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Wireless
AND TELEVISION REVIEW

6D.

The "Easy-Build" Three

An INEXPENSIVE, POWERFUL RECEIVER for ALL

Also John Scott-Taggart CONTRIBUTES TWO SPECIAL FEATURES

CONTENTS

As some of the arrangements and specialities described in this Journal may be the subjects of Letters Patent the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

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Wireless. Oct. 287.

MODEL 287 for A.C. mains is a magnificent radio-gramophone designed to give the first-class performance characteristic of the wide Marconi range. The very efficient 5-valve, 7-stage superhet radio chassis incorporates 'quiet' A.V.C., tone-compensated volume control and multiple Marconi valves. The impressive inlaid walnut cabinet of cradle construction strikes a new note in radio-gramophone design. **22 GNS.**

The same chassis is employed in an imposing Console cabinet, **MODEL 297 17 GNS.** and also in **MODEL 264**—a high quality table grand **12½ GNS**

The Editor's Chat

Wireless & TELEVISION REVIEW

Victor King's Latest "Three"—Next Month's Fine Issue

THE superheterodyne, with its slickly simple tuning, its keen selectivity and its apparent mastery of the programmes, has an immensely strong appeal to all classes of listeners. But many might well ask themselves if they are, in fact, served best by the extremely popular "super."

There is no doubt that a change over to a less "busy" straight set of an efficient character, with its quieter background, may come as a very interesting, if not to say enlightening, experience. And it is to be noted with regret that amidst all the myriads of "supers" which are now in use, the considerable merits of the tried and tested "straights" (which have been enhanced by valve and component progress) are tending to be overlooked.

A Significant Fact

But it is surely significant that the most popular products of the country's leading designers such as John Scott-Taggart, whose position in that sphere is pre-eminent, and Victor King and others are almost invariably "straights" in so far at least as they are not superheterodynes.

In this very issue of WIRELESS AND TELEVISION REVIEW it can be seen that Victor King has chosen for the first of his new season's sets a three valver of the H.F., Det., and L.F. type. We hope his article will be read by all readers, even those who have no immediate intention of embarking upon the construction of a receiver, for it explains *his* reasons for advancing a "straight" in favour of a "super." It will be observed that they are supplementary to the above brief general observations on the subject.

Two other prominent set designers are to contribute special set designs to the November issue of WIRELESS AND TELEVISION REVIEW. Dr. J. H. T. Roberts, F.Inst.P., will describe the "Roberts Four." It will be remembered that this popular radio scientist achieved a most outstanding success with his "Roberts Three" at the beginning of this year, and he tells us that he is confident that his new set will prove an even more attractive proposition.

"This Death Ray Business"

Also, in the next issue, G. T. Kelsey, the originator of the adaptor principle, will give full constructional details of an original short-wave design.

There will be an exclusive article by John Scott-Taggart entitled "This Death Ray Business," in which he asks and answers such questions as "What is the truth? Is a death ray possible and probable?" It is undoubtedly one of the most brilliant articles ever written by this master of radio design and journalism.

THE MIDGET PORTABLE

Here is a snap sent in by a constructor living at Malmo, Sweden, and it shows the 1935 Midget Portable in use in the open air. Our correspondent who is an enthusiastic builder of "Wireless" designs is delighted with the results given by the Midget Portable.

Among the many other great features of the November WIRELESS AND TELEVISION REVIEW there will be a magnificent eight-page special art supplement. If we could provide such fare for the same price as has hitherto ruled, we should do so but inasmuch as we have always given the fullest value for money in the past, it is obvious that the increasing of the size of the magazine, the addition of "art" pages, the use of better paper (yes, you will get all these things with the next number), and other such developments cannot be obtained without an increase of price.

Therefore, instead of sixpence we are going to ask you to pay one shilling for the next and subsequent issues, for some of these as well as other improvements are to be retained as permanent features.

Bigger and Better

But we confidently anticipate readers will willingly pay that price for a WIRELESS AND TELEVISION REVIEW that will be bigger and better in every way. WIRELESS AND TELEVISION REVIEW is already probably the most widely read monthly radio magazine in the world, and it is our determined ambition to achieve and maintain an even bigger lead in the substance and presentation of its contents.

There are to be no changes of fundamental policy. Regular readers, to whom our sincere thanks are due for their past and present support, need not fear that the essential character of the magazine will disappear in these many improvements and advancements which lie before us.

Practical HINTS FOR ALL

Some Topical Tips

By

A. S. CLARK

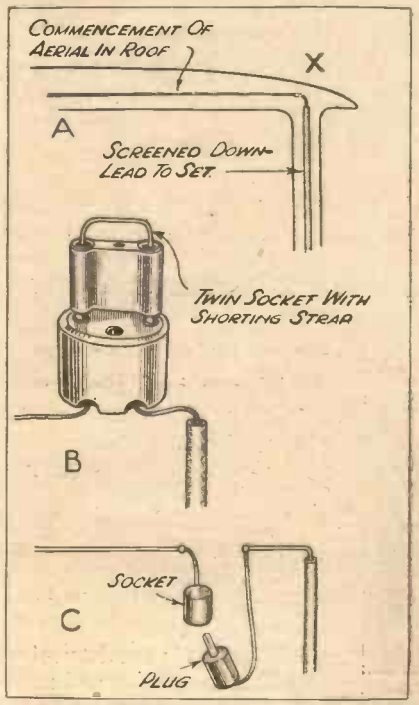
ADAPTORS seem to be becoming almost the standard way of receiving short waves these days, and car radios are also getting more common every day. So why not combine the two, and do a little short-wave listening in the car when you get out into the country?

Away from towns with their screening and static noises, and perched on top of a hill with a distant view, you will probably get some surprises in long-distance reception.

Connecting the Aerial

Of course, I am not proposing that you should expect much while driving along, although even that is worthy of experiment so long as the passenger operates the receiver! But with the engine running you are likely to pick up so much interference that an ordinary adaptor would be useless.

SUGGESTED SCHEME



How the aerial in a car may be arranged so that an adaptor can be plugged into the circuit.

However, what I am concerned with here, is how to tap on the adaptor to the car aerial and to the car radio.

The down-lead from the aerial to the set is usually a screened one, and it is not advisable to break this down-lead in any way for fear of upsetting the ordinary reception due to ignition interference. The best place to make the break is marked with an "X" at A in my first diagram. B and C show alternative methods of tapping in the adaptor.

The idea is to break the aerial from its down-lead and take it instead direct to the short-wave adaptor. The output from the latter then goes to the down-lead. The adaptor must naturally be of the superhet type.

In B the two ends of the break are taken to the two contacts of a two-pin-plug socket. When the car radio is to be used in the ordinary way, a simple shorting strip will join up the aerial and down-lead as before.

When the short-wave adaptor is to be employed, an ordinary plug or two separate plugs are used. But use separate pieces of flex for the adaptor leads, and keep them reasonably well separated.

A Wander Plug

In the C method, a socket is attached to the aerial side of the break and a plug to the other. When the adaptor is not in use the plug and socket are joined together, but for short-wave reception another plug and another socket are fitted up to the existing ones enabling leads to be run to the respective sides of the adaptor.

The adaptor itself will, of course, be run from its own batteries, and an earth connection made to any point on the car chassis.

The second diagram on this page illustrates the unexpected cause of a puzzling distortion which occurred on a radio receiver. The symptoms were chiefly distortion—a peculiar type of distortion of a rattly nature.

The usual causes of distortion were all suspected and checked over, but nothing proved wrong. Then the moving coil was suspected of touching the field magnets, but this proved not to be the case.

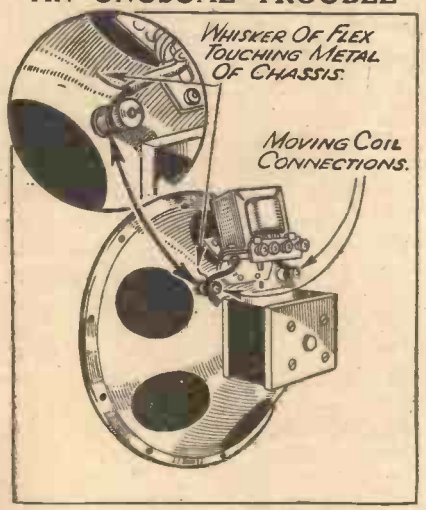
Finally, a search for a loose terminal or other part loose on the receiver was undertaken. But with everything quite tight the trouble still existed.

And then, quite by accident, the cause of the trouble was spotted, the wires to the moving-coil terminals were moved, and everything was O.K. Closer examination showed that a single strand of the flex was lightly touching the oxidised frame.

A Partial Short

It was apparently making poor contact and since the frame was earthed a partial short was occurring. Quite probably, too, the pressure of contact was varying with the vibration of the speaker according to the strength of the notes coming through.

AN UNUSUAL TROUBLE

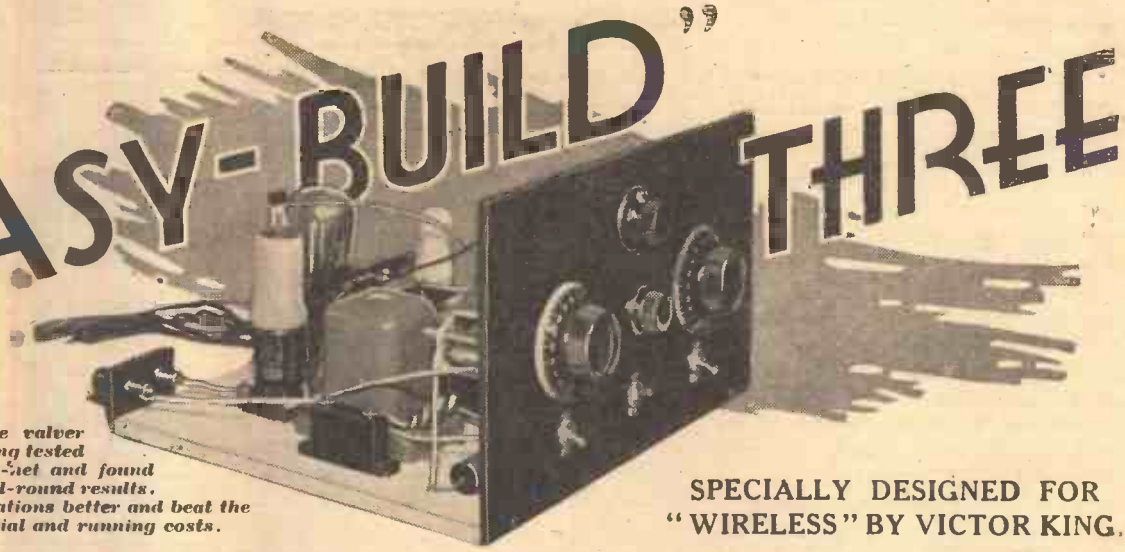


Owing to a loose whisker of flex, shown in this sketch, touching the speaker chassis, the results obtained were marred by a peculiar type of distortion.

Just one more item. A friend of mine was lamenting to me the other day that he had just had the workmen in pulling up floorboards, etc., to fit new mains-plugs in various rooms and he had forgotten to get them to drop in some loudspeaker extension wires at the same time.

He felt he had missed a good opportunity, and was surprised when I said it was a good job he did forget. The extension wires would have picked up a tremendous hum from the adjacent mains!

The "EASY-BUILD" THREE



This is the three valver that Mr. Victor King tested against his super-het and found it gave superior all-round results. It pulled in the stations better and beat the super on both initial and running costs.

SPECIALLY DESIGNED FOR "WIRELESS" BY VICTOR KING.

THIS is my first set of the new radio season, and although I do not suppose it will be the only one which I shall design during this Autumn and Winter, I can make the very definite statement that I shall produce nothing competitive with the "Easy-Build."

No Intricate Valves

As a matter of fact, I doubt whether I could. I have several novel ideas in regard to various types of sets which I have yet to present, but they lie in the direction of larger and more complicated pieces of apparatus. Mains supers with A.V.C. and visual tuning, for instance.

I anticipate producing three or four receivers in all this season, and probably two of these will be either A.C. or Universal types. As for the other, if there is another, that may be anything; it will depend upon the trend of technical development, constructor requirements and the results of my experiments.

But there will have to be a revolution such as has never occurred before in order to render the "Easy-Build" a back number. And yet there are no triode-hexodes, octodes, double-diode pentodes or any other such things in it! Just a good old S.G. and a couple of triodes.

Some of you may be thinking that I've suddenly gone all old-fashioned, pre-multifunctional in fact. Well, perhaps I may be forgiven for mentioning that I have probably done as much work on advanced superhet design as anybody. I have even built, with my own hands, a successful complete high-definition television outfit, and that, I will venture, is rather more than all but a very few indeed have done in this country, so far, at any rate.

It was while I was applying the finishing touches to this expensive and arduous proposition that the Editor invited me to produce a set for WIRELESS. "Something good; something which a lot of constructors will want to build," was, in brief, the specification.

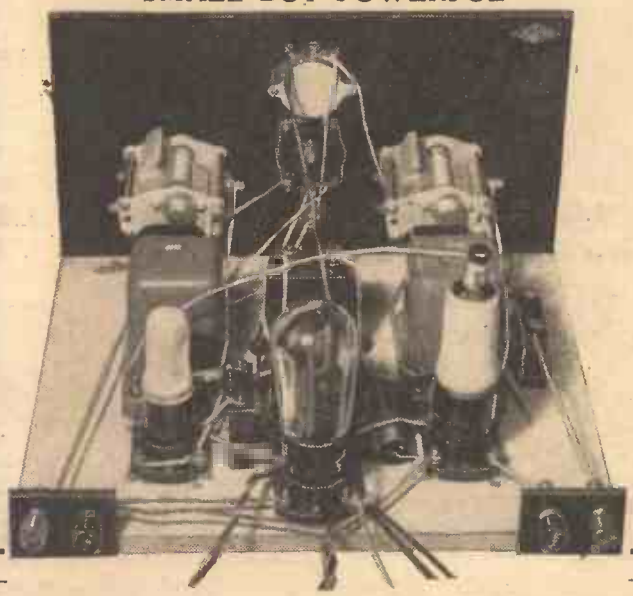
A Comprehensive Test

Naturally, being at that particular moment engaged on a super-het (albeit one using for vision and sound channels no less than fifteen valves, my mind at once swung in the direction of supersonics.

But it would have to be a battery super using only about a fourth or fifth the number of valves, I mused. Tentatively, I toyed with the idea of a three-valve super. Then that scheme began to take shape and shortly I was busy at work. Eventually the experimental hook-up was completed and ready for test.

It worked very well indeed. I handed it over to the WIRELESS Research Laboratory technicians for a thorough meter test in the unique WIRELESS AND TELEVISION

SMALL BUT POWERFUL



THE FEW PARTS—

2 Polar No. 2 slow-motion tuning condensers.
2 Wearite Universal coils, type A.
1 Bulgin 50,000-ohm volume control, type V.C. 36.
1 Bulgin toggle switch, type S.88, with "Long: Short" plate.
1 Bulgin 2-pt. toggle switch, type S.80, with "Long: Short" plate.
1 Bulgin 3-pt. toggle switch, type S.87, with "On-off" plate.
1 B.T.S. ·00015-mfd. differential reaction condenser.
1 Dubilier 2-mfd. fixed condenser, type B.B.
2 T.M.C-Hydra ·1-mfd. tubular fixed condenser.
1 Dubilier ·0003-mfd. fixed condenser, type 620.
1 Dubilier ·0001-mfd. fixed condenser, type 620.
3 Benjamin 4-pin Vibrolder valve holders.
1 Varley "Niclet" L.F. transformer 1: 3·5.

—YOU REQUIRE

1 Erie 2-meg. grid leak, 1-watt type.
1 Graham Farish 15,000-ohm "Ohmite" 1½-watt resistance in vertical holder.
1 B.T.S. H.F. choke disc type.
1 Peto-Scott Metaplex baseboard, 12 in. × 10 in. × ⅜ in.
1 Peto-Scott ebonite panel, 12 in. × 7 in. × $\frac{3}{16}$ in.
2 Peto-Scott terminal strips, 2 in. × 1½ in. × $\frac{3}{16}$ in.
4 Clix indicating terminals, type B.
5 Belling & Lee wander plugs.
1 Belling & Lee wander fuse.
2 Clix accumulator spades
1 Coil B.R.G. "Quikon" connecting wire.
Screws, flex, etc.

REVIEW Set Testing Cabinet. In due course, curves and figures were produced for my inspection. I drafted out a list of the parts and had them costed.

Superior Reproduction

Then a doubt crept into my mind. A straight three-valve arrangement using modern components would be much cheaper and wouldn't it give just as good, if not better results? Wasn't I, weren't we all tending to become rather hypnotised by the glamorous, fascinating superhet principle?

I decided to make up a straightforward three-valver using first-class parts and with the most efficient circuital and component layouts I could possibly devise. This outfit was tested comparatively against the super. It gave better all-round results! It pulled in the stations with greater power and in greater numbers and with less background. Its reproduction was superior, and even in regard to selectivity it would not concede anything to its superhet rival.

It was also simpler in its construction, and there was no matching and ganging to do. Finally, it beat the supersonic on both initial and running costs.

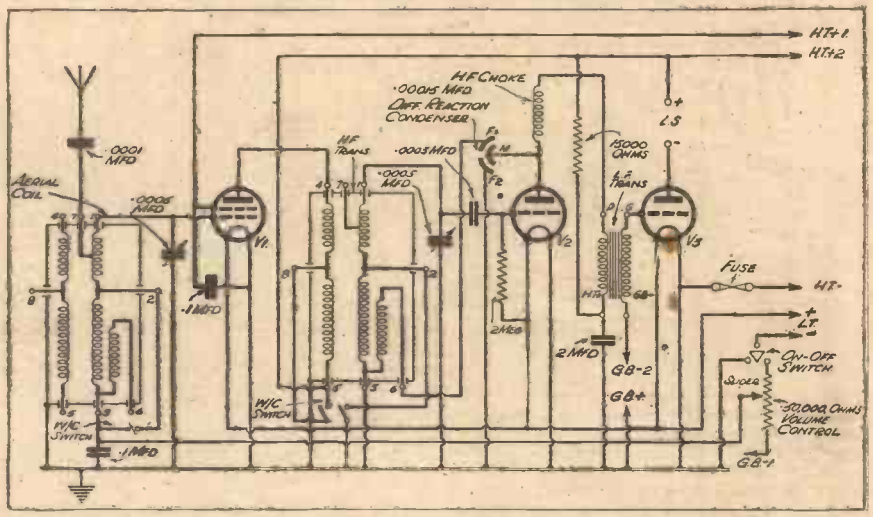
So I decided to jettison the super and go forward with the straight. A rather big decision to make in the circumstances, for the popularity of the super is such that I know from personal experience that many constructors will look at nothing else.

Mind you, I am not claiming that the "Easy-Build" is a better set than all those battery superhets which have been produced, some of which use a couple of multifunctional valves in addition to two or three pentodes. But, taking everything into consideration, I do not know of any other arrangement of three valves which will give a greater all-round satisfaction for the same outlay, or even a somewhat larger one, than this "Easy-Build."

Given a moderately good outdoor aerial, or a sizeable indoor arrangement, it will surprise the sceptical supersonic adherent with the quiet, fussless manner in which it will pull in the stations.

The S.G. is a variable-mu, and so the volume controlling is accomplished at the "front door" of the set. You need never let more energy in from the aerial than all the valves can deal with comfortably without being overloaded. You keep well below the "Plimsoll Line" for all stations, so long as you do not endeavour to make the set produce a greater volume than is represented by the maximum output of the output valve. And you are hardly likely to do that!

HOW THE CIRCUIT IS ARRANGED



New universal coils are employed in the "Easy-Build" Three, and contribute a great deal to the success of the design. Note that a double shorting switch is used for wave-changing the second coil.

TWO OF THE THREE STAGES

The detector and output valve holders and the detector tuning condenser and coil can be seen in this photograph. The potentiometer on the panel is for the control of the variable-mu S.G. valve.

A Logical Scheme

A variable-mu control is a control of the sensitivity of the whole set as it were, and is, therefore, a far more logical scheme than L.F. volume controlling alone. When you have an H.F. stage working all out all the time and adjust the volume at the L.F. end, the H.F. valve and the detector may be badly overloaded in the case of the powerful stations, and distortion of a more or less serious nature introduced. Also, you are leaving the "front door" wide open for disturbing noises, a fault which occurs in many supers.

The H.F. stage of the "Easy-Build" is coupled to the detector stage by means of a coil used as an H.F. transformer. There is smooth, effective differential reaction. The H.T. voltage to the detector's anode is

VALVES AND ACCESSORIES

VALVES.

	S.G.	Det.	Output.
Marconi or Osram	V.S.24	H.L.2.	L.P.2.

LOUDSPEAKER.—W.B. Stentorian.

BATTERIES.

H.T.	120 volts—Drydex.
L.T.	2 volts—Exide.
G.B.	9 volts—Drydex.

This photograph shows again the output valve holder and the L.F. transformer but includes the S.G. stage of the "Easy-Build" Three. The S.G. valve holder is not as unusual as it at first appears, the "centre terminal" is merely the top cap fitting for the S.G. valve.

automatically set by means of a series resistance which also functions as a decoupler.

Finally, we have a normal transformer-coupled L.F. stage in which is used a triode output valve, although you can if you desire employ a pentode. But if you will take my advice you will stick to the triode in this instance.

Your Own Components

I am now going on to say something which has been said many times before and will doubtless be repeated often in the future. But it really is most important that you should use those makes of parts which I recommend. Such a set as this "Easy-Build" must form a great temptation to constructors to use old components. There is room on the baseboard for them should they be somewhat larger in dimensions.

Well, it is beyond my power to restrain you using old parts in this set if you have set your mind on so doing, and I am not denying that in cases there may seem to be some justification for the practice. For example, I can visualise a constructor who sees in this "Easy-Build" just the set for a friend or relative and a set which, he thinks, he can easily and inexpensively assemble from a number of components he has remaining from his own hook-ups of the past, and who will go straight at the job in this way whatever might be said against it by me or anyone else!

Actually, of course, this is the sort of thing we designers do very often; that is, build new sets from old parts. I myself often run up simple receivers from old bits, sometimes for experimental purposes, and at other times to provide somebody with a set who would not otherwise be able to listen in.

