follower probe, it is as well to note that it has the disadvantage of requiring both heater and high tension supply. The heater supply must have completely separate wiring from the signal circuit if the voltage drop across the connecting cable is not to cause appreciable hum in the output. Since only 0.5 volt peak-to-peak is required to deflect the spot across the screen, in our case, it takes very little hum to cause appreciable thickening of the line.

For the same reason, the high tension supply must be well filtered and well regulated if spurious deflections of the trace are to be avoided. The amount of filtering required is not readily calculable, but practical work proved that the elaborate filtering in our own instrument is necessary.

INSIDE VIEWS OF TEST PROBES



Mechanical layout is important for both probes both from the reliability point of view and for ease of adjustment and servicing. The upper two photographs show the cathode follower probe and, the lower, the divider probe.



Minor changes to the input circuit of the instrument proper are required to accommodate the probes. We originally had in mind a different circuit arrangement.

As well as being well filtered and regulated, the high tension supply must have a reasonable voltage and a reasonable current from the point of view of voltage handling capability and output resistance respectively.

Elaborate commercial instruments sometimes go so far as to employ a complicated electronic valve regulator to remove the last trace of hum and variation due to mains pulses, but we took the view that such complications are only justified in more specialised equipment.

Despite the limitations of the cathode follower and difficulty in providing a suitable high tension supply, it offers the most practical way of designing a probe to handle low signal levels.

At high signal levels it is possible to adopt a different and very much simpler means of obtaining a high input impedance.

Consider again the details of the circuit. The input resistance of the vertical amplifier is, let us say, 1.0 megohm, and the effective shunt capacitance, including a shielded connecting cable, 70 pF. These two components can form the lower part of a compensated attenuator with a factor of 10 when the impedance at the tip of the probe would be made up of 10 megs and 7pF.

For a factor of 100 the impedance would be made up of 100 megs and 0.7 pF, neglecting stray capacitance between probe tip and shield case.

IMPRACTICAL VALUES

Highly stable 100 megohm resistors are difficult to obtain, but there is another difficulty which makes it impractical to design a probe presenting such a high impedance at high frequencies.

The difficulty is due to capacity between the element of the resistor and ground. Capacitance between the resistance element and the tip of the probe can also play a part. The effect is to introduce spurious time constants into the circuit, making it impractical to properly compensate the divider network.

Even for 10 megohms input impedance the probe would have to be very large physically in order to reduce the effect to small proportions. After much thought and experiment we feel that the highest practical value is 2.0 megohms.

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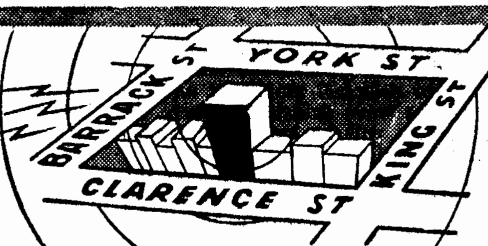

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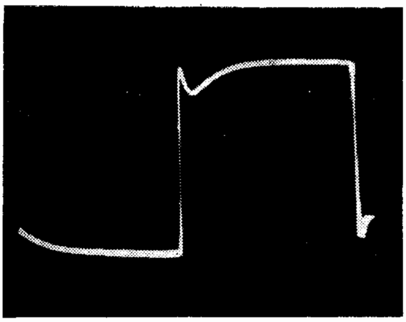
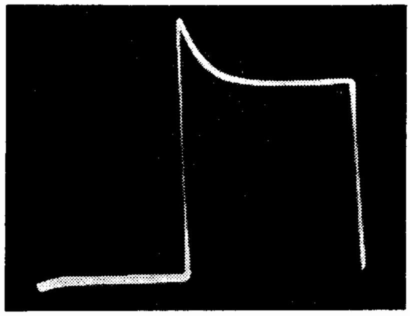
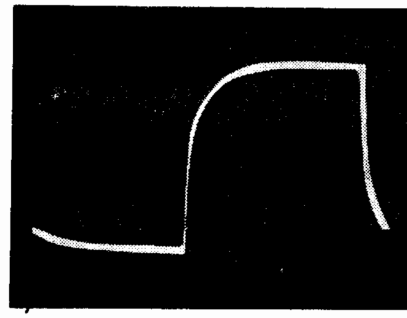


Effect of stray capacity between input resistance element and earth with the divider probe. Input resistance 10 meghoms and effect exaggerated by moving case close to resistor.



Input capacitor of divider probe set to too high a value. Peaks occur because high frequency components are amplified more than low frequencies.



Input capacitor of divider probe set too low. Adjustment is most sensitive with square waves in the range 1 Kc/s to 3 Kc/s.

It is then possible to use a probe housing with an overall diameter of 1 inch.

The lower value means that for a 100 to 1 division, the lower end of the divider must be a little over 0.02 meg only. The percentage change when this resistor is shunted by the different values of input resistance of the oscilloscope on different ranges is negligible while the adjustment of the capacitive component of the input impedance is also upset to a negligible degree because of the swamping effect of cable capacitance.

ADJUSTMENT METHODS

Consideration should be given to means of adjusting the capacitive divider network. Unlike the resistive component which can be made up of standard low tolerance resistors, the capacitive component is affected by stray circuit elements and must be adjusted accurately after the probe is complete.

Cable capacitance and the input capacitance of the instrument proper make up the lower arm of the divider. The total value is set mainly by the length of the cable and the shortest practical length is about 18 inches or two feet. Then to obtain the minimum input capacitance for the probe, about 1/100th of the cable capacitance should be connected across the high value resistor of the divider.

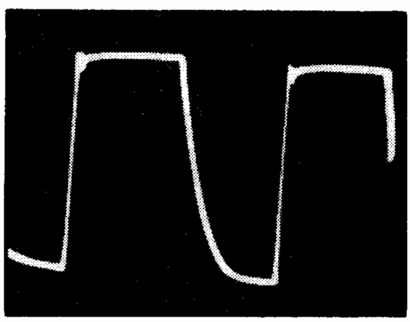
We made the capacitor up in the form of a clip which surrounds the centre poystyrene support rod. The threaded end of the probe tip screws into the end of the poly rod and, therefore, the polystyrene forms the dielectric of a capacitor, which can be varied in value simply by sliding the clip up and down the rod. Capacity is reduced as the clip moves away from the probe tip.

PRACTICAL DESIGN

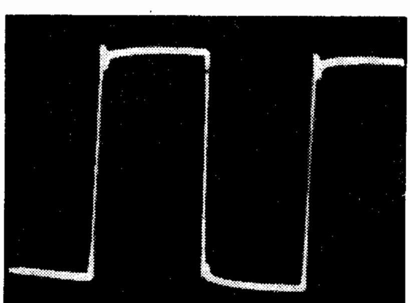
The discussion so far constitutes a consideration of the requirements of the probes and the general theoretical design. We now come to the practical design of probes to suit the "Wide Band Oscilloscope" described in the February, March and April issues.

A probe housing 1 inch max. diameter and 6 inches in length overall is available through trade channels. The body consists of a piece of chromium plated tubing while moulded polystyrene pieces are used at both ends. The housing is a little on the small side for certain elaborate probes but, on the other hand, a probe any larger would tend to be difficult to handle in cramped chassis. Therefore, an effort was made to keep the probe compact and, at the same time, all wiring components readily accessible.

Furthermore, it is a definite advantage if the inner part of the probe can easily be removed and returned to the case, particularly in the case of the 100 to 1 divider probe which has to be removed and replaced a number of times in the initial setting up in order to establish the optimum capacitor setting.



Serious distortion occurs when a high amplitude wave with small rise time is applied to cathode follower probe. In this case the frequency is 100 K/cs, the rise time is 0.04 uSec approx and the amplitude 15V peak-to-peak.



Distortion is small when the signal amplitude is reduced to 4 V peak-to-peak. Frequency and rise time are the same as above.

For both probes we have used a piece of ¼in outside diameter poly. tubing as a centre support pillar. The tubing is of such a diameter that it can be tapped 1-8in Whitworth or 5 B.A., and screwed over the end of the metal tip inside the housing.

In the case of the cathode follower probe, the poly. rod needs to be about 1in long. A 9-pin miniature valve-socket can be secured to the other end of the rod by means of a bolt soldered to the centre spigot of the socket. The two ½-watt resistors, the 1-watt resistor and the coupling capacitor can then be neatly soldered in place between the socket and the probe tip, using the photographs and circuit as a guide.

There is just room for the connecting wires to go alongside the valve envelope to join the connecting cable at the opposite end of the probe. At this point, a metal ring is soldered to the outer braid of the shielded cable in order to give firm mechanical support in case of strains on the cable.

INTERNAL WIRING

A definite connection is made between the centre spigot of the socket, the end of the 10,000-ohm resistor, and the case of the probe by means of a length of shim brass about 3-16in wide. It is soldered at the spigot at one end and is placed so that it jams between the metal case and the poly. moulding at the probe tip when the unit is assembled.

A shielded four-pin plug mates with the plug on the oscilloscope at the opposite end of the cable. Note that the earth return for the braid of the shielded cable is made via the shield of the plug.

Construction of the 100 to 1 divider probe employs the same central poly. rod. In this case it is 3¼in long overall, with a break at the 2¼in mark. The break is joined by a piece of 1-8in threaded rod (from a long bolt), with a small solder lug between the two poly. pieces. The idea is to make an anchor point for the live conductor of the connecting cable and the ends of the divider resistors.

Connection between the cable braid and the case of the probe is made by a piece of shim brass. Its shape and position can clearly be seen from the photograph. The lower end of the bottom divider resistor is soldered to this point.

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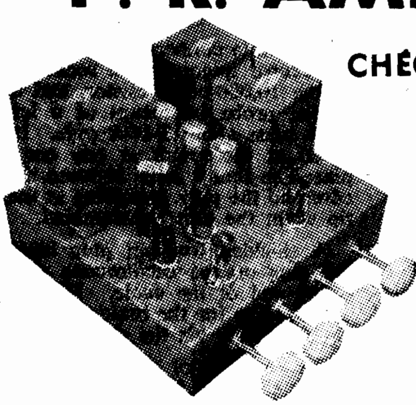

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The variable capacitor for adjusting the probe is made up of a piece of shim brass bent to clip tightly around the central poly. rod. It is joined to the junction of the divider resistors and the centre of the cable by means of a piece of small diameter flexible hook-up wire. This piece of wire should be kept away from the 680,000-ohm resistors in order to prevent spurious effects.

The value of the capacitor is adjusted by observing the behaviour of the probe when handling square waves in a similar manner to that used for the adjustment of the attenuator in the instrument proper. The adjustment is most sensitive at frequencies in the range from 1,000 cps to 3,000 cps.

OPERATION

There is very little about the operation probes likely to cause difficulty. The chassis of the oscilloscope will normally be earthed to the chassis of the apparatus under test. At the frequencies involved the inductance of the lead is not likely to be very significant and the special short lead from the probe housing to ground required with V.H.F. probes should not be needed.

The cathode follower probe should be used on ranges between 500 mV and 20 V peak-to-peak. Actually, at low frequencies it will handle about 50 V peak-to-peak but with sharp pulses distortion is likely to occur on the 50 peak-to-peak range. As shown in the photograph distortion can occur even on the 20 V peak-to-peak range but it is very rarely, indeed, that you will be calling on the probe to handle a signal with rise time as small as in the case shown. At low amplitudes, response is level up 3 Mc/s.

The 100 to 1 divider probe takes over for the 50 V peak-to-peak range which is achieved with the range switch to "500 mV." The upper limit of this probe's handling capacity is reached on the 2,000 V peak-to-peak range ("20 V") because of the 350 volt peak (700 V peak-to-peak) rating on the ½ watt high stability resistors.

FINAL TRIMMING

Incidentally, the division of the probe can always be accurately adjusted to 100 to 1 by placing a resistor either in parallel or in series with the lower end of the divider inside the probe. Since the maximum adjustment you are likely to require will be only a few per cent, this resistor need not be a high stability type.

Total input capacitance of both probes is only a few pF. The resistive component of the cathode follower probe input impedance is about 10 megohms while that of the divider probe about 2 megohms.

A minor alteration to the input circuit of the oscilloscope is required to accommodate the probes as shown. The "hot" lead from the socket should now be bridged across to the input terminal instead of to the centre of the divider as shown originally. This will mean a slight increase in the capacity of the trimmer across the input 1 megohm resistor and the adjustment should be made with the aid of a square wave generator. We originally had in mind another solution to the problem of providing a probe but the foregoing subsequently proved to be the more practical.

PARTS LIST FOR CRO WIDE-BAND

The instrument proper appeared in the February, March and April 1957 issues of Radio, Television and Hobbies. A description of accessory probes appears in this issue. Parts for both probes and instrument proper are included in the following list.

Certain small components are assigned odd values which will not normally be available from radio parts suppliers. These can be made up by combinations of standard small components. The peaking chokes mentioned will normally be adjusted to the required value by winding turns off a standard single pie RF choke.

1 special Wide Band CRO case including shield for graticule.
1 special Wide Band CRO chassis including shield pieces, brackets etc.
1 engraved front panel.
1 calibrated graticule.
1 special cathode ray tube shield.
4 lengths of ¼in. diam. brass rod 15in. long.
4 lengths brass tubing ½in OD, ¼in. ID and ¾in. long.
2 insulated couplers for ¼in. shaft.
1 kit of special transformers for Wide Band CRO consisting of two transformers with external copper bands. (1) 340v-0-340v at 150mA (2) 5v at 2A, 6.3v at 3A, 6.3v at 1.1A tapped at 4v, 4v at 1A tapped at 2.5v, 860v at 2mA.
1 4 henry, 200 mA filter choke 50 ohm resistance.
2 "Jabel" probe housings.
1 length polystyrene rod, ½in. OD, threaded ⅛in. whitworth inside.
2 Single pie RF chokes.

VALVES

1 0A85 germanium diode.
1 OD3/VR150.
1 2X2-A.
1 5BP1 cathode ray tube. (type VCR97 is suitable but requires a different shield and socket).
1 5V4-G.
3 6BX6.
2 6CK6.
1 12AT7.
2 12AU7.

SWITCHES

1 2 bank, 2 pole, 5 position.
1 2 bank, 1 pole, 12 position
1 1 bank, 3 pole, 3 position.

POTENTIOMETERS

Potentiometers with linear element are desirable in all cases and essential for the time base frequency control if the frequency is to correspond with the panel scale.

2 2 megohm.
1 1 megohm per section dual potentiometer.
1 0.5 megohm.
1 0.1 mekohm.
1 0.1 megohm with switch
1 0.05 megohm.
1 500 ohm.

HIGH, STABILITY PRECISION RESISTORS

Thes resistors will normally be ordered with a 5pc tolerance. Note that final adjustment of values for calibration purposes can be made by wiring ordinary carbon resistors either in series or parallel as required. There will be negligible change in the stability of the combination.

1 1 megohm, 1 watt.
1 1 megohm, ½ watt.
3 0.68 megohm, ½watt.
1 0.055 megohm, ½ watt.
1 0.02 megohm, ½ watt.
1 7,000 ohm, ½ watt.
1 5,000 ohm, ½ watt.
1 500 ohm, ½ watt.
4 200 ohm, ½ watt.
1 100 ohm, ½ watt.

N. F. B

RESISTORS

2 2.0 megohm, 1 watt.
1 2.0 megohm, ½ watt.
4 1.0 megohm, ½ watt.
4 0.47 megohm, ½ watt.
5 0.22 megohm, 1 watt.
1 0.15 megohm, 1 watt.
6 0.1 megohm, 1 watt.
1 0.1 megohm, ½ watt.
2 0.047 megohm, 1 watt.
3 0.033 megohm, ½ watt.
4 0.022 megohm, 1 watt.
6 0.01 megohm, 1 watt.
1 5,000 ohm, 20 watt, with mounting feet.
1 3,300 ohm, 1 watt.
2 3,000 ohm, 20 watt with mounting feet
2 2,200 ohm, 1 watt.
1 1,500 ohm, 1 watt.
1 1,000 ohm, 5 watt.
2 1,000 ohm, 1 watt
2 680 ohm, 1 watt.
6 100 ohm, ½ watt.
1 68 ohm, ½ watt.
3 33 ohm, ½ watt.

CAPACITORS

1 30 uF, 350 PV electrolytic.
1 25 uF, 40 PV electrolytic.
6 16 uF, 600 PV electrolytic.
1 8 uF, 600 PV electrolytic.
1 8 uF, 350 PV electrolytic.
1 1 uF, 2,000 volt working paper.
1 0.5 uF, 200 volt paper.
3 0.25 uF, 600 volt paper.
1 0.25 uF, 200 volt paper.
1 0.1 uF, 600 volt paper.
1 0.1 uF, 200 volt paper.
1 0.047 uF, 200 volt paper.
1 0.035 uF, 600 volt paper.
2 0.01 uF, 600 volt paper.
2 0.005 uF, mica.
1 0.0047 uF, mica.
2 0.001 uF, mica.
2 680 pF, HI-K ceramic.
1 390 pF, mica.
1 300 pF, mica.
1 250 pF, mica.
1 100 pF, mica.
1 50 pF, mica.
1 25 pF, mica.
5 3 to 30 pF, air dielectric trimmers.
1 10 pF, mica or ceramic.
2 4.7 pF, ceramic.

SUNDRIES

2 octal valve sockets, 1 4-pin valve socket, 8 9-pin miniature valve sockets (2 with shields), 1 socket for cathode ray tube, 2 4-pin shielded plugs (microphone type), 1 panel mounting shielded socket to match, 4 round instrument knobs, 6 pointer knobs, 6 terminals, dial lamp, bezel, approx. 4 feet low capacitance mic. cable, spaghetti tubing, rubber grommets, hook-up wire, tag strips, nuts and bolts, tinned copper wire, solder lugs, power flex, power plug etc.

Here's your answer, Tom!

In common with everybody starting out with radio as a hobby, Tom is bewildered by the array and complexity of electronic equipment in use today. Even the humble domestic receiver has its share of mysteries and this month's mail bag contains a wide selection of queries ranging from detectors in broadcast and UHF receivers to relaxation oscillators and radio altimeters.

If a diode is a rectifier valve, how is it that diodes are used for detection and for obtaining A.V.C.?

This question may be quite simply answered, Tom, for the process of detection is essentially a process of rectification applied to the incoming signal voltage. The A.V.C. voltage, too, is obtained by rectifying the radio frequency carrier wave, to produce a D.C. control voltage.

In the conventional diode detector only the positive half-cycle excursions are conducted and the resultant currents pass through a resistor called the diode load. The currents through the diode load are very sharp pulses of energy at the frequency of the carrier wave.

A capacitor placed across the diode load has the effect of storing these rectified pulses, merging them into what is virtually a D.C. voltage.

RECTIFIED VOLTAGE

When the carrier is modulated, the rectified voltage tends to vary according to the change in carrier strength. By selecting a storage capacitor of the right order, the voltage across it can vary at an audio rate, with modulation.

This is, in fact, what is done. The diode rectifies the incoming modulated signal and feeds it to a filter or storage capacitor which is not large enough to bypass the audio component.

To obtain an A.V.C. voltage, which must be free of both the R.F. and audio component, it is necessary to use a much larger value of storage capacitor. As a rule, the rectified pulses are taken from the diode circuit through an isolating resistor of about 1 megohm, then to a large capacitor of about .05 to 0.1 mfd.

The storage effect of the capacitor is such that the voltage cannot vary at an R.F. or audio rate but only at a slow rate, as might be caused by fading or tuning the receiver from one station to the next. By applying this voltage to the grids of one or more high frequency amplifiers, the gain of the receiver can be kept fairly constant.

★ ★ ★

Would you please explain selectivity.

The word "selectivity" refers to the ability of a receiver to select a wanted signal and reject other signals being radiated on adjacent frequencies. In the light of its performance in this respect, a receiver may therefore be described as "selective" or "unselective."

The overall selectivity of a receiver depends on the selectivity characteristics of the tuned circuits which it employs. There may be only one of these or several, depending on whether the set is a simple one or complex.

A set using several tuned circuits will normally be more selective than one using a single tuned circuit. At the same time any receiver will naturally be more selective if its individual tuned circuits are good in this respect.

RESONANCE GRAPH

It is usual to depict the characteristics of a tuned circuit as a graph of its resonance curve. The graph shows the degree to which the response falls off at either side of the resonant frequency.

A narrow, steep-sided curve indicates good selectivity, while a wide one with gently sloping sides indicates the reverse.

The selectivity of a tuned circuit depends, a good deal, on its high frequency loss or "R.F. resistance." The ratio of the capacitive or inductive reactance to circuit resistance affects the sharpness of the selectivity curve. Thus, for a given reactance, lowering the circuit resistance will increase the ratio and sharpen the resonance.

The inductor generally contains most of the R.F. resistance and much thought has been given to the design, as evidence by the use of litz, wire and iron cores.

Another factor which affects the selectivity of a circuit is the ratio of inductance to capacitance. In a parallel circuit the highest selectivity is obtained by using a large capacitance and a small inductance.

However, this circuit is required, in most applications to act as a high impedance and develop as high a voltage as possible across its ends from the oscillatory current flowing throught it. To obtain a high impedance at resonance the inductance must be large and the capacitance small. A compromise is therefore necessary.

It is not always necessary to strive for the lowest possible circuit resistance, since too sharp a selectivity curve will produce attenuation of the higher modulation frequencies. Thus, in receivers intended primarily for wide-range reception, actual resistors are often connected across the tuned circuits to increase their losses and broaden the selectivity curve.

★ ★ ★

What is the purpose of shielding in electronic equipment?

Shielding is used in electronic equipment to prevent coupling between circuits through electric or magnetic fields. Such coupling may allow energy to feed back from the later to earlier stages and cause instability.

Hum, too, may become a serious problem because of coupling between circuits carrying 50-cycle currents and high impedance circuits such as grid circuits.

Shielding takes many forms but essentially it consists of enclosing the circuits most susceptible to radiation pickup within metal screens. Valves which do not contain an internal shield are enclosed within cans. High impedance audio leads are made with shielded hookup wire, the circuits around high-gain preamplifier stages are frequently completely enclosed within shielded boxes, and so on.

CONDUCTIVE SCREEN

The screen must be of highly conductive material and must be well earthed. Copper and aluminium are the most widely used metals for shields, which may either be solid or in the form of a mesh.

Screens such as those used for the coils in a radio set must confine both electric and magnetic fields. However, radio frequency currents tend to flow on the surface of the conductors, due to skin effect, and very thin metal can make an effective screen.

As the frequency is reduced so does the effective thickness of the screen have to be increased for equivalent shielding. This becomes impracticable if carried out to the extreme and, for low frequency magnetic shielding, it is customary to use metals of high magnetic permeability such as Mu-metal and Permalloy.

★ ★ ★

What is a retarding-field detector?

A retarding-field detector is a type of detector used in ultra-high-frequency circuits. A special detector valve is used in which the electrons, in their transit from cathode to anode, come under the influence of an external field which alternately accelerates and decelerates them. Because this causes some electrons to move faster than others the electron stream is said to be "velocity modulated."

In their transit, the electrons have to move past a collector electrode which is placed at a low potential. This electrode actually tends to repel the electrons and succeeds in turning back the slower ones but the faster moving electrons are collected and withdrawn from the stream.

Since these faster electrons have been

introduced into the stream by the process of being modulated externally, the removal of these in effect, is a process of demodulation. It is thus possible to obtain a current varying in intensity with the original modulation.

★ ★ ★

What is a rotary converter?

A rotary converter, Tom, is virtually a single-unit motor-generator used for converting A.C. to D.C. or vice versa.

The D.C. section has a regular commutator while the A.C. section has slip rings for connection to the armature.

When converting from D.C. to A.C., rotation of the armature and output from the slip-rings gives the A.C. The other way round action of the commutator gives the rectification effect.

It is only a matter of design to give any required relationhip between the input and output voltage, while the size of the machine largely determines how much power it can handle.

★ ★ ★

What is a relaxation oscillator?

A relaxation oscillator is one in which the frequency of oscillation is governed by a combination of capacitance and resistance. The simplest relaxation oscillator consists of a capacitor and neon lamp connected in parallel and in series with a resistor and a DC supply which exceeds the striking voltage of the neon lamp. A circuit of this type is reproduced and, referring to this, the action is as follows:

When the circuit is closed, the capacitor charges through the resistor. The charge rises exponentially with time until the striking voltage of the neon is reached, at which point the neon tube draws heavy current. Due to the increased current through the resistor, the potential difference across the capacitor drops sharply until the extinction voltage of the neon is reached, and becomes virtually an open circuit again.

The charging cycle then recommences, the process continuing as long as the circuit is closed.

Normally, the output waveform of this oscillator has a sawtooth nature and the circuit is frequently used as a simple time-base generator.

A more complex circuit, as used in many test oscilloscopes, uses a gas-filled triode or tetrode valve. The charge and discharge action is much the same as for a simple neon oscillator, but the grid allows the rate of oscillation to be synchronised more easily with wave forms which may require to be observed.

★ ★ ★

What is a radio altimeter and how does it function?

A radio altimeter is a device used in aircraft for determining the height of the aircraft above the ground by means of radio waves. Two basic types of altimeters are possible. In one, use is made of the time taken by a radio wave to travel from the plane to the ground and back again. A sender in the plane is used to radiate a wave of a high frequency nature to the ground from a horizontal dipole.

The frequency is varied cyclically by one of several methods, and a receiving aerial is so mounted that it picks up the radiated waves, both directly and after reflection from the ground.

Since the aerial picks up both waves, the two waves received at the aircraft will differ in carrier frequency, because of the frequency change that occurs during the time taken by the reflected wave to travel to the ground and back.

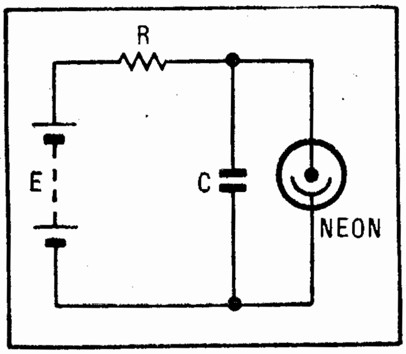
Since this frequency difference depends on the height of the plane above the ground, the output from a detector gives an exact indication of feet above the ground, the answer being displayed on a suitably calibrated meter.

A second type of altimeter is known as the capacitance altimeter and uses the capacitance of the aircraft to ground as part of a tuned circuit. Any variations in the height cause corresponding changes in the potential difference across the tuned circuit. Once again, an instrument calibrated in feet may be used to measure the changes in potential difference. This type of altimeter is useful only for relatively low altitudes, since the change in capacitance becomes negligible above about 100 feet. It is thus used for low level flight and landing operations.

★ ★ ★

What is neutralisation in receivers used for?

Neutralisation is a method of stabilising RF or IF amplifiers by means of negative feedback to balance out positive



feedback that may be present through the capacitance of valve electrodes or associated circuitry. Numerous methods of neutralisation have been devised, but consist essentially of feeding back some out-of-phase energy from the plate circuit into the grid.

A method which we have found useful in removing unwanted regeneration in IF channels, particularly in wide-band tuners, is to connect a capacitor, of about 30 pf, between the plate of the IF amplifier and the F terminal of the first IF transformer.

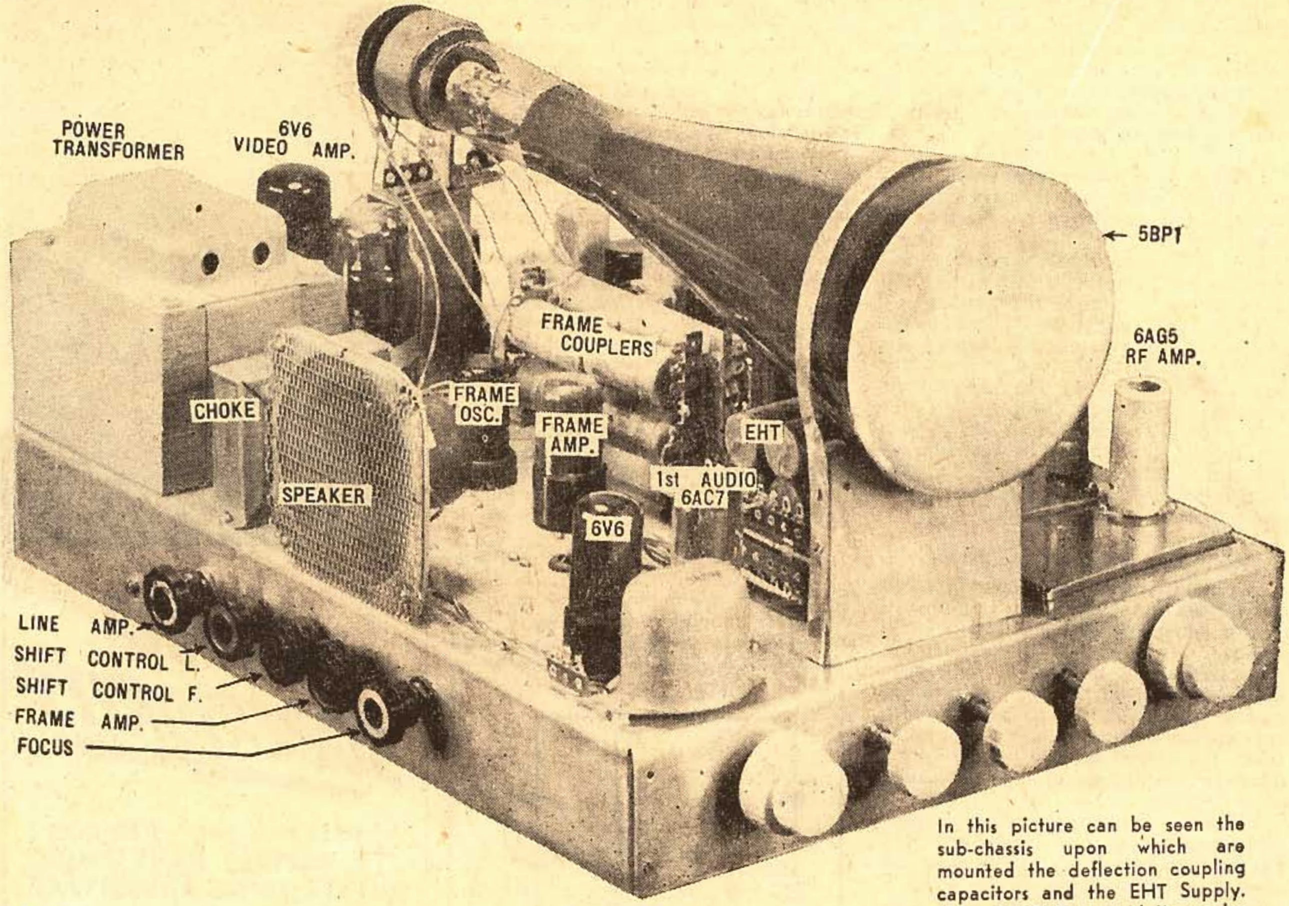
★ ★ ★

Why do reversed connections on a coil affect its performance? If the coils are wound in the same direction and we are dealing with A.C. currents I can't see the reason for this.

In addition to the normal inductive coupling between the two windings of a coil, there is a capacitive component due to their proximity. The manufacturer normally marks his component so that the capacitive component assists the inductive coupling.

If the connections are reversed, the components oppose rather than add with the result that the gain drops considerably.

In cases where the capacitance due to the proximity of the coils is insufficient to provide the desired characteristic a special capacitor is included. In this case reversing the connections would be even more disastrous, the extra capacitance acting as a bypass rather than a coupling medium.



In this picture can be seen the sub-chassis upon which are mounted the deflection coupling capacitors and the EHT Supply. If an RF EHT is used it can be mounted in the space now occupied by the speaker which can be moved elsewhere.

How To Build A 5-Inch TV Receiver

Here is our long promised 5-inch TV set which has outgrown the super-simple stage into a full-blown receiver. It will give perfect little pictures and contains some novel and interesting features. While cost has been kept low, it has not prejudiced performance.

EVER since the commencement of TV services in Australia, experimenters have been making their own receivers using the 5BP1 cathode ray tube.

Many of them have used the details we published in our issue of last December which covered many of the more difficult problems, including the video and sound IF strips.

It was our intention to describe such a receiver in full, for the details referred to left some of the receiver sections untouched and there are many points about layout and materials which the constructor will want to know about.

As it happened, our 17in receiver reached publication standard a little earlier than expected and we postponed the 5in model in favour of it.

The phenomenal response to the bigger set has more than justified giving it precedence.

Now, however, we can turn back to the 5BP1, quite convinced that there are still large numbers of our readers who are waiting for it. And we have been able to occupy the time in between with a series of experiments designed to establish the best circuitry to use.

MANY IDEAS

This in itself is not an easy matter, for many and varied have been the ideas which enthusiasts have pressed into service. These ideas have included the use of other types of tubes and quite a few have modified their normal CROs for the display of pictures.

For our own part, we have built and rebuilt the set many times, particularly the line and frame circuits, in order to select what we think to be the simplest and best. So that we could parallel experiences of our readers, we started with the circuits of last December, but the final design shows many departures.

For simplicity, the original concept proved very hard to beat. But it had some shortcomings, well realised at the time, which we have set out to modify.

