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As some of the arrangements and specialties 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.

Edited by NORMAN EDWARDS.
 Technical Editor: G. V. DOWDING, Associate I.E.E.
 Radio Consultant-in-Chief: P. P. ECKERSLEY, M.I.E.E.
 Scientific Adviser: J. H. T. ROBERTS, D.Sc., F.Inst.P.



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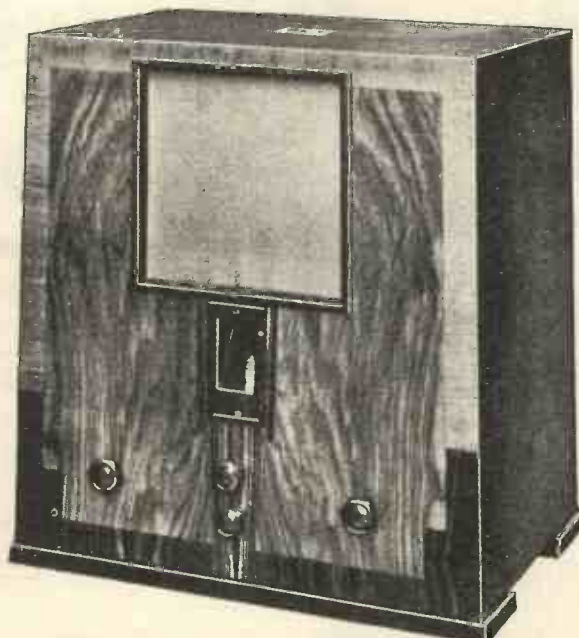
¶ To prove its supremacy needs but a fractional turn of the tuning knob—to prove its supremacy as a musical instrument, *just listen!* Here is the realism of the Concert Hall itself—a tone that is true to life! The technically minded will find further details to interest them in the brief specification below.

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Width - 1 ft. 5½ ins.
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MODERN WIRELESS

Vol. XX. No. 82.

BRITAIN'S LEADING RADIO MAGAZINE

October, 1933

Two Outstanding Contributions—The K4 and "Death at Broadcasting House."

IN this special issue of MODERN WIRELESS we are pleased to present to our readers two features of outstanding importance, namely, the exclusive contribution by Mr. G. P. Kendall or the construction of his latest and most ingenious receiver—The K4; and, secondly, the opening instalment of a new and thrilling serial story, "Death at Broadcasting House," which has been specially written for readers of this magazine by two very well-known B.B.C. personalities—Mr. Val Gielgud, the Director of Dramatic Productions, and Mr. Eric Maschwitz (under the nom-de-plume of Holt Marvell), the newly-appointed Director of Variety.

The Finest Ever Published

THESE two features alone, we think, go a very long way to making this issue of MODERN WIRELESS one of the finest ever published. To begin with, Mr. Kendall's K4 is undoubtedly going to prove the outstanding 4-valver of the year. The receiver has two very distinct and important novelties—the Step System of construction and the tone-levelling principle.

When discussing with Mr. Kendall the various possible methods of presenting the K4 receiver to readers of MODERN WIRELESS, Mr. Kendall suggested that he should not only deal with the problems arising out of his new set in a way which would make an immediate appeal to the more technically-minded reader of this journal, but should at the same time explain—when necessary at length, and always with clarity of detail—the actual detailed process of constructing the K4 that even the most inexperienced of set-

builders would feel that the set was not beyond his powers.

It was doubted at first whether such a method could be adopted in practice, but we think readers will agree that Mr. Kendall has achieved his ambition when they read the following pages giving the fullest possible details for the construction of his latest and finest receiver. For there is no doubt that not only are the technical merits of this receiver obvious to the initiated, but as the article is read they become increasingly easy to follow and to understand, even for the veriest tyro.

We feel confident that in presenting the K4 we are offering readers of MODERN WIRELESS a chance to build a receiver which, in every sense of the phrase, will "never let them down."

Our New Serial Story

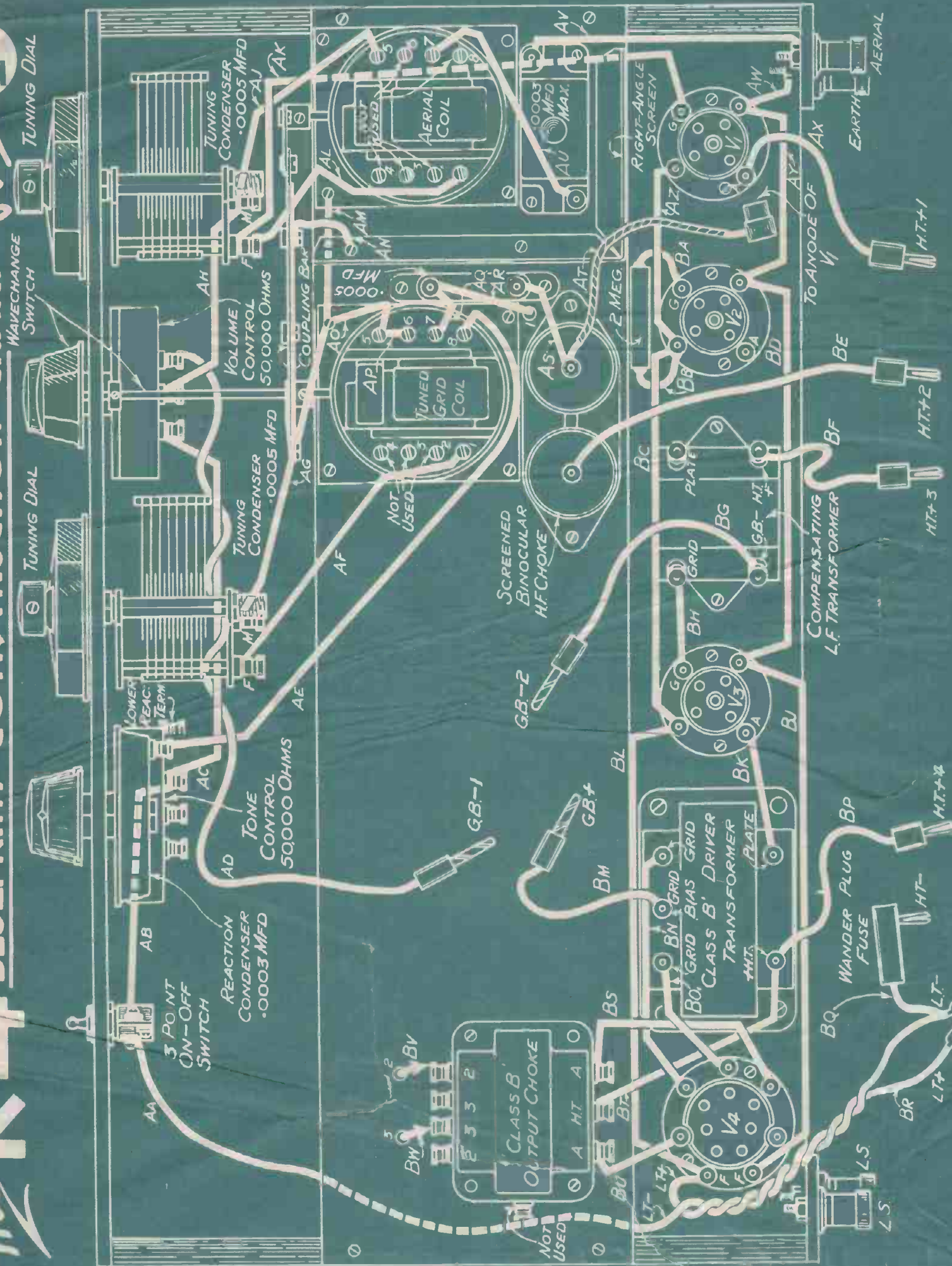
WE should very much welcome letters from readers concerning our new innovation in radio journalism—the introduction of a radio serial story. In the past we have from time to time published radio short stories, but we think we are right in saying that this is the first time any wireless magazine has ever offered to its readers a full-length novel in serial form by two very well-known authors. We hope you will enjoy the story—and we hope, as all Editors and all authors must—that it will keep you in suspense, and that not until the very last instalment will you guess the name of the miscreant who brought "Death to Broadcasting House." At any rate, although the chances are you will suspect most of the characters at one time or another, we promise you a big surprise!

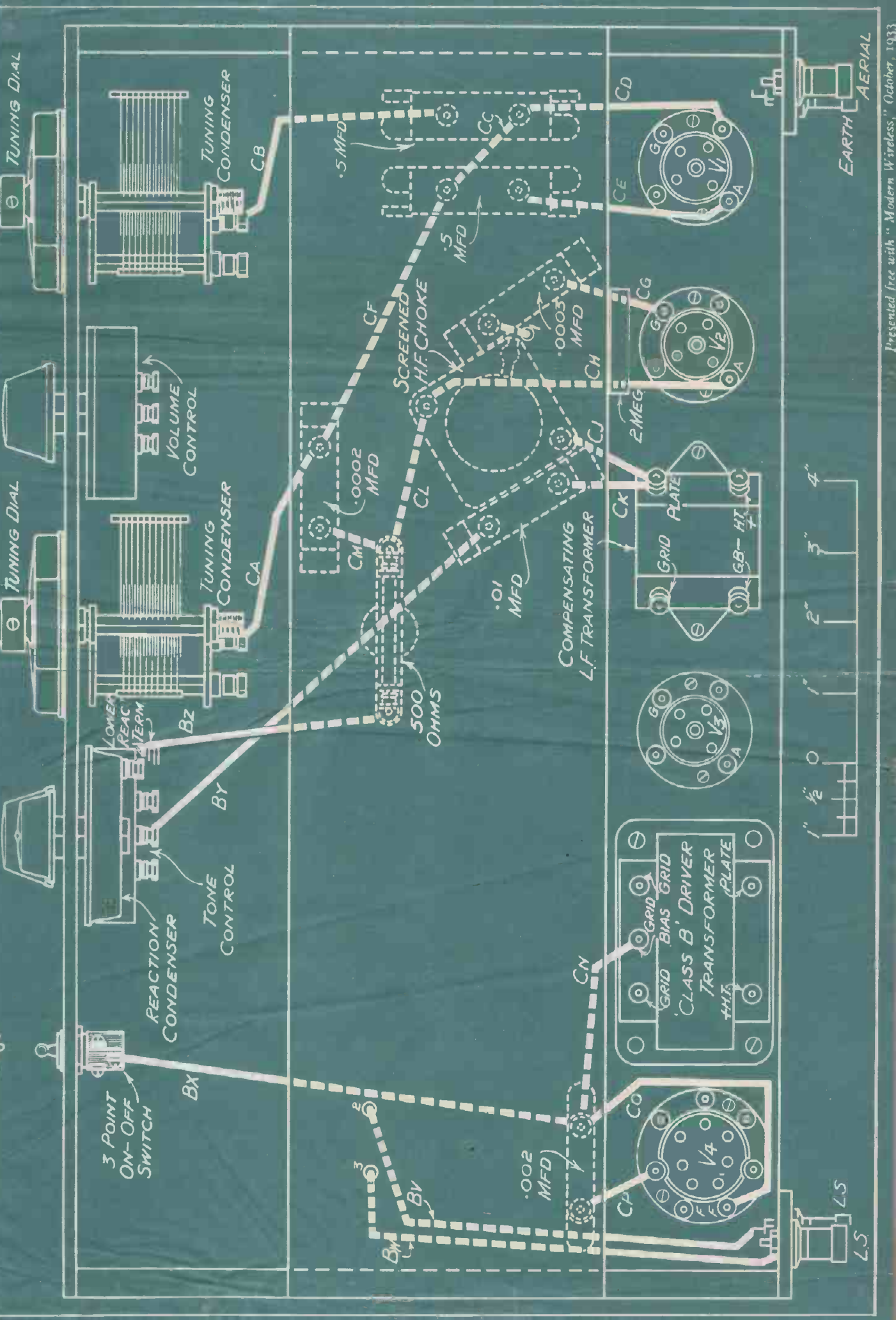


G. P. KENDALL, B.Sc.

The Inventor of the K4, and the Step System fully described in this issue.

The K4 BLUEPRINT CONSTRUCTION CHART *Price 16*





INTRODUCING



Here at last is the fundamentally new principle in set construction for which we have been waiting. The long stagnation is now at an end, the flat base-board system is dead so far as the bigger set is concerned, and the way to better radio is open.

The K4 is based upon this remarkable new invention, and it marks a definite stage in radio progress. No constructor can afford to ignore the possibilities it offers to him, for not merely does it possess the super efficiency of the new system, but it introduces also certain valuable electrical developments.—The Editor.

To stunt or not to stunt?—that was the first question I had to decide when I began to think how I should introduce my K4 receiver to the radio public. The way I have put the question makes it look like the beginning of a vulgarised version of Hamlet's soliloquy, I admit, but the problem was a serious one to me, all the same.

You see, for some time now the people who provide the home constructor with set designs have been feeling rather at a loss when it came to presenting any kind of "extra special" set, because all the superlatives have been used and over-used until they have lost all the force they ever possessed!

Designer and Reader

The only thing to do, it has seemed, was to carry out some spectacular "stunt" with the set, and rely on this to convince the reader that the instrument was indeed something out of the ordinary. Sometimes a series of notable radio personalities would be invited to give their opinion of the set; sometimes the receiver was taken round the country on a test tour. But the aim was always the same, that being to demonstrate to the reader that the set was really an important one.

Please, dear reader, do not think that I am here being unkind to my

fellow designers, or that you can detect a superior strain in what I am writing. The truth is far otherwise, for I have really an entirely sympathetic understanding of what is indeed a very difficult problem: the designer knows that he has a superfine set to present, yet he also knows that the readers of radio journals have been so surfeited by the repeated use in the past of all the laudatory adjectives in the dictionary that they have become very hard to impress!

The Inevitable Comment

It is therefore only natural that he should seek for some striking way of demonstrating the superiority of his new creation. I should be the last to blame him for so doing, because I have done the very same thing myself in the past.

Indeed, I believe I was one of the first, if not the very first, to carry out a test tour with a new receiver! In the year 1925, I think it was, I made a tour of the Western, Midland, and Eastern Counties to investigate and demonstrate the performance of a portable superheterodyne which I subsequently described in MODERN WIRELESS.

I would never, therefore, criticise a designer for using the "stunt" method of introducing a new and important set.

As you see, I have no real prejudice against the stunt method of introduction, but I quickly decided not

to use it myself. My reason for this was two-fold: first, anything of the sort was quite obviously unnecessary in the case of the K4, for reasons which you will discover in a few moments, and, secondly, it clashed with a much-cherished ambition of mine, which is to re-establish my old relations with the readers of this magazine, based on complete frankness on my part, and, I am proud to remember, a considerable measure of trust and confidence on theirs.

Now let me tell you why I think it is quite unnecessary to go in for any kind of startling stunts in order to make sure that my readers shall realise that the K4 is, in actual sober truth, a set of the greatest importance to every home constructor in the country.

It is really very simple: the tremendous step forward which the K4 represents is based upon a fundamental invention which is so obvious in its nature that it has only to be explained for its importance to be realised. Like all really notable inventions, it usually provokes some such comment as, "Why on earth didn't we think of that before!"

Forecasting Changes

It has indeed the beautiful simplicity of the essentially good idea, so that one can grasp its importance at a glance. It is true that one can only understand its more far-reaching effects on set design after some study, but it is obvious at once that its

THE K4

By

G. P. KENDALL, B.Sc.

effect must be to cause some quite revolutionary changes in all future sets.

By that remark, by the way, I do not mean that I think that other designers will copy my system, but I do confidently expect (and hope!) that they will try to get my effect with the aid of methods of their own.

The "Step" System

In passing, I should like to remark that I have just re-read those last few paragraphs, and two things strike me: the first is that I have entirely failed to emphasise sufficiently the great importance of the new system. I can see that I ought to have used some of those old favourite phrases like "epoch-making" and "marking a new era"! The second point, which strikes me even more forcibly, is that it all sounds as though I was re-

markably well pleased with myself! I'm sorry about that, for I hate it, but really I'm in a quandary. You see, I know that the new system is of very great importance, and if I don't tell you about it in good strong terms, no one else will do it for me!

Now that we have thus cleared the ground somewhat, I think we can proceed with the actual introduction which these ramblings of mine are intended to effect.

Readers of "M.W.," allow me to present the K4, a four-stage receiver in which you see for the first time my new Step System, which I firmly believe will be found to mark an important turning point in the history of home construction.

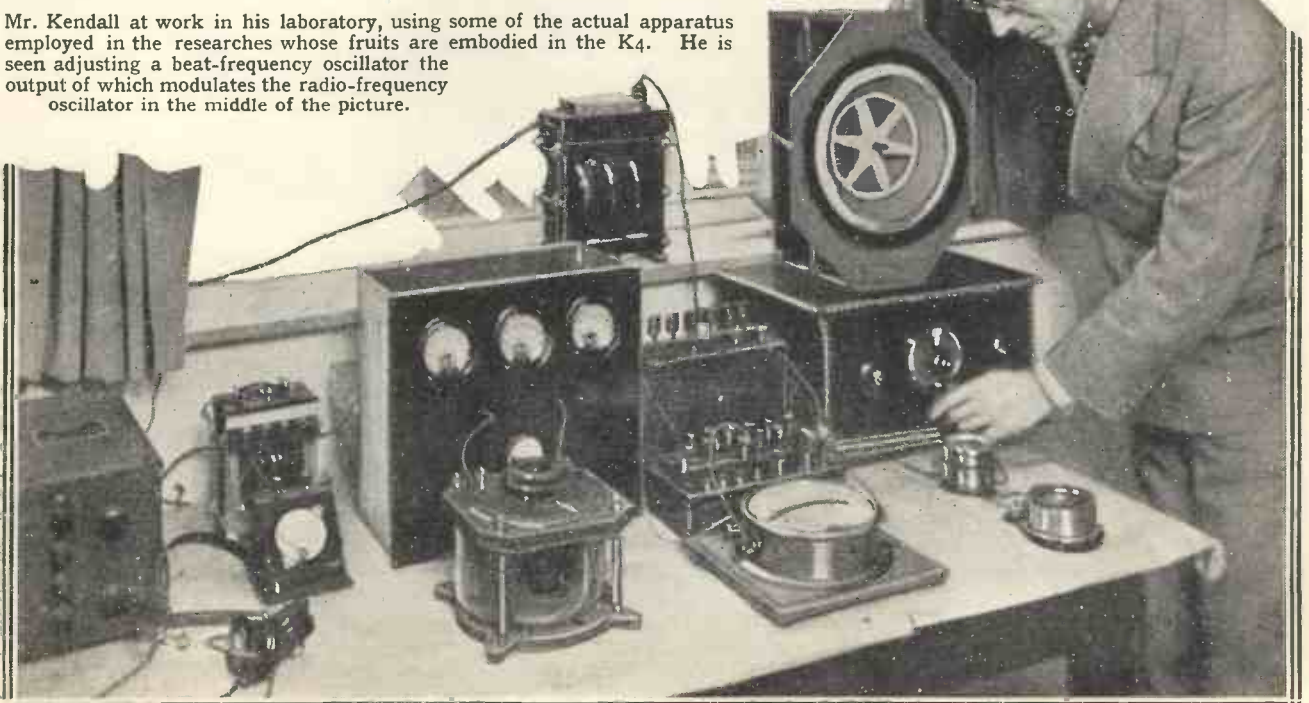
The receiver employs one variable-mu S.G. valve, with special razor-sharp tuning circuits which are neither ganged nor arranged on the band-

pass principle; I regard both ganging and band-passing as much over-rated pastimes. They are sometimes necessary, it is true, but I think they should be avoided when possible.

Balanced Reproduction

The selectivity of the K4 tuning circuits is extremely high—so high, in fact, that the reproduction would be definitely low-toned and poor if nothing were done to counteract the effect. Accordingly, the set is provided with adjustable tone correction of a very efficient type which enables the user to obtain properly balanced reproduction under all conditions.

Mr. Kendall at work in his laboratory, using some of the actual apparatus employed in the researches whose fruits are embodied in the K4. He is seen adjusting a beat-frequency oscillator the output of which modulates the radio-frequency oscillator in the middle of the picture.



A Masterpiece of Modern Design

Actually it does a great deal more, as we shall see later, but for the moment I will content myself with remarking that this, to my mind, is the proper way to design a modern receiver.

There are many other special and original features in the circuit, but we must leave them for the moment, and just note in conclusion that the set is provided with a Class B output stage of the best modern type, so that good quality moving-coil results can be obtained with a very small consumption of current.

New Developments

So far I have emphasised the importance of the Step System in making the K4 the truly remarkable receiver which it is, but I do not want it to be thought that this is the only feature of the set.

As a matter of fact there are a number of important new developments of a purely electrical nature in the circuit, and these alone would have been enough to make it stand

out from all previous four-valve receivers. In conjunction with the Step System they place it far ahead not merely of previous sets, but also, I am confident, of any four-valver likely to be brought out during this coming season.

So confident am I of this that I do not intend to publish another four-valve design for the rest of the season! For that period I shall be content to let the K4 stand, and I believe that it will not be equalled, let alone beaten. That is a strong statement, but my faith in the merits of the Step System is such that I am sure that it will be justified by events.

It has actually been my deliberate design all along to produce a set which I could allow to stand for a whole season, for it has seemed to me for some time that a more definite and settled state of affairs was an imperative need in the sphere of home construction.

For a long while now I have been getting the impression that the constructor was growing tired of being offered a continual succession of sets,

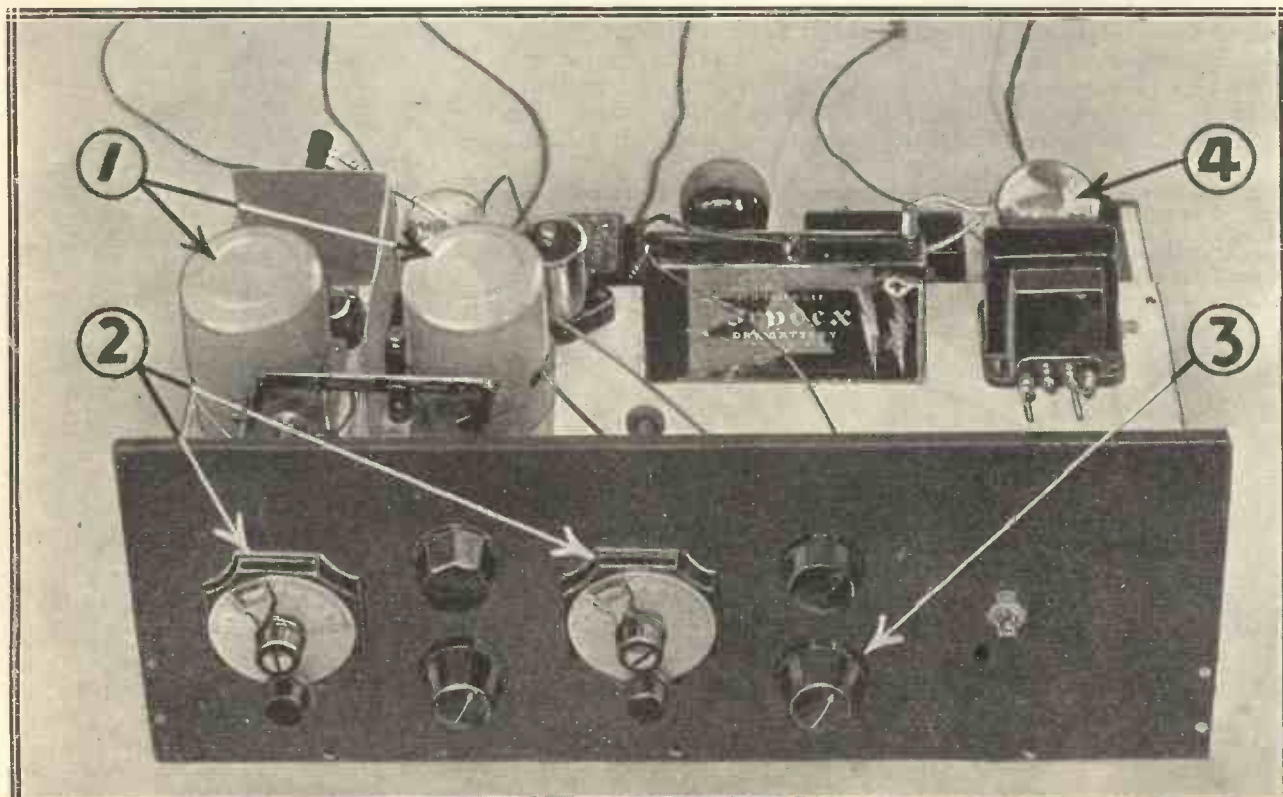
all incorporating some improvement or other. So far as I can gather what annoyed the keen constructor was that he realised that these claims were mostly true, and the continual gentle drip of new ideas made it impossible for him to settle down and build any set without feeling that it would be rendered semi-obsolete by the next issue of his favourite journal.

Accumulated Advantages

Only too often the result was that he waited and waited to see what was coming next, and before he knew it the season was over and he had been obliged to put up with his old set the whole time. The only cure for this irritating state of affairs that I can see is to do as I have done with the K4.

Each design for a particular type or class of set should contain not merely one good idea, but such an accumulation that it represents a sufficiently marked advance on all previous types and designs for the same class, so that it can stand for, at any rate, one whole season.

Some Secrets of the Success of the K4



The arrows you see here indicate some of the electrical features which help to make the K4 the most remarkable receiver of the day. 1 draws attention to the special low resistance tuning coils; 2 indicates the separate tuning controls; 3 is the control of the "tone-ledding" circuit, and 4 is the Class B output valve.



IN the last issue of MODERN WIRELESS an old friend of mine contributed a provocative article ("Time for a Change," by P. Woodward) in which he sought to show that the so-called American system of set construction, using a vertical panel and plain horizontal baseboard, is now out of date and due for replacement.

I suppose I ought to confess at this stage that I put him up to it, for at that time I had finished the development of my Step System, and I wanted to start an exchange of views which would help to make people realise that there was at any rate a possibility of a new development to replace the old method.

You see, we have been using the flat baseboard system so long that I knew it had become one of those institutions with great big roots which take a tremendous amount of pulling up! Pulled up they shall be if I can manage it.

Prepare for a Change!

But it is going to be such a tough struggle that I felt that a little preliminary propaganda work would be a help, and that must be my excuse for my little bit of artfulness last month.

I think I shall be forgiven for it when the reader realises how important it is to him to understand what a very great improvement can be obtained in the performance of a radio set by the use of an improved system of construction.

To achieve a clear understanding of the point we must first clear our minds of the idea that the accepted horizontal baseboard method serves its purpose well enough, for it

doesn't, and until we realise the fact we shall not see the need for anything better.

Of course, the panel and baseboard system is a great step forward on the previous method which used a panel only, but it is far from perfect, and it is a source of wonderment to me that we have put up with it for so long. It must be something like eight years now since the "American" system first became popular, and that

Mr. Kendall considers the Step System one of his most important contributions to radio progress. Here he explains how he has put an end to a period of arrested development which has lasted nearly eight years, and goes on to show how his new system produces a striking increase in the efficiency of a receiver as well as in the ease of construction and wiring.

is a most extraordinary time for anything to remain in vogue in such a rapidly developing science as radio.

Metal Chassis Limitations

The only explanation that I can see is that they have been eight years of amazingly swift progress in the development of circuits, valves, and components, so that we have almost forgotten about the possibility of improvement in the broader aspects of set construction methods.

The commercial designer, to be sure, has been awake to it, and has

developed the metal chassis system to a high pitch of perfection from his point of view. His point of view, unfortunately, is not that of the home constructor, and that is why attempts to introduce the chassis for general use by the latter have always failed.

The fact is that the metal chassis is too hopelessly inflexible to suit the home constructor.

It compels him to stick rigidly to the exact types of components for which the chassis was designed, and it makes it almost impossible for him ever to make any alteration in his set when once finished. He has consequently no chance of bringing it up to date or trying new developments in the future, and that is a state of affairs which does not appeal to the real experimenter.

The Value of Layout

Although the metal chassis may not suit our requirements so perfectly as it does those of the commercial man producing thousands of exactly similar sets, nevertheless it can teach us a great deal. If we study the way in which it permits a more efficient layout and better wiring to be obtained we shall begin to see where the ordinary baseboard scheme falls short, and what sort of system we require if we are going to improve on it.

The main thing about the chassis method, we shall discover, is that it provides a considerable increase in the number of surfaces on which we can mount our components. This, in turn, means that we shall be able to space them out better, and position them so that the connections between them are shorter and more direct. We are also able to separate out certain circuits as a whole from others with which they might interact undesirably.

G. P. K. Explains a Fundamentally New System

These points give us a clue to the main failing of the ordinary flat baseboard type of construction, which is that it gives us only one plane on which to assemble our parts. That plane is, of course, additional to the panel, and it is the reason why the "American" system was found superior to the older flat panel method.

Eight Years of Stagnation

The older scheme gave one surface only, i.e. the panel, and when the baseboard was added to this we immediately found that we could achieve a better layout and we built a set which worked better in consequence.

Since it was perfectly obvious that the improvement was due to this increase in the number of available "assembly planes," it seems to me rather extraordinary that no one took the logical further step of increasing the number still further, until he found he had got as many as he could advantageously use. I think the reason can only be, as I have already suggested, that it was at just about that time that the great spurt of progress in electrical design was beginning, and attention was distracted from the question of mechanical construction.

Whatever the cause, the result has been eight years of almost complete stagnation, so that to-day the panel and baseboard set is still practically universal among designs for the true home constructor.

True, there have been attempts, some achieving a certain measure of success, to popularise a sort of wooden version of the commercial chassis, and in some cases quite a good effect has been obtained by raising up the baseboard a few inches on supports, so that the underside became available for mounting components.

Out-of-Date System

However, none of these ideas made a sufficiently fundamental attack on the problem, and they mostly had quite considerable defects of their own, chiefly in making the set more difficult to build. For example, most of them compelled the constructor to bore a lot of holes in the wood and pass wires through them to make connections between parts on the upper surface and others underneath, and this made wiring a rather troublesome business.

I do not want to give the impression that these methods have no legitimate

application, for that is not the case, but I do maintain that they do not provide the universally useful and quite complete solution of the problem which we require to displace finally the out-of-date flat baseboard system.

Such a solution my new Step System provides, and does it with such amazing success that I venture to predict that in six months' time the ordinary flat baseboard method will be dead, except perhaps for the very simplest kind of sets. I am fully convinced that it is the most important single invention which has been seen in the world of home construction for years.

The reader has, I hope, been through my introductory article and got a general idea what it is all about and how the K4 came into being, and by now he will be wanting to have the Step System explained in detail. I hope, however, that he will bear with me while I deal with just one more preliminary matter before starting upon my main subject. I want

"I am fully convinced that it is the most important single invention which has been seen in the world of home construction for years."

to explain that the Step System is that most exceptional thing, an invention without a "catch" in it.

A Shining Exception

It is only too true that in the vast majority of cases we discover that new things, while they may be better than the old ones which they replace, contain some sort of drawback which was absent from their predecessors. We get our improvement, in other words, at a certain price, which was probably the fact at the back of the mind of the unknown philosopher who originated that sapient saying about roses and thorns.

The Step System is a shining exception. It is the means of making sets more efficient, which might be expected to involve increased difficulty of construction, yet it also makes them easier to assemble.

It produces much better wiring, yet it also makes the wiring far easier to do. It does all this, yet it does not involve any noteworthy increase in

the cost of the set; all you require is a very simple wooden framework made of some pieces of plywood costing only a shilling or so.

The principle on which the Step System is based is really very simple. It is just a matter of a carefully worked out increase in the number of "assembly planes," a point which will be readily understood upon inspection of the various photographs accompanying this article and the others in this issue.

Framework Arrangements

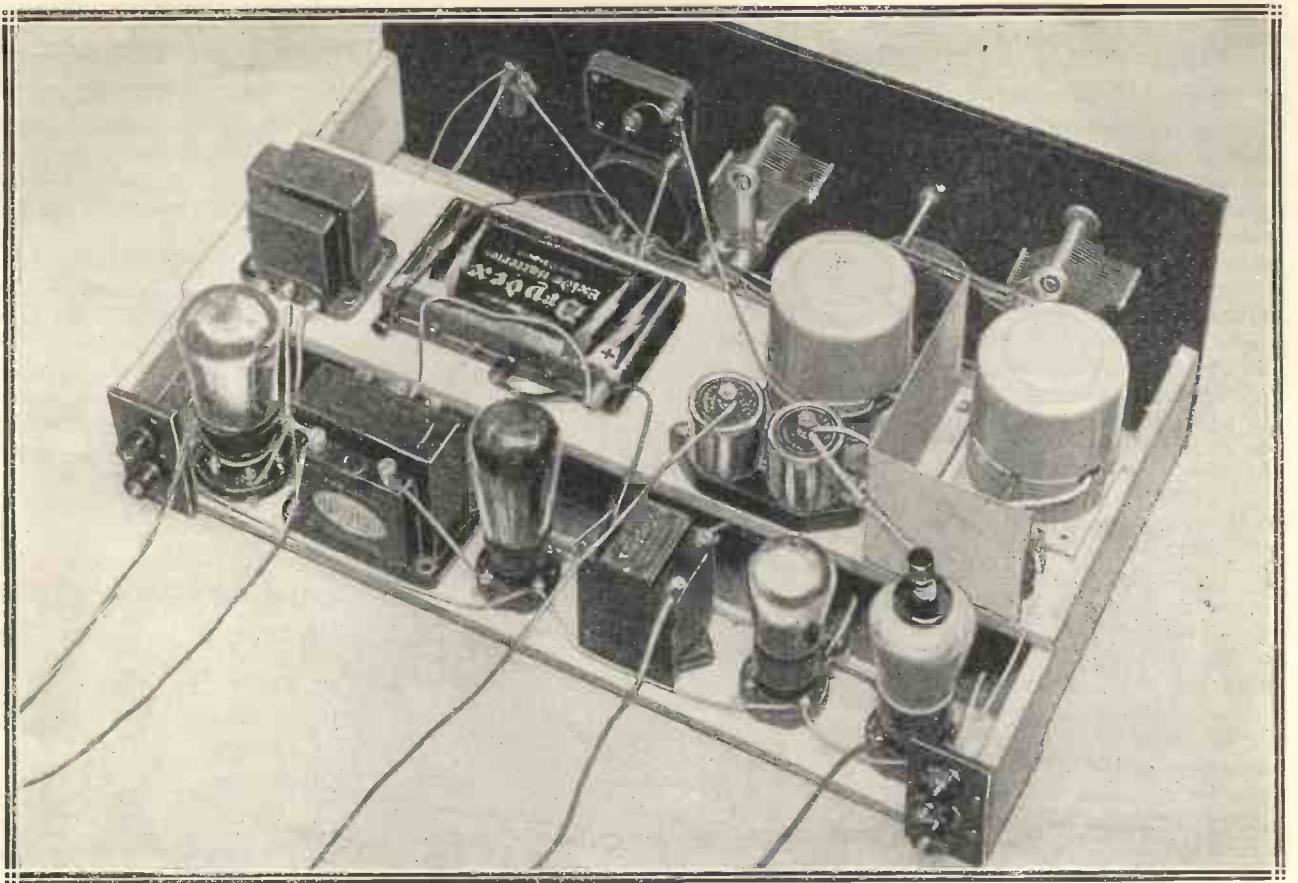
The Step framework actually gives five surfaces for the mounting of components, as against one for the ordinary baseboard or two for the raised baseboard. Those surfaces are arranged in a way which is the result of some months of experiment and thought, and which makes it possible to lay out the components in such relative positions that the actual circuits of the receiver are spaced out from one another in a way never before achieved, while the wiring is made incredibly direct and easy to do.