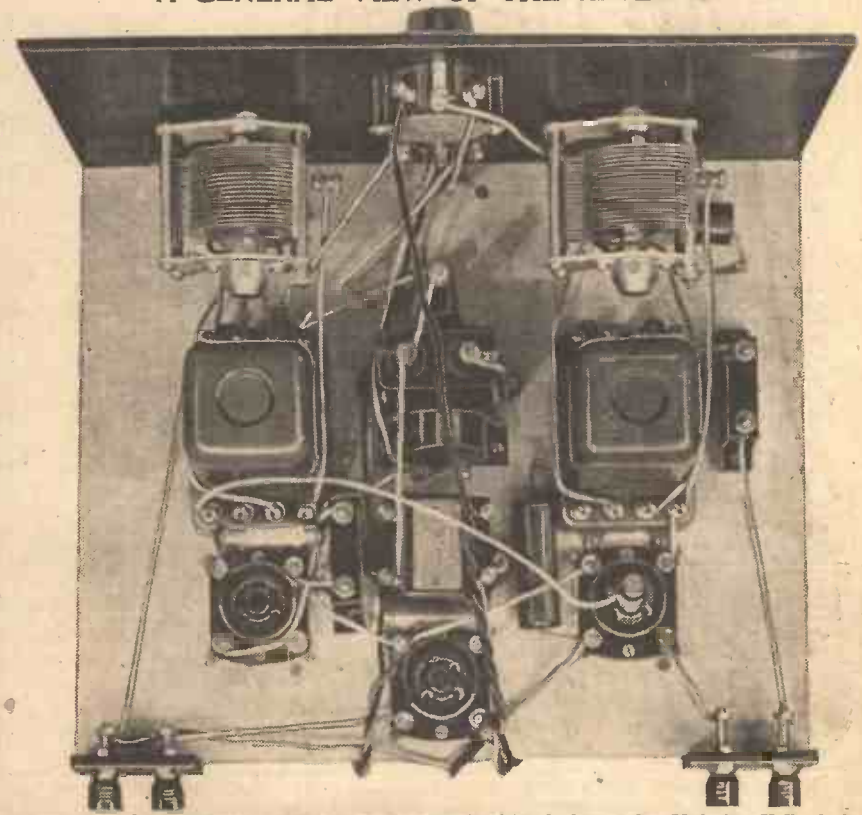
But it is very different when a constructor not possessing radio engineering skill acts this way. His effort may or may not be a success. It is largely a question of luck. I must make it clear that I have no personal axe to grind in this matter. Speaking purely and simply as an individual I really don't care one jot or scrap if constructors take the risk of assembling new designs from old and unspecified parts, so long as they don't hold me responsible for what they get.

Letters from Readers

Having, I hope, made myself quite clear on that point I will move on to another one. Every time I describe a set I receive a number of letters from readers containing queries about it. That is gratifying, and I welcome correspondence and try to deal with all of it myself. But this is not always possible; one's time is limited to twenty-four hours per day, and an hour or two of sleep has to come out of that!

However, there is one kind of query which I find difficult to handle. It generally comes from the more experienced constructor, the type of man who is never able to find quite the design which appeals to him. He wants to know if you can supply him with a diagram showing how, instead of separate tuning condensers, a gang can be introduced. How to modify the arrangement so that band-pass tuning is possible, and so on.

A GENERAL VIEW OF THE RECEIVER

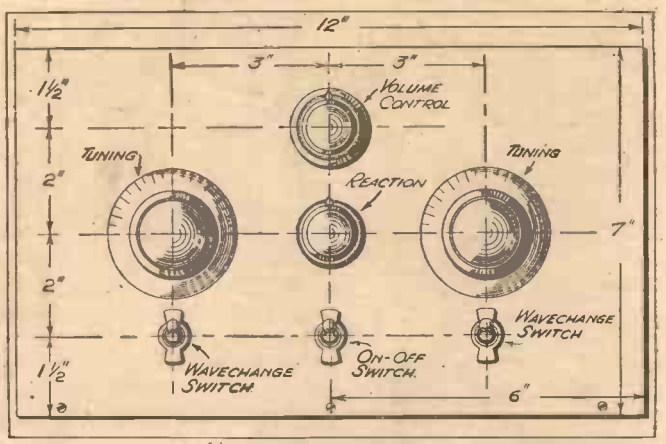


A large number of the connections can be seen in this photograph. Note the H.F. choke tucked away between the 2mfd. condenser and the L.F. transformer.

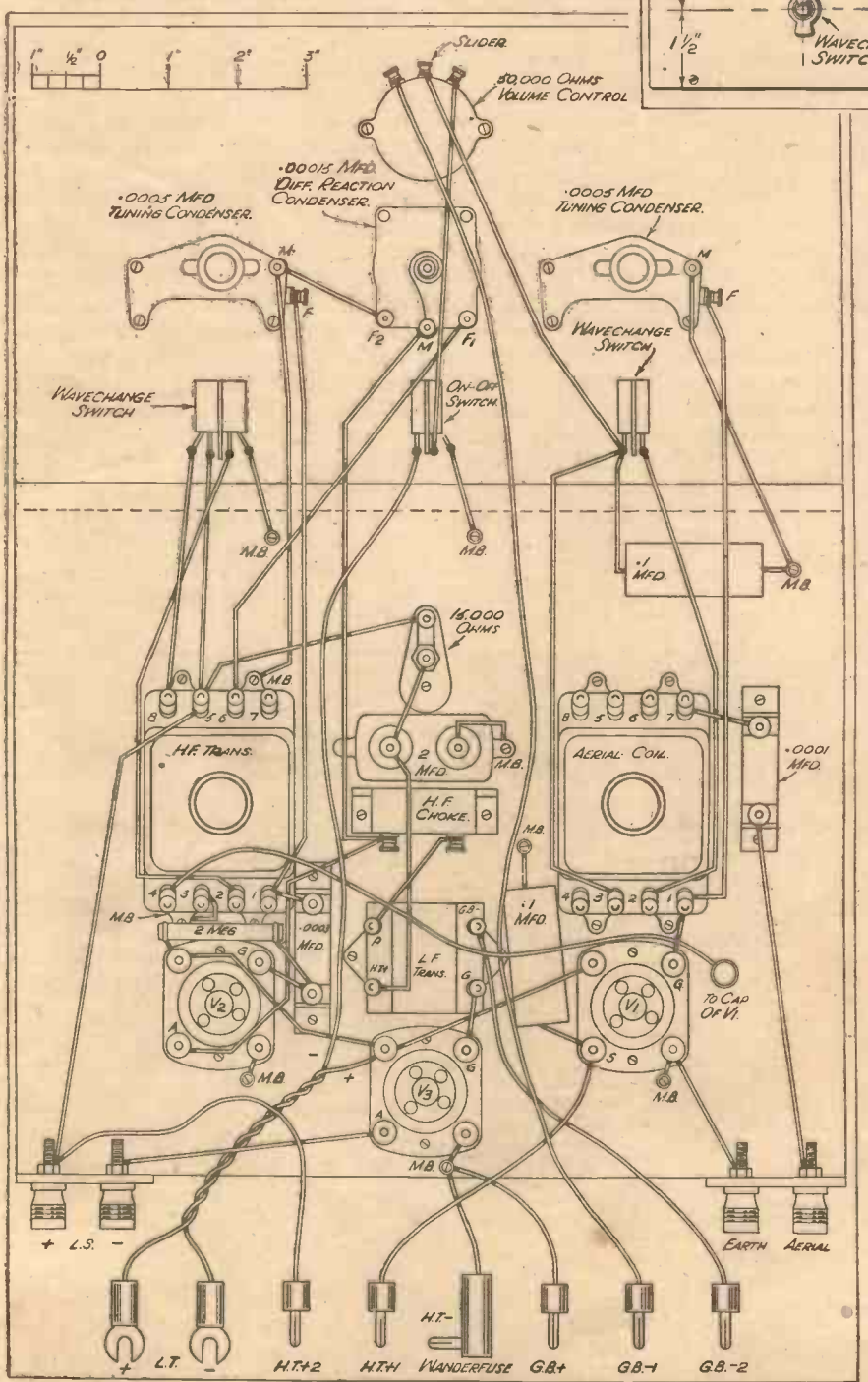
What it amounts to is that he doesn't want to build your set at all but something quite different. Personally, I find it hard to adopt a kind of take it or leave it attitude, and I'd like to be able to show every reader of this kind just how he can build a set which will meet his every requirement. Unfortunately, as I have said, there just isn't time to fit all this in and so I have to put up the shutters against communications containing requests for special modifications, and so on.

Still, in the case of a set such as the "Easy-Build" Three, the issue is much more clear cut than it is sometimes. Here we have my conception of a straight three, and either the constructor will want it as it stands or his aspirations will be in the direction of much more elaborate, more expensive, and often more troublesome apparatus!

HOW THE PANEL IS DRILLED



The separate tuning controls are extremely easy to operate and ensure that the very last ounce is obtained out of the receiver.



Every lead is clearly shown in this diagram. Follow the layout exactly if you want trouble-free operation and full efficiency. Note that every point where connection is made to the metallised baseboard is marked "M.B."

Constructionally, the set divides itself into three sections, the panel, the baseboard and the terminal strips. I have used two separate terminal strips, on the one are the aerial and earth terminals, and on the other the loudspeakers terminals. I have found that the majority of builders of the smaller sets, anyway, prefer their battery leads to go straight to the batteries. But there is no reason why you should not have one long terminal strip running the whole length of the baseboard, and mount battery terminals on it as well as the other four terminals.

No Trimming

Separate condensers are simpler to mount on a panel than gang condensers, which have escutcheoned dials, and so forth. That is one of the reasons I have used them. A further reason is that trimming is eliminated. So few constructors appear to be able to trim correctly. The energy that goes to waste every day through faulty trimming must amount to enough to drive an Atlantic liner!

And with even correctly-trimmed condensers there will be some loss somewhere on the dial where the matching goes out a little. You do know that with separate condensers you can obtain perfect resonance on both tuning circuits through the whole of both wave-ranges. In large sets where there is more amplification than it is ever practicable or desirable to use, a little loss here or there doesn't matter. But if you want to get the

(*Please turn to page* 220.)

Broadcasting & Education

by The Rt. Hon. LORD STRABOLGI

"The listening public wants information on topical subjects: but they want it hot, bright, and sparkling," says Lord Strabolgi in this article, in which he discusses the talks and news side of our broadcasting service.

EDUCATION is not only a matter of classrooms and lectures. Our real education begins after we leave school. There is a tremendous lot to learn in the world, and the more informed the public are on all useful topics, the better; and here broadcasting already plays a very considerable part.

The lesson is being learnt by the B.B.C. that the listening public refuses to be spoon-fed with "knowledge." But we do want facts, presented in an interesting way.

Exchange of Ideas

I believe the educational side of broadcasting could be extended. The B.B.C. could be made a great university of the air; and let it be remembered that a university is not only a place where book-learning is acquired. The greatest value of a university training is not what is picked up at lectures or from textbooks, the so-called book-learning, but in the exchange of ideas.

Some people are inclined to shy at the very word education; but we are all of us interested in certain topics. Most of us want to know what is going on in the world. There is a thirst for real knowledge. It may be only about sport or entertainment, or the most simple domestic matters; but there it is, and it ought to be satisfied.

Two Sections

Every broadcasting programme given during recent years can be divided sharply into two sections; one I would call entertainment—music, whether it is highbrow, middlebrow or jazz, the popular music-hall programmes and the lighter plays. In the other section can be placed all the news talks, the descriptive talks about the news, the lectures, the serious plays, historical and otherwise, farming talks, and so on. And this section, whether we like the word or not, is educational.

If it were announced that Professor So-and-So, the famous economist, would deliver a lecture at eight o'clock at night on the National, his subject being the Financial System and the History of Speculation, how many of the 30,000,000 potential listeners would tune in? Yet at eight o'clock on June 13th of this year, a very excellent story was told from the Regional station of the South Sea Bubble of 1720. It was accompanied by suitable music, and was a very fine piece of dramatic description of the first great financial crash on the London Stock Exchange. This great historical event contains a whole host of lessons for us to-day, was well worth listening to from an entertainment point of view, and was certainly educational. The same praise can be given to the historical plays. A recent series of these was most interesting, and of real instructional value.

Tommy Handley, the famous radio comedian, takes a special interest in sick kiddies. Here he is seen presenting a Mullard "Nursery Set" for the Great Ormond Street Children's Hospital.

Unsatisfactory Lectures

Now the above, together with bright, crisp, well-chosen talks on the topics of the day, are examples of what can be done; but some of the lectures that are given in the broadcast programmes are not satisfactory from the point of view of the ordinary listener. I suppose it is our innate conservatism which leads us to think that an informative talk on a subject that should be of popular interest must be given by an eminent lecturer using the same technique as for a class of students preparing for an examination. The general public definitely does not want that sort of thing.

There are plenty of continuation classes, night-schools, post-graduate courses already for those who want them; and education in the old-fashioned sense of the word is open to all who take the trouble to apply themselves to it. The listening public, on the other hand, wants information on topical subjects; but they want it hot, bright and sparkling.

Historical Novels

I am a publisher. We sell a great many historical books to the general reading public. There is a vogue for the historical novel; but we shouldn't sell many if we allowed them to be got up in the form of school text-books. The story must be told in an interesting way. There is tremendous drama and romance in the lives of the great

characters of history and in the accounts of the important events of the past; and the telling of them can be as thrilling as any Wild West cowboy or detective novel. The difference is that the historical novel is founded on facts.

More Auditions Needed

So it should be with broadcast talks; and just as we publishers, if we are not to go out of business, have to choose authors who know how to write and produce the literature the public wants to read, so the programme directors of the B.B.C. must choose lecturers who know how to present their facts and their descriptive accounts in a way that the licence holders want to listen to. Just because a scholar has a great reputation for his knowledge of a particular subject and the research work he has done, it does not follow that he can write a suitable "talk" for the microphone; still less does it follow that he can give the talk in an attractive manner. There ought, in my opinion, to be more auditions.

There are natural broadcasters; and there are others. Strange as it may appear, personality is really of more importance in broadcasting than it is on the public platform, on the concert platform, the stage, or in the lecture hall.

Television has not yet arrived, so far as the general public is concerned; therefore the person giving the talk is still invisible. A striking presence is of no value. It is as if the lecturer were speaking in a dark room. Everything, therefore, depends on the voice alone, and what lies behind it.

Three Examples

Let me cite as examples three very famous public men, each one of whom has been a Prime Minister, and whose main job is persuasion and argument by means of speech. Take Stanley Baldwin, the present Prime Minister; Ramsay MacDonald, who has just ceased to hold that office; and Lloyd George, who was the great Prime Minister of the war period.

Baldwin is a good man on a public platform, but he is not a spellbinder; as a broadcaster he is absolutely first-rate. I am not sure that his is not the most successful "voice" on the microphone of anyone living to-day. He knows the art of getting right into the listener's family circle. The King has this great art also, and the rare broadcasts of his Majesty once a year at Christmas, and on great occasions such as the Jubilee Day, have been wonderfully successful.

MICROPHONE PERSONALITY

Unable to "Get it Over"

In contrast, MacDonald, who in his prime was able to sway public audiences, and, in his Opposition days, was considered a great Parliamentarian in that highly critical assembly of the House of Commons, fails to "get it over" when he goes to the microphone. It is difficult to arrive at the reason; but it is there. He does not seem able to impress an invisible audience. No doubt personal appearance and personal magnetism have something to do with this contrast. Without wishing to be disrespectful to Stanley Baldwin, he is not exactly a striking figure of a man, and would probably describe his own appearance as homely. MacDonald, on the other hand, has a fine presence, and a handsome head; but this doesn't account for the difference between the two at the "mike."

As a platform orator, Lloyd George is supreme in this day and generation; but on the wireless he is mediocre. He is better than MacDonald, but he is not to be compared to Baldwin. Lloyd George is a man of dynamic personality, with wonderful powers of persuasion, and capable of great oratorical efforts. Yet he is deficient in microphone personality.

The same considerations apply to the general run of broadcast speakers. A man may be a wonderful teacher in a university, and yet worse than useless in the broadcasting studio. All the more need, therefore, for a very careful selection of those who are put "on the air."

I can cite another example, in the great world of entertainment. Miss Grace Moore is a deservedly popular operatic singer; but she would never have achieved her great fame without the aid of the cinematograph screen, an entirely different medium where the voice can be amplified and where a performance can be presented which has been hand-picked from a multitude of similar performances to produce a wonderful effect on the cinema screen. An operatic performance, where one false note cannot be rectified at the time, is far more exacting. This is not belittling the art of Miss Grace Moore, or the sweetness of her voice; it is an example of the different effects of the same personality through a different medium.

In the United States many great singers and actors achieve fame in the first place through the microphone; in this country fame is generally first achieved outside the broadcasting studio, and then the attempt is made to utilise the different medium of broadcasting to produce the same results.

A Special Study

All this goes to show that the educational side of broadcasting should be a subject of special study. There should be a departure from the hitherto accepted methods of giving information and instruction. And every part of the broadcast programme should be, if possible, superlatively good. The aim should be excellence to a hundred per cent. In a newspaper there is something to interest everybody, and the reader selects what interests him or her. But, except for the choice of programmes from alternative stations, there is no possibility of selection by the listener.

Still, we must remember that broadcasting is comparatively new. It is still in its infancy. It is developing and improving all the time. Television will bring new opportunities and new problems.

TEACHING THE DEAF

Radio has proved a great boon to the deaf. These children, for instance, can hear quite clearly with the aid of their special headphones.

Twelve Years of Progress in Valve Design

BY DR. J. HARRISON ROBERTS F. INST. P.

Have you ever thought how the progress of broadcasting and the development of the receiving valve are closely interwoven, or of the almost incredible developments that have been made in the valve in the past twelve years? This fascinating subject is taken as the theme of this interesting article by our renowned contributor and his intriguing resumé of the progress of past years makes fascinating reading.

IT is difficult for us to realise that the thermionic valve, so far as broadcast listeners are concerned, has reached its present extraordinarily high state of efficiency in the comparatively brief span of some ten or twelve years. It is almost a platitude to say that nothing has contributed more to the development of broadcast reception than the discoveries, inventions and improvements that have been made in this component.

No Practical Limit

There have been many times, in the development of the valve, when the experts have wisely shaken their heads and declared that there was nothing left to discover. But, as in so many other branches of discovery, that has invariably proved to be the precise moment when some new discovery has broken out and opened up the whole field afresh.

This has happened so many times that I think the most hardened sceptic has realised at last that no practical limit can be set to the possibilities of the thermionic valve. It has proved its worth, not only in radio reception, but also in telephony, talking pictures, television and a host of less spectacular but none the less important directions.

The Old "R" Type

I have been asked to give you, in the short space at disposal, a bird's eye view, as it were, of what has been done in this intensely interesting field during the past twelve years. I realise that I have been set a difficult task, but here goes!

Those of you who had receiving sets in what we may call "the early days," and that is not longer ago than 1923, will remember well enough the old "R" type of valve with tungsten filament, the high-vacuum triode.

We thought these good enough in those days, notwithstanding that each valve consumed something like one ampere of filament current, and even then gave a relatively small electronic emission. The filaments in these valves were very fragile, and manufacturing losses were very high.

Another reason for the large percentage of rejected manufacture was the fact that the residual gas in the electrodes had, in those days, to be expelled by electronic bombardment—in other words, the valve had to be pretty well worked to death in the actual process of its birth.

Heating by Induction

It was soon found that the same result could be attained much more satisfactorily by heating the electrodes, after their assembly into the valve, by means of an induced high-frequency current. This was done either during or after pumping. The same process which heated the electrodes and drove out the absorbed gases was also used to fuse off a small quantity of magnesium, and the magnesium vapour thus generated absorbed, or combined with, the small amount of remaining gas in the glass bulb, after the pumps had done their work, and left a remarkably complete vacuum.

The comparative inefficiency of these filaments, from the point of view of emissivity, worried valve manufacturers very much, and it was not long before they discovered that if a small quantity of thoria was introduced in the tungsten of the filaments this had the effect of greatly enhancing the electronic emission at a given temperature.

Thoriated Filaments

The well-known American physicist Langmuir, working in the laboratories of the American G.E.C., figured mainly in this particular research. Langmuir has picturesquely described what he visualises as taking place in a thoriated filament when it is in operation. He pictures the thorium oxide being reduced to thorium in the body of the filament and thence transferred to the surface, where it adheres to the tungsten and forms a highly emissive layer. As this layer gets used up or driven off, so a further supply perspires, as it were, from the interior.

ALL FOR DIODE RECTIFICATION

A trio of 1935 valves. On the left is a double diode, the centre one is the D.N.41, a double diode and steep slope output pentode; the right-hand valve is a multi-mu screen pentode with double diode inside.

INDIRECT CATHODE HEATING

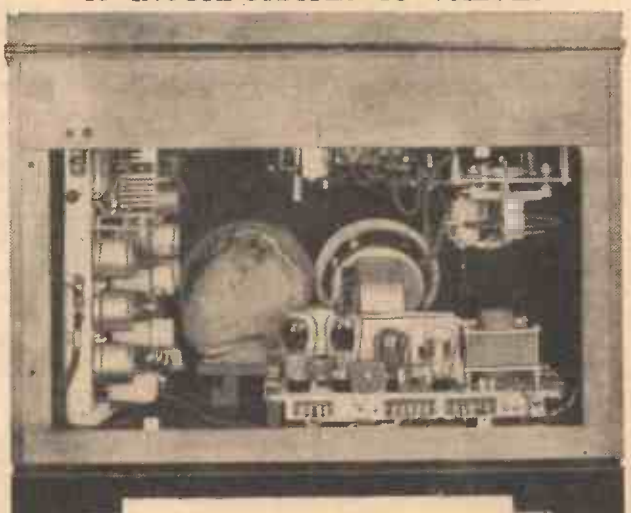
The introduction of thoriated filaments giving much higher emission enabled clearances between grid and filament to be reduced, with the result that valves could be made having a much better "slope" in their characteristic, and this was undoubtedly a great step forward in their circuit applications.

For some two or three years the thoriated filament filled the bill very well, but valve manufacturers, ever on the alert for further improvements in the reliability of the valves in service and also in valve charactertistics, set to work to go over researches which had been done many years previously with oxide-coated-filaments. As a result, a method was discovered in 1924 for the commerical production of satisfactory oxide-coated cathodes.

The process consists briefly in introducing an oxidised metal cathode into the valve, and then, after a preliminary evacuation, surrounding this cathode with metallic barium vapour. Usually the cathode is made of tungsten, although most high-melting-point metals in the form of wires can be used, such as nickel, iron or platinum.

You may remember that Wehnelt was the original discoverer of the oxide-covered cathode, and this type is still referred to as the "Wehnelt" cathode. The Wehnelt process is responsible for what we now call the "indirectly-heated" cathode, where the actual heated filament merely acts as a heater, not as an electron emitter, and is surrounded by a cylindrical cathode, which is heated by the filament, and which, in turn, acts as the emitter.

IT INCORPORATES 15 VALVES



Here is a good example of the use of modern valves. It is a photograph of the interior of an H.M.V. High-Fidelity Autoradiogram which contains fifteen valves and dual speakers.

A.C. for L.T.

It is this type of cathode that has made it possible to use alternating current straight on to the valves, and avoid the inconvenience of heating by accumulators, where alternating current electric supply is available.