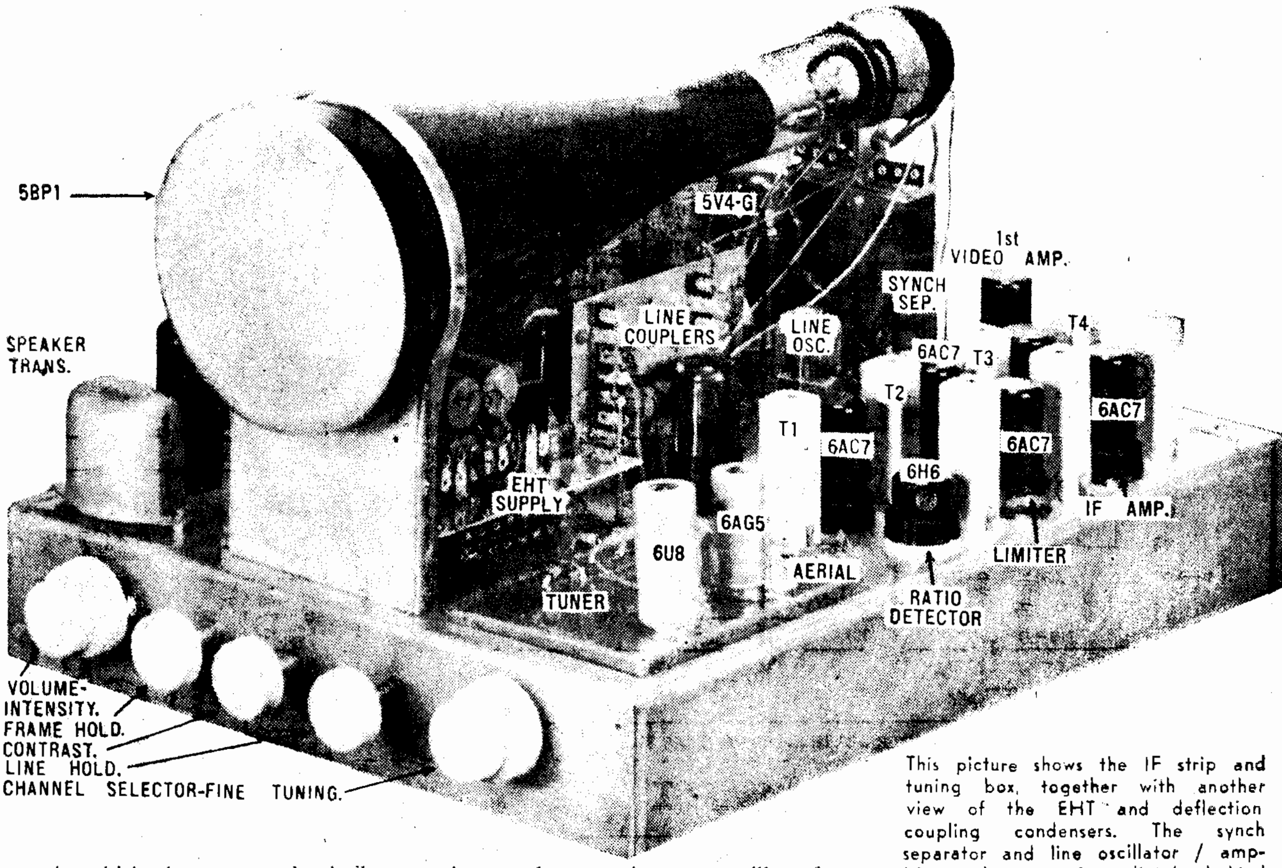
For instance, the frame linearity, despite some correction made possible with later amendments, needed some improvement. We solved that one by adapting the oscillator circuit used in our Wide-band CRO, which was notable for its linearity.

We found, too, that extra video gain was desirable in many cases and its addition allowed us more freedom in the provision of synch. pulses and better balance with the sound channel.

AGC will be found essential in strong signal areas, where differences in signal strength, even from station to station, can otherwise be embarrassing.

And, of course, we had to provide an EHT supply for the 5PB1, which we know has been causing some of our readers a little trouble.

We do not say that this is the only



This picture shows the IF strip and tuning box, together with another view of the EHT and deflection coupling condensers. The synch separator and line oscillator / amplifier valves are immediately behind the strip.

way in which the set can be built to give good results. But it is the best combination of all the ideas we have been able to accumulate, and we are satisfied that, properly put together, it should give comparable results in the hands of others.

Fortunately, the addition of extra valves has little significance when their low cost is considered.

In the ratio detector, for instance, it is cheaper to use a 6H6 than to buy two germanium diodes, and the circuitry is simpler. In this case, we used the detector of the 17in set previously described, for which our coils proved quite suitable.

A similar valve could have been used for the video detector, but here we thought the more compact wiring allowed by the germanium diode was an advantage.

IDEAL FOR EXPERIMENT

This opportunity for experiment is one of the most valuable points about a receiver of this type. There are many people who would like some practical experience with TV receivers, who cannot spend a large amount of money to get it. They may even own a commercial receiver but, for obvious reasons, they do not wish to commence taking it apart!

On these grounds the case for the 5in set is very strong.

In the first place there are very large numbers of 5BP1 tubes already stacked away in the junk boxes of people who bought them for a few shillings in the hope that some day they would come in useful. Some of our readers have three or four of them which they have never used.

And although the supply is now beginning to dry up, there are still a few tubes to be had here and there.

In the second place there are large stocks of disposals valves which electrically are ideal for use in such a receiver, such as the 6AC7 and 6H6, each currently selling for about 4/ each. More than half the valves used can be these types, and only one or two of the remainder need be bought at full price.

As our set uses 20 such valves, this represents a big saving in cost with no sacrifice in performance.

Many other parts, particularly resistors, can be pressed into service from the junk box, good condition being the only real requirement.

And because we are able to give full information on coil winding, it is quite possible to build your own IF strip from the ground up, thus reducing the total outlay still further.

When it is all finished, and maybe the constructor begins to think in terms of a bigger set, a great many of the components can be transferred without loss, including the tuning box and IF strip which are built to commercial standards of performance.

by John Moyle

Now because we have mentioned the use of disposals parts, it would be a mistake to imagine the finished receiver has no appeal in its own right.

In matters of stability, definition, sensitivity and the like, it is a perfect little TV set for everyday use, the only real limitations being the size of the screen and the fact that the picture is green instead of white.

You will have to accept our word that, despite its size, the tube will give good entertainment value and, after you have become used to the green picture, the colour is not really a worry.

GOOD CONTRAST

As a matter of fact, the sensitivity of the eye to green is such that this colour is one of the best for appreciating contrasts between dark and light picture areas. When picture definition is good, and the set correctly adjusted, the pictures appear almost as though etched on the glass.

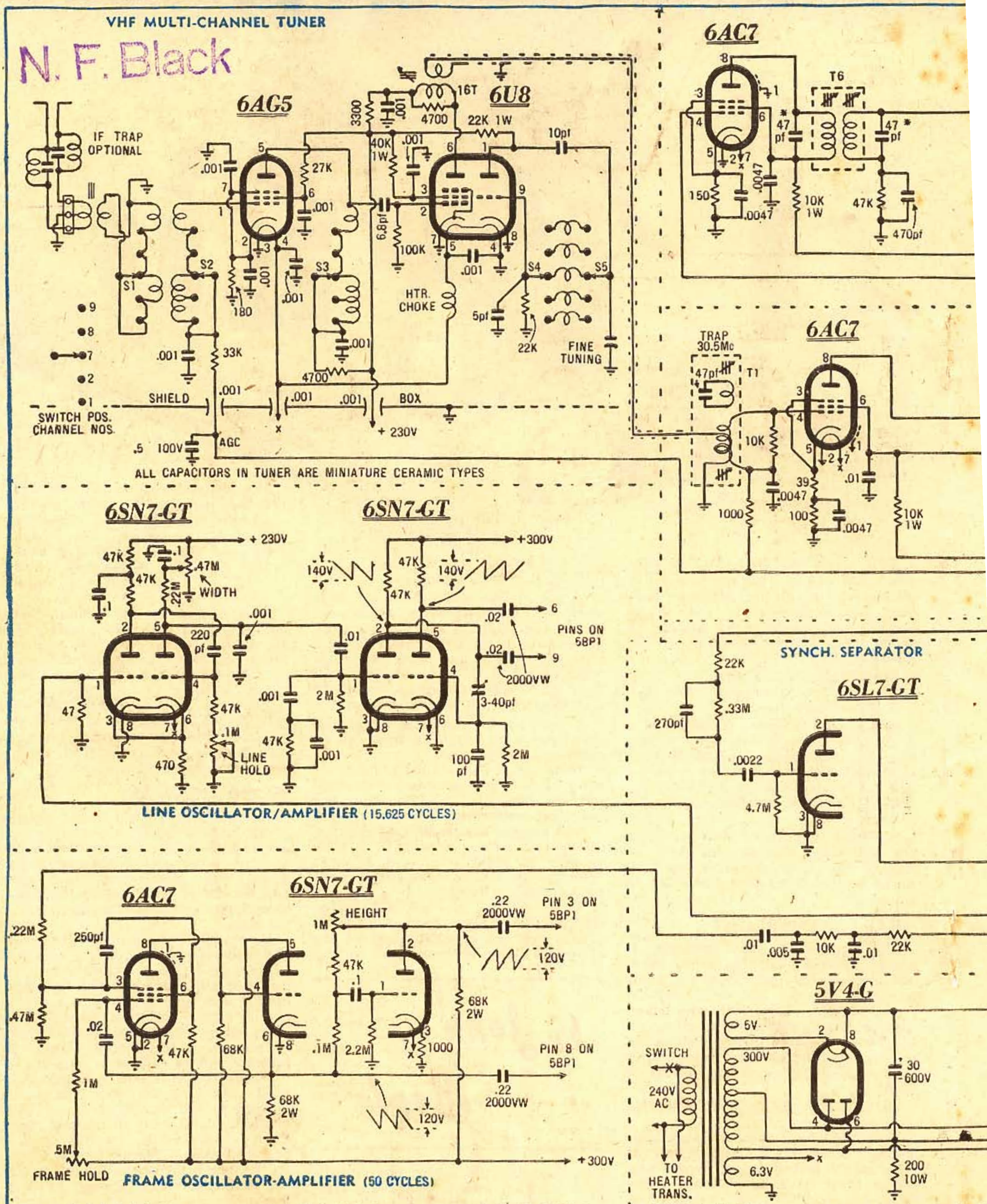
By extending the picture right out to the edges of the tube, where little will be lost, the image is considerably larger than one might expect. The line structure is too fine to be seen easily at normal picture size and, although there is no reason why interlacing should not be normal, it is doubtful whether its presence will be evident at all.

Picture brilliance, too, is unexpectedly good. As long as direct light is not allowed to fall on the screen at close quarters, particularly fluorescent light, there is no need to use the set in a darkened room. The use of full voltage on the tube is the reason for this and, as we shall later see, it presents no problem.

If you are lucky enough to find a 5BP4 or equivalent tube which has a black and white phosphor, you will not

(Continued on page 59)

CIRCUIT DIAGRAM OF 5-INCH TV RECEIVER WITH ALL

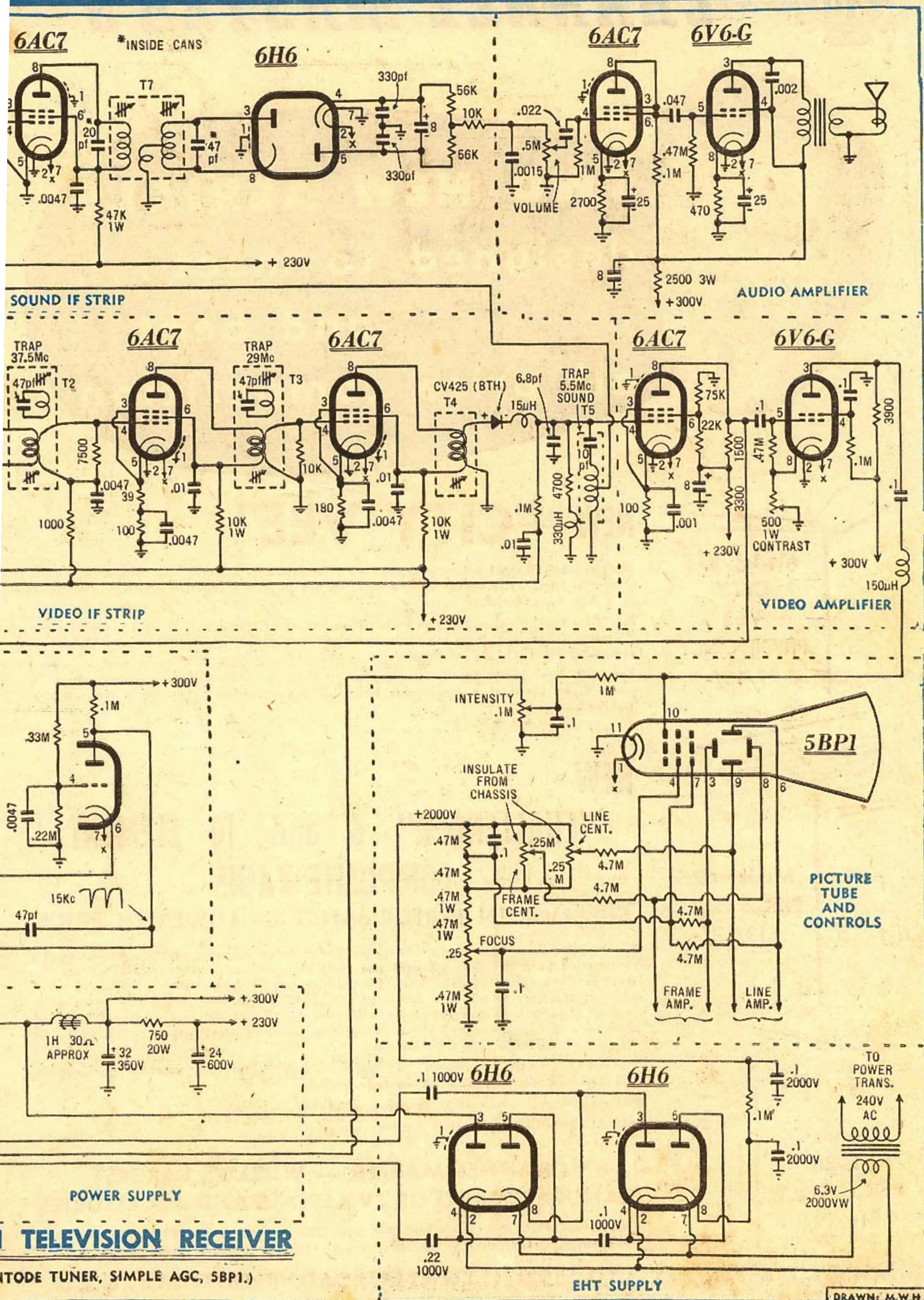


1. ALL CAPACITOR VALVES ARE SHOWN IN MICROFARADS, UNLESS OTHERWISE MARKED.
2. ALL RESISTORS ARE HALF-WATT UNLESS OTHERWISE MARKED.
3. VOLTAGES ARE AS MEASURED IN PROTOTYPE CHASSIS, USING STANDARD TOLERANCE NOT DESIGN CENTRE COMPONENTS.
4. ALL RESISTOR VALVES ARE SHOWN IN OHMS UNLESS OTHERWISE MARKED. (M = MEG., K = x1000).

5-INCH

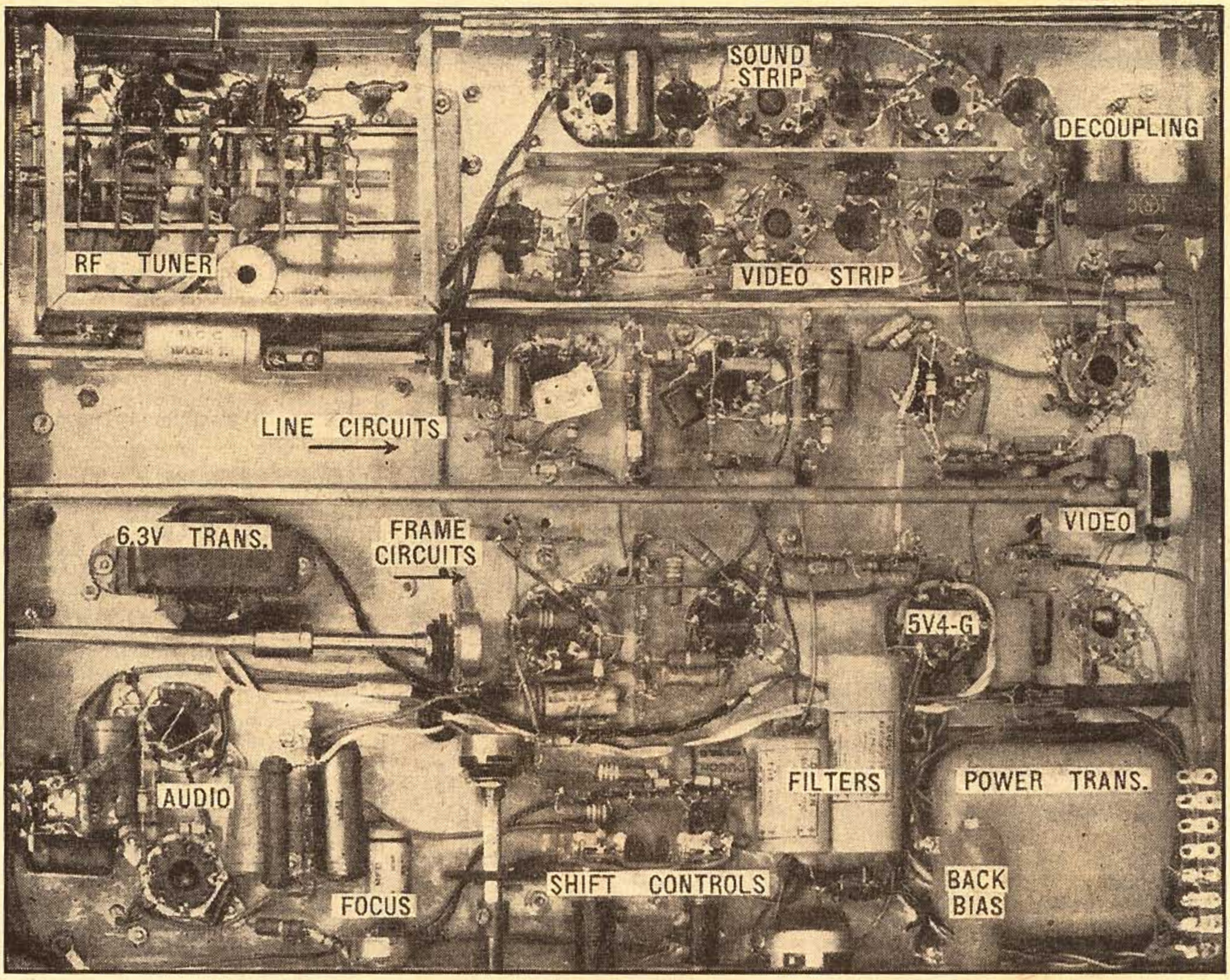
(PEN

MPORTANT VOLTAGES, VALUES AND WAVE FORMS



TELEVISION RECEIVER

NTODE TUNER, SIMPLE AGC, 5BP1.)



Here is the complete under chassis wiring. Most important components can be identified.

(Continued from page 55.)

be concerned with the unusual screen colour but, as a rule, neither contrast nor definition will be quite as good. Many black and white tubes exhibit a graininess in texture which is quite absent from the 5BP1.

Several readers have used the VR97, a slightly larger tube than the 5BP1, with good results. We may have something to say about this tube later on.

The overall response of the receiver as it concerns bandwidth is particularly good, and up to commercial standards.

The IF strip used was wound according to specifications published last December, and provided a response curve which was virtually a copybook pattern. It is probably not necessary to do as well as this in order to resolve a picture to the limitations of the small tube, but it does indicate the performance of the strip and its suitability for use with a larger set at some future date.

VIDEO RESPONSE

The video amplifier has been adjusted to give a response within 1 db up to 4 Mc, again well beyond the minimum needed for good results. Further performance details will be given when individual receiver sections are being considered, but they are mentioned here to indicate that we have not compromised with over-all performance.

For the purposes of description, we have divided the circuit into the following sections — R.F. Tuner, Video strip, Sound strip, Video Amplifier, Sound Amplifier, Synch. Separator, Line Oscillator-Amplifier, Frame Oscillator-Amplifier, 5BP1 Power supply, 5BP1 tube circuit, and Main Power supply.

After a general description of the layout on the chassis, we will deal with each of these sections in turn. Some will have to wait until next month, including the IF strips which will need fairly detailed treatment.

CHASSIS SIZE

The chassis we used is a little larger than is absolutely necessary, but there are reasons for this.

It is little use designing an experimental receiver if one is pushed for room in which to fit any size of components or valve sockets which may be required. As long as all major interconnecting leads are appropriately short, and the units arranged in logical sequence, there is everything to be gained in allowing some elbow room.

More constructors have run into trouble by unwanted inter-action between line and frame circuits, for instance, when trying to save space, than through any other reason.

As we are forced to use a fairly deep chassis to accommodate the tube in any case, we decided to follow an open layout and be on the safe side.

Secondly, having standardised on a size for the R.F. tuning box and I.F. strip in the 17in receiver, we felt it logical to do the same again, thus allowing easy interchange with any alternative arrangements for these vital sections which might arise in the future. Thus the chassis cut-outs specified are the same for both sets, and it is much easier to build these units as units than it is to wire them directly into a larger chassis.

There is less of a case for unit construction of the remaining sections, none of which calls for anything but standard wiring techniques.

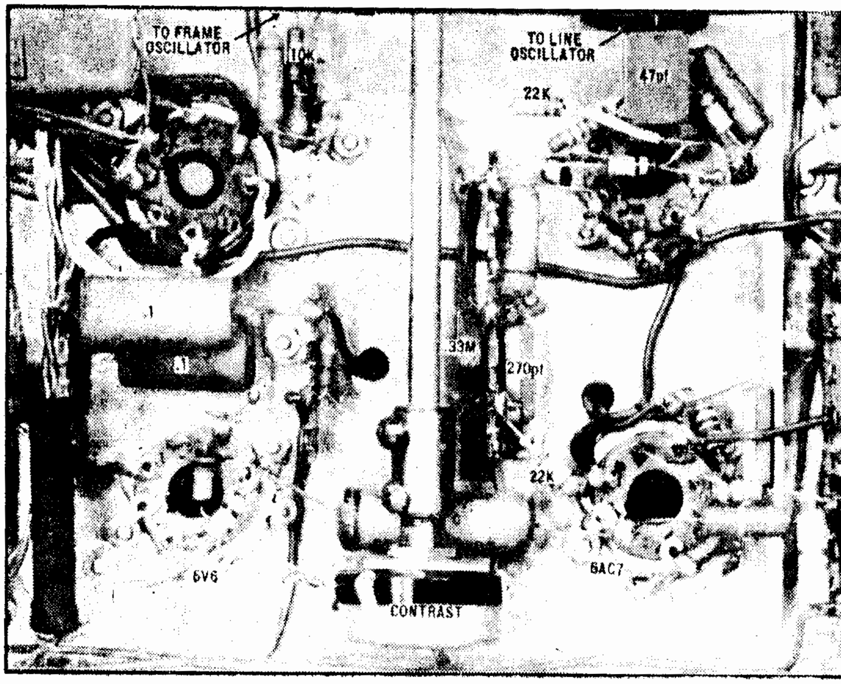
Looking at the front of the receiver, therefore, we have first of all the R.F. tuning box, an exact copy of the original unit described in the February issue. The newer cascode version is equally suitable and could be used, as could any commercial tuner of suitable dimensions. The fact that the original pentode tuning box may use a 6AG5 as the R.F. amplifier is an advantage, sufficiently so to tip the scales in its favour.

THE IF STRIP

Immediately behind the tuning box, looking from the front, is the I.F. strip. This is divided into two sections with a small shield partition down the centre, the inner section being the 30 Mc video strip, and the outside section the sound strip.

At the far end of this unit is the

CLOSEUP-VIDEO AND SYNCH. SECTION



The first video stage is at bottom right, connected to the synch. separator through the network mounted on the tag strip. Note the .022 resistor running from the synch separator to the frame oscillator at top left. The fourth valve is the second video amplifier. Its load resistor and peaking choke are at the extreme left.

video detector, a germanium diode, from which leads run to the tuning box with an A.G.C. voltage, to the sound strip with the inter-carrier 5.5 Mc frequency, and to the video amplifiers with the picture information.

The audio output is taken from a ratio detector using a 6H6 duo-diode following an IF amplifier and limiter which run back along the unit towards the tuning box. From this point, a shielded lead is taken to the two-stage audio amplifier located at the left-hand front corner of the chassis.

The audio amplifier is placed here to avoid mounting it on the interchangeable I.F. strip and, because there is free space available close to a convenient spot for the loud-speaker, a 4in or equivalent type can be used, which bracket-mounts to the chassis.

The two video amplifiers are positioned at the rear of the chassis where output from the 6V6 can be taken directly upwards to the picture tube socket for the shortest possible connection. The contrast control is mounted between them so that a rod can be run down to the front of the chassis to its control knob.

From the first video amplifier a lead runs via a suitable filter to the synch. separator, and from it through differentiating and integrating circuits to the line and frame oscillator/amplifier. These are spaced well apart from each other to avoid interaction, and wired so that a shield could be placed down the centre of the chassis between them if desired.

Line and frame hold controls are located near these valves on each side, and two more controls made available at the front. Width and height controls are adjustable from the left-hand side of the chassis.

MAIN POWER SUPPLY

The main power supply is at the rear left-hand corner of the chassis, and it supplies the high tension and filaments for the lower voltage circuits. A normal TV choke provides primary filtering, and a dropping resistor reduces voltage and gives extra filtering for some circuits. To avoid interaction through the power supply the audio amplifier is separately decoupled.

The power supply for the 5PB1 anodes is a simple voltage multiplier unit which requires only two 6H6 duo-diodes and three coupling capacitors. The output is filtered by a resistor and two more capacitors, after which it is fed to the tube and to the voltage divider network which provides deflector shift and focusing voltages. This network and its controls is at the left-hand side of the chassis, thus allowing all pre-set controls to be grouped together.

The intensity control for the 5BP1 is in its grid circuit, and picks up a negative voltage from a back bias resistor in the 300-volt supply.

The total controls available at the front panel are—left to right—a combined Audio and Intensity control, Frame hold, Contrast, Line hold, and a combined Channel Selector and Fine Tuning control. These are the normal controls found on the average TV receiver.

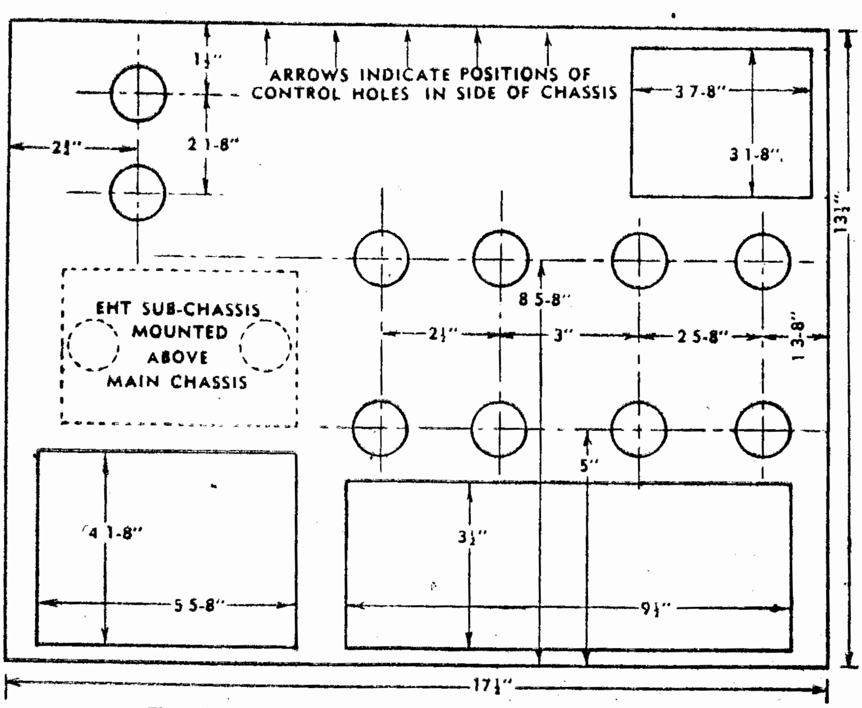
In practice it is rarely necessary to use any controls other than the Channel Selector, Fine Tuning, Audio, and perhaps the Focus control.

COUPLING CAPACITORS

The coupling capacitors to the deflector plates are mounted on a single shield plate mounted vertically underneath the tube, where not only are they out of easy reach but allow leads to be kept short. In front of this plate, also out of easy reach is the EHT supply, built on a second metal plate this time mounted horizontally. A small 6.3 volt high voltage-insulation transformer is bolted to the chassis beneath this supply, and is used to heat the 6H6 filaments which are left at a floating potential.

All the components mentioned can easily be recognised from diagrams and photographs, and these, together with this description, will give you a clear picture of the essential points in receiver layout.

So much has been published already about tuning boxes for our TV sets that it would be mere repetition to describe



This drawing shows the dimensions for the chassis.

the unit all over again. The chassis layout will allow either type to be accommodated and it is merely a matter of bolting it to the chassis, which we did with small angle brackets at the rear and the side. A bolt tunning through the outer edge of the main chassis and through the side of the box secured it firmly in place.

The 6AG5 plugs straight into the RF socket in place of the 6CB6 originally specified and results are indistinguishable. The 6AK5 could probably be used, with appropriate dropping resistors to control its voltages, but it could be that the extra gain might cause instability. The 6AM6 would be another good valve.

We do not suggest a change in the mixer tube, as there is no older type which will do the job satisfactorily, and major changes would be called for to use another combination.

AGC DECOUPLING

Note that the .5 mfd AGC decoupling capacitor is wired on the side of the tuning box.

The shaft controlling the line hold runs close to the tuning box, but there is enough clearance if you shorten the grub screw on the extension coupler so that it does not foul against the side.

The components, generally referred to as the IF strip, are built on the same chassis, and we will leave their description until next month, when we will publish full coil details at the same time. The cutout is the same as that used for the 17-inch set, so that even a commercial strip could be used if desired as a direct physical replacement. Our strip could be built on a slightly shorter individual chassis, but in our case there was little to be gained by so doing.

The audio amplifier is one section in which almost any combination of valves can be used with success, as there is plenty of signal available.

We have specified a 6AC7 triode and a 6V6 because these are probably the cheapest valves available.

The triode section could be any standard triode of the 6J5 class, or a 6SJ7, 6SK7, 6SH7, etc., wired as triodes. In general, bias and plate resistors can remain unaltered, as there is little chance of exceeding valve ratings. You can, of course, modify them if you wish.

OUTPUT STAGE

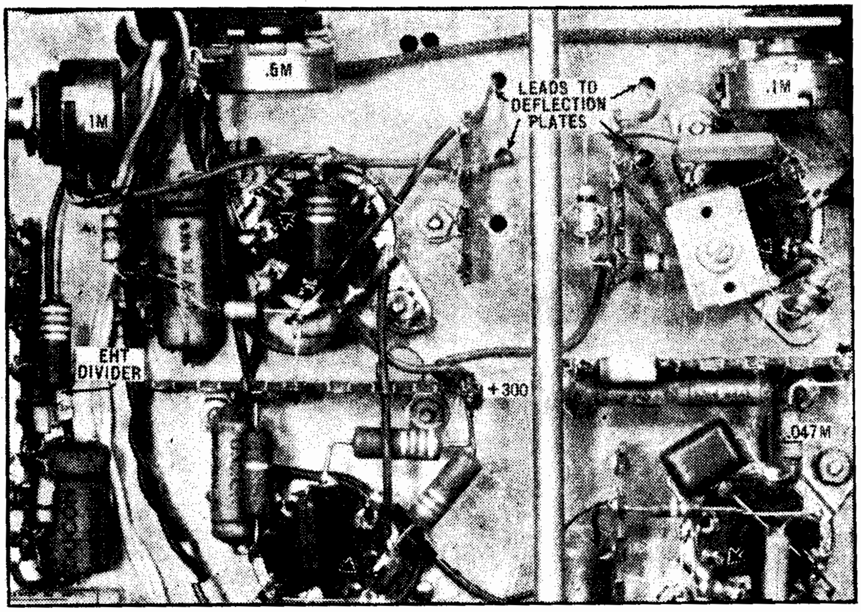
Similarly, there are numerous output pentodes which you can use, although it is best to use the right bias resistor for each.

It might even be possible to omit the first audio valve altogether, as the volume level needed is quite small. One experimenter even reported satisfactory results using a single 6SJ7 wired as a pentode output valve.

In any case, however, it is best to decouple separately the power supply to the audio amplifier, to prevent possible fluctuations affecting the voltage to the other stages. With low volume levels, this may not be important.