Now let us refer to one of the photos showing the inside of the K4, compare this with the drawing of the Step framework which will be found in these pages, and see if we can get an idea of the actual way in which the framework is arranged. It will be observed that it consists of only four pieces of plywood, which have a thickness of three-eighths of an inch, and are fastened together with screws so as to form two "steps" on different levels, two of the pieces of wood forming supports between the two steps.

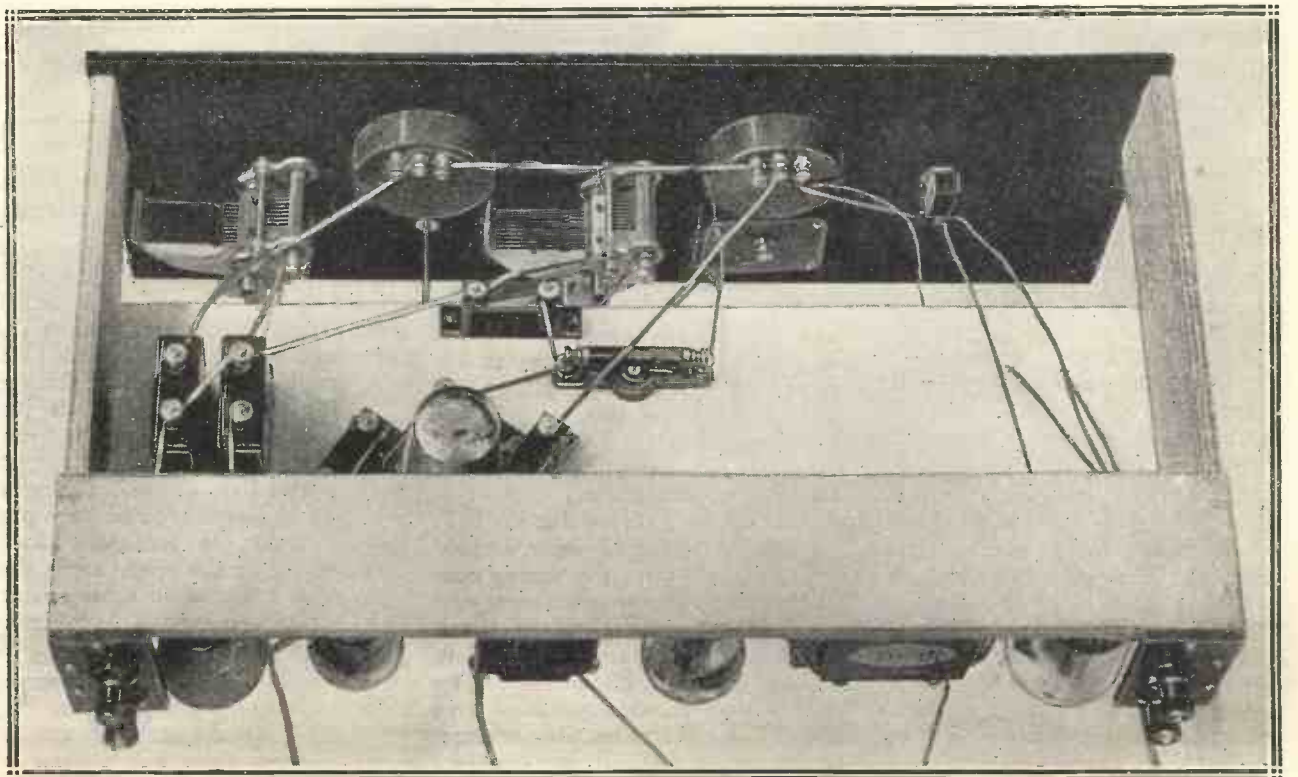
Component Accommodation

One of the step surfaces runs across the back of the set, at the level of the baseboard in the old-fashioned system, and on this are mounted the valves and the L.F. amplifying components; also a couple of little terminal strips for the aerial, earth, and loudspeaker terminals. This forms surface number one.

Immediately adjacent to it is the second step, raised up to a height of $2\frac{1}{2}$ in. above the first level. Both surfaces of this step are available for mounting components, and we will call them surfaces numbers two and three. It will be noted that the height of the step is such that there is room for quite large components on either of its two surfaces.



These two views of the upper and lower surfaces of the K4 will give the reader a preliminary idea of the amazing improvement in layout and wiring efficiency which the Step system automatically produces. The lower picture in particular gives a good impression of the wonderful accessibility "to all parts" a feature of importance in set design which has been far too much neglected during the last eight years of development in home construction technique.



Step by Step in Solving an Eight-Year-Old Problem

The remaining two pieces of wood are placed on edge between the two Step pieces, and form the means of assembling the two together to make the framework which you see in the photos. In addition to serving this purpose, however, their inner sides provide two further assembly planes which we will call surfaces numbers four and five. These are not used for the mounting of components in the K4, but it should be noted that they are available for use on future occasions.

What You Might Miss

These four pieces of wood constitute the Step framework proper, but it may be as well to point out in passing that if an existing cabinet is to be used for the K4 another piece of ply of the same thickness and measuring 18 in. long by 1 in. wide will be needed. This will be used for stiffening the panel along its lower edge, but I will explain the point in detail in the constructional article which will be found in later pages.

The reader has now got a general idea of the way the Step System framework is arranged, and it becomes possible for him to see a little more clearly what an extraordinary and truly revolutionary improvement it renders possible in set layout and wiring.

Let us take first the question of layout. I hope the reader will bear with me while I explain these things, and not become impatient to get on to the details of the set itself, because it is extremely desirable that he should understand the points I am discussing.

If he does not he may fail to realise what an important development the Step System really is, which might so easily lead him to decide not to build the K4, and thus miss his chance of sharing in the improved results which will be obtained by those who *do* build it.

A Drawback in Older Sets

Very well, then; the first thing to be noted is that the system increases the number of dimensions, so to speak, in which a set can be designed, so that it becomes possible to space out circuits from one another by arranging them at different levels vertically as well as spacing them out horizontally, as in the older schemes.

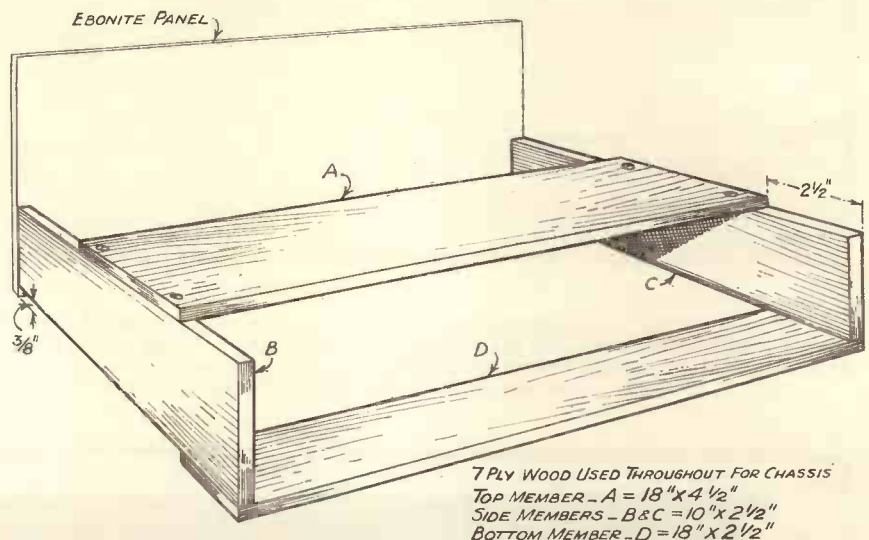
In practice this means that it is ridiculously easy to solve completely what was one of the most difficult of all set design problems when a flat baseboard was used, namely, the spacing out and proper separation of the tuning circuits and H.F.-carrying circuits generally from the other portions of the receiver.

In the older sets it was practically impossible to do this properly, and it frequently happened that one found the tuned circuits all mixed up with battery supply circuits, low-frequency amplifying circuits, assemblies of de-coupling components, and very likely

components of the detector stage are placed on the underside.

Here we see the clue to the remarkable efficiency which can be got by building a set on the Step System. It is just a natural and, indeed, inevitable consequence of the fact that for the first time the set can be laid out with proper separation and isolation for its vital H.F. circuits, without resorting to a mass of screening which, while it certainly has the desired effect of preventing feed-back and instability in the H.F. stage, cannot be considered desirable from any other point of view.

PUTS A BIG SET INTO SMALL COMPASS



Here is the Step framework on which the K4 is built, showing that the new system possesses the perfect simplicity which is the hallmark of the truly meritorious invention.

a mass of loss-producing screening.

Now look at the K4 and you will see that the tuning circuits are lifted up on the second step and isolated from all the other circuits in a way which would have needed a layout of quite twice the size even to approach by the old methods.

As a matter of fact, it could not have been more than approached by any size of normally constructed single-surface baseboard.

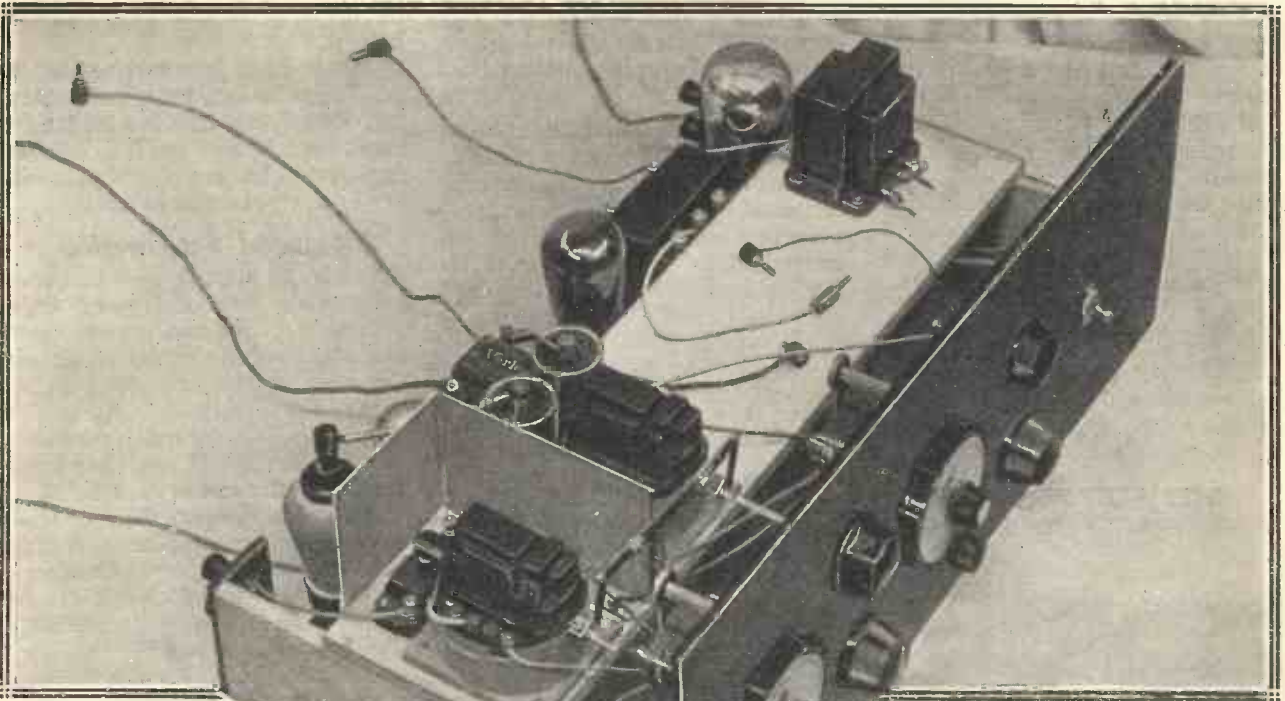
Actually, you will see that the H.F. department is grouped almost entirely on the upper step, the tuning condensers and other controls occupying their usual positions on the panel. The tuning circuits are confined to the upper surface of the step, along with the components associated with the H.F. intervalve coupling arrangements, while the various accessory

Little Screening Required

Note that in the K4 the only screen is a very simple little affair intended just to stop electro-static feed-back between certain wires and components in the grid and plate circuits of the S.G. valve. Otherwise the only screening required is just the conventional amount of "canning" now given to such components as coils and H.F. chokes. The usual foil-covered baseboard and large partition screen are rendered totally unnecessary by the proper separation from each other of all those circuits which might otherwise have interacted objectionably.

As a matter of fact, the little screen which is actually present in the final model is not really essential, and the set will work quite well without it!

Perfect Spacing is Essential for Efficiency



The Step System puts the valves where they belong—all in a row at the back of the set.

I only added it because I found that with certain very "lively," i.e., efficient, screened grid valves the set was not quite so completely stable as I could wish. Instead of using a screen I could have moved the coils farther apart, and so made room to space out the grid and plate circuits a bit more, but this would have upset my panel layout badly, and I chose the screen instead. It is far too small to cause any of the troubles one sometimes gets from too elaborate screening, in any case.

The Lavish Hand

By the by, don't let me give the impression that I am arguing that all screening is bad; the truth is that screening can be perfectly harmless, but that it must be done with great cunning for that to be the case. As so often done, with a lavish hand and very little thought, it is most definitely apt to produce losses in the H.F. circuits which are not necessary.

If the reader will bear all these points in mind, and go over the photographs, he will be able to trace out the way all the H.F. circuits have been taken out from the conglomeration of stray wiring, decoupling condensers, screening, and general odds and ends with which they are so often

Symmetry of panel layout is achieved with ease on the Step System. Note how well balanced and conveniently placed are the controls of the K₄, yet how ideally direct and short are their connections.

portant point of the two. There is no need for me to explain at length here, for even the most casual glance at the photographs cannot fail to show that the wiring of the K₄ is quite unlike that of any preceding receiver.

Observe how it runs straight from point to point, and yet is better spaced out than is customary in any set of the kind in which the wires are all laboriously bent into special shapes and run by circuitous routes in order to keep them apart. The fact is that the flexibility of the Step System is such that it is easy to lay out the parts for a set in such positions that ideal wiring can be got in where practically every wire goes straight from one point to another, yet is perfectly spaced out from all others with which there might be undesirable effects.

Easy and Quick Wiring

As a result, the wiring of a stepped receiver is not merely perfectly spaced, but it is also as direct and short as well as can be. In a word, it is efficient.

The fact that all important wires run straight from point to point and

mixed up, and given the isolation, which is so desirable for them.

So much for the virtues of the Step System in giving a more efficient layout. Now let us see what it does for the wiring of the set, for I am not sure that this is not the more im-

SUMMARY.

The Step System :—

- (1) Makes a really efficient layout possible for the first time.
- (2) Dispenses with all elaborate screening.
- (3) Makes a set far easier to build and wire.
- (4) For the first time provides a positive guarantee that every constructor will make an exact copy of the original wiring.
- (5) Achieves this most important effect automatically and without the need for any conscious effort on the part of the constructor.
- (6) Surely justifies the use of the word revolutionary ?

New Ideas, New Simplicity, New Performance Values

need no bending to shape or running round corners is one obvious reason why a Step set is so easy and quick to wire up. Not one single wire in the K4 needs to be bent into any particular shape, and the whole set can be wired up correctly with the aid of the following rule: wherever possible, run each wire in a straight line between the points which are to be joined.

Duplication with Accuracy

If there is an obstacle in the way, take the wire round it by the shortest possible route. It will be found that this occurs only in the case of quite

unimportant wires like filament connections, all those in the tuned circuits and so on going quite straight from point to point.

What this means in making the set easy and quick to wire up need hardly be explained, for it is quite obvious, but what is not so evident is a very important subsidiary effect of the method which I must emphasise. It follows from what I have explained that the run of the wires is really fixed by the *positions of the components*, i.e. by the designer of the set, and not by the constructor, so long as the latter obeys the injunction to stretch every wire straight between

the points to be connected and pull it tight.

This in itself is a development of great significance, for it means that here for the first time is a set for the home constructor which can be duplicated with almost perfect accuracy by everyone who builds it.

Assured Satisfaction

So long as suitable makes of components are used the wiring quite automatically becomes a perfect copy of that of the designer, and all without any difficulty or even effort on the part of the constructor! Surely that is a great step forward in assuring the set builder of complete satisfaction at the end of his labours?

Always in the past there has been a feeling among constructors that the sets they built might not function so well as the original models of each design, simply because the spacing of the important wires had been less successfully done. For this feeling of uncertainty the designer himself has been to some extent to blame, for he has, I think, tended to exaggerate the importance of lead spacing.

Importance of Spacing

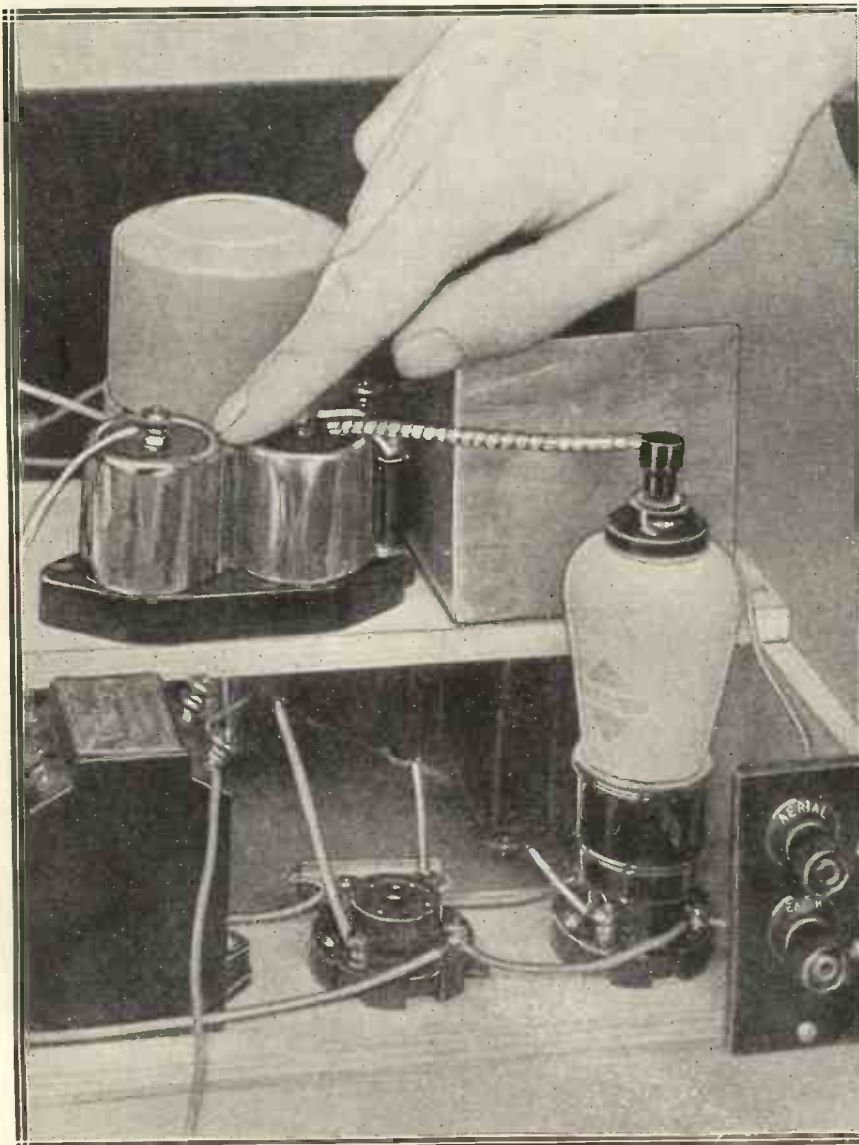
Making all due allowance for such possible over-emphasis, the fact remains that sets built to the same design but wired differently would undoubtedly perform with varying degrees of efficiency.

That feeling of uncertainty has been banished completely and finally by the Step System. No longer need the constructor have the slightest doubt that he will be successful in making so perfect a copy of the original wiring that he can be assured of duplicating precisely the original results.

And now a final point before we leave the Step System. I want to make it very plain that *spacing* is really of greater importance than length of leads, especially in ensuring stability with high-magnification H.F. stages.

The common idea that the length of the leads is a fair measure of the efficiency of the wiring is really due to rule-of-thumb design methods. It was discovered that short leads often meant a set which worked well, and it was not realised that the real reason was that short leads gave less chance of inter-action with neighbouring wires, even if the spacing was not too good.

THE VIRTUE OF KEEPING TO A STRAIGHT PATH!



In old-fashioned sets the vitally important H.F. coupling choke was often stowed away in some corner where it could neither be got at nor wired efficiently. See how the Step System treats it: perfect accessibility, perfect directness of wiring.

The K4 Circuit



IF you were to assemble the K4 circuit on the old-fashioned panel and flat baseboard system, I believe it would still be the best four-valve battery set so far described. As a matter of fact, I did all my experimental work on the circuit with the aid of a test receiver made up in that fashion, and it was only when I had developed the circuit to such a pitch of perfection that I was sure it was the best I had yet handled, then, and only then, did I allow myself the luxury of rebuilding on the Step System.

No "Hocus-Pocus"

This, of course, was a very important precaution, because if I had started with a "stepped" receiver and done my experimental work therewith, it would have been so easy to think that I had developed the circuit to the desired efficiency when all that I was getting was the normal improvement due to the Step System alone.

When I refer to "developing" the circuit to the required degree of efficiency, I do not want to give a false impression. I am not pretending to be able to take just any circuit and perform some sort of magical hocus-pocus over it until it becomes the very last word in super "hot stuff" receivers; anyone who could do that would be able to produce one of these special "star" sets whenever he wanted to, and to the best of my belief there is no such individual living.

The Origin of the K4

The actual process by which such sets come into being is very different, for they are essentially the result of quite a long period of thought and research on general lines which only gradually crystallises into an investigation in some definite direction, using a particular circuit as a basis. The final development of the circuit to the highest possible pitch of efficiency is thus largely a matter of experimental work on its smaller details, the broad outlines having been settled long before.

So it was with the K4.

For more than two years I have

A full description of the carefully engineered circuit whose details are the result of several years of research, with a complete explanation of the important principle of "Tone Levelling" which plays such a vital part in giving the K4 its extraordinary efficiency.

been studying the problem of getting a really satisfactory performance from the battery set, and carrying out research on both the broad general aspect of the question and on the specialised detail problems which are involved in it.

Only Two Tuned Circuits

My aim from the first was to give the battery user the same volume and quality which is available to the mains set owner, and a standard of selectivity and sensitivity adequate to ensure real programmes from a large number of stations whenever conditions permit. The first object only became capable of attainment with reasonable economy of H.T. current when "positive drive" output circuits were developed, while the second I soon found depended upon the use of tuned circuits of considerably lower H.F. resistance than those in use when I began my investigation.

The last is a point which I should like to explain, for it is rather important. What I actually found was that so long as I used tuning coils of the comparatively high-resistance types which were current until quite recently, it was necessary to use three tuned circuits to get the sort of results I wanted, and that in turn meant band-passing and gang tuning, with all the expense and troublesome adjustments which those two things bring in their train. For this reason I turned my attention to the problem of higher efficiency tuning coils, for

my object was to get the desired results with only two tuned circuits if I possibly could.

I regarded this as very important, for it seemed very clear that gang tuning was out of place in the kind of set I had in mind: the receiver I wanted to design was to appeal to the home constructor who makes a hobby of radio, and to him, I know, ganging is merely a nuisance which has to be tolerated when there are three or more circuits for the simple reason that he has only two hands.

Why Ganging?

After all, why should he have to have his sets ganged? "One-knob tuning" was first introduced for the benefit of the lay public who, poor souls, know nothing of the finest hobby in the world and find even one dial too much for them at times.

The novelty of the thing at first attracted the rest of us, and I think the publicity talk that went on in favour of the new ganged sets when they appeared must have made some impression upon us; but before long we got a clearer view of things and began to see that the set for the general public has really little or no relation to the one which appeals to the hobby man.

All that the general public wants is a set with the best possible performance and appearance at the lowest cost and with the least trouble in operation. The home constructor, it is true, wants performance and appearance at low cost, too; but a set means far more than that to him, for the pleasure which its construction and use gives him depends to a large measure upon the success with which it provides him with an opportunity to exercise the knowledge and skill which it has taken him years to acquire.

A Misleading Way

The finest of life's intellectual pleasures is surely to be found in just that same use of acquired skill and knowledge in some worth-while accomplishment, and that is precisely what a good hobby gives us. Radio does it to a superlative degree, and brings us as well the pleasure and interest of entertainment from

G. P. Kendall Explains the Principles which—

all the corners of the earth, which is probably one reason why it is beyond question the finest hobby of them all.

Be all that as it may, it must be agreed that a considerable part of the pleasure of using a radio set is, to the keen experimenter, a matter of using one's skill in operating it. After all, it is the possession of that skill which distinguishes the experimenter and constructor from the layman as an operator, and enables the former to get better results from almost any receiver.

results which have to suffice for the general public. Only in exceptional cases is it a successful substitute over the whole of the tuning range, more particularly in the home-constructed set, so it is my contention that it should only be used in such receivers when it is really necessary.

Litz Wire Researches

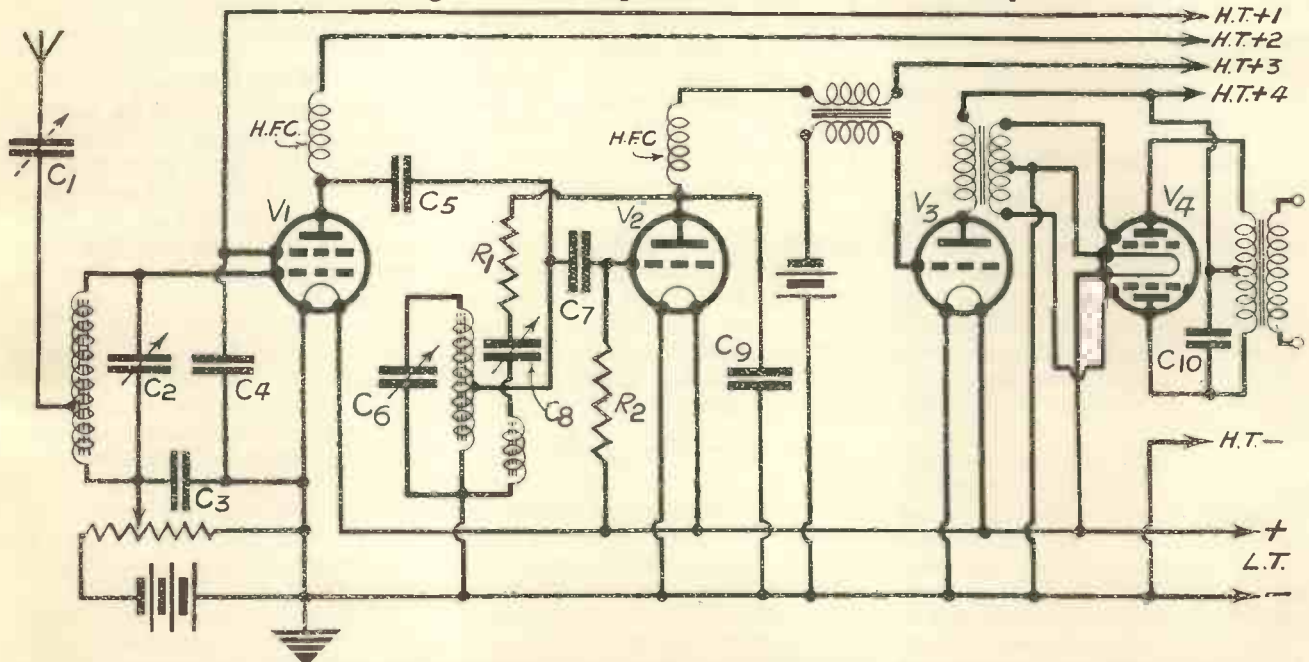
To get the results I wanted with only two circuits, I soon discovered, meant better coils than were generally available until quite recently, and so

A little while ago this would have been considered a highly criminal proceeding, for everybody was then infatuated with the idea of band-pass circuits, and the principle of L.F. correction was little appreciated outside certain commercial laboratories where it was being developed.

I saw a great deal of this research, and did some of it myself, with the result that I became convinced of the fact that herein lay the solution of my problem.

Let me explain. Instead of using

The Starting Point of the K4's Development



Here is the elementary outline of the circuit on which the final highly perfected K4 arrangement is based. This diagram is intended to serve as an introduction to the fully detailed one on a following page, which shows the complete K4 circuit with the Tone Levelling device, the instantaneous signal-quenching scheme which is operated by the on-off switch, and all the other special features.

What ganging does, we are sometimes told, is to enable the layman to get as good results as the skilled operator, but I think this is a most misleading way of looking at the question. Actually, what it does is to enable the layman to get fairly good results where previously he would have got little, but at the same time it prevents the skilled man from getting any better performance, as he generally would if he could use his skill in making separate adjustments.

A Poor Alternative

Ganging is just a rather crude mechanical substitute for the skilled fingers and trained ear of the experienced operator, giving passable

I have spent a good deal of time on researches into the use of what is called Litz wire for the purpose of lowering the resistance of the coils. The results I got soon proved that I was on the right track; but, of course, it was not very long before the special iron-cored coils began to be heard of, and therein I found the entirely satisfactory solution of my problem.

The two tuned circuits of the K4 will therefore be found to contain coils of the Colvern "Ferrocart" type, which I have found to be very satisfactory representatives of the new class of high-efficiency coils. These circuits are arranged to give the maximum selectivity, without regard (at this stage) to the effect on quality of reproduction.

all the tiresome and expensive complications of the band-pass circuit, in order to avoid the weakening of the higher audible frequencies in relation to the lower ones, the L.F. correction method puts the balance right again by the use of low-frequency amplifying circuits which have what is called a rising characteristic.

By this is meant that they amplify the weakened upper frequencies more than they do the over-emphasised lower ones, and if the one effect is cunningly set off against the other, the result is reproduction of a perfectly normal, correctly balanced tone.

To get this, of course, calls for considerable skill on the part of

—Make the K4 His Greatest Achievement

the designer, and it can really be achieved only in the large set which does not use reaction. Even then there is liable to be some slight amount of regeneration going on which will vary in intensity at different points on the tuning range, so that the correction will not be exact for all stations.

"Tone Levelling"

The principle, by the way, provides a very interesting example of the way the commercial designer works; instead of aiming at a well-nigh impossible standard of perfection at every stage of his receiver, he allows an imperfection to occur at one point where it may have some sort of incidental advantage, and then corrects it with an imperfection in the opposite direction at some other point in the set. The result is just as good as that obtained by the less practical "theory merchant," and the method yields a great reduction in the cost and complication of the receiver.

It fails, however, in the case of the set which uses reaction, because the amount of correction needed varies according to the amount of reaction being applied at any given moment. The reason is obvious: reaction varies the sharpness of tuning, and it is this which governs the amount of L.F. correction required.

To get over the difficulty in the case of my ideal receiver, I have adopted a principle which I call "tone levelling," which is one of the very important features of the K4.

Getting Correct Balance

At first glance you may think that this consists merely of the use of a tone-controlled device, such as has been used many times before, but actually it is something much more than that. It is, indeed, a development of the highest importance, without which (or some equivalent) no set of this type can in the future be considered complete.

This is how it functions: we start by so arranging our tuned circuits (in the interests of selectivity) that they produce low-toned reproduction, with an excess of low and a deficiency of high frequencies, due to the extreme sharpness of the tuning. We follow this up with a low frequency amplifying side which is a little over-

corrected, even for those cases when reaction is being used almost up to the practical limit. In other words, it has such a steeply rising characteristic that it would result in the reproduction being a little too "bright" at all times, and decidedly so when no reaction is being used.

This gives us our "margin of control," and makes true tone levelling possible. We achieve it by providing in our over-corrected L.F. amplifying circuit a device that I call a leveller, which is in effect a tone control of a special type operating entirely in a downward direction; that is, with the control set at one end of its travel it has no effect, and then when it is taken round towards the other end of its range it *lowers* the tone progressively.

Since we started with a tone quality which was too high, or "bright," it follows that somewhere

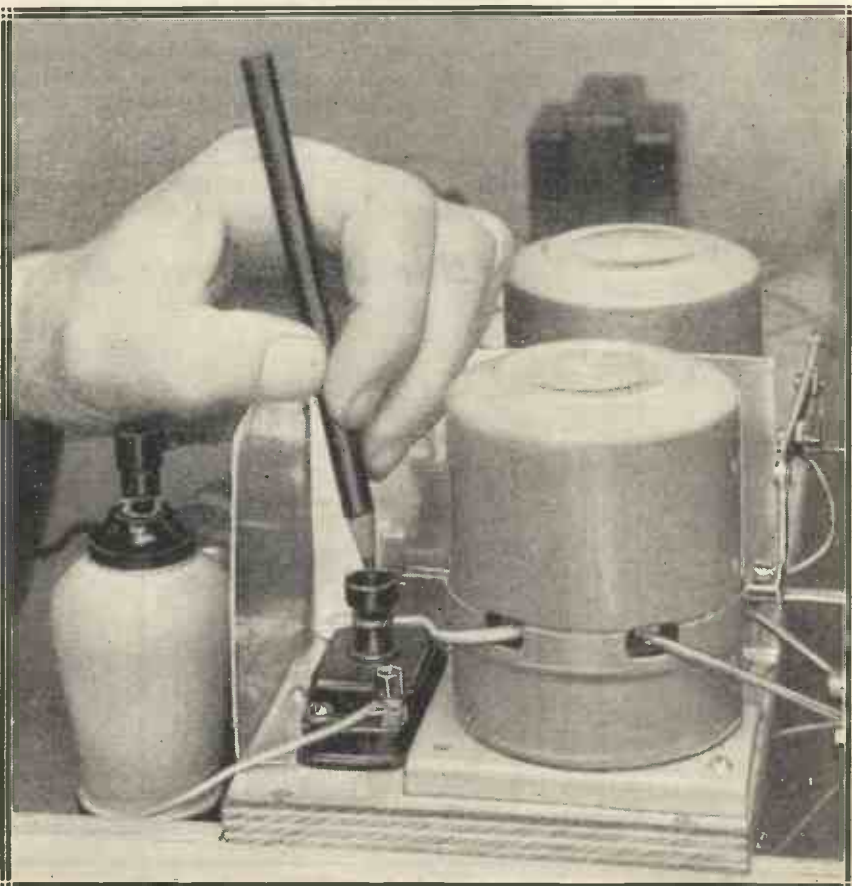
in the range of control afforded by the leveller there will be a point at which a correct balance is obtained. Further, this point of correct balance can always be found for any particular transmission, whatever amount of reaction may be in use.

"Tone" Without Risks

It is an extremely quick and easy adjustment to make, for one merely gives the leveller knob a twist one way or the other, and in a few moments a normally balanced tone can be obtained. It is not an adjustment calling for frequent re-setting, for it will usually be found that one adjustment will serve for all distant stations which need reaction, another for those which do not (these are in the majority, of course), and a third for the local station.

Actually, it is not a critical adjustment, and quality is quite bearable

THE K4 POSSESSES SELECTIVITY IN EXCELSIS!



An important feature of the K4 is the method of achieving high selectivity. There is the usual control in the form of an adjustable capacity in the aerial lead, but there are many other features which play their part. The H.F. resistance of the tuned circuits is exceptionally low, and it can be forced to extremes by reducing the amplification of the variable- μ S.G. valve and applying strong reaction at the detector stage. This restores the lost volume, and quality is maintained by an adjustment of the tone leveller.

The First Set in Which the Secrets—

if it is completely out. What this means, of course, is that the range of control is only just sufficient for the purpose, so that it is not possible to make the quality unpleasant by putting the leveller right out of adjustment. Its effect is just sufficient to enable you to get properly balanced tone at all times, without the risk of any unpleasant noises due to wrong settings.