The indirectly-heated cathode, since there is no current flowing through it, has the same electrical potential over the whole of its surface. It is becoming much more generally used, and I think it is a fair statement to say that only in places where electric supply is not available does the battery-heated type of valve hold its own against this indirectly-heated type.

The "Cold" Filament

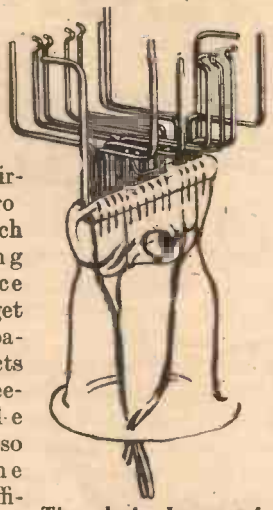
No account of valve development would be complete without some reference to the "cold valve" which, as you know, has been the dream of valve designers for many years. It is not for a scientific man to say that any scientific discovery is impossible, but, undoubtedly, theoretical considerations would seem to indicate that the cold valve, as the description would ordinarily be understood, is out of the question.

It is possible that cold cathodes may be found serviceable, relying upon an external source of radiant energy, such as light, especially if proper use can be made of ionisation and secondary emission. But so far as the ordinary type of emitter is concerned it seems that a certain minimum energy will always be necessary to release the electrons.

When broadcasting started, it very soon became clear that there was a need for amplifying valves with a much larger output than any that were at that time available. Experiments in this direction soon yielded results, and the new valves which were then produced may be regarded as the forerunners of the remarkably efficient output three-electrode valves which we use to-day.

RIGIDITY

The investigations into high-frequency amplification led to the well-known "neutrodyne" circuit being produced, in which a balancing capacitance was used to get rid of the capacitance defects of the three-electrode valves, and so to overcome coupling difficulties between input and output circuits.



The electrode mountings of an up-to-date battery pentode are particularly rigid.

The attempt to produce stable cascade amplification with three-electrode valves soon gave way, however, before a valve of entirely new design, which was introduced about 1927. The valve I refer to is the screen-grid four-electrode valve, or tetrode, in which the grid-anode capacitance was made so small that it was possible to use tuned circuits of very low decrement, and yet to obtain stable amplification.

With three-electrode valves, it had often been necessary previously to make the circuits deliberately inefficient in order to get stability, and at the same time only something like a hundredth of the amplification obtainable with the screen-grid valve was obtained. The screen-grid tetrode thus quickly established itself, and the previously-known triode defects were got over.

Birth of the Pentode

The high differential anode resistance of the four-electrode valve made it ideal as an output valve, except for the negative resistance part of its characteristic curve. This pointed the way to the introduction of a fifth electrode between the anode and the auxiliary grid, which prevented secondary emission from the two neighbouring electrodes, and yet retained the desired high differential resistance. It eliminated the dynatron or negative resistance part of the characteristic.

You will realise that we are

witnessing here the birth of the *pentode*. The introduction of this five-electrode valve was a fundamentally important step in low-frequency amplification, quite as important, in its way, as the introduction of the screen-grid valve in high-frequency amplification, and the pentode has almost entirely ousted the triode in the output stage of modern radio receivers. The sensitivity and large output of the pentode valve not only gave improved volume, but practically saved a complete low-frequency stage of amplification.

Quiescent Push-Pull

As you know, more recently double pentodes for quiescent push-pull have been developed, and their application is the same as that already described, except that the two pentode elements are contained in a single bulb.

Now I come to the question of automatic volume control. This was rendered necessary by the great increase in the number of stations, and the consequent need for receiving conveniently both powerful local stations and long-distance feeble ones. The so-called variable-mu valve is now in universal use for this purpose.

The sensitivity of the receiver can readily be regulated by varying the grid bias of the H.F. valves, decreasing as the grid is made more negative. In the variable-mu type of valve, owing to the particular shape of the characteristic, variations of the steady negative grid potential have the effect of varying uniformly the amplification, and modulation distortion is reduced to a minimum.

You will note that when you control the amplification by means of the negative potential on the control grid, very little energy is required, and the process can easily be made automatic, since the strength of the signal determines the grid potential.

The "Delay" Action

A strong station yields a large negative bias, and so diminishes the amplification of the receiver, whilst a weak signal, on the other hand, produces practically no diminution in amplification. A further refinement of this is the so-called "delay" action by which signals up to a certain strength have no effect on the amplification at all.

The screened pentode is another development in high-frequency amplification. This arose from the natural desire to apply the electrical characteristics of the pentode to H.F. amplification. The combination of

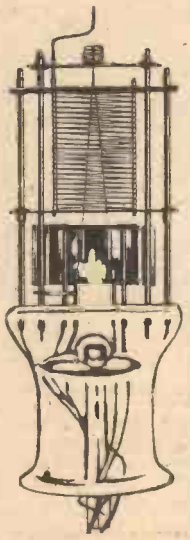
THE SCREENED PENTODE

internal screening (by which capacitance feed-back is virtually overcome) with the pentode characteristic of high constant internal differential resistance led to the design of an amplifying valve of great uniformity and practically unrestricted anode potential swing.

The relationship between load impedance and stage gain is practically linear, and so with this type of valve it is possible to take advantage of each and every improvement in coil efficiency as it comes along.

Now we come to the group of multi-

VALVES OF—



The sketch above contrasts strikingly with that on the right. Above we have the electrode arrangement of a battery double-diode triode. Note the spring tension for the filament. Compare it with the crude hand-made assembly of the "R" valve of years ago, shown in the other sketch.

TO-DAY AND—

The valve above is a recently introduced heptode superhet "mixer"—type M.X.40, and is an indirectly-heated A.C. mains valve.

electrode valves which have made their appearance recently, and which are used more particularly in connection with the supersonic heterodyne type of receiver. This receiver has, as you know, come greatly into favour again in the past year or two, owing to its high selectivity and its simplicity of operation.

Electron Coupling

The earliest of such valves is the *pentagrid*, which, like all its successors, consists essentially of two valves in series, the cathode and the next two grids forming a triode oscillator. Surrounding this are two screen grids, with a control grid interposed, and an anode.

The triode current does not all pass to the triode anode; part of it passes through to the anode of the second valve system which is in effect a screened tetrode. The anode circuit is arranged to amplify the intermediate frequency, and pass on only this component to the succeeding stages of the amplifier.

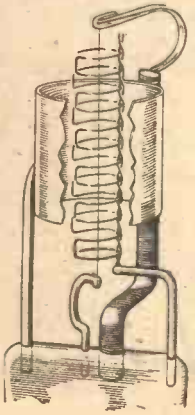
For Short Waves

In view of the advantages of the screened pentode over the tetrode, the pentode type of valve has been adopted in place of the tetrode for the modulator portion of electron-coupled valves, resulting in the production of the "*octode*" valve, which represents the high-water mark in multiple-electrode valves up to the present time.

Now we may look at possible future developments, and here one of the most important fields is that of the short-wave signals which are becoming increasingly important in connection with special types of communication service and also with television.

Valves of very small dimensions, and therefore of very small time-constant, have been successfully made, and have enabled reception to be carried out at wavelengths down to 1 metre, or even less, with very good high-frequency amplification.

YESTERDAY



Progress

Intensive work is at this moment being concentrated on this particular section of valve design, and we may look for similar progress here to that which has been made in other directions.

I said at the commencement that I was faced with the difficult task of giving you a quick survey of valve developments which have taken place in the past twelve years.

I have only been able to give you a sketch of the work which has been done in these different fields, but those of you who would like to read a much more detailed and exhaustive account of this intensely interesting subject should consult Captain S. R. Mullard's address, which he gave recently as Chairman of the Wireless Section of the Institution of Electrical Engineers, and which is published in the Journal of the Institution, 1935.

Questions I am Asked

One of the questions dealt with this month is particularly interesting since it asks why two tuned circuits are used in preference to three in S.T.'s "boom" sets.

Q. 152. How can I cure the effects of overloading?

A. By not overloading! You can (*a*) reduce the signal strength, or (*b*) make the valves capable of handling without distress the signals which have been causing the trouble. Probably the best method is to reduce the input signal i.e. the H.F. currents at an early stage in the receiver. In simple sets, this can be done by reducing the setting of an aerial "coupler" condenser, i.e. a series aerial condenser. Failing this, a variable-mu valve, if used, may be given a greater negative potential on the grid.

A reduction of an L.F. volume control, if fitted, may be better if overloading is occurring on the output valve. A diode or Westector rectifier may give better quality when strong H.F. signals are applied, so that a reduction of the H.F. is not advisable.

Incorrect Grid Bias

So-called overloading of the output valve is often due to inadequate or excessive bias voltage on the grid. Too small a grid bias will result in grid current distortion, while too much bias will cause anode bend distortion. Anode bend distortion will cause upward kicks of a milliammeter in the anode circuit; grid current distortion will cause downward kicks. Absence of kicks, however, does not prove that there is no overloading.

If you require a bigger output volume, you can use a "bigger" valve with a larger grid-bias base, i.e. a bigger "grid swing." Instead of doing this you can (if the valve permits) increase the H.T. voltage. This will give stronger signals or better quality or both. It can be strongly advised on all battery sets. An increase of H.T. to 150 volts often works wonders. The negative bias on the last valve must be increased, and if there is a 1st L.F. valve, its bias may also be increased.

Q. 153. Why is it your "boom" sets all have only two tuned circuits? Is this just a coincidence or have I stumbled on some secret formula which you employ? If so, I think it is absurd. You presumably know that three tuned circuits are better than two, so why all the various unnecessary devices to give selectivity to two?

A. You have stumbled not only on the secret formula but over some technical points. It is true that I have used two tuned circuits only, but the very fact that I have explored practically every possible way of using two tuned circuits must suggest to you that excellent reasons lie behind their consistent use. Actually the reasons are technical, economic and expedient. When price is no object, number of valves no concern, and constructing skill no impediment, I have designed a variety of sets which have been described in print.

But my "big" receiver of the year has not merely to set a high standard of performance but must give high results at a low price. A public ignorant of radio construction and technicalities must be capable not only of constructing but of adjusting and operating the finished set; although, of course, there are some constructors of these sets who possess exceptional skill and unexceptionable ability.

Three tuned circuits cost a lot of money, they involve a gang condenser, and the trimming up of three circuits will bowl out the average constructor. The correct diagnosis of mis-trimming will also stump even a good amateur. Three tuned circuits stretch—often to breaking point—our trust in the ability of manufacturers to market for the constructor coils and/or condensers which are really wedded to truth and therefore to each other.

Extremely good coils and extremely good condensers would cost an extremity of price. So we come back to what we can do for the money. Three sets of coils were costing 37s. 6d. when the S.T.400 and S.T.500 coils were retailed at 8s.—and the circuits in which the dearer coils were used gave worse results.

Need for Trimming Skill

Three sets of coils call for a triple-gang condenser which adds further to the complication and cost. Assuming almost perfect components—a stupendous assumption—we should still need trimming skill on the part of the constructor and, frankly, he—in the bulk—does not possess it. Separate condensers for each coil are out of the question, as most users would find them as hard to tune as they would find it tiresome to pick a combination lock.

In my earlier sets, a ganged set of coils (two or three) would have been impossible, because it would have ruled out variable selectivity, double reaction, and other devices which affect tuning and would therefore have been prohibitive. In the S.T. 600, however, I used a ganged set of two coils and two condensers, and was therefore forced to avoid changes in tuning; but I think quite a number of people had ganging trouble, through lack of experience or, in a few cases, component inaccuracies.

My preference for two as against three circuits has been also a technical one. When you use three circuits, you can use two high-frequency amplifying valves to separate the circuits, or you can use a so-called band-pass arrangement. If the set is limited to four valves, you lose greatly in average

(*Please turn to page* 215.)

B.B.C. News

A Debate Experiment—Presentations to Colonel Dawnay—B.B.C. Correspondence Falls Off—Careers for Office Boys

By Our Special Commissioner

More Contrast Programmes

At least one long overdue reform is to flow from the new B.B.C. programme organisation. We are now definitely promised more alternative programmes, that is programmes so distinguished from each other as to satisfy widely different tastes, demands, and moods. Also I understand that next summer there will be no repetition of the mistake of this summer when, during the important period from 6.30 to 8 each evening, there has been no alternative programme in the B.B.C. service.

That "Silent Fellowship"

I understand that close on 50,000 listeners have petitioned the B.B.C. to restore the "Silent Fellowship," the late Sunday feature conducted for many years by Mr. Appleton, the West Regional Director. The "Silent Fellowship" was a period of personal meditation and intimate reflection on life, religion, and conduct generally. It was stopped last year when Mr. Iremonger became Religion Director of the B.B.C. The agitation for its restoration has persisted, but the B.B.C. is taking no notice.

The attitude of the B.B.C. is that the "Silent Fellowship" was too sentimental and not dignified enough for that solemn and orthodox institution. Also, there is more than a hint that the Governors of the B.B.C. do not look with favour on any development of microphone personality such as the "Silent Fellowship" involved.

Representations on the principle at stake were made to the Ullswater Committee in June.

"Unrehearsed Debates"

I confess to being intrigued with the idea of the "unrehearsed debates" which the B.B.C. is offering us this autumn and winter. It has been suggested that the set debates sound too pre-arranged. In order to get away from this atmosphere, the Talks Department has decided to risk a series of debates not only uncensored but also unrehearsed. Controversial subjects will be chosen, but I suspect that most of the debates will degenerate into "rags."

Take, for instance, that planned for Saturday, October 26th. The resolution will be "That free food rather than free education should be provided by the state." Then on November 9th keen minds will concentrate on this, "That women are bored by Emancipation." But I give the cake to the subject for the climax debate arranged for November 16th. The resolution then will be, "That parents are unfitted by nature to bring up their own children."

Mr. Bertrand Russell will speak first, and Mr. G. K. Chesterton will oppose. I can safely prophesy that that debate will have more entertainment value than the majority of vaudeville shows! Perhaps it is just as well that there is a chance for these debates to become "rags"!

Farewell to Colonel Dawnay

The B.B.C., both Governors and staff, have been giving impressive farewells to Colonel Alan Dawnay, who had been seconded from the Army for two years to study and report on the B.B.C. for the National Government. The Governors and the Director-General made a special presentation of plate on a suitable occasion. The staff gave a handsome present, and there was a complimentary luncheon from those with whom he had been most intimately associated.

In the event of the outbreak of war or internal trouble of a serious nature, it is understood that with the enforcement of a new Defence of the Realm Act, Colonel Dawnay will be available to take over the B.B.C. for the period of the emergency. Until his seconding, there was no one in any Government service who could have done this.

(*Please turn to page* 218.)

"GERT AND DAISY"

Here is a dressing-room snap of those two popular radio and stage stars, Elsie (left) and Doris Waters, listening to a programme on a Portadyne set.

BELOW TEN METRES

Much research is being done throughout the world on ultra-short waves, and these details of the latest developments in America show how deeply engineers are going into the matter.

A CONSIDERABLE stir has been created in American wireless circles by the latest invention of Major Edwin H. Armstrong, who is at present Professor of Electrical Engineering at Columbia University, and famous throughout the world for his pioneer work in the use of reaction, and in the development of superheterodyne circuits.

Above about 100 metres natural and artificial static is very much in evidence, particularly when intensive high-frequency amplification is used.

Electron Gushes

Below 10 metres this is not the case. A certain amount of artificial and natural static does of course occur, but it is practically negligible compared with what is found on the longer waves. On the other hand one comes up against another source of trouble in the form of what is called "tube" noise. In a valve electrons are not given off from the filament in an absolutely smooth and regular fashion, but are liberated in a series of gushes. In the ordinary way this does not affect reception.

FOR FREQUENCY MODULATION

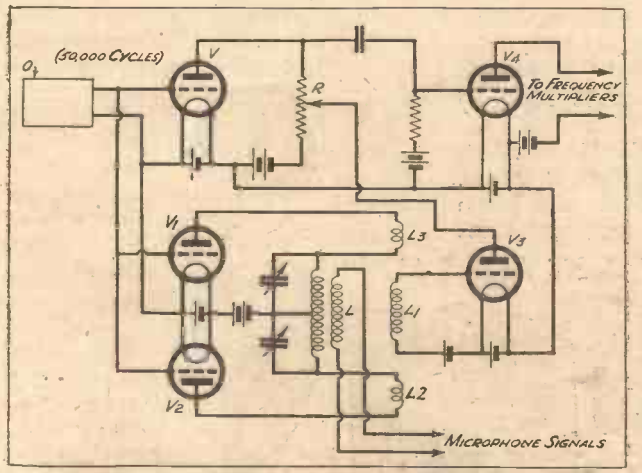


Fig. 1. The Armstrong frequency modulator in simplified form. The circuits V_1, V_2, and V_3 are quiescent until modulation is applied.

But when handling ultra-short waves, where it is necessary to use intensive amplification if one wishes to reach out for the signals, the hissing sound rises in volume until it definitely blots out everything else.

Major Armstrong accordingly found himself up against this situation. Working on the ultra-short waves, where the ether is comparatively free from ordinary static, he could use more amplification than is possible on the longer waves. But he found that he could not push it as far as he would like, in order to get the longest possible "reach," without masking the signals by tube noise.

He proceeded to tackle the problem on the following lines: First of all he went to the transmitting end, and replaced the ordinary method of amplitude modulation by another method known as frequency modulation. That is to say, to cause the signal to vary the frequency instead of the amplitude of the carrier wave.

The Sideband Width

This in itself is not new, but Major Armstrong pushed it to a further degree than had previously been thought possible. As we all know, the sidebands produced by ordinary modulation spread roughly for 10 kilocycles on each side of the carrier wave, or 20 kilocycles in all.

But in frequency modulation, once the signal has been applied to the carrier wave, it is possible by passing the resulting wave through a series of frequency-multipliers, to produce practically any desired width of sideband.

100 Kc.

Major Armstrong accordingly transmits sound signals on sidebands which spread for at least 50 kilocycles on each side of the carrier, or a total width of 100 kc.

He is able to do this without causing any unnecessary interference because he is using a carrier wave of only 6 metres.

Fig. 1 shows the Armstrong frequency modulator in simplified form. A constant-frequency generator O of, say, 50,000 cycles feeds simultaneously an amplifier V, and a pair of push-pull valves V_1, V_2. The latter are carefully balanced so that normally no energy passes from them to the input coil, L_1, of a third valve, V_3. But as soon as a microphone signal is applied through a coil L, the original balance is upset and either the valve V_1 or the valve V_2 transfers energy into the input coil L_1, according to which of the two anodes is made more positive.

The phase of the energy so transferred to the amplifier V_3 will "lag" or "lead" that of the wave supplied from the source O according to the way in which the output coils L_2, L_3 are wound and coupled to the input coil L_1. The output from the valve V_3 is

THE NOISE RATIO

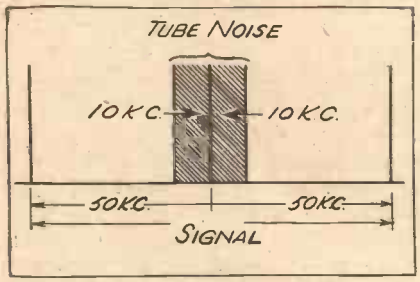


Fig. 2. Valve noise covers only the 10 kc. bands on either side of the carrier frequency and so is very small compared with the full 50 kc. of frequency modulation.

then fed back to a resistance R in the plate circuit of the first amplifier V, and in this way serves to change the phase, or what is the same thing, the frequency of the wave supplied from the oscillator O.

Interference Balanced Out

The original wave which has a frequency of only 50,000 cycles is next passed, as modulated, through an amplifier V_4 followed by a series of frequency multipliers until it has been jumped up to fifty million cycles—corresponding to a wavelength of 6 metres. By this time the sidebands due to the microphone signal will occupy a space of no less than 50 kc. on each side of the carrier.

Fig. 2 shows a 50 kc. frequency-modulated signal compared with the 10 kc. sidebands produced by an ordinary amplitude-modulated signal. Any tube noise due to irregular filament emission can only exist within the comparatively narrow region shown shaded, because it is actually due to amplitude variations.

At the receiving end a pair of push-pull valves are used to balance out the "shaded" tube noise, whilst the frequency-modulated signal is passed through to the speaker at full strength.

BRITAIN'S Wireless Watchers

An interesting description of the Post Office Stations which maintain constant communication with our Merchant Shipping.

By W. T. LOWE.

BOLT HEAD, in Devonshire, was the site chosen for the first Post Office coast wireless station. Opened in 1908, it was the forerunner of the system which now extends around the coasts of the British Isles. Every important etheric shipping lane is now covered by these marine watch-dogs.

Erected for short-distance coastal work, the present eleven stations have a normal range of three to four hundred miles. But reception of their signals is a nightly event far out across the Atlantic and in the Mediterranean.

Originally equipped with spark apparatus all the stations have now been brought up-to-date with valve gear. In effect, this reduces much of the old interference with broadcast listeners, in addition to considerably increasing the effective range of the stations.

The Old Spark Days

In the days of spark, intercepting any kind of signal on, say, Merseyside when Cullercoats (G C C) was working, presented considerable difficulty. Now all that is changed. A few degrees movement of the tuning control on selective receivers cuts out this powerful Northern station.

For commercial reception directional receivers are employed. They have been found very useful in overcoming the excessive jamming encountered in coastal waters. It is a great pleasure indeed to handle one of these fine yard-long receivers!

But apparatus at the coast stations is naturally not so conspicious as that at the high-power long-range stations at Rugby (G B R) and Portishead (G K U). The super transmitters at Rugby, with their plate voltage of twenty thousand, can communicate with ships at any point on the high seas.

World-Wide Broadcasts

Although telephony channels are now being concentrated at Rugby, the station was originally intended to provide a twenty-four hour system of world-wide radio-telegraphic communication.

Most powerful of valve telegraph transmitting stations in the world, Rugby claims to be the first high-power station to have been equipped with thermionic valves.

From here news is broadcast to ships and outposts of Empire. On the high seas navigators welcome the time signal from Greenwich Observatory twice daily.

A forest of masts of all kinds has appeared on the nine hundred acre site—miniature telegraph poles to imposing sky-scrapers. Each of the twelve steel masts supporting the long-wave antenna weighs two hundred tons and is 820 feet high. Carrying over 150 miles of overhead wires, the masts are securely stayed to porcelain insulators mounted on granite blocks. Capable of withstanding a wind velocity of 140 miles per hour, it is estimated that each mast-top has a seven-foot sway in a moderate breeze!

Electric lifts large enough to hold three people are provided on these slender masts. For Rugby's colossal signal an enormous pressure is provided on the aerials. So nobody is allowed to ascend in those lifts unless accompanied by an experienced engineer.

The Receiving Stations

Records indicate that few stations can compare favourably with Rugby in the number of short-wave experimental and commercial channels in use. This world-famous station's telegraph and telephone signals are thus very conspicuous on all waves.