For convenience in arranging controls, the Volume control and Intensity controls are grouped together as a dual potentiometer. We made the knobs by drilling through the larger with a suitable drill and grinding a flat on the top with a sandpaper disc and electric drill. A small split brass sleeve was slipped into the hole of the smaller knob to make up

LAYOUT OF LINE AND FRAME SECTION



The frame oscillator and amplifier are at the left—line oscillator and amplifier at the right. Note placement of the frame controls. The EHT voltage divider circuit is at the extreme left.

the difference between its diameter and that of the centre spindle.

The speaker transformer is above the chassis for easy connection to the output valve, and the speaker mounted nearby. Provided a speaker having a low leakage flux is used, little reaction will be found on the tube, which in all our experiments, was purposely left with the minimum of magnetic shielding.

The function of the video amplifier is to accept the output from the video detector, amplify it without loss of bandwidth, and feed it to the grid of the 5BP1 in order to intensity-modulate the electron beam.

In the original circuit, a single tube was used for this purpose with no control of any kind. This meant that the degree of picture contrast was largely a matter of signal strength received, which obviously would vary a great deal from one locality to another, and even from one station to another.

CONTRAST CONTROL

Our first step was to fit a contrast control to the 6V6 cathode circuit in the form of a 500 ohm carbon-type potentiometer which immediately gave greater flexibility to the receiver.

As the circuit developed, it became obvious that a little more video gain would be an advantage, apart from other benefits which would accrue from the presence of the extra stage.

In the first place, it would necessitate reversing the connection of the video detector to preserve the correct negative-going voltage output from the 6V6.

As a result, the negative voltage at the detector can now be used as a source of simple AGC, some form of which is really essential in a TV set. And by using a suitable synch. separator circuit, we can use the amplified synch. pulses to get good locking, particularly in the case of the frame oscillator, which is often a difficult matter in practice.

The first video valve is a 6AC7 operated under low plate load conditions which reduce its gain to about six times and allow it to handle a wide bandwidth. A bypass capacitor of .001 across the cathode resistor is part of the compensation system to build up high frequency response.

DIRECT COUPLING

The grid of the 6AC7 is returned directly to the video detector so that the detector load resistor becomes the 6AC7 grid resistor. The voltage developed at the detector therefore swings the grid from near zero volts to whatever peak negative voltage it develops from the incoming video signal.

The decoupling in plate and screen circuits is very important with this circuit, as any hum voltages appearing at the 6AC7 plate are passed on to the synch. separator, and could degrade the clean background from which the synch. pulses must emerge. Further comments on decoupling will appear when the power supply is discussed.

The video amplifier proper is a 6V6 operated with a grounded cathode and a high value of grid resistor. The flow of grid current which results, provides an automatic negative voltage on the 6V6 grid, a simple method of obtaining bias suitable for the handling of the asymmetrical video signals.

The 6V6 has a low plate load in the interests of wide response, and a lowered screen voltage to keep the plate current within dissipation limits. Its output is coupled to the grid of the picture tube through a blocking capacitor.

A peaking choke is included in the plate circuit coupling to the tube, again for frequency correction.

In this respect, the measured response of the entire video system, measured from the 6AC7 grid to the 6V6 plate, is flat within 1 db up to 4 Mc, after which it falls away fairly steeply. This performance is more than adequate for the 5BP1 and is good enough for any picture tube under the present standards. Distribution of high frequency compensation—there is a further peaking choke in the video detector circuit — helps avoid too much correction at any one point, and the danger of ringing which might result.

The plate load is a standard 5-watt wire-wound resistor. The contrast control wired between cathode and ground should ideally be a large carbon type. Many people have used wire-wound potentiometers without trouble, but there were some heavy-duty components which came from disposals meter boxes which could be just right. The main thing to avoid would be a midget type potentiometer, which is almost certain to give trouble.

HT VOLTAGES

A high output from the 6AC7 is not required and its plate voltage therefore comes from the 230-volt point. The 6V6, on the contrary, should be capable of the maximum possible output voltage and, for this reason, is connected to the 300-volt point.

The function of the synch. separator is to separate the synchronising pulses from the video wave-form, and to distribute them through suitable circuitry to the line and frame oscillators, the frequency of which is kept in synchronisation thereby. In the process, the pulses are amplified sufficiently to give positive locking for the oscillators.

In our case we used a frame oscillator which requires a fairly high amplitude pulse, and a line oscillator which requires quite a small one. Both should be negative-going pulses, although the multi-vibrator line oscillator does not appear very sensitive on this score.

The original circuit of last December used a twin-triode separator together with a germanium diode as a clipper. This worked quite well, but an even simpler circuit was adapted from commercial practice and used in the 17-inch set, which had the added advantage of producing line and frame pulses of the same polarity.

MODIFIED CIRCUIT

Unfortunately, there was a double phase change due to the two valve sections, which, if we had picked up the incoming pulses from the first video tube as we had planned, would have given positive-going pulses from the separator instead of negative.

We solved this one by modifying the connection between sections to use direct coupling, which meant that we now had our negative-going pulses.

The actual pulse-clipping—removal of the video waveform from the synchronising pulses—is accomplished in the grid and plate circuits of the first triode section, by using a very high value of grid resistor and a low effective plate voltage.

The positive-going voltages taken from the plate of the video tube cause grid current to flow in the triode which builds up a negative bias on the grid, the value of which will be automatically determined by the carrier level.

When the line and frame pulses come along, the grid time constant is too long to respond immediately to them in the way of increased bias generation, and the valve therefore passes them on, although still unresponsive to the video waveforms.

It is quite important that the pulse separation should be as good as possible if clean synch. pulses are to emerge. Otherwise, particularly in the case of the line oscillator, triggering may be inaccurate and clean synchronising made difficult.

SIMPLE SEPARATOR

The second section of the valve does not contribute any worthwhile clipping, but it does amplify the pulses, the ratio of the two resistors in the grid circuit setting the overall operating conditions for the two sections.

From all this, we find ourselves with a particularly effective and simple separator.

The shunt-connected resistor and capacitor in the lead from the video plate is a high-pass filter, whose function it is to sharpen the pulse response.

To preserve the highest possible output from the separator, mainly for the benefit of the frame oscillator, the valve is fed from 300 volts.

The constants given here are suitable for the 6SL7 mainly because this valve gives higher gain than a 6SN7 and is still available from disposals.

The separator is connected to the line and frame oscillators through circuits having long and short time constants, for this is the difference in characteristic which enables the separation to take place.

The frame pulses are of the longer duration, and pass through an integrating circuit consisting of two resistors and two capacitors, thence through a blocking capacitor and an isolating resistor to the grid of the frame oscillator.

LINE AND FRAME ISOLATION

This connection is made by locating the 22K resistor right at the plate of the 6SL7, and running the lead on the far side across the centre of the chassis to the tag strip on which the integrating components are mounted.

It is quite important that line and frame circuitry be kept well away from each other, which is why we have positioned them this way. Do not mount the integrating components close to the synch. separator, and thus close to the line oscillator.

The line oscillator is connected to the separator by means of a very small capacitor which, with the low-value grid resistor in the line oscillator, produces a very short time constant to accommodate the short line pulses. The longer frame pulses do not penetrate this network.

The function of the line oscillator is to produce a saw-tooth type of waveform at a frequency corresponding with the desired number of lines in the TV picture.

The rate at which the CRO spot moves across the screen to trace out a line is governed by the shape of the long edge of the saw-tooth. If this is a straight line, the spot movement will be linear, and proceed at a uniform speed. If the long edge is curved, then the linearity of the picture in a horizontal direction will suffer as a result.

The short, almost vertical edge of the saw-tooth represents the return of the spot to its starting point, and should be so fast that it cannot be seen on the screen.

The TV waveform as broadcast provides a blanking period between the tracing of each line during which the screen is blacked out, and the retrace should at all times be complete in a time interval no longer than that represented by this period.

Probably the simplest type of oscillator which approximates these requirements is the simple multivibrator which is used in the line circuit.

Its linearity is not particularly good, but when used with a simple corrective circuit, this failing is almost completely removed.

FAST FLYBACK

Its flyback or return trace time is quite short, and well within the requirements of the circuit.

The only point upon which it is touchy is in the injection of the synchronising voltage which keeps its frequency locked to the line pulse from the sync. separator. The multivibrator locks very easily, and too much injection will often cause violent irregularities in the triggering point, and consequent "tearing" of the picture.

It is essential, therefore, firstly to make sure there is no trace of video or other unwanted voltages which could upset the oscillator triggering. Secondly a low value of grid resistor should be used together with a selected value of coupling capacitor which is also the differentiating component.

The value we have used is 50 ohms, and even this can be reduced if warranted. Ideally, this grid should operate at ground potential, and, if too high a resistance appears between the grid and ground, it may prove sensitive to odd radiations with which a TV set is filled, and pass them on to the line circuits, where they may appear as small imperfections in the line structure.

Using the 50 ohm resistor, and 47 pf coupling condenser, clean traces were obtained, but do not hesitate to experiment with smaller values if you consider it necessary.

This 47 pf condenser should be located right at the output lug of the separator valve socket, so that the lead running across to the oscillator carries a low amplitude voltage and is at low impedance.

INJECTION VOLTAGE

Do not use any higher injection than that required to obtain reliable line locking and freedom from picture tearing.

In some cases, a second capacitor from the grid to ground may improve results, and up to .001 mfds. can be used with a 47 pf coupling capacitor.

Our set of values allowed synchronisation good enough to hold for all three local stations without the need for resetting the Line Hold control. Whether this will be so in all cases will depend a good deal on the relative strengths of the stations themselves.

It may also be profitable to experiment with the plate voltage applied to the oscillator which has ample output to drive the deflection amplifiers.

Another point to watch is the routing of the lead joining the .05 meg. resistor to the Line Hold potentiometer. This lead is part of the grid circuit, and must be run around the oscillator socket on the side distant from the leads to the deflector plates.

It is a combination of all the points mentioned which will enable you to get reliable and stable line hold

The oscillator circuit is essentially the same as that used in our original circuit of last December.

The same is true of the push-pull line amplifier. This is a paraphase circuit in which the input signal for the second grid is taken via a capacitive voltage divider from the first plate. This is a particularly successful circuit, and experiment indicates that it will give a high output and good balance more easily than any of the standard circuits we tried.

It should be remembered that, although the fundamental line frequency is 15.625 cps the shape of the waveform being handled is such that harmonics up to the 20th (about 300 Kc) and components down to 1/20th (about 1 Kc) must be catered for. This means that circuits as normally used for audio work are not necessarily the most suitable to use.

At such high frequencies considerable radiation can take place from components and wiring, so that short leads and adequate spacing is valuable to reduce the danger of unwanted coupling particularly into the video circuits. This is one reason why the Line Hold control is mounted close to the line section of the receiver.

The Line Amplitude control is not so critical, being merely a means of varying high tension voltage, and it can be bypassed close to the valve it controls.

The voltage output from the amplifier is balanced by adjusting the 3-40pf trimmer which forms the upper portion of the divider. A fixed capacitor could be used here, but it might be difficult to specify a value easily obtainable.

LINEARISING

In our case, the adjustable capacitor could be replaced by a mica capacitor of 50pf.

The two .001 mfd. capacitors and the .047 resistor from the first grid to ground are the linearising network.

It is a good idea to check the resistor value by first using a .1 meg potentiometer to set the exact value, checking with a test pattern, measuring with a ruler the centre point of the picture.

A good CRO is invaluable for balancing the push-pull output voltages and for checking the nature of all synchronising and deflecting waveforms. But if you follow our instructions, you should not be far wrong.

In general, we have found it easier to obtain the necessary deflection voltages from the recommended 6SN7 than from any other valve, although makers' specifications indicate that the 6SL7 should serve under favourable conditions.

You will notice that both Frame Hold and Amplitude controls are located quite close to the frame amplifier valve. In the case of the amplitude control this is most important, as it is connected directly to the deflection circuit, and we have found it wise to restrict the length of these leads to the shortest possible path. Study carefully the use of tag strips to group these components.

The load on the two .068 meg. resistors is just over 1 watt, and it is wise therefore to make up approximately this value with two 1 watt series resistors. The exact value isn't critical as long as the total is not less than that shown.

The frame circuits gave us quite a bit of thought, and many have found them the hardest part of the set to handle.

We found the multivibrator not so successful here, although once the triggering pulses had been correctly filtered out, it operated well enough. Our main quarrel was that we did not think the linearity quite good enough.

After much experiment, we finally extracted the Wide Band Oscillograph time base almost in toto which uses a transitron type of oscillator. This has excellent linearity but rather a slow flyback time, which exceeded even the limits of the blanking pulse when used on its own.

The coupling circuit developed for the CRO serves the double purpose of providing an extremely fast flyback time, and a push-pull output of sufficient voltage to scan the tube. There is not a great deal to spare, but enough is enough when the 300-volt feed point is used for the amplifiers and suitable load resistors.

HIGH AMPLITUDE

The oscillator requires a fairly high amplitude negative-going pulse for synchronising, which is why we collected it from the first video amplifier. We also carefully selected the circuit values to provide adequate filtering with the least amplitude loss.

With the circuit constants as shown, frame locking is extremely clean and positive, as inspection on the CRO reveals. One advantage of the circuit is that it uses yet another 6AC7.

One of the most inconvenient items about a CRT is the provision of the high-tension supply for the anodes.

In the case of a TV set this should be as near to the maker's maximum as practicable because we are interested in fine definition which only high voltage can ensure.

Mostly an extended power supply is used, calling for a special high-tension transformer.

We have already described a very successful RF power supply which many experimenters have used, but even this has its own problems.

EHT SUPPLY

In casting around for a solution, we remembered an old trick of using a pair of 6H6 valves as voltage doublers, with the high voltage winding of a standard power transformer to energise the circuit.

The weakness of this idea is that, in the case of our 2,000-volt supply, one of the 6H6 sections must withstand the full voltage between its heater and cathode if the filament circuit is earthed.

But if it is left floating, there will be a division of voltage across the various heaters and cathodes, but none is likely to receive more than about 1,000 volts, according to the relative insulation resistances concerned.

Examining the valve data, we discovered what was news to us— the 6H6 has a special heater-cathode rating of about 350 volts peak, well ahead of ordinary receiving valves, which rarely go above 90 volts.

(Continued on Page 111)

FROM THE SERVICEMAN WHO TELLS

Things are certainly moving in the TV industry these days, and I find this fact reflected in the number of sets I have to service. Of those I handled this month, at least two are worthy of particular mention. On the radio front I have a portable which was a lot harder to service than it ought to have been.

TV set number one was a well-known commercial model which had been in operation only a few weeks. The owner complained that "The picture won't keep still, no matter how much I twiddle that knob thing in the front."

A little questioning soon established that "that knob thing" was the vertical hold control, and that the picture was "rolling," i.e., moving slowly up or down the screen, with another frame replacing it from below or above.

This is not an unusual fault in itself, since anything which prevents the frame synchronising pulses from reaching the frame oscillator will cause this effect. Sometimes, by setting the hold control very carefully, it is possible to hold the picture stationary for quite long periods though, naturally, the whole thing is at the mercy of the frame oscillator stability.

STRANGE SYMPTOM

What surprised me in this case was the owner's insistence that he was unable to hold the picture steady, even briefly, by any setting of the adjustment. As far as I could judge, the control had no effect at all.

However, there seemed little point in speculating further at this stage so I simply said I would call later in the day and check it over. When I finally did come face to face with it and tried it for myself I realised that the owner's description had been quite accurate. Whereas, in the normal way, twisting the hold control this way or that will cause the picture to roll one way or the other, in this case it had no effect whatever.

Even more puzzling was the way in which the picture rolled; a steady even pace which seemed far more stable than one usually finds in an unsynchronised oscillator, yet it obviously wasn't synchronised.

I slipped the set out of the cabinet, upended it and, armed with the manufacturer's circuit and data sheet, commenced to find my way around the chassis. The first thing I did was deliberately to disconnect the frame synch. circuit from the frame oscillator, reasoning that a fault in synch. or integrator circuits might easily affect the hold control.

STILL ROLLED

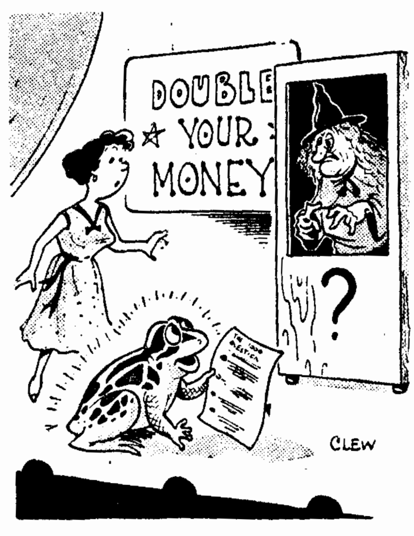
This made no difference whatever, the picture still rolling steadily and persistently as before, and the vertical hold remaining inoperative. At this stage I fished out the voltmeter and commenced making a few routine measurements around the frame oscillator circuit.

This used a twin triode in the frame oscillator socket, one section working as a blocking oscillator in a fairly conventional circuit. I prodded at each pin in turn, performing the dual job of noting the voltage and checking for any obvious dry joints and similar troubles at the same time.

While I was thus engaged the test prod slipped off one of the socket lugs—the cathode of the blocking oscillator as it happened—and shorted the lug to chassis. This would have been a harmless enough accident in the normal way, so I was both surprised and perturbed when it caused a bright flash inside the valve, followed by complete failure of the stage.

It didn't take long to establish that the valve now had an open circuit heater though I confess I was still puzzled as to why this had been caused by the accidental short. But by the time I had fetched a new valve from the truck, a theory was commencing to form in my mind; a theory I considered would be proved if the new valve cured the original trouble.

I restored the circuit from the synch. separator, plugged in the new valve and switched on. When the picture appeared it was still rolling—but violently, this



"I'm sorry, but you have failed to answer the jackpot question on 'witchcraft'!" TV Times

time, and a half turn of the vertical hold control sent it rolling in the opposite direction. This was more like normal and a more precise adjustment allowed it to lock quite positively.

This proved the point as far as I was concerned and I advised the owner that I would return the valve to the makers for replacement under guarantee, for I had no doubt now that this was the cause of the trouble.

More particularly I was convinced that the valve had been suffering from a heater-cathode short, a condition which would account for both the queer picture-rolling and the failure of the filament.

The rolling picture could be due to two causes. Either the 50 cycle signal being injected into the frame oscillator was strong enough to over-ride the synch. pulses, causing the oscillator to synch. on the mains, or the short could have killed the blocking oscillator, causing it to function as an overloaded amplifier delivering very distorted 50-cycle signals to the frame output stage.

Either way, the frame oscillator would run at mains frequency, not the frame frequency of the transmitter. While both are nominally 50 cycles, the mains are likely to deviate quite appreciably from this figure, whereas the station normally derives its pulses from a master crystal generator. The rolling frequency would be the difference between the two.

Of course, a distorted mains pulse might not be linear, but I confess that I did not particularly notice this aspect of the picture. After all, it's not easy to assess the vertical linearity when a picture is rolling at a couple of cycles per second.

HEATER FAILURE

The failure of the filament could also be due to this cause. Assuming that the cathode and heater were making contact at some point along the filament—probably fairly close to the active pin—then the act of shorting the cathode to chassis would apply the full 6.3 volts to that section of the filament only. Naturally this section couldn't take it, and simply disintegrated.

Before I accidentally caused this state of affairs the DC resistance of the blocking oscillator secondary winding, something around 150 ohms, had effectively protected the filament. In a more conventional circuit, where the cathode was earthed, the filament would have failed immediately the internal short occurred.

TRANSMITTER LOCKED?

Before leaving the subject of frame pulses altogether, have you noticed that one of the Sydney TV stations does, in fact, appear to have its frame pulses locked to the mains? Some tests I made a few days ago (after the above incident occurred) seem to suggest that this is so, though I must confess it rather puzzles me.

For one thing it is contrary to the recommended standards, which state that the frame frequency shall be 50 cycles, plus or minus .1 per cent, and non-synchronous with the mains. Perhaps my observations are wrong—though I don't think so—or the station concerned has a very good reason for departing from the standards. Either way I'd like to know.

My next TV fault was quite a different kind. The owner complained of

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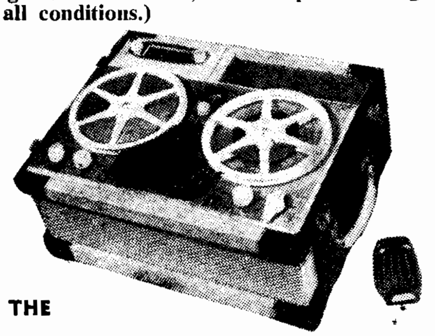

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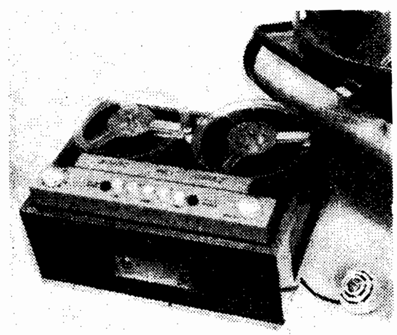

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a very "dull" picture and I had some difficulty in determining whether this meant that it lacked brightness or contrast. The owner seemed unable to differentiate betwen the two, at least as far as the effect on the picture was concerned, but was able to tell me that the brightness control appeared to be ineffective.

(I am rapidly reaching the conclusion that getting a coherent story out of the radio set owner is child's play compared with what it is going to be getting it out of the TV set owner.)

The set in question was an imported model (though made for our standards) and employed the AC-DC type of power supply. This, in itself, did not endear the thing to me particularly, though I'm afraid we may have to get used to this idea in the future.

A check over the manufacturer's service data helped me familiarise myself with the circuit, but was not much help in suggesting any particular reason for the trouble. I did not overlook the possibility of a faulty picture tube, but refrained from mentioning this to the owner. Most owners are touchy enough about potential picture tube failures as it is, without the serviceman adding fuel to the flames.

BRIGHTNESS CONTROL

Apart from the picture tube I imagined that some relatively routine fault would be found associated with the brightness control circuit, or even the actual control itself. The circuit showed that the video amplifier was direct coupled to the picture tube cathode, making the latter the same potential as the video amplifier plate.

The grid was connected to a moving arm of the brightness control pot, and which connected between one of the HT lines and chassis. Thus the grid could be made sufficiently positive almost to offset the high positive voltage on the cathode and assume the required negative potential relative to it.

If, therefore (I reasoned), the brightness control was faulty in such a way as to prevent adequate positive voltage being available for the grid, this would have the effect of holding the grid at too low a positive potential, at least partially blacking out the picture. Thus it seemed a logical first step to check the brightness control circuit.

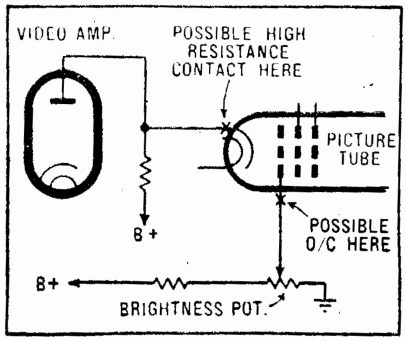
A preliminary test confirmed the owner's description of the complaint. The picture was extremely dark, and, although the contrast control seemed to work normally and have adequate reserve, the brightness control was completely inoperative.

VOLTAGE CHECK

I slid the chassis out of its cabinet, propped it on its side and, after making sure the chassis was not alive, began tracing out the brightness circuit. Then I commenced checking voltages. Strangely enough, everything seemed to check OK. The brightness pot had voltage across it and which, as nearly as I could see from a quick check of the circuit, was about normal.

This same voltage was available at the moving arm and I traced it right through to the picture tube socket. Similarly, the voltage on the cathode was reasonable and I was able to measure what I considered to be a normal range of effective bias being applied to the picture tube. There was certainly no suggestion that the grid was running with improper bias, as I had originally suspected.

In the light of this I began once more thinking in terms of a faulty picture tube, though I wanted to be quite sure of this before I suggested it to the owner. I took a few minutes off to think about other possible causes and things I should check, and, while doing so, I more or less automatically pushed the picture



Although the true story may never be known, the two failures shown above are the most likely in the circumstances. Either would cause similar symptoms

tube socket to make sure it was firmly in position.

In fact it was, but the picture immediately jumped to full brilliance, even though I was not conscious of the socket having moved. Further wiggling of the socket was rather inconclusive; sometimes I could make the picture fail and at other times it stubbornly remained normal.

However, I had no doubt I was on the track now. I removed the socket and went over each contact carefully, cleaning it and squeezing it to increase the tension. Then I went over the pins on the picture tube base, scraping each one lightly with the blade of a knife. I did not overlook the possibility of a dry joint in one of the base pins, but decided to try this much first.

BACK TO NORMAL

When the set warmed up again the picture came up to full brilliance and the control worked quite normally. What was more important was the fact that nothing I could do to the socket would re-create the fault, and I felt reasonably confident that I had found the trouble. I suggested to the owner that he check its performance over the next couple of days and let me know if it played up again.

In fact I made a point of checking with him myself a few days later (always a good policy in doubtful cases like this) and he assured me that the set was working perfectly. So that was that, and it only remained to explain to my own satisfaction exactly what had happened.

Two possibilities occurred to me. One was a faulty grid contact, and the other a faulty cathode contact. It was fairly obvious that a completely open cathode circuit would render the tube completely inoperative, but there was also the possibility of a high resistance contact between pin and socket.

This would function in the manner of self bias resistor, making the cathode more positive and, therefore, the grid excessively negative. It would also tend to reduce the video signal applied to the cathode, but the effect of this could have been masked by the dull picture. However, I had some doubts as to whether it would render the brightness control as completely inoperative as was the case.

An open grid pin, on the other hand, would most certainly wreck the brightness control, though it is difficult to predict just what potential it would assume if left floating. My guess is that it would almost certainly exhibit some grid emission, partly by reason of possible cathode material particles which often find their way on to it, and partly by reason of heat which would reach it from the cathode. After all, the so-called "grid" in this case is really a cylinder almost surrounding the cathode.

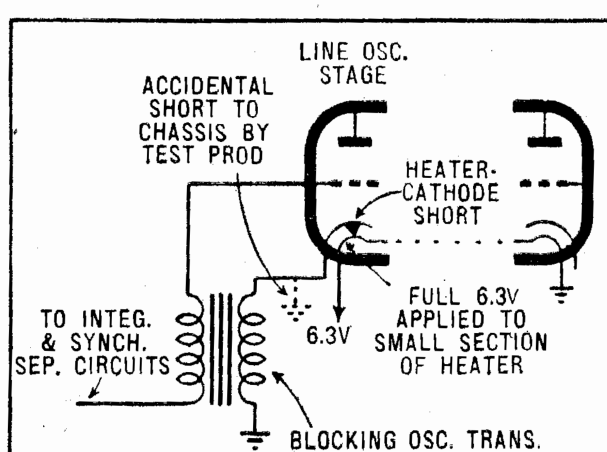
POSITIVE DRIFT

Such grid emission would cause the grid to assume a positive charge — it would be losing negative charges in the form of electrons—and it could possibly drift sufficiently positive to approach the potential of the cathode. Then it might even collect a few electrons from the cathode and drift slightly negative again, eventually establishing a point of equilibrium somewhat negative with respect to cathode.

All this, of course, is pure speculation, since I have no practical way of checking these theories. Nevertheless, it is not a bad thing to try to clarify the cause of these obscure faults as a precaution against similar faults in the future.

The only other moral I can draw from the incident is prompted by the comment of a colleague to whom I related the story. He said, grinning:

"You're too flamin' scientific. The first thing I always do with a faulty set is give it a hearty bash. It's mar-



There is little doubt in this case that the trouble was a heater-cathode short in the line oscillator. The result was a frame oscillator locked on the mains instead of the synchronising pulses and an overloaded heater when the cathode shorted to chassis.

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U or F40/150	"	40	150/150		6.3v/2a		Upright or Flat
U or F40/285	"	40	285/285	6.3v/2a		5v/2a	Upright or Flat
U or F40/325	"	40	325/325	"		"	Upright or Flat
U or F50/225	"	50	225/225		6.3v/2a		Upright or Flat
U or F60/285	"	60	285/285	6.3v/2a		5v/2a	Upright or Flat
U or F60/325	"	60	325/325	"		"	Upright or Flat
U or F60/385	"	60	385/385	"		"	Upright or Flat
U or F80/285	"	80	285/285	6.3v/2a	6.3v/2a	5v/2a	Upright or Flat
U or F80/325	"	80	325/325	"	"	"	Upright or Flat
U or F80/385	"	80	385/385	"	"	"	Upright or Flat
U or F100/285	"	100	285/285	6.3vcf/2a	6.3v/2a	5v/2a	Upright or Flat
U or F100/325	"	100	325/325	"	"	"	Upright or Flat
U or F100/385	"	100	385/385	6.3vct/2.5a	6.3v/2a	5v/2a	Upright or Flat
U or F125/285	"	125	285/285	6.3vct/2a	6.3v/2a	5v/2a	Upright or Flat
U or F125/325	"	125	325/325	"	"	"	Upright or Flat
U or F125/385	"	125	385/385	6.3vct/2a	6.3/5a	5v/3a	Upright or Flat
U or F150/285	"	150	285/285	"	"	"	Upright or Flat
U or F150/325	"	150	325/325	"	"	"	Upright or Flat
U or F150/385	"	150	385/385	"	"	"	Upright or Flat
U or F175/425	"	175	425/425	6.3vct/3a	6.3/2a	5/3a	Upright or Flat
U or F200/385	"	200	385/385	6.3vct/3a	6.3/3a	5/3a	Upright or Flat
U or F250/385	"	250	385/385	6.3vct/4a	6.3/3a	5/3a	Upright or Flat
TELEVISION	**PRIMARY**	**mA**	**A.C. H.T. VOLTS**	**FILAMENT RATINGS**			**MOUNTING**
TV275/260	200/220/240	275	260/260	6.3v/4a	6.3v/4a	6.3v/5v/3a	Upright or Flat
TV280/210	210/220/240	280	210/210	6.3v/5a	6.3v/5a	6.3v/0.6a	Flat
RH275/295	210/240	275	295/295	12.6vct/4.5a		5v/3a	Upright or Flat

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C.20/60	20	60	500
D.30/60	30	60	600
C.15/80	15	80	430
E.20/80	20	80	300
E.30/80	30	80	380
F.15/100	15	100	300
F.15/125	15	125	250
F.15/150	15	150	200
F.12/175	12	175	160
F.12/200	12	200	125
F.12/250	12	250	133
Television			
RH1/275	1	275	70
TV3/275	3	275	60

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vellous the number of times it fixes 'em."

I knew he didn't mean to be taken too seriously, because he is just as capable of the "scientific" approach as anyone when the occasion demands, but I couldn't help feeling that he might have something. Perhaps we have been so conditioned by the complexity of TV that we automatically look for the "hard" faults and overlook the obvious ones. Doubtless, time and experience will temper such a tendency, but it's worth keeping in mind.

Reverting to radio sets, I have a story about a universal portable. The owner was rather vague about the exact nature of the complaint, but I eventually established that it was a cranky intermittent. Sometimes the set would work perfectly, other times it wouldn't go at all, and sometimes it could be "persuaded" by bashing the side of the cabinet.

In the workshop I plugged it in—it had no batteries—and switched on. It worked, but only just, the strongest signal being barely audible. I tapped the side of the cabinet gently, a procedure which killed the signal immediately and nothing I could do would restore it.

TOUCHY 3V4

Opening the back of the case gave me access to the valves, the chassis being inverted, with the valves hanging upside down underneath it. I wiggled each one in its socket, without result, until I touched the 3V4. Almost as soon as I touched it and before I had moved it appreciably, the set came good; really good, that is, not the weak signal I had obtained at first.

Well, I thought, this one's going to be easy. Probably a faulty valve socket or soldered joint on the socket. Shouldn't be hard to find.

But I hadn't reckoned with the cabinet or, more correctly, getting the chassis out of the cabinet. It was the first time I had ever had to dismantle one of these models, and I'll bet the designer's ears were burning before I had finished. Frankly, I don't believe he could have made the job more difficult had he set out with that deliberate intention.

First I had to find the chassis bolts. These were discovered cunningly hidden beneath a couple of embellishments associated with the handle mechanism. So the first thing I had to do was take these off.

I removed the chassis bolts and the control knobs, one on each side of the cabinet, and hoped that the chassis would now slide out. But not a bit of it. Theoretically, I suppose, the tuning and volume control shafts should have been trimmed to make their overall length slightly shorter than the inside width of the cabinet. Instead, they were slightly longer.

BRUTE FORCE

Working on the theory that a set which went in must be capable of coming out, I risked springing the bakelite cabinet enough to free the shaft. This allowed the chassis to move a few more inches toward freedom, but I was still battling.

There were a number of cables—battery, loop aerial, etc.—which disappeared inside the chassis and which were also cemented to the inside of the cabinet. I had no desire to break these away from the cabinet, yet their presence made it extremely difficult to withdraw the chassis.

The situation was made worse by the presence of a cover plate over what would normally be the underside of the chassis, but which was against the top of the cabinet, due to the inverted chassis arrangement. It was securely fastened to all four sides with self-tapping screws, making it impossible to remove until the chassis was right out of the cabinet. On the other hand, it effectively prevented me from reaching the termination of one or two leads in the chassis and which, if freed, would have simplified things considerably.