A Basic Principle

These questions will, of course, be gone into in greater detail in the separate article on the operation of the set. It must be remarked in passing, however, that the leveller has another important use, that being to reduce heterodyne interference when it is necessary to do so even at a slight sacrifice of quality, as is sometimes the case. It is possible to set the various controls so that there is a considerable cutting off of the highest audio frequencies, and a consequent reduction in the strength of an interfering whistle. The selectivity of the K4 being so high makes this an unusual occurrence, but there are occasions when it is the lesser evil.

This is a brief and by no means exhaustive explanation of the important development of tone levelling, but it will serve to give the reader a

general idea of the basic principle on which the electrical design of the K4 is founded.

It is really just as important in its way as the "Step" principle, which is the basis of the mechanical design, and has just as much to do with the wonderful performance of the set.

Now let us see more in detail how these various effects are obtained. First, the sharp tuning of the individual circuits, and hence the high selectivity of the set as a whole, is due to the very low H.F. resistance of the coils, to the use of a comparatively small series aerial condenser, a special tapped input and tapped grid lead in the H.F. intervalve circuit, and the use of a variable-mu screened grid valve.

Maintaining Quality

This last is only an indirect cause, it is true, the point being that with such a valve the volume of a given station can be turned down by means of the bias control and then brought up again by the fairly strong use of reaction, whereupon tuning becomes even sharper. Quality is maintained meanwhile, of course, by the levelling process.

A novel detail refinement which may be noted at this point concerns the connections of the 50,000-ohm

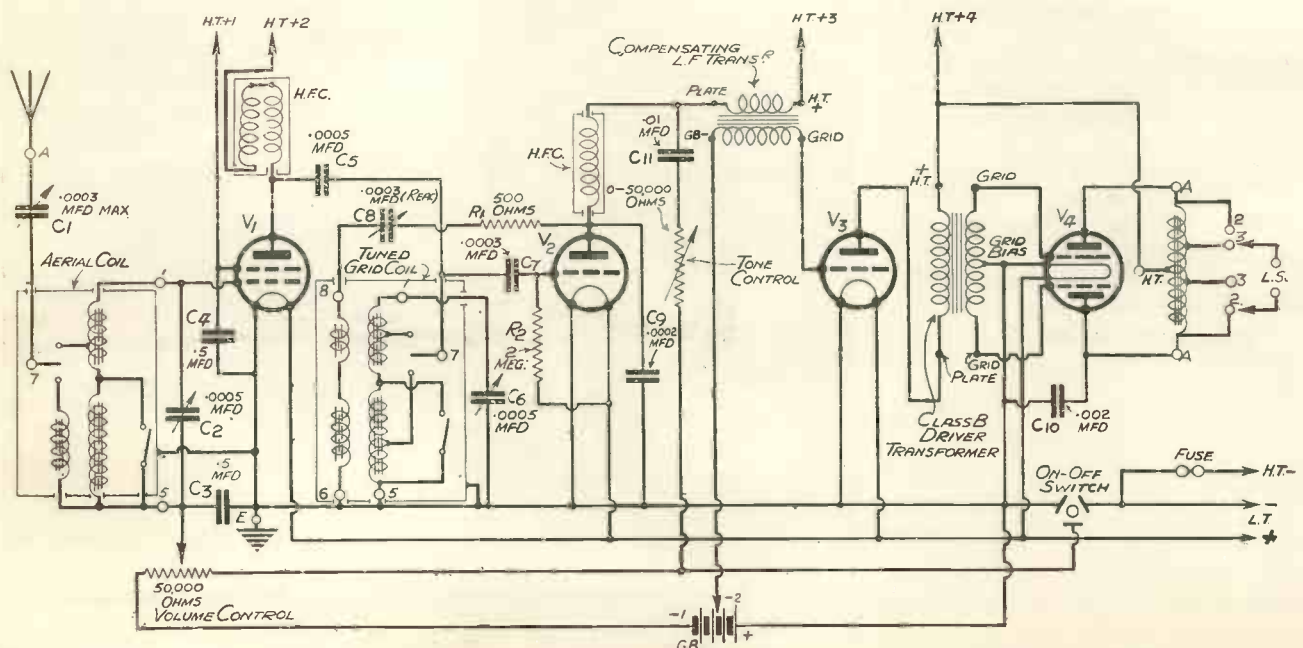
potentiometer which provides the bias adjustment on the S.G. valve. Observe that one element of the three-point on-off switch for the whole set controls a connection in this potentiometer circuit in such a way that in the off position the *current* from the bias battery through the potentiometer is cut off, but the full *voltage* of the battery is then applied to the grid of the S.G. valve.

Reaction Arrangements

The result is that as soon as the set is switched off any signal which was being received will be instantly quenched out by the excessive bias on the S.G. valve. This is important, for if the signal were allowed to go on for the brief instant while the valve filaments were cooling off there would be a considerable risk of damage to the Class B output valve.

In the detector stage you will observe that matters have been arranged with much care to secure the maximum sensitivity and enable the best possible use to be made of reaction. Note the way the reaction circuit is arranged, with a 500-ohm resistance to prevent parasitic oscillations, the .0002-mfd. by-pass condenser from plate to filament, and the now unfashionably large capacity of the grid condenser.

The K4 Secrets Revealed



Here is the circuit which co-operates with the Step system construction to make the K4 such an outstanding achievement in receiver design. Many of the special features can be understood from this diagram, but the vital principle of tone levelling can only be followed from the description in the text.

—of the “Tone-Levelling” System are Revealed

Following after the detector you will see a transformer-coupled L.F. stage, and it is here that most of the tone correction is done, the transformer used being of the “compensating” type. A certain additional tendency to a rising characteristic is obtained in the Class B output circuit, where I have omitted the usual tone-lowering condenser and resistance for that express purpose.

Conserving the H.T.

There are other points of a special nature in the circuit, but they are mostly matters of detail, and can be taken for granted. The one exception is the tone leveller, which consists of the fixed condenser of .01-mfd. capacity and the variable resistance of 50,000 ohms which you will see in the plate circuit of the detector. In effect the condenser is shunted to a greater or less extent across the primary of the compensating transformer, and so has a variable bypassing effect on the higher frequencies controlled by the setting of the variable resistance.

This method of tone adjustment, by the way, has an important incidental advantage which should be mentioned. It will, of course, be known to the reader that the H.T. consumption of a Class B stage is proportional to the strength of the signals which it is handling, and a moment's thought will show that it is bad policy to allow undesired frequencies to get as far as the output stage and then tone control them out of existence.

To do so is merely to waste H.T. in amplifying them, and then throw them away, so to speak. In the K4 the levelling system ensures that H.T. is only used to amplify frequencies which are actually wanted and will be allowed to reach the loudspeaker.

Combined Advantages

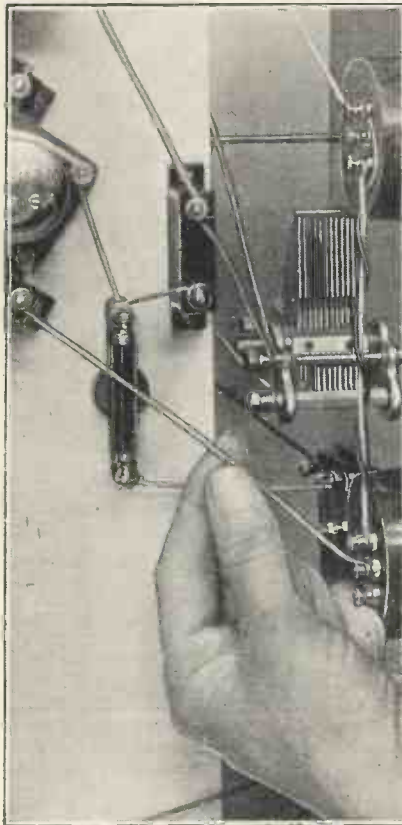
I rather stress this point, because the opposite procedure is so common that the reader may wonder why I have not followed the fashion. Actually, this is just one more illustration of the fact that the design of the K4 has been engineered, and not merely strung together on the lines of abstract theory.

There, we have now completed our survey of the K4 circuit, and I think the reader will be beginning to get an idea what a remarkable set it really

is, and how far ahead of contemporary design.

To sum up, I think we may say that it is the first set in which modern engineering methods of balanced design have been combined with all those features which the home constructor values most. In

PERFECT SPACING



A beautiful example of the way the Step System ensures perfectly accurate spacing of every lead. All that the constructor has to do is to stretch the wires between the points to be joined and pull them tight.

making that combination, of course, I have been so fortunate as to be able to draw upon both my considerable experience of commercial design and an acquaintanceship of ten years' duration with the likes and dislikes of the home constructor.

Of the two I really do not know which has been of the greater value to me. One sometimes sees commercial designs spoken of in a mildly patronising sort of way in journals devoted to amateur radio matters, but those who do this are really thereby convicting themselves of a great lack of understanding of the commercial man and his aims and methods.

The essence of commercial design work is that it is conducted within sharply defined limits, of which cost is only one. The designer who can get his results successfully within the limits which he must respect has to exercise a degree of skill and ingenuity which is far in advance of that required under the free and easy conditions which usually obtain among those who provide designs for the home constructor.

Attention to Details

To get his results in spite of the limitations imposed upon him, the commercial man must obviously devote much thought and research to his problems, and the training which he unconsciously receives is of the utmost value in teaching him that no detail is so small that it can be taken for granted. Every one must be scrutinised most carefully, and nothing must be regarded as too trivial to receive its due share of attention.

Let me take an extreme example of the way he must go into even the most seemingly minute details if his work is to be as successful as it should be. It may come as a surprise to the reader to know that a good designer will go so far as to devote anxious thought to the question of the kinds of screws to be used in assembling his set, but it is true.

First, there is the question of the material of which the screws shall be made, the general choice being between brass and plated iron (or mild steel). The iron screw is cheaper and also stronger, so that a smaller size can be used, but it is prone to rust if exposed to a damp atmosphere. Consequently, you will often find that iron screws are used in mains sets, where the designer knows that the slight warmth from the valves will keep the inside of the set fairly dry, whereas in battery sets brass screws are more likely to be seen.

Saving Money

In sets for certain overseas markets, of course, the effects of damp must be borne in mind very carefully, and here the screws are practically certain to be of brass. Many of the other materials of the set will in these cases also be chosen with due thought for their damp-resisting powers.

Having decided upon the material for his screws, the designer who knows his job will next go over his set in

Valuable Lessons from Commercial Work

detail to see whether he can reduce any further the number of different sizes of screws required in its assembly. The fewer the sizes needed, of course, the larger the quantity of each that will be required, and so the lower the price at which they can be bought.

Fewer sizes mean money saved in handling the screws in the stores, and also in the operations of the buying department of the firm. In some cases it may even pay to eliminate one or more of the shorter lengths and use a longer one which is required at some other point in the set, but not always, because the longer screw is more expensive, so you can see what complicated questions even the smallest details can raise for the commercial worker, and how involved his task really is.

Problems of Servicing

In some cases he has even to consider whether he shall use screws at all, or decide instead in favour of rivets or eyelets. This method of assembly has many advantages in a set built upon a metal chassis, for the materials are considerably cheaper than screws and nuts, and assembly is speeded up a great deal.

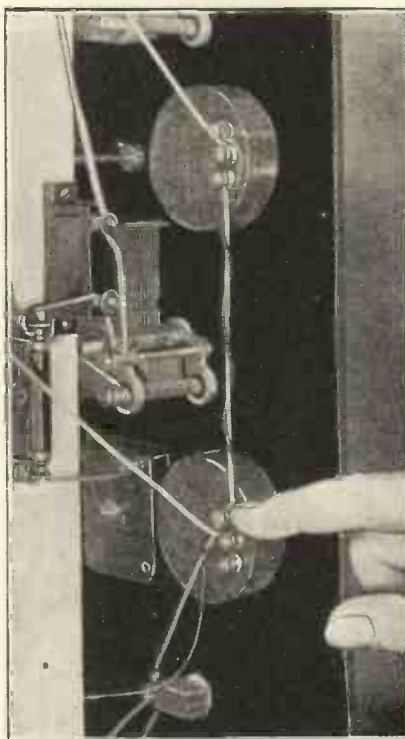
Instead of the comparatively slow process of inserting screws and tightening up nuts, the assemblers have merely to drop the rivet or eyelet in place and a punch does the rest. From the designer's point of view the method has also the important advantage of making as near certain as is humanly possible that every part will quite automatically be securely attached, a matter which is otherwise dependent upon the skill and care of the assemblers.

The reason why the system is not universally used is a good example of the way the commercial designer must weigh up all the factors and balance one thing against another. Apart

from certain obvious mechanical limitations, the rivet or eyelet system has the serious drawback that once a part is attached by this method it is on for keeps, and a surgical operation is needed to get it off again.

Serious problems connected with

ERRORS RULED OUT



You cannot fail to produce a perfectly wired copy of the K4 design if you just run your leads straight from terminal to terminal.

servicing therefore arise, and they may be so weighty that the method is ruled out. Imagine the struggles of a serviceman trying to replace a riveted part with his limited tool equipment, while the customer watches him! Actually, any set of this kind has almost always to be sent back to the factory for even the simplest of replacements.

It is therefore considered suitable only for those very simple kinds of sets, mostly of the battery-operated variety, which can be depended upon to need very little servicing. It may occasionally be seen in mains sets, but it is rather rare in the bigger ones, and when it is seen therein it denotes either a quite unusual degree of confidence on the part of the designer, or else the fact that he has been over-ruled by the production department!

After which digression I should like to return to a detail of the circuit

which rather illustrates my point. The reader will probably have noticed that in many Class B sets the output circuit is just a maze of by-pass condensers, put there for the purpose of combating the well-known tendency of push-pull circuits to generate oscillations of a high audible or super-audible frequency.

Just how strong this tendency may or may not be in the case of a modern "B" stage, no one seems to have taken the trouble to try to find out. Instead, the warnings of the valve makers as to the dire consequences of allowing a "B" valve to oscillate would appear to have led to a panicky determination to put in every possible kind of a "stopper," with the result that the cost of the set goes up by quite a number of totally unnecessary shillings.

The Oscillation Bogy

Now look at the circuit diagram of the K4, and you will see that a single .002-mfd. fixed condenser is all I have provided to prevent these dreaded effects. I have done all I can to make the set go into audio oscillation, and it just will not do it, so you may be pretty confident that here also I have saved you some money!

Actually, I believe the oscillation bogy has been very much over-estimated in the case of Class B circuits, especially in those which are wired up with a little care. Where I have found it troublesome, curiously enough, is in the quiescent type of circuit.

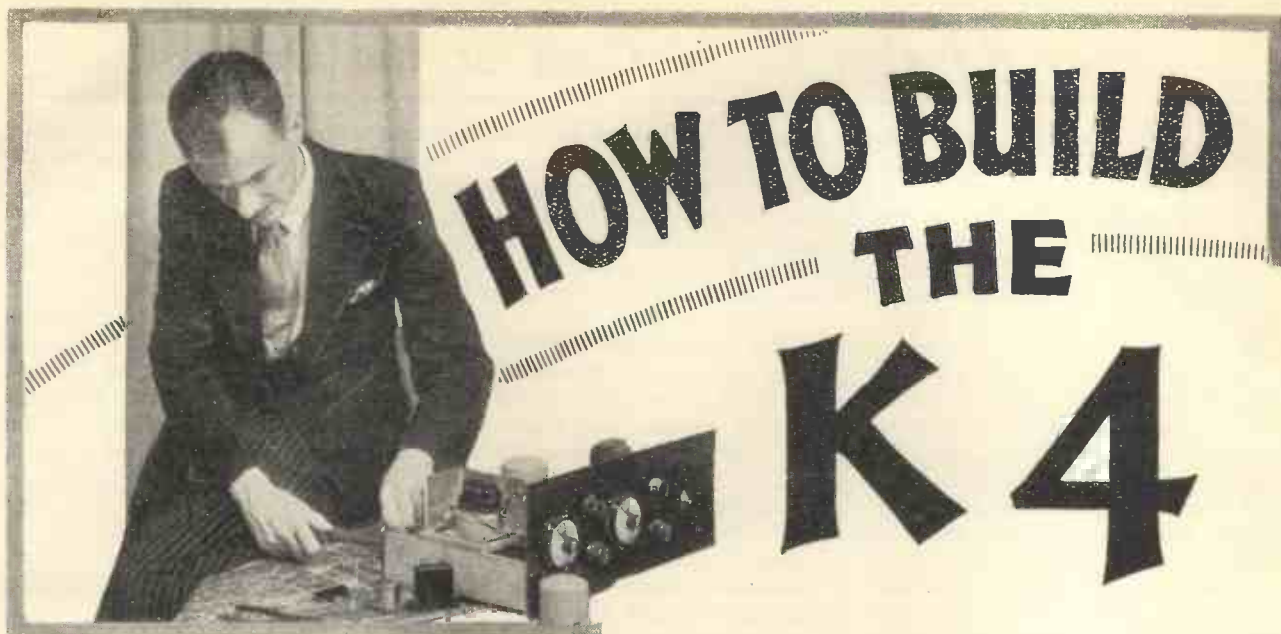
In the K4 the single condenser of .002 mfd. is adequate, and it is not even critical in value. Actually, the only capacity in the set which can be called critical is the one of .0002 (detector anode by pass). If this be much increased the set will not oscillate at the bottom of the dial, probably on the medium waveband.

TONE LEVELLING

In the tone-leveiling system used in the K4, Mr. Kendall makes the first properly-engineered application of the modern principle of tone correction to the needs of the home constructor's type of set. The result is perfectly balanced tone under all conditions, with complete control by the user.

SIGNAL QUENCHING

Typical of the thoroughness of Mr. Kendall's design work is the provision in the K4 of a special device to quench the incoming signal the instant the L.T. switch is opened. The emission of the "B" valve is thereby safeguarded, yet the cost of the set is not increased, again a very characteristic touch.



HOW TO BUILD THE K4

Superb Performance—Unparalleled Ease of Construction—Automatic Accuracy of Wiring

I MAGINE that if any designer has ever failed to remark that his latest set is particularly easy to build, it must have been the result of pure forgetfulness! It's just one of those things that one does always say, and of course it is always true, because there is progress in these matters, and so well-designed sets get more and more simple to build as time goes on.

Unfortunately, however, the idea has gradually come to be taken as a matter of course, and now that I have to introduce a set which marks a really substantial step forward in simplicity of construction, I want some stronger word than "easy" to emphasise the fact! My vocabulary doesn't seem equal to the task, for all the superlatives that I can think of at the moment either understate the case or else sound positively hysterical, so I think I'd better let it alone and trust to the reader to see for himself that the ease of construction of the K4 is something in quite a different category from that of any set built on the old-fashioned panel and base-board plan.

The Step Frame

Let us therefore make a start and see what we discover as we go along. We might well begin with the Step framework, for that may have struck the reader as a possible source of difficulty, and we may as well find out right away whether any awkwardness is really involved in putting it together.

If, of course, you buy your Step frame ready-made, the question will not arise, and I expect it will be possible to do this, for the usual enterprising firms are pretty sure to offer it complete and ready for use. I don't know what the price will be, but it should be very moderate, and no doubt those who are not fond of carpentry will take advantage of the fact.

The Best Start

Even if the constructor decides to make his own framework he will find it a perfectly simple job, but if he likes woodwork as little as I do he will be well advised to do as I did and get the local joiner to cut the four pieces of wood to size for him, so that he has merely to screw them together.

I should have got the screwing done but for the fact that I was anxious to preserve the secret of the Step System as long as I could. I was obliged, therefore, to do it myself, and much as I dislike working in wood I must confess that it proved such an easy and quick job that it was over long before I reached the stage of muttered profanity to which I am usually reduced by such operations.

This is what has to be done. You take the piece of wood which measures 18 by 2½ inches (Step No. 1) and to the ends of this you screw the two short pieces, edgewise to it. Not very lucid, did I hear you say? Well, you try and put it clearly in words yourself

and you will soon find it can't be done!

It doesn't matter, however, because all you need do is to refer to the drawing in my separate article on the Step System and you will see exactly what has to be done. All that I am doing here is to suggest that it is best to start by fixing the two short spacing pieces to Step No. 1 (bottom member).

In doing so, be careful to see that you get the two edgewise bits parallel to each other, and at right angles to the piece which forms Step No. 1. This done, the wider piece which forms Step No. 2 must be screwed to the other edges of the spacer pieces.

To see where this should be attached reference should again be made to the drawing which I have already mentioned. As a guide I would mention that the front edge of Step No. 2 should come exactly over the rear edge of Step No. 1, without overlapping at all, another point which will become clear after inspection of the drawing and almost any of the photographs.

Making a Strong Job

To make a really strong job it is best to glue the joints in addition to screwing them together, and the easiest way to do this is to assemble the frame first of all without the adhesive, then take it apart again and smear the joint surface lightly with any convenient "sticker" like "Seccotine," after which it can be put together again finally.

By the way, it pays to "Seccotine"

Your K4 Can be as Good as the Original

just one joint at a time, screw that one together, and then go on to the next. No doubt if one was sufficiently careful it would be satisfactory to treat all the joints at once and then proceed with the assembly, but in practice it would be found awkward to handle all those bits of wood with sticky places at each end.

There is no real need to put the finished frame aside for the joints to set, because they will be held quite sufficiently by the screws, and you could if you wished go straight ahead and mount the components in their places. However, you really want the panel with all its parts mounted thereon to help you with the interior layout of the set, so if you next drill the panel and attach the various components which belong there it will give the framework joints a chance to harden a bit.

Panel drilling is a job we all understand, I think, and I am not going to insult the reader's intelligence by telling him how to do it. There are, however, one or two points peculiar to the Step System, or to the K4, to which I must direct his attention.

An Important Point

First, there is an important little detail about the method of attaching the panel to the Step framework. This is done by passing screws through the panel and into the ends of the two wooden side members of the frame. These screws should be of fair length, since they have to stand a considerable strain while the set is being handled, and I suggest $\frac{3}{4}$ -in. ones, round or countersunk heads,

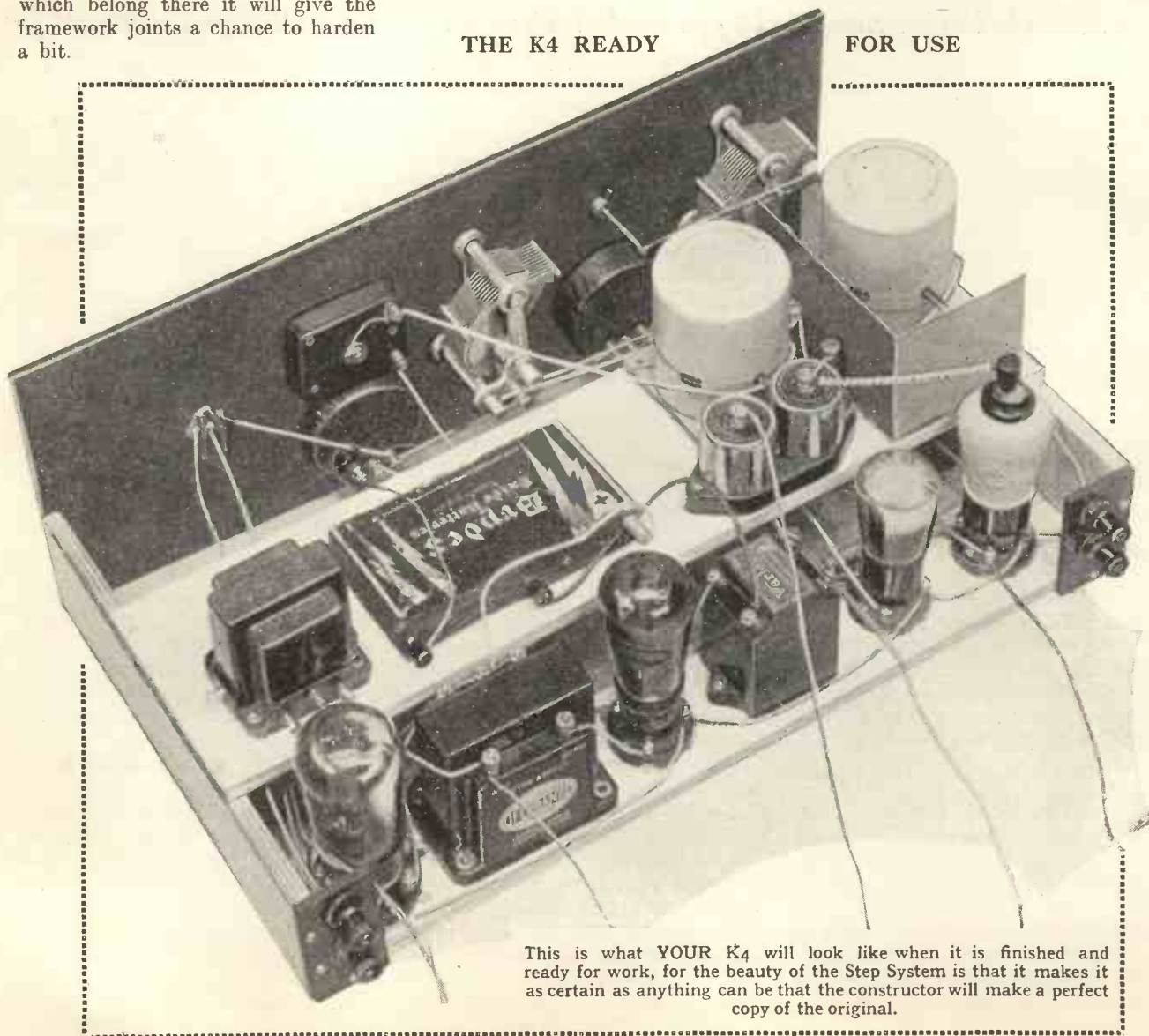
according to the type of cabinet which will eventually house the set. If this will cover the screws they may be of the C/S head variety, but round heads are to be preferred in those cases in which they are left exposed by the cabinet-work.

The important point really concerns the *position* at which the framework is attached to the panel, for it is not difficult to go wrong here. The point is this: the side members of the frame must be fixed at such a height that there is a space of $\frac{3}{8}$ in. between their undersides and the lower edge of the panel.

Let me make this quite clear. Examine one of the photos showing the finished set, and imagine that it is standing upon a table, out of its

THE K4 READY

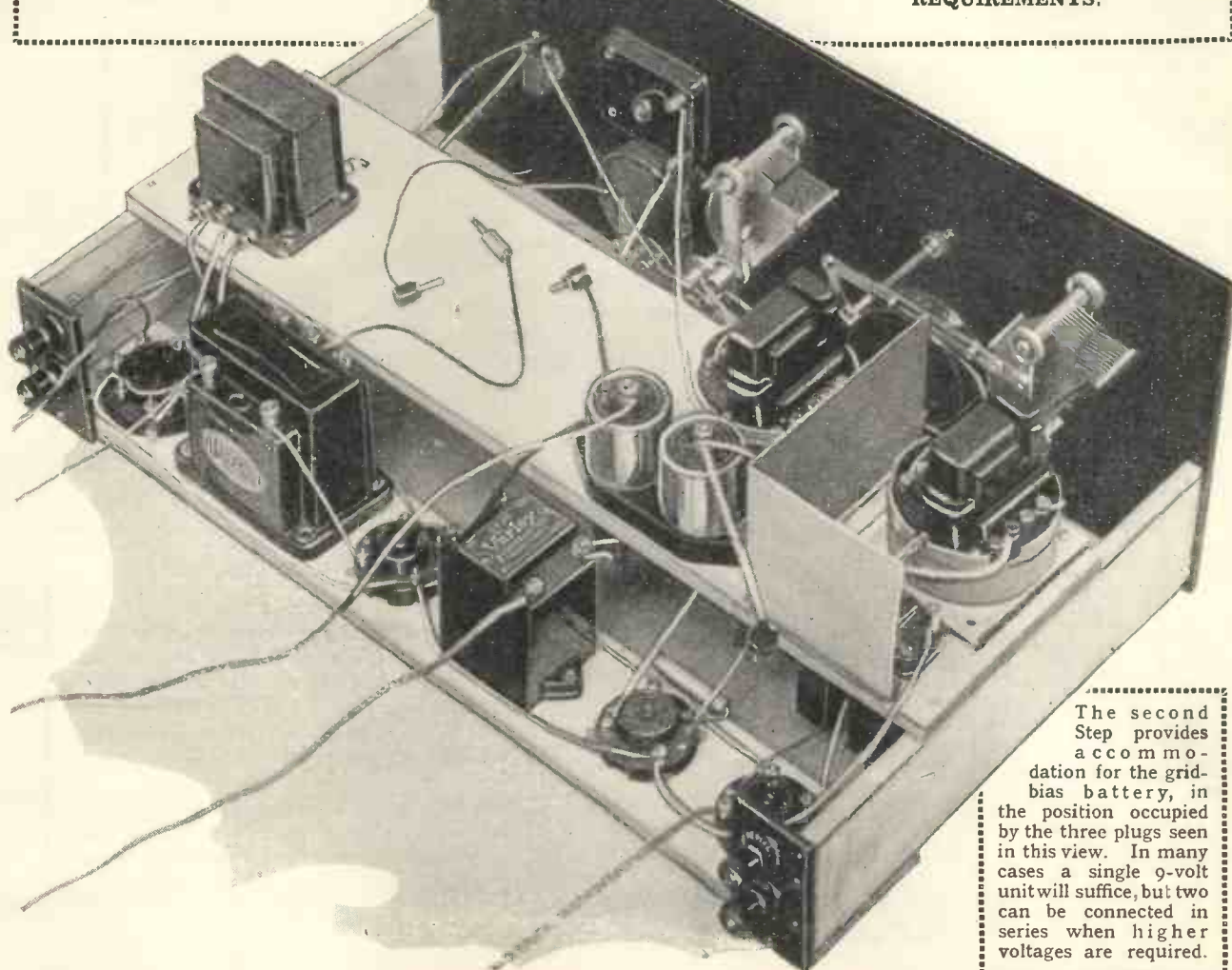
FOR USE



This is what YOUR K4 will look like when it is finished and ready for work, for the beauty of the Step System is that it makes it as certain as anything can be that the constructor will make a perfect copy of the original.

WHAT ARE THE PRIMARY ESSENTIALS FOR A FIRST-CLASS RECEIVER ?

WITHOUT A DOUBT THEY MUST INCLUDE SELEC-TIVITY — RANGE — POWER. THE K4 ANSWERS "YES" TO THESE THREE MAIN REQUIREMENTS.



The second Step provides accommodation for the grid-bias battery, in the position occupied by the three plugs seen in this view. In many cases a single 9-volt unit will suffice, but two can be connected in series when higher voltages are required.

cabinet. Resting in contact with the table will be the lower edge of the panel and the underside of Step No. 1 (the one on which the valves are mounted). The lower edges of the side members of the wooden frame (the two spacing pieces which separate the two steps, and are placed on edge) will not touch the table, but will have a space of $\frac{3}{8}$ in. underneath them.

A Third Step

This space is equal to the thickness of Step No. 1, and would leave room for another strip of plywood to be screwed to the underside of the side members if desired. Thus, a third Step could be fixed so that it was close up against the back of the panel, at the same level as Step No. 1. In some sets I can imagine that such an addition might be helpful, but it is not needed in the K4.

Instead, we may in some cases want to fix in this position a much narrower strip of wood than a Step for the purpose of stiffening the lower edge of the panel. This must be done in some suitable fashion, for if it is merely supported at the ends where it is screwed to the side members of the Step frame it will be rather whippy, and the controls of the set will be difficult to operate.

There are various ways of producing the desired stiffening, the simplest being the one I used myself. This applies to those cases in which the cabinet is of the type where the set pushes in from the front, and in which a little strip of wood called a fillet will usually be found running across the top of the cabinet inside.

It is intended that the upper edge of the panel shall rest against this fillet when the set is pushed right

home in the cabinet, but I found that better support was given if the fillet was removed from its original place and refitted in a corresponding position along the bottom of the cabinet, so that the lower edge of the panel rested against it.

Panel Support

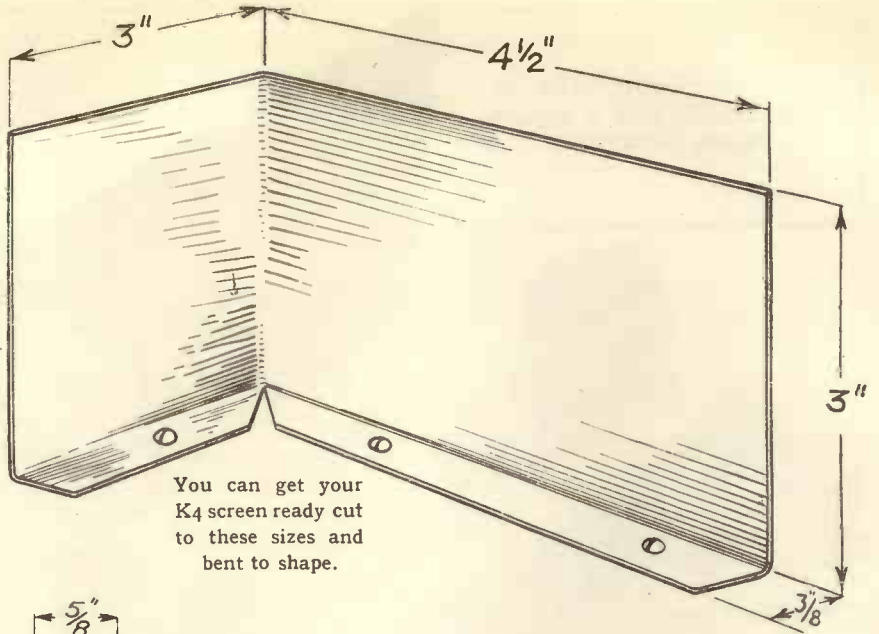
When this is done some small screws can be passed through holes in the lower edge of the panel and into the fillet, whereupon the panel will be found to be well supported. Suitable positions for the holes for these screws are indicated on the panel drilling diagram.

If the cabinet employed is of the kind in which you push the set in from the back, this method of panel support will not serve, and it is in these cases that the extra strip of wood should be attached to the Step

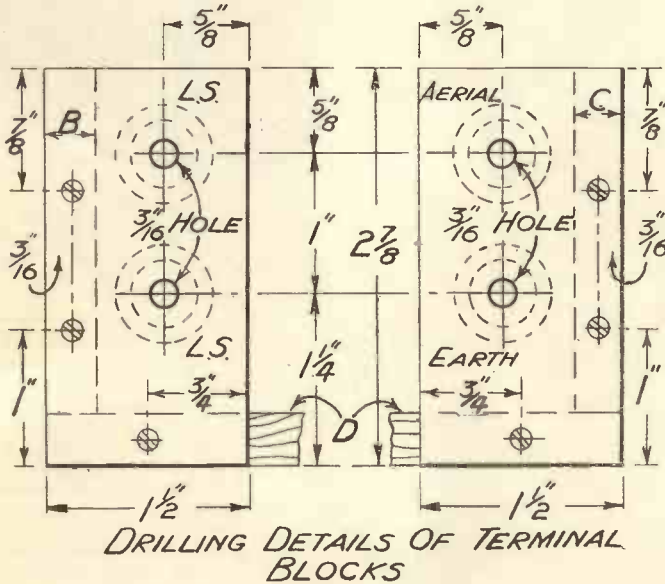
ALL IT NEEDS

Here are the actual dimensions of the little screen which is all that the K4 needs to ensure adequate stability. A comparison with the elaborate screening of earlier types of receivers will help the reader to a better understanding of the remarkable efficiency of layout spacing which can be achieved with the aid of the Step System.

To dispense with elaborate screening not merely makes construction easier, but removes a potential source of losses of various kinds.



You can get your K4 screen ready cut to these sizes and bent to shape.