In radio telephony it is a matter of great importance to prevent interaction between the outgoing and incoming speech channels. To obviate this difficulty the transmission and reception points are isolated. The short-wave receivers used in conjunction with the Rugby transmitters are concentrated at Baldock, Herts., whilst the long-wave telephony reception point is located at Cupar, Fife.

It is estimated

INSIDE AN OCEAN LINER'S RADIO CABIN

The elaborate Marconi Wireless transmitting and receiving apparatus installed on the "Empress of Britain."

that the annual electrical consumption for the valves, generators, etc., at this wonder station is five and a half million units. Calculate this at your house-lighting rates!

Wheatstone transmission at hand speeds is usual through Rugby. The actual operating is carried out from the Central Radio Office, Central Telegraph Office, London. Messages are transmitted over landlines and relayed automatically through the radio station.

Unfortunately, not all the 3,000 ships which can be reached can give direct acknowledgment. This is due to the long wavelengths used and extreme range.

To guard against the possibility of a distant operator missing a word or figure group, however, arrangements are made to permit of each message being transmitted twice.

A series of important, continuous watch, traffic-exchange services are conducted from Portishead.

With ships suitably equipped, the 36-metre transmissions have a world-wide range.

There is a 600-metre coast station point replacing Fishguard-Radio (G R L), and several channels in the 2,000-2,500-metre band are used for working the more important liners. The long-wave transmitters have an effective range of about 3,000 miles. Under call-sign G K U, they handle a large amount of commercial traffic. Perhaps the most spectacular service is that radiated on the short waves.

Ship Telegrams

Using a 36-metre night wave and a still shorter day wave, Portishead, with call-sign G K C, may be heard exchanging telegrams with shipping at surprising distances. Vessels may be contacted with equal readiness in the English Channel, or near the South Pole.

The long- and short-wave transmitters at Portishead are remotely controlled from Burnham Radio station, where ships' transmissions are intercepted.

The transmitter H.T. supply of 8,000 volts is only partially smoothed. This permits of an I.C.W. wave being radiated with excellent characteristics for short-wave long-distance work. Protective switching devices are fitted to all the apparatus enclosures. Any gear adjustment being made with open gates automatically interrupts the H.T. leads, making the equipment easy to handle. Facilities are also provided for rapid wavechange.

DIRECTIONAL AERIALS AND SUPERHETS

New Type of Set

Vertical aerials were originally employed. These consisted of copper tubes mounted on porcelain insulators attached to stayed poles. Energy was fed to the centre of the tubes by twin non-radiating feeder lines. The deflections of the aerial ammeter were read from the station windows with a telescope! Now, however, directional transmitting and receiving antennae have been erected.

For reception purposes a new type of superhet set evolved by the Post Office Research Section at Dollis Hill

FOR TELEPHONY WORKING

A Marconi wireless telephone receiver as supplied to the big liners for communication with shore stations.

laboratories has been installed. A masterpiece of modern commercial receiver design—seven feet long, seven feet high, and one foot wide!

To obtain maximum efficiency the world has been divided into several zones. At pre-arranged times each zone is explored and specially covered so as to permit of most favourable operating conditions. In this manner it is anticipated that every shipping route, even the more distant, will be traversed twice daily.

From my own observations it would appear that Portishead is the most important station of its kind in the world, messages flowing into it like water running from a tap. These telegrams are re-transmitted with the least possible delay to the Central Radio Office by means of the latest high-speed Creed teleprinters.

So much for the ocean-spanners. Now let us go back to have a final look at the coast stations.

Not the least important of the operator's duties is keeping a continuous watch on the international 600-metre band for maritime casualties. You can imagine a little of what he does on intercepting an S O S. Since distress signalling takes precedence over all traffic, he entirely suspends commercial working; if necessary taking sole charge of the situation. The second operator maintains close touch with the nearest coastguard. In general, the latter man deals with the matter on the land side, informing all parties concerned.

Medical Advice

Present-day aircraft activity tends to add considerably to the operator's responsibilities. Arrangements have recently been made whereby radiograms, routed through the appropriate station, may be delivered to passengers on board trans-continental, or local air-liners.

In addition to traffic exchange, medical advice, navigation warnings and weather reports add to the important duties of these efficient maritime policemen.

Certain stations, suitably situated, are calibrated and equipped with direction-finding gear. Reliable bearings may be given to vessels within the station's service area. This service, for which a nominal charge is made, is in increasing demand by navigators.

Operators are recruited mainly from the inland telegraph service. Their qualifications and undoubted reliability of the stations makes the British shore service the envy of other nations.

SHORT-WAVE NOTES

By W.L.S.

IN the August issue of WIRELESS I gave the circuit diagram of what I called an "advanced" two-valve receiver, and in the special Exhibition Number I promised to deal in detail with its layout, in response to several requests from readers. Unfortunately, owing to the various minor excitements connected with "Show" time, I wasn't able to do this in the last issue.

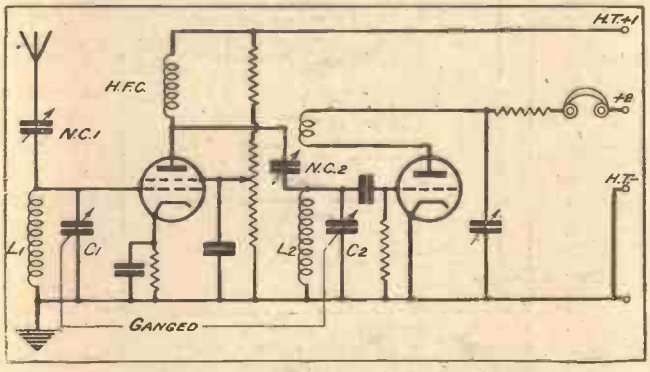
Our short-wave expert gives some valuable information on the design and layout of a set employing high-frequency amplification. He also has a few words to say about an interesting detector circuit

Using H.F. Amplification

That particular two-valve circuit is rather ancient history by now, and I don't propose to talk about the layout of that arrangement, just as it stood. It can, as a matter of fact, be readily evolved from the layout given for a simpler two-valve set in the Exhibition number.

What I want to go on with now still concerns the laying-out of a set, but I am bringing in H.F. amplification to add a little variety. After all, unless your ideas are unbelievably bad, there isn't much for you to fall over in the layout of a detector-and-L.F. job. It's when the H.F. starts getting in the way that trouble often commences.

A TWO-VALVER WITH GANGED TUNING



TOO OFTEN USED

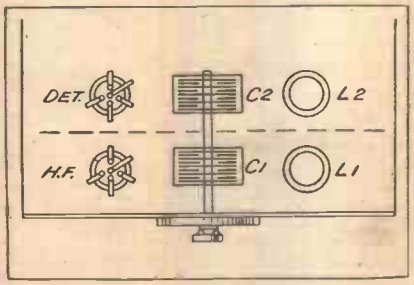


Fig. 1 (above) shows a two-valve short-wave circuit using a conventional stage of screened-grid H.F. amplification, the aerial and detector grid circuits being ganged.

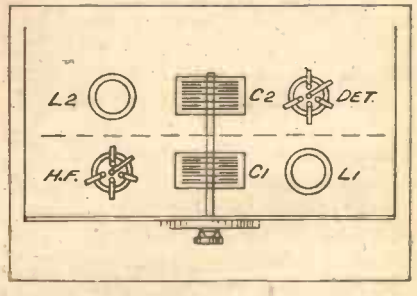
★ ★

Fig. 2 (left) illustrates a common method of arranging the valves and coils in a ganged short-waver. W.L.S. does not advise this scheme.

★ ★

On the right (Fig. 3) is an improved layout for the same circuit arrangement.

A BETTER LAYOUT



Let us look, therefore, at the Fig. 1 circuit first of all, and see what we can say about it. Here we have a perfectly conventional stage of H.F. amplification using a screened-grid valve. Its input circuit is tuned, and its anode circuit is coupled by parallel feed to the grid circuit of the detector.

The first objection that the home constructor invariably raises, when he sees this arrangement, is that he doesn't like to have two tuning controls to handle. Neither do I, and I *don't!* I just gang them—a perfectly simple procedure, quite childish in its straightforwardness.

The grid coils for the two valves will be similar in size; the external loading applied to each circuit is roughly the same, and can be adjusted, anyway, by the two neutralising condensers. Ganging is simply a joyous business.

Nor need it make the layout any more complicated. You must simply get in the habit of planting the detector and H.F. stage "behind each other," as the Irishman said, instead of in a straight line along the baseboard.

Most of the ganged short-wave condensers on the market mount straight on the panel. The old side-by-side type with a drum drive has almost disappeared, and none of us regrets its passing, for it was a cumbersome business.

The present fashion of neat little "tandem" condensers, or of separate small condensers with a flexible coupling between them, makes for a much more satisfying layout.

The Valve Positions

I find that many people are tempted to place their parts, however, as in Fig. 2, with the H.F. valve and the detector side by side, and the two coils side by side, with the condenser in between them.

I do not advise this scheme. Even in these days of small-diameter coils, I don't think it is at all nice to have two tuned circuits as close to one another as that. To get the best out of such an arrangement it would be necessary to provide a screen between the coils.

Why not save trouble by arranging them as in Fig. 3? Here we have simply crossed the coils over, so that we have the H.F. valve on the left of the condenser, the detector valve on the right, and each coil in the best possible position.

Work out the actual wiring of such an arrangement from the Fig. 1 circuit, and you will see that it is nearly ideal. It is the leads from the coils to the condensers that must be short and direct. Those to the valve holders are *relatively* unimportant. Don't let them straggle about, though, whatever you

do; I only wish to imply that you must give primary care to the others.

If you want to have a real band-spread receiver, you will probably be boggling at the idea of having to use two pairs of ganged condensers. At first sight, such an arrangement does seem necessary. In actual practice, however, you will find that the tuning of the H.F. circuit is probably flat enough to enable you to use a very small band-spread condenser on the detector circuit only.

The Aerial Coupling

This may be placed in any convenient position on the panel, although if your layout is like that of Fig. 3, it would be rather nice to have the new condenser mounted back from the panel and controlled by an extension handle, so as to bring it level with the main detector tuning condenser.

Of course, you can make the H.F. tuning as sharp or as flat as you like. If you couple your aerial to the first tuned circuit *really* tightly, you will spoil your chances of deriving any amplification from it, but will certainly have very flat tuning! If you use extremely loose aerial coupling, your tuning will be quite sharp and the H.F. stage may tend to become a little unstable.

Experience will show you the right degree of coupling to use. Similarly you must discover just how tightly your H.F. stage likes to be coupled to the detector. That second neutralising condenser is really quite an important control. Too tight a degree of coupling here will flatten out the detector tuning by introducing an unnecessarily heavy load into its grid circuit.

Some people prefer to use a six-pin coil arranged as an H.F. transformer. It certainly has its advantages, one of which is that the coupling *is* fixed for you, and you are not likely to upset all your calibrations by a hasty and unthinking movement of one control.

Try it on the Bench

There is a lot to be said for the building of a "trial" set with separate controls for the H.F. and detector, especially if you are not accustomed to handling an H.F. stage. You will, at least, be able to see whether your first-circuit tuning is sharp or flat, which, naturally, you can't determine when the two are ganged together!

I am very much in favour of rough baseboard try-outs, so long as they don't degenerate into mere untidy "lash-ups," which tell one absolutely nothing. Wire up all the parts decently, and use a good layout. The only thing you can afford *not* to bother about is the appearance of the arrangement.

By that I mean to say that you can mount your tuning condensers on little brackets instead of bothering to use a front panel; you need not plane the edges of your baseboard or pull all your leads straight!

I will make up a specimen set of the kind that I am thinking of, and have it photographed for your guidance.

When first handling a set with tuned H.F. you will probably be somewhat disappointed. It may not seem any more "peppy" than a similar

AN INTERESTING CIRCUIT FOR EXPERIMENTERS

TRY THIS ONE

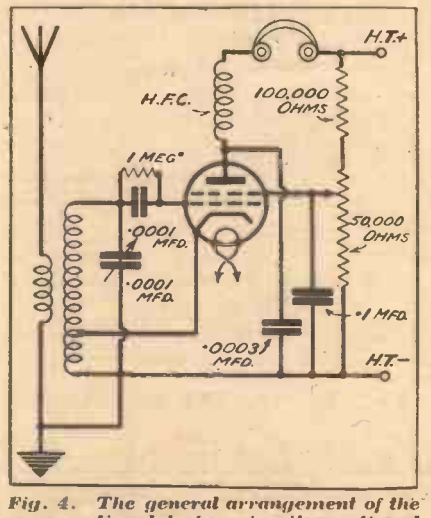


Fig. 4. The general arrangement of the regenerative detector circuit mentioned in the article. The cathode is tapped into the coil about one-third of the way up.

receiver without the H.F. stage. (Quite possibly it *isn't*—but you can soon rectify that). Get in the way of tuning in fairly *weak* signals on the detector control alone. Then rotate the H.F. tuning control until they definitely come into tune.

If they disappear, or if the detector stops oscillating as you get into tune, you can be sure that the coupling between the two valves is too tight. Remedy (obviously)—loosen it at once. If signals still seem to run about the dial when you bring the H.F. control into step, the chances are that your aerial coupling to that valve is too *loose*, and that the stage is consequently bordering on a state of instability.

Tighten the aerial coupling a little, and if the same thing still happens you can assume fairly safely that the instability is being caused by something quite different. Possibly the screen voltage is wrong; that's easily found out by shifting wander-plugs or changing resistances.

Possibly it's a matter of layout after all—you may have taken too many liberties. See that the grid circuit and the anode circuit of the first valve are not coupled back against each other in any part of the layout. A screen between the two halves of the tuning condenser (already provided in some makes) is useful. In extreme cases you may want a little screen, parallel with the panel, going right across between the two halves of the condenser and also separating the H.F. stage from the detector completely.

Should Work "First Go"

I can't possibly explain, in print, all the little dodges that you *may* have to try out if your H.F. stage doesn't come up to scratch. But there is every reason to suppose that it will be satisfactory practically at the start, and that these "wangles" will prove unnecessary. It is personal experience that counts, and any time that you spend in amassing that will not be wasted.

To change the subject a little, I should like to talk about these so-called "electron-coupled" circuits that are so much in the news lately. They use a form of screen grid reaction and are wonderfully constant and "easy" in operation. Fig. 4 shows the general arrangement.

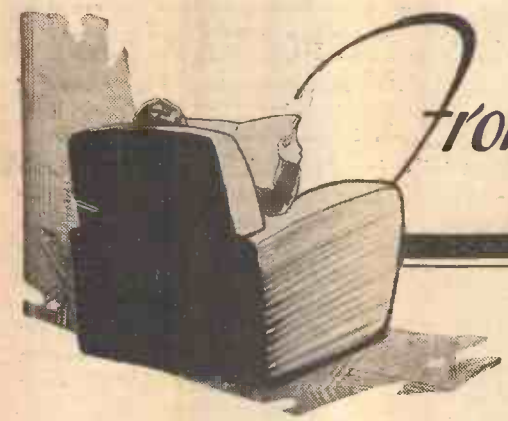
The tuning coil is tapped in the same way as the familiar Hartley circuit. The tap, however, is no longer the zero-potential part of the circuit. The grid, cathode and screen of the valve form the three electrodes for the oscillating circuit, but the screen is at zero (H.F.) potential, and the cathode is consequently "up in the air."

Battery Valve Modification

This means that if we use an ordinary battery valve, one side of the filament is connected to the coil, and the other side must have a special H.F. choke in series with it. For this reason I have shown, in Fig. 4, the simpler arrangement in which an indirectly-heated valve is used.

The tap is about one-third of the way up the coil. The output, of course, is taken from the anode circuit, whether it goes to headphones or to the coupling device to an L.F. stage.

I will have more to say about the details of this circuit later on.



From My Armchair by S.T

This month Mr. Scott-Taggart has something to say about "boom" sets—radio engineers with beards—and television.

THIS is my bad month for armchair meanderings. I have no time for an armchair, and I feel like anything but meandering. This is known as the "boom season" when I am busy on what is vulgarly termed a "boom" set. When ordinary decent citizens are abroad—not necessarily *abroad*—playing tennis, bowls, shove-ha'penny, swimming or showing other people the naked truth, I—a wage-slave—have to work to design the so-called "set of the year."

Of course, it ruins my summer. I cannot do the work in the winter as I should be unable to take advantage of any technical developments. Besides, between winter and autumn I would surely develop something new. And the S.T.700, fruit of my travail, certainly *is* new—in construction, circuit and general handling.

What *is* a boom set? Is it a set that is boomed or is it a set that starts a boom? Fortunately, for four seasons my own chief set of the year has both been boomed and has created a boom. But a set that is boosted is very often busted. There's far more in set-designing for the constructor than meets the eye.

Those Questionnaires!

There was a day when I asked readers what they thought a boom set should be—the kind of set they would feel so irresistible that they would pant for the day of publication. Since then many another designer and editor has conducted questionnaires seeking to satisfy the fickle populace by asking them what they want. But the overwhelming choice is never built. The receiver everyone wants is the set that nobody constructs. Funny, isn't it?

My own experience proves that the public expects *me* to do the thinking. It does not know what it wants. It is not an inventor, not a designer. It can only think in terms of what it has known. Whereas I regard it my job to develop something you have never seen or known.

This sounds mighty like giving you what you ought to have and making you like it! Well it is, rather. I always go to great lengths to explain novel features or features which clash with the average modern idea. It is my job to give a lead and it would ill behove me to lick the boots of constructors and whiningly wonder whether this or that will please them.

A vast amount of thought goes into one of my "boom" sets; every detail is weighed a dozen times in the balance. Work actually begins nearly a year ahead and the S.T.700 therefore represents the accumulated experience and experiment of twelve months. When therefore *der tag* arrives and the blare of trumpets announces the new set, I am quietly confident that, no matter what anyone thinks, here is the set for the forthcoming year.

And so it is with the "seven hundred," heir to whatever confidence I may enjoy in the stern bosoms of a cynical and hard-bitten congregation of radio rough-necks.

I recently declared in these columns that I knew no radio engineers with beards. I must have been dozing. As soon as I saw my remarks in print, I thought of Isaac Schonberg, extremely competent administrator, engineer, and patent expert, and a very big noise in the H.M.V.-Columbia organisation. He does not frequent the bazaars, nor have I seen him take tea and cherry cake at the Institution of Electrical Engineers. But at one time I had many dealings with him—in fact fifteen years ago I persuaded him to pay me five hundred pounds for a patent of mine.

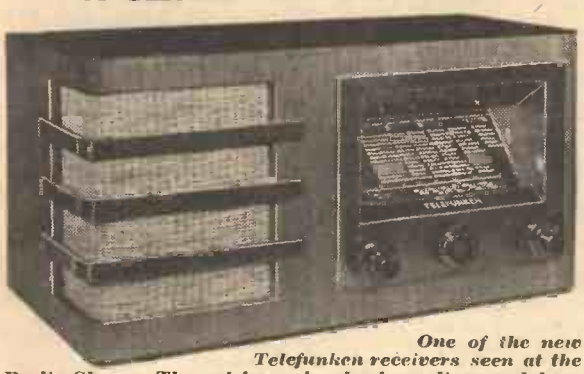
He is dark, bearded, and his penetrating eyes are magnified by lenses that give him—till he smiles—a somewhat sinister expression which has scared, no doubt, many an infringer of patents guarded by this—in private life, most genial—Cerberus.

Expert on Patents

Before the war he was chief engineer of the Russian Marconi Company, a post he later relinquished to become chief of the Patent Department of the Marconi Company in this country. I must have been crossing swords with him a good deal because in 1920 I was myself Chief of the Patent Department of the Radio Communication Company, Ltd., Marconi's greatest rivals. Nearly everyone who had any patent trouble with the Marconi concerns in any part of the world would consult with us, who were commercially dependent on either the avoidance of Marconi patents or on fighting them.

The enforcement of patents is not a popularity-producing occupation, and I myself preferred the rôle I undertook of acting for the defence. We were in goodly company, and the British Government was not averse to letting commercial concerns pull some of their chestnuts out of the fire; although, be

A GERMAN ALL-WAVE SET



One of the new Telefunken receivers seen at the Berlin Show. The set tunes to short, medium and long waves, the station names being clearly marked on the scale.

it said, they gave every assistance they could, holding our paws and so forth.

After a few years I departed the battlefield and was able to enjoy the status of an independent technical man. My erstwhile opponent subsequently left Marconi's to join Columbia and he now holds a most important executive position with the E.M.I. group and keeps his vigilant eye on research and patents. In a wider field of activity he has had the opportunity of exercising his brilliant gifts with signal success.

* * *

I spent several days at the Olympia Show. Record crowds, but the place was half empty whenever I was there. I was told that the theatre soaked up the visitors like a sponge. There was no television to see or imagine—a hush-hush policy of great wisdom and commercial expediency. Television from Alexandra Palace is six months off—later therefore than we were led to expect by the committee's sanguine report. However, it would be a mistake to rush fences before everyone is fully protected. We want the same treatment for all pioneers but no monopolies. There is fierce rivalry behind the scenes, but no bloodshed on the stage as yet. The Postmaster-General, of course, has the whip-hand.

Meanwhile, the technical people in the research departments of radio firms want some technical data to chew on; they are pathetically starved of their just diet. The P.M.G. has promised them a few bones. Meanwhile, the Exhibition-cupboard is bare, and there is nothing to put people off buying a new "sound" set.

* * *

I see G. K. Chesterton is frothing at the mouth over such words as television, which are compounded of Greek and Latin derivatives. There have, of course, been scores before him to deplore this welding of two dead languages to the service of the scientist. What does it matter anyway since the word is in any case not Greek but an invented corruption?

The usual reason for mixing Greek and Latin is that bits of each have been used in other words we well know. Take telescope and telephone—words of Greek derivation. We know "tele" suggests distance, and so we conveniently tack it on in front of vision, which just happens to be English of Latin origin. A "Televisor" is a form of television apparatus and is a mixture of Greek and Latin but if one had kept to Greek one would have had "telescope"!

How Negatron was Derived

Most of these new words were invented by inventors. Some Greek words such as kenetron or pliodynatron seem clumsy or unnecessary, while a wholesome abortion like Negatron—my own offspring, by the way—is a Latin-Greek description of a valve used in hundreds of ships. The defence is that it had to be called something and "Neg" at once suggested negative resistance (or so you think when you know the valve) and "tron" was the tail-piece of many fancy American "tube" names. Solodyne and Unidyne are two other Latin-Greek compounds, but they sound reasonably pleasant.

The fact is that English is such an illogical hotch-potch of a dozen languages that are dead but won't lie down that to object to a few harmless invented names is to strain at gnats and swallow etymological camels.

TELEVISING THE SUN

There is plenty of work for television to do when it has thoroughly proved its worth. Here is an ingenious proposition to harness the new radio science for the benefit of astronomy.