The problem was further complicated by the presence of sundry small brackets which threatened to break or "unstring" the dial cord as I juggled the chassis in an attempt to free it.

While I did get the thing out eventually, I'm still not certain how, or whether I could repeat the performance if I had to. As i said earlier, the chap who designed it must have had pretty hot ears that afternoon.

Why do manufacturers do things like this? I'm blowed if I know. But it may be some consolation (though not much) to learn that other countries have the same bother. In a recent American technical magazine I found an article by one of my opposite numbers who was complaining bitterly about exactly the same thing—except that this time it was TV sets.

NOT NECESSARY

More than that, he was able to show that all the cases he cited could have been avoided—without extra cost, without loss of circuit efficiency, and without sacrificing the appearance of the set—simply by the exercise of a little care and commonsense when the set was designed.

What is worse, I have already heard some dark mutterings from colleagues about some of our own TV receivers. While I must admit that I have not experienced this myself as yet, neither have I seen the inside of all our current models.

Is it too much to hope that our local manufacturers will see the light and give some consideration to the serviceman; not to mention the customer who, after all, has to foot the bill for all this lack of planning?

Summing up, I would say that the worst condemnation any set manufacturer could have levelled at him is the oft repeated phrase: "That so-and-so set needs half an hour just to get it out of the cabinet."

I trust my readers will bear with me for having strayed somewhat from my original story. I can only plead extreme provocation.

So back to the intermittent. When I did eventually gain access to the chassis, I thought I had spotted the trouble in one. Hard alongside the 3V4 socket was a paper capacitor mounted so close that one of the socket pins was actually buried in the outer moulding. Apparently the lug had been pressing against the capacitor when it was soldered, and the heat had done the rest.

It seemed likely that it had penetrated far enough to reach the outside foil, a situation which could easily account for the symptoms. But I was wrong. More careful examination showed that this was not the culprit, though it was more by good luck than good management that it wasn't.

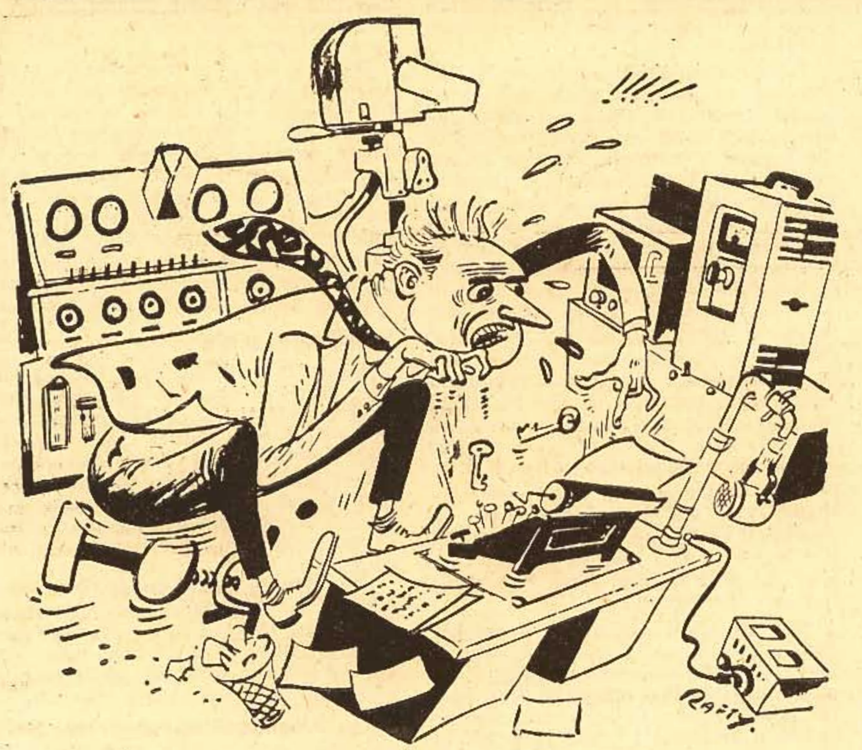
So now what? The valve was still extremely touchy, working perfectly in one position and cutting completely if moved a barely perceptible amount. There seemed little doubt that it was associated with the socket in some way, yet, search as I might, I could find nothing wrong. There were no dry joints, the actual pins were intact (I have known them to be broken internally) and, as far as I could see, it was 100 per cent. Yet the fault persisted.

VOLTAGE LOSS

Apart from the occasion when I had first switched the set on, there had been no suggestion of half-measures; it either went or it didn't. This suggested that the valve was being deprived of one or other of the vital voltages, rather than signal. In the latter case it is usual for some small amount of signal to sneak through due to stray capacitive coupling.

This left the plate, screen or filament pins as the possible culprits. Of these, I was least inclined to the filament pins, since the sharp nature of the break was not in keeping with the slight thermal delay normally associated with directly

(Continued on page 105)



lator grid is passing between zero bias and cut-off. When positive, the grid has low impedance to earth, and is not very sensitive to signals from the input circuit; when beyond cut-off, it can have no effect whatever.

If a difference should occur during the conduction period, sufficient to disturb the average grid potential from field to field, and if this should effect the discharge of the timing capacitor, then interlace will not be strictly accurate and some pairing may be evident.

Though referring particularly to a blocking oscillator, similar remarks would apply to other types.

SPECIFIC EXAMPLE

The article quotes a particular example of what might happen if the extra line pip on one field should occur at the instant when the grid is passing into the cut-off region. In such a case, the conduction time may be lengthened on one field to produce an inaccuracy of up to .06 per cent. This is nearly equal to the .08 per cent necessary to bring about complete pairing of the lines.

To this, one might be tempted to add "Q.E.D.," which, in my Maths II days, meant that the theorem had been proved, the matter was henceforth closed and one could go on with something else.

Let's Buy An Argument

I give up, completely and absolutely. No matter how hard I try to avoid the subject of television, it comes up again and again. Yes, I give up. If readers and circumstances conspire to keep it to the fore, I'll just have to go along without further protest.

TAKE this month for example. When I opened the June issue of our contemporary, "Radiotronics," what should meet my gaze but an article by W. W. Burns, A.S.T.C., carrying the intriguing title, "The Purpose of the Post-Equalising Pulses in the Television Composite Video Signal."

Now that's a subject we've been arguing about, on and off, for months, and here was a discussion of it by an engineer in the TV *Development* Section of A.W.A.

COMMENT INEVITABLE

What could one do but read it and make appropriate comment?

In point of fact, the writer develops the line of thought which was discussed on page 80 of our own June issue.

He shows the grid waveform of, in this case, a frame blocking oscillator, and points out that, for a brief period during its conduction cycle, the valve is sensitive as an amplifier to any signal which may penetrate the integrating network feeding its grid circuit.

Though this integrating network is supposed to isolate the frame synch. block from the line information, the separation may not in fact be complete and residual line information can appear at the blocking oscillator grid, either by penetration of the integrating network or by stray coupling.

For the sake of illustration, the writer of the article assumes that the frame oscillator triggers on the leading edge of the last vertical frame pulse and remains active for a period of 165 microseconds thereafter.

If no post-equalising pulses follow the frame block, the grid may then be subjected to three vestigial line pulses in one field and two in the other, bringing about an immediate unbalance between the two fields.

The really critical period, during which such inequality is likely to be troublesome, is when the blocking oscil-

by Neville Williams

We might simply assume, in this case, that interlace was dependent on the post-equalising pulses, that since we are provided by the Standards with such pulses, we do not have any interlace troubles.

Not much, we don't! As we pointed out in the June issue, perfect interlace is very much the exception in current model receivers, nearly all of them showing some degree of pairing. Why?

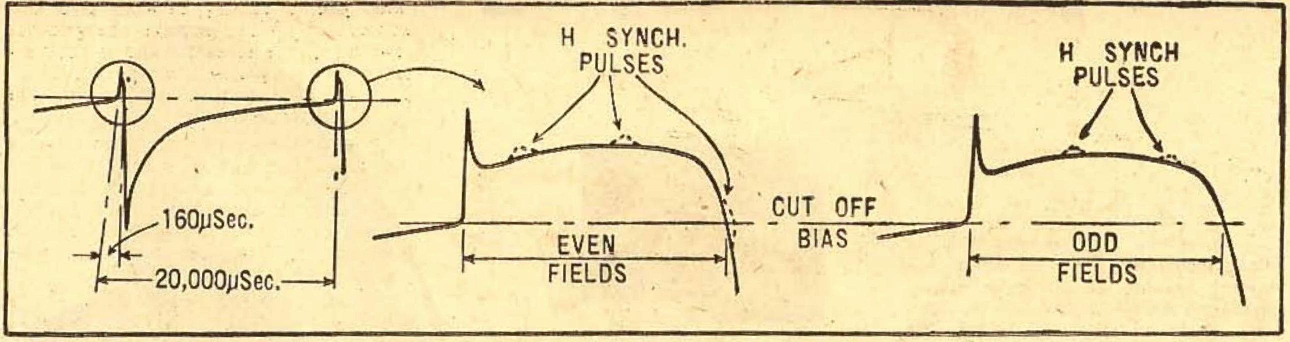
ISOLATING H PULSES

The explanation is found very largely in the point we have stressed in connection with the 17in receiver—the absolute necessity of preventing pulses from the receiver's own line circuits from penetrating the frame oscillator. Hence the little shield bracket beneath the chassis and the suggested shield over the frame oscillator-output valve.

Significantly enough, in such circuits, the troubles does not appear to come by penetration of the integrating network but by radiation and coupling into the frame oscillator grid. Introduce some deliberate coupling and watch the interlace disappear!

The writer of the "Radiotronics"

AN EXPLANATION FOR THE POST-SYNCH. PULSES



Copied from "Radiotronics," these diagrams illustrate, at left, the grid form of a frame blocking oscillator. The two remaining sketches show the conduction period in detail for respective frames, with either two or three line pulses superimposed thereon. One might ask (1) Is this condition likely to occur in practice? (2) Will it necessarily cancel interlace if it does? (3) Do half-line pulses necessarily overcome the objections?

article acknowledges the importance of line-scan leakage and we quote:—

"However, the equalising pulses cannot correct for the effect of any H pulses fed back from the horizontal output stage, either by circuitry or radiation. This problem has to be dealt with separately. The effect of these unwanted pulses is to cause a variation of the interlace as the Vertical Hold control is adjusted through the control range."

While we therefore agree as far as the end result is concerned, I'd be surprised if this leakage from the receiver's own line circuit has its greatest influence during the post-synchronising period. Its full-line interval must combine unequally with the half-line pre-equalising pulses and partially defeat their object.

In cases I have seen of receivers with no interlace at all, I suspect that the frame oscillator is actually triggering on prominent leakage pips, superimposed on the normal integration slope.

GREATER HAZARD

Be that as it may, however, I have the feeling that the hazard to interlace presented by many kilovolts of line deflection energy is far greater than the presence or absence of a few 50-volt half-line pulses from the synch. separator. The remark is applied, of course, to typical domestic receivers, where economy and simplicity limit the amount of shielding and filtering which can be provided.

And if the frame oscillator can be made to interlace reasonably well, despite the presence of these very potent line output circuits, there is surely reason to think that it does not rely too heavily on the presence of half-line pulses from the synch. separator.

In saying this, I'm not trying to buy a fight with the writer of the "Radiotronics" article. What he says may be quite correct but the very act of divorcing post-equalising pulses from the whole subject of interlace may contrive to give the reader an exaggerated idea of their importance.

To demonstrate his point, the writer has assumed the unlikely circumstance of the frame oscillator triggering on the last vertical frame pulse, whereas the second or third would be the more likely. Therefore, at least one full-line pulse in his drawing would be replaced by a couple of half-line pulses, constituting the rest of the frame block.

Thus the difference in average grid potential would be less than inferred from the 2:3 pulse ratio shown.

Even with the half-line pulses, the balance may not be perfect, because there is an even chance that an unbalanced number of such pulses will still occur on successive fields during the critical conduction period of the oscillator.

WHY NOT HALF-LINE?

And, last but not least, if an individual full-line pulse can operate to extend the conduction time as suggested, what guarantee is there that a half-line pulse will not by chance fall in the same position?

In the face of this, the incorporation of half-line pulses would appear only as a palliative measure, which will contribute to balance between respective fields but not guarantee it.

But enough of that. If I go on any longer, I will be buying an argument.

It seems likely to me that, assuming a stable oscillator, the factors which then control interlace are as follows and in order of importance:

(1) Isolation of line output energy from the frame oscillator. The line output energy contains no half-line intervals and will tend to disturb the interlace function, even to the point of locking the frame oscillator positively to full-line triggering intervals.

(2) Pre-equalising pulses, which have not been the subject of debate, as far as we are concerned.

(3) Post-equalising pulses, for the reasons outlined above.

Having thus relegated these post-equalising pulses, rightly or wrongly, to a minor place, it then remains to ask how minor? Perhaps Deutch, whom we quoted earlier, thought it so minor that he was prepared to write off the post-equalising pulses as of no special significance to ordinary domestic receivers.

EXTREME VIEW?

In the light of the foregoing, this may be an extreme view, as also the statement that they are a "technical nicety."

The point seems to be that the post-equalising pulses can be added very easily to the composite video signal and do undoubtedly contribute to the sym-

A further word from M.G. —

Dear Sir,

I was pleased to see my remarks on TV viewing in your Argument pages. I considered your replies informative and at times rather amusing.

A few points to clear the decks:—

- *I consider I have had reasonable viewing experience.*
- *I do have a little more than passing knowledge of the human eye.*
- *I do not have a chip on my shoulder, nor am I trying to start a witch hunt. In this respect I believe I am considerably more tolerant than average.*

However the above few points are, at this stage, irrelevant in an intellectual debate.

Now to action: I enclose a TV viewers' handbook, which on page 12 has three TV viewing room layouts. Each layout shows a source of light almost directly in the viewing line.

It was principally this which prompted me to write to you. From your remarks in the August issue, I take it we both agree this type of layout is bad. Our disagreement now centres around how much less light there should be.

I'll come your way a little and concede that if the extraneous light was only that from a well-shielded spotlight used by another member of the family for reading or knitting, etc., no significant harm will be done to the eyes.

However, I maintain that with a screen size of 17in upwards no harm will be done, and improvement in viewing comfort will be noted, by viewing in complete darkness.

As argument to support this view: the intensity can be turned down, and a non-aluminised screen used, both of which both cut down diffusion of light across the picture tube, thus giving finer focus.

Yours faithfully,
M.G.

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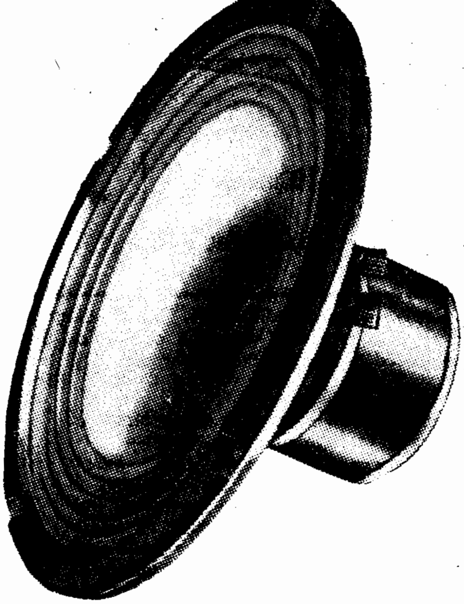

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metry of the frame information for alternate fields.

If individual receivers can take advantage of their presence to secure "perfect" interlace, that's fine. If they don't contribute much or solve the problems of another receiver, that's regrettable but their inclusion has cost nobody anything.

And with these words, we might well write "Vale," to a subject which has proved to be the most long-lived, the most elusive ever raised in these columns.

That's unless somebody wakes it up again.

I had a talk during the month from someone who has a lot to do with television receiver and aerial problems, supporting what was said in the August issue. You may remember that we deplored in these columns the practice of dumping a set in a house for "demonstration," sitting an indoor aerial on top and leaving the customer with whatever picture appeared on the screen — good bad or indifferent.

IN SPITE OF . . .

Our conclusion was that many receivers are sold, not because of such a demonstration but IN SPITE of it.

According to our friend, this is a very real problem and just as widespread as we had thought it must be. Apparently it's a headache for manufacturers and distributors, who find their sets roundly and quite unjustly criticised because a distributor has been too busy or too lazy or too tired to give a proper demonstration.

We could quote a few more stories to emphasise the point, but no good purpose would be served. The point has surely been made well enough.

Quite apart from "noise," which is the major failing of inadequate indoor aerials, very serious degradation of the picture can occur through multiple image effects, or "ghosts." It's just amazing the difference to a picture which a good aerial can make.

Perhaps, one should add, however, that it mustn't be too "good." Over the last few weeks there has been quite a deal of speculation as to what would happen when the National Station ABN went on full power and full aerial.

As I write, the changeover has just been made and one member of the staff who lives well away from the transmitting site is expressing delight at the excellent pictures. I personally am relieved to find the A.G.C. still holding its own but another member's reaction is best expressed by his own *words* . . . "O Brother, what a signal."

TOO MUCH SIGNAL

It's too early to know, however, how many viewers are going to be embarrassed by excessive signals, producing overload and tearing effects.

Maybe a few of the ponderous aerials round the place will have to be shorn of some low frequency elements. There's no doubt that television is a lot of fun!

And, talking of fun, the advertising boys are still having theirs. We're still being told that sets with 90-degree deflection tubes give wider viewing than those using 70-degree tubes. Will somebody tell me what possible connection there is between the two things.

A "MERE FEMALE" WANTS TO KNOW

Dear Mr. Neville,

This is a letter that will probably end up in the wastepaper basket as it will have no technical usefulness whatsoever. But I think it is important as it may end up by keeping the hospitals from becoming overcrowded and I mean this seriously.

The "new Sound" high fidelity is the cause of it all. We have a home-made set in the house and, to be fair and truthful, I think it is a very cleverly thought-out put-together bit of mechanism.

As I am told "every tinkle of a bell can be heard". I admit this is so, also every other sound, good and bad along with it. Men with hard-to-listen-to voices can cause irritation, earache and headache. And what is beautiful about the Sydney Symphony Orchestra coming into a 12 x 9 room and making one sit up with clenched teeth, instead of relaxing with the beauty of mellowed music? I ask you?

Yes I ask you if in the articles written on radio-sound, someone can evolve a method, whereby the listener of the "new Sound" can overcome his irritability. Otherwise let's go back to the plain old wireless which in some houses is bellowed out all day without the ill-effect of one hour of hi-fi in a 12 x 9 room.

Very sincerely yours,
"Mere female."

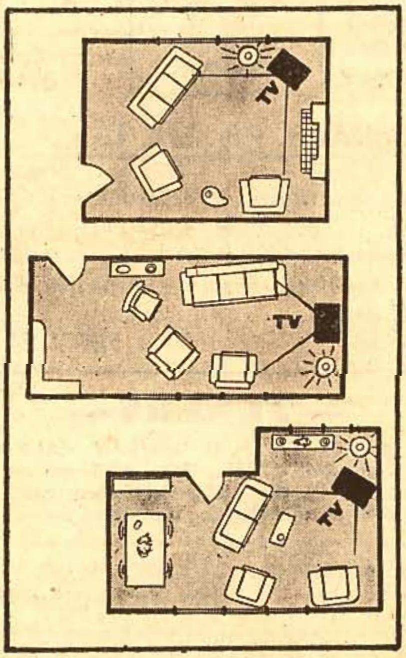
P.S. Yes, there is a tweeter to "Keep out distortion" but it doesn't and why is any set "practically useless if tuned down"?

On that reasoning, it would be a poor lookout for a newsreel theatre, whose picture is projected on to the screen through a very narrow arc. Presumably, the patrons would have to line up down the centre of the place, in Indian file, to view the performance.

Gentlemen, please!

But even that inference pales before the recent gimmick advert., which purported to show that a particular receiver offered an abnormally wide viewing angle.

I'll say it was wide. A line drawn from an extreme viewing position at one side just about formed a tangent to the far side of the curved screen! Not even local theatre expects you to watch uni-dimensional actors.



Correspondent G. K., whose letter appears on the previous page, objects to these layouts for a television viewing room. He says that the lamp should not be in the field of view.

Besides, who but a beach girl wants to look at a tan gent?

Our confrere, Phil Watson, tells me that he's just waiting for someone to offer a TV set with "The Thicker Picture."

For those of a photographic turn of mind, we must mention in passing the receiver which currently offers the "softest," most sharply focused picture on the market.

That's really something.

From M.G. comes a letter, further to what he had to say in the August issue, on the subject of ambient light and television viewing. You may recall that he was extolling the virtues of viewing television in complete darkness, as against the common practice of having the room partially lit.

He yields some ground in his further letter, but reveals the cause of his protestations in the accompanying illustrations. As you can see, they suggest placing a reading lamp in the immediate vicinity of the TV receiver and, therefore, directly in the field of view.

Well, quite frankly, I'm not keen on that either. Whether it is good or bad for the eyes I'm not competent to say but I can't help feeling that it would be a disturbing influence in the position shown.

VISUAL TENSION

What makes me say this is the experience of a couple of evenings back when someone put a radiator in the room right in front of the set. I watched the screen for a while before becoming conscious of an unpleasant *tension in* the eyes. Shifting the radiator to one side produced immediate relief.

Was it the glare or the heat rays? I don't know but it was unpleasant.

Putting the lamp on the other side of the room has its problems, also, mainly by reason of reflection from the tube-face or safety glass. One can usually find a spot for the lamp, however, the problem being much simplified if the tube-face and glass are slightly tilted, as in our own 17in receiver.

One of the most obvious solutions to the problem is one which, strangely enough, I have never seen mentioned anywhere for domestic use. It is the solution used in most TV demonstra-

(Continued on Page 112)

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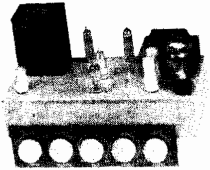

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A COURSE IN TELEVISION

PART 24 . . . VIDEO AMPLIFIER STAGES (continued)

In this further article on video amplifier stages, factors are discussed which tend to limit their high frequency response. The article outlines the steps which are necessary to minimise the loss and the influence which these steps have on gain and signal output voltage.

As explained in an earlier article, the video signal frequencies which are involved in the reproduction of a television picture extend to several megacycles. While a passably good picture may be obtained from frequencies no higher than 2 to 3 megacycles, definition and detail continue to improve, with good program material, as the video pass-band is extended toward 4 and 5 megacycles.

It must be remembered, however, that the effective video response in an ordinary television receiver is not just a function of the video amplifier. It is dependent, in the first instance, on the pass-band of the I.F. channel.

For reasons which have been explained elsewhere, the I.F. channel must attenuate sharply picture sidebands displaced more than about 5 Mc from the parent carrier, in order to prevent mutual interference between picture and sound signals.

Having respect to what can be achieved with practical I.F. systems and trap circuits, it is generally considered as good practice if sideband components can be preserved representing video frequencies up to 4.5 Mc. Beyond that frequency, the response is likely to fall steeply toward the sound plateau.

On this basis, the prime requirement of a video amplifier system is to respond to frequencies up to the same approximate limit. Toward 5.5 Mc, the response can also fall away sharply, as a further insurance against the 5.5 Mc intercarrier beat pattern appearing on the screen. In point of fact, one or more trap circuits may be provided to secure maximum attenuation at this critical frequency.

RESISTANCE COUPLED

Basically, the video amplifier in a television receiver is a resistance-coupled system, involving the video detector's output circuit, one or two amplifier stages and the input circuit of the picture tube.

As far as visible components are concerned, there is nothing to suggest loss of high frequency response. One might assume that a changing signal current through a load resistor must produce a proportional voltage across it, irrespective of the signal frequency involved.

In actual fact, there are many invisible circuit properties which conspire to limit the upper frequency response and, thereby, degrade the ultimate qualities of the picture. These are depicted in figure 136.

Diagram (a) illustrates, in a general way, two cascade resistance-coupled stages. The solid lines represent the essential wiring and components, the dotted lines the "phantom" quantities which have to be considered in the design of a video amplifier system.

From the input grid, there is inevitably some stray capacitance to earth, which can be minimised but not eliminated by careful placement of wiring and components. To this must be added any parallel capacitance belonging to the signal input source.

Within the valve itself, additional capacitance exists from grid to cathode and from grid to screen, both cathode and screen being at near-earth potential for the signal frequency. Here the valve designer faces the constant problem of achieving high transconductance, involving close electrode spacing, without producing prohibitive figures of input capacitance.

Typical video pentodes have an internal input capacitance from these sources of about 11 pF.

The capacitor shown dotted between plate and grid represents the total grid-plate capacitance, both within the valve and from the socket and wiring.

MILLER EFFECT

By reason of "Miller effect," any grid-plate capacitance is multiplied, in its effect at the grid, by a factor (M plus 1) where M is the stage gain. The resultant appears as an apparent input capacitance in parallel with that already mentioned.

Because of their low inherent grid-plate capacitance, Miller effect is not a serious problem with pentodes. The same cannot be said of triodes, however, which exhibit a much higher internal capacitance.

Coming to the plate circuit, the output capacitance of the valve itself will amount to several pF, to which must be added the inevitable capacitance to ground of the wiring and components.

This is virtually in parallel with the input capacitance of the second stage, which will exhibit the same general effects as outlined for V1.

The picture tube grid or cathode circuit may be fed from the plate circuit of V2 or from V1, if the receiver uses only a single video stage. Either way, it will exhibit its own attendant capacitive effects, notably the stray capacitance of the lead running from the video amplifier to the picture tube socket.

EXTRA CAPACITANCE

Depending on the physical arrangement of the receiver, this lead may need to be several inches long and will have some capacitance to earth, even if kept deliberately separate from other wiring.

For purpose of analysis, it is normal to lump together all capacitances in each distinct inter-stage coupling system.

Thus, all input capacitance effects to do with V1, plus those pertaining to the detector, would be considered as single capacitive shunt across the detector-to-amplifier coupling network.

In the same way, the output capacitance of V1, together with the input capacitance effects of V2 may be considered as a single shunt across the V1-V2 coupling network. Similarly for the picture tube signal circuit.

It should be noted that the use of direct coupling between stages does not materially alter the position. Most of the capacitance effects remain, the only difference being in the elimination of minor "strays" from the coupling capacitor and grid resistor to chassis.

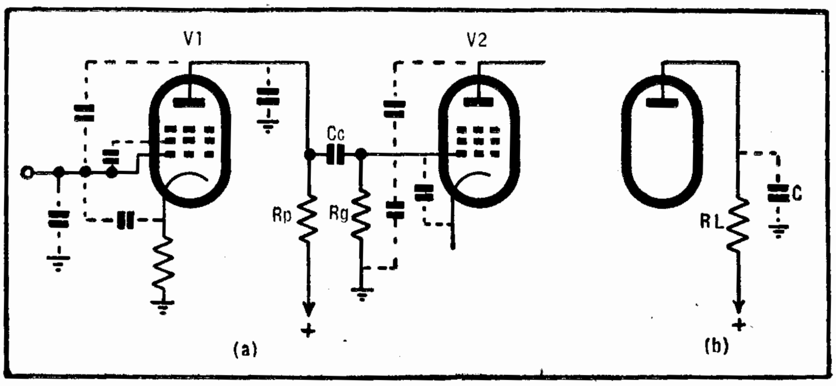

Figure 136: Diagram (a) shows the capacitance effects which tend to limit high frequency response in a resistance-coupled amplifier system. In (b) the resistive and capacitive quantities have been lumped together.

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The degree to which shunt capacitance will reduce the relative gain at high frequencies depends on the total effective resistance of the circuit across which it is connected. As in audio practice, the high frequency attenuation for any given value of shunt capacitor is greatest when it is present across a circuit of high effective resistance.

EFFECTIVE RESISTANCE

What we have referred to as the "effective resistance" of a coupling network is not a simple quantity. For example, in figure 1a, the effective resistance of the V1-V2 coupling network comprises three resistive quantities in parallel:

(1) The internal plate resistance of V1:
(2) The plate load resistor Rp;
(3) The grid return resistor of V2.

In the particular example, two of the quantities are not very significant to the end result. Because V1 is a pentode, as indicated, its plate resistance will be about 0.1 meg. and therefore much larger than likely values of load resistor Rp.

Again, the grid resistor Rg is likely to be kept high in value, if only because it permits adequate low frequency response to be maintained with moderate values of coupling capacitor Cc.

In many such cases, therefore, the parallel resultant of (1), (2) and (3) is not much less than the plate load resistor alone, so that (1) and (3) can be ignored, without introducing any major discrepancy.

Where a triode is involved or a cathode follower, its effective output resistance would obviously have to be included in any relevant calculations.

Be that as it may, an interstage coupling network can be reduced to the essentials shown in figure 1b—an effective resistance load or "source," shunted by a capacitor, each being the sum of several individual quantities.

The effect of the shunt capacitance is to modify the load which the coupling network presents to the preceding valve and therefore to modify the stage gain as a whole.

At low and medium frequencies, the reactance of "C" in ohms may be very much greater than the resistive quantity RL. Signal current flowing via B-plus and earth in the plate-cathode circuit therefore flows predominantly through RL and develops across it a voltage which is essentially the simple product of I times R.

"C" FALLING

At higher signal frequencies, however, the reactance of "C" may diminish to a degree where it begins to compare with the ohmic value of RL. A significant proportion of the signal current is then diverted through "C", causing less signal current to flow through RL and a smaller voltage to be developed across it.

Alternatively, it may be said that the effect of "C" is to reduce the nett plate-to-cathode load at high frequencies. This tends to reduce the output voltage developed across the output circuit for any given grid signal, which simply means that the gain of the stage concerned will diminish with rising frequency.

It follows from the above that the CHANGE IN GAIN will be less for any given value of shunt capacitance if the resistive content of the load circuit is deliberately kept low in value.

Figure 137 illustrates in a general way the relationship between gain, frequency response and the value of RL.

When the total resistance load is high, so also is the stage gain, but the response is flat only over a limited range of frequencies. A condition such as this would normally be used for audio applications.

Reducing the resistive quantity to some medium value extends the region of flat response but markedly affects gain.

Where an extremely wide response is required, as for video service, the resistive quantity must be reduced to a very low figure in order to secure something like the necessary response. For the reasons stated earlier, this generally entails using a low value for the plate load resistor Rp.

It can be demonstrated mathematically that the gain of an amplifier stage is reduced by 3db or to about 0.7 or normal at a frequency where the

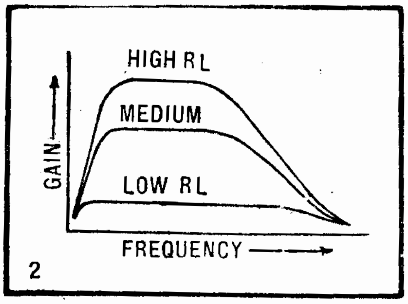

Figure 137: This diagram illustrates the relationship which exists in an amplifier between the resistive component in its output coupling circuit, stage gain and overall frequency response. The resistive component includes the valve impedance, plate load and following grid resistor but plate load is usually the determining factor.

shunt reactance in ohms is equal to the resistive component, also expressed in ohms.

If the total shunt capacitance relative to a particular coupling network can be assessed or determined, the "3db point" can be made to occur at any desired frequency by working out the capacitive reactance at that frequency and manipulating the resistive component so that it has the same value.

Except where a triode or a cathode follower is involved, this generally means choosing a plate load resistor of the calculated figure.

It is normally accepted that picture degradation due to a 3db loss is not perceptible or is at least negligible. Therefore a video amplifier is commonly said to be "flat" between the 3db points at the two ends of the spectrum. The same is true, in fact, of the IF amplifier system previously referred to, handling video components as sideband energy.

It should also be noted that all such losses are cumulative. Therefore, if a 3db loss at 4.5 Mc should occur in the IF channel, a further 3db in the detector-to-video coupling circuit and also in the video-to-picture tube circuit, the total loss will amount to 9db and the true 3db point for the system as a whole will occur at a much lower frequency.

MUST BE KEPT DOWN

This being so, losses must be minimised wherever possible. If a wider than necessary pass band can be secured in one particular circuit, it will ease the problem in another circuit, where a more difficult compromise may be called for.

Unfortunately a few simple calculations along the lines suggested can lead to some rather alarming figures.

It may easily be that the total shunt capacitance in typical coupling circuit will amount to 25 or even 30pf. Consider the lower figure.

At 4.5Mc, the reactance of 25pf is about 1400 ohms, which would seemingly indicate a plate load resistor of the same order for a conventional pentode, to give a 3db point at 4.5Mc. In audio service, the same class of valve would typically work into a plate load of at least 100,000 ohms.

The stage gain of a pentode is nearly equal to the product of the plate load in ohms times the working transconductance in amps-per-volt.

For a simple pentode like the 6SJ7, this would be about 1400 times .0016, which works out to just over 2. In other words, a pentode which customarily gives high gain in audio service, will seemingly give a gain of about two as a wide band video amplifier. Such a state of affairs is obviously unsatisfactory.