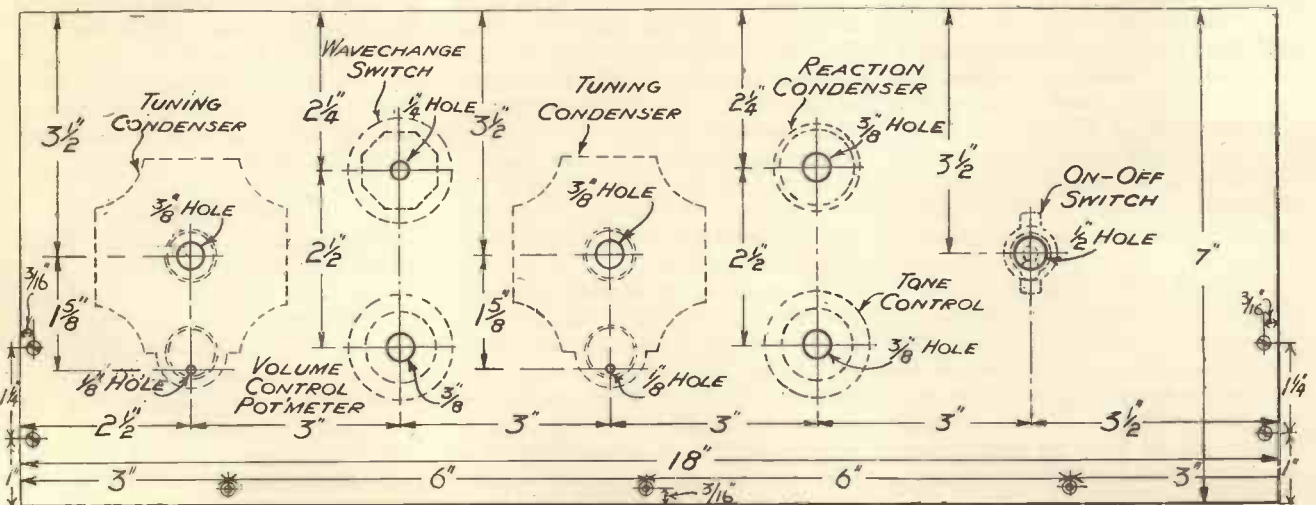


ONLY FOUR TERMINALS

The battery leads take the form of flex connections made direct to the appropriate points on certain components in the receiver, so the only terminals which the set needs are those for aerial and earth, and loudspeaker.

The drilling points and dimensions for two little ebonite plates to carry these terminals will be found in the diagrams on the left.

Note that they form a right- and left-hand pair, and bear the point in mind carefully when countersinking the holes for the screw-heads.



The sizes for the holes given here are correct for the specified makes of components. This is a point which should be taken into account if any changes are made in the makes actually used.

Real Moving-Coil Volume

frame itself. This strip should be of the same thickness as the rest of the woodwork, i.e. $\frac{3}{8}$ in., 18 in. long, and about 1 in. wide, and it should be screwed to the side members, so that it runs along behind the lower edge of the panel.

No Piecemeal Wiring

To secure the maximum support for the panel, screws should be driven through holes in its edge as before, and into the stiffening strip. The same positions will serve for these screws as those referred to in connection with the previous method, and the drilling diagram should, therefore, be consulted.

The stiffening strip, by the way, should not be fixed in place until the wiring of the set is finished, in order that access to the various parts on the back of the panel may be as easy as possible while the wiring is being done. The strip does not get seriously in the way, but things are a trifle more accessible if it is not there.

With some sets, it is best to wire up the parts on the panel, as far as possible, before screwing panel and baseboard together, but there is not the slightest need to do so with any set built on the Step System. Every component on the panel remains completely accessible after the panel is attached to the frame which replaces the baseboard of the old-fashioned set, and can be wired up with the greatest of ease. The assembly of the set can, therefore, be carried right through to its conclusion, and then the wiring can similarly be done as one complete job. There is an obvious saving of time here, and the elimination of the risk of wiring errors due to carrying out the operation in two stages.

Order of Assembly

There are just one or two special points I should mention about the assembly process which will save the constructor time and trouble, being mostly things which I did wrong myself when I built the first K4. In this connection, the reader may be amused to learn of a little institution of mine which enables me to make quite certain of including all such points in my articles for the benefit of those who will follow in my footsteps.

Whenever I build a set I have beside me on the bench what I call the "Silly Ass Book," and when I find

that I have done something which would have been better done differently, I just reach for the book and make a note therein, instead of wasting time in calling myself names. Then when the time comes for the "How to make it" article to be written, I go through my notes and see that my readers are duly warned not to do likewise. By the way, the title of the book, it is to be understood, refers to myself, not to my esteemed readers!

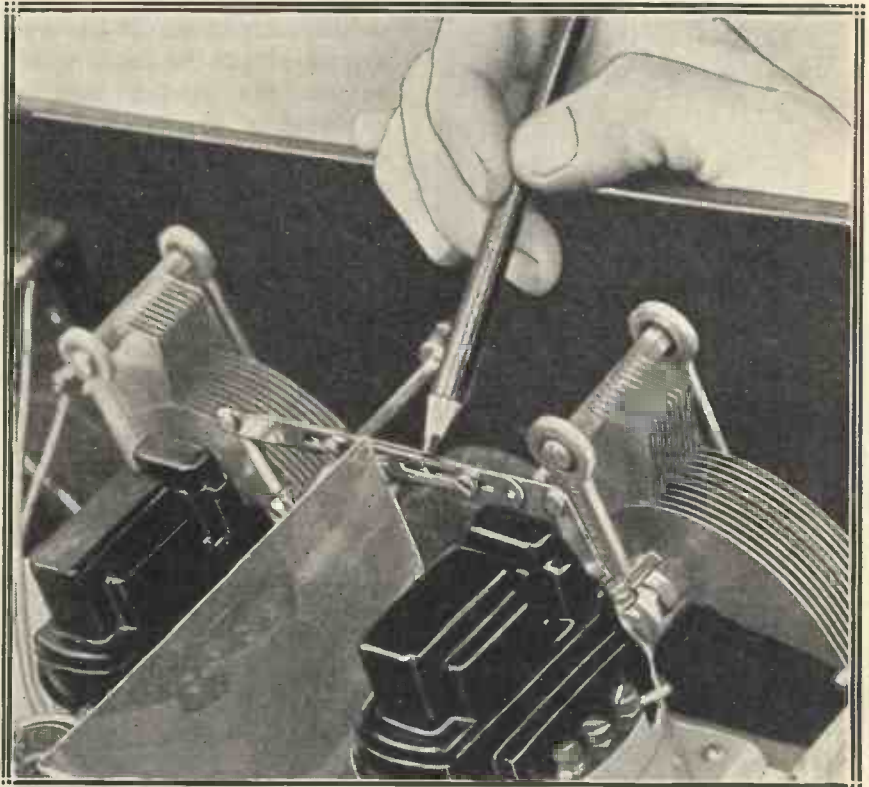
The first thing I discover from my notes on the K4 is that it is advisable to mount certain parts in Step No. 2

mounted, and the position for this is not critical, so long as it is just lined up by eye with the other unit. Next the two wavechange switching rods should be slipped through the coils, the long spindle being placed in the F3 unit and the short one in the F10. The long spindle, of course, reaches to the panel and is inserted in the bush of the control knob, being secured therein in the usual manner with a grub screw.

Linking the Coils

The short spindle is linked up by means of the Telsen coil ganging de-

ONE KNOB CONTROL OF WAVECHANGING



The wavechange switching spindles are linked so that they may be controlled from the customary single knob on the panel, and it is interesting to note that the linking device must be earthed as shown on the Construction Chart by the lead marked AN.

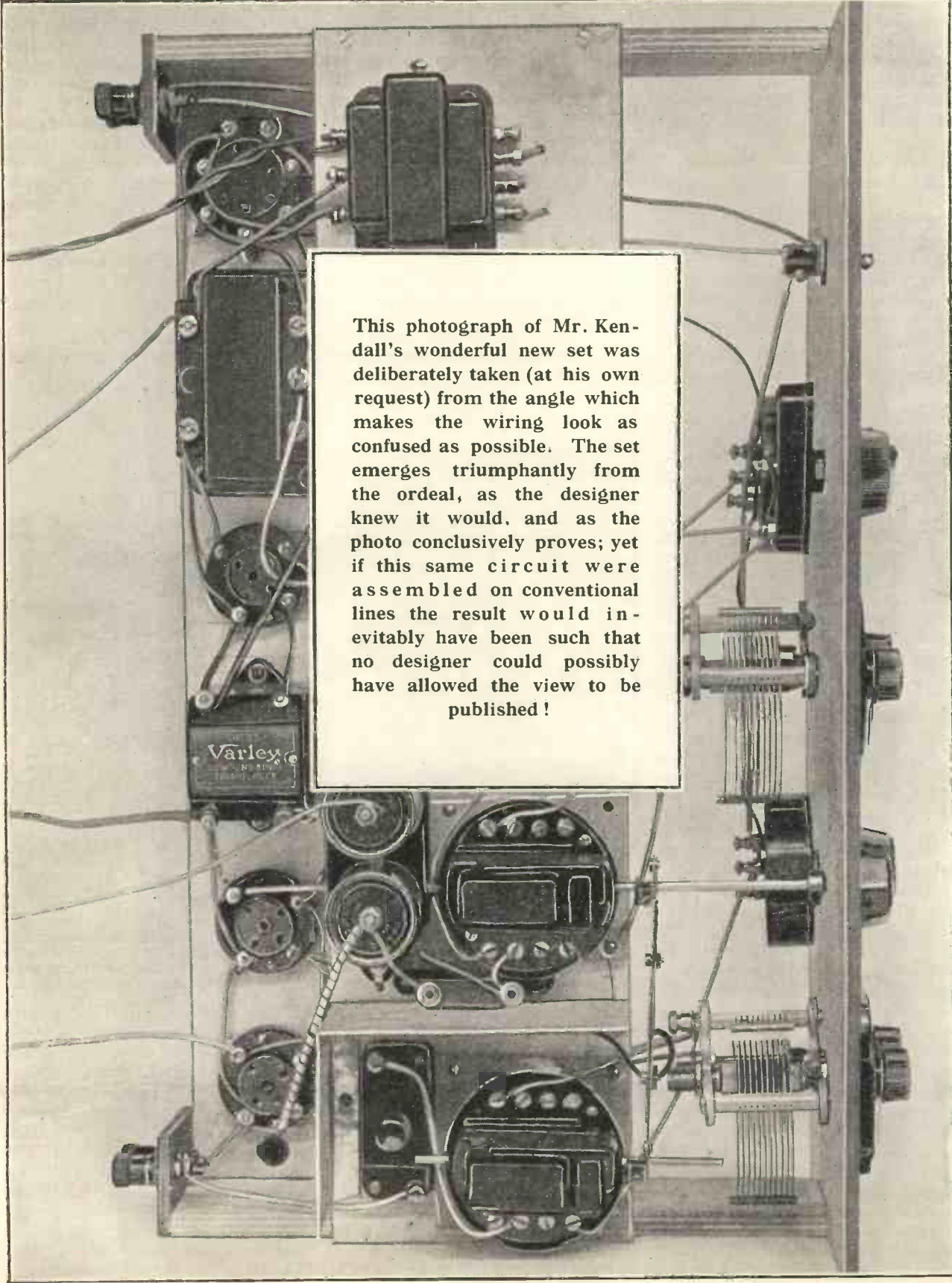
in a particular order if the job is to be as easy as possible. This is how you should set about it: Fix first of all the F3 type coil unit, taking care to line it up accurately with the hole in the panel for the wavechange spindle, slipping the spindle into place to act as a guide while you do this. Of course, you will also be careful to see that the coil is mounted the right way round, so that the terminals come in the positions shown on the Construction Chart.

The F10 type coil should next be

vice, the fitting of this being quite obvious upon inspection. See, however, that the two coil switching spindles are in the same positions before you finally tighten up the grub screws of the ganging link, otherwise you will find that one unit is switched to long waves when the other is on medium. To guard against this just see that the flat on each spindle points the same way.

With the two coil units in position and their controls linked up successfully, you should next proceed to fix

“Unscrambling” the Radio Receiver



This photograph of Mr. Kendall's wonderful new set was deliberately taken (at his own request) from the angle which makes the wiring look as confused as possible. The set emerges triumphantly from the ordeal, as the designer knew it would, and as the photo conclusively proves; yet if this same circuit were assembled on conventional lines the result would inevitably have been such that no designer could possibly have allowed the view to be published!

Novelty in Design, Novelty in Performance

the .0005-mfd. fixed condenser which goes alongside the F3 unit. If you examine the wiring blueprint you will find that a connection comes away from one terminal of this condenser and goes down through a hole in the Step to a terminal of the .0003-mfd. condenser underneath, and the hole for this should next be bored close up alongside the condenser. It rather depends on the kind of weapon you are going to use to make the hole, but in some cases it may be easier just to mark out the position for the condenser first and then bore the hole before actually fitting the component in question.

Avoiding Accidents

With the hole bored and the .0005 condenser in position, you should next fit the .0003 condenser on the underside of the Step, taking care not to cover up the hole you have made. An obvious point, perhaps, but I have proved in my own person that it is quite possible to forget it! (What I actually did was to fit the two condensers first and then try to bore the hole afterwards, which led to a heavily underlined entry in the "Silly Ass Book.")

The next components to be fitted should be the binocular choke and the series aerial condenser (the compression type, beside the F10 coil unit), also the output choke at the other end of the Step. This completes the upper surface of Step No. 2, with the exception of the fitting of the screen, which should be left until later because it gets in the way if fitted too soon, making the set less easy to manipulate while the various parts are being fitted to the underside of Step No. 2.

Obvious and Simple

These parts, comprising the reaction choke, anti-parasitic resistance in the reaction circuit, and sundry fixed condensers, should be fitted next. The only point for comment here is the rather obvious one of reminding the constructor to take reasonable care to copy the original layout, because it must be remembered that in the Step System it is the exact position of the parts which settles the run of the wires, and hence the correctness of their spacing.

When you have finished both sides of Step No. 2 you can turn your attention to Step No. 1, and here there are really no special points requiring

actual explanation. It is a perfectly straightforward job, in which the photographs and chart will give you all the information you need, but the same warning as to taking reasonable care to position the parts correctly should perhaps be repeated.

As regards the two little terminal plates, one of which will be seen at either end of Step No. 1, these can, of course, be cut, drilled and fitted with their terminals at any stage of the proceedings, but I should advise that their fitting should be left until the wiring of the set is finished as far as it can be done without them. The reason is simply that they make it a little difficult to wire up certain parts at either end of Step No. 1 if they are fitted too soon. This applies more particularly to the L.T. leads for the set, i.e., the flex lead which goes off to the battery, so don't forget to fit this before you fix the loudspeaker terminal plate.

SOONER OR LATER you will build a set on the Step System. Why not build the K4 NOW, and begin to get the benefit of the wonderful efficiency of the new system right away? Why tolerate that old-fashioned receiver any longer?

I have now crossed out all the entries in the "Silly Ass Book," in other words I have warned you of all the pitfalls into which I fell myself, as well as certain others which I managed to dodge, but which would be less obvious to anyone who has not studied the Step System as exhaustively as I have. All the rest of the construction of the set is really absolutely obvious and simple, and I am not going to presume to teach the readers of "M.W." how to do it.

When we come to the wiring, however, there are certain points which I think I ought to explain, because there are special aspects of the job which are peculiar to the Step System.

In the first place, you will remember that the general rule for wiring a stepped receiver is to stretch each wire between the appropriate points and pull it tight. Now, to do that easily and without putting a heavy strain on the terminals of the components you should really wire up

with a thinner and more flexible material than is commonly used.

I used, and strongly recommend, ordinary tinned copper wire of No. 20 gauge, which can be pulled straight with very little strain, especially if it is given a preliminary straightening before use. (Cut it up into lengths of about 18 in., and give each a good stretching by clamping one end in the vice and pulling hard on the other with a pair of pliers.)

Straight Wiring Methods

For the best results, the wire used should not be thicker than the gauge I have mentioned, but the next thinner (No. 22) could be used if No. 20 cannot be got. If you find it impossible to purchase either size locally, and don't want to wait until it is obtained for you, by all means use one of the heavier sizes, like No. 18, which are commonly sold for the purpose, but you must expect to find that you will then have to take a little extra trouble to get the neat and perfectly spaced wiring which is so characteristic of the Step System when the "pull it tight" method can be used.

What you will have to do, you will discover, is to cut each wire to length and fit it in place very much as though you were wiring up one of the older types of sets, so that you will have lost one of the benefits of the new system. You will still have the advantage of straight leads, of course, so that it will still be much easier than it used to be in those sets in which the leads had to be bent into all sorts of complicated shapes in order to dodge obstacles and secure proper spacing.

No Risk of "Shorts"

If you are using the thinner gauge, and pulling each lead tight, there is just one point at which you must exercise care, and that is in making any connections between components on the panel and others on the Step framework. If you pull these too tight you will find that the panel is drawn out of true and becomes bowed, so be a little gentle with all these leads.

It is the custom to encase the leads of a radio set in insulating sleeving or other protective material, but this is not strictly necessary in the case of the majority of the leads in the wiring of the K4, because they are so well spaced and held in position that it

(Continued on page 304)

COMPONENTS

THE COILS



One pair Colvern Ferrocart coils, type F10 and F3, with one 4½-in. and one 5½-in. switch coupling rod.

Separate coils, not the type on a common base, are required for the K4, in order that they may be mounted side by side in the positions seen in the photographs. The coils

play a very important part in the design of the K4, and alternative types would involve circuit alterations. The F3 is used for the tuned grid coil, with the F10 as the aerial coil.

REACTION CHOKE



One reaction type H.F. choke. Graham Farish in original design, actually of the screened type, but this is not essential; an unscreened type will

be satisfactory. A few good alternative makes are these: Telsen, Bulgin, Wearite.

In choosing a choke for this position some attention should be paid to the placing of the terminals, in order to ensure that the wiring shall run as in the original design. Remember that the Step System calls for component terminals to be placed in certain definite positions if full advantage is to be taken of its "straight-line" wiring features.

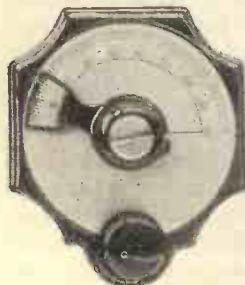
TUNING CONDENSERS



Two .0005-mfd. variable condensers. Graham Farish, or Polar Utility, etc. It is essential that the projection of the condensers behind the panel

should not exceed three inches, otherwise they will foul the raised "Step" baseboard.

SLOW-MOTION DIALS



Two slow-motion dials. Ormond, or Igranic, etc. In ordering these be careful to specify the size of the condenser spindles.

The type used on the original set were chosen for their clear and well-graduated scales, which

make accurate logging easy. The moving cursor carries a "hair-line" indicator which permits very close readings to be taken.

POTENTIOMETERS



Two 50,000-ohm wire-wound potentiometers. Graham Farish, or Wearite, Igranic, Lewcos, etc. Only one of these components is actually used as a potentiometer, the other serving merely as a variable resistance. This latter is the tone-leveiler control.

SEVEN-PIN HOLDER



One seven-pin valve holder. Benjamin, or Wearite, W.B., etc. A good holder is very important for the Class B valve. Just imagine the difficulty of tracing one poor contact among seven! Be careful, also, to see that you wire up

this holder according to the positions of its terminals, having first mounted it exactly as shown on the Construction Chart.

FOUR-PIN HOLDERS



Three ordinary four-pin valve holders. W.B., or Benjamin, Telsen, etc. The K4, in conjunction with modern valves, is not prone to microphonic effects, hence it is not necessary

to select holders of the very elaborately sprung type. Certainty of contact is the main requirement nowadays.

TERMINALS



Four indicating terminals, one marked aerial, one earth, and two loudspeaker. Igranic, or Belling & Lee, Bulgin, Clix, etc.

No battery terminals are required for the K4, because the battery flex leads are connected direct to appropriate points on the internal wiring. There is therefore no full-size terminal strip.

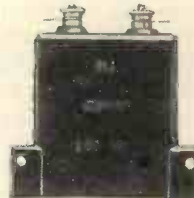
REACTION CONDENSER



One .0003-mfd. reaction condenser. Telsen, or Polar, Graham Farish, J.B., etc. A solid-dielectric component was used here, but, of course, any good condenser the constructor may possess can be used.

A capacity of .0002 mfd. would serve, so long as a detector of the "lively" type is used, the larger capacity being used in the original to provide a reserve of safety.

FIXED CONDENSERS



Two .5-mfd. condensers. T.C.C., or Dubilier, Telsen, Lissen, etc. These serve as H.F. by-passes, and must therefore be of the non-inductive type. Their capacity is not critical, and if you have some of any size round about the one specified you

should try them. If the set is to be used with a mains unit, however, do not go below .5 mfd.

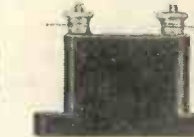
FIXED CONDENSERS



One each of the following sizes: .01, .0003, .0002 mfd. Dubilier, or T.C.C. It is essential that these should be of the edgewise type, with terminals in the positions shown in the photographs, for the sake

of the Step System wiring.

FIXED CONDENSERS



One each of these sizes: .002 and .0005 mfd. T.C.C., or Telsen, Dubilier, Lissen, etc. Of these two condensers the one of .0005 must be of the edgewise type as above, since it fits into a small

space between the screen and the second coil unit.

OUTPUT CHOKE



One Class B output choke. Sound Sales in original set. In the case of this component and the Class B input transformer it is possible to choose alternative types from leading makes such as Varley, Ferranti, R.I., Telsen, etc.

The reader is urged, however, to study with care Mr. Kendall's remarks on this subject in his article on the operation of the finished set.

COMPENSATING TRANSFORMER



One compensating transformer, type D.P.35. Varley, or Telsen, R.I., etc. This component forms an essential part of the tone-leveiling scheme, and great care must be taken to comply with the author's specification. Any ordinary transformer here would

put the whole system of tone compensation out of action and impair the quality given by the set.

FOR THE K4

DRIVER TRANSFORMER



One Class B input (or driver) transformer Ferranti type A.F. 17(C). For general notes on the question of alternative types, refer to the remarks made in connection with the output choke.

Note that the centre-tap terminal on the secondary of this transformer is marked "G.B.," but since no bias is used on the particular B valve in the K4, this terminal is wired straight to the filament circuit. It would be connected to the grid battery with a Marconi-Osram B.21 valve.

COMPRESSION CONDENSER



One .0003 mfd. compression condenser. Telsen or Igranic, Polar, etc. This component provides a form of selectivity control which enables the

set to be adjusted to individual aerials and local conditions generally. On very small aerials it should be short-circuited.

WIRE-END GRID LEAK



One 2-meg. grid leak with wire ends. Lissen or Telsen, Dubilier Igranic, etc. This component is fitted direct to the appropriate terminals of the detector valve holder.

FIXED RESISTANCE



One 500-ohm resistance and holder. Graham Farish "Ohmite" or similar type. The function of this resistance is to prevent para-

sitic oscillations in the reaction circuit, and its value is not critical. 500 ohms is the conventional figure, but any value from 300 to 1,000 ohms was found to serve the purpose satisfactorily.

H.T. PLUG AND FUSE



One combined H.T.— plug and fuse. Belling & Lee. Costs very little, but may save a good deal some day. If it

ever blows make sure that you have found the cause before replacing it, but note that a fairly heavy rating one is needed for any Class B set.

PLUGS AND CONNECTORS



Seven battery plugs, two L.T. spades, and one "anode connector." Belling & Lee, or Clix, Bulgin, etc. For markings see Construction Chart.

ON-OFF SWITCH



One three-point on-off switch. Bulgin Q.M.B. type. The third contact is used to switch off the bias battery from the pre-detector volume control and to operate the instantaneous signal-quenching circuit. This last is an important

feature of the receiver, since it has to safeguard the health of the Class B output valve.

SCREWS



Packet of assorted screws. Peto-Scott. A suitable size is No. 4 and round heads are preferable. A selection of lengths such as $\frac{1}{2}$, $\frac{3}{8}$, $\frac{1}{4}$ and $\frac{3}{16}$ will be required, but the actual assortment will depend upon the particular makes of components used in building the set.

WIRING MATERIALS

Six yards No. 20 or 22 gauge tinned copper wire, five yards insulating sleeving, a few inches of screening material for anode lead of S.G. valve. Goltone or Leweos, etc. It is to be noted that the use of a comparatively thin gauge of wire for the leads is important if



the full benefit of the easy wiring of a Step System receiver is to be obtained. This point is fully explained in the article on the construction of the K4 receiver.

BINOCLAR CHOKE



One screened binocular H.F. choke. Telsen or Graham Farish, etc. A component of high efficiency is essential here, for it has a very

important duty to perform in the H.F. amplifying circuits.

SCREEN



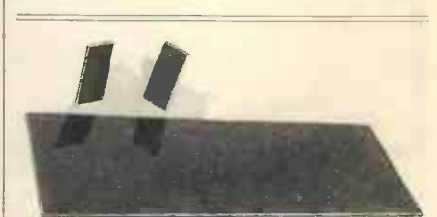
One special K4 screen. Peto-Scott. A detailed drawing giving the dimensions of this screen will be found elsewhere. It is an interesting tribute to the efficiency of the Step System layout of the K4 that so small a screen is all that the set needs to ensure adequate stability.

STEP FRAME



One complete Step System framework, or set of pieces of wood for making. Peto-Scott. The necessary information as to sizes, method of assembly, and so on, are given in the special article on the Step System elsewhere in this issue.

PANEL AND STRIPS



One panel, 18 in. x 7 in. and two terminal strips or plates, $2\frac{1}{2}$ in. x $1\frac{1}{2}$ in. Peto-Scott, or Becol, Permeol, etc.

COIL CONTROL GANGING LINK

One coil switching ganging control link. Telsen. This device is used for the purpose of linking up the switching spindles of the two-coil units so that they may be operated by a single knob on the front of the panel of the receiver. Full instructions for the fitting of the link device are given in the constructional article which precedes this component list. The knob shown here is one of those which are supplied with the coils.



Real Moving Coil Quality

is practically impossible for short-circuits to occur.

However, it is needed at a few points, so you may as well use it throughout for the sake of appearance. It certainly makes a set look better and provides a certain measure of safety in case of some metal object being dropped into the interior of the instrument at any time.

Negligible Resistance

In wiring the original set, I covered

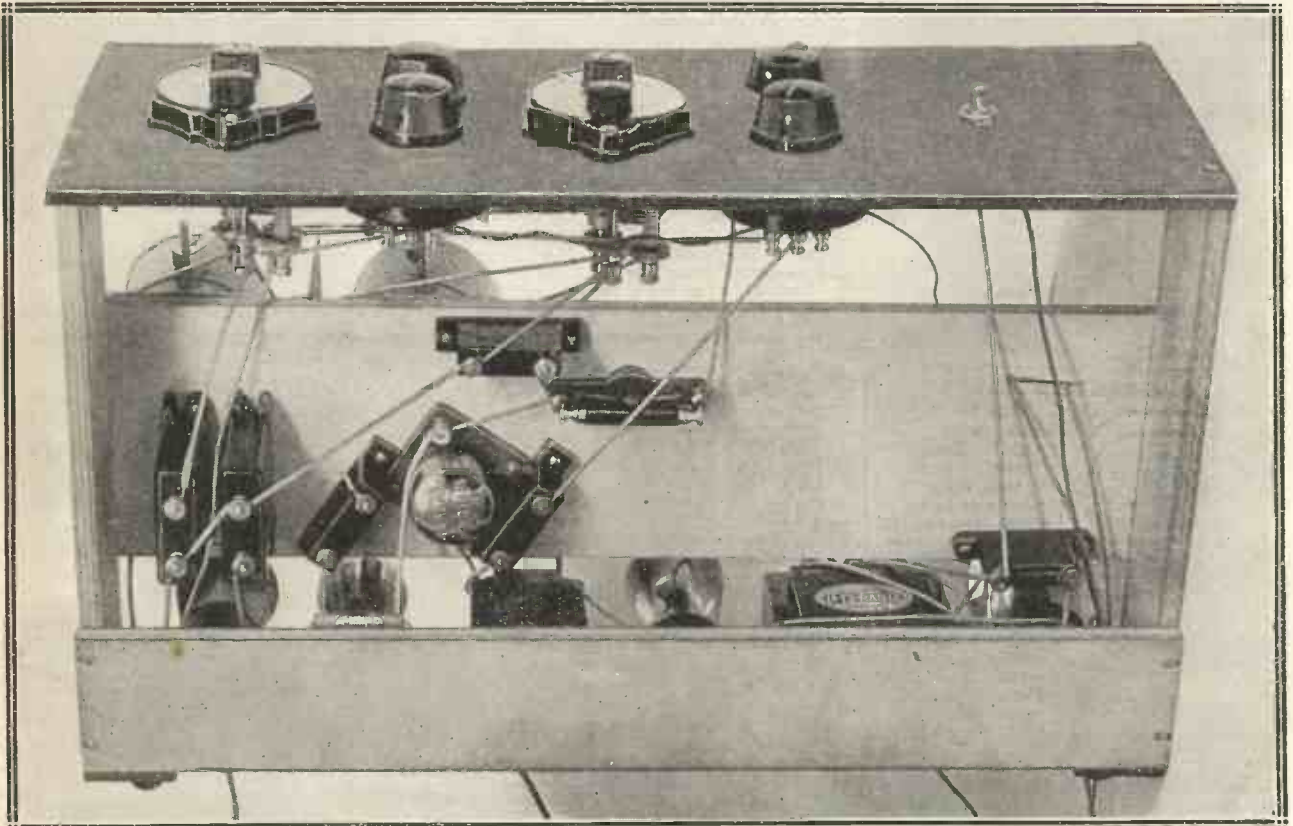
number on the market, be careful to see that each lead really is of exactly the correct length, for if you use leads which are even a little too long the slack in them will prevent you from securing the proper automatic spacing which is such an important feature of the Step System. Instead, they will sag about and it is quite possible that some will approach each other which ought to be well apart in the interests of stability.

By the way, it is just possible that

I agree that this is only the D.C. resistance, and the H.F. resistance will be somewhat higher, but it, too, will quite obviously be negligible.

Now let us take a look at the wiring as a job and see what has to be done. Here we immediately discover an incidental advantage of the Step System which was not at first apparent. Instead of having to tell the constructor which wires to insert first and which to leave until the last, I am in the happy position of being

ACCURACY AUTOMATICALLY ACHIEVED



The spacing of the wiring in a Step System receiver is settled by the positions of the components, and is therefore under the complete control of the designer. The constructor for his part has merely to take a little care to copy the layout, and then he can be sure that his wiring will automatically become a perfect facsimile of the original. The point is well illustrated in the photograph seen above, but in examining this it should be borne in mind that wires which appear to approach very close to each other when crossing are really in entirely different planes.

all leads with a good grade of Systoflex of rather small bore, and this certainly made the wiring look very neat when done. An alternative method would be to use one of the various special proprietary materials which are already provided with an insulating cover, but beware in this case that the wire within is not too thick to be entirely satisfactory for the "pull it tight" method.

Also, if you use any kind of ready prepared leads, of which there are a

someone may object to my use of a thinner gauge of wire for connections on the ground that such wire must have a higher resistance. Well, so it has; but believe me, it is still so low as to be absolutely negligible in comparison with the other resistances in circuit.

The resistance of No. 20 gauge wire is just under 24 ohms per 1,000 yards, so the resistance of an average sort of lead, which I will assume to be 6 in. long, will be .004 of an ohm!

able to tell him that every wire is so completely spaced or, at least, so accessible that it does not matter which he puts in first and which last.

Wire in Any Order

The wiring can, in fact, be done in absolutely any order, and you may decide to wire up by circuits, or to work from one end of the set to the other, or to wire each "step" separately, or to proceed quite haphazard,

(Continued on page 376)

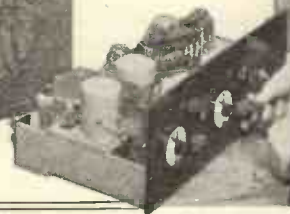
WIRING *in* WORDS

IMPORTANT.—The order in which the leads are given in the table below is not intended to be taken as a guide to the order in which the wiring should be done, but is merely a convenient sequence for checking. The actual order of wiring is discussed in the text.

In this table, "front" means nearest to the front of the set, i.e., nearest the panel. "Rear" means nearest to the back of the set. The terms "right" and "left" assume that the set is being looked at from the back and from above. The reference letters of the leads will be found to be marked against them on the wiring chart.

Lead Reference Letters	Points to be Joined.	Lead Reference Letters	Points to be Joined.
AA	Left terminal of on-off switch and L.T. neg. spade terminal.	BK	Plate or anode terminal of third valve holder and plate terminal of "Class B" input transformer.
AB	Right-hand terminal of on-off switch and ditto of tone-control resistance.	BL	Front filament terminal of third valve holder and ditto of fourth. (See also BC and BR.)
AC	Right-hand terminal of tone control and left-hand terminal of volume control.	BM	Grid-bias terminal of "Class B" input transformer and G.B. + plug. (See also CN.)
AD	Right-hand terminal of volume control and G.B. - 1 plug.	BN	Right-hand grid terminal of input transformer and one grid terminal on fourth valve holder. (Identify by position on wiring blueprint.)
AE	Moving vanes of reaction condenser and No. 8 on F3 coil unit.	BO	Left-hand grid terminal of input transformer and remaining grid terminal of fourth valve holder.
AF	Fixed vanes left-hand tuning condenser and No. 1 on F3 coil unit.	BP	H.T. + terminal on input transformer and H.T. + 4 plug. (See also BT.)
AG	Moving vanes left-hand tuning condenser and right-hand rear fixing screw of F3 coil unit. (See also AM, AO and CA.)	BQ	L.T. - spade terminal and H.T. - plug. (Wander-fuse.)
AH	Centre terminal of volume control and moving vanes of right-hand tuning condenser. (See also CB and AJ.)	BR	L.T. + ditto and front L.T. terminal of fourth valve holder. (See also BL.)
AI (not used.)		BS	Right-hand "A" terminal of output choke and rear anode terminal of fourth valve holder.
AJ	Moving vanes of right-hand tuning condenser and No. 5 on F10 coil unit. (See also AH and CB.)	BT	H.T. terminal of output choke and H.T. terminal of input transformer. (See also BP.)
AK	Fixed vanes of right-hand tuning condenser and grid of first valve.	BU	Left-hand "A" terminal of output choke and front anode or plate terminal of fourth valve holder. (See also CP.)
AL	Fixed vanes of right-hand tuning condenser and No. 1 on F10 coil unit.	BV	One secondary terminal of output choke (correct one will be determined by test) and lower loudspeaker terminal. (Through hole No. 2.)
AM	Right-hand front fixing screw of F3 coil unit and left front fixing screw of F10 unit. (See also AG and AO.)	BW	One secondary terminal of output choke and upper loudspeaker terminal. (Through hole No. 3.)
AN	Front fixing screw of screen and coil ganging link. (Flex.)	BX	Middle terminal of on-off switch and right-hand terminal of .002-mfd. fixed condenser. (See also CN and CO.)
AO	Right front fixing screw of F3 and No. 5 on F3 unit. (See also AG, AM and AP.)	BY	Centre terminal of tone-control resistance and front terminal of .01 fixed condenser.
AP	No. 5 and No. 6 on F3 unit.	BZ	Fixed vanes of reaction condenser and left-hand terminal of 500-ohm resistance.
AQ	No. 7 on F3 unit and front terminal of .0005 fixed condenser.	CA	Moving vanes of left-hand tuning condenser and right-hand terminal of .0002 fixed condenser. (See also AG and CF.)
AR	Front terminal of .0005 fixed condenser and front terminal of .0003 ditto. (Through hole No. 1.)	CB	Moving vanes of right-hand tuning condenser and front terminal of right-hand .5 fixed condenser. (See also AH and AJ.)
AS	Right-hand terminal of binocular choke and rear terminal of .0005 fixed condenser.	CC	Front terminal of left-hand .5 condenser and rear terminal of right-hand .5 condenser. (See also CD and CF.)
AT	Right-hand terminal of binocular choke and anode connector for S.G. valve. (Flex, screened.)	CD	Rear terminal of right-hand .5 condenser and rear filament terminal of first valve holder. (See also CC, AW and AY.)
AU	Left-hand terminal of compression condenser and No. 7 on F10 coil unit.	CE	"A" terminal of first valve holder and rear terminal of left-hand .5 condenser. (See also AX.)
AV	Right-hand terminal of compression condenser and aerial terminal.	CF	Front terminal of left-hand .5 condenser and right-hand terminal of .0002 fixed condenser. (See also CA and CC.)
AW	Earth terminal and rear filament terminal of first valve holder. (See also AY and CD.)	CG	Grid terminal of second valve holder and rear terminal of .0003 fixed condenser. (See also BA.)
AX	"A" terminal of first valve holder and H.T. + 1 plug. (Flex.) (See also CE.)	CH	"A" terminal of second valve holder and front terminal of reaction H.F. choke. (See also CL.)
AY	Rear filament terminal of first valve holder and ditto of second. (See also AW, BD and CD.)	CI (not used.)	
AZ	Front filament terminal of first valve holder and ditto of second. (See also BB and BC.)	CJ	Plate (or anode) terminal of compensating transformer and rear terminal of reaction choke. (See also CK.)
BA	Grid of second valve holder and right-hand end of 2-meg. grid leak. (Actually done with the wire end of the leak itself.) (See also CG.)	CK	Plate (or anode) terminal of compensating transformer and rear terminal of .01 fixed condenser. (See also CJ.)
BB	Front filament terminal of second valve and left-hand end of grid leak. (As above.) (See also AZ and BC.)	CL	Front terminal of reaction choke and right-hand terminal of 500-ohm resistance. (See also CH and CM.)
BC	Front filament terminal on second valve holder and ditto on third. (See also AZ, BB and BL.)	CM	Right-hand terminal of 500-ohm resistance and left-hand terminal of .0002 fixed condenser. (See also CL.)
BD	Rear filament terminal on second valve holder and ditto on third. (See also AY and BJ.)	CN	Grid-bias terminal of "Class B" input transformer and right-hand terminal of .002 fixed condenser. (See also BM, BX and CO.)
BE	Left-hand terminal of binocular choke and H.T. + 2 plug.	CO	Right-hand terminal of .002 fixed condenser and rear filament terminal of fourth valve holder. (See also BJ, BX and CN.)
BF	H.T. terminal on compensating L.F. transformer and H.T. + 3 plug.	CP	Left-hand terminal of .002 fixed condenser and front plate or anode terminal of fourth valve holder. (See also BU.)
BG	Grid-bias terminal on compensating transformer and G.B. - 2 plug.		
BH	Grid terminal on compensating transformer and grid terminal of third valve holder.		
BI (not used.)			
BJ	Rear filament terminal of third valve holder and ditto of fourth. (See also BD and CO.)		