A UNIQUE attempt to place the resources of television at the service of astronomy has been made by A. M. Skellett, of the Radio Research Department of the Bell Laboratories.

A Complicated Affair

Many readers are doubtless aware that the constitution of the sun, according to recent theories, is a rather complicated affair, there being, even far beyond the central and most brightly luminous section or "Photosphere" (which corresponds to the actual solar disc), some regions of decreasing, though still considerable, luminosity, viz., the "Chromosphere," from which flame-like protuberances are seen to emanate.

Outside this region, however, there is another still fainter region, the "Corona," which it seems is made up of particles emanating from the sun, and on which both magnetic storms and disturbances in telegraphic and radio transmission on earth are thought to depend.

Now, to test this theory, which, if found true, would prove of great importance to radio research workers as well as to investigators in other fields, it would be necessary to keep a close and continuous watch on the corona by means of spectroscopic readings.

Trouble from Glare

However, it has so far been impossible to separate the image of the corona from the diffuse glare surrounding it and which, under ordinary conditions, may be up to a thousand times as bright as the corona. A skilful design of the telescope and a proper selection of the observing site, it is true, will enable the ratio of brightness to be reduced considerably (to 1:10), but a method of even greater discrimination is obviously needed if corona research is not, as heretofore, to be confined to eclipses.

The top photo (Fig. 1) shows the general appearance of the sun's corona taken during an eclipse. Fig. 2 (right) shows how the corona would look if it could be analysed by television, as described in this article, to cut out the main glare and leave just the streamers and other light "patterns" which form the true corona formation.

It has occurred to Mr. Skellett that television would afford a means of separating the corona image from that of the masking glare. If the image of the sky round the sun's disc were scanned spirally and thus converted into the electrical state, the resultant photo-electric current would be made up of several parts.

There would be a large direct current due to the glare, a smaller low-frequency component due to variations of brightness of the glare as the scanning spot moves out from the sun, and, finally, a spectrum of high-frequency components of relatively low intensity, caused by the passage of the spot over the hoods, arches and streamers of the coronal image.

ANALYSIS BY TELEVISION

Filtering the "Light"

By passing this composite current through appropriate electric filters, the high-frequency components due to the corona could be separated from the low-frequency and direct-current components due to the glare. The coronal components could then be amplified and reconverted into an optical image, thus eliminating the glare and showing the corona on a black background.

A laboratory trial of this method gave rather encouraging results. With the co-operation of Dr. Ives a test could be made, using the apparatus that had been employed in connection with the Laboratories' television work, which comprised a seventy-two hole scanning disc.

The Test

The coronal image used was a lantern slide of a coronal photograph taken at the eclipse of 1908,

(*Continued on next page.*)

RADIO VIENNA

The story of a dreary climb and a cold welcome at the end of it.

WHILE on a visit to Austria, I tried to visit Vienna's radio transmitter, the station who's words and music are heard with regularity in British homes on a wavelength of 506·8 metres. A forlorn hope, as you shall read.

The ascent to the transmitter, nine miles from the city and up the side of a steep hill, was long and arduous. A raging gale howled around us with unceasing vigour; whilst the sky was obscured by dark clouds. A cold commencement, but nothing to the frigidity of our reception at the top. The path was rough and muddy, and at intervals grim-looking notices warned us not to leave the path.

At times the path would suddenly turn, and we were rewarded with excellent views of the transmitter and aerial.

At the Top

When the path reached the top of the hill, we found ourselves on a bleak, windswept plateau, overlooking Vienna. We admired the view of this famous city, and then turned round and came face to face with the transmitter, which was not more than a hundred yards away. The two masts—the radiator to the west, and the reflector to the east—tapered majestically into the sky, like two oddly-shaped torpedoes, waiting, as if ever-ready to project themselves into the void above.

The transmitter building was of an odd shape; the part to the left was tall, with large windows, and presumably housed the dynamos and other power equipment, while the other part of the building curved round in a quarter of an ellipse. On a little platform on the roof we could see one of the lights which send out warning to passing aircraft.

On approaching nearer to the building we perceived a railed-in terrace, which ran round the taller part of the building. The figure of a man appeared round a corner, and as we drew nearer we perceived with a slight shock that he was a soldier. When we were within earshot he shouted to us, and the wind caught his words, and tossed them to the heavens.

A second time he shouted, and to our surprise we learnt that we had approached far too near the transmitter, and that we must turn back or we might get into serious trouble. Hardly a hospitable welcome!

"Nicht Erlaubt"

After retreating a few yards the author turned round and focused his camera to get a "close-up" of the transmitter, but the guard's sharp eyes had perceived this action, and he gesticulated wildly and bawled: "Nicht erlaubt!" (Not allowed).

Keeping outside the forbidden area, we made a complete détour of the transmitter.

Then, descending the other side of the hill, we found more soldiers, stationed in a little straw hut built to protect them from the cold. They, too, looked at us with suspicion. At the bottom of the hill, looking back in the dusk, we saw the red light flashing its warning. A symbol of the unapproachableness of the station?

Thus we received our last impression of our visit to Austria's chief broadcasting station, We returned, feeling satisfied with the picturesqueness of our journey, but rather disappointed at the cold reception which had awaited us. **D.C.S.**

IN FAR OFF INDIA

This photograph of a radio set and the Stentorian speaker comes from Quetta, India, where, despite the heat and sandstorms, radio reception is carried out with remarkable success. It speaks well for the robustness of the speaker that even these climatic conditions do not harm it.

TELEVISING THE SUN

—continued from previous page.

the field scanned being approximately one and a half degrees square, while the size of the scanning holes corresponded to about one minute.

The glare was obtained by directly flooding the photo-electric cell with light behind the scanning disc, so as to obtain a very large ratio of steady to intermittent photo-electric signal. The flooding light was increased until strong enough to spoil the discrimination of the coronal features.

The flooding light could be increased to about 10,000 the normal television level before discrimination was seriously impaired. The brightness of the halo surrounding the sun's image which is produced by a clean telescope objective of the simple lens type is less than a thousand times the brightness of the corona on a clear day; in fact, the method seems to provide adequate discrimination.

Difficulties Could be Met

Though some difficulties would be encountered in an actual test, these could certainly be met, the glare being reduced by optical means until its brightness was only about ten times that of the corona.

A glance at Fig. 1, which is a print from a negative obtained during the eclipse of May 28th, 1900, on the one hand, and, on the other, at Fig. 2, a drawing made from this and similar negatives taken at the same time, will show that the new method compares favourably with the only one so far available, viz., the occasional taking of photographs at times of total eclipses of the sun.

While the negatives comprise all the details of the drawing, they are far from showing the same wealth of contrast and, accordingly, fail to bring them out as strikingly as the drawing. The proposed method would mainly enhance the contrast, and it seems possible that even better images of the corona may be obtained by its means than are afforded by photography at the time of an eclipse. **A. G.**

IN LIGHTER VEIN

By VAYFARER

THE MUDBURY WALLOW JUMBLE SALE ACTS UP TO ITS NAME

"SAD though it is to have to say so," boomed Sir K. N. Pepper from the chair, "there is no question that the financial position of the Mudbury Wallow Wireless Club is none too sound. This meeting has been convened to see what can be done about it."

I carefully studied the copy of the annual balance sheet which had been placed before me. Balance sheets, I must admit, have always been something worse than Greek to me, and this one was no exception to the general rule. What has always been a puzzle to me is that they seem to show that assets are things that you haven't got, and that liabilities are things that you have.

By far the best asset appearing was unpaid subscriptions. This cheered me up immensely, for mine is about seven years overdue, and the idea of anybody calling *that* an asset seemed pretty flattering.

"Has anybody any suggestions to make?" inquired our chairman.

"Why, yes," I cried, rising to my feet. "I observe that we have a debit balance of £149 14s. 3½d. Now, that is all wrong. The first thing clearly is to get rid of this, or liquidate it, as they say in Russia."

Cries of "Hear, hear!" came from everyone except Tootle, who murmured something that sounded *rather* like "Bilge."

Harmless Toying!

I have a little trick when speech-making of toying with small objects on the table in front of me. As I continued to expound my ideas I somehow managed to lay a foot-rule across a pencil and to place an inkpot upon one end of the rule.

"And what," I asked, "do great financial concerns do if faced, when they make out what I believe are called their trial balances, with a good fat sum on the wrong side?"

A SLIGHT MISHAP

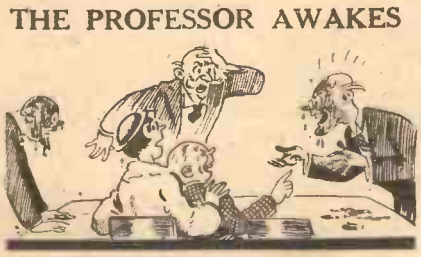
"Oh! Hello, Tootle! I'm so sorry."

Everyone looked more or less blank except Tootle, whose countenance wore a nasty sneering expression.

"Why," I roared, bringing down my fist with a thump to emphasise the point, "why they simply put in on the other side: Goodwill, so much. Oh, hello, Tootle, I'm so sorry!"

My descending fist must somehow have caught the free end of the foot-rule, for the inkpot, after describing a parabola through space, scored a bull's-eye on Tootle's proboscis. Accidents will happen to the best regulated speakers, and I don't really see why Tootle should have so forgotten his manners as to hurl another inkpot containing red ink in my direction. Seeing what was coming, I dropped beneath the table with my usual agility, and the missile smote the Professor, who was sound asleep, fairly upon his bald cranium. So remarkable is the development of bone beneath Professor Goop's forehead that I doubt whether the impact of a hard-flung inkpot weighing only a pound or two would have awakened him. What did arouse him to consciousness was the fluid trickling over his neck and ears. He dabbed with his hand, looked at the red mess on his fingers, and cried, "Bleeding to death! Help! Doesn't anyone know how to stop bleeding from a wound in the head?"

THE PROFESSOR AWAKES



"Bleeding to death! HELP!"

"Why, of course," I cried, seizing the foot-rule and flicking off Tootles' necktie. "All you have to do is to put a tourniquet tightly round the neck."

The thought of that calmed the Professor down quite a bit, and we were then able to explain what had happened. Meantime, I had borrowed all the handkerchiefs in the room by extracting them deftly from their owners' pockets, and in a few moments he was himself once more.

The meeting thought that my suggestion about goodwill would hardly meet the case; nor was it prepared to accept another about writing down capital, since there appeared to be no capital to write down.

Our Solution

All sorts of silly ideas were then mooted, none of which were in the least workable. Then the Professor had a brain-wave.

"Let's have a jumble sale," he smiled.

This proposal was accepted unanimously. Miss Worple was willing to let us have the sale in her house, with an overflow into the garden if the weather was fine. As nobody else seemed to want to, the Professor and I undertook the task of running the old-clothes stall.

Stocking an old-clothes stall for a jumble sale is really quite easy if you set about it in the right way. On several consecutive mornings, for instance, the Professor and I arranged to stroll down Mudbury Wallow's High Street, he preceding me by about 100 yards.

If he met Miss Worple or Captain Buckett, or any of the others, he would engage them in conversation. like this:

"Good-morning, Miss Worple. I know I'm absent-minded but I always recognise you by that red hat of yours. For years it's been, so to speak, a landmark in Mudbury Wallow."

(*Continued on next page.*)

THIS GANGING

An imaginary conversation between a puzzled home-constructor and his more experienced friend.

My dear chap, what's the trouble? Trouble! Why, for two solid hours I have been messing about with this beastly set—can't get any results worth speaking about.

What's up?

Well you might ask. I returned the coils to the manufacturers as I considered they were faulty, and also sent the condenser to the makers. Both components have been returned and in each case they say in their letters that they are accurately matched and up to standard. Yet when I put them in my set—well, just listen to this—three stations on the medium-wave band, that's all!

The Vital Point

Have you ganged the set up?

Why? What do you mean? The coils are supposed to be matched and the condenser is also accurate—what more does one want? If they are O.K. it is bound to work and yet I have spent hours on the beastly thing and the results are hopeless.

My dear chap, this is where I come in. Get a low-reading milliammeter, and put it in the anode circuit of the detector valve. Your coils are matched?

Yes!

Your condensers are accurate?

Yes!

Right. Now when you put them in your set they should still be O.K.?

I suppose so!

Well actually they are, but another fact has to be considered.

Ever heard of stray capacities—which are introduced by the valve, valve holder and wiring? Apparently you haven't; well, they exist and are in parallel with your tuning condenser. They are the cause of your trouble. You see those very small condensers across each section of the ganged tuning condenser?

Yes.

Additional Capacity

Well, they are trimmers and are the solution to the problem.

Oh; I thought they were only to be adjusted by the manufacturers.

Each of the trimmers represents a certain amount of additional capacity, and as they are semi-variable they are capable of adjustment. All that is necessary is to add a certain amount of capacity to our circuits, and this will enable us to equalise the stray capacities we have been talking about.

First of all tune in a station transmitting on a wavelength of about 250 metres, or less, preferably a weak one. Now adjust the trimmer in the detector circuit until you get a deflection of the meter pointer.

Watch the Meter

As you adjust your trimmer you will notice that the pointer is deflected to a certain extent, and if adjustment is continued beyond a certain point it may return to its original position.

Our aim should be to adjust the trimmer until we get the maximum deflection of the meter pointer.

Having done this now turn to the other trimmers and adjust them in the same manner, but leaving the meter in the same position in the anode circuit of the detector valve.

IN LIGHTER VEIN

(*Continued from previous page.*)

Then I'd come along after he had parted from his victim and say:

"Isn't it interesting to notice that almost every woman in Mudbury Wallow is wearing a red hat with a thingamyjig in it?" As sure as eggs are eggs that red hat would arrive by the evening post and, working on the same lines, we secured a mass of garments including most of Captain Buckett's wardrobe, Tootle's riding

COLLECTING GOODS

"I always recognise you by that red hat."

breeches, Primplesom's overcoat, and heaven knows what else besides.

The day of the jumble sale was fine, though the morning and early afternoon were distinctly cold. Mudbury Wallow came in its thousands. The *élite* were there because they considered it a duty; the rest, because they hoped to pick up wireless and other bargains. The Professor and I did a roaring trade with our old-clothes stall; so much so that by three o'clock we were almost sold out. By this time it had turned very much warmer, and the *élite* of Mudbury Wallow was rather regretting it had come in its furs and mufflers and overcoats and things. So remarkable, in fact, was the rise in temperature that the Professor removed his jacket and handed it to me. In less than fifteen seconds I had sold it to Ephraim Bugsnip for a perfectly good half-crown.

Then I had one of those inspirations that come only to great intellects. Quite close to our stall was a small room which proved to be entirely empty save for a couple of tables. It was the work of a moment to write a notice, "*CLOAK ROOM* 6d." and hang it upon the door. I was taking in the coats and cloaks and furs and things, and the sixpences, as fast as I could work for the next half-hour.

Fatigued by the superhuman efforts, I sought a little diversion by visiting the other stalls to inquire how they were getting on.

When I returned to the Professor I couldn't at first get anywhere near our stall, for not just a queue but a mob appeared to have formed in its neighbourhood. Elbowing my way through I found the Professor auctioneering almost the last of the contents of my cloak-room. On the outskirts of the crowd I had observed Lady Pepper and other bloated plutocrats waiting to retrieve their property. The situation was clearly one that called for instant action.

A SUCCESSFUL SALE

"I sold it to Ephraim Bugsnip."

"How much have you taken from the contents of that cloak-room?" I whispered to the Professor.

"I rather lost count, but it's somewhere about thirty-five pounds."

"There's an express train in ten minutes' time," I breathed, "and if we start now we can just do it."

We started. We *did* just do it.

Society News.

Professor Goop and Mr. Wireless Wayfarer are taking a prolonged holiday in Yugotoblazia. No letters will be forwarded.

Round the world of TELEVISION

A REVIEW OF DEVELOPMENTS IN THE VARIOUS COUNTRIES

By J. H. Roberts, F.Inst.P.

Long-Distance Television Transmissions

At the recent Broadcasting Exhibition held at Berlin (further details are given on another page), a number of television sets of five different makes were on view. The prices varied between about £60 and £200, the cheaper sets giving a picture of about 9 in. by 7 in.

The more expensive sets gave only a slightly larger picture, but this was much more free from distortion, especially at the edges. The difference in price was not accounted for solely by technical superiority, but also by cabinet work and other considerations.

A very curious fact was mentioned by one of the officials of the German Broadcasting Corporation, who said that, although a distance of about 30 to 35 miles would be the ordinary range of the television transmitters, they had actually found that, owing to the "skip" effect, transmissions sometimes went much greater distances than this. In one case they got a report from New York saying that a television and sound programme sent out on ultra-short waves from Brocken, in the Hartz Mountains, had been received there.

Visual Telephone

The transmissions are made by the German Post Office and operate for one and a half hours on three occasions in the week, experimental programmes being sent out at other times.

Arrangements are being made in Germany for a "visual telephone" to be tried out experimentally. This will soon be arranged for trunk calls between Berlin and Leipzig, so that a caller goes into a telephone box and not only speaks to the man at the other end, but also sees him on a small screen.

Why Alexandra Palace?

Some readers have asked me why it is necessary to have the television station so far away from Town as the Alexandra Palace. They point out that the B.B.C. studios are in the West End of London, whilst in some cases the transmitters are a good distance away.

The reason is that whilst the microphone currents can be sent a considerable distance in ordinary broadcasting, the high frequencies necessary for television cannot (at present, at any rate) be sent very far, and therefore it is essential to have the studio in fairly close proximity to the transmitter, if possible in the same building. The Alexandra Palace forms a convenient compromise; it is well placed for ultra-short wave transmissions for the London and surrounding area, and at the same time it is not very far from the West End for artists to make the journey.

SEEN IN BERLIN

The Lorenz-Von Ardenne television receiver shown at the German Radio Exhibition. The size of the picture is about 7½ ins. by 9 ins. A four-stage superhet is used for vision and a three-stage reaction receiver for sound.

As I mentioned in these notes some little time ago, however, developments are now taking place in connection with special cables which will carry the television high frequencies over relatively long distances. When such cables are available it will not be necessary to have the studio cheek-by-jowl with the transmitter.

A New C.R. Screen

In making the fluorescent screen for cathode-ray tubes, one of the practical difficulties has always been to find some suitable "cement" to secure the grains of the material against the glass. When I was in Cambridge we used to make the screens by grinding up the fluorescent material into an extremely fine powder and then "floating" this, as it were, over the glass surface in pure alcohol. When the alcohol had evaporated there was just sufficient adhesiveness left, possibly due to some impurity in the "pure" alcohol, to make the grains stick in position.

You will see that it is undesirable to have any appreciable amount of cementing material, because this is liable to cover the grains over completely and so protect them from the impact of the cathode stream. Furthermore, the cathode bombardment is liable to drive out gas or vapour from such adhesive substances or cements and give all sorts of trouble.

Locking the Grains

Fluorescent screens have been greatly improved of late, but I see that rather a new departure is proposed by the Marconi Company, in a new patent, in which they actually sink the grains of fluorescent material into the surface of a sheet of glass without any other binding material whatever.

A piece of beryllium glass, having a melting point of about 900° centigrade, is used, and the powdered zinc sulphide is sifted over the surface of the glass when the latter is in a semi-molten condition. The grains of powder sink into the glass surface, like stones into a macadam road, and when the glass cools they are locked firmly in position.

ITALY FORGES AHEAD

Scanning Discs

Another very interesting development is due to Captain West, of the Baird Company, who has invented a convenient method of duplicating scanning discs. These in the ordinary way are made from light-gauge metal sheet from which holes are punched; as this presents certain difficulties, sometimes a disc is made of thicker, more suitable sheet and small discs of a finer material, with the holes punched through, are secured to the disc, the small holes "registering" so to speak, with the larger holes in the thick disc.

The new method, however, gets away from all these mechanical operations and uses a photographic process. The scanning disc is in effect a large photographic plate on which is an image of the series of spirally arranged holes. This can be done either by exposing the sensitised disc to one hole at the time or by making a "master" plate and forming copies of it, just as in ordinary photographic reproduction.

Electrical or Mechanical

I daresay many of you have noticed, in references to the Television Advisory Committee, that the Committee seems to favour the cathode-ray system of reception, and some people have complained that this is almost to the exclusion of mechanical systems. After all, it is not safe to assume that the cathode-ray system will have it all its own way, because there are many people who still pin their faith to the scanning-disc or other mechanical arrangement and, in fact, some of the leading German experts seem to believe that in the long run mechanical methods will prevail over purely electrical ones.

The Committee's Object

The point really at issue is whether the transmissions from the B.B.C. will be capable of being received on the one set, without it being unduly complicated or expensive in adjustment. As you know, it is the intention of the Committee, which they have expressed quite definitely, that the different types of transmissions shall be such as to be capable of being received on one-and-the-same home television receiver.

Many people in the trade are a bit worried as to how this is all going to work out in actual practice. It is stated that two different scanning systems will be used, one employing 240-line and the other 405-line, in the latter case interlaced, giving 50 pictures per second of 202½ lines.

Importance of Simplicity

It would seem to be very important indeed to make sure at the outset that no complications shall arise when the system gets going and large numbers of the public have provided themselves with television receivers. It will be very bad for all concerned, and especially for the owners of such television receiving sets, if it should be found at a later stage that the sets were not capable of receiving one or other of the types of transmission sent out from the B.B.C. station. Personally, I think you will find that the above-mentioned proposed types of scanning will be revised before the B.B.C. gets down to brass tacks, as the Advisory Committee must be fully alive to the need for keeping everything as simple as possible for the home user.

Amateur Enthusiasm in Italy

Italy seems to be going strongly ahead in the matter of television, and I hear that the International Institute for Educational Cinematography, which has its head offices in Rome, has formed a special committee to deal with television matters. This is following a meeting which was held in April, in Nice, when it was decided to form such a committee.

It is interesting to note that one of our fellow-countrymen, Mr. J. L. Baird, the well-known television pioneer, has been asked to act as an expert consultant to the committee. The object of the committee, I understand, is to collect together all sorts of technical data relating to television progress in different parts of the world, with a view to economising time and effort in television research. They are also going to have a special laboratory in Rome and propose to establish co-operative experimental arrangements with similar groups of enthusiasts in different parts of the world.

Italian High-Definition Service

Another bit of news which I have just received from Italy is a reference to the Italian S.A.F.A.R., which is going to start regular high-definition television services very soon, within a month or two. I understand that they have already made a number of trials, with very satisfactory results.