SPECIAL VALVES

In order to achieve worthwhile figures of gain, valve manufacturers have had to produce new types, having much higher figures of transconductance. In doing so, they have had to reconcile conflicting factors such as close electrode spacing, close manufacturing tolerances, low interelectrode capacitance, high transconductance and moderate plate and screen current.

Based on such figures, it is, in fact, possible to derive a "figure of merit" for various valve types.

Typical modern video pentodes have transconductance figures of more than 10 milliamps per volt, which would effectively boost the figure of 2, previously mentioned, to at least 14.

It is important to note, however, that the transconductance of a valve is not a fixed quantity but varies with operating conditions, and notably with plate current. Any calculations involving gain must therefore be based on transconductance at the selected operating point.

Another complication which arises from the use of a low plate load is that of reduced output voltage.

Taking the 6SJ7 again as an example, the maximum permissible standing plate current is about 8 milliamps. For class-A amplifier service, the peak plate current deviation could not possibly exceed 8 milliamps, representing an excursion of from zero to 16 milliamps.

Across a 1400-ohm load, this would produce a peak-to-peak output of only 22.4 volts. In actual fact, because of non-linear regions in the valve's characteristics, the output would be a good deal less than this.

PRACTICAL LIMITS

Seemingly, the obvious way to overcome this difficulty is to use a valve with a higher plate dissipation rating, which will then permit a higher standing plate current. This can then deviate between wider limits with signal, allowing a greater peak-to-peak voltage to be developed across the plate load resistor.

While video pentodes commonly do have higher ratings with this in view, there is a practical limit beyond which the dissipation of ordinary receiving valves cannot readily be carried. In addition, high current has its own problems in the overall design of a receiver.

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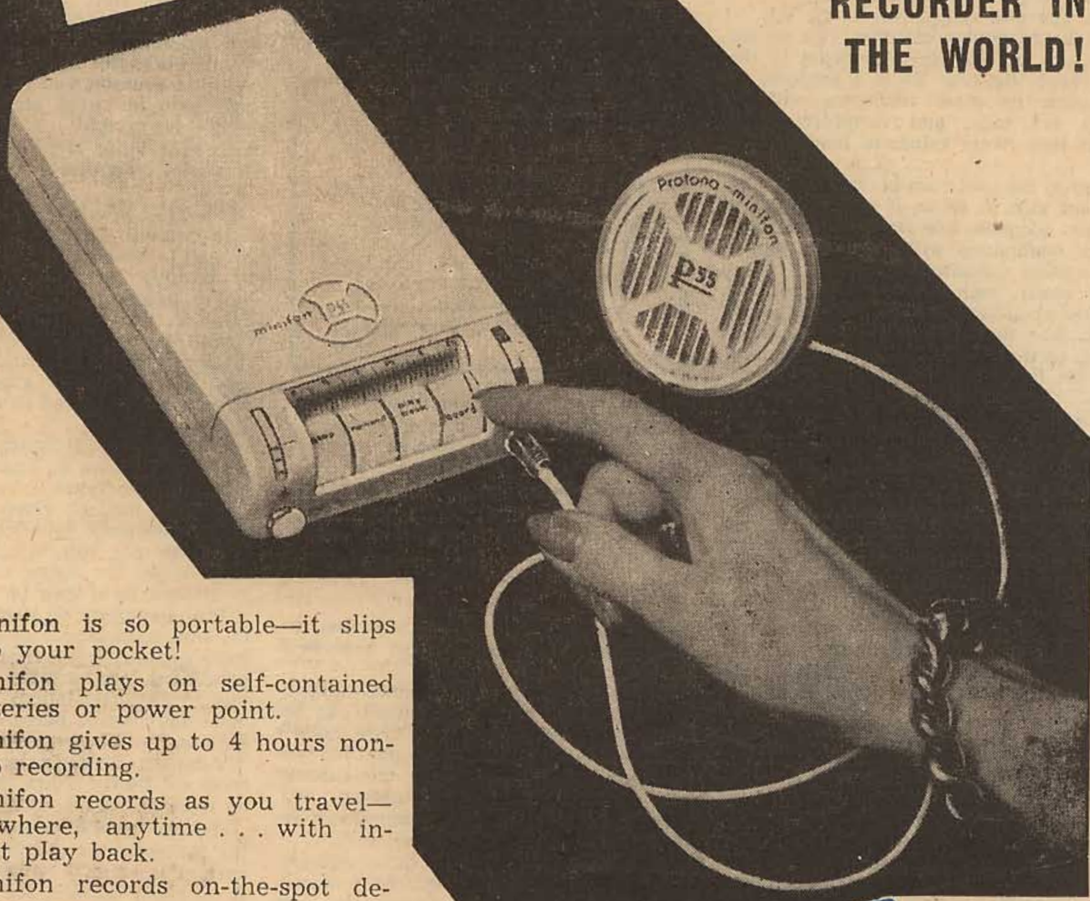

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Because of these problems — limited gain and limited output voltage — designers seldom attempt to achieve nominally flat response by the simple choice of plate load. It is normal to accept some compromise and also to employ various tricks of circuitry, which will give an acceptable result with better overall economy in design.

Some modification may therefore be accepted to the "flat to 4.5 Mc" concept previously mentioned on the grounds that the last half megacycle or so do not contribute much to the quality of the average picture. The designer may be prepared to sacrifice some response, in order to use a higher load and thereby improve performance in respect to gain and linearity.

Accumulative attenuation from two or more circuits at 4.5 Mc may therefore be accepted, so that the overall response falls away rapidly beyond 4 Mc.

HIGH FREQUENCY BOOST

It is universal practice also to employ high frequency compensation (or boost) in one form or another. The simplest method is to connect a selected small value of capacitor across any unbypassed cathode circuit which may be found in the video amplifier system.

As explained earlier, the cathode bias resistor in a video stage is frequently left without a bypass because of the difficulty of providing one which will be effective down to very low frequencies. As a result of the omission, the stage gain suffers, usually by about 2:1 — this at all frequencies.

The lost gain can be recovered over any portion of the spectrum by wiring a capacitor from cathode to earth of such a value that its reactance is small compared with the value of the resistor.

By plotting the initial curve of the video amplifier, a value of capacitor can thus be selected which produces a rise in the region where the natural roll-off tends to occur, thereby extending the flat response.

NOT UNLIMITED

Obviously enough, if the initial loss by omission of the capacitor is 6db, then only 6db of high frequency compensation is available by making good the loss. However, if greater initial loss can be provided and tolerated, additional compensation can be effected by these means.

For all its simplicity, cathode circuit compensation is of limited interest because it may conflict with other more urgent circuit requirements which may involve the cathode circuit or circuits. These latter include notably the provision of 5.5Mc trap circuits and Contrast Control.

If, as often happens, there is only a single high-gain video stage, it is difficult to accommodate all three functions in the one cathode circuit and other methods of high frequency boost have to be relied upon. These will be discussed next month.

A SIMPLE COURSE IN RADIO

(Continued from page 41)

have to be accepted and constructed on their merits. As knowledge increases, the general ideas conveyed by this article will gradually be supplemented by other knowledge.

It should be mentioned also that the provision of high gain or amplification in a receiver can introduce the problem of OVERLOAD. The word is almost self-explanatory.

On weak signals, the amplification available in a receiver may be just enough to raise their level sufficiently to operate the phones or loudspeaker.

If the same amplification is applied to signals which are already fairly strong, they will be amplified so much in, say, the first stage that they are too great for the second stage to handle. As a result, the stage overloads and produces a very distorted output signal—sounding rough and harsh to the ears.

To avoid this difficulty, it is often necessary to include in a receiver some means of varying the amplification. To use another phrase, some method of VOLUME CONTROL, or GAIN CONTROL must be included.

REACTION CONTROL

A certain amount of gain or volume control effect can be obtained by varying the setting of the reaction control. The more nearly this control approaches the position for oscillation, the louder will the signals become, and vice versa.

The big difficulty with this method is that the setting of the reaction control also effects selectivity and it may easily happen that a position which gives adequate signal level may not give enough selectivity to select the wanted from the unwanted signals.

Ideally, the reaction control should be operable for best detector performance, with an entirely separate control for gain.

Over the years, many methods of gain control have been devised, including variation in filament voltage with a rheostat, variation in plate voltage or grid bias or variation of screen voltage in a pentode or tetrode. All of these schemes are open to criticism because, in reducing gain, they also limit the valve's ability to handle strong signals, thereby introducing distortion in many cases.

Nowadays, the method adopted almost universally in audio circuits uses a potentiometer. (See chapter 1.) The relevant circuit is shown in figure 6.

VOLTAGE DIVISION

Instead of the signal voltage being applied directly from one plate to the following grid, it is coupled through a capacitor to one end of a potentiometer. The following grid connects to the moving tapping.

When the potentiometer is set so that the tapping is at the end connecting to the coupling capacitor, all the available signal passes to grid. With the tapping right down at the other end, the grid receives its normal bias but NO signal.

At intermediate positions, the grid receives more or less of the signal for further amplification. Thus, moving the tapping by means of the control shaft and knob varies the volume of sound heard in the phones or speaker.

In designing a receiver, it is normal to place the control ahead of the first point in the circuit which is likely to be overloaded. In simple receivers of the type under discussion, this would normally be between the detector and first audio amplifier.

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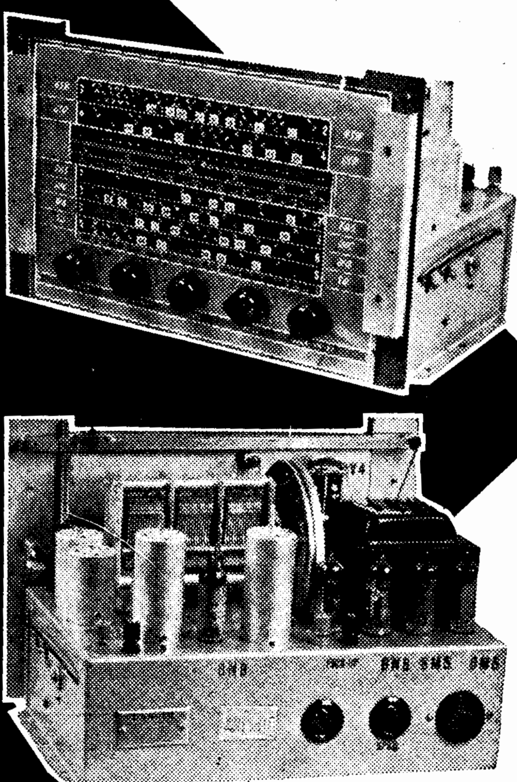

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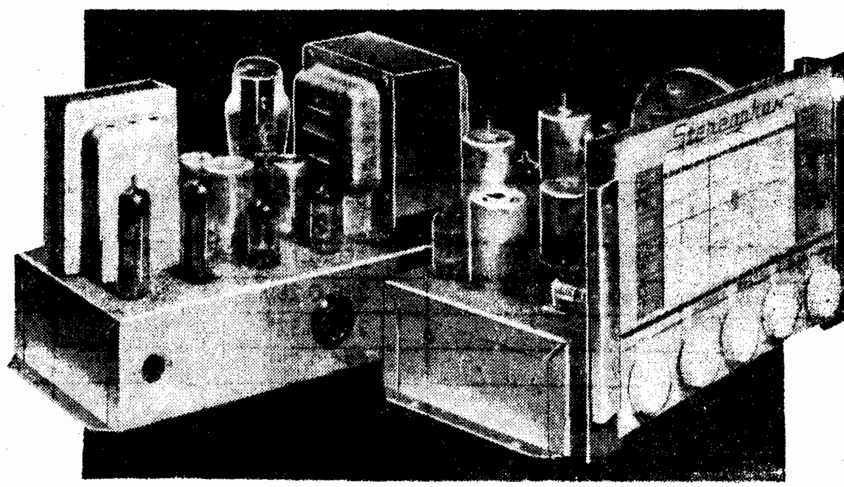

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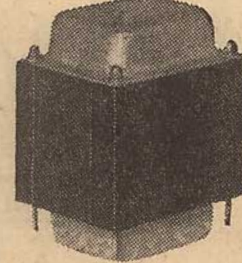

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PF151 PF151-F	230-240	285-0-285	60	6.3V-2A, 5V-2A
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PF165	230-240	385-0-385	60	6.3V-2A, 5V-2A
PF170	230-240	285-0-285	80	6.3V-2A, 6.3V-2A, 5V-2A
PF1073	230-240	300-0-300	80	6.3V-2A, 6.3V-1A
PF169	230-240	325-0-325	80	6.3V-2A, 6.3V-2A, 5V-2A
PF168	230-240	385-0-385	80	6.3V-2A, 6.3V-2A, 5V-2A
PF130	230-240	285-0-285	100	6.3V-2AC.T., 6.3V-2A, 5V-2A
PF164	230-240	325-0-325	100	6.3V-2AC.T., 6.3V-2A, 5V-2A
PF160	230-240	385-0-385	100	6.3V-2.5AC.T., 6.3V-2A, 5V-2A
PF1072	230-240	300-0-300	120	6.3V-4AC.T., 6.3V TAP5V-2A
PF152	230-240	285-0-285	125	6.3V-3AC.T., 6.3V-2A, 5V-2A
PF163	230-240	325-0-325	125	6.3V-2.5AC.T., 6.3V-2A, 5V-2A
PF181	230-240	385-0-385	125	6.3V-3AC.T., 6.3V-3A, 5V-2A
PF174	230-240	285-0-285	150	6.3V-2AC.T, 6.3V-3A, 5V-3A
PF142	230-240	325-0-325	150	6.3V-2AC.T., 6.3V-2A, 5V-3A
PF175	230-240	385-0-385	150	6.3V-2AC.T., 6.3V-2A, 5V-3A
PF173	230-240	425-0-425	175	6.3V-3AC.T., 6.3V-2A, 5V-3A
PF1067	230-240	400-0-400	180	6.3V-4AC.T., 6.3V-2.5AC.T., 5V-3A
PF1193	200-220-240	295-0-295	275	6.3V TAP 5V-3A, 6.3V-9A
PF1265	240	—	—	6.3V-2.25A
PF162	240	—	—	6.3V-3A, 6.3V-3A
PF265	230-240	—	—	17V, TAPS 11.5V, 10V, 8.5V-4.2A

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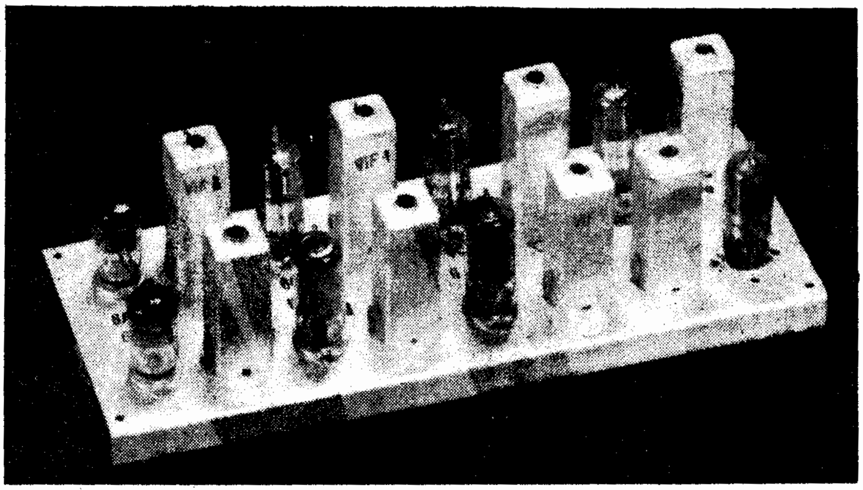
NEW PRE-FABRICATED TV IF STRIP



An item which will interest constructors of home television receivers is the "Q-Plus" pre-fabricated IF strip, Mark II. It differs from the Mark I strip by the inclusion of an extra sound IF stage.

THE Mark I strip was used in the original R.T.&H. 17-inch TV Receiver and, as explained in the last issue, was found to be quite adequate for all normal conditions. Assuming correct alignment and tuning, sound was always available, even under conditions where the receiver could not resolve a useful picture.

The Mark II strip, with its extra sound stage, does however offer greater tolerance to misalignment, mistuning or extreme interference. It may therefore be considered worthwhile in some cases.

Physically, the Mark II strip is similar to the simpler version. It employs the same chassis and mounting holes and has the same external connections. The difference is purely internal, involving an extra valve and 5.5 Mc coupling coil.

The unit shown in the photograph has 6CB6 valves in the 30 Mc section but the strip can also be supplied with 6BX6 valves, should they be preferred.

All components in the strip are standard and interchangeable with those used in the Mark I. It can therefore be built up from transformers and chassis, bought as separate items. Alternatively, existing Mark I strips can be converted to Mark II by the addition of a 6AU6 valve, a VIF7 coupling coil and a few small components.

The complete pre-fabricated and pre-aligned strip is available on order through trade supply houses. Parts to build the strip can be obtained through the same channels.

IRC POTENTIOMETER

THE Radio, Television and Hobbies 17-inch television receiver specifies a 500 ohm potentiometer as a contrast control. A carbon rather than a wire wound unit is specified because of possible frequency selective effects.

In the original we used a 500 ohm 1 watt potentiometer but this is no longer readily available.

Wm. J. McLellan and Co. Pty. Ltd. have suggested that the IRC dual potentiometer, rated at 1,000 ohms per unit, with the two units connected in parallel will do the job required.

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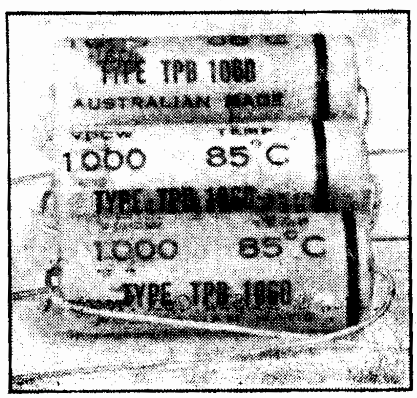
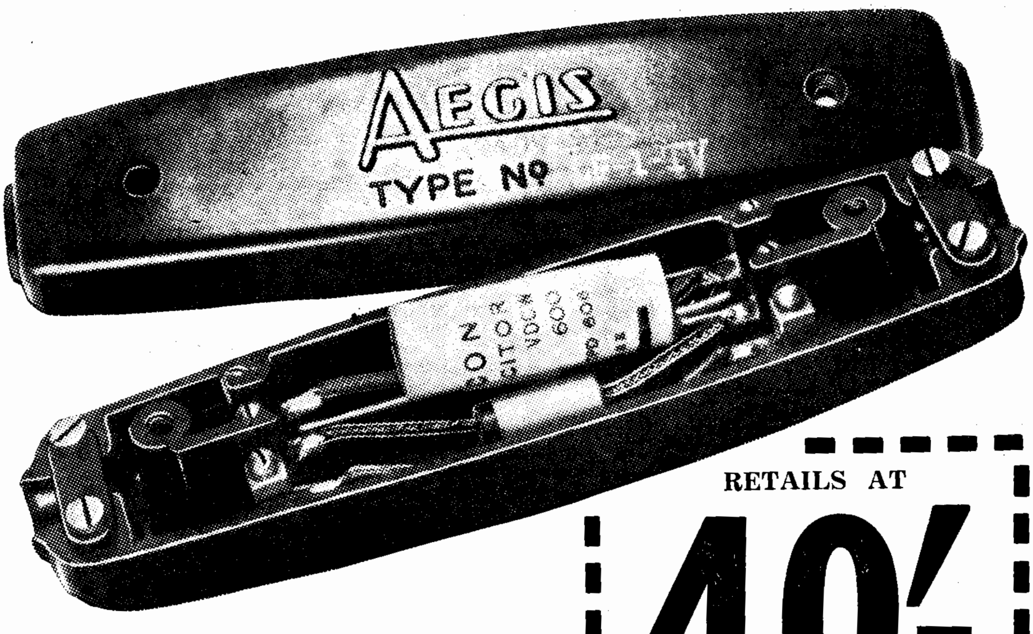
DUCON CONDENSER LTD. have submitted samples of their High Seal 85 capacitor type TPB 1060 rated at 0.047 uF and 1,000 volts DC working at temperatures up to 85 degrees centigrade. The body of the capacitor is 1¼ inches long and approx. 9/16 inch diameter, remarkably small for a capacitor with the above ratings.



POWER LEAD FILTER

from AEGIS



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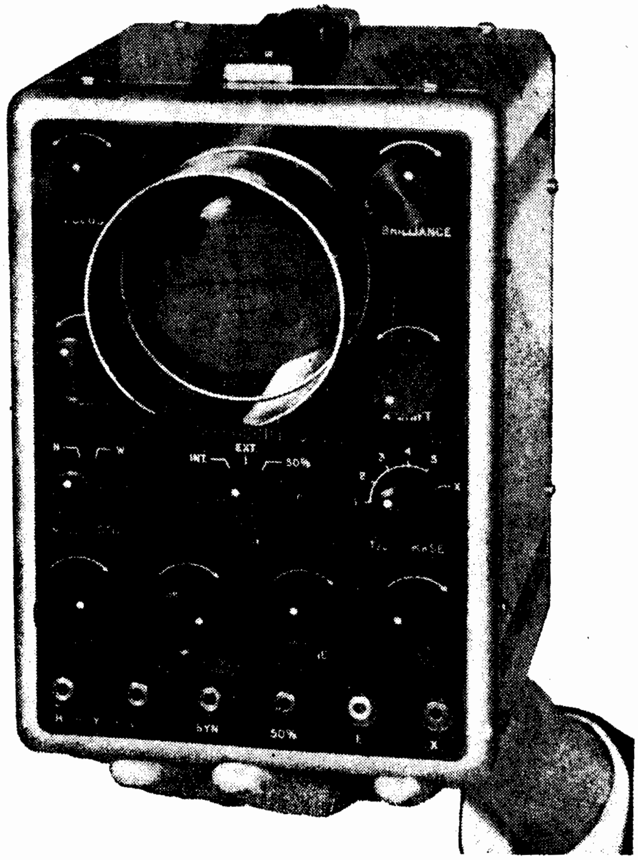
Latest 2¾" Cathode ray tube . . . technically sound . . . lightweight, portable unit. Push-pull vertical and horizontal amplifiers.



Specifications—

Vertical Amplifier: 2 position switch for choice of gain/bandwidth conditions. Push-pull amplifier gives a symmetrical undistorted picture.

"N" position . . .

sensitivity 50 mV/Cm. D.C. to 100 Kc/S. (—3db).

"W" position . . .

sensitivity 500 mV/Cm. 20 c/s to 3Mc/S. (—6db).

Deflection is not limited in the "N" position and the undistorted amplitude may be expanded to more than fill the screen. In the "W" position, the undistorted amplitude is limited to a height of 2 Cm (¾") which is quite adequate for the examination of television pulses.

In addition to a gain control, alternative input sockets are provided, the "H" position utilising the total amplifier gain, with a D.C. input resistance of 0.5 megohms.

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Horizontal Amplifier: D.C. to 100 Kc/S. (—3db) with a maximum sensitivity of 70 mV/Cm and an input impedance of 1 megohm. A continuously variable gain control is fitted.

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Synchronisation: Manual amplitude control.

Miscellaneous: All deflection plates and grid of C.R.T. are available for direct connection at the rear of the instrument. Direct coupled shift controls give instant spot shift.

Power Supply: The instrument is mains operated from 200–250 V. a.c. 50 c/s.

Power Consumption: Approximately 30 watts.

Dimensions: 6½" x 9" x 8".

Weight: 6½ lb. approximately.

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3682

OFF THE RECORD — NEWS & REVIEWS

Several letters I have received lately have asked whether there is any possibility of the 16 rpm records being made available in the near future. Apparently the appearance of four-speed turntables has given many people the impression that there must be something in the wind for which the manufacturers are making preparation.

by John Moyle

AS far as I know, this very slow speed has been confined to records made for special purposes where long playing time is required but high quality is not.

In the U.S.A., for instance, there are large numbers of talking records both for entertainment and instruction, on sale in the shops.

I have one containing extracts from speeches made by famous statesmen; others will teach you languages, some contain readings from well-known books.

The only case where music has entered seriously into the picture seems to be the slow speed, very fine-groove records made by Columbia for the Chrysler Motor Corporation, which made available a record player in their luxury motor cars.

The grooves on these discs are approximately half the diameter of the normal microgroove, and special pickups are needed to play them.

The scaling down of groove size coincident with playing speed allows much better frequency response than would the normal-groove LP standard, and the discs have surprised many who have heard them with their quality.

But the addition of a new stylus size, if nothing else, rules them out in my opinion for general assimilation.

The fourth speed on the turntables is there because, in most cases, it isn't very hard to arrange, and it does allow a mass-produced article to be sold to the widest possible market.

I doubt whether, without the use of the ½-mill groove, there would be any considerable advantage in the use of the slow speed. Record users have now become used to a very high standard of reproduction, and would react very strongly to any reduction of it.

And can you imagine pickups with three turn-over styli? I think this would be too much to expect.

If there is any major change projected either in record speeds or in groove dimensions, I have not heard of it.

MOZART—Eine Kleine Nachtmusik; le Nozze di Figaro; Cosi Fan Tutte and Die Zauberflaute Overtures. Played by the Philharmonia Orchestra, conducted by Rudolf Kempe. H.M.V. OBLP 1088.

MOZART—Eine Kleine Nachtmusik played by the Bavarian Radio Orchestra, conducted by Eugen Jochum. STRAUSS — Der Rosenkavalier and Schlagobers Waltzes. Played by the Berlin Philharmonic Orchestra, conducted by Eugen Jochum. DGG 17020 LPE.

Two Eine Kleiners to choose from and each in a different style.

The DGG recording is chamber music, graceful, sensitive, and even tiny in stature, backed by equally adroit examples of Richard Strauss.

Kempe uses the Philharmonia, and it produces a larger and more resonant effect.

I don't know that there is a great deal to choose between them apart from this—it will depend largely on what kind of performance you desire. Kempe takes the music rather more quickly, and his general effect is less detailed than Jochum's.

It could well be the backing that will decide you, for Kempe has filled his side with more popular Mozart, and the total adds up to a most tempting disc.

But if you would like to temper Mozart with Strauss, then the DGG is one you should hear.

Both recordings are clean—Kempe's I thought the most impressive—but they are not records which really imply a comparison.

MENDELSSOHN—Italian Symphony. SCHUBERT — Unfinished Symphony. Played by the Orchestra National de la Radiodiffusion Francaise, conducted by Igor Markevitch. Columbia 330cx 1394.

Not a particularly stylish piece of work. Mendelssohn's Italian Symphony is one which must be played with atmosphere, for it has that in full measure.

The headlong dive into the opening bars of the first movement can mean only sunshine, white clouds and happiness. It is one of the most effective pieces of descriptive music.

On this disc, the orchestra dives all right, but I lost a good deal of the atmosphere in the splash.

Some of this may be due to the orchestral balance which allows much to be lost behind a wall of string and tympani.

At all events, the exciting staccato horn playing in the first movement is quite drowned behind them.

There is very little reverberation on the disc, a fact which has sharpened the sound but not sustained it.

At the same time, the orchestra plays brightly, so much so, that some of the earlier competitors sound dull by comparison.

The conductor keeps pressure on the players all the time, whereas some letup in the third movement, for instance, would have helped.

The Schubert is a more impressive performance, and Markevitch builds it up to quite a size. In the quieter passages the orchestra seems more relaxed than in the Mendelssohn.

But neither symphony is as smooth as is the direct contemporary an H.M.V. by Cantelli.

Theirs, I feel, is a better proportioned effort, and the recording is almost as good.

FIVE STAR RECORDING OF BEETHOVEN SONATAS

BEETHOVEN—Sonata No. 17 in D minor Opus 31 No. 2; Sonata No. 18 in E flat, Opus 31 No. 3. Played by Solomon. H.M.V., OALP 1303.

It is not often one can give a five-star award to a piano record. A few years ago such a thing would have been impossible on technical grounds alone, for sooner or later there would have been a break or a blast to spoil a heavy chord.

I listened to this disc in vain for such a sound.

From first to last I give it a clean sheet.

The microphone placing is such as to catch the middle and lower registers with a beautiful body and richness without any loss of clarity.

The same can be said of the top register which never tinkles or becomes thin.

It sounds very much like the piano in the St. John's Wood studios of E.M.I. in London. If so, it is the one on which I gave a surreptitious performance to myself while my guide was occupied elsewhere. By a coincidence, the music was the Minuet from the No. 18 sonata, but not, I fear, the way Solomon plays it!

Not only is the recording of this disc outstanding, but the performance deserves the highest praise.

Solomon's Beethoven was never aggressive, but it has a dignity and sincerity which, together with his impeccable tone quality, suits these sonatas to perfection.

Some may wish for more crispness, particularly in the first and last movements of No. 17, but Solomon's way is so beautifully handled that I, for one, am quite happy to listen.

It is difficult to choose between the two, nor is there really any reason to do so, but I enjoyed No. 17 most.

Greater contrast between the sections of the third movement would have been good, but nothing could surpass the delightful presto with which it ends.

I am sure there is no better all-round piano record to be had, and certainly no better performance of these magnificent sonatas.

You must not miss them.

SONGS YOU LOVE. — Sixteen songs by Elisabeth Schwarzkopf, accompanied by Gerald Moore. Columbia 33CX 1404.

A release notable, if for nothing else, for the beautifully printed colour picture of the singer on the front of the jacket.

Psychologically this is a good thing, for one cannot imagine anyone who looks so charming being capable of a bad song.

But Schwarzkopf has more than beauty. She is probably the most successful lieder singer of her type at the present time.

Her 16 songs are rather too many to list in full, but they contain "Plaisir d'Amour," "Songs My Mother Taught Me," "None But The Lonely Heart," Grieg's "Ich Liebe Dich," and "Wiegenleid" of Richard Strauss, to name only a few.

PERFECT CONTROL

Every one is a work of art. Every one is an example of almost perfect vocal control, so well recorded that the slightest slip or fall from grace would be horribly evident.

But, for me at least, there were none.

Some of the songs, I'm sure you agree, have never been better sung.

Two points only I would make. It is a pity that, for one who can be so charmingly animated, there are not more in lighter vein (most of them are lovelorn). It is equally regrettable that Schwarzkopf tends to dramatise some moments which it would have been better to play straight.

"Plaisir d'Amour" is so obvious a case that it cannot escape mention. If ever a song did not require ornamentation, this is it. It is her only really serious lapse.

Technically, the disc is a beauty. There is no surface noise to worry about, or to cut into Gerald Moore's lovely accompaniments. Whether you will want to play them all at once is your affair. But if you want Schwarzkopf to sing to you, maybe you won't watch the clock.

One of the month's best.

HANDEL.—"The Water Music" (complete), played by the Philharmonic Promenade Orchestra with Christopher Taylor (recorder) and Ralph Downes (harpsichord) conducted by Sir Adrian Boult. Nixa NCL 16017.

Kurt List, who wrote the booklet which goes with this record, says that, as a collaborator with Adrian Boult, "we conceived the 'Water Music' as a coherent suite of dance movements interconnected by concertante pieces of almost symphonic character. — we proceeded to reconstruct both instrumentation and order of selections."

I quote this because it is significant when attempting to appreciate this record.

Without presuming to contradict, I wonder whether we are justified in assuming any real or implied continuity between the various sections—about 20 all told. List himself points out that they were probably composed at different times, and virtually collected as a series of divertissements, as much for convenience as anything else.

They were, in fact, the counterpart of the modern "mood music," except that they have considerably more musical significance.

And if you are in the mood, they will delight you.

List (of Westminster fame) is known for his insistence on inner clarity in his recordings, and makes a point of his efforts here to arrange orchestration and instruments so that we can clearly hear everything that goes on.

He has succeeded in this. The sound is appropriately weighted, and if the more modern instruments have their own quality, it is probably as good an estimate in general stature of what Handel intended, as you are likely to hear.

This is claimed as the first full recording of the "Water Music" and it is not hard to see why Harty selected as he did for his suite, which is the form we most often hear.

But a full presentation has its own and obvious virtues, and these must be placed on the credit side. It must counterbalance an inflexibility I found throughout the recital. I would have liked to hear more made of the individual character of so many sections.

Except for a few moments of uncertainty, both orchestra and recording are good.

Probably the best "Water Music" to date.

RAVEL—Piano Concerto for the Left Hand. Played by Robert Casadesus and the Philadelphia Orchestra conducted by Eugene Ormandy.

SAINT-SAENS—Concerto No. 4 in C minor. Played by Robert Casadesus and the Philharmonic Symphony Orchestra of New York conducted by Artur Rodzinski. Coronet KLC582.

Casadesus is well enough known as a performer of Ravel for the customer to buy this record unheard, and after hearing it I should say he would be safe enough.

I am a bit Cortot's way, who, as the jacket note tells us, could not understand how Ravel's heirs rejected his two-handed version as being contrary to the composer's wishes.

From this hearing, I doubt whether you could tell whether Casadesus is using one hand or two.

It is brilliant and fascinating music, characteristic with colour and rhythm, into which the piano part darts with brilliant forays and intrusions.

It was written for a pianist, Wittgenstein, who had lost an arm in World War I, but who did not like the work when it was done. This seems to be the only reason why the left hand only ever came into the picture.