OPERATING THE K4



To make a good set is only half the battle: you must operate it under the proper conditions if you want to give it a fair chance to show you what it can do. Still more so is this the case if you have built a really superlative set like the K4: to get to the full the marvellous results of which it is capable you must be careful, in fairness to the design, not to use some unsuitable valve or other accessory which might let down the performance to the merely "good" level.

Causes of Disappointment

To the experienced constructor these may seem very obvious remarks to make at the beginning of a practical article like this, but I must ask him to bear with me, because I have seen so much of the disappointment which is caused by the less experienced operator making changes which seem to him perfectly innocent.

There is only one safe rule in these matters, and that is to make no changes unless you are absolutely certain your experience is great enough to enable you to predict the result with complete certainty.

After which rather portentous beginning, let us get down to details, making a start with the question of valves for the set. For the first position you want a *metallised* variable- μ type of screened-grid valve, and for most of my tests I used the Cossor 220V.S.G. This is what is called a "long-base" valve, which means in practice that you will want some 18 volts of bias available for full control of volume.

A "short-base" valve which deserves special mention is the Mullard P.M.12M., with which you will find that you only require a

How to get super results from the super set. Notes on the choice of valves and batteries, the uses of the special controls, output matching, aerial adjustments, and everything you need to know to get your K4 working at concert pitch.

9-volt grid-bias unit. This is a point to bear in mind, because in the K4 the only valve requiring much bias is the S.G., none being used on the output stage and only some $4\frac{1}{2}$ or 6 volts on the driver valve.

Another short-base valve which gave excellent results is the Mazda S.215V.M.

For the second socket I advise a valve of the "special detector" type, such as the Mullard P.M.2D.X., which again was my standard for the final tests of the set. Another good specimen of the type is the Cossor 210 Det.

Choosing a "Driver"

When we come to the driver and Class B stages we reach the point where some discretion is required. My own preference is for the rather larger type of valve here, for the consumption is still very moderate, and it is no longer so essential to get things just right in the output circuit to get a large volume without any risk of possible blasting.

Accordingly, I used as a driver either the Osram or Marconi L.P.2, or the Mullard P.M.2A., while the Class B valve was a Cossor B240. Excellent results were also obtained with the Mullard P.M.2B.

These combinations will give extremely good quality and great

volume with the input and output components specified. If you want to use other valves let me urge you to take the obvious precaution of asking the valve maker as to suitable types of transformers and output chokes, so that you may be sure that you are getting conditions as favourable as can be obtained by using the exact specified components and valves. The same advice applies, of course, to those who contemplate making a change in the make or type of input transformer or output choke: When in doubt on a Class B question, ask the maker of the valve.

Function of Class B

In general, I do not advise that changes be made in this part of the set if they can be avoided, because I know how easy it is to get things wrong in a Class B stage. I have given some good combinations, and I should be very much happier if I thought that everybody would stick to them.

Now we come to the question of batteries, and here I want to correct what seems to be a very common misapprehension. The proper function of Class B amplification is not to permit large sets to be run from ridiculously small dry batteries, but to enable us to get real moving-coil volume and quality from a battery of the normal size for the type of set.

To get such volume at all in the past has meant the use of batteries of quite prohibitive voltage and capacity, the accumulator type being practically essential. We can now do it with dry batteries or normal voltage, and it is only reasonable that we should use batteries of fair capacity, just as we have always done in the past for our bigger sets.

The Master Set at Work

After all, the old rule about very small batteries being false economy still holds good. The larger sizes will still last longer than the extra cost seems to indicate, so that this is definitely the proper way to get full value for our money. If we have previously used an output valve of the super-power type it is quite likely that we shall find that our H.T. batteries last longer with a Class B valve, but it would be foolish on that account to start buying a smaller size.

In the case of the K4 what is called the "standing" or "no signal" H.T. current will often be under 10 milliamps., the exact figure depending upon the setting of the volume control, which has the incidental effect of varying the anode current of the S.G. valve. This consumption, by the way, is that for the whole set.

Grid and Plate Voltages

When reproducing a fairly strong signal the current may run up to an average of 15 or 20 milliamps., but it must be remembered that this is not continuous and there are frequent rest periods. Even so, it is obviously no job for the smallest type of battery, and it will pay to buy one of the larger sizes, just as it has always done.

The L.T. and grid-bias batteries are an obvious matter, and the reader will require no guidance here beyond a reminder that he will want either two 9-volt G.B. units joined in series,

or else a single one, according to whether he uses a long or short base variable- μ valve.

The H.T. voltages should be as follows. Plug No. 1 should go in the 60-volt socket, No. 2 in the one giving 72 volts, No. 3 in the 110-volt point, and No. 4 in the 120-volt. (The voltage of the battery must, of course, not be less than 120 volts). If the battery used has no 110-volt socket, remove the plug from the H.T.+3 lead and join this wire to the H.T.+4 plug, so that both may go in the 120-volt socket.

Preliminary Adjustments

It will be noted that no mention is made of any adjustment of H.T. voltage for the purpose of getting smooth reaction. Actually, one never uses reaction so intensively with the K4 as to need this condition. As a matter of fact, you will probably find that there is a slight "growl" as the set goes into oscillation, which I find very useful for reminding one that a set with Class B output should be allowed to oscillate as little as possible. The reason is that if a strong carrier is tuned in when self-oscillation is going on in a really powerful set the resulting appalling yell makes the output valve drink H.T. at a rate which is not good for one's pocket.

The question of grid bias is simple. Plug No. 1 supplies the bias for the variable- μ (adjusted by the volume control), and should be given either 18 or 9 volts, as I have already

explained. Plug No. 2 is the one for the driver valve, and requires usually $4\frac{1}{2}$ volts. If, however, you find that you can give it 6 volts without causing the set to overload easily, by all means do so, and cut down your H.T. consumption.

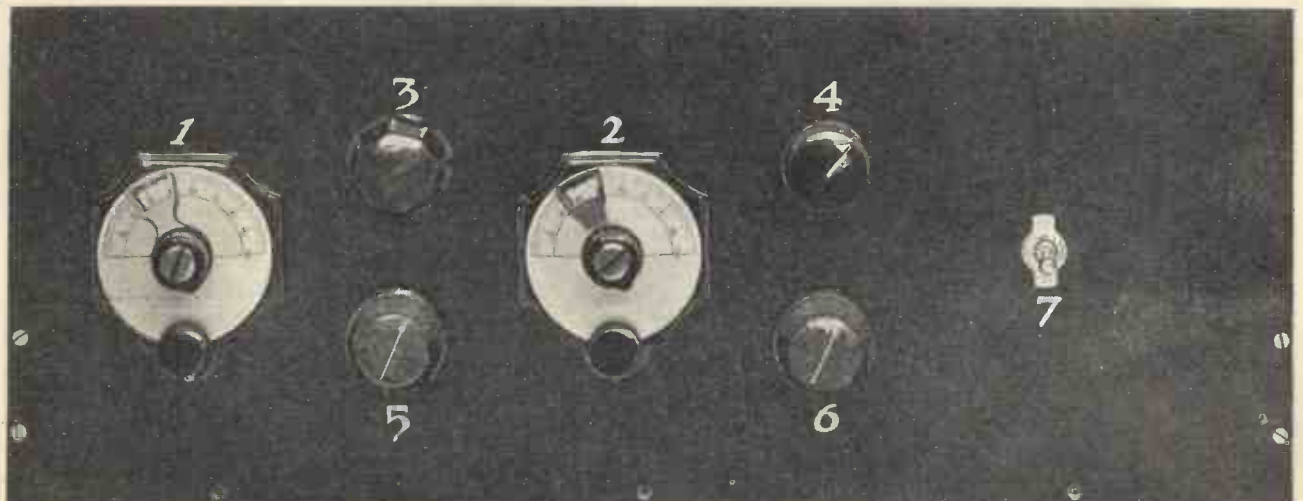
These are all the preliminary adjustments, and now we can turn to operating questions proper, leaving the matter of output circuit adjustments until later.

The actual handling of the two tuning dials is a matter which I am sure I need not explain to the readers of this magazine. The art of keeping two dials in step is one which I know they understand, and they will merely have to find out where a few known stations come in before they will be able to start tuning in all Europe.

Selectivity Controls

A very important adjustment is that for the degree of selectivity required for any given purpose, and this I must explain fully. First, it should be noted that there is a main control in the form of a compression condenser in the aerial lead, and this should first be screwed right down. Unscrew only as much as you find necessary to get the selectivity you need. On small or medium aerials you may well be able to leave it at maximum, while on very small ones, especially of the indoor variety, it may even be advisable to short it right out with a piece of wire across its terminals.

Controls Which Conquer Distance



A pictorial guide to the K4 controls. Nos. 1 and 2 explain themselves; 3 is the wavechange knob; 4 controls reaction; 5 is the volume or sensitivity control; 6 is the tone-leveler knob; and 7 is the on-off switch wherein one contact operates the instantaneous signal quencher.

YOUR CALIBRATION GUIDE

In this table will be found a selection of stations which have been found useful for calibration purposes, with their readings on the first dial of the original receiver. If the constructor determines the variation of his own instrument for a few of these he will soon be able to locate many others by a simple process of proportion, and so proceed to calibrate his set. Note that the dials were divided into 180 degrees.

Station.	Dial Reading.	Station.	Dial Reading.
Gävle	45	Milan	113
Magyarovar	49	Barcelona	120
Cork	57	London Regional	123
Fécamp	60½	Hamburg	130
Kiel	63	Scottish Regional	132
Beziers	68	Toulouse	136
Belfast	70	Leipzig	137½
Trieste	73½	Midland Regional	140
Gleiwitz	75	Katowice	143
London National	79	Athlone	145
Bari	83	Belgrade	150
Hellsberg	87	Stockholm	153
Lisbon	89	Rome	154½
Viiipuri	94	Beromünster	159
Hilversum	96	Langenberg	163
North National	100½	North Regional	164
West Regional	103	Prague	171
Göteborg	108	Florence	172
Breslau	109½	Brussels	173½

This is just an initial adjustment to suit your local conditions, size of aerial, and so forth. The adjustment to suit the exact needs of any particular transmission in order to free it from interference is performed very simply from the front of the panel.

In general, you will find that if you first turn the volume control down a little, so that there is a perceptible drop in the strength of the station you are listening to, and then

bring back the volume by means of a very moderate application of reaction, you will get enough selectivity for any normal case. Indeed, the selectivity of the K4 is quite exceptionally high if no more than this is done, and in many places this will be the normal way to operate it.

For special stunts, like separating some difficult pair of stations, just carry the process a little further. Keep going back on the volume

control and bringing up the reaction a little at a time until you find that a further reduction of volume cannot be made up by means of reaction, and the station is becoming too weak, and then you will know that you have reached the limit of the K4. I venture to predict that you will very rarely do that in practice without finding that you can get the desired station clear of interference!

Adequate Power Reserve

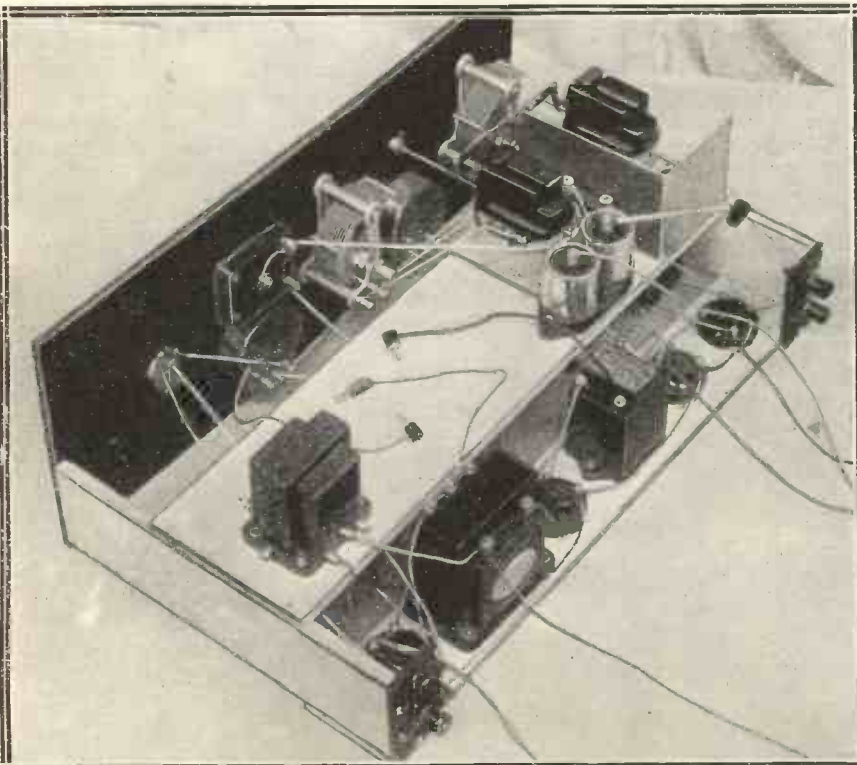
The essential point to grasp is, that the amplification of the set is so great that you very rarely indeed will find it either necessary or desirable to have the volume control full on, so that there is an ample reserve of power to enable this method of selectivity increase to be employed with good effect. A simpler way of looking at the matter is perhaps to say that, in those cases where you need extra selectivity, you get it in the main by using reaction to make an already sharply-tuned circuit still more razor-edged, and to enable you to do this without making the station become unbearably loud, you cut down on the volume control.

This is a somewhat generalised account of the matter, and a full technical explanation would take a number of other factors into consideration, but it will serve our present purpose. All that we need to remember in practice is to keep the volume control back enough to enable us to apply a spot of reaction now and again without producing excessive volume.

Remarkable Selectivity

Skill can be acquired and put to good use in juggling with these two controls, but there is no need to fear that good selectivity cannot be got until such skill has been obtained. On the contrary, the natural unaided selectivity of the K4 is quite good enough to delight most people, and it is only the very super variety of station-separation which calls for anything more. Even a very moderate use of the special method I have described will suffice to set up conditions which will achieve most remarkable feats of selectivity.

Of course, it is to be understood that it is only the presence of the tone-levelling device which enables this method to be used with such good effect. It could be used after a fashion in many sets, although it would not achieve the same effects unless similar ultra-low resistance, specially arranged tuning circuits were provided, but the result on the



The grid-bias voltage required by the K4 depends upon the type of variable-mu S.G. valve employed. The space on the second Step will accommodate either a single 9-volt unit or two connected in series.

How to Get Correctly Balanced Tone

quality of reproduction would put it out of court so far as most people were concerned.

In the K 4, however, you have only to make a slight adjustment of the tone leveller and excellent quality is obtained even when reaction is being used quite strongly. In general, you will find that the knob should be turned about half-way round for the reception of the stronger distant stations, and fully round to the right for those stations on which you have to use a good deal of reaction in order to achieve selectivity of a specially high order.

For the very strongest stations, upon which no reaction will be used and the volume control will have to be brought well back, the tone leveller will require to be turned a good way round to the left (anti-clockwise), otherwise the tone will probably be found a little too bright. This is particularly the case with the local station, of course.

Range of Control

You will discover that the difference in tone between the midway position and one with the knob turned fully round to the right is not very great, so that you will have to listen carefully on a suitable item to hear it, but this is as it should be. At the other end of the range (turned fully to the left), the control acts much more strongly, and the last few degrees produce quite a marked lowering of tone.

This, again, is intentional, for I have provided here a greater range than you will ever need for quality reasons alone—that is to say, that the control is at all times and in all cases capable of making any trans-

mission sound much deeper-toned than it should be. My intention here was to provide you with a sort of emergency device for the reduction of heterodyne whistles in those few cases where they cannot be removed by more legitimate means. This should happen only rarely, but it is occasionally of great value to be able to get rid of a whistle, even at the cost of making the transmission sound a bit too "mellow," as it is still sometimes called.

The Normal Setting

At all other times you will presumably keep away from the extreme left-hand position of the tone leveller, and just set it to give normal, properly-balanced reproduction. It

ACCESSORIES FOR THE K 4

Such matters as valve types, battery sizes, etc., have been dealt with in the text. The following notes may also be useful in showing makes which have been used with the set and found suitable.

H.T. and G.B. batteries: Ediswan, Exide, G.E.C. and Block Batteries all produce suitable units. The latter, of course, are of the H.T. accumulator type.

Loudspeaker: Blue Spot and Celestion.

is very easy to do, you will find, for it is by no means a critical setting, nor is the ear really sensitive in the matter, having become used in the past to sets which give nothing like a true balance!

And now we come to the question of getting a correct adjustment in the output circuit, without which good quality is in any case impossible.

Now, here I am going to give a rather unconventional piece of advice: don't worry too much about theory, but try all the possible output ratios which your choke or transformer offers you.

The treatment of Class B valves is still rather empirical, and the final test must always be the old "Try it and see!" Therefore, even if you think you know the correct ratio for your speaker and valve, try all the others which may be available. Note, by the way, that the type of speaker required for the K 4 is the ordinary variety with a winding for use with normal, NOT Class B, valves. (It may at a pinch have a winding for pentodes, but this does not, as a rule, lead to satisfactory results).

The speaker (preferably a moving coil, of course) should be connected up to the speaker terminals of the set, and then you can go and try the various output ratios by altering the connections to the secondary terminals of the output choke. To emphasise the fact that this should be done, I have had these leads shown with arrow-head ends on the Construction Chart, thus indicating that the wires should be tried on each pair of terminals in turn until the arrangement is found which gives the best quality.

A Guide to Stations

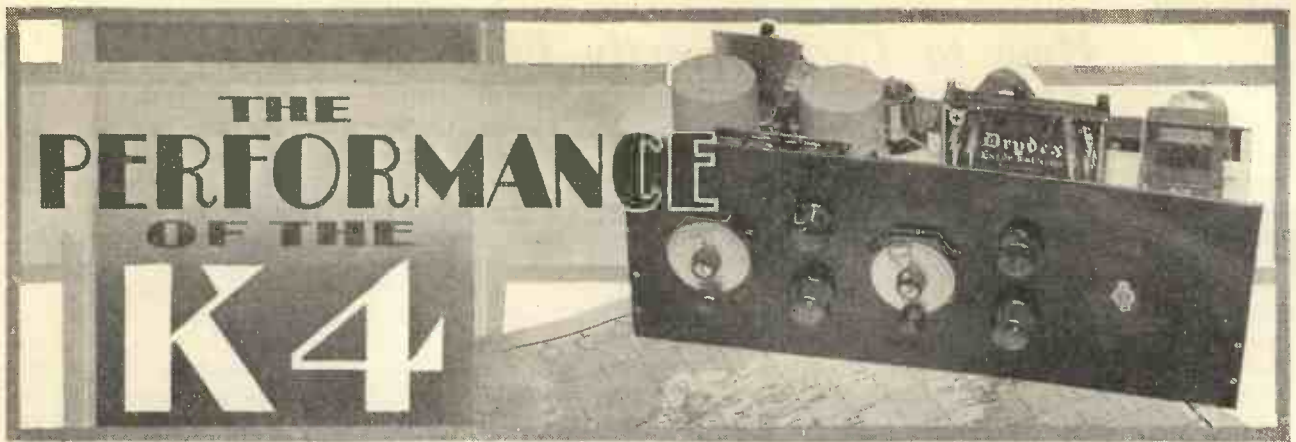
Finally, let me add a word about the "calibration guide," which is given elsewhere. This is intended as a general guide only, for no two sets will give exactly identical dial readings.

Of course, the list should not be taken as an indication of the total number of stations received during my tests!

ALL READY TO GIVE YOU YOUR BIGGEST RADIO THRILL!



The complete installation ready for initial testing and adjustment. It is always easier to do this before putting a set in its cabinet.



Great volume, razor-edge selectivity, transcontinental range, moving-coil quality, the master set gives you them all.

IF there is one thing I dislike above all others, it is to appear to make exaggerated claims for some new receiver design. I know, too, that the home constructor nowadays is rather quick to feel that such claims are being made, as a result of certain experiences he has had in the past, and that knowledge makes me anxious to be doubly careful in what I say.

I have no fear as to the opinion which will be formed by those who wait until they have built the K4 and found out for themselves what it will do, but what I *am* afraid is that if I say what I really think about the performance of the set, there will be a great many readers who will immediately say to themselves, "This man is obviously a direct descendant of Ananias!" and not even consider building it. I feel pretty confident that my old friends among the readers of "M.W." would not react thus, but there must be many newcomers who might, and hence my quandary.

Clearing Up Doubts

Mind you, I can quite understand how it is that the constructor has come to be a little sceptical about the claims he reads, for he has often had experiences which must shake his faith in human nature a bit.

Most emphatically, however, I do not mean that exaggerated claims are made by set designers nowadays. On the contrary, I do not believe that reputable designers ever do it. There are black sheep in every flock; but you can be very sure that if a designer has been taking a prominent part in radio for a number of years his position makes it absolutely impossible for him to do otherwise than to give a carefully accurate account of the performance *in his hands* of any set he describes.

As a matter of fact, I should perhaps have said that there *used to be* black sheep in this particular flock, for I do not think that any of the people who used to indulge in exaggeration are with us now.

The real reason for the trace of cynicism which I have observed in the constructor's outlook of late is something less simple, I believe. I think it is due to a certain lack of mutual understanding between designers and their public which should be cleared up, and that must be my excuse for enlarging upon the point at such length.

The trouble, I think, has been simply that it has not been sufficiently clearly realised that the results which any set will give in the

Mr. Kendall gives a very carefully conservative account of the performance of his latest achievement, as has always been his custom. His explanations of the standard to be expected in the constructor's own hands is very characteristic of his policy in these matters.

hands of its designer are not necessarily the same as the constructor will get from it. The designer, it may be assumed, is a very highly skilled operator, he knows his set intimately, and he normally uses an accurate wave-meter for purposes of station identification.

Experience Teaches

The constructor, on the other hand, has to learn how to get the best from the set, and he very rarely possesses a wave-meter, two facts which are a

greater handicap than is generally realised. As an operator he is usually much more skilful than a member of the non-technical public, it is true; but even so he cannot hope to compete on quite equal terms with a man who has been knob twisting for anything up to perhaps twenty years, and that again must make a difference to the results which he will get.

The net result of all this is that the constructor should realise that the results obtained by the designer are intended to be taken as a guide in estimating the efficiency of any particular set in comparison with others.

He must understand that before he can equal those results fully the constructor must expect to have to spend some time becoming fully acquainted with the receiver and gradually accumulating a log of stations identified by the exercise of a good deal of patience.

Ahead of Its Time

With all that for a preamble, I feel that I can now go ahead and say something about the actual performance of the K4. I am considerably emboldened in so doing by the knowledge that the standard of operating skill and technical attainments generally of the readers of MODERN WIRELESS is very much higher than that of the average group of home constructors. "M.W." has always been the more advanced constructors' paper.

The performance of this set is such that I believe it will be found an entirely satisfactory means of receiving home and foreign programmes not merely for this season, but in all probability for several seasons.

In other words, it is distinctly better than it need be at the moment. It possesses a reserve of both

What the K4 Will Do in Your Hands

sensitivity and selectivity which should enable it to cope quite easily with any even remotely probable increase of congestion in the ether and the reductions of transmitting power which it seems inevitable will eventually occur.

A considerable degree of control of selectivity and sensitivity is provided for, and so the set can readily be adapted to very widely differing conditions.

Impressive Performance

As an example of this adaptability I may mention that my first tests with the set in its final form were made on an aerial of the kind which I know many unlucky people are compelled to use for lack of room. It was only twelve feet high and fourteen feet long, which really meant that it was little, if at all, better than an indoor one.

for by the small room in which the tests were made.

On the medium waves there was naturally less reserve of power, but even here quite a number of stations gave really excellent volume, and, of course, the quality of reproduction on all good transmissions was of a very high standard indeed once the correct output ratio had been found which suited the speaker.

After dark things were, of course, very different, and a really good string of medium-wave stations could be received with the greatest of ease at really fine volume.

I regard this test as being of great importance, for a good performance under very bad conditions always impresses me more than an absolutely staggering one under normal conditions.

Even with the controls set for volume, as they had to be most of

like than run the risk of being called a liar for giving lists of stations which look impossible with only four valves!

Try It Yourself!

Some idea of the number of stations which I got can be obtained from the list I give elsewhere for calibration purposes, but it must be remembered that this list gives merely the more important and reliable stations. Beyond this I do not intend to go, for I prefer that the reader should size up the technical merits of the K4 design for himself and realise from that survey what the performance *must* be.

I believe that I can trust to the technical knowledge of the readers of "M.W." to lead them to a full appreciation of the merits of this definitely revolutionary design better than any long-winded description of mine.

I am confident that the importance of the Step System and the electrical developments which are now combined with it in the K4 are so completely self-evident that I should merely be wasting the reader's time if I in any way laboured the point. After all, if the merit of the basic invention is as great as I believe it to be, there is no risk that it will not at once be appreciated at its full value immediately it is disclosed.

I am quite content to allow it to stand or fall by what is really the only true test of an invention, namely, that it should from the first be capable of securing full recognition with only the simplest and most straightforward explanation.

So far as this first K4 issue of "M.W." is concerned, therefore, I am going to limit myself to the general account of the set's performance which you have just read. Next month, of course, I shall be contributing further articles about the set, and then perhaps I shall feel free to say a little more about the results I got in my full-sized aerial tests.

Comparing Results

By then the reader will have had a chance to try his own K4, and I think he will be interested to compare my results with his. In doing so, he will be making an interesting check on my claim that the Step System makes it almost impossible for him to produce anything except a well-nigh perfect electrical and mechanical copy of the original model of the K4.

PRELIMINARY RESEARCH WORK



Mr. Kendall is seen here repeating, for the benefit of the camera, some of the preliminary calibration work on the apparatus he designed and built specially to assist him in the researches which have produced the K4.

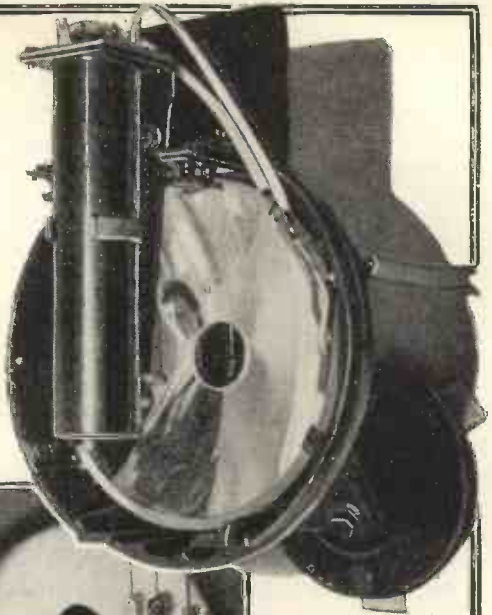
Under these adverse conditions I set the selectivity control at minimum and turned up the sensitivity fully, and then was able to receive quite a good number of foreign programmes at satisfactory speaker strength in daylight. The various long-wave stations such as Kalundborg, Huizen, Eiffel Tower, Radio Paris, and so on, were all capable of providing a real programme, and in many cases called for some reduction of sensitivity to keep the volume down to that called

the time in this case, there was an ample reserve of selectivity, and a number of the well-known stunts, like separating Langenberg and North Regional, were performed with ease.

Later tests on an average sort of aerial produced results which I do not intend to give in great detail, because they were so extraordinarily impressive that they made me think I had struck a "freak" night time. And again, I would rather the constructor found out for himself what they were

A MAINS DRIVEN

INVISIBLE RAY
BURGLAR
ALARM



The application of infra-red rays to burglar alarms is not new, but their production on a commercial basis shows how reliable the scheme has been proved to be.

Although infra-red rays come within the spectrum of light-waves, and are capable of affecting photo-electric cells, they are invisible to the eye. This, together with the fact that anything solid such as a human

body will interrupt their passage, renders them ideal for detecting the passing of an unauthorised person through a doorway or across a room.

Thus, the burglar stealthily creeping between glass-topped jewel counters, crosses the path of the invisible light. The infra-red ray from the small transmitter ceases to fall on the receiver, the resistance of the photo-electric cell in the latter changes, the current through it drops, a relay closes.

AS GOOD AS
CAUGHT

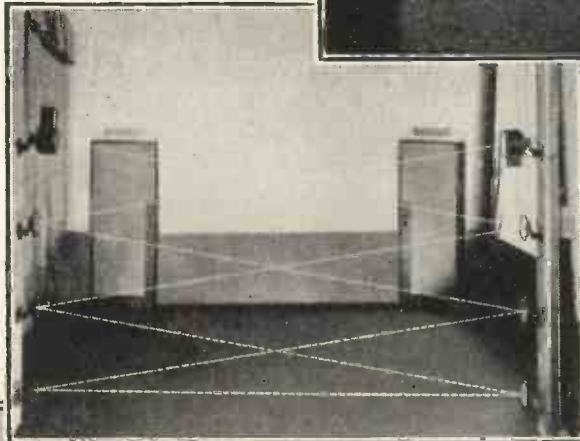
The thief is as good as caught!

As soon as the contact points on that relay touch, the building is flooded with light, bells clang, watchmen come running, and soon the criminal is in the hands of the law. Science has scored another triumph.

The scene just depicted is made possible by quite simple apparatus such as that illustrated on this page, which is of Siemens make and design.



The two photographs at the top of the page show the transmitter from which the infra-red rays originate. On the left it is seen, with cover removed, being plugged into the mains. The small electric motor at the top turns the shutter, which covers the source of "light."



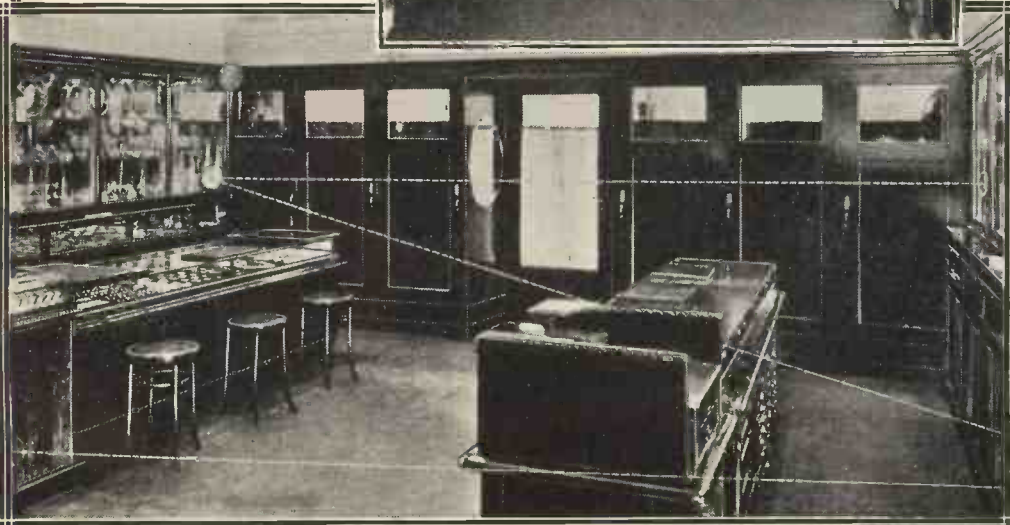
LIGHT-
ACTUATED
RECEIVER

Of the other three pictures, the upper one shows the small receiver which is also plugged into the mains. So long as the rays eventually reach this instrument, it does not matter what course they pursue in getting there.

A NETWORK OF
RAYS

The two bottom pictures illustrate how the rays may be reflected back and forth so as to cover quite a large area. In this way a burglar would not necessarily be safe even if he crawled along flat on the floor.

The mirrors need not be mounted conspicuously, and could easily be arranged to look quite innocent.



The MYSTERY STATION OF SWITZERLAND



TRAVELLING through the Gotthard tunnel past Airolo, where the former Swiss President Motta owns an hotel, then sweeping down the valley of the Tessin, you get to Bellinzona, the capital of that canton. It lies close by the river Tessin and is surrounded by small hills crowned with frowning castles from olden times. I arrived there in the evening in quest of Switzerland's third national station: the Monte Ceneri transmitter.

DIFFICULT TO SEE

Bellinzona has no studios (they are at Lugano), so I left next morning by train. Looking out of the window to the right you have a wonderful view of Locarno and the Lago Maggiore. Sharp eyes are required to discern the masts of the broadcasting station straight ahead against the green hillside in spite of their coat of red and white paint. After about 12 minutes' run they came closer, but just as I was going to take a photo of them the train banged into the Ceneri tunnel.

At the other end, a few hundred yards from its mouth, we stopped at Rivera Bironico. Getting out of the train I looked round and found that we must have passed right under the transmitter.

ON MILITARY GROUND

About thirty-five minutes' walk up the newly-made Ceneri road took me to what seemed close to the station.

Our Special Correspondent in Switzerland visits the third and latest of the Regional broadcasters in that country, and tells "Modern Wireless" readers about the studios at the foot of Monte Bré.