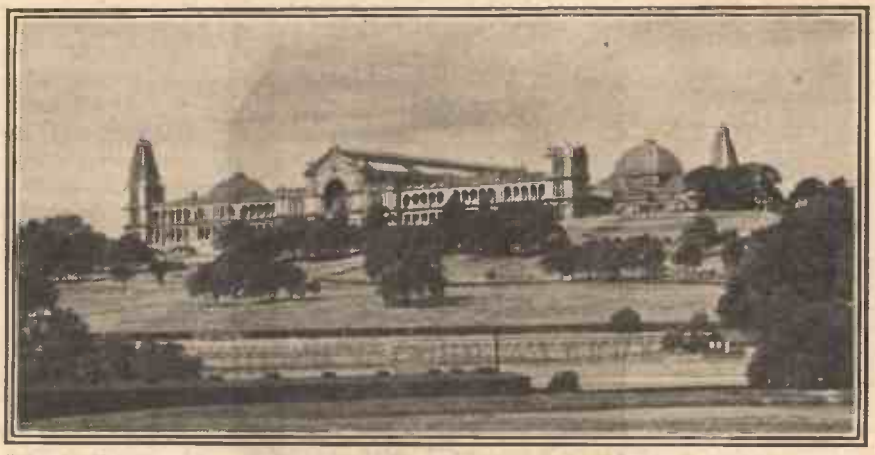
You will recollect that, as I mentioned in these notes a little time back, the German Fernseh A.G. of Germany has been supplying television apparatus to Italy for some time past. Some people say that Italy is making a bid to lead the world in television developments. Whether this be so or not, she evidently does not mean to be left far behind.

The Persistence Effect

Most people know that with television, just as in cinematograph pictures, we rely on the effect known as "persistence of vision" in the eye to get over the flicker effect. If the successive pictures in cinematography or the successive scanning lines or pictures in television, follow one another with sufficient rapidity, the

(*Please turn to page* 219.)

GETTING READY FOR TELEVISION



This is the Alexandra Palace whence the B.B.C.'s high-definition television broadcasts will be transmitted. At the time the photograph was taken the top of one of the towers had been removed in preparation for the erection of the aerial system.

WATCHING OSCILLATIONS

The cathode-ray tube is not merely a device for television reception. It is of the utmost value to the research worker and plays a very important part in the laboratories of all first-class radio manufacturers, as well as in the test departments of many branches of industry. How this modern wonder is used for the visualization of otherwise invisible happenings is explained in a special article, of which the first part appears this month.

By ARTHUR TOWNSEND

THE applications of the cathode-ray oscillograph are numerous to an almost unbelievable extent, but whether used for television, photographing of atmospherics, studying the make and break of a motor car magneto or diagnosing some disease of the heart, it requires a time base, in addition to any other incidental equipment that may be necessary.

Time bases may be divided into two groups, independent time base and specialised forms of time base which

NO "TIME"

Fig. 1. An oscillogram of a 50-cycle A.C. potential applied to one pair of plates, with no time base connected.

are part and parcel of the phenomena to be studied. The latter group is obviously too wide for consideration here, as it is necessarily inseparable from sciences having little or no connection with the aims of this journal. The independent time base has the advantages of having a more or less self-contained entity, and is described in detail below.

The Principles

Quite apart from those interested in using or constructing it, a knowledge of its principles and method of functioning is necessary to those who desire to take even the most passing interest in the cathode-ray oscillograph and its applications. Fig. 1 and Fig. 2 give an excellent idea of the use of the *time* base. Both are actual photographs and both are taken with the same apparatus, set up in the same manner and recording an ordinary A.C. 50-cycle supply. The only difference in the two photographs is that in the case of Fig. 1 no *time* base is applied, whereas in Fig. 2 time is represented.

In Fig. 1 the 50-cycle supply is expressed as amplitude only, and consequently while the voltage can be measured, no clue is given regarding the shape of the wave form under observation.

A little reflection will show that the shape of a wave is necessarily a comparison between voltage and time.

Fig. 2 is a photograph of approximately 2 cycles on a 50-cycle supply; it, therefore, represents from one end to the other $\frac{1}{25}$th second and shows by its vertical rise and fall the way in which the voltage varies with the progress of time in the horizontal direction.

For example, if from details of the time base we know that the picture represents $\frac{1}{25}$th second, it would show at once that it was a 50-cycle supply.

Linearity Necessary

Quite apart from its use to demonstrate what a time base does, Fig. 2 serves very well to show that it must be sensibly linear—that is to say, the cathode-ray beam must travel at a uniform speed across the screen of the tube. If the time base used to show the wave form, Fig. 2, were not

WITH THE "BASE"

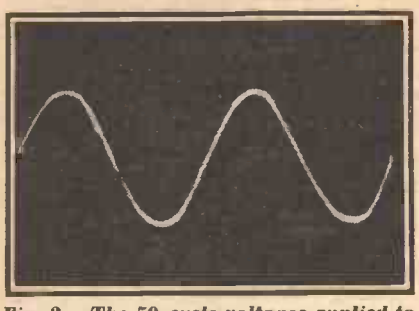


Fig. 2. The 50-cycle voltages applied to one pair of plates as in Fig. 1, but with time base connected.

linear, the two complete cycles shown would not appear identical.

The very simplest form of time base is shown at Fig. 3, where an ordinary neon tube is used as the trigger element. Readers will be aware that a neon tube has the characteristic of ceasing discharge at a lower voltage than that required to start the discharge, these two voltages are known as the breaking voltage and striking voltage respectively. The time base Fig. 3 relies on this phenomenon for its action which is as follows.

The condenser C is charged through the resistance R by means of the H.T. supply; the time taken for the condenser to charge up is obviously dependent on the values of R and C and the applied H.T. voltage; it is usual to control the frequency of the

A SIMPLE METHOD

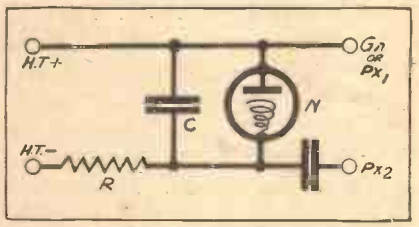


Fig. 3. A very simple form of time base using a neon tube as the trigger element.

time base by making R variable, and if necessary, providing a series of different values for C.

When the voltage across C reaches the striking voltage of the neon lamp a discharge occurs and the voltage across C falls until the breaking voltage of the tube is reached, when the discharge ceases; the voltage across C again commences to build up and the whole sequence is continually repeated until it is stopped by switching off the H.T. supply. This sequence of events can only take place when the value of R is high enough to provide a reasonable time to elapse during the process of charging the condenser.

Usual Voltages

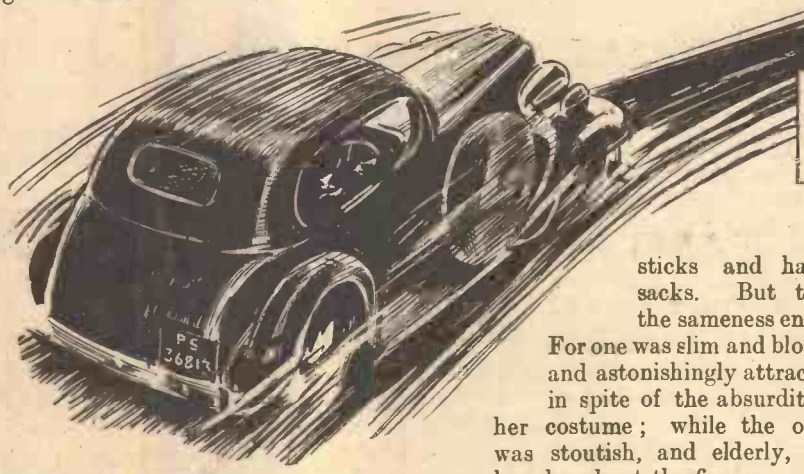
The striking and breaking voltages of a neon tube are usually somewhere in the region of 200 volts, while the difference is usually between 30 and 40 volts. Since this is a convenient time base amplitude when very high H.T. voltage is not desired on the cathode-ray tube "gun," it may be applied direct to the deflectors of the tube.

(*Please turn to page* 218.)

SHOT in the DARK

A Thrilling Murder Story

By Val Gielgud



"THAT," said Miss Harriet Pendyce, "was a shot!"

"That," retorted her niece Angela, with more point than politeness, "was nothing of the kind. It was a tyre bursting."

Miss Pendyce thrust out her determined jaw. It was a habit of hers in the face of contradiction or correction. An argument of the more disagreeable type so common in the case of blood relations would certainly have ensued, had she not recognised the essential justice of Angela's next remark. For Miss Pendyce, in spite of her rather bull-dog face, her greying hair, and an inelegant figure, had a breadth of view-point infrequent among middle-aged women.

"We must get on," said Angela, more irritably than became an exceptionally pretty girl. "We're miles from anywhere, and I believe we've taken the wrong road."

"Our old friend the wrong turning?" said Miss Pendyce grimly. "You may be right. But I still think it was a shot."

She got off the stile on which she had been sitting, and looked at the watch on her wrist.

"Nine-thirty-five p.m. exactly," she pronounced.

"Why not write it down?" queried Angela sarcastically, jumping down in her turn.

"I think," said Miss Pendyce, "that I will."

She proceeded to do so, and her niece proceeded, with a deliberation which she hoped was sufficiently exasperating, to light a cigarette under her aunt's disapprovingly tilted nose.

While they stood there beside the stile, a motor purred softly along the lane. Its driver saw illumined in the glare of his headlights a couple, queer and incongruous: both wore shorts, stockings, brogue shoes, and shirts open at the neck; both carried stout sticks and haversacks. But there the sameness ended. For one was slim and blonde, and astonishingly attractive in spite of the absurdity of her costume; while the other was stoutish, and elderly, and bunchy about the figure.

And while the sight of the girl in her shorts only made the driver of the car wish to see her in less ridiculous garments, the older woman inspired him with that general dislike of the sex which "hiking" has done so much to inculcate in persons so old-fashioned as to believe that the principal functions of women can be summed up in the words "beauty" and "charm."

The car passed by. Miss Pendyce had a glimpse of a small black moustache, queer square-rimmed horn glasses, and a russet golf jacket with its collar turned up. And under "nine-thirty-five p.m." she scribbled almost unconsciously "P S 36813" and added "Buick sedan, 1932 model." Miss Pendyce was observant, and a passionately keen motorist. She owned a second-hand baby Austin, and never failed to inquire the prices of the latest Rolls-Royce model at the Motor Show.

"Hiking," observed Angela viciously, after about half-an-hour's steady plodding, "is a grotesque occupation."

"It benefits the figure," replied her aunt, "whatever it may do to your temper. Besides, we're lucky. There mightn't have been a moon."

Angela grunted, and swung onwards. With a little sigh Miss Pendyce followed. She would have liked to have stopped again; to have leaned against that convenient gate, and watched the moon sailing, like some bulbous Chinese lantern at a garden-party, across the sapphirine sky; to have listened quietly for a few minutes to all the tiny disembodied sounds of hedge and field and ditch; to have drunk in, with a certain intoxication, all the limitless beauty of the English countryside during a summer night. But she was fond of Angela, and Angela wanted to get home. She hated elderly women who exploited the good nature of their younger relatives.

Suddenly Angela stopped.

"I say," she said, "can you hear that? It must be a road-house past the bend. 'You're the Top,' no less. I thought I'd never hear a dance band again."

Again Miss Pendyce sighed quietly to herself. She did not like dance bands. She remembered the days when dancing meant bands with lots of violins, and gentlemen wearing white gloves, and chaperones, and the waltzes of Lanner and Leo Fall. But she stopped half a pace behind Angela and listened. The music was unmistakable, bursting through the silence of the silvered dark, like a splash of whitewash across a window.

"Come on," said Angela impatiently. "We'll get some supper—if they don't jib at our legs!"

" Well," said Miss Pendyce curtly, " your legs are lovely, and mine are hideous. Yours will help, and mine can't excite, so we should be safe, unless all the bench of bishops is in residence." And they walked on.

But to their considerable surprise, when they rounded the bend, no road-house was visible. Yet the dance music continued, raucous and incongruous between the bare road and the moonlit sky.

Then Angela pointed, and Miss Pendyce saw a large saloon car, standing rather askew on the grass border running between road and hedge.

" Is that how you make love nowadays ?" enquired Miss Pendyce grimly. " We preferred silence as well as privacy."

" I know," said her niece. " You also preferred long skirts for tennis, and lots of other queer things. Damn ! I wanted a drink ! Let's get on ! No, by George, if they're not necking up to the hilt I'll make 'em give us a lift ! " And she had run forward before Miss Pendyce could protest against either suggestion or language.

Her shoes crunched on the road surface. Followed a little silence as she crossed on to the grass border, and approached the car. Then she screamed and Miss Pendyce nearly jumped out of her skin. She would as soon have expected a pig to fly as her niece Angela to scream—to scream and run, and clutch at her aunt as if she were about to have an old-fashioned attack of hysterics.

" A man ! " gasped Angela, making futile, helpless little movements with her hands. " He's—he's dead ! "

" Nonsense, child ! "

" It's true, auntie ! " Angela had reverted for the moment to the schoolgirl who had been Harriet Pendyce's favourite niece. " I think he's been shot."

" Shot—rubbish ! "

And Miss Pendyce made Angela sit down and light a cigarette, before she herself went slowly up to the car.

One steady look told her all that was necessary. The man sat in the driver's seat, shot through the head. Miss Pendyce was surprised that there was so little blood ; that the body lay so naturally, the head tilted backwards, one hand still on the wheel. And from the radio in the car dance music continued ironically and nerve-raspingly to blare.

Miss Pendyce leaned through the window, turned off the wireless, returned to where Angela was sitting, sat down beside her, and felt exceedingly sick. There was clearly nothing

THE DREADED INTERVIEW

to be done. Yet her tidy mind and civic conscience revolted at the thought of leaving a corpse on the King's highway in such circumstances, while a natural shrinking from publicity made hideous what she foresaw as the inevitable result of the interview she would be bound to have with the police ; headlines, reporters, pictures of Angela in the illustrateds—they would jump at getting her in her shorts !

She felt her niece's hand on her arm.

" Sorry I made a fool of myself, auntie. It was a bit sudden, you see."

Miss Pendyce kissed her abruptly.

" That's all right," she said, and stood up. " Now for the police——"

But the dreaded interview with the local police proved the best part of twelve hours away, and when it came proved to be largely a matter of answering a number of routine questions. The detective in charge, looking far more like a successful butcher than a hunter of men, sat behind a large and shabby desk, taking notes. On the other side of the room sat Miss Pendyce, Angela, white about the face with dark shadows under her eyes, and a man in a leather motoring coat and square, horn-rimmed spectacles. And it was Angela, of the two " hikers," who did most of the talking—rather too much, it seemed, to please the detective.

" Of course, miss," he said firmly, after a little, " we're most grateful "—and he coughed—" for your offering to make a statement, but this is just a routine matter, if you follow me. A clear case of suicide, tragic, of course, but satisfactorily clear. Victim's finger-prints on the revolver. Weapon found on floor of vehicle. Financial worry and domestic unhappiness to supply motive. Clear as crystal, if you follow me ? "

" Good ! " said Miss Pendyce curtly. " Then we'll be getting along."

The police-officer coughed again.

" Just a moment," he said, lifting a large hand like a slab of bacon ; " just a moment, if you please. The young lady said something about fixing the exact time of the—er, unfortunate occurrence."

" Yes," said Angela breathlessly. " Exactly nine-thirty-five——"

" At that moment," said Miss Pendyce, " we heard a shot."

" Your watch trustworthy, madam?"

" Yes—and set by wireless in the morning ! " snapped Harriet Pendyce.

The detective caressed his massive jaw, and looked at the gentleman in horn-rimmed glasses.

" Confirms you in every particular, Mr. Bassett," he said.

Mr. Bassett nodded.

" I wasn't aware," he said stiffly, " that you disbelieved my statement. But it does. I left Carey about nine-twenty-five, after our talk. We had driven out separately, because, as I admit, we've been on bad terms and weren't exactly hankering for each other's company. I believe I passed these ladies about nine-thirty-seven or so. I remember seeing them just after I'd heard what I thought was a shot. I wondered who was assing about with a gun at that time of night."

" The man sat in the driver's seat shot through the head . . . . and from the radio in the car dance music continued ironically and nerve-raspingly to blare."

He adjusted his glasses with a gloved hand, and grinned.

" And that lets me out, if you're thinking of pinning murder on to me, my good policeman. I couldn't have got from where the car was found to where I passed those ladies if I'd been Malcolm and Segrave rolled into one, and you know it ! "

He stood up.

(*Please turn to page* 217.)

Remove That INTERFERENCE!

ONE of the biggest drawbacks to broadcasting reception to-day is the existence of interference caused by electrical plant in general, and the purpose of this article is to correct some popular fallacies regarding this bugbear, and to point out how much of the trouble it causes can be eliminated.

Price of Sensitivity

The problem has received increasing attention during the past two years, due, probably, to the vast strides that have been made towards reception free from other troubles, and due, certainly, to the advent of the many systems of automatic volume control, as a result of which there are periods during which the high frequency side of the receiver is amplifying, for subsequent issue from the loudspeaker at considerable volume, nothing but harsh noises and whines attributable to electro-medical apparatus, small electric motors, neon signs, and a host of other everyday electrical apparatus.

Many cases have come to light where the replacement of an old insensitive receiver—used only to receive a strong local signal, and unable to receive distant stations, due to its lack of selectivity—by a modern set, has disclosed acute electrical interference which before was inaudible. "Why," asks the listener, "can I not hear a programme from Vienna as clearly as I used to hear my local station? It is as loud, but by no means as pleasant."

The reason is that his new receiver, sensitive enough to respond to the very few microvolts the aerial picks up of the Vienna programme, also responds to any irregular radio signal, created somewhere in the neighbourhood by electrical plant, and transmitted to the grid of his first valve either via his aerial and down lead, via his earth lead, or more probably by his mains lead. Moreover, the most annoying part of such signal consists of the higher of the audio frequencies in the noise it causes in his loudspeaker. Consequently, the programme from Vienna on his modern high-quality loudspeaker is spoiled more than it would be on his older low-pitched speaker.

One of the biggest bugbears to the user of a modern sensitive receiver is interference. Not necessarily the whistle caused by a jamming station, but the miscellaneous collection of crackles, hums, and background noises that betoken external "man made" static. In this article by a leading radio service engineer the problem of interference and the means of curing the trouble are fully discussed.

As a result, we find many receivers set with the tone control turned right back, making reproduction as low pitched as possible, in an attempt to overcome trouble which should never exist.

Efficient Aerial Essential

It cannot be emphasised too strongly that an efficient aerial and earth system are essential if maximum freedom from interference is to be ensured. Obviously it is necessary to have as high a ratio as possible between the signal voltage and noise voltage at the input to the receiver, and this is best obtained by a good outdoor aerial, of which the horizontal portion is as high as possible, well away from power lines and any other source of radio interference. As regards the vertical down lead on the aerial, it is obvious that if this passes through the field of influence of interfering plant, the voltage induced in it will adversely affect reception.

Screening the Down Lead

It is seldom that a long down lead of itself adds to the signal voltage picked up. It often, however, picks up appreciable radiated noise voltages which do not reach the horizontal portion. How, then, may we prevent this? Screening the down lead by simply running it in an earthed metallic tube is, of course, effective, but if the length of wire run in this way exceeds a few feet, a high shunt capacity to earth is built up which causes a serious loss in the signal voltage delivered to the receiver.

This objection can be overcome by running the shielded line at considerably lower impedance than that of the aerial-grid circuit. This is achieved by installing a high frequency transformer at the lead-in end of the horizontal aerial wire, consisting of a few turns of, say, 24-gauge D.S.C. wire wound on top of a normal tuning coil. The lead-in is then a twin lead connecting this low impedance secondary coil to another similar coil on a similar transformer at the receiver.

A VERY SUCCESSFUL SYSTEM

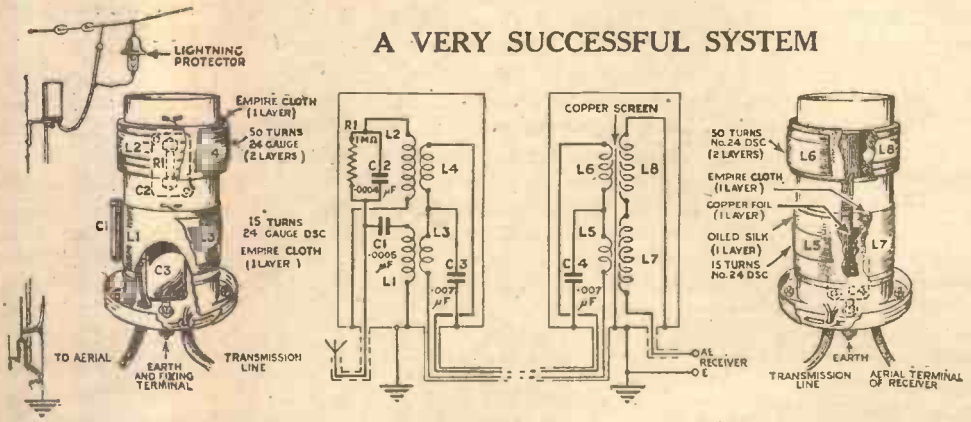


Fig. 1. How aerial transformers are used to provide a low impedance down lead to the set. Such a down lead can be well screened without noticeable signal loss and thus obviate interference pick up by that portion of the aerial system.

This lead is, of course, shielded to eliminate interfering voltages, and the effect of the shunt capacity due to the shielding is practically nil. Up to 500 feet of lead can be employed with such a system, so that where space allows, it is advisable to erect the high horizontal aerial well away from any possible source of interference, and introduce the signal it picks up via a long, low impedance line. A typical arrangement is shown in Fig. 1.

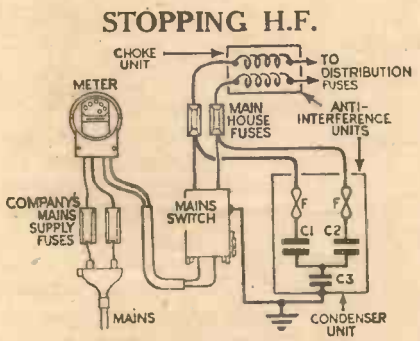


Fig. 2. How house mains H.F. interference-stopping filters can be fitted.

The Earth Lead

Now for the earth system. Quite 30 per cent of the trouble due to interference may be traced to pick-up on the earth lead. It is still common practice to use a water-pipe for the earth connection of a receiver. Unless such a connection is made to a rising main pipe which runs immediately back to earth, it is liable to cause trouble. A long earth wire leading to a fairly high impedance earth system will pick up interference even more readily than a down lead, especially in a building where the water supply pipe runs for some distance parallel to the house lighting and power circuits, along which a great deal of the interfering H.F. energy is probably being transmitted.

Wherever possible, an earth tube or plate should be buried near to the receiver, and a short low-resistance earth wire run to it. The connection of this wire is a point at which trouble often arises, due to corrosion or looseness, and it should, therefore, be given frequent inspection. Connection should never be made to what is termed the "earth side" of the mains supply. Although this line may be earthed at the power station it is usually some volts above true earth at any outlet socket on a consumer's premises, reaching earth only via a relatively high impedance.