If it were not for the fact that a pianist would lose face if his single hand wasn't good enough, it would surely be heard more often.

The piano recording is very good, although at times its presence varies as though some recording adjustments had been made during takes. This effect is most noticeable at the first piano entry. The orchestra, too, is brilliant.

The Saint-Saens may have been a fill-up, but is given a vigorous and attractive performance. If anything, the recording is best on this side, and the music suits the pianist's strong articulation.

It is a quite tuneful, garrulous work, and contains many brilliant testing pieces for the soloist.

The surface isn't completely quiet; there are some crackles and a slight rushing sound on my copy.

COOK FREQUENCY AND INTERMODULATION TEST RECORD SERIES 10 LP.

One of the best standard test records now available. One side has a series of spot checks from 100 to 12,800 cycles with standard LP characteristics, a band cut with V groove for intermodulation check using 100 and 7,000 cycles recorded with less than 4 per cent distortion and a gliding tone from 1,000 to 20 cycles, with five breaks.

The reverse side has a series of spot frequencies from 20 Kc to 20 cycles with 1,000 cycles reference bands at the start and finish.

Full technical details concerning crossovers, levels, etc. are given on the jacket, so that the best use may be made of the disc. It is one of the very few which carries a 20 Kc test tone at 33 r.p.m.

Every worker in sound should have one.

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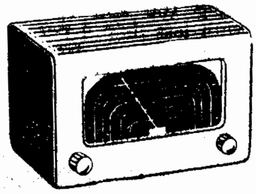


ONE VALVE KIT SETS FOR THE LEARNER

Although this little set is quickly and simply built it looks like a factory job. The wooden cabinet is covered with burgundy leatherette and the dial has all Australian Stations marked in different colours. Parts are mounted on a wooden baseboard and anyone can build it if they can use a soldering iron. Circuit diagrams wire, solder, etc., supplied. Price of complete Kit of parts including Valve, Headphones and Batteries. Normal price £8/5/.

Our Price £5/19/6

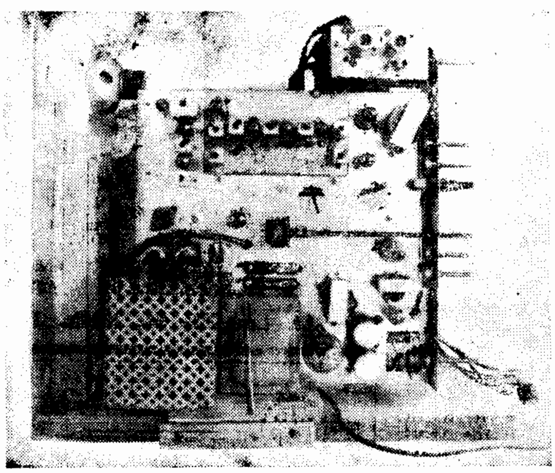
RECORD PLAYER AMPLIFIER

Very compact and light weight. This unit combines a 4½ watt amplifier with two inputs, one for the built-in 3-speed Philips record player and one for a crystal microphone, each input has its own volume control, also two outputs, one connected to the built-in speaker and one for a separate extension speaker. An on-off switch and tone control is provided. The cabinet is finished in two-toned leatherette. Ideal for parties or for playing records in the home. Well worth 35 gns.

Price only 27gns.

6in Extension Speaker in leatherette covered box. Worth £3/4/-. **Our price 49/6.**
Crystal microphone to match this unit. 45/-.

WIZARD TELEVISION KIT SET



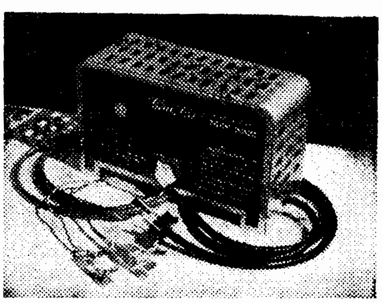
This kit has proved itself to be a good performer which will give an excellent picture and good quality sound under any normal operating conditions.

When properly aligned it will work quite as well as a commercially built TV receiver.

The circuit uses 18 valves plus 2 diodes plus a 17HP4B or 21 ALP4A Picture Tube, will receive all ten channels and uses well-known and reliable components throughout.

To all purchasers of a complete Kit of Components we make this offer.

We will align your set for 25/- hour labour charge. Please write for full details, prices, etc.



BATTERY CHARGER KIT SET

You can make the Battery Charger as illustrated. It will charge a 6-volt or 12-volt battery at 4 amps. It has a selenium rectifier and will give long life and reliability. Price for a complete kit of parts and circuit diagram, £7/19/6.

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TCHAIKOWSKY—Symphony No. 6 in B minor Opus 74. Played by the Leningrad Philharmonic Orchestra conducted by Jewgenil Mrawinsky. D.G.G. L.P.M. 18334.

This is one I have been trying to fit into these pages for the last few months, and it deserves less laggard treatment.

For it is indeed a mighty performance, a fit companion for the Tchaikowsky symphonies already reviewed, and played by the same orchestra.

Mrawinsky has concentrated on its power, and it is possibly the most powerful of all Tchaikowsky's symphonies.

There is, as with the other two, much more echo audible than in the average disc of today, and if it were not that the wild profusion of sound can stand it, I would mark this on the debit side.

But if I had to choose between this and a dead studio, I would not hesitate.

Once more I must comment upon the tremendous virility of this fine orchestra. It takes the dramatic outbursts, particularly of the first movement, and builds them up with overwhelming force.

I doubt whether you will hear anywhere brass of such magnitude. It's a tribute to the Russian lung power!

And during the quiet clarinet passages which follow, you will hear how effective the liveliness of the recording hall can be.

There is no relief in the pressure put upon the players. Any easing up of the drive merely lends further point to the excitement as the music sweeps on to its terrific conclusion.

If it is a big conception of the symphony you are looking for, no other version has the edge in this one, and there are some good ones to be had.

Touching the actual performance, the Leningrad orchestra shows its equality with any other recording at the present time, in the quality and authority of its playing.

Although bass is not lacking, I found an extra notch to the R.I.A.A. curve sounded best.

This is a superb disc.

BEETHOVEN—Sonata No. 7 in C Minor Opus 30 No. 2; Sonata No. 10 in G major Opus 96. Played by Ruggiero Ricci, violin, and Friedrich Gulda, piano. Decca LXTA 2942.

Both Ricci and Gulda play with particularly clear articulation, and their styles blend well.

This, and the extremely good recording, are the main virtues of these performances.

There is a good deal of contrast between the two sonatas.

The Opus 96 was Beethoven's last of its kind, and although it is not a profound work in the style of his piano sonatas and string quartets, it bears the stamp of the period.

The Opus 30 belongs to the Kreutzer era, and there is a marked similarity in the general style of the two works, particularly in the first movement.

Neither Ricci nor Gulda appears to have the touch to make their performances memorable, and to tell the truth, they are not as easy to make sound that way as many other Beethoven works.

A fuller and stronger tone than Ricci's would have done better in the adagio of No. 2, for instance.

On the other hand, the scherzo suits them much better.

But even here, the violin tone thins out and loses authority more than once.

As these are the only recordings I have of either sonata, I have no comparisons to make, but none is needed to find plenty of merit in this one.

Technically, it is one of the most successful violin-piano records I've heard, and it has no surface background to speak of.

It plays well with the R.I.A.A. curve.

BEETHOVEN — Symphony No. 5 in C minor Opus 67. Played by the Philharmonia Orchestra conducted by Otto Klemperer. Columbia 33OC 1051.

If you are used to the brisker tempo of the recent Karajan recording, you will probably rate this one as being rather tame, and by contrast, it does at least sound subdued.

But it is probable that more conductors have handled this symphony in different ways than any other.

I always see it as a thing of great urgency, an effect which must be obtained in combination with dignity and grandeur.

In this respect there is no symphony like it. Its form is so perfect, physically and emotionally, that, as orchestral music, it is a thing apart.

In the field of big music it has no parallel.

Klemperer's sober reading is rather deceptive, for although he approaches it analytically, he does not pull it apart.

He just doesn't get as excited about it as I do, or as Karajan does, and Karajan is far from being the world's most excitable conductor.

But there are many people who go along with Klemperer. Without doubt these will choose this as the best Fifth there is, for in all other respects it is as good as the best in the field.

I often wonder how an orchestra, even one as good as the Philharmonia, can adapt itself to the same work under different conductors with such different ideas.

But it does, and produces characteristically fine playing and balance of tone.

Particularly good are the double basses in the scherzo.

The crescendo and opening bars of the last movement go through without a hitch, but here again there is no great agitation. But Klemperer does include the rarely heard repeat of the first section.

I'd say your choice is clear. If you want a brisk performance, you will choose Karajan. If you ideas are more conventional, you will prefer Klemperer and his 10-incher.

Both are in the front rank.

PROKOFIEFF—Alexander Nevsky, Cantata Opus 78 for Orchestra, Chorus and Voices. Played by the Vienna State Opera Orchestra and Chorus, with Ana Maria Iriate, mezzo-soprano. Conducted by Mario Rossi. Vanguard PVL 7001.

This is said to be the only complete recording yet made, although a Suite from the music is sometimes heard.

It was written originally as backing for

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a film production of the famous Russian director Eisenstein, a nationalistic saga of how the warrior Prince Alexander Nevsky led the Russians to overthrow the invading Teutonic Knights.

Just before the last war, Prokofieff rearranged the music as a Cantata.

It is clearly thought out music, strongly rhythmical, and it is not hard to imagine how effective it would have been with the film. Its appeal will be a special one to anyone who saw it.

Listening to it "cold" I thought it lacked sufficient dramatic cohesion to give its various sections full point. But as those most likely to buy this record will do so for their special interest in the musical treatment of the theme, this may not be a disadvantage.

Nobody is likely to be disappointed with the performance, or with the recording. The Vienna players handle the contrasting orchestration and interplay of instruments with ease; there is a well-placed bass to give it the full dignity and darkness of colour as, for instance, in the "Field of the Dead," in which the singer helps to provide one of the most successful sections.

On the other hand, I thought the final scene, a joyful festival of victory, lacked the size it needed. Prokofieff isn't at his strongest when writing in big scenes like this.

Altogether an interesting and well-made record.

RICHARD STRAUSS — Scenes from Der Rosenkavalier Italian Aria; Baron Och's Scene; Marschallin's Monologue; Duet—Marschallin and Octavian; Presentation of the Silver Rose; Waltz Scene; Trio, Duet and Finale. Sung, with the Berlin Philharmonic Orchestra conducted by Wilhelm Schuchter. H.M.V., OALP 7506.

If you cannot have a complete recording of Rosenkavalier, then extracts are the next best thing.

Here are some of the highlights, taken apparently from a complete recording, all beautifully played and sung.

Every voice is a good one. Even the famous tenor aria with which it begins is in tune, and we don't always find that!

Baron Ochs is suitably masculine and ridiculously wicked, and Marschallin's Monologue and duets with Octavian have high quality.

It has the air of the theatre, and the orchestra at no time outweighs the vocalists. Its contribution is in fact one of the things which makes the disc so successful.

A great deal of enchanting music in a single parcel.

TCHAIKOWSKY — Nutcracker Suite, Swan Lake Suite. Played by the French National Symphony Orchestra, conducted by Roger Desomiere. Capitol P-8140.

It seems strange that neither of these ballets was successful at its first performance when we remember how frequently the music is heard today.

I can always listen to it with pleasure. As I have often remarked, for me the best of Tchaikowsky is in his ballet music.

The main advantage of this disc is that it has cleanly-played versions complete on a single record.

The recording is remote, and this gives it a light weight when compared, for instance, with Mercury's full score. But then there is a big difference between the intent of the two versions.

There is little reverberation, as though it was made in a rather dry studio.

This gives it an intimacy which goes with the ballet flavour rather than with a concert hall performance. There is no attempt to exploit the music for show purposes.

Both suites are the conventional groupings with which most people are familiar.

Not among the heavyweights, but acceptable in its class for all that.

Point of interest — the tone of the French woodwinds, particularly well instanced in the Dance of the Flutes.

SCHUBERT — Symphony No. 9 in C major, played by the Philharmonic Promenade Orchestra, conducted by Sir Adrian Boult. Nixa NCL16006.

The only other contemporary version I have is that of Barbirolli, which musically I like, but which can't compete with this one from a recording viewpoint.

A most noticeable characteristic of Boult's record is the forwardness of the double basses, whose part I have rarely heard so deliberately and clearly.

It is most effective in quite a number of cases, for Schubert frequently provides them with little figures of their own which are quite important in the over-all picture.

At the same time, this isn't a work in which analytical playing is always the best. I think Boult has been worked rather too close to the microphone. I like it better when the symphony is heard from further away.

But at least you will be unable to complain that you can't hear everything that goes on.

This fairly close recording, added to Boult's unrelenting beat, gives a feeling of hurry which isn't always implied in music so consistently melodious. But it's a long symphony, balanced against its net content, and he was probably anxious to avoid any suggestion of dragging. There is, too, the minor matter of how long two sides will last.

A bright record rather than a smooth one, and, judged on all points, is probably as good as there is.

Incidentally, watch out for the recording of the pizzicato bass notes in the last movement — they are rarely heard to better effect.

Surface is O.K. and it plays cleanly.

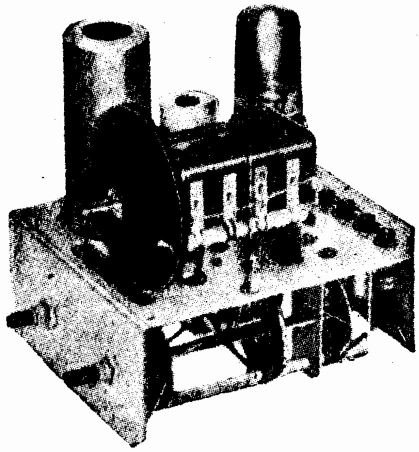
PUCCINI—Tosca Highlights, sung by Luisa Malagrida, Carlo Franzini and Antonio Salsedo, with the Orchestra Antonio Guarnieri di Milano, conducted by Arrigo Guarnieri. Philips S 04004 L.

A record to demonstrate that you don't need a world-famous name to be a good singer, although we are conditioned to this idea, I am afraid, by the intensive publicity given to recording stars.

Fortunately this position isn't as acute as in bygone days, when a score of singers produced pretty well the entire classical repertoire on discs.

This record has all the highlights from Tosca, and all are most competently performed.

It is, in fact, refreshing to hear some



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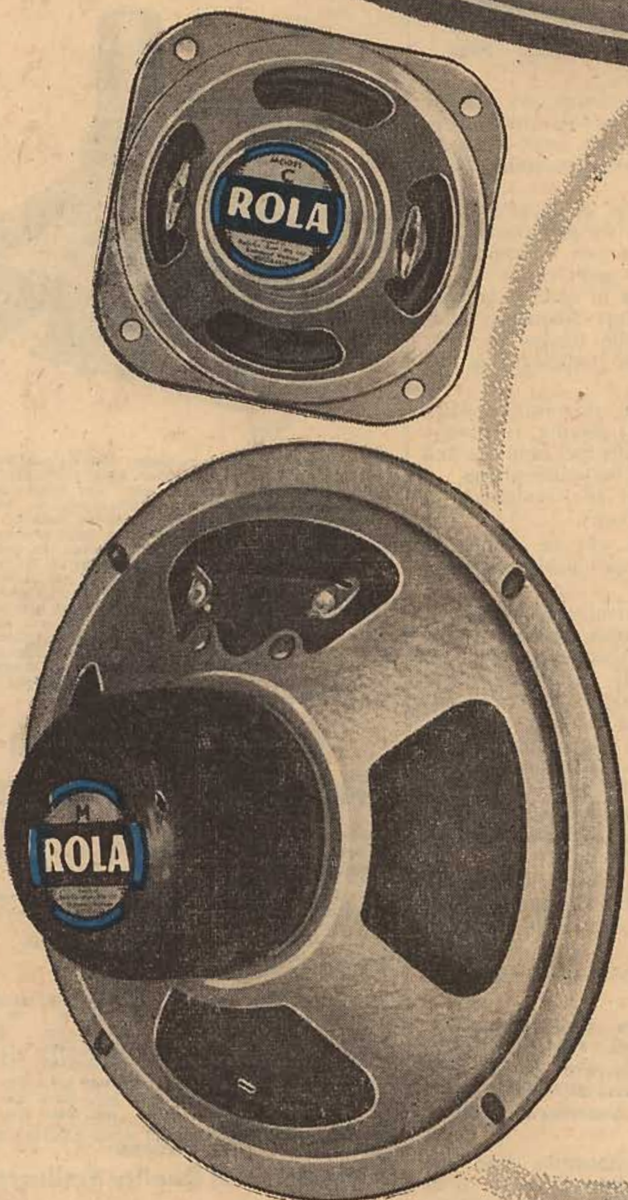

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new voices, for opera these days centres rather too much around a few principals, so that there is a danger of becoming weary of them, no matter how good they are.

The recording is most satisfying, probably made in a theatre, judging from the live atmosphere.

I recommend it. The pressing, too, is first class.

SCHUBERT. — Symphony No. 5 in B Flat Major. Rosamunde; Overture, Entr'acte and Ballet Music. Played by the Columbia Symphony Orchestra, conducted by Bruno Walter. Coronet KLC 596.

It's very hard to criticise work of this standard, other than to say that, if you are familiar with Bruno Walter, you will know exactly what to expect.

One can well imagine that this is the kind of music he loves to play.

He gives full value to its melody and line, for in this music Schubert handles both as well as he ever did.

The symphony is shaped with care, but not obviously so. I think it is the most nicely proportioned of all Schubert's symphonies, and this proportion is firmly but sympathetically held from the first bar.

Only in the slow movement is the orchestra inclined to lay it on, and then quite definitely playing to instructions, or to exhortations, as is more probable.

Rosamunde shows more evidence of Walter's careful style, and this has robbed it of its brightness a little.

It is most interesting to observe the conductor's tempos — the first movement is as good an example as any.

His changes of pace, often infinitesimal and often subtle, are one of his most effective weapons, never accidental, and sometimes a little annoying, as though he has determined that, above all else, the music must not lie still in its groove.

However, that is the manner of the man, and at least one is never in danger of hearing the music or the orchestra merely ploughing through the pages.

I liked, too, the graceful touch which illuminates both sides, and the sensitivity which it foretells.

The orchestra plays very clearly and cleanly — it is not over-sharp in its attack, but its response is immediate and its ensemble extremely good.

It has a nice air to it — that word again! — and exhibits, as a result, a cohesive sound the lack of which I commented upon when reviewing the Nixa disc.

Altogether it is a disarming and gracious performance, which is where I came in.

RACHMANINOFF. — Rhapsody on a Theme of Paganini. Played by Benno Moiseiwitsch and the Philharmonia Orchestra, conducted by Hugo Rignold. CHOPIN. — Barcarolle Opus 60. Nocturne in E Major, Opus 62, No. 2. Ballade in F Minor Opus 52. Played by Benno Moiseiwitsch. H.M.V. OCLP-1072.

There is a relaxed air about this record which I liked. Moiseiwitsch was never a member of the hard-bitten pianistic school — on the contrary, I believe he was once called the poet of the piano, and the two don't really go together.

He is still poetic, and most graciously so. Particularly is this evident in the Chopin, where we hear the quality of touch which made him famous. I liked the Ballade best of all, and if there are some edges rounded off, both emotionally and technically, they don't cloud the music or detract from his idea of it.

Moiseiwitsch was a close friend of Rachmaninoff, and has made a special study of his work.

In the Rhapsody, the tension is lower than that of some performances, partly because that is the pianist's way, and possibly, too, because in his later years he does not command his erstwhile power.

I would not let this discourage you about the record, however, for he has re-discovered many facets of a fine and brilliant work which Katchen, for instance, often hurries over.

Moiseiwitsch trades excitement for warmth and an inner glow which I found very easy to take.

The piano tone is possibly best in the Chopin where it is full of body and warmth.

In the Rachmaninoff it sounds just a bit tubby, but only a bit. The Philharmonia, sometimes overborne by the piano, plays beautifully here, with great clarity and sympathy. It has a fine rounded weight, heightened by a most authentic touch on the bass drum which you can't miss.

You could easily develop an affection for this disc. It's one in which the music is given first consideration.

The surface has a few rustles, but not enough to get angry about.

ELGAR—Enigma Variations, Opus 36; Cockaigne Overture Opus 40; Serenade for String Orchestra, Opus 20. Played by the Royal Philharmonic Orchestra, conducted by Sir Thomas Beecham. Coronet KLC 527.

This is another re-release by Coronet of a popular disc originally issued under a different label, and unavailable for some months.

It will be welcomed, for it contains a great deal of Elgar's most popular music on a single disc.

The Enigma Variations are second only to Land of Hope and Glory in their fame, and consist of a series of musical sketches, each representing a friend of the composer.

In them we hear Elgar in just about every mood, and in a characteristic treatment of each. Everybody likes this graceful and interesting music, and there isn't much point in commenting further upon it.

It's much more profitable to note once again that technically it is beauty, and quite the best there is.

The orchestra must know Enigma backwards, and the engineers have made a top notch job of coping with its powerful moments, just as successfully as with its softness and delicacy.

Hearing it again, I'm inclined to think that Beecham has rounded it out with just a little too much emphasis and color —"Beechamised" I think the phrase is. But he does it so well that we can forgive him.

The Serenade for Strings, a quiet, romantic interlude, is played smoothly and with quiet feeling.

Cockaigne, one of Elgar's noisy pieces, is as good an example as any of his "Pomp" style, and isn't so often heard.

I can't remember whether I gave this disc five stars when I first reviewed it, but because of its lovely sound, its fine music, and high-class performance, I do so now. Everyone should have it on the shelf.

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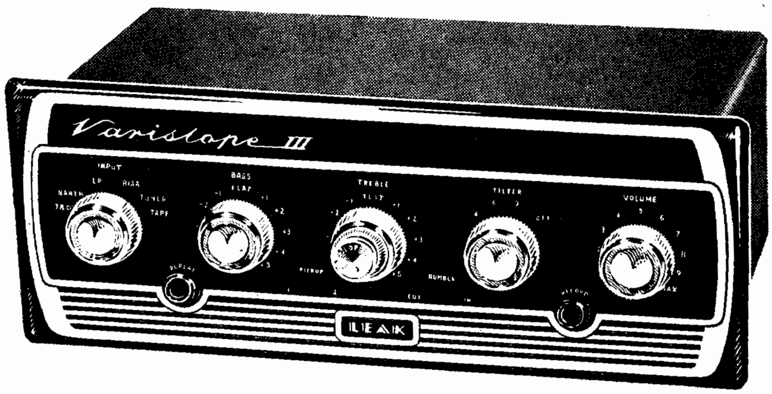

SPECIFICATION VARISLOPE III:

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TL/50 : Full Details are not yet available.

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N.B. These new models do not supersede the TL/10, still in production, which remains one of the best sellers throughout the world.

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SHORT-WAVE NOTES BY ART CUSHEN

INDIA ADDS TWO NEW TRANSMITTERS

Two new regional transmitters have been added to the broadcasting network of All India Radio.

INDIAN regional shortwave coverage for many years has been provided from stations in Madras, Calcutta, Bombay and from All India "Radio's" headquarters in Delhi. In the past year new stations have been under construction to supplement the normal broadcast band stations' coverage, and three of these are now on the air.

Simla, the summer capital of the Republic, has been operating for some months, but the new ones have just commenced broadcasting, being located in Gauhati with 10,000 watts and belonging to the East regional service, and the new Bhopal.

The Gauhati station operates 11.15 a.m.-1.00 p.m. (Sunday 1.30) on 7,125 Kc; 5.30-6.30 p.m. and 8.30-11.00 p.m. 9,575 Kc, and 11.15 p.m.-2.30 a.m. (Sunday 3.30 a.m.) on 9,575 Kc also. The new Bhopal station is operating 11.30 a.m.-1.30 p.m. on 7,150 Kc and 10.00 p.m.-2.30 a.m. on 4,940 Kc.

Simla now broadcasts 7,170 Kc 11.30 a.m.-1.00 p.m. and on 4,760 Kc 10.00 p.m.-1.45 a.m. (Sundays 3.30 a m). Radio Kashmir at Srinagar operates noon-2.00 p.m. on 6,110 Kc, 5.00-6.30 p.m. on 9,660 Kc and 10.30 p.m.-3.30 a.m. on 4,860 Kc.

EXPERIMENTAL SERVICES

The normal external services of All India Radio are generally carried from Delhi, but new experimental services to overseas areas are being broadcast by Madras and Bombay. The Madras transmission is to South-East Asia in the 25 metre band at 9.45 to 10.15 a.m. and in the 16 metre band 10.00 p.m.-midnight. A program in Konkani is broadcast from Bombay to East Africa in the 19 metre band at 3.15 to 4.00 a.m., the target area being East Africa.

RADIO NETHERLANDS has a new program booklet which is now being published and can be had on request from the Radio Netherlands offices, P.O. Box 137 in Hilversum, Holland.

The interesting information in the latest copy to hand includes the news that two of the 100kw transmitters are now on the air, while the unique rotary beam which has been used in the 19 and 31 metre bands has now been withdrawn.

This novel antenna system will be remembered by listeners to be the old PCJ station when it was operated by Philips Radio. The antenna was slung between two masts which were built on a broad crosspiece, which was in turn pivoted on a circular track so that the antenna could be beamed in any direction.

This antenna, which has served the station for some 20 years, has been replaced by permanent antenna arrays. The station when the further new transmitters are installed will be able to introduce two independent programs, one in Dutch and the other in English, and the other foreign language broadcasts they transmit.

Brussels World Fair

THE special broadcasts from Brussels for the World Fair to take place in that city next April has resulted in good signals from the Belgium National Radio in transmission directed to North America. The signals are best reseived on ORU3 on 15,335 Kc from sign on at 9.15 a.m. to sign off one hour later. The program on Sunday consists of classical music, and this is the only day the broadcast is made. The session is interrupted at 9.45 a.m. for a mailbag session during which reports from listeners are answered.

Three transmitters are used in the service—ORU3 on 15,335 Kc, ORU4 9,705 Kc and ORU5 on 9,745 Ks, the former channel being the better received. The transmission is also carried on the Leopoldville station OTC using 9,665 Kc. Reports are requested to Box 26 Brussels. At 9 a.m. the local Flemish transmission from Brussels has been noted on 15,280 Kc when signing off, signals are in the clear with the clearing of the frequency by Radio New Zealand to 17,820 Kc at this hour, though Prague on 15,285 opens at 9 a.m. just the the Brussels transmission ends.

Far East network

THE Far East Network, which has been broadcasting programs from Japan for the American Forces for the past 12 years, is to reduce its operation in the next few months. F.E.N. broadcasts, which are heard on four frequencies, are expected to be affected when some 30,000 troops leave Japan in the next few months.

To compensate this a step-up in the broadcasts of the stations of the American Forces Korean Network is expected, as most of the troops will be transported to that country. The present A.F.K.N. transmissions on 6,980 Kcs are expected to be extended with the increase in stations in that area.

In the past the A.F.K.N. stations have been identifying with a code name and the calls of Homesteader, Vagabond, Kilroy and Gypsy. This has been changed and the actual station location is now given. The present stations in Korea are located at Seoul (560), Osan (1060), Kuma-ri (1,400), Pusan (1,250), Taegu (1,510) and Junsan (1,440) and Uijongbu (1,150), so that the location of any of these six stations network will be carried on the new A.F.K.N. frequencies in the future.

NOTES from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Standard.

Brazilians on 3.5 Mc

WE were indeed surprised to hear two Brazilians on the low frequency 90M band in the past few days, and these are the first signals we have heard from this country on such a low frequency.

In the late afternoons signals from Venezuela, Peru and Colombia have all been heard on this band, and at 8.30 p.m. we can regularly hear the Venezuelans sign on. The two Brazilian stations we have heard are both only 1,000 watts and have been heard at fair strength for such a low frequency.

The signals of ZYK21 on 3,265 Kc, opens at 7 p.m., Radio Tamandare in Recife, on 3,335 Kc, ZYR59 La Voz do Sertao, Sao Paulo, opening at 8 p.m., with some interference from CBU, the Canadian time station on the same channel.

FLASHES FROM EVERYWHERE

RADIO CEYLON in its commercial services beamed to India has been reported on the new frequency of 15,265 Kc and has been opening at the usual time of 11.30 a.m. An American report states that the station has been announcing as also on 7,190 Kc with the same program.

MEXICAN station XESC in Mexico City is reported by Radio Australia to have returned to 15,205 Kc and to be heard in the daytime hours on this channel. This station, which carried the programs of XMEC on 1,590 Kc, is somewhat notorious for its unreliable verification policy. At times the station sends postcards and requests for further reports, but more often no reply is received.

A further new Mexican is reported on 11,855 Kc with the callsign XELZ and has been announcing as also XELZZ, which appears to be the short wave callsign, as XELZ is assigned to the broadcast band 1,440 Kc frequency.

VIETNAM transmissions from Hanoi have been the subject of frequency changes and this station has been noted for its instability. The 15,030 channel has English news at 7.30 p.m. and the other frequencies are 11,905 and 9,840 Kc. These stations were formerly on 12,000 and 9,460 Kc. On Sundays a mailbag session is heard, with answers to listeners' questions in the 30-minute session.

PERU has added several new stations, reports the "World Radio Handbook," and these include Radio 1,160 Lima, OCX4R on 4,880 Kc with 750 watts; Radio Junin, Huancayo, OBX4Y, 3,300 Kc, 350 watts; Radio Ica, Ica, formerly Radio Universal, OAX5C, 9,950 Kc, 200 watts; Radio Mundo, Huancayo, OCX4G, 6,160 Kc, 1 Kw; Radio Pisco, Pisco, OAX5O, 5,010 Kc, 1 Kw; La Vox del Antiplano, Puno, OAX7L, 5,960 Kc, 300 watts; Radio Atlantida, Iquitos, OAX8K, 9,625 Kc, 1 Kw.

SPANISH transmitter EFE3, on 7,380 Kc, using the slogan Radio Alerta, Madrid, formerly Voz del Falange. The station operates 6.00-9.00 a.m. and is soon to extend schedule and also add foreign languages to its broadcasts.

TANGANYIKA is now operating as follows: 1.15-2.50 p.m. on 7,167 Kc, 1.00-4.00 a.m. (in Kiswahili), 4.00-5.30 a.m. (English) on 5,050 Kc. There is no broadcast on Sunday and Monday morning.

BRAZZAVILLE station Radio AEF, broadcasting from French Equatorial Africa, now broadcasts 3.00-6.30 a.m. in French on 4,795, 5,970, 9,964, also on 9,625 for the period 3.00-3.53 a.m. and 15,420 4.00-6.30 a.m. A transmission at 9.00-10.30 p.m. is radiated over on 1,485 Kc only.

KOREA has made a further change on the new 100 Kw transmitter frequencies and now uses the 7,180 Kc channel for part of the broadcast. The latest schedule from the International Short Wave Club reads: 10.00 a.m.-2.30 p.m., 5.30-7.00 p.m. and 8.30-10.00 p.m. on 9,640 Kc. English programs are carried 7.30-8.00 p.m. on this frequency. Further transmissions are from 9.00 p.m. to 1.15 a.m. and from 6.00 to 10.00 a.m. on 7,180 Kc. The complete transmission, 6.00 a.m.-1.15 a.m. is on 3,910 and 8.00 a.m.-7.40 p.m. on 5,980 Kc. The HLKA station has 17,895, 15,255 and 11,925 Kc as assigned frequencies.

ALBANIAN transmitter on Tirana has made a move to 6,900 Kc from the old channel of 6,815 Kc. The station has programs in English on 6,900 and 7,850 Kc from 6.30 to 7.00 a.m., 8.00-8.30 a.m. on the same frequencies. The Albanian station is perhaps the hardest of the European stations to verify and we have been able to confirm reception of the 7,850 Kc outlet only, and that was some years ago.

ROME in its transmission to the Far East has discontinued the use of the 11,810 Kc frequency in the session in English, 8.40-9.00 p.m.; the program is now on 21,560, 17,770 and 15,400 Kc.

POLAND has added the frequency of 17,800 Kc in the North American transmission and has been received at good strength by Kevin Dunhan in N.S.W. and several other readers. The new schedule from Warsaw is at present reading: 9.00-9.30 p.m. 11,740, 15,120; 10.15-11 p.m. on 11,740, 11,755, 15,120; 10.30-11 a.m., 12.30-1.00 p.m. on 11,740, 15,120, 17,800; 3.30-4.00 p.m. 11,740, 15,120. To Europe, 4.30 p.m., on 9,540, 11,775, 11,945; 4.30 a.m. on 6,105, 9,555, 11,775; 5.30 a.m., 6.30 a.m., 7.30 a.m. on 9,525; 8.30 a.m. on 9,555, 9,615 and 11,775. Each program to Europe is of 30 minutes duration.

MONROVIA station ELWA in Liberia has been heard by Dick Pollard of Golden Downs, New Zealand, on 21,535 and 4,760 Kc. The lower frequency is fair at 5 p.m. and the 13-metre signal has been heard here as early as 3 p.m. with weak signals and some side interference from Melbourne on the next frequency.