By A. A. GULLILAND

Another half an hour's wandering right under the frowning nose of a fortress took me to the sign-board intimating that beyond the fence lay military territory. In Berne I had attempted to obtain permission to visit the Ceneri transmitter. The Minister of Posts referred me to the military authorities, who regretted not to be able to furnish me with a pass as the station stands in the very heart of the Ceneri fortress, which is part of the great Gotthard fortifications.

A FALSE ALARM

Just as I was taking a photo of the high barbed-wire fence, I heard a motor-cycle approaching from behind. Perspiration poured off me. I thought that I had been spotted and that I would be arrested and locked up for spying. When I turned round, there, right enough, was a soldier with his rifle slung across his back approaching.



The studio building at the foot of Monte Bré, in Lugano.

To my great relief he passed with a pleasant "Grüss Gott." Wiping my brow, I followed him, and found that he had only been going to shooting practice. But after that I had had enough and returned to the main road. At the summit of the Ceneri pass I discovered the main entrance to the broadcasting station, which is well guarded by a sentry complete with box.

In spite of my escapade, I had been unable to see more than the masts of the station. I therefore decided to climb up the hillside opposite to see if it would be possible to get a glimpse of the station building from there.

GIVING UP THE ATTEMPT

This, incidentally, entailed crossing a ravine twice and having a friendly pushing tussle with a young bull which refused to move off the mountain track. But it did not give me the desired view. As I got closer to some kind of buttress up the mountain side, I thought it better to give up and returned to Rivera to continue my journey to Lugano and the studios there.

Geographically the Ceneri station is in the centre of a triangle formed by imaginary lines connecting the three towns Bellinzona, Locarno and Lugano. It is visible from both sides of the pass. On one side it seems pressed against the wooded mountain side, on the other it is silhouetted against the sky with a background of far-off hills.

INDEPENDENT OPERATION

The Monte Ceneri station was built for any wavelength between 400 and 1,200 metres. It has been testing since April last on 1,156 metres. Under the new Lucerne plan it will obtain a wavelength around 250 metres. The

A CURIOUS STUDIO THAT FORMS A CUBE

power in aerial is 15 kw., the altitude is 627 metres plus masts 125 high. It is the only station in Switzerland which has in reserve its very own power station, a group of Diesel engines. Should at any time the electric supply from Lugano break down, the station can operate independently. Therefore Monte Ceneri actually can be called not only the mystery station in the fortress, but the war-time station of Switzerland, as in the case of a war Ceneri could continue operations even if the enemy were close by.

Arriving at Lugano railway station, high up above the town, I asked one of the policemen, in their brown uniforms and brown helmets resembling topees, the way to the broadcasting studios. He pointed right across the town, and I understood that I would have to go down and across to the other side, to the foot of the Monte Bré. I walked along the promenade close by the deep blue immovable water of the lake, through a park, and reached the Campo Marzio, a sports ground, and the broadcasting house situated at one corner.

THE STUDIO BUILDING

The brown building contains four studios and offices. The main studio is exactly rectangular; undesired acoustic effects are prevented by means of alternate panels of wood and cellotex. The decoration is tastefully

light. Walls are yellowish, the ceiling dark red and grey. The studio itself can be divided into two by means of grey curtains. The windows of double



VISITORS, KEEP OUT! The barbed wire fence which surrounds the Monte Ceneri station to prevent visitors from coming too close.

glass are high up in the walls. Sixteen by 11 metres and 7 metres in height is the size of this studio.

What seemed to me a curiosity was the form of the medium studio—an exact geometric cube, six metres all

over. The walls are treated similarly to those in the big room, and the engineer told me that this adequately prevented any acoustical reflections. A small talks' studio goes off from the "cube." Then there is the announcer's studio. A winding staircase takes one from it straight up into the control room.

SAD INTERVAL SIGNAL

Radio Lugano's interval signal is an exact reproduction of the bells of the Campana di Pazzalino, a church in the old Roman style, close to Lugano. The sad melancholic tones are typical of the Tessin and its inhabitants.

Ente autonomo per le audizioni radiofoniche nelle Svizzera Italiana is the rather complicated name of the company exploiting the Ceneri station under the direction of Mr. Vitali, Europe's youngest broadcasting director. Signorina Nini incorporates the voice of Radio Svizzera Italiana.

 USING UP ODD RESISTANCES

Series or parallel connections for resistances will often enable the desired values to be obtained from components on hand.

It is, often necessary to make use, for automatic grid bias or other purposes, of a resistance of a value which cannot be found among the constructor's spare components.

In such cases it is useful to remember that, by connecting two or more resistances in series or in parallel, various odd values can be made up.

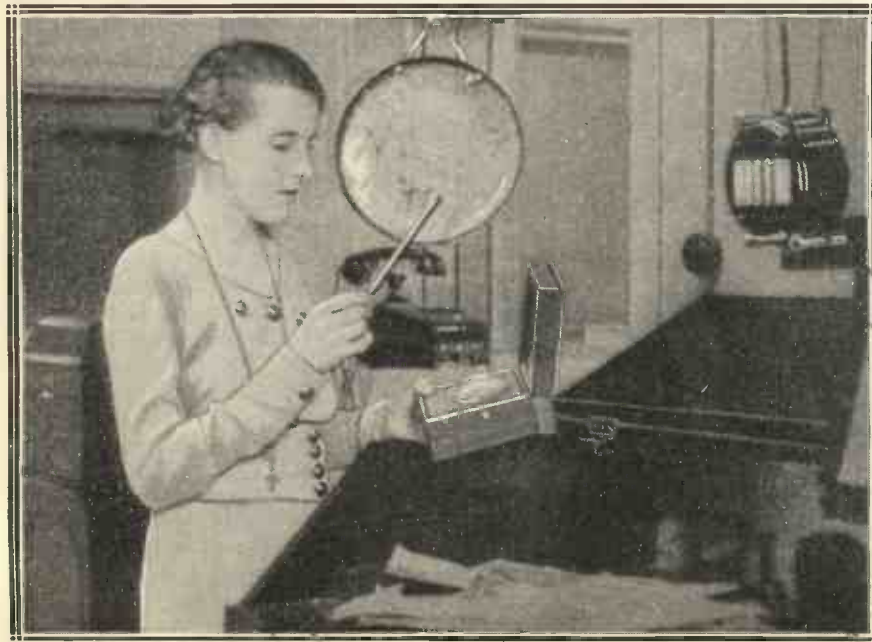
ADD THEM TOGETHER

When resistances are connected in series their total resistance is equal to the sum of their individual resistances. Thus the result of connecting three resistances (values 500, 800 and 1,000 ohms) in series would be 2,300 ohms.

Connected, however, in parallel, the total resistance is equal to the reciprocal of the sum of the reciprocals of the individual resistances. Or,

$$\frac{1}{\frac{1}{500} + \frac{1}{800} + \frac{1}{1000}} = 235.3 \text{ ohms.}$$

You can easily work out for yourself the varying values which you can secure with the resistances in your possession.



SIGNORINA NINI caught in the act of broadcasting the time signal. She was educated at the Scottish school in Alexandria and speaks fluent English.

SPOTLIGHTS *on the* PROGRAMMES



Comment and Criticism on Recent Radio Entertainment.

TRYING it on the dog was a popular proceeding in the old music-hall days. Sir Harry Lauder owes his success to having been put on as a "trial turn" at one of the halls. Non-stop variety saw the revival of this custom. I could tell you of more than one variety artiste whose first engagement resulted from a public audition—and of many more whose hopes of fame and fortune were sadly dashed in the same way.

These public auditions certainly saved the management many hours of worrying about what their patrons wanted. If a trial turn went down well, he was "retained for a further week." If he got the "bird," then the manager added the "sack."

Now the B.B.C. is trying the same idea with its Saturday afternoon variety "First Time Here." How this is going to help in selecting good turns for the evening shows I can't imagine. Nothing will be achieved which could not just as well be done at a private audition. A few letters from listeners cannot, by any stretch of the imagination, be taken as popular opinion.

However, it makes a very good story.

The Glare of the Footlights

The undoubted success of the Broadcasting Theatre at Radiolympia has not had altogether wholesome effects on the programmes. Some of the production department at Broadcasting House seem to have been caught in the glare of the footlights, as witness the permanent introduction of the "Eight Step Sisters."

Not even the kindest critic would admit that these young ladies are distinguished for their voices, while their dancing, excellent as it may be,

is not outside the scope of the "effects" department's coconuts.

There is a very sharp division between radio and stage. Val Gielgud has realised this from the beginning. That is why radio drama is better than radio variety.

A Step in the Right Direction

All the same, the first of the Eric Maschwitz shows in No. 10 studio under the Bridge was a very definite step in the right direction. Whether the show was good radio technique is

THE LADY ANNOUNCER



A new picture of Mrs. Giles Borrett, who has now quite settled down to her duties at Broadcasting House. Mrs. Borrett is the wife of a naval officer.

doubtful. That it was good entertainment, and a distinct improvement on what we have been having, is very definite.

Possibly Eric Maschwitz's own commentary on the turns had a lot

to do with it. Certainly his whole-hearted advance publicity methods showed a little unusual ingenuity.

What is Radio Costing Us ?

Mrs. Westlake is a hundred years old. She lives at Stratford-on-Avon. She refuses, with stubborn resistance, to listen to "that wireless," maintaining with perfect logic that she got along very well for ninety years without it and she will get along just as nicely without it now.

I wonder if she is missing very much? Or, rather, whether she is missing as much as some people would like to make out. Listening takes up quite a lot of our spare time to-day. What have we sacrificed for it? Reading, perhaps—conversation certainly. And how many of our children will be able to play any instrument for themselves, with the possible exception of the gramophone?

Classified Talking

Many years ago I went shooting. I had never gone shooting before and I was then, as I am now, a pretty poor hand with a gun. My host was sympathetic (he might well have been seeing the amount I was paying him for the privilege of wasting cartridges over his land) and offered me some advice.

"Look here, old man," he said, "you just go on shooting at two-minute intervals for a bit. There's a law of averages which says you must hit something."

There have been occasions on which the B.B.C. Talks have seemed like that. Just go on talking long enough on every subject under the sun and you're bound to interest someone sooner or later. However, no such

C. B. Cochran Invades the Studio

accusation can be made against the programme of talks for the coming season.

A great amount of care has obviously been spent on thinking them out, and the man who finds nothing to interest him will indeed be a dull dog.

Brighter News Bulletins

Perhaps the most encouraging announcement is the promise of better News Bulletins on Saturday nights. I have long wondered how many people were *really* interested to learn that the population of Norwich had increased by point two-five per cent, or other such world-shattering items. If the thirty-minute "radio newspaper" can infuse a little colour and life, a "little corroborative detail into an otherwise bald and unconvincing narrative," then the news will become, as it should have done long ago, a part of the programmes.

The first of these "news reels," as they are to be called, will be broadcast on October 14th. I advise listening to it.

The Place of Agriculture

Farmers have always been rather chary of politicians. I once heard the candidate for an agricultural constituency ask a farmer what a plough was used for, so there's nothing very surprising in that!

Lately, Major Walter Elliot has done a lot to alter this opinion, and the talks to farmers have been characterised by an unusual amount of common sense.

The programme of farming talks for the autumn will make interesting listening for plenty of listeners who are unconnected with agriculture but interested in its problems.

The Lady Announcer

In the ordinary course of events it is probable that most of us would have accepted the introduction of a lady announcer as part of the natural progress of the B.B.C. The advance publicity, however, which was quite out of all proportion to the importance of the event, turned the whole thing into a nine days' wonder and invited criticism which would otherwise have lain dormant.

I quote the following from the correspondence columns of the *Radio Times*.

"Our 'Erbert had just come in to tea as the Lady Announcer was readin' the News Bulletin! 'Mum,' 'e sez, 'ain't she got a rather sorerful

doubt that Mrs. Borrett (whose photograph is on the preceding page) does her job very well. Still, I feel there was a little justification for that letter. As a friend of mine put it the other evening:

"Mrs. Borrett of the B.B.C. Makes her announcements in a minor key."

Stunt Broadcasts That Fail

I feel that it will be only a matter of time before the B.B.C. announces as part of its programme the stupendous spectacle of forty Arabs on forty camels beating forty drums, probably relayed from Algeria to give even more local colour.

The fact that the beating of forty drums would have, in itself, no entertainment value would not matter, any more than it mattered the other evening when the programme was interrupted for half an hour to hear eight pianos and an unannounced drum render that masterpiece of song plugging—"I Cover the Waterfront."

Actually the eight pianos were of no more entertainment value than two would have been, while the drum was, frankly, atrocious. Still, it made a spectacular programme announcement, so I presume nothing else mattered.

But it wasn't worth keeping us out of our beds for!

Broadcasting and Mr. Cochran

It is no secret that the claims of C. B. Cochran as a suitable personality to supervise the B.B.C. programmes were put forward recently in certain quarters. While there is no possibility of such a thing as that happening, C. B. will have a hand in the programmes on October 14th, when he introduces the show "Mr. Cochran Presents—"

It is thirty-one years since Cochran's first show and many happy memories will be stirred by the songs to be sung by some of the original artistes. One of Henry Hall's last jobs before sailing for America was to arrange a selection of representative tunes from the numerous Cochran productions, and he will conduct the B.B.C. Dance Orchestra "on the night."

With Cochran and Charlot in the programmes, the autumn looks like being a gay one.

PATRICK CAMPBELL.

In the Programmes

TESSA DEANE

Miss Tessa Deane, modestly described in "Who's Who of the Theatre" as an actress and vocalist, was one of John Watt's many triumphant radio discoveries.

After appearing as Carlotta in "Silver Wings" in 1930, she achieved fame for her excellent rendering of Rose, the barmaid, in A. P. Herbert's light opera, "Derby Day," and aroused



the serious attention of Broadcasting House.

Was starred in one of the "Songs from the Shows" programmes, under the direction of John Watt—and overworked the postmen who had to deal with her "fan" mail!

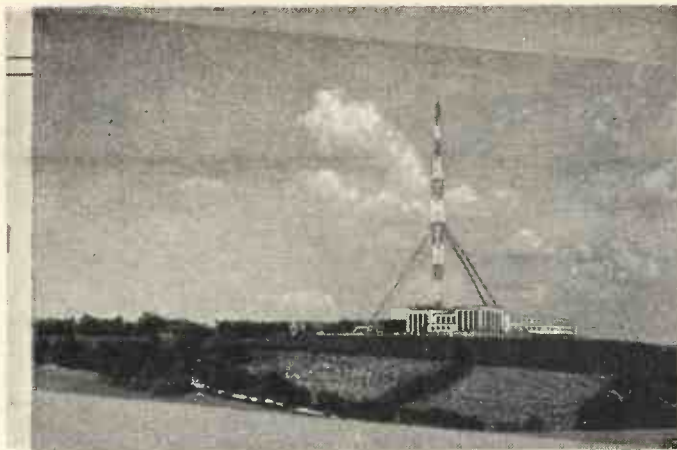
Was heard again in the broadcast version of "Derby Day," in which she sang the part she made famous.

Tessa Deane is undoubtedly one of the best and most individual of the light sopranos of broadcasting—and one who is not heard nearly enough in the programmes. P. C.

voice?' 'Oh, be quiet!' I sez, 'praps that's the lady's eddication!'

"Then 'Erbert suddenly discovered that 'e 'ad backed a winnin' double, and with a smile 'e said, 'Well, Mum, it doesn't matter much 'ow sorerful one gits the noos, as long as one *does* git it!'"

Chivalry forbids any elaboration of this theme. Besides, there is no



LONG DISTANCE MISTAKES

The unwary listener who goes in for long-distance reception is liable to fall into numerous traps unless he has the good advice of an old hand to help him. In this article some of the more common causes of poor results from distant stations are dealt with by

A. S. CLARK

LIFE is far too short to learn everything by first-hand experience, and the wise are prepared to profit by others' mistakes. Although the errors dealt with in the following paragraphs are not ones into which the old hand at distant reception is likely to fall, their reiteration will prove helpful to the newcomer to this fascinating branch of radio reception.

Gradual Movements Desirable

First of all, let's clear up right away the question of why one person is able to get so much more out of a certain set than another. Is distance-searching an art? Is it something inborn that cannot be learnt? Certainly not, except perhaps so far as the quality of patience is born in one.

Experience and practice in handling receivers certainly helps in bringing in those very, very faint foreigners, but what really counts is the way you go about turning the dials. Gradual movements are always desirable.

Unless you know the exact setting for the station you are after, and no matter whether the set has single-dial tuning or not, the dials must be turned slowly, and every carrier or sound which may be a station must be investigated. It is the biggest mistake out to swish the dials backwards and forwards quickly, and then pronounce that "There's nothing much on apart from the locals."

Another mistake is to assume that the setting of one control can have no effect on any of the others, par-

ticularly where reaction is concerned. Whenever using reaction, advance it a little at a time, and check up the tuning in between each small increase.

Ganged receivers are probably more common these days than those with separate tuning dials and, due to the great amplification provided by modern efficiency, trimming is far less important than it used to be. But while you may get quite a number of



The careless adjustment of a preset condenser may completely upset the tuning of a receiver.

the more powerful Continentals when trimming is a good way out, this state of affairs is fatal to the covering of really great distances.

Adjust the trimmers carefully on weak reception, and don't assume they are going to stay put for ever. Check them over occasionally.

If you change a valve or a fixed condenser, or similar small component, the trimming may be thrown out and require re-setting. Even the effects of time on the aerial may alter its electrical constants, which may, in turn, make further setting of the trimmers a necessity.

Points to Watch

The finding of the absolutely best setting for the trimmers may seem a small point—by itself it most certainly is—but there are other small items, and together their detrimental effects may be detracting from the results as much as quite a big fault.

A partly run-down battery, dirty contacts to batteries or in valve holders, valves that are losing their emission, and dozens of other small

items of this nature, are all important. Attention to such points can make success out of failure.

On small sets the reaction control simply must be smooth; any sign of ploppiness will have to be removed. Lower H.T. voltage, different values of grid leak, different detector valves, variation of the reaction coil, if this is possible, are all ways of tackling the smoothing out of reaction.

Improves Selectivity

While writing about reaction, it is a mistake to imagine its one and only use is to bring in or increase the volume of weak stations. It makes an ideal improver of selectivity.

And now three small points to finish off with. Too big a capacity on the gang condenser trimmers limits the wavelength range. Keep their settings as small as possible.

Too big an aerial may upset selectivity. You'll probably get more stations properly with a medium-sized aerial. And don't forget the importance of making a log.



Small faults may not appear important—but they mount up! Look at this faulty S.G. anode lead for instance; it may ruin reception.

The FUTURE OF

GERMAN wireless is rapidly taking the place of the evening newspaper. The Teuton doesn't require his news quite as red-hot as the Anglo-Saxon. Consequently the radio has time to step in while the Berlin equivalent of Fleet Street lingers over its late night finals. Not that it is correct to say that anything to do with wireless merely "steps" in Germany. It rushes. It owns a flying squad with its own record-making vans. It hypnotises the Post Office into supplying unlimited lines. It commands express trains. It proposes to possess its own planes. And the result of all this is that everything



The recent revolutionary changes have made radio in Germany an affair of intriguing interest. The tremendous part which news and political propaganda play in the daily programmes is the subject of this unique first-hand commentary.

"Let there be noise!" he begged. "There can't be, you fool!" retorted the pilot. "That's the whole point of the thing." "There *must* be!" said the frenzied commentator.

A passenger who happened to have a mechanical contrivance neatly packed up as a present for his children, offered to provide noise of approximately the right sort. The Herr Direktor who told me the story didn't say whether the pilot shot him or whether the commentator embraced him!

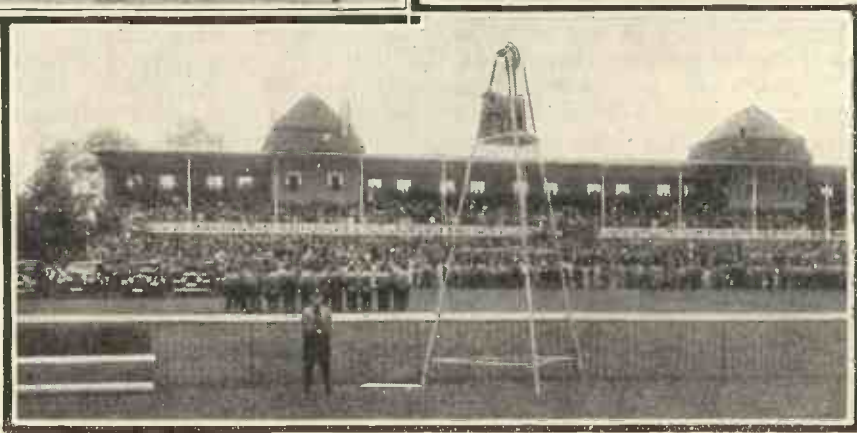
RECURRING NEWS BULLETIN

German wireless seems to me to concentrate on news. Any programme at any time may be interrupted in order that listeners may take part in some happening a mile away or several thousand miles away.

The News Budgets, "illustrated" with sound atmosphere because they are generally produced from records made on the spot, recur at intervals during the day and they are admirably balanced. The German is interested in sport, but he does not exaggerate its importance. It is to him physical training and amusement, but not business. It ranks far below politics and patriotism in the Brown Germany of to-day. In fact, a parody quoted to me in Berlin aptly describes the situation.



which happens during the day is repeated on the wireless at nine o'clock in the evening. It is not merely described by a sympathetic young man of doubtless godlike appearance, with the sort of voice every woman wants to marry. It actually happens to an accompaniment of all suitable noises. Sometimes the noises are unsuitable in order to be more realistic, as, for instance, when a record was being made of a new silent motor fitted for the first time to an aeroplane. The commentator was so worried lest his listeners shouldn't realise that the record was being made on the plane that he ordered the pilot to open the throttle, or exhaust, or anything that would show the engine was really there.



METHODS OF PROPAGANDA by radio in Germany are shown in these two photographs. Above is a mobile loudspeaker van, invaluable for election purposes, while below a Nazi demonstration is listening to a rousing broadcast speech. In Germany to-day the greatest possible use is made of the loudspeaker for propaganda purposes, and the broadcasting service has been placed under the control of the State.

GERMAN BY ROSITA FORBES BROADCASTING

"Sport is of our life a thing apart.
'Tis the English whole existence."

Consequently, on the wireless, sport is reduced to reasonable dimensions, and a good deal of time given to what I should call representative national life. One of the best broadcasts was made from a moving train. A commentator was apparently passing from carriage to carriage talking to the passengers. Above or in between the usual sounds of travel, came scraps of conversation.

HITLER'S STRONGEST WEAPON

"I'm going to Hamburg."

"Why?"

"Because my niece is getting married, etc."

"I also am going to Hamburg, but it is an affair of business."

The impression was extraordinarily intimate. One felt one was looking into the minds and purposes of a trainload of people who were no



IN CHARACTERISTIC ATTITUDE Herr Adolf Hitler addresses his Brown Shirts during a visit to the famous port of Kiel.

longer strangers. One even imagined that one would recognise them, if one met them.

Hitler has introduced a complete innovation in the form of the National hour which all stations are obliged to relay. During this period there is a certain amount of classical German music, while the rest of the time is devoted to politics with a suitable bias.

An official in Berlin said to me frankly: "The radio is Hitler's strongest weapon."

SENSATIONAL POLITICS

And when I countered with, "How much of your programme is political?" he retorted, "All of it."

But this does not mean that Brown Germany listens to the sort of debate which nightly sends the House of Commons to sleep. Nazi politicians are theatrical in that they appeal by



POTTED NEWS. Running commentaries and eye-witness accounts of important events in Germany are made during the day and reproduced in the news bulletins the same night. A real radio news-reel!

"A STUPENDOUS CRESCENDO OF SOUND"

every popular means to audiences who can be enthralled by sound as well as sight.

"The marriage of Hitler's oratory to the thunder of the air" (as it was described by a contemporary writer) is something new in the history of sensation. Listening to the record of a Nazi meeting is as stimulating as attending one. The floodlights and the flags are missing, but one hears and feels the excitement of the packed

nobody thinks of time. The audience, whether it is in the hall or listening in a draughty shed on the Baltic coast, remains mindless, motionless, a sounding-board for the eloquence of the man who believes in Germany.

THE GREAT CREED

Hitler never discusses, argues or explains. He asserts, he attacks, appealing thus to the convictions which have so long lain fallow, deeply

young brown-shirted Germany to look forward towards peace rather than backwards to the War. Their objective was a sensible revision of the Treaty of Versailles, so that, once and for all, the War could be forgotten. I heard no militarist propaganda.

"We have enough unemployed of our own. We don't want to have to cope with other people's," said Hitler.

BROADCASTING A FIRE

Every German carries a newspaper tucked into a bulging pocket, but for news, as well as inspiration, he depends on the radio.

There was a fire in Berlin. A whole block was burning. Before the flames reached the roofs, simultaneously with the fire brigade arrived the radio van. While ladders and hoses were brought into action, in a cloud of smoke, amidst the hiss of steam and the crumbling of old masonry, the record-makers (and record breakers) started work.

EXPERIENCED BY ALL

By the time they'd finished they were unrecognisable, but two hours later all Germany, listening in farms and flats, factories, cafés and clubs, knew what it was like to be in the middle of a fire.

"Next year, that sort of thing will be done from an auto-gyro," said the youngest director. Which is just simply typical.

MUSICAL FARE



Representative national life is here well portrayed by a typical country family at supper, with the radio providing its quota to the general conversation.

GERMAN SPORT AND RADIO

Sport interests the German but he does not exaggerate its importance. Consequently on the wireless sport is reduced to reasonable dimensions. It ranks far below politics and patriotism.



audience, the hush of expectation, the broken comments, then, from far away, the tramp of marching feet. The music swells so that it is like a tidal wave on which the black battalions of the bodyguard with the death's head on their caps are swept into the hall. One hears the audience rise as one man. There is no shuffling of feet. It is a stupendous crescendo of sound, to which one's pulses march in unison.

"WHAT IS ADOLF HITLER?"

"Heil, Hitler!"

When the salute crashes into the air, one has no difficulty in seeing the thousand arms uplifted or the young, bronzed faces alert with new hope.

The music dies. Somebody speaks slowly and with repetition—a Te Deum, in which phrases recur like the beat of a hammer on an anvil.

"Germans, prepare yourselves! Perish the alien in our midst. What is Adolf Hitler? Our hope, our faith, our future, and our leader!"

Military bands thunder. Men shout and women sob.

Hitler rises, and there is silence. In a rough and powerful voice he speaks. One hour, two hours—

buried beneath the weight of Versailles obligations; so that every man in the audience feels that—"Germany cannot be a second-class nation. Something is going to happen. It has got to happen. We must follow our leader—he is not an accident, he is German destiny. Follow and our day will come as surely as to-morrow's sun!"

At the end of one of these great meetings, to which I had listened together with some four million people all over Germany, I asked a stolid young engineer: "What would happen if Hitler died? Could the party carry on?"

He looked at me as if I blasphemed. "How could he die until his work is finished?"

NO WAR PROPAGANDA

Here is the explanation of Germany's faith, and the air is the proper element for the promulgation of the new religion. Where Russia says: "Greetings, Comrades, Moscow speaking"; where America descends to "Good evening, folks"; Berlin preludes its aerial bombardment with "Germany, awake!"

Yet the speakers I heard urged

REAL GRAMOPHONE TONE CONTROL



OF late particular attention has been paid to the necessity of tone correction when reproducing gramophone records. Unfortunately, many of the arrangements devised are almost worse than useless from both the musical and technical standpoints, inasmuch as they attempt to make good the deficiency of the bass by attenuating the treble more and more as the frequency rises, resulting in a general deadness of reproduction.

Perfect Correction

Certain tone - controlling transformers have been put on the market of late which are useful (though not ideal for gramophone work), but generally these necessitate structural alterations of the receiving equipment.

Details of how to construct units which will add realism to your record reproduction, and which can be adjusted to suit anyone's taste.

By H. E. J. ORTON.

An average electrical recorder is adjusted to have a response curve showing a falling off of sensitivity at the bass and extreme treble; this being, of course, intentional.

For perfect tone correction, our reproducing apparatus should obviously have a response which corrects recording errors. The arrangements condemned above fall very short of the mark.

These arrangements take various forms, but usually they are either a capacity in series with a resistance

shunted across the pick-up, or an inductance in series with a resistance in series with the pick-up.

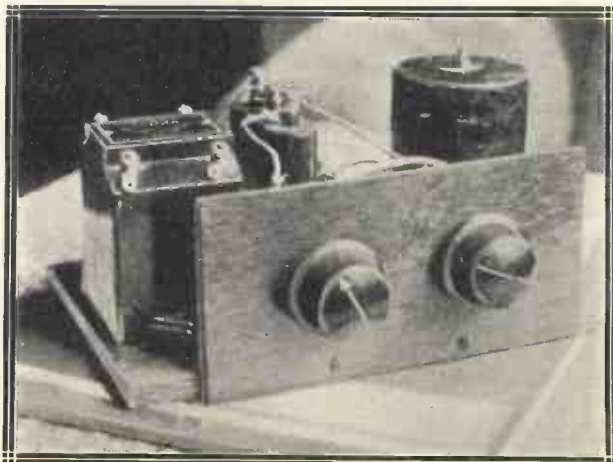
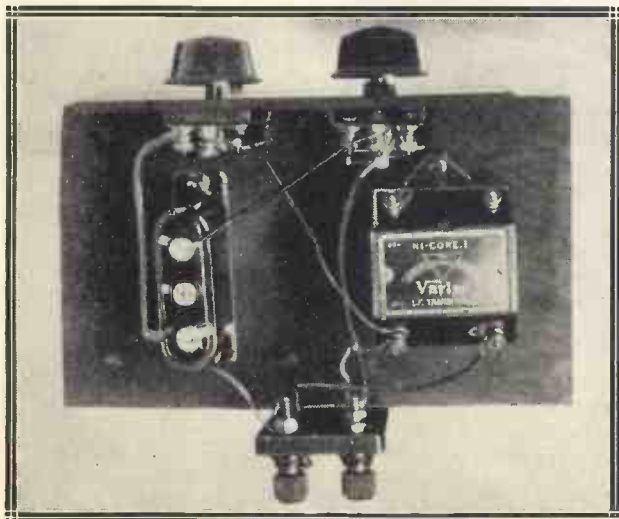
Now, with the arrangement I am about to describe a much more desirable response is obtainable. The arrangement has also the advantage that it can be adjusted, by the turning of knobs, to allow for individual variations in pick-ups, reproducers, and so on.

More Realistic

There are two alternative arrangements possible; one enables a life to be given to the bass only and the other compensates both bass and extreme treble.

In the usual way, the bass "lifter" provides all the correction necessary to make record reproduction much more realistic, the additional aid of the

SIMPLY-MADE UNITS TO COMPENSATE FOR BASS AND TREBLE



The unit to the left is one which improves the bass reproduction, while that above gives a "lift" at both ends of the frequency scale.

top "lifter" being needed only when the remainder of the apparatus has an unusually poor high-note response.

The circuit arrangements and the values of components are shown in the accompanying diagrams.

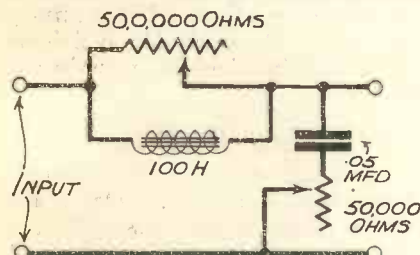
Low-frequency transformer primaries or secondaries are quite suitable for the inductances in both "lifters." For the bass "lifter," the primary of a good transformer or the secondary of a cheap one suffices; for the treble "lifter," the secondary of a fairly good transformer.

As can be gathered, none of the values is very critical, considerable differences in values having, judged from the aural standpoint, only negligible effect upon the performance of the lifters.

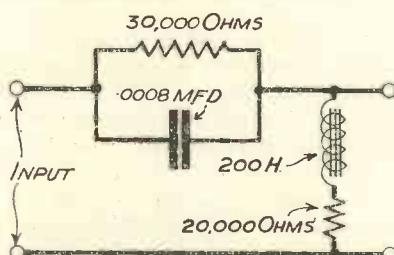
Avoid Interaction

The two tone-controlling resistances, which can be ordinary volume controls with one outside terminal not in use, should be wired up so that if both knobs are turned in the same direction the resistance in circuit of one control is increasing, while the resistance in circuit of the other is decreasing.

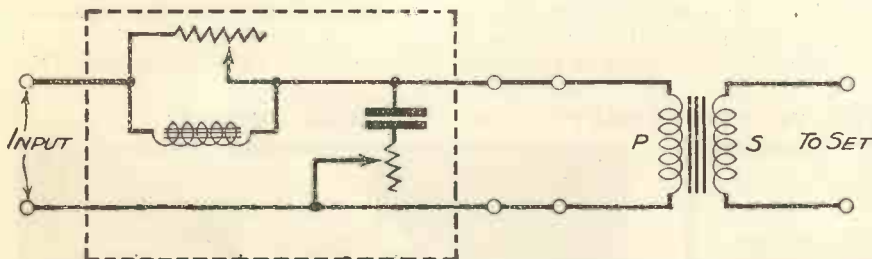
CONNECTIONS FOR COMPENSATOR AND "STEP-UP"



LOW NOTE COMPENSATOR



HIGH NOTE COMPENSATOR



SHOWING USE OF STEP-UP TRANSFORMER

The schemes in the top two diagrams are specially suitable for amplifiers with a surplus of power. The bottom scheme will help with sets of limited output.

The gadget can be made up as shown in the photographs, or it can be arranged on the motor-board or somewhere in the set. Wherever it is put, care should be taken to avoid undesirable interaction with the set and mains equipment—if such be used.

As can be seen from the diagram, the corrector is connected between the pick-up and the set.

The device, in either form, is most suitable when used with amplifying equipment which is not ordinarily pushed to the limit.

There are two particular reasons why this should be the case. The one is because the use of the filter tends to reduce somewhat the input to the set; and the other is due to the fact that for a given seeming loudness, more power has to be expended if a reproduction has a correct proportion of low notes than if the middle and top predominate considerably.

Indications of Balance

If the set does not give sufficient amplification, a good step-up transformer, wired up as in the diagram, is sometimes useful.

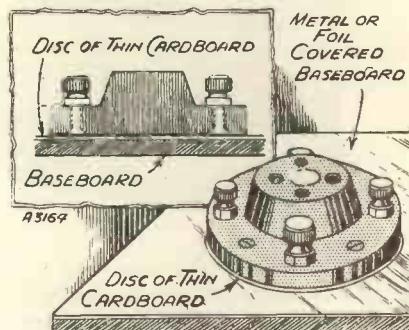
In actual practice, the two knobs are varied together until a suitable balance of high and low notes is obtained.

If a good balance has been obtained it can generally be checked by observing whether upon turning the volume slowly down the illusion of moving farther and farther away from the music is produced. With equipment

CONCERNING METAL FOIL
A precautionary idea and a helpful tip.

WHEN the baseboard of a set is covered with copper foil or a metal chassis is used, great care must be taken to prevent shorts to this.

In particular a disc of thin cardboard or thick paper should be placed between the valve holders and the



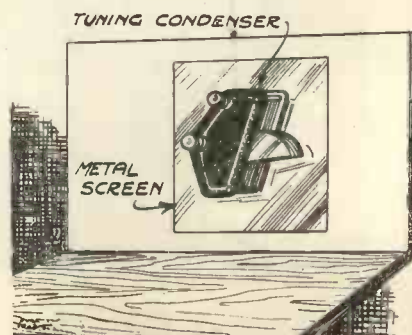
Screws which might touch the baseboard foil can easily be prevented from doing so by a piece of card.

baseboard to prevent the underside of the terminals touching the baseboard.