Moreover, the practice is definitely dangerous in the event of breakdown, and lastly, it is a serious contravention of the Board of Trade regulations.

The other channel through which interference may reach the receiver is via the mains lead, and this accounts for perhaps over fifty per cent of the trouble present to-day. Let us take the case of a small fractional horse-power electric motor such as might be used to drive a refrigerator, sewing machine, hair dryer or any of the hundreds of other domestic electrical appliances widely used to-day. As the segments of its commutator successively run past the carbon brushes, a series of sudden changes takes place in the potential of the various sections of wire in the windings, and the high-frequency components of these changes are immediately radiated in the same manner as is an ordinary wireless wave. They have very similar main characteristics, but in general they do not go very far—as pure radiation.

What does happen, however, is that the wiring connected to the motor provides a very easy path for the propagation of these waves, and that wiring is the main supply wiring from which all other people on that section of the mains are drawing their power for cooking, lighting and running the radio receiver. At any one plug point on the main supply system, therefore, there will be the normal voltage of the supply, e.g. 230 volts 50 cycles A.C., but on top of this will be a whole series of smaller H.F. voltages due to the various apparatus working on the system.

As soon as a wireless receiver is connected, these H.F. voltages are fed into its mains transformer, and readily reach the grid of the H.F. amplifying valves.

From that point they are treated just as ordinary radio signals, and issue from the loudspeaker as noise. Our problem is to eliminate them as far as possible, so far, at any rate, that the amount of noise present is at least 30 dB below the level of the music signal being received.

Inserting Special Chokes

The most usual method, of course, is to provide a low-impedance path to earth for these high-frequency currents and to insert some high impedance in the mains supply lead so that their entry into the receiver is hindered. A useful filter consists of two 2-mfd. condensers in series across the mains with the centre point taken to true earth via another condenser, and two chokes, one in each mains lead. The value of these chokes should be between 0·2 and 1 millihenry depending on the severity of the trouble. Fig. 2 illustrates such an installation. The wire of which the chokes are wound should be sufficiently large in diameter to carry without distress the current necessary.

Moreover, the resistance of these chokes may result in the volts actually applied to the mains transformer being low. This should be checked, therefore, and the necessary tapping adjustment made.

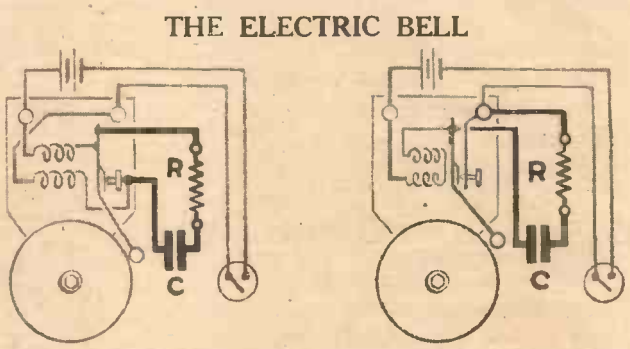


Fig. 4. Electric bells need treatment of this style if their ringing causes radio interference.

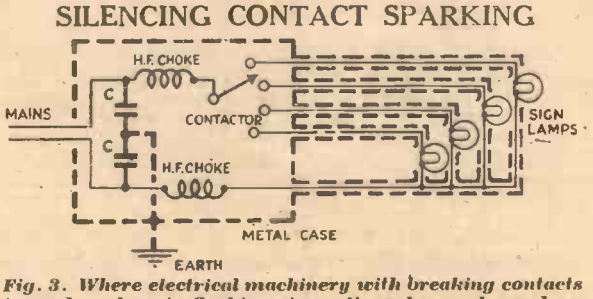


Fig. 3. Where electrical machinery with breaking contacts is used, such as in flashing signs, the scheme shown here is effective.

A Point to Remember

It must also be remembered that the condensers across the mains will be taking a certain current if on A.C. supply. They should, therefore, be kept as small as possible consistent with providing a good by-pass. On a 240-volt 50 cycle main, two 2-mfd. condensers will absorb about 40 watts.

The only really sound method of curing interference is, of course, to prevent the offending machinery from transmitting these H.F. wave trains. In the case of small domestic motors,

it is often sufficient to connect a 2-mfd. condenser across the mains supply at the brushes, or alternatively, to connect at this point two 2-mfd. condensers with the centre point earthed.

Condensers should, naturally, be of sufficiently high rating to withstand the working voltage of the machine.

USING EARTHED FOIL

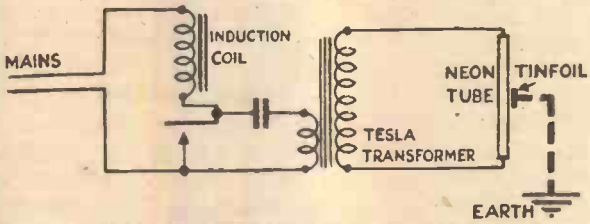


Fig. 8. Balancing out interference from a neon tube by means of earthed tin-foil which is moved along until a position giving silence is obtained.

Such a cure applies equally to any small machinery in which a contact is being made or broken between rotating or sliding and rolling contacts; as in flashing signs, etc., see Fig. 3.

Where a contact is being made and broken by a spring action, as in the case of bells or vibratory rectifiers, it is often sufficient to connect a 2-mfd. condenser in series with a 50-ohm damping resistance across the offending gap. Either of the arrangements shown in Fig. 4 may be used.

Medical Apparatus

High-frequency medical apparatus acts very like a transmitter and gives rise to perhaps the most difficult type of interference. High-frequency voltages at about 100 kcs/sec are in use, and the apparatus is connected between the supply mains and earth via the patient. The only effective method, therefore, is to re-design the high-voltage circuit to be used, eliminating earth H.F. currents as far as possible.

The apparatus should be operated only in a totally screened room, and a filter unit consisting of two 2-mfd. condensers should be connected across the mains at the point where they enter the room, see Fig. 5.

Tramways and trolley 'bus systems are well-known sources of serious interference trouble, and the problem is

THE NEON TUBE

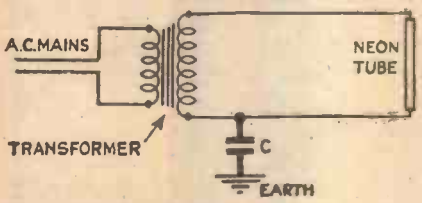


Fig. 7. One method of reducing "static" created by a neon tube.

INTERFERENCE CAN BE STOPPED

somewhat different, as the distribution wires feeding the vehicles act as very efficient aerials for broadcasting the high-frequency energy sent out from mechanism.

Mile Away

Cases have been known where a tramway feeder has induced trouble into a receiver over a mile from the traction motors and controller position of the car causing the trouble.

With trolley 'buses —in which two feeder wires are used—the extent of the trouble is much greater.

Where possible, an improvement may result from connecting the motor field coil in the feeder side of the motor, thus imposing a high H.F. impedance

DOCTORS, PLEASE NOTE

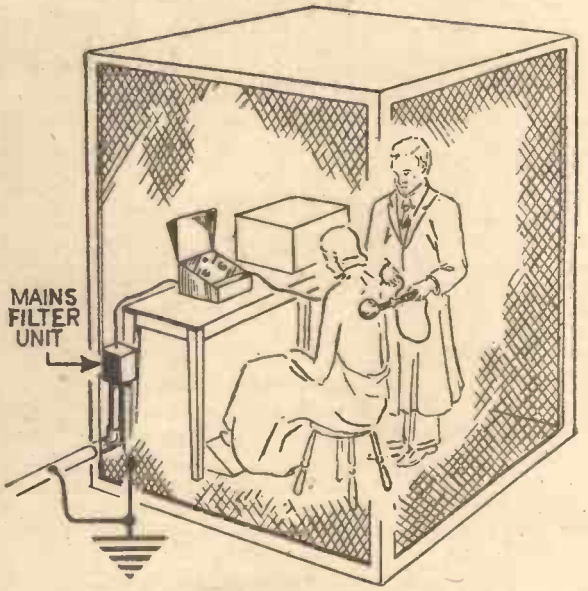


Fig. 5. Where high-frequency medical apparatus is used it should be operated in a screened "cage" with mains filters as shown, if interference with neighbouring radio sets is to be avoided.

between the source of interference and the feeder wire. Much research has been done in Germany on this particular type of interference, and in a paper published at the beginning of last year it was claimed that it was possible to render tramway tracks absolutely non-interfering.

No Legislation

This has been done largely by inserting in the down lead from the feeder a coil and condenser circuit having a high impedance around the frequency of the important broadcast station.

In this work many interesting facts have come to light, it being found, for example, that very little of the trouble is due to the collector system.

A CHOKE SUPPRESSOR

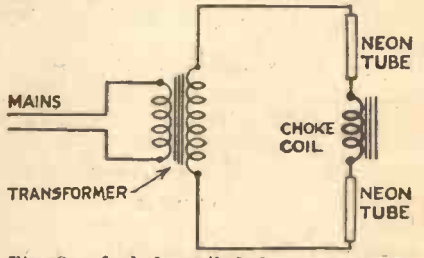


Fig. 6. A choke coil between two neon tubes will often help to stop radiated interference.

There is, unfortunately, no legislation in Britain enforcing the fitting of suppressor devices on interfering plant, so that the elimination of trouble from such sources as trains and buses becomes a matter for agitation by groups of listeners and amicable settlement with the authorities concerned.

Arc Rectifiers

On D.C. mains another prominent cause of trouble is the converter machinery at the sub-station, especially if the rectification is by mercury arc tubes. This feeds on to the mains a high-frequency component bearing a persistent L.F. component of frequency equal to the product of the frequency of the supply and the number of poles in the rectifier. This results in a hum in the loudspeaker, which can sometimes be cut down by the installation of the filter shown in Fig. 2, in the mains supply lead.

Neon signs are yet another prevalent source of interference which is intensified if the sign be operating from converter plant. In such cases, the interference from the sign may be suppressed by connecting a choke coil capable of carrying 100 m.a.'s in series with two equal sections of the tube, see Fig. 6. Further relief may result from earthing one side of the high-tension wiring via a condenser capable of withstanding up to 7,000 volts. The dielectric

(*Please turn to page* 215.)

TELEVISION AT THE BERLIN SHOW

Our Special Correspondent gives details of the latest developments in Germany.

THE fire which broke out at the Berlin Radio Exhibition on Monday, August 19th, luckily destroyed only one of the eight Exhibition halls, but, unfortunately, this hall contained as a permanent fixture the two 16 k.w. ultra-short-wave transmitters supplying Berlin with a high-definition television programme. These were completely destroyed together with the 1·5 kw. old Witzleben broadcasting station which still was used occasionally as a stand-by in cases where a breakdown occurred at the 100 kw. Tegel station.

New Transmitters

Within 24 hours of the fire the German Post Office had provided a 20 watt auxiliary transmitter so that television demonstrations at the Exhibition could continue. But the public televiewing rooms in Berlin had to be closed.

Two days after the fire it was announced that the German Post Office had placed orders with the Telefunken Company for the supply of new high-power ultra-short-wave transmitters for Berlin to take the place of those which had been destroyed. At the time of writing it is still uncertain what definition these will employ, but it can be taken for granted that at least 300 lines will be aimed at so that this certainly proves the proverb that: "It is an ill wind . . ."

Variety of Receivers

The main television exhibit at the Show consisted of "Television Street" the centre gangway of Hall III, which had been plunged into semi-darkness. To both sides of the "street" the Broadcasting Company had placed 20 of its sight and sound television receivers. These were of six different makes.

The broadcasters' idea to arrange various television receivers of different makes one next to the other in the same hall was certainly excellent for the visitor who wished to gain a comparative impression of the general standard of the German high-definition television service. Eighteen of the receivers operated with cathode-ray-tubes and only two employed a mechanical system. The cathode-ray-tube pictures were very much better illuminated and a larger number of people could look-in at one time. On the other hand, the mirror screw receiver gave a clearer cut black and white picture very pleasing to the eye. Unfortunately the size of this receiver is much too large for home use, and the fact that the mirror screw has to be viewed in practically total darkness is a grave disadvantage. It also seems doubtful if it will be possible to adapt this system when definition standards in Germany are increased above the present 180 lines.

TeKaDe, the makers of the mirror screw receiver, have produced an interesting solution for receiving interlace television pictures, and their engineers seemed optimistic about the future. They may have something up their sleeves which they did not reveal.

The Fernseh A.G. has certainly made the most astounding progress since last year. Not only were they showing five commercial cathode-ray-tube television receivers in "Television Street" and some more on their own stand, but they were also demonstrating a 320-line picture produced by mechanical means of scanning! The film scanning apparatus to produce this is of entirely new design, and the company claim to be able to go up still further with definition before they reach the limit placed by technical requirements to any mechanical system of television transmission.

Larger Pictures

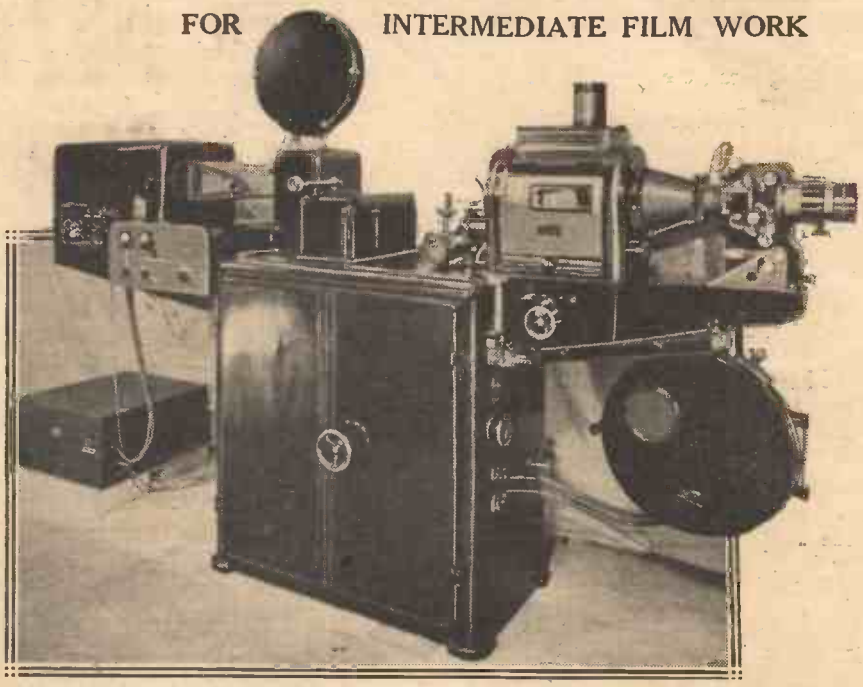
The 320-line picture was shown on a screen 24 × 30 cm. in size, whereas reception by wireless of the programme service picture with 180 lines was usually on cathode-ray tube screens 19 × 22 cm. or smaller.

Radio Loewe were the only firm showing wireless transmission and reception of a 240-line interlace-scanned film picture. They had installed a small transmitter on their stand which actually broadcast to a receiver a few yards away. Interlace scanning completely solves the problem of flicker so that it seems unnecessary to push development towards 50 or more frames a second, especially as the frequency bands which would be required for this would be better employed for providing higher definition.

There were two large screen television receivers at work. One was

(*Continued on next page.*)

FOR INTERMEDIATE FILM WORK



The Fernseh A.G.'s intermediate film television projection receiver which produces a picture about the size of those normally seen on a cinema screen.

TELEVISION AT THE BERLIN SHOW

—continued from previous page.

operated by the Broadcasting Company whose apparatus had been supplied by the Fernseh A.G. This operated on the intermediate film method. The other large screen set was by Telefunken-Karolus. It consisted of a large screen two metres square in size, dotted with 10,000 electric bulbs. This was operated on the multi-channel system and gave a surprisingly good head and shoulder picture.

"Television Telephone"

The Post Office's television exhibit attracted large crowds at the Exhibition. They were demonstrating 180-line 25-frame-per-second two-way point-to-point television over a new type of cable. This "*television telephone*," where one could see as well as hear, caused quite a sensation. It is generally understood that the German Post Office intend opening a regular "television telephone" service between Berlin and Leipzig next spring; statements according to which the Post Office is operating a television service between Berlin and Munich are entirely imaginary. The Berlin-Leipzig service next spring will be the first in the world if the Americans do not get their intended New York to Washington service under way before.

Interlaced Scanning

The television hall at the German Radio Exhibition this year, which was nearly destroyed when Hall IV burnt down, but was operating again within 24 hours of the fire, shows that the trend of development in Germany goes towards interlaced scanning and still higher definition, i.e., at least 320 lines, and towards cathode-ray tube receivers. At the time of writing the manufacturers have not decided whether the present commercial receivers will be placed on the general market. Enthusiasts, however, will be able to obtain them direct from the manufacturers. The destruction by fire of the Berlin ultra-short-wave transmitters seems to solve the question, at least for the moment, as it will take some three or four months before the new stations can be installed. And until then Berlin is without television except at the Exhibition. But the mobile unit of the German Post Office at present testing on the summit of the Brocken mountain may be brought back to Berlin.

"CLASS B" SCANNING

The development of television receiving circuits is going on apace. Here the latest advance in time-base operation is described by G. Stevens.

THE advantages of the "hard" valve scanning circuit have been emphasised in previous articles, and one or two types have been outlined. Most of these suffer from excess of valves, with a consequent increase in cost to say nothing of the complications in the circuit.

THE FUNDAMENTALS

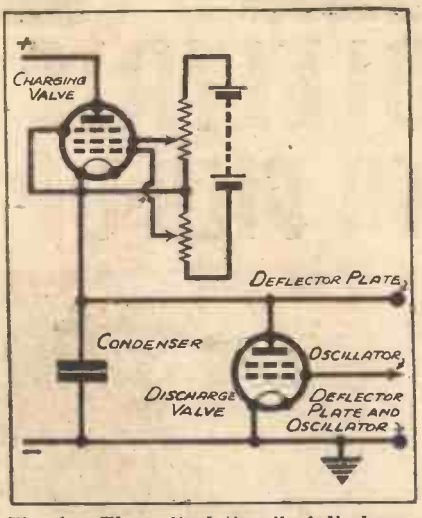


Fig. 1. Theoretical circuit of discharge valve actuated by a separate oscillator.

Most of the trouble arises from the fact that it is difficult to make a triode valve imitate the action of the gas-filled relay in the sudden sharp discharge of anode current.

Novel and Useful Circuit

To obtain such a result in the high vacuum valve, the characteristic curve would have to start abruptly at a given grid bias and rise almost vertically. In other words, the valve would need to have a slope of amperes per volt with an excessively sharp cut-off! So far this valve has not been achieved, but there are ways in which this effect can be imitated, and recently a very novel and useful circuit has been produced in America.

It relies for its working on the fact that a so-called Class B output valve has a sharp lower bend to its characteristic, and when the grid is made positive the anode current reaches a very high value without damage to the valve. If such a valve is connected in a circuit and the grid is made positive at regular intervals a heavy anode current will flow each time and the impedance of the valve will drop to correspond. A condenser connected across the valve will therefore be discharged at regular intervals by the sudden decrease in impedance, and if the grid is then made negative the condenser will recharge until the next positive swing occurs.

Practical Connections

The timing of the positive swing is obtained from a separate oscillator to which the valve is connected, and since this can be made stable, the condenser circuit will charge and discharge with perfect regularity, unaffected by temperature changes or, within wide limits, by anode voltage fluctuations.

The full circuit is shown in theory in Fig. 1. The condenser, the value of which is chosen for the scanning frequency required, is charged through a pentode valve which acts as a constant current device and makes the rise in potential linear. Across the condenser is the Class B valve, the grid of which is biased negatively.

The anode and cathode are connected across the condenser in the usual way, and the plates of the cathode-ray tube are taken to these points. The grid of the discharge is connected to a separate valve oscillator, which is not shown in the figure.

The frequency of oscillation of this valve is set by the coil constants and by the condenser and leak in the grid circuit. When the circuit is switched on the oscillations build up until the peak of the voltage across the oscillator valve swings the grid of the discharge valve positive. The discharge valve then becomes conducting and the condenser is discharged very rapidly.

OSCILLATOR CONTROL

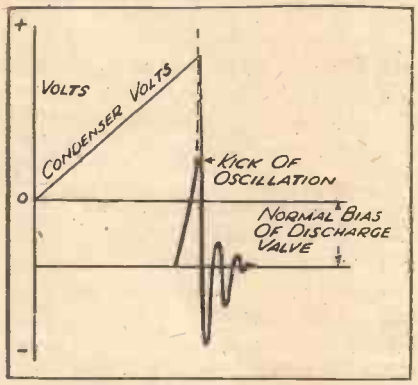


Fig. 2. How the oscillator trips the discharge valve, swinging the grid positive.

Condenser Discharge

The peak of oscillator voltage lasts just long enough to keep the discharge going until the condenser is practically discharged. Then the oscillations die down and the grid of the discharge valve becomes negative again, allowing the condenser to recharge.

The action is better understood from Fig. 2, which shows the condenser voltage rising to its maximum just as the "kick" from the oscillator sends the grid of the discharge valve positive. The condenser discharges throughout the duration of the kick, and as soon as this dies away, the voltage increases again.

On studying the curve of Fig. 2, one or two interesting points will be brought up. One is that the kick from the oscillator must not be too short, or the condenser will not have a chance to discharge properly. This is shown in Fig. 3,

(*Continued on next page.*)

POINTS TO BE AVOIDED

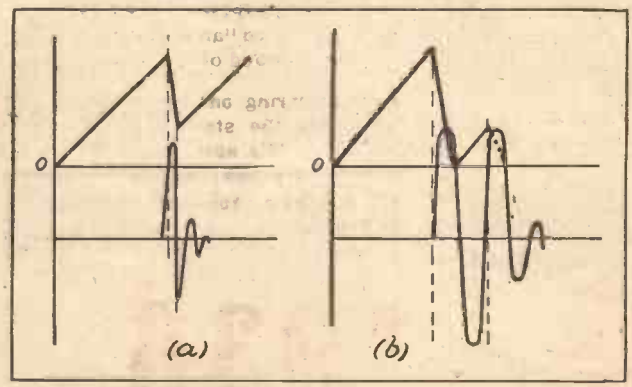


Fig. 3. A short kick such as (a) will not be long enough to discharge the condenser—while sustained oscillation (b) will not allow it to recharge fully.

"CLASS B" SCANNING

—*continued from previous page.*

which also shows what happens if the oscillations persist for too long a period. The grid remains positive and the condenser is prevented from charging again. From studying Fig. 3 we see that the right kind of oscillation for producing the effect is one which consists of a single kick of reasonable length followed by an immediate cessation—in other words a highly damped oscillation.

A standard oscillatory circuit can be made to produce such an impulse.