THE HAM BANDS WITH BILL MOORE

Radio amateur operators in the decade from 1920 to 1930 were responsible for pioneer work in establishing communication on the medium and short waves. They opened world wide communication links often using comparatively simple equipment and very low power.

NEWSPAPER cuttings covering amateur radio activity in the 1920's provide an insight into the field of operation during the period. The following are a few facts gathered from an inspection of these cuttings and cover the period 1920 to 1923.

In 1920, the Argus (Melbourne) reported that the Victorian Division of the Wireless Institute membership was 130, and that main discussion at the annual general meeting was on the subject that the Prime Minister's Department was considering the possibility of granting transmitting permits to amateurs.

In February, 1920, "The Sydney Morning Herald" ran a feature story on the work of two amateurs who were receiving signals from Nauen in Germany, over 12,000 miles. Other long wave signals were being heard from many parts of the globe.

The two amateurs concerned were Jack Pike (VK2JP) and Joe Reed (VK2JR), both still very active.

A syllabus of lectures conducted by the N.S.W. Division of the Wireless Institute showed that lecturers included Ernest Fisk, Harry Stowe, Phil Renshaw, and a still active amateur, Bill Zech, VK2ACP, of Katoomba.

Chas. Maclurcan, 2CM (now VK2CM) in 1922 was being heard in New Zealand, using CW and nine watts input. The wavelength was in our Current Broadcast Band.

REQUIREMENTS IN 1923

Radio amateurs in 1923 had to satisfy the Controller Wireless that they were competent to control and adjust the transmitting equipment they proposed to use and must submit to an examination if so required. The Morse speed test was at 12 words per minute and the licence fee 10/-.

Close to commercial transmitting stations the power of amateur stations was limited to 10 watts input.

From a distance of five to 50 miles the permitted power was 20 watts, and over 50 miles the power could be increased to 250 watts.

Spark and CW transmissions were allowed in the band from 150 to 250 metres, and a special C.W. and telephony allocation was in use between 410 and 440 metres.

The first recorded duplex working between amateur stations in Australia was between Jack Davis, 2DS, and Wally Best, 2ER.

The estimated amateur population of the world in 1922 was 25,000.

Even in those days, the W's were permitted to use high power—the limit, 1KW. Close to naval stations the power, however, was limited to ½ KW. Licences were divided into classes, one class was permitted to operate up to 200 metres, a second up to 375 metres.

In 1923 there was quite an eruption in amateur radio affairs when Amalgamated Wireless, Australasia Ltd., threatened to take action against amateurs who were infringing patent rights held by the company—they covered practically every phase of wireless reception and transmission.

There were no broadcasting stations at the time and a number of programs were being transmitted by amateurs on varying wavelengths from 1350 down to 250 metres.

The patent problem was finally resolved after much debate and some action taken against amateurs who listed their programs in the local papers.

In May, 1923, the first signals were heard from an amateur station in America, the word "Mott" transmitted by 6XAD, Major Mott, of Berkeley, California, using a power of 1 kw on 270 metres. He was heard by five Sydney amateurs. They were Basil Cooke, Chas. Maclurcan (VK2CM), Joe Reed (VK2JR), Jack Pike (VK2JP) and C. Gorman.

During this period (1920-1923) amateurs overseas had already spanned the Atlantic and Pacific to Hawaii with two-way workings. CW was gradually taking over from spark as a more effective means of communication. Signals from the American mainland were first heard in Hawaii in 1920, when 6EA broke through. The first two-way working was in 1922 when 6ZAC on C.W. contacted 6ZQ in California.

TRANS-ATLANTIC TESTS

The Hawaiian station used CW and 6ZQ used 750 watts of spark. From reports the first rare DX pile-up developed with stations from Vancouver to Arizona stacking up to try to QSO 6ZAC.

Around this time the second trans-Atlantic tests were conducted and 1BDT in Massachusetts managed to get across using only a 5 watt tube.

It was pointed out that possibly the input was around 20 to 25 watts. In the 1920 and 30's it was quite common to run transmitting tubes well overloaded as large valves were very dear and not available to the average amateur. 60 to 70 watts input to a single 245 was not a rare occurrence in the early 30's.

In 1922 signals were exchanged across the American continent.

The original Reinartz Tuner was described in QST in 1921 and the improved tuner appeared in the March issue 1922 providing a boost to CW operation. All this DX was worked on the Broadcast band as we now know it.

Regulations were being liberalised in many countries with 2KW in Manchester, England permitted to use 1KW for the Atlantic tests.

The French amateurs were permitted to use 100 watts up to 200 metres and the Finns were allowed to use these wavelengths.

Some of the amateur station installations were very elaborate. The outstanding one in the Americas was 3ZO whose main antenna was erected between two 200 ft masts and comprised a five wire flat top 375 ft long. One transmitter ran 500 watts on 2500 metres and the station was described as "fabulous."

A staff of seven manned the station and occupied the following positions. Radio Engineer, Director and Constructor, Assistant Constructor, two operators, stenographer and Recordkeeper and an official chauffeur. The station was owned by a Mr. Horace Beale.

It was the following two years with the general migration of amateurs below 100 metres that the shattering effect on worldwide communications was recorded. Amateur stations using lower power, worked around the globe at practically any hour of the day.

It is hoped to cover some of this original short wave working in future issues.

The VK/ZL contest

NATIONAL amateur radio organisations in New Zealand and Australia, the NZART and the WIA, again invite amateurs throughout the world to participate in the 1957 VK/ZL DX contest.

Divided into telephony and CW sections it will be run over two weekends. The phone section from 1000 GMT, Saturday, October 5 to 1000 GMT, Sunday, October 6, and the CW section between the same times on October 12 and 13.

Duration for all contestants is 24 hours.

The following is a summary of the rules:

There will be three main sections. (a.) Transmitting phone. (b.) Transmitting CW. (c.) Receiving phone and CW. The contest is open to all licensed amateurs in the world. Mobile marine or other non-land-based stations are not permitted to enter.

Cross-band operation is not permitted and only one contact per band is permitted with any one station for contest purposes.

Only one licensed amateur is permitted to operate any one station under the owner's call. If more than one operates any one station separate logs must be submitted.

Ciphers: Before points may be claimed for a contact serial numbers must be exchanged and acknowledged. Serial numbers will be as usual, five and six numbers. RS (telephone) and RST (CW) plus three figures beginning with any number between 001 and 100 for the first contact.

Entries should be postmarked not later than October 31 and addressed to the Federal Contest Committee, WIA, Box 1234K, G.P.O., Adelaide, South Australia.

Scoring: Five points will be scored for each contact on a specific band with an overseas station and in addition for each new country worked on that band a bonus of 20 points will be added.

For the purpose of this rule the official countries list will apply with the exception that each VE, W and ZS call area will count as a separate country.

Logs submitted should show on page 1, name of operator, section entered, address, call sign, claimed scores total and individual band scores. The transmitter input should also be given and the aerials used. A signed declaration must be presented stating that the rules of the contest have been observed. Page two covers the log proper.

Data should be listed as follows:— date, band, time GMT, station worked, serial sent, serial received, points claimed, bonus points and a blank space.

Awards: The WIA will award certificates to the top scorer on each band and the top scorer in each VK and ZL district. Additional certificates may be awarded depending on the number of logs received.

Receiving section: Is open to all members of any short-wave society in the world.

The contest times and logging of stations on each band per weekend are as for the transmitting section.

Logs will take the same form as mentioned. It is not sufficient to log a CQ.

VK receiving stations may log overseas and ZL stations, ZL receiving stations may log overseas and VK stations.

Certificates will be awarded to the highest scorers on the same basis as for transmitting stations.

The rules of the contest have been varied and the operating period of 24 hours only may attract additional entrants.

New officers for N.S.W.

THE following amateurs have been appointed to positions with the N.S.W. division of the W.I.A. Vince Cahill, VK2VC, treasurer in 1956-57, will continue in the position for a period and has been nominated as the seventh member of council.

Dave Duff, VK2EO, continues as engineer at VK2WI, and has been working consistently on the equipment. Quality of the transmission is now excellent.

Bill Lewis, VK2YB, who has addressed the bulletins for some years, will again assist.

Frank Hine, VK2QL, is QSL manager, and Allan Smith, VK2AIR, assistant QSL manager. Other positions will be filled as required. Any inquiries on N.S.W. W.I.A. matters can be made by telephone to George Shelley, VK2QF. No. XX1616.

Lecturer at the July meeting of the N.S.W. division was Mr. R. Mondel, assistant supervisor, School of Electronics and Communications. Mr. Mondel, for an hour and half, covered all phases of "Impedance Matching," a subject of great importance to amateurs. His observations on many cases of mismatching were of great interest, especially those causing ghosting of TV signals.

News from the ARRL

The minutes of the 1957 annual meeting of the ARRL board contain a number of decisions of interest to overseas amateurs, but most of the debate covered league policy and organisation. The following are some items of general interest:—

Little support was given to a suggestion that the low end of the 144Mc band be set aside for C.W. transmissions. It was decided that a request be made to the F.C.C. for an increase of power to 1KW on the 420Mc bands.

Considering the financial problems involved in running a national society in this country, some of the appropriations for the year show the extent of amateur organisation in the U.S. and how much easier it would be here if we could increase the amateur population to say 10,000.

Divisional directors' expenses for the year totalled 17,500 dollars. Allocations for committees—planning 2,000 dollars; finance, 2000 dollars; membershp and publicity, 1,000 dollars. An amount not exceeding 5,000 dollars was set aside for emergency co-ordinators' travel, and a similar amount for Q.S.L. managers to attend official functions. Both these last sums would be in excess of the total income of some of the largest W.I.A. divisions.

DX notes

WITH the 28 and 21Mc bands quiet 7Mc has been providing some fair DX. Europeans can be contacted the long way around just before sunset and again in the mornings before sunrise. Best DX heard during the month on that band was John, VP8CW, in the Falkland Islands, who could be contacted from 1730 to 1800 hrs. EAST. W stations were audible from 1500 hrs. onward and QSO'ed from 1600 hrs.

The council of the RSGB has re-affirmed its instructions to the society's QSL manager not to handle cards addressed to Argentine and Chile amateur stations which operate from British Antarctica.

In making the decision the council kept in mind that the territories concerned form part of the British Commonwealth of Nations. Amateur stations which operate from Commonwealth territory without a licence issued by the appropriate

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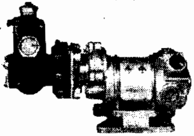

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In heavy proofed canvas, with zippers on side, leg and sleeves.

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Ex-R.A.F. . . . . . . **PRICE 50/- EACH**
Intercommunication Tubes **50/-**
MK7 Goggles . . . . **25/- pair**
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Fine thing for Motor Cyclists, Tractor Drivers, etc. Wool-lined.

£5/19/6 a pair.

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HERE'S AN ALL-PURPOSE CAP FOR YOU

Great wearing for motor bikes or when you want to ski.

GIVE-AWAY PRICE: ONLY 12/6.

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CAR RADIO AERIALS

Telescopic; Chrome-plated.

These are very real bargains at a remarkably low price: **39/6.**

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Special Offer!

Magnifying glasses, 8 mags., **8/6;** 10 mags., **12/6.** New head phones for crystal sets, **32/6** pair. Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, **45/-.** Tweezers, **5/6.** Watchmakers' Eyeglasses, **6/6;** extra strong, 10 mag., **15/-.** Set of five Watchmakers' Screwdrivers, **13/9.** American Oxywelding Torches, **£5/10/-.** Metric open-end Spanner Sets (7 spanners), **29/6.** 24 volt, 1500 watt Generators, **£12/10/-.** 200 am. Generators, ideal for welding, **£37/10/-.** Ball Bearing Stepdown Gear Box, **39/6.** Steel Masons' Squares, 24 x 12, **14/6.** Pope 5½in Steel Planes, adjustable, **52/6.**

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0-14 amps AC-DC, 4½in	**59/6**
0-200 amps DC	**£4/10/-**
20-0-20 amps DC	**37/6**
0-50 amps AC-DC, 3½in	**75/-**
0-60 amps AC-DC, 3½in	**75/-**
0-1 amp DC, 2½in	**45/-**
0-200 amps AC-DC, 3½in	**£4/19/6**
0-50 amps AC-DC, 2¾in	**45/-**
0-150 milliamps DC, 2½in	**45/-**
0-20 volts DC, 2½in	**22/6**
0-5 milliamps, 2½in	**45/-**
0-30 volts Weston	**30/-**
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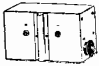

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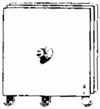

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Never before at this price: **45/- a pair.**

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authority must be regarded as unlicenced and irregular.

A new award, a little out of the ordinary, is granted for working maritime mobile DM5MM on three or more oceans. The call is assigned to the Eastern German ship Wilhelm Pieck on a trip around the world. Special certificates will be awarded covering contacts on the required number of oceans. To receive the award QSL cards and 2 IRC's should be sent to DM5MM, Box 185, Schwerin (Meckl) German Democratic Republic.

Use of 50-54 Mc

AUSTRALIAN amateurs hope to obtain the use of the 50-54 Mc band for the duration of the International Geophysical Year. A number of National Authorities in other countries, especially in Europe, have granted this facility to amateurs. An approach is being made through WIA channels for this privilege. Apparently this band will not be used for TV for some time and there appears to be some possibility of obtaining permission to operate.

It would permit Australian amateurs to explore the frequencies under the best possible propagation conditions.

The suggestion was originated by Major Collett, VK2RU, well known for his observations on the band in the past and his working with the JA's on these frequencies.

VHF outing

THE VHF and TV section of the N.S.W. division enjoyed an excellent outing on July 21 when they visited the C.S.I.R.O. research station at Fleurs out from Sydney. They later proceeded to the Overseas Telecommunications Receiving Centre at Bringelly. At Fleurs, Chas. Fryar, VK2NP, explained the equipment, and an actual recording of the sun's activity was shown. John Pecll, VK2WJ, conducted at the receiving centre.

The section's July nocturnal hidden transmitter hunt on 144mc was won by Dave Andrews, VK2AWZ. Dave found the "Fox," Bob Winch, VK2OA, in the record time of 18 minutes. Second place, Jim Cuming, VK2ZBD, 29 minutes; third, Phil Pearson, VK2ZBB, 64 minutes.

Additional activity in the country on 144 mc/s has been noted in N.S.W. VK2ANP, of Nowra, is putting excellent signals into Sydney along the coastline. In the north-west, VK2ATS, of Inverell, has been working successfully with VK4CU, over a 130 mile path.

Work on reflections of amateur signals from meteors on the 144Mc band is receiving much attention in the U.S.

In May complete exchanges of signals were made between many States. During the Aquarid Showers W2NLY, New Jersey, QSO'ed W5DFU in Oklahoma over 1,200 miles with 17 good bursts recorded in half an hour. W2NLY's antenna is very complex, comprising eight 24ft long yagis, with two wavelength spacing bays stacked four high.

One burst between W2AZL and W0IFS lasted two minutes, 5-9 signals were exchanged, the loudest ever over a 1,000-mile path. W1MMN was hearing W9KLR at the rate of 100 bursts per hour. A number of stations active in this period are boosting their States' worked totals. Leading amateur on 144Mc is W9KLR, who has contacted 32 States on the band, and in second place is W4HHK, with 29, out of the 48 possible total. W9KLR is now seriously thinking of a WAS on the band.

Mid-Western amateurs are in the most suitable position to qualify for the award. W9KLR intends to direct his transmissions to the west in an endeavour to contact the W6 and W7 States.

Transmission from WWV

THE latest code added to the normal WWV Standard Frequency Transmissions is on a temporary basis for the duration of the International Geophysical Year. Information on alerts and special world intervals is being sent at 4½ and 34½ minutes past the hour. These terms refer to periods during which efforts are made to intensify the observations and activity of the thousands of scientists engaged in IGY work throughout the world.

The code is as follows: 5 A's—state of alert, 5 E's—no state of alert, 5 S's—special world interval begins at 0001 Z on the following day, 5 T's—special world interval terminates at 2359 Z, 3 long dashes—special world interval in progress.

DL1CU and DL3PT are apparently carrying out a two-man assault on the commercial occupancy of the 80 and 40-metre bands. These two amateurs are responsible for the issue of defence labels to be attached to the back of QSL cards. A cartoon depicts the commercials as rather a stalwart gentleman, complete with horns, placing a straight right in the face of an inoffensive amateur. The main theme of the text is an appeal to amateurs generally to occupy these bands and so cause the commercial stations operating some interference.

It is pointed out that commercial stations are systematically occupying exclusively amateur portions of these allocations. Full occupancy must have some impact on commercial transmissions. Many amateurs in Europe refrain from operating on the bands due to the degree of interference experienced.

This type of action might be effective in Europe where interference is most serious. The defence labels can be obtained from either DL1CU or DL3PT, who would welcome voluntary contributions of IRCs to cover postage and printing.

Another club venture in the old-timers' field is the "Old Old-timers' Club." W1CPI is president and to qualify for admission an amateur has to hold a current licence and must have over 40 years ago held a two-way contact over his own transmitter with some other wireless station, either amateur, commercial, or naval. Applicants need not have been continuously active in the art during the intervening years.

These real old-timers should apply to W1CPI, Old Old-timers' Club, Wakefield, Rhode Island, U.S.A., for details.

Emergency work overseas

PRESS reports covering recent overseas flood and hurricane disasters in many countries during recent months gave due credit to amateur radio operators for their work in effecting communication when other services failed. According to these reports the JAs were very active in late July when portion of Kyushu Island was flooded in the worst disaster in memory.

It was stated that amateurs were providing the only means of communication with the devastated areas. The hobby these days receives a much improved coverage in the daily Press for their work in the public interest.

EXPERT TECHNICAL ADVICE AND ASSISTANCE AT ALL HOURS

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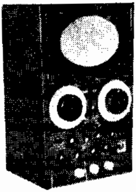
EVENINGS and WEEKENDS: "KALUA"



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12 valve. Converted to 240v. A.C.
Thoroughly Tested Re-aligned
Latest Ovaltone Permag Speaker

£34/17/6

Type T3 press to talk CARBON MICROPHONES

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NEW 24V MOTORS

Series wound Hi-Speed miniature 12,000 RPM £2/10/-
Shunt wound with gear box 2 speed 5 and 25 RPM £2/10/-

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New C.A.V. 80 amp. Generators. Ideal for lighting or fast charges.

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Throat Mikes New 3/6
12V. 420 watt Prefocus Globes 7/6

NEW C.R.O. TUBES

All tested on TV picture

3BP1 with shield and socket £3/17/6
VCR 97 .... £2/17/6
ACR2X & Shield £3/0/0
CV, 112 White 5" £3/10/0
CV 254 9in. Blue Screen, Magnetic Deflection & Focus

£4/10/-

Every tube capable of perfect picture
Fast persistence and simple construction using standard components

NEW 2½" MOVING COIL R. F. METERS

350. MA and 1. Amp.
Can be shunted for other ranges

7/6 ea.

POSTAGE 1/6

Used units as above. Good order

4/6 ea.

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AR8-AT5—COMPLETE STATION

AIR TESTED

Transmitter-Receiver, Aerial Coupler
Cables, Plugs, Phones, Mike.
1 Crystal to desired Frequency
24V Power Supply & Circuits of 2 units
GUARANTEED IN PERFECT ORDER

£62/10/- Other voltages available

NEW B.S.R. FP10 GRAMO MOTORS

240 or 110
FOR THAT TAPE RECORDER

£1/19/6 POSTAGE 2/6

NEW VALVES

217C	10/-	6E5	12/6
12C8	12/6	12K8	12/6
6J8	17/6	VT502	12/6
VT501	12/6	7A6	7/6
EBC33	12/6	AV11	3/9
1H6	7/6	832A	£3/0/0
6L6	20/-	6K7	7/6
1C6	12/6	12SJ7	12/6
1G4	12/6	12SK7	12/6
1D4	12/6	12SL7	12/6
1J6	12/6	39/44	10/0
1K4	12/6	46	12/6
1K6	12/6	47	12/6
1LH4	12/6	78	12/6
1P5	5/-	828	£2/10/0
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6F6	12/6	829B	£3/0/0
VR65A/SP41	2/6	6G8	15/-
KT66	27/6	6B8	12/6
806	£3/10/0	807	£1/0/0
6V6	12/6	EL3NG	12/6
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6X5	10/-	EM1	12/6
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6V. 12V. 24V. 32V. DC to 240 AC
60 Watt to operate Radio, Fluorescent Lights, Shavers, etc.

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350 x 350 extended to 1000V.
6.3V. 6.3V. 215V. 4V. **£4/5/-**

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8 Valve

4 Band 195 KC. to 9.025 Megs.
24V. D.C. Operation £22 10 0
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12 volts DPDT 5 amp £1/-/-
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½in Square Section DURAL TUBING UP TO 12ft lengths 1/- per ft.
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Tx Var. Condensers, 300 pf £1/5/-
100 pf £1/1/-
60 pf with Vernier £1/1/-
30 pf 10/-

RADIO

PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE. SYDNEY, N-S-W

TRAM AT DOOR. STOP 42

COLLAROY ST., COLLAROY—XW5956

Telephone Equipment

Hand sets	£1/9/6
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12 Volt operation
3 to 9 megs. 10 watt output
Airtested complete with 1 Crystal
£29/10/-

NEW No. 122

2 to 8 megs as above. Converted to Crystal Control. Power increased to 20 watts. Includes Plugs and Cables, Mike, Speaker, Circuit, 2 Crystals to wanted frequency conforms to PMG requirements for small ships and other services. **£49/17/6**

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8-day movement. Cost Govt. £28
2¼" £4/15/0
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Coils B/C 455 KC	9/6
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Standard P.M.G. Type Pedestal Magneto Phones tested in perfect order.
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E.M.I. & Scotch. Hi. Coercivity, Excellent Condition. Ex ABC.

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600 ft. Spools		18 6
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Input	Output				
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12V	1200V 200MA	£6	10	0
6V	500V 150MA	£6	10	0
24V	250V 100MA New	£2	0	0
12V	300V 250MA	£4	10	0
12V	235V 50MA	£2	15	0
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Rotary D.F.D.T.	3/9
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10 WATT OUTPUT
12V. D.C. powered. 5 valve input for crystal mike & P.U. Fader Controls & Tone Control Standard Octal valves. **£14/17/6**

SPECIALS for Sept. Only

WE ARE OVERSTOCKED, WE NEED THE SPACE. PRICES APPLY ONLY FOR 1 MONTH

STEEL INSTRUMENT CASES

8in x 7in x 6in deep. Hinge Lid.
Price 7/6
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N.S. All these units are in excellent condition. For original use parts or conversion

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24V. 100MA. BRIDGE, ideal for trickle Chargers. Relay operation etc.
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Heavy duty motor develops 1 hp cont 2 hp intermittent. Ideal motor for operating power tools off 32V-DC.
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Laboratory Standard Instruments. Will operate to 3000 Pulse per minute
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Operate on 3 volts.
Fully adujstable ideal for models, Alarms etc.
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New condition V.H.F. TX. RX. 10 valves 24V genemotor and a host of parts. No circuits.
£2/17/6

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600 Megohm Grade
15/- 100yd reel

2½" Moving Coil Meters

Flush Panel Mount 15 MA & 30 MA
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5ft. Horns. O.P.T.X. 500 & 1000 fitted
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With Reflex Horns **£22/10/-**

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Gas Sealed Octal Base as Used Bendix BC221
Price £5/5/-

24 to 32v INPUT GENEMOTORS

Fully filtered. 250V 60 MA Output & 6V. 2.5 Amp. Secondary.
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Amplification Communication Electronics

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EVENINGS and WEEKENDS: "KALUA", COLLAROY ST., COLLAROY—XW5956

DULWICH HILL, UNDERCLIFFE, EARLWOOD, TRAM AT DOOR, STOP No. 42

8 VALVE RADIOGRAM HI-FI CHASSIS

Dual wave, bass & treble boost tuned R F stage 12" speaker.

£28/17/6

5 VALVE RADIOGRAM CHASSIS

DUAL WAVE 12in SPEAKER

£18/15/-

5 valve also available as home constructors Kitset **COMPLETE WITH CIRCUIT £14/15/-**

7 VALVE DX RECEIVER

3 band, 2 to 6 to 18 megs 160 to 16 metres and broadcast. Exceptional selectivity sensitivity 2 microvolts. **NEW AUSTRALIANS,** listen to European short wave stations.

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PUBLIC ADDRESS RANGE 240-AC

6 valve 10 watt **£14/17/6**
6 valve 25 watt **£25/7/6**
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BATTERY ONLY OPERATION

6 valve 6 volt 10 watt **£18/15/-**
7 valve 12 volt 10 watt **£19/15**
7 valve 12V 25 watt **£24/17/6**

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6 valve 10 watt 6V. **£20/15/-**
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HI-FI RANGE

MULLARD 5/10

£34/15/-

Complete with Jensen twin cone speaker, Ferguson O.P. transformer, 301 & U.L. taps.

MULLARD 5/20 AS ABOVE

£42/15/-

Tuner & separate control box with mike, pre-amplifier.

£12 extra

THE FINEST SET AT ANY PRICE

CHECK THESE EXTRA FACILITIES

Built-in Preamplifier to suit crystal microphone tape deck, electronic guitar, sound on film, TV, etc.
Hear it demonstrated on these units.

DEMONSTRATIONS EVERY SUNDAY 2 to 5 p.m.

OR EVENINGS. BY PHONE APPOINTMENT

AT COLLAROY

PHONE XW5956

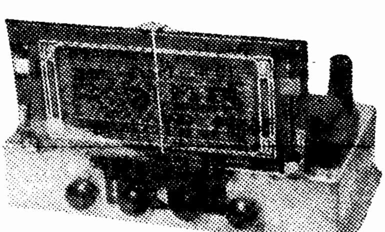
CABINETS AND ALL ACCESSORIES TO SUIT

THE OUTSTANDING 10-VALVE HI-FI

RADIOGRAM CHASSIS

Incorporating Mullard 5/10 bass boost amplifier, treble boost dual wave tuned R.F. stage. Built-in pre-amplifier for microphone or tape recorder including Jensen twin speaker.

£44/15/-



Dual wave, 6 valve radiogram chassis includes bass & treble boost, 12" Jensen or Magnavox speaker.

£23/15/-

TV

R. T. & H. TELEVISION SET AS DESCRIBED IN THIS ISSUE will give excellent performance at reasonable cost. But the limitation of the picture tube must be considered. We propose to use **THE BETTER 6IN. TUBE VCR97.** The only circuit changes will be socket connections and maybe 2 resistors.

DETAILS OF CIRCUIT ALTERATIONS AND COST AVAILABLE 2nd SEPTEMBER.

R.T. & H.

CHEAP 5 VALVE SET IN THIS ISSUE

This will be available in Kitset form
Price available 2nd September

T V TEST EQUIPMENT

Crystal marker generator $5\frac{1}{2}$ megs. & every $\frac{1}{2}$ meg. to 50 megs.

£22/10/-

R.T. & H. WIDE RANGE C.R.O.

Wired & Tested.

£52/10/-

Also simplified version. 6in C.R.O. P.P. Deflection.

£44/15/-

4 SPEED PLAYERS

£11/17/6

4 SPEED CHANGERS

£16/17/6

A VIRUS IS TO BLAME FOR THIS, SONNY!

(Continued from Page 17)

is acid or alkaline. It turns red in the presence of an alkali and this property was used in the experiment.

A linen sheet was wet with a solution of bicarbonate of potassium which is an alkali, and suspended in one end of the room.

The demonstrator took into his mouth a weak solution of phenolphthalein and talked, coughed and sneezed.

Soon afterwards pink spots began to appear on the sheet at the furthest end of the room while larger and more red spots appeared on the sheet closest to the sneezer. This was conclusive proof that droplets from coughers, sneezers or talkers carry for long distances.

The lesson of course is to, not only cover your own mouth when coughing or sneezing but to take care when in the presence of a similar person. It is difficult of course to talk with the mouth covered but even this may have an advantage in giving people a little rest from constant ear bashing.

It can easily be seen therefore that bacteria must be swarming in crowded spaces such as trains, trams, picture shows and such places. One needs to be very fortunate during an epidemic of influenza to escape.

Some bacteria are more highly infectious than others. In other words when one of these particular germs enters the body the latter succumbs more readily to the attack than to other germs.

There are several reasons for this. Firstly it may be a "new" germ and the body is not accustomed to its presence. Secondly it may be particularly active and wastes no time multiplying and boring into the system once it enters.

Whilst some diseases contracted by the human being protects the individual from a second attack by the same disease, as mentioned above, other diseases may pre-dispose the patient to further attacks.

The latter is true of influenza, diptheria and pneumonia. Thus it is reasonable to suppose that people suffering from or just recovering from an attack of common influenza may be the more prone to "catch" this Asia 'flu of which we hear so much about.

So look after yourself. Eat well, have plenty of rest, keep warm, go to bed early. What a life.

MINIATURE HEARING AID

(Continued from Page 9)

users will obtain from this arrangement.

It has been established so far, for example, that the sensation level need not be identical for both ears, as might be expected. It is true that this is the desirable condition, but a difference of up to 20 db is not serious, and will still enable the user to obtain worthwhile benefit from the binaural system.

To cope with degrees of deafness requiring a higher order of gain, the same organisation has developed a more powerful unit, but which still retains most of the advantages of the smaller model.

It is made in two units, being a separate earpiece for use in the ear in the normal way, and a complete microphone-amplifier-battery combination which is supported behind the ear. Although slightly larger, it is still relatively inconspicuous and retains the ear level microphone placement with all the previously mentioned advantages, including the binaural system.

Considering that either of these devices would have been looked upon as virtual impossibilities even ten years ago, it may be safe to predict that we may eventually see an aid which will fit right inside the ear passage. This would not only render it completely invisible, but would also retain the acoustic characteristics of the ear passage — a vital factor in providing directional perception.

Assuming the development of a suitable long-life battery it is conceivable that such devices could be fitted more or less permanently in the patient's ears and be allowed to run continuously. Removal would be necessary only at long intervals for battery replacement and routine maintenance.

THE RADIO SCENE

(Continued from page 7)

if TV is to best serve the people, it must be at all times of the people. Australians are perhaps the least conditioned people in the world — you have to see how other countries get used to the being given what is good for them, instead of what they want, to realise it.

I believe there is a middle path, and this country is in the best possible position to tread that path. To be fair to all, TV is too green in its shoes as yet to find its right level. But I'm sure it will.

And, talking of the future, what about colour TV?

The best that can be said for colour at the present time is that only the Americans have taken it on, and they are having a hard battle.

The years ahead are challenging years in radio. They are challenging years for every one of us. What will come out of them will touch us more keenly than anything we have known in the past. The old days of radio are running out, and we cannot stop the steady revolution of the air on any terms.

And why should we try? In this uncertain world there is nothing so certain as change. With it comes opportunity, and, with what we can see ahead of us, we will have as much of that as we can stand.

THE SERVICEMAN WHO TELLS

(Continued from Page 69)

heated valves. At the same time, the filament line was easy to check, so I applied the voltmeter to it while I wiggled the valve.

Since the 3V4 was at the end of the series string, I was able to measure the full filament supply voltage at one of the pins. I expected this voltage to rise sharply if the filament circuit was opened, due to the high resistance and poor regulation of such power supplies. When it remained fairly steady while the valve cut in and out I dismissed the filament line and turned to the other pins.

The best way to check these seemed to be by means of a current check in each circuit, and I was about to do this when I realised that the socket seemed to be wired in an unusual manner, the screen pin being connected to the socket's central shield. Further investigation showed that this shield was being used as a H.T. anchor point; a novel arrangement, to say the least.

More important at the moment, however, was the fact that the connection was made by means of a short length of tinned copper wire, and that the pin appeared to be pulled hard towards the shield. On an impulse, I grabbed the iron and applied it to the joint. The pin flicked sharply outwards as the solder melted, confirming that it had been strained. The next point was whether this could have caused the trouble.

A STRAINED CONNECTION

I substituted a short length of hookup wire for the tinned copper (thus allowing the pin some freedom of movement), tightened the contacts, plugged the 3V4 back in, and switched on. The set came on immediately, and nothing I could do in the way of wriggling the valve or applying moderate vibration had the slightest effect. After several such checks at various intervals, I considered the set fixed, even if I wasn't exactly sure why.

To be truthful, I was more concerned just then as to whether it was going to be as hard to get the set back in the cabinet as it was to get it out. A broken dial cord with the set almost in the cabinet would have been the last straw!

As it happened, the set went back with somewhat less trouble, partly. I suppose, because I had learned a few tricks while getting it out. Nevertheless, it was no snack and my earlier remarks still stand.

Thinking the problem over later, I concluded that the socket pin had been forced at such an angle that the valve pin had first distorted it and then failed to make contact with it except at a certain critical angle. Removing the rigid connection had allowed it to follow the angle of the valve pin and make proper contact.

I assume that the one time it worked very faintly must have been a rather rare condition where the pin was making high resistance contact with the socket and thus reducing the screen voltage, without actually removing it.