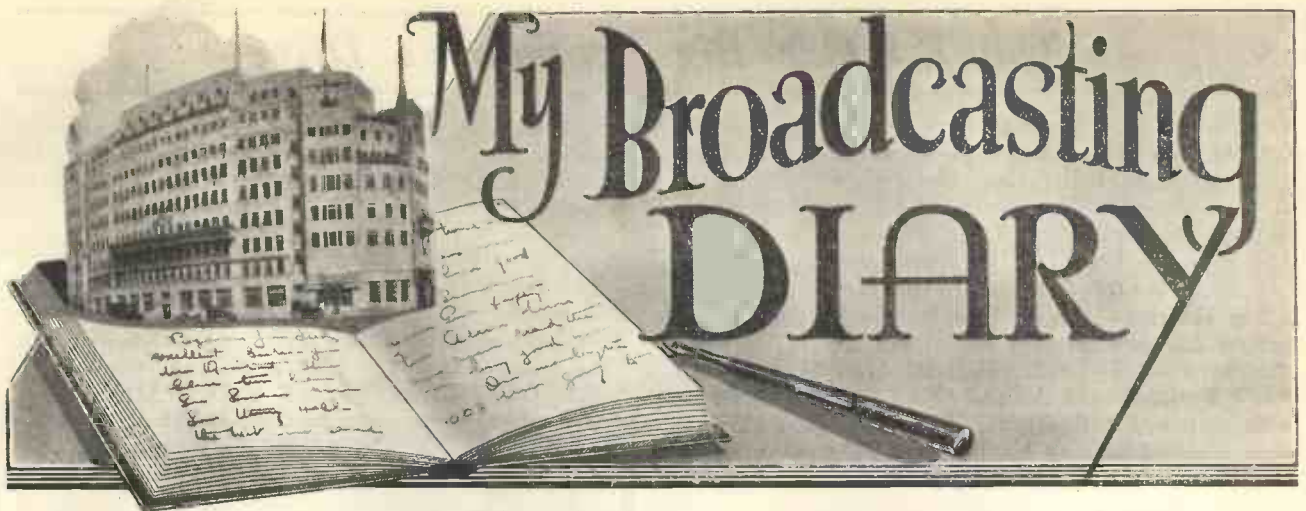
This precaution is also necessary with some makes of preset condensers and grid-leak holders in which the terminal screws are countersunk into the base.

REDUCING HAND-CAPACITY EFFECTS

IF you are troubled at all with hand-capacity effects, an improvement can often be effected by fixing an earthed shield on the back of the panel behind the tuning condenser. In many cases this will give a complete cure, but even if it does not do this it is bound to do some good.



A metal screen behind the panel in the vicinity of a tuning condenser will often stabilise tuning.



The B.B.C. and the Music Halls

IF Sir John Reith revealed one half of the plans for combating the opposition of the music halls, I fear that he would bring down upon the B.B.C. the wrath of the entire entertainment industry. The trials and tribulations involved in the B.B.C.'s fight for supremacy in the field of music would be as nothing to the bitter attacks which the stage and variety chiefs would at once launch.

Even a few of the more harmless suggestions laid before the Board of Governors would cause an outburst of indignation from Mr. George Black and others. Sir John's proposal—made half facetiously—to erect a big B.B.C. Broadcasting Theatre roused some of them to fury and certainly did nothing to relieve the tension.

The Governors have rightly taken the view that the music halls are acting through fear—fear, that is, of competition from outside the industry—and have agreed that non-aggression and an attitude of sympathetic understanding is the best line for the B.B.C. to adopt at present.

Symphony by Sir Edward Elgar

The crop of rumours regarding the symphony that Sir Edward Elgar has been commissioned to write for the B.B.C. is not surprising considering the unusual reticence that is being observed in official quarters. Neither the B.B.C. nor Sir Edward will disclose when or where the symphony is to be given its first performance, yet both deny that the privilege is to be given to the Hallé Society. Presumably it will first be heard in London next spring.

There are rumours, too, concerning the fee that the B.B.C. has promised for the work that Elgar is now busy on in his Worcestershire home. I am told that it is the biggest sum ever paid for a commissioned musical work and runs into several thousands of pounds.

Television Transmissions to Continue

The inner history of the television discussions at Broadcasting House will some day make interesting reading. Meanwhile, it is worth recording that but for

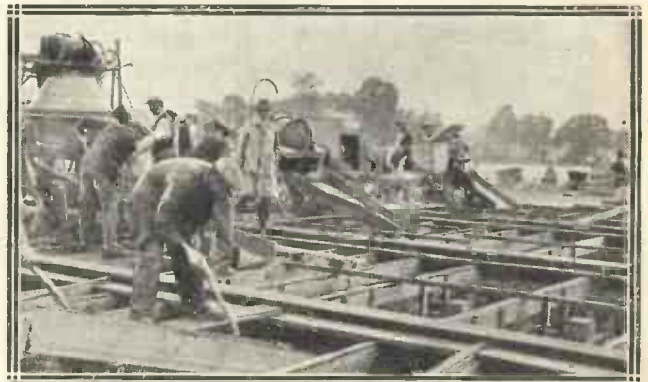
the action of a daily newspaper Britain might even now have ceased regular television transmissions.

The Governors, after consultation with Sir John Reith and the Chief Engineer, Mr. Ashbridge, had definitely agreed to announce the abandonment of all television transmissions apart from a few experimental broadcasts on ultra short-waves. Then came the newspaper article denouncing this action and calling forth such an uproar from the radio trade that the B.B.C. at once climbed down and within a few hours decided to continue the existing television programmes.

Apart from the effect which this has had upon the development of television, it illustrates very clearly the power of the Press over the B.B.C. In this case that power was applied to some useful correctional purpose and is the most outstanding instance I remember of a newspaper having shown the B.B.C. the right course to adopt on any important question of policy.

Keeping a critical eye on the affairs of the B.B.C., our Special Correspondent comments frankly and impartially for the benefit of listeners on the policies and personalities controlling British broadcasting.

THE NEW MIDLAND REGIONAL



Workmen busy on the new B.B.C. station. They are constructing the huge concrete foundation for the Diesel engines that will supply the power for transmitting.

The Power of Droitwich

Many will seek an explanation but few will know the reason for the secret decision of the B.B.C. to make provision at Droitwich for an extension of power from 100

The B.B.C.'s Big Programme Drive

kilowatts to 200 kilowatts. If it were thought on the Continent that this excessive power might be used there would be general indignation. Hence the secrecy and the official statement that "the licensed power of Droitwich is only 100 kilowatts."

The Nationals to Go

The shutting down of three of the National transmitters has now received official sanction. The three stations affected—London National, West National and North National—will definitely close down when Droitwich has passed its final tests. There is now some question as to whether Scottish National could not profitably be transferred to the Highlands,

Seeking a Super Studio

Search for a new concert hall, to take the place of No. 10 "underneath the arches" by Waterloo Bridge, has been widespread. The Maida Vale skating rink is favoured, but there is also a more advanced group that demands nothing less than Albert Hall.

"C. B. Cochran Presents . . ."

We are now in the thick of the B.B.C.'s Big Programme Drive (as they call it), so it is natural that we should expect something outstanding in the way of variety programmes and light entertainment generally. There need be no disappointment, for on Saturday, October 14th, comes the much-talked of reminiscences entitled "C. B. Cochran Presents . . ." in which the great impresario will himself take part. The programme is a



*
HENRY HALL
AUTOGRAPHS
A
CONDENSER
*

The popular leader of the B.B.C. dance orchestra autographing a condenser for a blind radio enthusiast.

straightforward co-operation between Cochran and Henry Hall, and consists, naturally, of practically nothing but musical hits from Cochran's successes.

"First Time Here"—the Saturday variety matinées—continue throughout the month, and there is much hope of discovering talent in this way.

On Tuesday, October 3rd, is a burlesque by the Melhuish Brothers, produced by Martyn C. Webster, and on the following day Billy Merson puts on his revue.

A Talk by Lord Rutherford

The next of the B.B.C.'s National Lectures, two or three of which are broadcast annually, is on Wednesday, October 11th, on the National wavelengths. Lord Rutherford, probably the most outstanding physicist in

the country, is to deliver an address on "The Transmutation of the Atom," presumably dealing with his researches in the famous Cavendish Laboratory where he is popularly said to have "split the atom."

Relays from Sadlers Wells

Two relays from Sadlers Wells have been fixed for this month. They are "Snow Maiden" (Rimsky-Korsakov), of which Acts 1 and 2 will be broadcast on

A POLITICIAN FACES THE "MIKES"



The Governor of New York State making an appeal to the public by means of radio. Politics have a much larger part in the programmes in America than in this country.

Thursday, October 5th, in the London programme; and "Cavalleria Rusticana" (Mascagni), relayed on Friday, October 13th, also in the London programme.

Special concerts booked for the near future include: Ketelbey Concert, from Kingsway Hall (London, Saturday, October 14th); Military Band (National, Friday, October 6th).

"An Unlikely Tale of the Crimean War," entitled "The Pride of the Regiment" will be heard from the Regional on October 14th.

The last "Prom" of the season on Saturday, October 27th, is to be broadcast throughout with a short break for the News Bulletin. The soloists in this concert are Stiles Allen, Samuel Worthington, and Maurice Cole.

A Civil Service B.B.C.?

The sharp division of the B.B.C. staff into "Administrative and Creative" leads some of the higher officials at Broadcasting House to believe that the time is not far distant when one half of the B.B.C.'s work will be run by Civil Servants. The reorganisation has definitely paved the way for this move, and it would be but a formal change to make the Administrative staff Civil Servants.

Sir John Reith's view is that the creative side of broadcasting can never be run by people whose only qualifications are that they have passed an entrance examination. Come what may, the question is sure to be considered during the grand parliamentary inquiry that is to be held prior to the granting of a new Broadcasting Charter in 1936.



FAULTS I HAVE FOUND

By a
SERVICE ENGINEER



I HAVE recently completed investigations into a fault—or, rather, a series of faults—which was not only baffling but also extremely expensive in the amount of replacements that the trouble involved.

A recently-purchased radiogram—in the 100-guinea class—behaved perfectly well for exactly one week after its installation and then suddenly refused to function at all.

A Weekly Occurrence

An engineer was sent for to discover the trouble, and found that the main reservoir condenser had broken down, and since the set had been left on after the breakdown—the worthy owner imagining that the trouble was a break in the programme—the rectifier valve had been short-circuited for some minutes and consequently had completely lost its emission.

Quite naturally, the engineer suspected that the condenser had been faulty and replaced it with a new one.

When a new rectifier was fitted all was well again.

But not for long!

After another week's service the same fault occurred again.

Exhausted Patience

And since all good engineers are incurable optimists, the same remedy was applied and the same assurances given as before that from then on the receiver's performance would undoubtedly accord with the glowing accounts of the manufacturer's advertising agent.

I will not weary the reader with a more detailed account of the history of that set beyond mentioning that the same fault occurred again and again, and—

Eventually the unfortunate owner's patience came to an end, and he took up his pen and wrote several regrettable and heartbreaking things which reached He Who Must Be Obeyed, at the Service Depot.

Wide, first-hand experience of trouble-tracing in all kinds of receivers well qualifies the writer of this feature to advise readers how to locate faults in their own sets. Condenser breakdown on mains receivers due to incorrect centre-tapping, and crackles caused by a variety of faults are two of the subjects dealt with this month.

Thus it was that I found myself hurrying with all possible speed to the scene of these disasters with the most dire threats overhanging me as to my fate if I did not manage to clear up the trouble completely and permanently.

Some readers may have guessed the cause of the repeated condenser failure by this time from this description; in case that is so I feel I must

USE THE RIGHT TAP



Unsatisfactory tone and poor quality of reproduction are sometimes traceable to the use of the wrong tapplings on the loudspeaker's input transformer. Incorrect matching of output to speaker thus results, and the circuit becomes unbalanced.

offer some explanation as to why the trouble had not been more fully investigated at an earlier date.

An Unsavoury Reputation

One reason is that engineers are not normally given full details of the "histories" of the various receivers to which they have to attend—for this would involve a colossal and, in most cases, unnecessary amount of

work; another reason is that service work very naturally produces prejudices with regard to certain components which are found from experience to give repeated trouble.

Suffice it to mention that the condensers in this particular type of radiogram had already earned themselves the title of "Totten."

Thinking It Out

However, there was no doubt that in this case the condensers were blameless, and I therefore set to work to find some other cause for the repeated failure.

Now, assuming good condensers, what can cause a complete breakdown of dielectric insulation?

Excessive peak voltages—right!

And what will cause excessive peak voltages?

A faulty mains transformer—again quite right!

I tested the secondary H.T. winding and obtained the correct reading across the outers—800 volts.

Next I put the A.C. meter across the outers and the centre tap in turn.

And here I found the cause of all the trouble.

The Guilty Component

The centre tap was *not* a centre tap at all; it was, electrically speaking, 40 volts out of centre, so that the peak voltages developed on the "larger" side were probably as much as 100 volts above normal!

If you should experience this type of trouble with your mains set, it is as well to test for this fault before indulging in reckless expenditure on new condensers and rectifying valves.

It is, however, extremely unlikely that you will find such a fault on a good commercial type of mains transformer.

Full immunity is assured, of course, if you fit a thermal delay switch to the power pack so that peak voltages are entirely prevented.

A New Cause of Fading Reception

While we are on the subject of rectifiers, here is a useful tip in regard to A.C. mains receivers.

When you are carrying out tests or making such alterations to the set

AVOIDING A SHOCK



Fixed condensers of 1 mfd. and upwards may be tested by being momentarily connected across an H.T. battery, then left for ten minutes or so, and afterwards discharged—a good snappy spark indicating the condenser is O.K. Use a wooden handled instrument for the shorting.

which require constant working of the receiver for checking purposes, a great deal of time is wasted in waiting for the A.C. valves to warm up after each time of switching on.

This difficulty is avoided by the simple expedient of removing the rectifier valve from its socket whenever it is necessary to render the chassis "dead."

Reasons for Fading

The L.T. is still fed to the set, of course, so that the valve cathodes are constantly at working temperature and the signals will be received as soon as the rectifier valve is returned to its holder.

This "dodge" does *not* apply, of course, when you are making adjustment to the power pack itself.

I am constantly coming across new reasons for fading signals.

I have already mentioned several in this series, and I thought that I had covered all the likely ones.

However, a new one has reared its ugly head and looks like making a real nuisance of itself.

The most distressing feature of the trouble is that it will affect a very large percentage of the ever-increasing number of owners of powerful receivers who operate them on small indoor aerials or, worse still, on "mains aerials."

Confirming Suspicions

The symptoms are sudden changes of volume on all stations, sometimes accompanied by loud crackles and clicks, and are, in fact, identical to those which obtain when faulty joints exist.

It was only after a very long period of looking for such loose joints—which did *not* exist—that I began to suspect the real cause of the trouble.

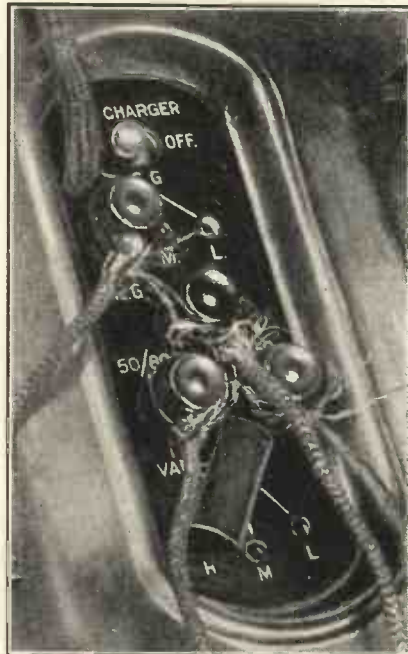
Confirmation was obtained when I connected up a different receiver to the same "picture-rail" aerial and obtained the same fault.

The trouble in this case was that the steel piping through which the house wiring was run was improperly earthed and consequently caused a varying degree of screening of the indoor aerial.

I was able to cure the fault by very careful and laborious earthing of the conduit.

Even now there is a lot of crackling

RISKING SHORTS



Neat flex ends are always a safeguard against short circuits, which in the case of a mains unit might be particularly harmful. Just one stray strand of the flex is sufficient to cause trouble.

which I am not convinced is genuine "man-made static."

When a "mains aerial" is used it is easy to see that the fluctuation in signal strength will be even more pronounced, for the conduit in this case entirely surrounds the "aerial" wire.

After long use, volume controls often become noisy in operation, and particularly is this the case with those that employ a carbon track for the resistance element.

I have seen many of these components discarded as being worn out

and unfit for further service, but in most cases complete repair can easily be effected.

The cause of the irregular behaviour of a carbon element volume control is either that dust and dirt have got in on to the track or that the track itself is worn or scratched.

Reversing the Element

In the first case the remedy is obvious, and careful cleaning of the element and the "wiper" will nearly always set matters right.

In the latter case a little ingenuity will usually produce the desired effect.

In nine cases out of ten, the track wears at one end—that is, at the "maximum" end where the control has been used most.

The simple remedy is to dismantle the components, remove the carbon element and to reverse it; this means that the "maximum" or worn end will now be in the "minimum" position, so that not only will it seldom be used, but the amplification of the set at this point will be so low that any irregularities of contact will be inaudible.

Such repairs, of course, do not apply to "logarithmic" or "graded" controls.

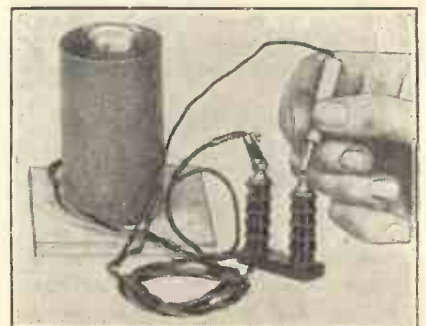
Pick-Ups that Hum

Here is a little trouble concerning pick-up arms that is often encountered and usually endured unnecessarily.

When a metal-cased pick-up is taken in the hand, either to change a needle or to place the pick-up in the record groove, a loud hum or crackle is produced; as soon as the operator removes his hand the noise ceases.

This is caused by the pick-up casing being insecurely earthed and currents are induced in the pick-up coils when the potential of the casing is altered.

NEON-TUBE TESTER



A neon tube in series with two testing points and with the mains is useful for continuity tests of components.



by OLIVER HALL D.Sc.

THE most difficult wireless problem of to-day is undoubtedly the problem of selectivity. In every wireless receiver, home-constructed or of commercial make, this problem exists to a greater or less degree.

There are few receivers which are sufficiently selective on the long-wavelength band to separate the Eiffel Tower and Warsaw transmissions from each other completely, and to give Königs Wusterhausen at good strength without interference from Daventry National or Radio Paris.

The results of some extremely interesting experiments which prove how closely volume and selectivity are interlinked.

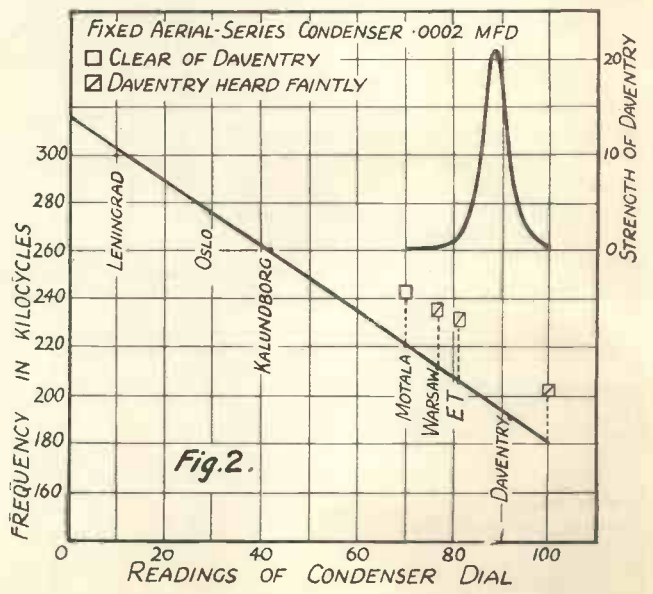
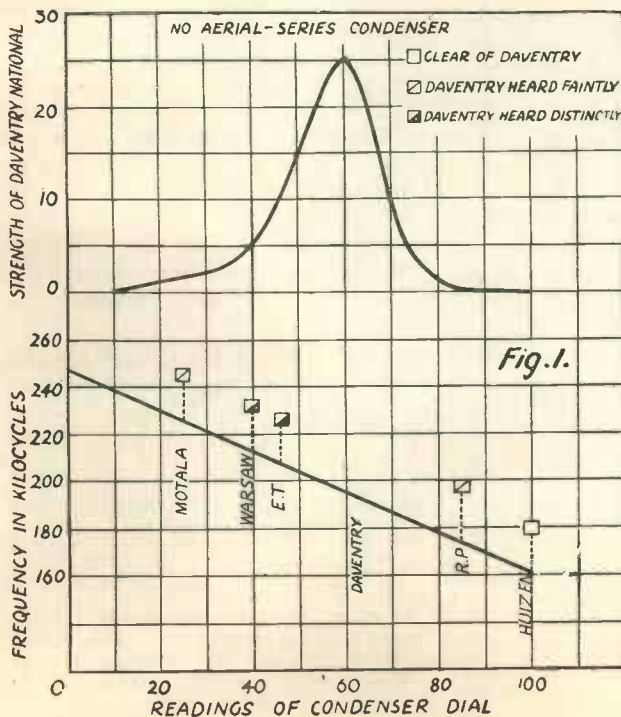
Similarly, there are few receivers which, on the medium broadcast wavelengths, are sufficiently selective to give Prague and Langenberg clear of North Regional, at least in the North of England, or to give Breslau clear of Poste Parisien, or Hilversum clear of North National and Scottish National.

Now it is fairly obvious that this difficult problem of selectivity should

be tackled first of all in the aerial circuit of a wireless receiver. The more selective we can make the aerial circuit, the better chance we shall have of obtaining a good measure of selectivity throughout the whole receiver.

When the problem of selectivity in the aerial circuit is attacked experimentally, the most striking thing about the results is the manner in which selectivity is gained only at the expense of volume. This is very clearly shown by a series of experiments recently carried out by the writer.

The aerial used in the experiments was a good outdoor aerial of standard size, and the earth connection was of proved efficiency. Using aerial and earth and a coil tuned with a variable



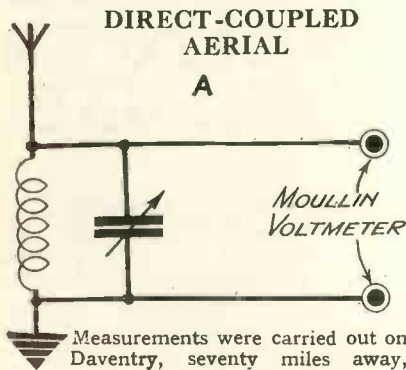
The Fig. 1 curve was taken under the conditions given in Table 1, and shows how the "spread" of Daventry was sufficient to cause a background on Motala and Radio Paris. With a fixed condenser of .0002 mfd. in series with the aerial there was a very considerable reduction in Daventry's "spread" (Fig. 2).

**AERIAL CIRCUIT
SELECTIVITY**

—Continued

condenser, measurements were made, by means of a Moullin voltmeter, of the strength of Daventry National.

The circuit diagram of the very simple apparatus is given in circuit Diagram A. For convenience, the



Measurements were carried out on Daventry, seventy miles away, using a simple tuning circuit connected to a Moullin voltmeter.

readings of the Moullin voltmeter were made on an arbitrary scale, the values given being strictly comparable throughout the experiments.

The coil used in the first experiments consisted of 110 feet of No. 32 gauge D.C.C. wire tuned with a variable condenser of maximum capacity .0003-mfd. Readings of the strength of Daventry National were taken at every tenth division of the variable condenser dial from 0 to 100. These readings are given in Table 1, and they are illustrated in Fig. 1.

Daventry's Spread

In order to show how the transmission of Daventry National spread over the condenser dial and so interfered with the reception of other long-wave stations, a tuning curve for this coil of 110 feet of wire is also shown in Fig. 1. As will be seen from this diagram, with this coil,

TABLE 1. Coil 110 feet of No. 32 D.C.C. wire. Variable tuning condenser .0003 mfd. No aerial series condenser.

Dial reading	0	10	20	30	40	50	60	70	80	90	100
Strength of Dav. Nat.	0	0	1	2	5	15	25	10	1	0	0

TABLE 2. Coil 110 feet. Tuning condenser .0003 mfd. Aerial-series condenser .0002 mfd.

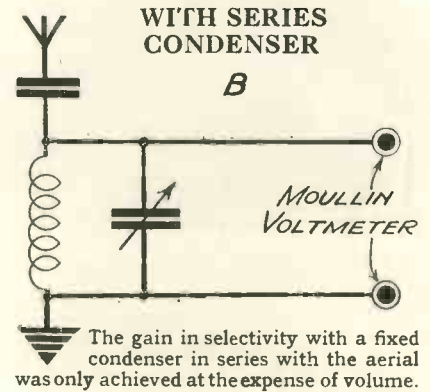
Dial reading	0-70	80	85	88	90	92	94	96	100
Strength of Dav. Nat.	0	1	8	21	18	8	4	2	0

Daventry National was heard through Motala and Radio Paris when the receiver was tuned to these stations. Also Daventry was heard distinctly enough through Warsaw and the Eiffel Tower transmissions to spoil reception of those two stations.

Huizen, however, was quite clear of Daventry.

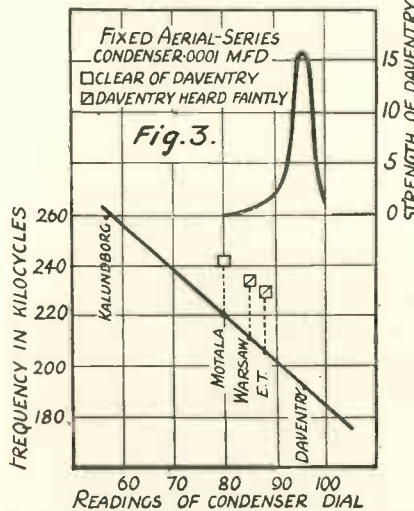
In the next experiment an aerial-series fixed condenser of .0002-mfd. capacity was brought into circuit, as shown in circuit Diagram B. Readings were taken of the strength of Daventry National over the whole of the tuning condenser. These readings are given in Table 2, and are shown in the form of a diagram in Fig. 2. On the same diagram is drawn, for comparative purposes, a tuning curve for the coil with this .0002-mfd.

aerial-series fixed condenser in circuit. The beneficial use of an aerial-series fixed condenser of .0002-mfd. capacity is at once seen from Fig. 2. With no aerial-series condenser, the "spread" of Daventry National, as



The gain in selectivity with a fixed condenser in series with the aerial was only achieved at the expense of volume.

A "SLIMMER" CURVE



The use of a .0001-mfd. series condenser reduced the volume by 25 per cent.

shown, was approximately from 20 to 80 divisions, i.e. over 60 divisions on the dial of the tuning condenser. With an aerial-series condenser of .0002 mfd., the "spread" of Daventry National, as shown in Table 2 and Fig. 2, is from 80 to 98 divisions, i.e. over 18 divisions on the dial.

Another Advantage

Another advantage arising from the use of an aerial-series condenser is also shown by comparison of Figs. 1 and 2. In Fig. 1 the available range of the coil is seen to be from 245 to 160 kilocycles, i.e. 85 kilocycles. In Fig. 2 the range of the same coil is seen to be from 315 to 182 kilocycles, i.e. 133 kilocycles.

Hence, not only did this .0002-mfd. aerial-series condenser reduce the "spread" of Daventry National, but

TABLE 3. Coil 110 feet. Tuning condenser .0003 mfd. Aerial-series condenser .0001 mfd.

Dial reading	0-80	90	92	94	95	96	98	100
Strength of Dav. Nat.	0	2	4	10	15	16	6	2

TABLE 4. Variable aerial-series condenser at .0001 mfd.

Dial reading	30	38	47	52	56	59	60	64	67	70	74	80
Strength of Dav. Nat.	0	1	2	4	10	20	21	10	4	2	1	0

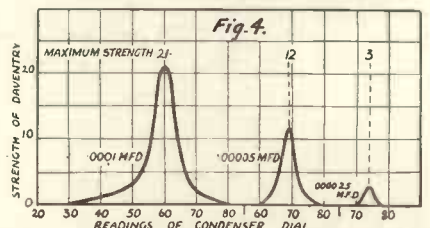
Variable aerial series condenser at .00005 mfd.

Dial Reading	60	62	64	66	68	69	70	71	73	76	78
Strength of Dav. Nat.	0	1	2	6	10	12	10	6	2	1	0

Variable aerial-series condenser at .000025 mfd.

Dial reading	70	72	74	76	79
Strength of Dav. Nat.	0	1	3	2	0

THE RESULTS COMPARED



Here we have three curves drawn to the same scale for comparison, and the loss of volume due to the reduction in the capacity of the series condenser can be clearly seen.

AERIAL CIRCUIT SELECTIVITY

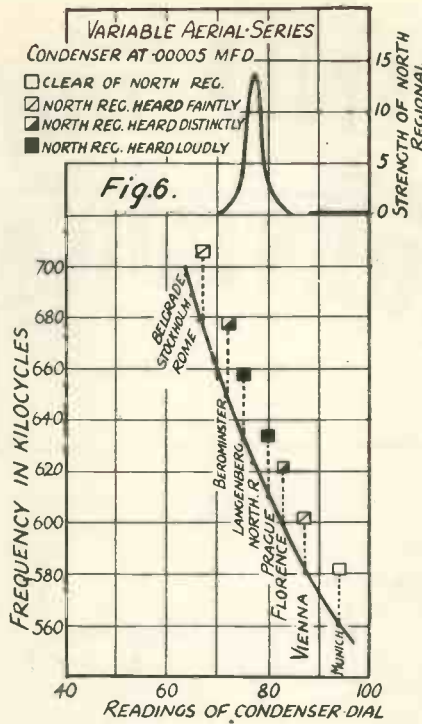
—continued

it also increased the tuning range of the coil.

With Daventry audible through the Warsaw and Eiffel Tower transmissions, selectivity would hardly be considered satisfactory. Accordingly, in the next experiment, a fixed condenser of .0001-mfd. capacity was used as an aerial-series condenser. Readings taken of the strength of Daventry National over the tuning condenser dial are given in Table 3, and are illustrated in Fig. 3. A tuning curve is also drawn in Fig. 3.

Reduced Strength

The first thing to notice about Fig. 3 is the reduction in the strength of Daventry. With no aerial series condenser the maximum strength of Daventry was 25 units (see Fig. 1). With an aerial-series condenser of .0002-mfd., the maximum strength of Daventry was 21 units (see Fig. 2);



and with an aerial-series condenser of .0001-mfd., the maximum strength of Daventry was 16 units (see Fig. 3).

the capacity value at this setting being approximately .00005-mfd. Lastly, the "spread" of Daventry was taken for a setting of the variable series condenser of .000025-mfd. approximately. The three sets of readings are given in Table 4, and are shown as a diagram in Fig. 4.

Increasing Selectivity

With the variable series condenser set at .0001-mfd., Daventry could be heard faintly through Radio Paris and through Warsaw. With the condenser at .00005-mfd., Radio Paris was clear of Daventry, but Daventry could be heard faintly through the Eiffel Tower and Warsaw signals.

With the condenser at .000025-mfd., Radio Paris, Eiffel Tower and Warsaw were all clear of Daventry. A reasonably good measure of selectivity was thus obtained.

A Typical Example

Looking at Table 4, however, we see that this selectivity was obtained at the expense of a big reduction in the strength of Daventry National. With the variable aerial-series condenser set at its maximum value of .0001-mfd., the maximum strength of Daventry was 21.

With the condenser set at a low enough value to give a necessary degree of selectivity for the receiver

(Continued on page 380)

TABLE 5. Coil 40 feet. Aerial-series condenser .0001 mfd.

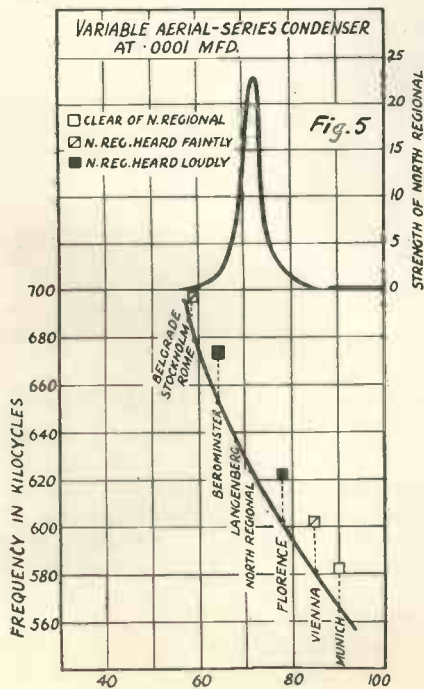
Dial reading	55	65	68	69	72	74	75	78	85
Strength of North Reg.	0	2	6	10	23	10	6	2	0

TABLE 6. Coil 40 feet. Aerial-series condenser .00005 mfd.

Dial reading	70	74	75½	76	77	78	78½	80	82
Strength of North Reg.	0	2	6	10	14	10	6	2	0

TABLE 7. Coil 40 feet. Aerial-series condenser .000025 mfd.

Dial reading	81	83	85
Strength of North Reg.	0	2	0



Reducing the value of the aerial-series condenser from .0002 to .0001-mfd. brought about a reduction in signal strength of Daventry from 21 to 16, roughly a 25 per cent reduction. Some compensation, however, is seen in the "slimmer" strength curve of Fig. 3.

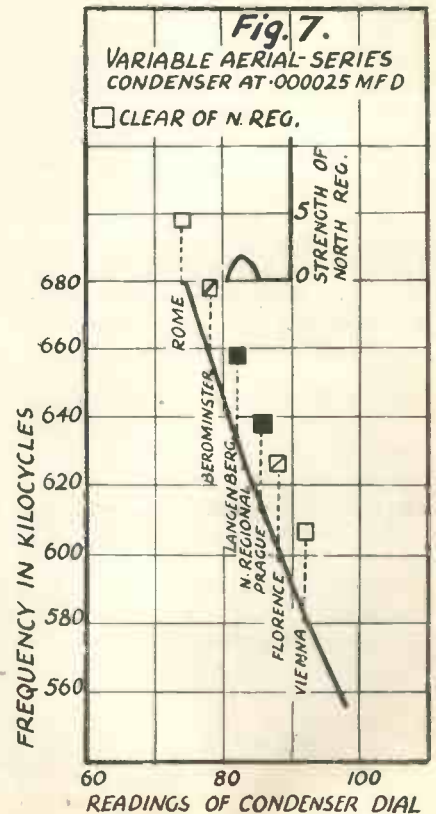
Further Experiment

In the next experiment a slightly different coil was used, and a variable aerial-series condenser. The "spread" of Daventry was first taken for a setting of the aerial-series condenser at its maximum capacity, approximately .0001-mfd.

The "spread" of Daventry was then taken for a half-way position of the variable aerial-series condenser.

NORTH REGIONAL TESTS

For the medium waveband tests the aerial coil was tuned by a .0003-mfd. condenser, and the curves in Figs. 5, 6 and 7 show the effect on volume and selectivity of decreasing the aerial-series capacity.





least. It is an excellent piece of electrical and mechanical engineering. It is, of course, the product of a world-wide famous gramophone concern, who should (and undoubtedly do) know what it is doing where record reproduction is concerned.

Making Allowances

The response curve is excellent, showing that adequate allowance is made for deficiency in bass recording on the record without in any way overdoing it. Many pick-ups fall short of the ideal by over-emphasising the bass "lift" in their design, but Columbia have not fallen into this mistake.