For the picture frequency the design of a suitable oscillator presents a little difficulty as the frequency is so low (25 per second) and in most cases it is preferable to use the straightforward timing circuit with a gas-filled relay. The oscillator should be carefully screened from the rest of the circuit, particularly where it is to be used near a receiver, or an irritating note will be heard in the speaker.

REMOVE THAT INTERFERENCE!

—*continued from page* 211.

should be either glass or ebonite, and be of such a construction that there is no fear of leakage across the edge of the dielectric, Fig. 7.

Another simpler cure involves finding the electrical mid-point of the tube by sliding an earthed metallic foil cylinder along the tube until minimum interference is heard (Fig. 8). This provides a capacity earth to the electron stream in the tube, but due to the high voltage on neon installations, it is advisable to have this work done only by specialised neon engineers.

Tracking the Source

One of the difficulties in dealing with a particular case of interference is identifying and tracing the source, and to assist in this the Marconiphone Company have issued a series of records together with a comprehensive manual on the subject. On these discs are recorded about thirty different types of interfering noise, and each is identified so that by comparison the cause of noise can be placed.

The tracing of a source is then a matter for observation, and the use perhaps of a portable receiver. A portable employing A.V.C. should not be used for this, of course, as it will not readily give a directional bearing on the source.

QUESTIONS I AM ASKED

—*continued from page* 190.

output loudness by using two of them as H.F. amplifiers, while a band-pass arrangement is notorious as a reducer of signal strength, besides presenting a host of problems in itself.

The two-circuit arrangement as a means of cutting out the "local" stations is wasteful and by no means ideal, but the introduction of ultra-efficient rejector circuits as in the S.T.600 has removed the local station entirely from the activities of the two tuning circuits.

Q. 154. I have been advised by a friend that a vertical wire up the side of the house and standing about a foot away from it is better than the usual back-garden pole outfit. Is this so?

A. No. There is a vast amount of quackery about aerials, presumably because out of 7,000,000 licensees only a small percentage have the foggiest idea what an aerial does. Keep to your back-garden aerial and shame the devil.

"LABELLING" THE WAVEBANDS

Our contributor divides the short-wave spectrum into narrow wavebands which can be "labelled" with some outstanding characteristics in regard to the stations occupying them and their general behaviour.

WE short-wave listeners have as our playground so many kilocycles that we probably don't make nearly as good use of them as we might. How many who read this page can claim to have a receiver that really covers everything from 60,000 kc. to 3,000 kc. (in other words, 5 to 100 metres)?

Most sets seem to miss out the slices at the extreme ends, and are content with a range of something like 20,000 kc. to 6,000 kc. (15 to 50 metres). True, there is a lot to be said for the use of a separate receiver to cover the ultra-short waves, but its range should, at least, overlap that of the ordinary short-wave receiver, which, therefore, should be capable of going down to 10 metres.

Arbitrary Divisions

To make things easy, suppose we regard our working range as something of the order of 10 to 60 metres. How many people can claim to be really familiar with the characteristics of these wavelengths alone? For we have within these limits a tremendous collection of frequencies which change their behaviour very considerably as we go up or down the scale.

Let us try to divide them arbitrarily into narrower bands which can be "labelled" with some outstanding characteristics, not only with regard to the stations occupying them, but concerning their general behaviour as well.

I am going to split them up in this fashion: 60–45 metres; 45–35 metres; 35–24 metres; 24–16 metres; and the rest—16 metres downwards.

The first band, between 60 and 45 metres, is occupied by many commercial and broadcast stations. The portion between 45 and 50 metres is almost entirely populated by broadcast, although the official broadcast band is a narrow one centring round 49 metres.

Autumn Characteristics

Seeing that you are reading this in the autumn, I must deal with autumn and winter characteristics only. This band is definitely at its best after dark. You will hear plenty on it during the late afternoons, but during the hours of daylight there is not much doing except from local stations.

It is not subject to very severe fading, except during periods of freak conditions, and sometimes in the early hours of the morning. Distances up to 10,000 miles can be heard (if the stations are working!).

Well "Populated"

The next "slice" of the spectrum includes the 40-metre amateur band, which certainly does not suffer from a lack of "population." If anything, the trouble is that there is far too much on the air within this little band, only 300 kc. in width. Unofficial broadcasting stations can be heard between 42 and 45 metres, and, again, below 40 metres, and on 36 metres we have one of the principal shipping wavelengths.

All these waves may be regarded as "all-rounders," with the exception of the period between 7 a.m. and about 1 p.m. At any times but these real DX may be heard in the 40-metre amateur band and, therefore, on the waves round about it if suitable stations happen to be on at the time.

On 40 metres the Americans come in at any time between 10 p.m. and 7 a.m.; the Antipodes may be heard between 6 and 8 a.m., and again between 4 and 8 p.m.; and Asia seems to arrive at all sorts of odd times.

Nearer "Daylight Waves"

The next band, between 35 and 24 metres, is getting nearer to the idea of a "daylight wave" by the time we get down to the lower limit. The 31-metre broadcast band, however, lasts out until the small hours of the morning during the winter. The only useless times for this band are, once more, something like 8 a.m. to 1 or 2 p.m. During that time European stations will be heard at excellent strength, but probably very little else.

The 25-metre broadcast band exhibits roughly the same characteristics as the 31 metre, "only more so," to quote an unknown character. It fades out earlier; it is more subject to conditions and their variations; and, generally speaking, the extremes are more marked. W 8 X K (Pittsburgh) in this band is sometimes one of the strongest short-wave stations ever heard, irrespective of distance.

The Lowest Band

The band from 24 to 16 metres includes the 20-metre amateur band and two broadcast bands, on 19 and 16 metres approximately. The last two may almost be treated as "daylight bands," and the former is in a class by itself. We used to think of it as a daylight wave, but nowadays, during the summer, it is active all through the night as well.

In the winter, however, it is exceptional to hear anything except South

(*Continued on next page.*)

A WELL-EQUIPPED LABORATORY

A corner of a short-wave enthusiast's laboratory. Note the world clock, barograph and neat storage arrangements.

"LABELLING" THE WAVE-BANDS

—continued from previous page.

America on 20 metres after 8 p.m. or thereabouts. The 19-metre broadcast band is usually at its best during the late afternoon and early evening, although in December the "fade-out" may occur as early as 6 p.m.—compared with midnight in the summer.

Nineteen metres is undoubtedly the best wave on which to receive North American broadcasting. Sixteen metres is also good, but, as one would expect, less reliable. The fade-out occurs quite early, and only two or three stations work regularly in the band.

Direct and Indirect Rays

The wavelengths from 16 metres downwards require a whole article on their own. There is every reason to suppose that those between 16 and about 8 metres can be treated as normal "short-waves," the reflected ray coming into play in the usual manner.

Somewhere between 10 and 5 metres, *under normal conditions*, that reflected ray disappears, and we have to rely upon the direct ray. When conditions are not normal—but that's another story.

SHOT IN THE DARK

—continued from page 208.

"Well," he said. "I'm afraid I'm a busy man."

"Just a moment," said Miss Pendyce. "Did you see if there were any finger-prints on the tuning-knob of the car radio?"

"No," said the detective. "Why?"

"If you find any," said Harriet, "I'll tell you."

"Well, don't start getting ideas," said Mr. Bassett, "if you find mine. I was fiddling with the beastly thing before I started talking to Carey. We sat in his car."

Miss Pendyce paid no attention to Mr. Bassett. She looked straight across the room at the massive figure of the detective, speaking in a low, level tone of voice, and emphasising her points by tapping her fingers in turn on the shiny surface of her black bag.

"The dance music we found coming from the radio when we found the car," said Miss Pendyce, "was being relayed from an English restaurant. It came from somewhere in the West End on the London Regional Wave."

"Well, what of it?"

"Did you think of looking," continued Miss Pendyce, "at the other programme items on the London Regional that night?"

"No," said the detective. "I'm a police-officer, madam, and a practical man, if you'll forgive my saying so."

"I don't mind forgiving your saying a very silly thing," retorted Miss Pendyce curtly. "But there's a 'Radio Times' on the table, and I'd be obliged if you'd turn to the programme page in question."

The detective blinked a little, but he obeyed. Angela, looking in some bewilderment from him to her aunt, and from her aunt to Mr. Bassett, observed that the latter's cheeks had flushed deep red; that he was licking his lips in a rather disgusting manner; and that his eyes were straying continuously towards the door. . . .

"You will see," Miss Pendyce was saying, "that on the wavelength and at the time in question—the time at which my niece and I heard the shot—a play was being broadcast—a play of the 'thriller' variety. And I may say," she added severely, "that it wasn't up to the standard I've been accustomed to expect from the Corporation's dramatic work."

"My aunt," explained Angela gently to the bewildered detective, "enjoys listening to the works of Tchehov on the air."

An expressive grunt was the only reply.

"I heard that play on the other wavelength the previous night," Miss Pendyce went on. "I happened to notice the time after its commencement that the murder in it was committed—thirty-five minutes. On the night of Carey's murder the play started at nine o'clock."

Mr. Bassett jumped to his feet, and stood swaying slightly from side to side, one hand in his pocket.

"The murder in that broadcast play took place by means of shooting," said Miss Pendyce. "As a constant listener I can tell you that the Effects Section is lately much improved. The shot we heard at nine-thirty-five killed no one, and was fired in Broadcasting House, and——"

"And Mr. Bassett's ingenious alibi is all washed up," said the detective grimly. "What have you to say, Mr. Bassett?"

"Nothing," said Mr. Bassett, putting one gloved hand to his lips. "I didn't bargain for a lot of blasted radio fans!" He subsided, writhing, on to the floor.

Miss Pendyce gripped her niece's arm, and drew her firmly through the door.

WATCHING OSCILLATIONS

—*continued from page* 205.

It is quite usual to use the same power pack to supply both a time base of this type and the gun current in the tube itself, and it is usual to earth the gun, i.e. H.T. +.

The time base described above has the advantage of great simplicity, but, unfortunately, it is nowhere near to being linear, because a condenser charges in an exponential manner when charged through a resistance.

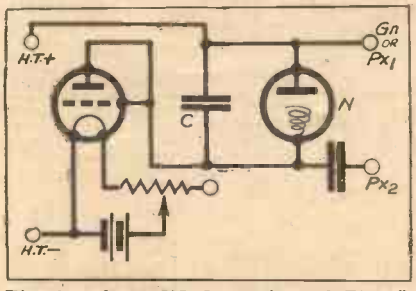


Fig. 4. A modified version of Fig. 3. with constant current device in place of a resistance.

But it is only necessary to replace "R" by a constant current device to make the time base sensibly linear.

Fig. 4 shows this modification with "R" replaced by a constant current device in the form of a saturated diode, the valve actually being a bright emitter triode with anode and grid strapped together.

The period in seconds of the time base, Fig. 4, is given by—

$$C \frac{Vn}{Is}$$

when C is the value of the condenser "C" *in farads*,

Vn is striking voltage—breaking voltage of neon tube.

Is is the saturated current supplied by the diode.

Locking the Base

Having so far understood the time base operation we now have to "lock" or synchronise the scanning system. This means forcing the time base frequency to be a multiple of the "work" frequency so that a stationary picture is obtained; Fig. 5 shows the same time base circuit as Fig. 4 with the addition of means for locking.

Reference to Fig. 5 will show that a resistance "Rs" has been placed between the condenser C and the neon tube. It is desirable that this resistance should be as high as possible without unduly slowing down the fly back of the spot, i.e. the return of the Cathode-Ray from the end of its traverse (at the moment of discharge of C) in the time direction in order that it may repeat.

The time base output voltage is provided by Px_2 and gun (Px_1 will be shorted to gun), and the "work" to be observed is connected to one of the Py plates and to some other electrode that is appropriate.

It will be seen that a little of the "work" voltage is fed to the anode of the neon lamp through a resistance and condenser—the latter to keep D.C. off Py—so that the tripping point of the time base is controlled by the

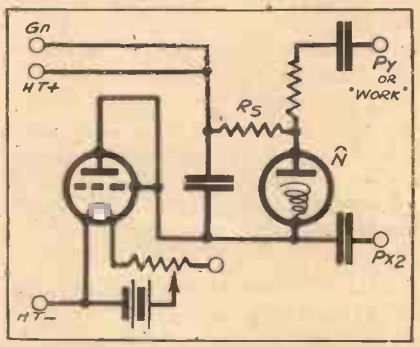


Fig. 5. In this case a "locking" device has been added to the arrangement shown in Fig. 4.

"work" voltage, provided one frequency is sufficiently close to a multiple of the other.

A time base such as that shown in Fig. 5 is a useful piece of apparatus and will be found very satisfactory in general use, provided that frequencies of 30 to 40 kilocycles are not to be exceeded.

(*To Be Continued Next Month.*)

B.B.C. NEWS

—*continued from page* 191.

More Money for Empire Service

I hear that as a result of steady agitation by the programme staff of the Empire Department of the B.B.C., an addition of £50 a week is to be made shortly to the allowance of that Department. They tried for £100, but the finances would hardly justify this until it was clear what the Ullswater Committee would recommend in the way of extra income for the B.B.C.

Decline of B.B.C. Post

Some months ago I mentioned that there was a falling-off in the post-bag of the B.B.C. Apparently there is no improvement, rather the decline has become more marked. For instance, for the week beginning July 22nd, 1934, there were 863 favourable letters about programmes and 95 unfavourable; for the corresponding week this year there were 456 favourable and 134 unfavourable.

Personally, I do not attach much importance to this decline. People are taking the wireless for granted these days. And the B.B.C. should not rely too much on this very sketchy reflection of public opinion.

Furniture Removals

It is typical of the difficulties of the B.B.C. that such a mundane problem as the removal of the furniture of staff should threaten to create a crisis involving political trouble. It seems that most of the staff who are transferred from one centre to another are in the habit of moving their furniture by road transport. The railways got to hear of this preference and promptly made representations.

Now there has been issued an instruction to all B.B.C. staff warning them that in all removals of furniture and other personal effects the railway must be given an opportunity to bid.

Careers for Office Boys

It has always been the rule at the B.B.C. that office boys are taken on at about fourteen on the strict understanding that they will be employed only until they are eighteen, when they must find work elsewhere, making way for younger lads. Occasionally, however, an outstanding boy is kept on and given a proper job.

I hear the proportion of these is increasing, and that the material is proving excellent.

Another Eckersley

There is a new Eckersley on the staff of the B.B.C. He will be Number Three of this famous clan to be associated with broadcasting. First of all there was the great "Peter Pendleton," who founded the Writtle station before the B.B.C. was thought of, and afterwards as Chief Engineer of the B.B.C. devised the Regional Scheme.

Then there came his brother Roger, who rose from being a junior in the O.B. department to be Director of Entertainment, and now Assistant Controller of Programmes. Number three is Timothy Eckersley, son of Roger, who has just joined the programme staff of the B.B.C. and has promise of brilliance of the same high order as that of his Uncle Peter.

ROUND THE WORLD OF TELEVISION

—*continued from page 204.*

impression in the eye due to one illumination has not yet died completely away before the next one comes along, and so they fuse together more or less into a "continuous" effect.

You may know also that a somewhat similar effect occurs in the fluorescent screen used in a cathode-ray tube. It has sometimes been said that if there were no persistence of vision in the eye it would be impossible to show television pictures. This is not strictly true, however, because we could to some extent provide the corresponding persistence effect in the apparatus itself as, for instance, the effect just mentioned in the fluorescent screen.

Can it be Artificially Increased?

Experts are now considering just how much advantage we can gain by adding to the persistence in the screen and so using it to help out the effect in the eye. Obviously we do not want the persistence to be too long, otherwise the pictures would become all blurred and mixed up. But if we can utilise "screen persistence," as it is called, to advantage, this would in a sense amount to increasing the persistence effect of the eye (which, of course, is a natural one which we cannot adjust) and so reduce the number of pictures or impressions per second necessary to give the "continuous" effect.

Mounting the C.R. Tube

Manufacturers and designers who are devoting their attention to television sets have found that sometimes it is not altogether convenient to have the cathode-ray tube mounted in a horizontal position, with the circular screen appearing at a hole in the front of the cabinet. In some ways it is more convenient to have the cathode-ray tube in a vertical position, in which case the circular fluorescent screen appears in a hole in the horizontal upper part of the cabinet.

It is only necessary in this case to use an ordinary mirror on the inside of the lid of the cabinet and then to lift the lid and look at it at an angle of about 45 degrees, when an observer sitting in the front of the machine will see the fluorescent screen in a vertical position, just as though it were in the front of the cabinet. It is possible that this arrangement may find a good deal of favour with manufacturers when television sets begin to appear on the market.

Interlaced Scanning

Several readers have asked me what is meant by interlaced scanning and what its object is. It sounds rather complicated, but in point of fact the system in principle is quite simple.

One of the primary objects of interlaced scanning is to reduce the number of complete pictures per second which has to be thrown upon the television screen in order to avoid flicker or, if you like to look at it another way, keeping to the same number of pictures per second, to reduce the amount of flicker which is perceptible.

A Question of Flicker

On the recent low-definition system the number of pictures per second was 12½, or 25 pictures per two seconds. This gives a perceptible flicker, and on the new high-definition system it is proposed to give at least 25 pictures per second.

If we number the scanning lines 1, 2, 3, 4, etc., then on the ordinary system of scanning the spot goes along line No. 1, then flies back and goes along line No. 2 and so on. On the interlaced system, however, the spot goes along line No. 1 then flies along to line No. 3, then to No. 5, and so on, until it has completed the area of the picture, after which it goes back and starts at line No. 2 then flying back to line No. 4, then to No. 6 and so on, that is, it then goes over the lines which it *omitted* at the first traverse.

Equal to High-Picture Frequency

If the "line-definition" is sufficiently high, it has been found that this arrangement gives practically the same effect in the eye per picture as the full scanning of all the lines, whereas the picture-frequency is doubled, because only half the lines go to each picture. At first sight it sounds like a catch, and you might think that the result would be no different from ordinary "sequential" scanning, but, as I say, in practice it works out all right and better results, as regards flicker, at any rate, are obtained by this interlaced scanning.

The E.M.I., according to present information, propose to scan at 405 lines, that is 202½ lines each way. At a picture-frequency of 25 pictures per second, reckoned on the complete pair of pictures, this gives the equivalent of 50 pictures per second. Should the definition then be reckoned as 202½ or 405? There's a very pretty problem for you.

THE "EASY-BUILD" THREE

—*continued from page* 184.

optimum out of an inexpensive set like the "Easy-Build" (it is a pretty hefty optimum, by the way), then separate tuning condensers are certainly advantageous.

The preparation of the panel, then, resolves itself into merely the drilling of a few holes, and the positioning of these is shown in one of the diagrams.

Fix the panel components in place before you screw the panel to the baseboard with flat-headed five-eighth screws. And don't forget neatly to countersink these screw holes, so that the screw heads lie nicely level with the panel surface.

I would advise you to connect the wires to the three switches before you place the baseboard components in position, cutting them more or less the right length with an inch or so to spare. You can easily snip them off to the correct lengths afterwards, when the time comes to join up their other ends.

Two Important Connections

Make sure you take those short connections from two of the switches to the metallised baseboard at this juncture. You'd find them rather difficult to carry out after the other parts have been mounted. You will see that I have taken it for granted that you have purchased a metallised baseboard! This is quite essential to the design. You could use ordinary plywood, covered with copper-foil, but that is a troublesome method.

You make connection to the metallised baseboard merely by looping the bared ends of the leads concerned and screwing these into close contact with the metallising by means of small wood screws.

The next main step in the assembly of the set is to mount the terminal strips and the baseboard components. Two of the condensers and a resistance are of the wire-end pattern, and do not need any other securing than that which is supplied by their connection into circuit by means of the short wires at their ends.

There is no soldering to be done, but make sure that you scrape the ends of the leads to clean them, and screw down the terminals moderately tightly.

A good tip is to screw a terminal as far down as you can with the fingers, and then give it half a turn more with pliers. You mustn't turn too hard or you will strip the thread.

A point to watch is that none of the soldering tags on the valve holders gets bent over and comes into contact with the baseboard. In that way a short-circuit can occur. Also make sure that you wire the potentiometer and the differential condenser correctly. Each has three terminals, and it matters quite a lot which wire goes to which of these points.

However, the wiring can clearly be seen in the diagram and photos, and it is all very straightforward and snagless. Indeed, I do not think there is anything else to be said about it at all which would not be redundant in the circumstances.

But do use flexible wire for the battery leads, and not the stiff wire such as you employ for the component wiring. And don't forget that the Wanderfuse for the H.T. minus lead is your safeguard against burning out the valves through some accidental short-circuit within or without the set. Therefore, it is most desirable to have the fuse *in situ* before you make your first test, for it is at this time even more than at any other period when the fuse is likely to be most wanted.

The full H.T is given to H.T. plus two and about eighty to H.T. plus one. The grid bias will be dependent on the S.G. and the output valve employed.

Very Smooth Tuning

You will find the tuning delightfully smooth and easy if everything is as it should be. The dial readings may not be exactly in step, degree for degree, all the way round, but that should not matter a scrap for you will calibrate, if you desire to log stations, on the right-hand condenser. This condenser will provide pretty sharp tuning, and so long as the other dial is kept more or less in step with it, as you search for programmes, you will encounter no difficulty in arriving at the most sensitive points and, particularly in the evening, the stations will soon be rolling in as you ply the dials.

At first you may tend to forget the reaction control, or to get a little mixed up between the variable-mu volume control and the reaction, but you will quickly acquire experience and marvel at the flexibility of the adjustments.

New Constructor Designs

Full constructional details of ten different radio receivers and amplifiers make up the contents of "10 Tested Circuits," a publication recently issued by Messrs. A. F. Bulgin & Co., Ltd. The descriptions are easy to understand, and the clear diagrams should be a pleasure to work from. At one shilling, the book is indeed value for money to all home-constructors.

Wide Variety of Sets

The designs include both battery and mains receivers, superhet and straight circuits, a portable and two superpower amplifiers, one for A.C. and one for D.C. mains. There are also battery and mains short-wave converters and a complete short-wave superhet.

Such is the variety that almost every constructor is likely to find his requirements catered for. A valuable feature is the pricing of each item in the lists of components, thus enabling the builder to see exactly what the designs would cost him.

A. S. C.

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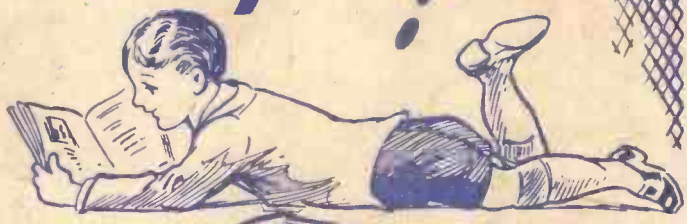
S.S.

Grand Gift Books for Boys!



IDEAL GIFTS FOR BOYS

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