NEW VALVES AT REDUCED PRICES

1A7G	7/6	6B8 (metal)	10/6	6J6	15/-	KTW62/6U7	6/6
1Q5G	7/-	6C8G	7/6	6SA7GT	12/6	VR65A	2/6
1P5G	7/-	6E5	8/6	6SQ7GT	9/6	CV6	3/6
1C7G	5/-	6H6	3/-	6SH7GT	5/6	7193	3/6
1D5G	7/6	6H6GT	3/-	6L6 (metal)	20/-	954	4/5
1K5G	2/6	6J7G	7/6	6A3	15/-	955	10/-
1K7G	7/6	6K7G	6/-	7C7	3/6	12A6	10/-
1M5G	7/6	6K7GT	7/9	7A6	3/6	EF50	3/6
1L5G	9/6	6U7G	6/6	78	7/6	110TH	£2/9/-
6AC7	3/6	6V6GT	12/6	71A	7/6	829B	£3/5/-
6B6G	9/6	6X5GT	10/-	EL32	10/6	811	£1/-/-
6B8G	9/6	6K8G	10/6	EL33	12/6	866/866A	15/-
				EBC33	9/6	828	£1/9/-
						806	£4/9/-

PLEASE ADD POSTAGE ON ALL VALVES.

ALL GOODS ADVERTISED ON THIS PAGE ARE NEW

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping, Sec. 285 x 285 with 6.3v filament winding.

26/6

Plus Postage: N.S.W., 3/6: INT. 5/3.

MICA CONDENSERS

Standard Mica Condensers, small current types. .00003 to .005 including most wanted values.

Per 100 20/-. . . . . **Postage 1/6**

New Midget Power Trans.

40mA Prim. 250v. Sec. 225 x 225 with 6.3v Fil. Winding. Upright or Flat Mounting. Size 2in x 2½in

24/6

2/6 Postage, N.S.W.; Interstate 4/6.

30mA, 240v. Prim. 150 x 150v. Sec. with 6.3v. Fil. Winding.

22/-

Postage N.S.W., 2/6; Interstate, 3/6.

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12 mfd 525v	4/6
16 x 16 mfd 350v	4/6
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250 mfd 12v	1/6
30 mfd 350v	3/6
300 mfd 12v	1/6
8 mfd 350v	2/6
10 mfd 40v	1/6
8 mfd 525v (miniature)	4/6
8 mfd 525v	3/6

(Plus Postage)

12 inch P.M. Speakers

12in per-mag speaker by well-known manufacturer. 10T. CT. or 5000 Transformer **£3/5/**

Postage, N.S.W., 6/6; INT., 9/6

NEW 5in. PER-MAG SPEAKERS

5C Standard **30/**

5F Heavy Duty **35/**

Supplied with 5T, 7T, or 10T. Transformer.

Postage Extra: N.S.W., 2/3; INT., 4/6

6in x 9in Oval Dynamic Speakers with 5T or 7T Transformer.

27/6 **Postage Extra: N.S.W. 2/9, INT. 4/6**

New Carbon Resistors, well-known make. Colour code supplied. Low values to 5T. ohms.

7/6 per 100. **Postage 1/6.**

I.F. TRANFORMERS

Standard I.F. transformers, square can (1 3/8) 455 Kc permatuned, **4/6**

(Plus Postage)

SAPPHIRE NEEDLES

Rothermel sapphire needles play 2000 recordings. Made in England.

Each 2/9 or 25/- dozen.

Telephone Generators

New small telephone generators. ideal for bell ringing, etc.

12/6 **Postage Extra**

MERCURY SWITCHES

The switch with 1000 uses **2/6**

Postage 6d.

NEW SELENIUM RECTIFIERS

S.T.C. Rectifiers 6-12 Volt 3 amps. Suitable battery chargers, etc.

29/6 **Post 2/6**

POTENTIOMETER SPECIAL

Box of 10 new Carbon Potentiometers.

Containing .5 and .1 switch pots., long spindle, .5 and .1 standard and miniature pots, long spindle and other mixed sizes, short spindle.

20/-

Post 2/6.

CONDENSER SPECIAL

Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf. mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1, Also 500 mfd/12v, 10 mfd/40v, 8 mfd/525v. 16 mfd/350v, electrolytics

30/- per 100.

Post Extra: N.S.W. 2/6; INT., 3/6

POTENTIOMETERS

½ Meg. Miniature Switch Pots, d/p Switch Long Spindle	5/6
1 Miniature Long Spindle	3/6
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½ meg or 25T, ohms short spindle switch pots	2/6
½ meg or 100T standard pots, long spindle	3/6
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5 meg. high insulation	5/-

All plus postage.

NEW SMITH'S 8-DAY CLOCKS

These English Clocks — which are new in original cartons—are panel mounting and are ideal for cars, etc. Luminous dials.

2in **£4/15/-**

2½in with sweep second hand **£5/15/-**

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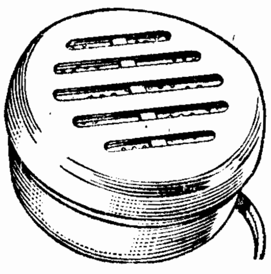
FULL WAVE. NEW **15/-.**



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IT'S A REAL MINIATURE WITH ROLA UNIT

Install it anywhere, in the sick-room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED.
3½in Diameter by 1¾in deep POST FREE.

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"Mercury" (American Made.) These relay counters register from 0 to 99,999 can be supplied with 250-ohm coil 24v D.C. operation.

25/-
Plus Postage

NEW AMERICAN BOX KITES

These kites are constructed of Silk with Metal Frame.
SIZE 15in square x 3ft long. Originally used for Aerials for Lifeboat Transmitters.

30/- Post 2/-

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 mc and contains 15-6.3v valves including 1-807 2-6V6S, 6-6K7G, 2-6K8G, 6B8S ETC, 0-1MA Meter 4-GANG cond H.F. Unit ETC.
£6/15/
F.O.R.
12v Gene Motor for above, **£3/5/**
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20/- will purchase any one of the following valve Specials

2	EL3NG	4	6U7G
3	1P5	3	6K8G
4	1Q5	5	6SH7
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10	1K5	4	6J7G
5	954	4	KTW62/6U7
8	EF50	4	12A6
4	6C8G	2	6X5GT
3	6SA7	8	EA50
		5	6K7G

Post and Packing 1/6 extra
ALL VALVES ARE NEW

NEW 6H6 OR 6H6GT VALVES

Individually Cartoned

20/- per doz.

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TRANSMITTING VALVES

829B	£3	5	0
100TH	£2	10	0
866		15	0
811	£1	0	0

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A.W.A. variable Transformers. Primary 240V, Secondary 0-240V at 2 amps.

£8/17/- F.O.R.

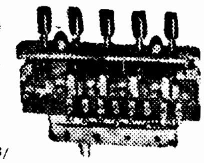
No. 122 TRANSCEIVERS

In new condition, complete with valves, vibrator power supply, leads, and dynamic microphone and headphones. These units are easily converted to comply with P.M.G. requirements for small boats, etc. Freq. 2 to 8 meg.

£19/15/-

Packing 20/- extra

NEW PUSH-BUTTON SWITCHES 20/-



Five pole push-button switches. New control box fitted with above switch also 5 bezels with globes and multi contact key switch.
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These English B.S.R. Motors as used on most tape decks, also have many other uses. Size of motor, 3in x 2½in x 2¼in with 3/16in shaft for 240 or 110 volt AC operation.
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New H.M.V. spring gramo motors less turntable. Adaptable for many uses 19/6
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These units which are in new condition cover a frequency of 2.5 to 3.5Mcs and are supplied complete with 6 1.5V valves, Microphone and headphones.

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12A6	7/11	6E5	7/6	VR150	15/-	958A	10/6
12K8	12/6	6F6	8/11	VR78	7/6		
12SJ7	12/6	6H6GT	3/11	VR65A	2/6		
12SC7	12/6	6J5	12/6	7A6	5/-		
12SL7GT	10/6	6K7	6/11	7A8	5/-		
12SF7	12/6	6K8G	10/6	7C5	5/-		
1626	5/-	AV11	5/-	7C7	5/-		
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Cathode Ray Tubes,

3AP1	£3/-/-
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Suitable for Crystal Sets.

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CABINETS FOR CRYSTAL SETS

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7/6 each

Call and choose your cabinet.

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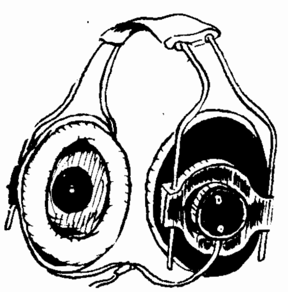
HIGH IMPEDANCE



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DYNAMIC HEADPHONES and microphone combined, **25/-**. LOW IMPEDANCE HEADPHONES, **17/6.** No. 3 MICROPHONES, **12/6.** Packing and postage (all States), 3/-.

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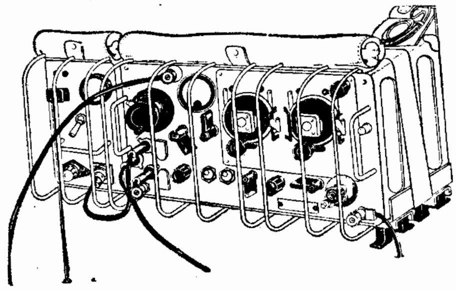
No. 11 TRANSCEIVER. A NINE-VALVER. THIS: 1M5 (2) 1C7 (2) 1K7 (4) 807 (1). Complete with valves, headphones and microphone, power supplies, power packs (L.P. and H.P.) and full set of cables. THIS SET HAS BEEN AIR-TESTED.

PRICE: £9/19/6 Packing and delivery to railhead, 7/6.

This is No. 122 Transceiver



A Bargain at the price

No. 122 TRANSCEIVERS. In fair condition. Complete with valves and vibrator, power supplies, dynamic head and breast set.
These units can be converted easily to comply with P.M.G. requirements for Small Ships, etc. Frequency, 2 to 8 Mcs. **PRICE £17/10/.** Packing and delivery to railhead, 7/6.

No. 19 TRANSCEIVERS. Cover a frequency of 2 to 8 Mcs. Contain 15—6.3 volt valve, including 807 (1) 2-6V6S, 6—6K7G, 2—6K8G, 6B8S, ETC, 0—1MA-Meter, 4—Gang cond., HF unit, ETC. **PRICE £5/19/6.** Packing and delivery to railhead 7/6. 12-v Genemotor for this set, **£2/19/6.**

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No. 108, Mk. II.
Ideal for country work.

Five Valves: ATP4 (1) ARP12 (4)
Frequency 6.9 Mcs.
Powered from 3v and 120v batteries, obtainable from any local electrical dealer. Complete with mike, headset and 4ft aerial section. **Price £9/10/-**
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ANSWERS TO CORRESPONDENTS

J.F.C. (Coburg, Vic.) wants to know if we can supply details of a simple portable transmitter and receiver.

A. We have described a number of transmitters and receivers for use on the amateur bands and we could probably supply something suitable if we had further details of the frequency on which it was intended to operate, the power required, and other details.

M.W.P.M. (Nowra, N.S.W.) asks if we have the circuit of a small regenerative receiver and also the cost of a year's subscription to Radio, TV and Hobbies.

A. A two-valve receiver with coils for three bands was described in the May 1957 issue and copies of the complete magazine are available from our office at a cost of 2/- including postage. Twelve months subscription costs 24/-, again including postage to your address.

H.L.M. (Tarraleah, Tas.) asks the price of folders to hold a years subscription to Radio, Television and Hobbies posted to his address.

A. The cost of the folder is 14/ to which must be added 1/6 for wrapping and postage making a total of 15/6.

P.W.A. (West Brunswick, Vic.) asks about the addition of a third valve to the three-band receiver described in the May issue.

A. We have in mind to publish an additional circuit describing the extra stage in an early issue. Sorry that space did not permit the details earlier.

A.W.W. (Hectorville, S.A.) says that he has been listening recently on his crystal set to "Radio Australia." He has been using a version of the "Twin-Tune" crystal set but has rigged up a sliding tap arrangement instead of fixed tappings.

A. Your letter is further evidence that shortwave signals can be heard under favourable conditions. Once again, however, their reception would be due to accidental resonance effects in your aerial and tuning system. The letters "PV" and "VP" mean the same thing, either "peak volts" or "volts peak," and apply to the rating or the operating condition for electrolytic capacitors.

W.J.C. (Richmond, Q'ld.) writes to tell us of the numerous stations he has heard on the small crystal transistor receiver which was described in the April, 1957 issue.

A. As you are already aware, the polarity of the battery is reversed in the circuit on page 31. This is unlikely to damage the transistor since the current will be limited by the resistance of the phones. The circuit appearing at the top of page 29 is the one we suggest you use. With regard to your other remarks, we feel that there must be something wrong, either with the coil or the tuning capacitor you are using, otherwise the tunning would behave more normally. Perhaps you are trying to use the set with too long an aerial. This is good for range but can upset the tuning somewhat.

J.B. (Kingsford, N.S.W.) wants to know how to substitute a 3S4 valve for the 1A4-P which was suggested for the Basic One Valve Set of September, 1954.

A. Although a 1A4-P was used in the original set, there is no reason why other types cannot be used, as was explained in the text. The only changes would be in the type of socket and socket connection. This would make the circuit very similar to that described in the December, 1952 in the Teach Yourself Radio Series, and a copy of this circuit is available through postal service in the usual way.

H.W.R. (Pascoe, Vic.) would like information on the availability of copies of photographs used in the magazine, particularly those of the 17-inch Television Receiver and the 5-Channel TV tuner.

A. Photographic prints as appear in the magazine are available through the query service. In regard to the TV tuner and TV receiver, copies of prints may be ordered by sending the required remittance and indicating the particular prints required. Cost of a 6in x 8in glossy print is 4/6.

A.D.B. (Caulfield, Vic.) is anxious to obtain his amateur licence but is somewhat confused as to the various certificates, licences etc., and asks if we can clarify the matter.

A. We suggest that, in addition to such information as we can provide you apply to the Chief Radio Inspector at the G.P.O. in your capital city for the information normally supplied to prospective candidates. Briefly, however, the situation is as follows: There are two licences available, one issued to those who pass only the theory exam and limited to frequencies of 56 Mcs and higher, and the more general one requiring the morse exam and available for use on all amateur bands. Whichever one is required, it is first necessary to sit for the appropriate exam. If this is passed the applicant is granted the Amateur Operators Certificate of Proficiency (A.O.C.P.) and this entitles him to apply for a station licence. This is normally granted automatically upon completion of the necessary simple formalities. The minimum age for a licence is 16 years.

L.L.S. (Earlwood, N.S.W.) has built the AC Standard Five of April, 1954, but is not happy with its performance. He complains of a howl when tuning in to stations and a continual buzz. He wants to know if filters can be fitted to overcome this.

A. Your troubles sound like instability (causing the howl) and AC hum (causing the buzz), but it would be difficult for us to say exactly why these effects are occurring. However, it should not be necessary to add anything, such as "filters" to the circuit to cure it. We can only advise that you seek the assistance of someone with a little more experience in such matters to help you track down the trouble. Unfortunately we know of no commercial organisation which is equipped to undertake this work.

N.W.G. (Marrickville, N.S.W.) has made a modified version of the Standard Tuner (September, 1954) and included a short-wave band. His main criticism of the arrangement is that selectivity could be better and suggests that we describe a tuner and the necessary coils to give improved performance.

A. We assume that it is on the short-wave band that the lack of selectivity is most obvious N.W.G., and this is not really surprising if you are expecting something equivalent to a communications receiver. To obtain maximum selectivity it is normally necessary to resort to such techniques as double-change superhets, multiple low gain IF stages, and so on. We have described some short-wave receivers in the past embodying at least some of these ideas, a typical example being the Double Conversion Superhet of January, 1951. It would be possible, as you suggest, to increase the selectivity somewhat by increasing the distance between IF transformer windings, but a better way is to use additional tuned circuits, specially designed for moderate rather than maximum gain. Such IF transformers are available commercially. Once the IF channel of such a receiver is functioning correctly it is usually not difficult to wind coils to cover the various bands, particularly if advantage is taken of the iron-cores. We may be able to describe something along these lines in the future and will keep these ideas in mind.

O.C.D. (Camperdown, N.S.W.) is keen to obtain other references on the subject of electroluminescence discussed in a recent article. He also wants to know if we plan to produce a miniature transistor set in the near future.

A. Sorry we cannot offer you any direct references O.C.D., but we would suggest you try the Public Library, which may be able to put you on the right track. We certainly intend to describe some small transistor sets just as soon as the market is sufficiently favourable. Just at present, however, we are faced with the uncertainty of transistor supplies and a shortage of suitable associated components.

E.L. (Villawood, N.S.W.) sends along a simple idea for providing multiple taps on home wound coils, using small glass beads or imitation pearls.

A. Many thanks for the idea E.L., and it certainly sounds a good idea. We will file it for possible use in the Reader Built It section.

J.M. (Nathalia, Vic.) has a 240/100v. transformer which does not appear to operate as well one way as it does the other, and he would like to know why this is so.

A. A transformer should work just as well in one direction as the other J.M., and we can offer no exact explanation of the symptoms you describe. One explanation is that the secondary winding is incorrectly rated at 100 volts, being in fact considerably lower. This could be established by operating the transformer in the normal way and checking the secondary voltage. Another query concerns the accuracy of the 100 volts applied to the secondary and by what means it was obtained. If you could supply some of these details we may be able to help you, but we would emphasise that the apparent anomaly is more likely to be due to faulty observation and measurement than to some freakish condition in the transformer.

A.B. (Tongala, N.S.W.) sends a 12-month subscription for the magazine and also enquires whether he could use an oval speaker with the 1957 Standard Radiogram.

A. Many thanks for your subscription A.B., and this has been forwarded to the appripriate department. There would be no objection to using an oval speaker with the 1957 Radiogram and no changes to the circuit would be necessary. However, it should be appreciated that the power output from the est is high enough, if used, to severely overload a small speaker. It would thus be necessary to ensure that the speaker was not run at too high a level.

B.M.B. (Indooroopilly, Q'ld.) writes to the serviceman concerning the mysterious voltages developed by capacitors and mentioned in a recent article. He also comments about a certain brand of resistor which seems to have a fairly predictable life. Finally he queries a statement in the list of corrections to the TV set in the June issue.

A. Many thanks for the Serviceman comments B.M.B. and we will pass your letter on to him. We agree that the failure of so many resistors after a certain time seems to be stretching coincidence a trifle far, though we have not heard of any similar experiences in which the exact age was so carefully noted. Your comment regarding the correction is correct, the text being intended to read "12AU7 plate" instead of "12AU7 grid."

A.K. (Granville, N.S.W.) wonders if we can supply information on double track tape recorders.

A. Unfortunately, no. We have not done any work with tape recorders since the series in 1952-3. It is one of the projects we would very much like to tackle but can make no definite promises for the immediate future because of pressure of other work.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

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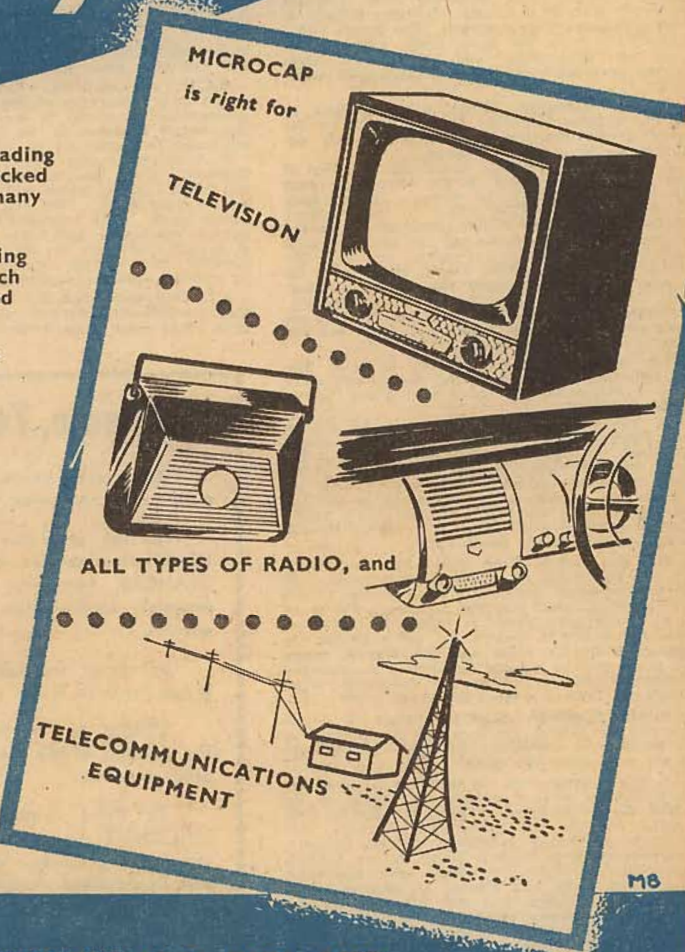

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Despite miniature size, note the generous non-hygroscopic moulding enclosing the capacitor unit: pigtails are soldered directly to unit by special process.

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476 LATROBE ST., MELBOURNE. FY 2638

How to Build a 5-inch TV Receiver

(Continued from Page 63)

It seemed likely, therefore, that this would be a conservative rating, and as 6H6's at the moment can be obtained for as little as 2/ each, it was worth risking a few to find out how they would stand up.

To be brief, we wired up the circuit shown here, and ran it on test for several weeks, and for up to 36 hours non-stop, delivering about 2,200 volts into a resistive load. Only when we earthed the filament supply did we ever experience failure of a valve.

The present power supply has been operating in the TV receiver for countless hours on end, and has never given a moment's trouble. In all, we have tried probably a dozen different metal and glass 6H6's and they have all stood the strain.

We are forced to conclude, therefore, that although the valve makers would hide their pride and renounce the scheme, it is a perfectly practicable one, and we would not hesitate to use it for any receiver or C.R.O. in which a 2000 volt supply was needed.

In practice there is a fairly heavy bleed across the supply — approximately 1 mill.—in order to preserve good voltage regulation, and, with the values shown, just on 2000 volts may be expected. During experiments in which the supply has often run with no load but the measuring meter, we have extracted over 3000 volts from it for short periods without failure.

Be particularly careful with this part of the set when it is switched on, as the voltage used can be lethal. It is for this reason we have mounted the power supply and the deflection coupling capacitors underneath the tube where they are not easily contacted. Their physical shape allows an insulating cover to be fitted, and this is strongly advised. Similar treatment can be given the adjustment potentiometers beneath the chassis, which are grouped together for that reason in the space of a few inches.

One of the coupling condensers is shown as .22 mfds, twice the value of the other two. This is because it must not only pass sufficient current for its own cathode, but sufficient for the second coupling condenser also.

Several hundred volts may be lost if this extra value is not used. Conversely extra voltage will be obtained with three .22 capacitors, probably up to 2200 volts in all.

The capacitor voltage rating should be 1000 volts working and suitable types are obtainable as standard items from local manufacturers.

Similarly there are some special high voltage insulation filament transformers available which will fit under the chassis as seen in the photographs.

The E.H.T. filter is made up of two .1 mfd capacitors of 2000 volt working rating and one .1 meg resistor.

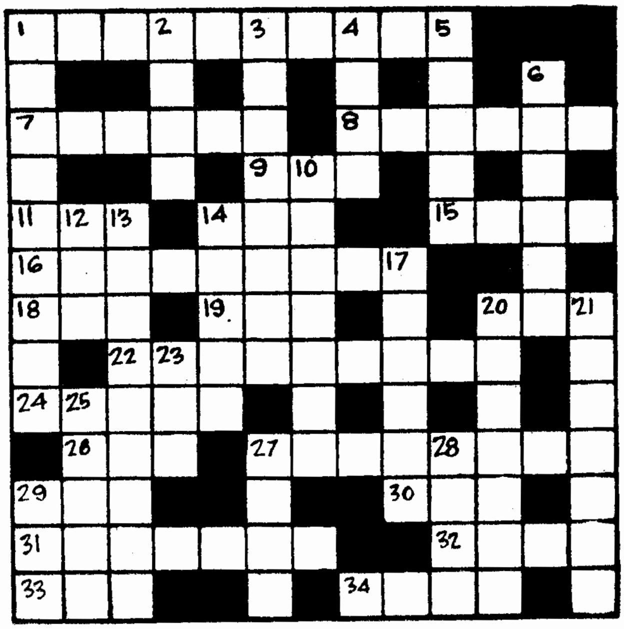
The entire unit is made up on a metal plate, with the filter circuit on the top section. All capacitors are mounted with tag strips which have proved their ability to stand the voltage without breakdown.

As .1 mfd capacitors with 2000 volt rating may not be easy to get, we used pairs of 1000 volt .22 capacitors in series.

Although the heavier insulated types of hookup wire have shown no tendency to break down under the high voltage, it is a good plan to keep these away from the grounded chassis, and to pass them through it in rubber grommets. Ordinary moulded valve sockets appear to be suitable.

Note that the power supply is "earthed" to the 300 volt power supply for the receiver, thus gaining extra voltage.

THE R., T.V. & H. CROSSWORD No. 40



ACROSS

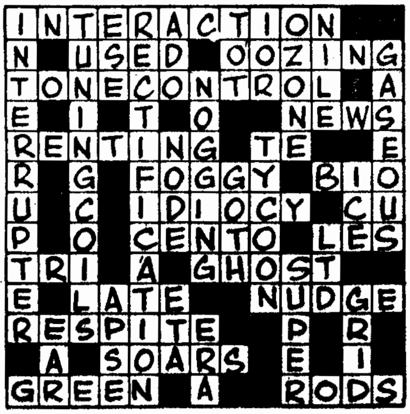
1. TV Camera tube.
7. Type of Antenna.
8. Succession of things.
9. Hundredweight (abbrev.)
11. Columbia Broadcasting System (abbrev.)
14. South (abbrev.)
15. Elevated.
16. Metallic element used in the electrolytic refining of zinc.
18. Girl's name.
19. Augustus (abbrev.)
20. Prefix meaning three.
22. Valve designed to overcome the effects of secondary emission (2 words)
24. More pleasant.
26. Doublet of "neither."
27. To convey electrical energy over a distance.
29. Necklace of flowers.
30. To talk idly.
31. City in France.
32. A troublesome insect
33. Sydney Technical School (abbrev.)
34. Unrestrained.

DOWN

1. Term used to denote action of a magnetic field.
2. Gas used in glow-discharge lamps.
3. An arrangement of frequencies in order.
4. To eject.
5. Ground.
6. Instrument used for measuring insulation resistances.
10. To speak softly.
12. Something on which to sleep.
13. Inductors in the form of a flat spiral (2 words)
14. A sweet crystalline substance.
17. Cutting down with a scythe.
20. To quake.
21. First letter of a name.
23. Contraction from "ever."
25. Destitute of the power of moving.
27. Character of a sound.
28. Secure.
29. Precedes Angeles in North America.

Solution and further crossword next month

Last month's solution



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FOR SALE: B.R.S. type R.12 disc, cutter and playback, unmounted. As new, £5/10/. **XL1417.**

FOR SALE: P./p. 807 Amplifier with tuner. 12 ox and V.E., 2 p./u.s. and ¼-speed T.T. **67 Maple St., Blackburn, Vic. WX2201.**

FOR SALE: Complete old 200-watt A.W.A. B'cast xmitter comprising Class A base unit, Class B Linear R.F. amp., filament and bias generators and 3 phase 2-3/4 a/c/. motor. Units in 2ft 6in x 2ft 6in x 6ft 6in metal cabinets. Includes 12 meters, chokes, H.T. transformers, field controls, coils, condensers. At Deniliquin, N.S.W. What offer? **Haig-Muir Pty. Ltd., Stanhill, 33 Queens Road, Melbourne, S.C.2.**

FOR SALE: Yacht 39in. Blueprints, 17/6. Design suitable radio control. **Bolton, 72 King St., Sydney.** Catalogue 5/.

FOR SALE: One Thorens C.B.A. 83 automatic record player with G.E. variable reluctance pick-up with diamond stylus. New and unused. **Melbourne BX7370.**

FOR SALE: Quad 11 amplifier and preamplifier. Wharfdale super 12/sc/al. speaker 9 cubic ft., polished speaker cabinet filled with Goodman A.R.U. filter unit. Connoisseur 3 speed turntable pickup Leak dynamic MK II 2 heads. Chapman wide range tuner S6BS. All in condition as new. **J. A. Dunne, Morjo St., Uranga, N.S.W.**

SELL: R. and H. TV Tuner wired less valves, £5. B.S.R. 3-sp. T.T., £3½. Goldring 500 var. Rel. P.U., £3. Sync Vib. kit 6V, £4. 0-1 Ma meter 3½in Multim. Scale, 25/. 6V6/807's A.B. dvr. Trans., £1. 110 Kc IF's (3) B.F.O., £2. 5in A.W.A. spkr., 15/. 78. T.T. Xtal P.U., 30/. Steanes torpedo mic., 30/. Hi-Z H'phones, £1. Rx chassis complete, five 2v valves, £3. Decca Hi-Z L.P. head, new w/spare stylus, £3½. 2 Audio Scribe P.U. 16in arms, 30/ each. Pyrox Wire rec., needs attn. 10 reels wire, £15. 2-6U7, 3-6J7, 4-6C6, 2-6N7, 2-1M5, 1-ea. 37, 2A5, 25Z4, 25L6, 6B6, 1K5, 1L5, 1C7, 5/ each. Radio and TV Engineers, Ref. book, Molloy Pannett (Newnes), unused, £4. **Foot, 43 Munro St., Ascot Vale, Vic.**

SELL: 80 back copies R. and H. Vols. 1-5. Service Manual. What offers. **Palmer, Bridge Street, Uralla.**

SELL: 1-xtal P.U., £3. 1-mag. P.U., £2. 1-Amer. mag. vox 8in dy. speaker, £3. **25 McKittrick Road, Moorabbin, Vic.**

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SELL: Better bass response with a cloth surround for your speaker. Fitted by specialist. 19/6 plus tax. **Scientific Inventions, 385 Forest Road, Bexley. LX5289.**

SELL: Chucks. Chucks. Chucks 4½in four jaw. List price £9. Our price £6. You save £3. Other sizes up to 16in. A few A.R. 7's from £4. Dural sheets, drills, taps, dies, milling cutters, lathe tools, lathes and parts, small gears, worms, bevels everything for the experimenter at **Munro Machinery, 2 Munro St., North Sydney. XB9450.**

SELL: Hallicrafters com. rec. s29 a.c. or batt. post. size 12in x 9in x 8in, 500kc to 30mc in 4 bands orig. service manual, £27. **FJ1573 Sydney, nights only.**

SELL: Beautifully finished Special Pocket Radio Cases in glistening Maroon. Perspex with Plated Fittings. Boxed, brand new and not cut or drilled. Size 2¾ x 1 x 5 inches. Production cost was 73/ each. Price 42/ each. New cream Moulded cases eminently suitable for Pocket Radio, considerably reduced to 15/ each. Only limited numbers available. Variable condensers, .0005 with miniature pantographed dials in k.c. reduced to 7/6. Miniature specially made on off panel switches pocket radio use 3/6. 200 Quality Hearing Aids by leading world makers. Used, several cost to £95. Most unusual value at 40/, 50/, 60/, 70/, 80/ each, according to condition. All are perfect miniature amplifiers and complete. Assorted sub miniature audio components are being boxed at £2 per box, worth vastly more. Please add postage to orders, or we will send C.O.D. Money refunded if sold out. No callers please. Apply to **Crystalaid, 201 Wickham Terrace, Brisbane. Telegrams: Crystalaid, Brisbane. Telephones B7277 or B9289.**

SELL: Midget Radio, 6in cube, 2/3 valve, range 300 miles, 14 gns (usual warranty). Ham gear (ex-ham): Com. receiver, 13 tubes with xtal gate n.l. and amp. AVC complete with 10 m. converter, £30. Type W.1034 freq. meter, £15. F.M. receiver, 88 to 108 mc, £35. **B. E. Cabena and Co., 146A Cotham Rd., Kew, Vic. WY3777.**

SELL: R., TV, and H. back issues 2/ ea. incl. post. All copies in good supply. **T. Weir, 56 O'Connor St., Haberfield, Sydney, N.S.W. UA2569.**

WANTED: V.H.F. Receiver 116-130 Mc. 240V. XB1752 day, XX1183 night.

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LET'S BUY AN ARGUMENT

(Continued from Page 73)

tion showrooms — that of an overhead light, of limited power and shaded so as to cast a soft glow over the floor and lower walls.

It doesn't get in your eyes, it saves people from falling over one another, it allows one to check an occasional program item and gives plenty of light for chat and coffee.

It has the obvious disadvantage of requiring an extra installation but is that really a big item when considered against a 200 guinea (or more) outlay for a television system?

The main advantage of a reading or standard lamp is that one can buy it in a shop and have it going immediately, even if it does need 20 feet of flex.

But if one needs a power point, it is customary to call in the electrician and have one installed. Why not then an extra light in the ceiling or a ballast and switch to cut down the intensity of an existing light. In fact, many present-day multiple lamp fittings should be easy enough to modify as a unit so that lamps can be switched to a series connection or else switched out altogether.

Personally, I don't plan to do any of these things. It just happens to be convenient to leave on the light in an adjacent room, giving ample illumination for the things I've referred to, without glare or reflections of any kind. It's probably the best way of all.