The high end of the musical scale is well rendered, too, the reproduction being brilliant without being scratchy or harsh—another score over many of the designs that have come my way. At the price of 32s. 6d. the Columbia pick-up is excellent value and I have no hesitation in recommending it to radiogram owners and constructors.

Preventing Induction

Three leads are provided with the instrument, two for the L.F. feed, and the third for earthing the frame of the instrument. This is a valuable feature, especially where mains sets are concerned, and a certain amount of A.C. induction into the pick-up may take place.

The pick-up is moderately sensitive, giving an output of 0.75 volts r.m.s., while its impedance is of the order of 4,200 ohms at 800 cycles. The D.C. resistance is 1,350 ohms or so, while a volume control of 50,000 ohms is recommended as most suitable by the makers.

High Notes

This latter value, of course, pre-

supposes that the amplifier characteristics are reasonably straight, for if the latter is prone to over-emphasise the high notes, as it may well do where a pentode output valve is used, a volume control of lower value may be more satisfactory, 10,000 to 20,000 ohms being suggested.

THE record-producing war is going on apace. Better and better value for money (and what little money!) is being provided, so that there is not the slightest excuse for the owner of gramophone or radiogram not to have a large percentage of the latest dance hits and other numbers in his record library.

On the Humorous Side

The most recent gun to be fired in the war is that by the Crystalate Gramophone Record Manufacturing Co., Ltd., who have produced the "Rex" records at the astonishing price of one shilling. They are ten-inch double-sided discs of undoubtedly high quality from the playing point of view, and they represent remarkable value.

The first issue arrived on September 7th, and consisted of 15 records comprising a wide variety of bands and artistes. There were Chick Bullock, the famous American Radio artiste, and Dan Donovan, whose voice is so well known to listeners.

On the humorous side, Sandy Powell leads the way, and it is interesting to know that his records on Broadcast have passed the three-million mark. He is assisted in the list, on another record, by Charlie Higgins.

A Weak Point

The rest of the fifteen are equally excellent value, and should be heard by all gramophone owners who are out for real bargains.

But however good a record is, it cannot give of its best unless the reproducer is properly designed, with a good amplifier and loudspeaker, and, most important, a pick-up that can handle the musical variations with ease and precision.

The pick-up has been the weak point in a great number of radiogramophones I have heard recently, and I fear that too many commercial

designers, having put good apparatus into the radio and L.F. amplifier side, have tried to cut down cost on the pick-up.

Specialised Knowledge

This is a false economy indeed, for this link in the chain need not be expensive to be good, but will undoubtedly ruin the whole instrument if it is of poor design.

There is a number of pick-ups on the market which can be termed first-class, and I try to test as many of them as possible so that I can truly judge the qualities of commercial

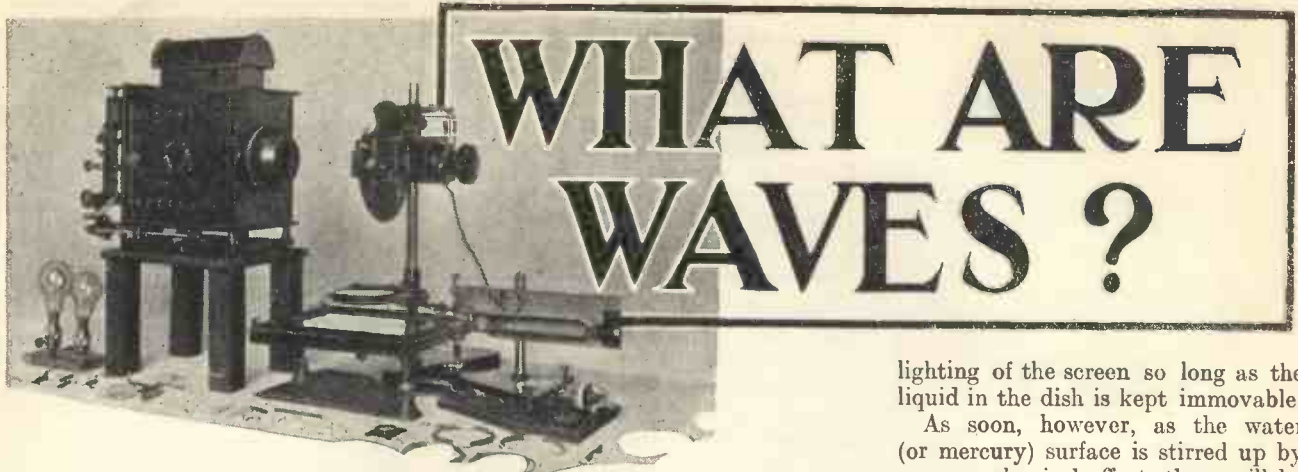
A TRULY EXCELLENT PICK-UP



Of proved make, this pick-up is fine value for money. It has just the right amount of bass compensation, and the arm will remain fixed in a raised position for needle changing.

apparatus I have to hear, and it is surprising how excellent many are. There are others which are not well-designed, of course, but they are becoming increasingly few.

The Columbia pick-up is the latest addition to my test bag, and I feel that it is truly a case of last but not



WHAT ARE WAVES?

WAVES are everywhere: all physical phenomena, whether acoustic, thermic, optical or electric, even those occurring in the interior of atomic systems, are due to wave motion.

In order to arrive at a closer understanding of Nature and the way she behaves, a more definite knowledge of wave motion—how it arises and how it asserts itself under a variety of circumstances—is found indispensable.

Insurmountable Difficulties

Though the formation and propagation of waves is illustrated most simply by throwing a stone into water, no means of actually visualising how—in accordance with laws common to all of them—they behave on being reflected, refracted or diffracted was so far available. All endeavours made in this direction had met with insurmountable difficulties.

Even in the case of light there was no possibility of demonstrating actual

“RECORD-LIKE” WAVES

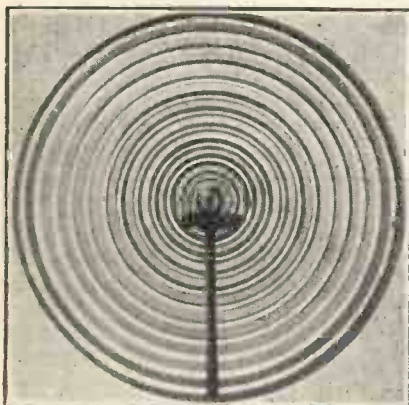


Fig. 1: A simple wave-form produced by a single “point.” It is very much like the water movement produced when a stone is dropped into a pond.

wave motion, all optical phenomena illustrating the behaviour of beams rather than trains of waves.

Now, it will be readily understood how invaluable such a demonstration would be, not only for purposes of instruction but for the solution of many problems in scientific and engineering practice; theoretical speculation being superseded by or being supplemented with the much more convincing evidence of actual tests.

It's called an “Ondoscope”—the apparatus at the head of this page—and it shows up wave-form in a strikingly clear manner hitherto impossible. Complicated wave combinations on the top of a bath of liquid are projected on to a screen for examination.

By Dr. ALFRED GRADENWITZ.

An apparatus lending itself to such a demonstration has just been devised by Professor E. Charbon, of Lille University, and is termed the “Ondoscope” by its inventor. Its design and its very interesting mode of working are briefly outlined in the following paragraphs.

Reflecting Prisms

The “Ondoscope” primarily comprises an electric arc and an optical system projecting this on a screen. If the latter were struck direct by the light of the arc, a brilliantly illuminated surface only would be visible. As it is, however, the beams of light are deflected from their straight course by a reflecting prism throwing them (through a lens) vertically downwards on a flat dish filled with water or mercury.

The latter (or else, in the case of a water-filled dish, its silvered bottom) will reflect the beams of light back upwards on another prism, deflecting them once more into their initial horizontal course. In fact, the addition of reflecting prisms will make no difference to the uniformly bright

lighting of the screen so long as the liquid in the dish is kept immovable.

As soon, however, as the water (or mercury) surface is stirred up by some mechanical effect, there will be a marked change in the appearance of the screen. Such an effect is exerted by an electrically operated tuning fork arranged over the liquid, which, by means of a point carried by one of its branches will stir its surface, producing ripples and trains of waves, in the same way as throwing a stone into a pond.

Shaded Picture

In fact, by so doing, only the light from the horizontal parts of the liquid surface is allowed to reach and illuminate the screen. All inclined portions of the ruffled surface, on the other hand, will be kept in the dark more or less by a stop intercepting the beams of light, thus projecting on the screen a beautifully shaded picture of a train of waves passing over the liquid surface with all such alterations as can be effected by the most diverse means.

However, in order that these phenomena may be watched and

A DOUBLE EFFECT

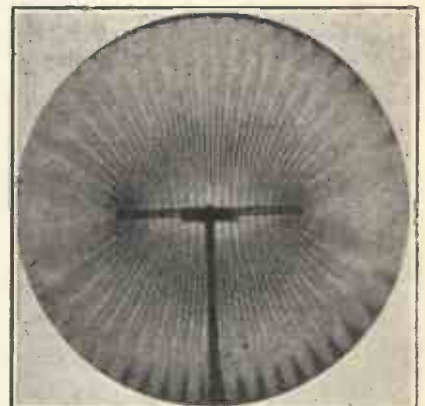
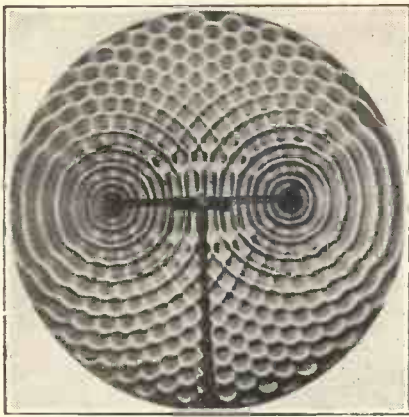


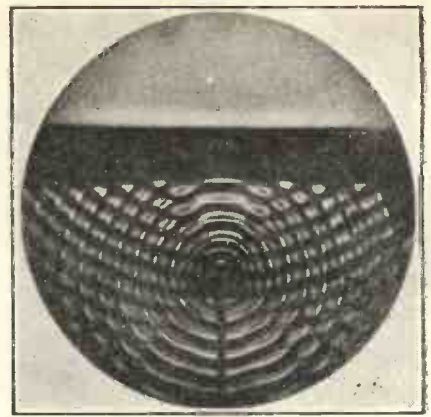
Fig. 2: With two “points,” and viewed with a steady light, this stationary wave-form is produced.

gauged with even greater ease and accuracy, the “Ondoscope” can be combined with some sort of “Stroboscope,” i.e. with a device which, as



CRISS-CROSS EFFECTS

The waves shown in the left-hand picture (Fig. 3) are similar to those illustrated on the right of the previous page, but this time are viewed with an intermittent light. On the right (Fig. 4) are waves from single "point" being reflected from a ruler.



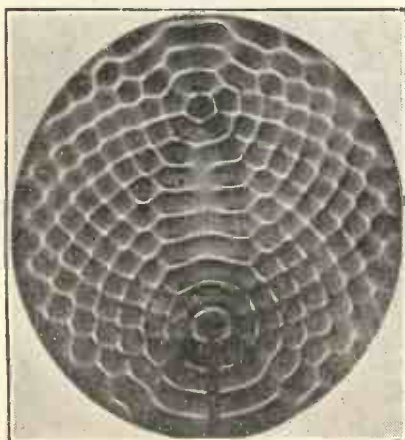
inferred from the following, effects an intermittent illumination.

Supposing a disc on which a radial stroke, i.e. a straight line from the centre to the circumference, has been traced, to be rotated at considerable speed, the rapidly moving stroke cannot any longer be discerned. If, however, the disc be lighted intermittently—say, once for a brief interval during each rotation—the stroke will be distinctly seen on a seemingly immovable disc.

Rotating Disc

If, on the other hand, the flashes of light follow up one another more rapidly than the disc is rotating, the stroke will appear to move forward—while in the case of a slower succession of flashes it will be seen to move backward at a low rate of speed.

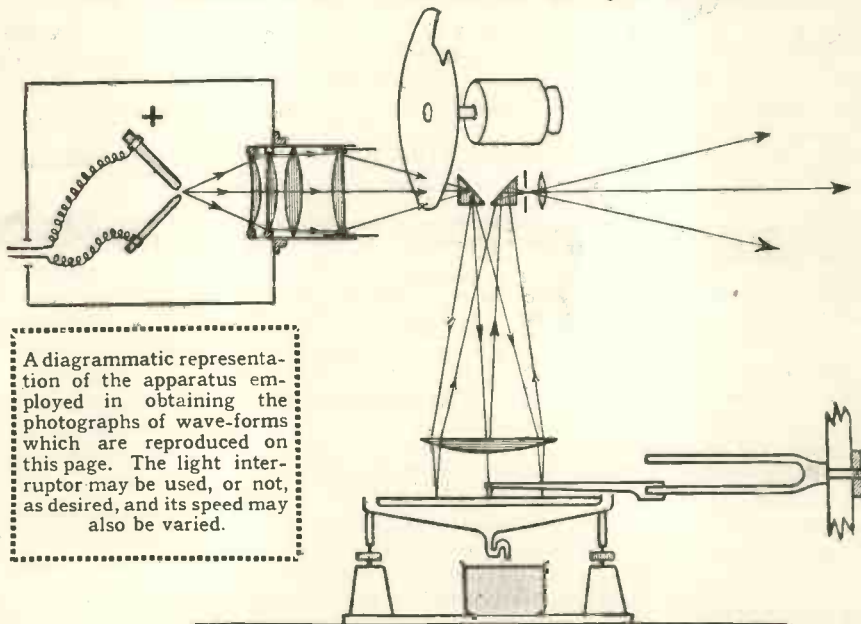
ELLIPTIC REFLECTIONS



The light-flash is, in the present case, given the form of a rotating disc comprising a hole near its circumference, and enables trains of waves to be watched either at rest or at considerably reduced speed.

If the tuning fork has a single point there will appear on the screen a sequence of circular wave trains of remarkably plastic effects,

THE "ONDOSCOPE" PRINCIPLE IS QUITE SIMPLE



A diagrammatic representation of the apparatus employed in obtaining the photographs of wave-forms which are reproduced on this page. The light interruptor may be used, or not, as desired, and its speed may also be varied.

which, in accordance with the actual adjustment of the intermittently illuminating "Stroboscope," are seen either to remain at rest or to move slowly forward or backward—a beautiful phenomenon of which Fig. 1 gives at least a certain idea.

Permanent Illumination

When two points, instead of one, are used, the picture shown in Fig. 2 of two trains of hyperbolic wave trains is obtained without the flash-lighting device, i.e. in the case of

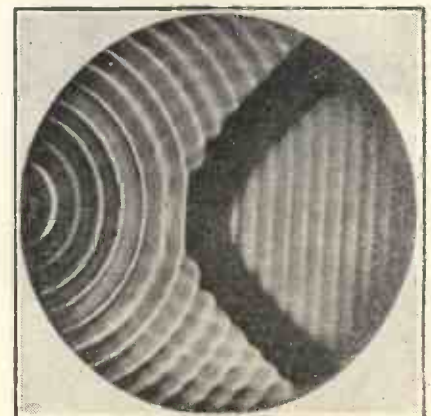
permanent illumination. If, on the other hand, this device be resorted to, i.e. in the case of intermittent illumination, there is a perfect change in the picture projected on the screen,

the two original circular trains of waves being seen distinctly, starting from the two points, crossing each other and forming most beautiful figures (Fig. 3). When photographing the phenomenon, the picture, as in Fig. 3, is obtained in the case of a very short exposure, whereas the one in Fig. 2 is obtained by a more prolonged exposure, of the order of a second.

In Fig. 4 a circular wave is shown which is reflected from the edge of a ruler, the reflected train of waves seeming to start from a symmetrical point.

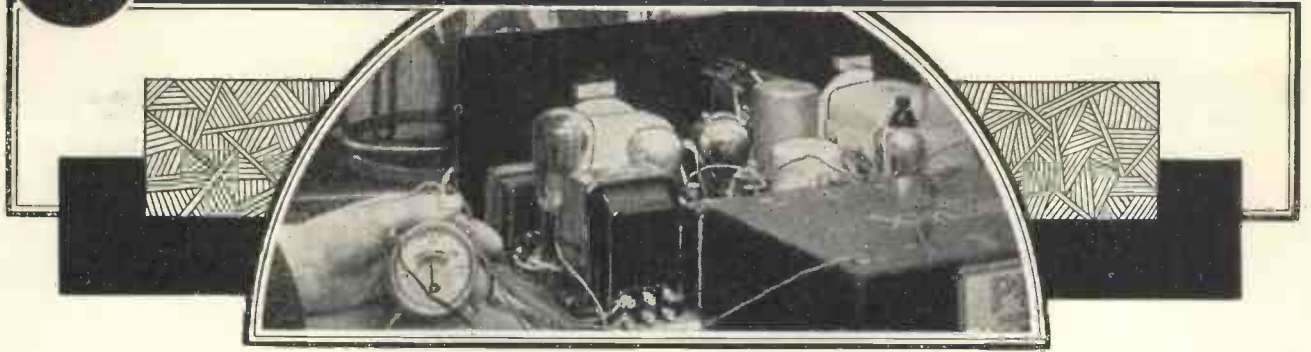
(Continued on page 382)

REFRACTION OF WAVES



The waves on the left (Fig. 5) are produced at the lower focus of the ellipse, but the reflected rays are focussed at the upper focus. On the right (Fig. 6) the waves are seen passing from water to mercury and thus being refracted.

ON THE TEST BENCH



The R.I. Auto-Parafeed

THE R.I. Auto-Parafeed Transformer is one of the latest developments of the parallel-feed method. It is a very compact component, having a nickel-iron core of high permeability and a system of internal shielding.

But instead of the usual four terminals, it has only three, and is thus correspondingly easier to connect in circuit.

Nevertheless, alternative methods of connection are still available, although the satisfactory ratio of 1-4 is maintained.

The primary inductance is 85 henries, and the resistance of the primary is 1,100 ohms. The secondary winding has a resistance of 3,900 ohms.

It is a very well-made component, and its shape is distinctively original.

The price is 6s. 9d. On test the R.I. Auto-Parafeed functioned admirably, a sensibly straight line amplification being given.

It is interesting to note that the descriptive literature concerning this

FOR PARALLEL-FEED



Simplification of the connections for auto-transformer coupling is provided by this R.I. component.

Our comments regarding some interesting new components.

R.I. product embodies curves calculated on a decibel basis, and these give a clearer idea of the actual response of the device than do voltage amplification curves.

PROTECTION FROM DUST

One of the Telsen totally enclosed differential reaction condensers.



A Telsen Condenser

We particularly recommend the attention of constructors to the new Telsen differential condenser. It is a first-class component, available at a particularly reasonable price.

It is of the completely enclosed type, the vanes being protected against both dust and mechanical damage. And even though it is encased, its size is rather less than the average.

A pigtail, very firmly anchored, is provided.

Various values are available from .0003 mfd. to .0001 mfd., each at 2s.

The samples we tested were found to be entirely in line with their specifications. The capacities were as specified and, what is even more important in many cases, the two halves were perfectly balanced.

The movement is smooth and, indeed, the component is a delight to handle. We consider it to be among the three best differentials made, quite irrespective of price.

"Metaplex" Baseboards

One of the most useful materials ever placed before the home constructor is "Metaplex," the metallised baseboard manufactured by Messrs. Peto-Scott.

It is particularly useful now so many set designs specify shielded baseboards. "Metaplex" is a stout plywood on the surface of which metal has been sprayed.

But a completely homogeneous layer is deposited, due to the employment of a patented process instead of the inefficient particle-separated layer that might be anticipated from a normal spraying process.

The result is perfect shielding. And it is shielding with which it is very easy to make connections, for screws can be driven through the metal layer with the wood beneath without the necessity of special boring or drilling operations.

Finally, the price of "Metaplex" is sufficiently low to make it competitive with ordinary wooden baseboards!

SPRAYED WITH METAL



"Metaplex" baseboards, made by Messrs. Peto-Scott, provide screening and also simplify wiring.

Short-Wave Condensers

British Radiophone have recently gone into production with a short-wave variable condenser that

Items for Class B and Short Waves

embodies several valuable novelties of design.

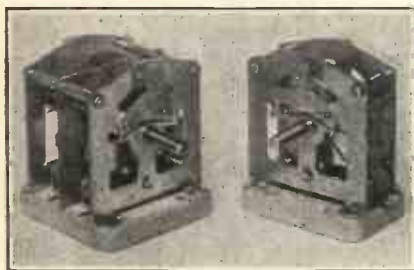
It is mounted on a base of porcelain material and, with the exception of that, there is negligible solid dielectric—practically none at all in the electro-static field. Losses are therefore reduced to a minimum.

The vanes are of hard brass and are very rigidly assembled, as is also the robust frame.

The pigtail is arranged in accordance with the latest technique. It is kept at tension and is led out from the hollowed spindle.

Mechanically this British Radiophone condenser also reflects the greatest credit upon its manufacturer, for the movement is quite above criticism.

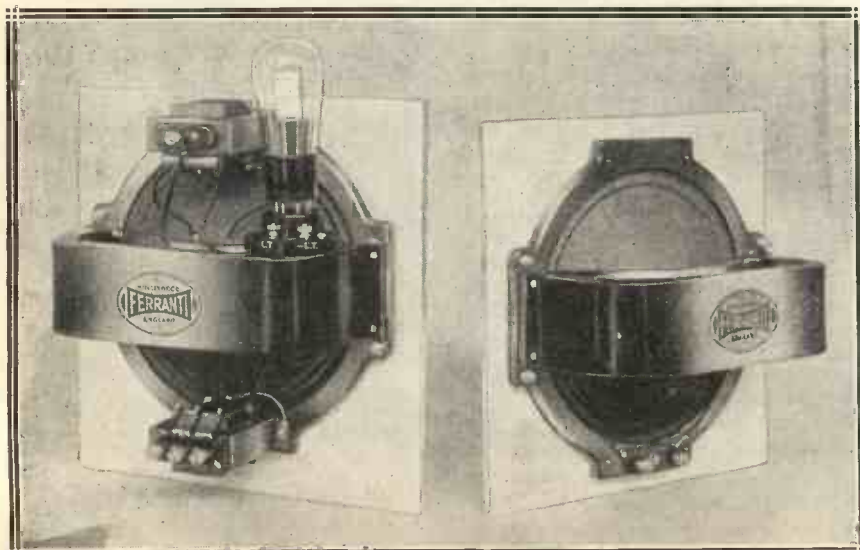
S.W. CONDENSERS



Ganged and single variable condensers specially constructed by British Radiophone for short waves.

The condenser is available in two types, a singlet for normal purposes and a two-gang for superhet and other special purposes.

AN ATTRACTIVE FERRANTI SPEAKER-AMPLIFIER



The recently introduced Ferranti "Class B" speaker and amplifier combined. The plain speaker on the right shows up the simple nature of the amplifier components.

A Good Battery

We have had the opportunity of testing a Millgate H.T. battery. It

**FITTED WITH
A FUSE**



An incorporated fuse is one of the features of the Millgate H.T. battery.

is of the standard capacity type—at least the one we tested was—and it is fitted with a fuse.

While not being an entirely novel idea, this scheme is one that has much to commend it, for the safety device is placed in the one spot where it can be of the greatest use, i.e. at the source of power itself.

In this way even the battery leads are prevented from carrying a dangerously high current.

We gave the "Millgate" our usual series of period test discharges and the battery showed up well under them.

The voltage drop was delayed, and was even over the cells.

The R.I. "Audirad" Choke

That extremely useful component, the R.I. "Audirad" choke, has been still further improved. Its resistance has been dropped to below 500 ohms, and its general efficiency has been raised.

Also, a third terminal is now provided so that either the H.F. or L.F. winding can be used separately or the component employed in special filtering circuits.

As readers will doubtless know, the R.I. "Audirad" is a combination of H.F. and L.F. chokes.

Wherever an L.F. choke is normally specified, such as for smoothing in a mains unit or set, or as an output choke, the "Audirad" can be used. But it has the added advantage that it chokes at H.F. as well as L.F.

This is an enormous advantage in a smoothing circuit. Very often there

FOR H.F. AND L.F.



The new Radio Instruments "Audirad" choke can be used for H.F. or L.F. separately or as a combined component.

are H.F. irregularities on the mains—indeed, there always are to some extent—and frequently they are so bad that mains H.F. chokes have to be brought in to deal with it.

If an "Audirad" had been used in the first place this would be quite unnecessary.

And inasmuch as it costs no more than most ordinary L.F. chokes, it is not surprising that even in its original form it proved an exceedingly popular component.

With the added improvements and no increase in price, it should command very big sales this season.

Ferranti Class B Speakers

Ferranti, Ltd., are now making special Class B loudspeakers, and this will, we feel sure, be good news to constructors.

Their speaker-amplifier is a particularly interesting and important production. As its name suggests, it is a combined Class B amplifier and loudspeaker.

Simplifying the Construction of Radio Receivers

The accompanying photograph will give you a very clear idea of its general appearance and size, for the speaker shown in the same picture is of normal proportions, and is, of course, the same type as figures in the speaker-amplifier.

The unit is all complete for connecting to practically any existing battery set. And the addition is a quite simple one to carry out.

The result of adding a stage of "Class B," and in particular one composed entirely of Ferranti apparatus, can easily be appreciated.

Actually, the power output is increased many times without greatly adding to the H.T. consumption.



HIGH VOLTAGE ELECTROLYTIC CONDENSER

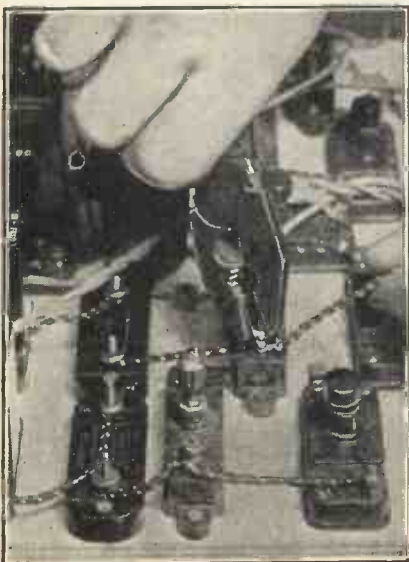
Being of the dry type, this Telsen condenser may be mounted in any position desired.

A Convenient Material

The wiring of a set is greatly facilitated by "Pull-Back," a new material due to British Radiophone.

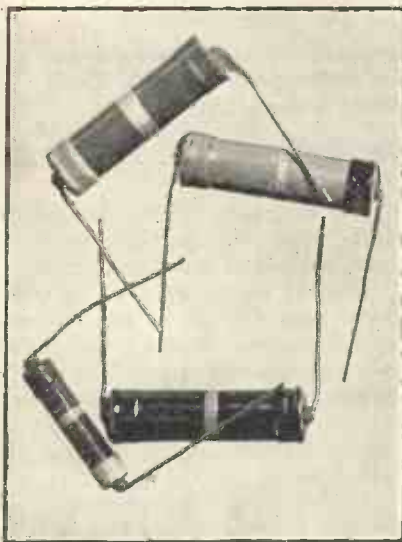
It consists of tinned copper wire covered by a flexible treated fabric. This is an excellent insulator and is

WIRING WITH "PULL-BACK"



The wiring-up of a receiver is greatly simplified by the use of Radiophone "Pull-Back" insulated wire.

WIDE RANGE AVAILABLE



Examples of the Telsen resistors which are available in various wattage ratings.

very tough. Also, it does not tend to fray.

It is a tight fit over the wire, but, being flexible and compressible, it can be pushed back to bare the end of the wire, which, when exposed, is clean and all ready for connecting.

When the connection is made the covering can be slipped up to complete a neat and tidy job.

We use quite a lot of "Pull-Back" in our Research Dept., and find it a great time-saver.

Telsen Resistors

The Telsen resistors with wired ends are available in an extremely wide range of values. Also they can be obtained in $\frac{1}{2}$ -, 1-, and 2-watt and, on demand, 3- and 6-watt ratings.

The $\frac{1}{2}$ - and 1-watt types, ranging from 250 to 500,000 ohms, cost only 1s. each, and the 2-watt types in values from 250 to 100,000 ohms, retail at 2s. each.

Their wire ends render them very useful to the constructor, for they can with great ease be wired into or added to a set. Also, this feature makes them easily interchangeable.

We have used a considerable number of them for various purposes and have found them consistently satisfactory. Those we have checked for resistance have been found to be accurately rated and their values are maintained after they have been subjected to current flow or used in areas of considerable temperature change; such as close to large power

valves and mains resistances, etc. Another fine little wire-end component made by Telsen which we can also strongly recommend is the Telsen small tubular condenser.

This is made in values from .0001 mfd. to .006 mfd., and retails at 1s. In addition there is a .01 mfd. at 1s. 3d., and a .1 mfd. at 1s. 6d.

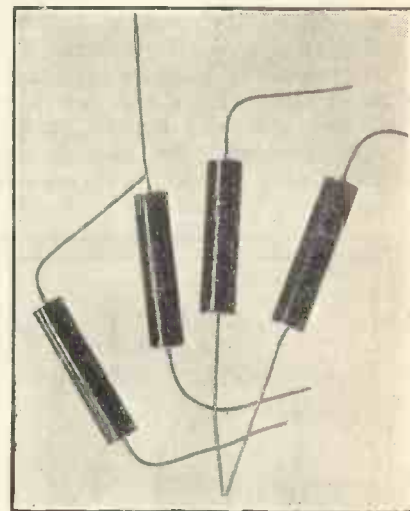
Despite its extreme compactness and low price, this Telsen condenser is tested to 1,500 volts, and it is a most efficient and dependable component. Constructors owe a great debt to Telsen for producing such desirable apparatus at such prices.

There is also a Telsen high-voltage electrolytic condenser to which we must draw our readers' attention. This is a very attractive component, and is as well designed and made as anything of its kind we have ever seen.

A valuable practical feature is that it is supplied with a special bracket for mounting on any type of base-board or chassis.

There are two types: the one is for a working peak voltage of 275 volts, and 4-mfd., 6-mfd., and 8-mfd.

WIRE-END CONDENSERS



Another Telsen production. Fixed condensers which can be wired into circuit.

models list at 3s. 6d., 3s. 9d., and 4s. respectively; the other is for a maximum peak voltage of 500 volts, and the 4-, 6-, and 8-mfd. values cost 4s. 6d., 5s. and 5s. 6d. respectively.

These are astonishingly low prices, it must be mentioned.

It should also be added that, being of the dry type, these Telsen electrolytics can be mounted in any position.

SCOPHONY TELEVISION

A NEW DEVELOPMENT

Described by J. C. JEVONS.

The scanning method of this new system is such that to and fro movements only are necessary—no up and down motion being required. Great simplification of the apparatus is thus achieved.

PROSPECTS are looking distinctly brighter just now, so far as television is concerned. One hears of new methods of approach being opened up, and of a steady stream of invention which is concentrated on the object of bringing real television into the home.

In America and Germany especially the technical Press is all agog with recent developments in the cathode-ray receiver, and we may be sure that British designers are not lagging behind. In fact, there are good grounds for stating that a larger measure of success has already been won with cathode-ray reception than is generally realised, and that before long some surprising results will be made available to the general public.

Length and Breadth

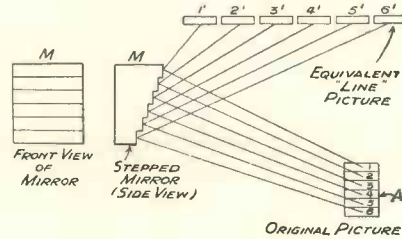
Meanwhile we have to record the enterprise of Messrs. Ferranti, who are backing the work of a British inventor—Mr. G. W. Walton. This firm intends to place on the market at an early date a new television-receiver possessing unusual features which make it quite distinct from either the rotating-disc or the cathode-ray type of instrument.

The Scophony system depends, in fact, upon the peculiar action of certain kinds of lenses or mirrors.

Most of us, at one time or other, have been amused at the distorted image produced by the ordinary convex or concave mirror. The kind of thing, for instance, that is sometimes placed outside a restaurant to indicate the liberality of the fare provided inside.

On entering, the customer sees himself drawn out to a lean lath-like

THE SCHEME EXPLAINED



The special stepped mirror splits the picture to be transmitted into sections, and at the same time forms it into one line.

figure which, one might say, represented length without breadth. As he leaves the premises, a second mirror transforms him into a replete person of overwhelming breadth.

Fidelity Via Distortion

Considering that an ordinary mirror will do this kind of thing, Mr. Walton conceived the idea of going a step further and producing an optical arrangement capable of actually transforming an ordinary two-dimensional image into a single straight line.

At first sight one might wonder what advantage is to be gained from introducing such distortion—since the object of television is naturally to

Basing his theory on the principles which are used to produce those weird effects sometimes seen in distorting mirrors outside restaurants, the inventor of Scophony television set to work and produced an optical arrangement capable of transforming a two-dimensional picture into a single straight line. Thereby, of course, considerably simplifying scanning.

reproduce a picture as nearly like the original as possible.

The explanation is that it greatly simplifies the process of scanning. In ordinary methods of television the picture is scanned or cut up into a number of parallel lines by a rotating disc, which must effectively scan from top to bottom of the picture, as well as from side to side.

A "Straight-Line" Process

By first transforming the picture into a single straight line, the whole of the scanning process can be reduced to a simple to-and-fro movement in one plane, for instance, a uniform horizontal "sweep." No up and down motion is necessary.

It therefore becomes possible to replace the large and relatively-clumsy rotating disc by a single small mirror, which need only vibrate to and fro 12 to 15 times a second.

Space is saved and driving power is reduced. In addition the problem of synchronisation is simplified because the mass of the moving mirror is so much less than that of a rotating disc.

Converting Back

The initial distortion of the picture into a "straight line" image presents no insuperable difficulty. The effect introduced by one optical arrangement can always be reversed by a second. In other words, at the receiving end the "line" of light signals produced from the neon lamp is converted back into the original two-dimensional picture by interposing a distortion-reversing lens between the lamp and the viewing screen.

(Continued on page 383)



Wherever
wireless
terms are
understood
"Ohmite"
means
"The
Best
Resistance"



"Better than wire wound."

OHMITE RESISTANCES

The most popular and efficient type of fixed resistance for all general purposes. "Better than wire wound." All values, 50 ohms to 5 megohms.

HEAVY DUTY TYPE 2/3

1/6

GRAHAM FARISH PRODUCTS



Safe maximum current carrying capacity of "Ohmites."

100° F Temperature Rise			
Ohms.	Milliamps.	Ohms.	Milliamps.
1,000	40	20,000	8
2,000	35	30,000	6.75
3,000	29	40,000	6
4,000	24	50,000	5.5
5,000	20.25	60,000	5
10,000	12	80,000	4.24
Other values pro rata		100,000	3.5

Safe maximum current carrying capacity of "Ohmites" Heavy Duty Type.

100° F Temperature Rise			
Ohms.	Milliamps.	Ohms.	Milliamps.
1,000	80	20,000	16
2,000	70	30,000	13.5
3,000	58	40,000	12
4,000	48	50,000	11
5,000	40.5	60,000	10
10,000	24	80,000	8.48
Other values pro rata		100,000	7

Ensure a safe and efficient Aerial and Earth. The new AEROFICIENT KIT provides all you need. Complete 6/6

Send a postcard for our new Catalogue, which describes all our products.

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Export Office: 11/12, Fenchurch Street, E.C.3.

QUESTIONS



ANSWERED

A Simple Addition

G. M. (Erith).—"I have heard a lot about Class B amplification, and I have been wondering whether I can convert my present set without completely rebuilding? The set in question is an ordinary S.G., detector and 1 L.F. 'three,' and the valves are a battery variable-mu followed by an 'H.L.' type with a small power in the output stage."

We have received numerous questions similar to yours.

No doubt you have seen reference made in this journal to the special Class B units that are on the market. You could quite easily add one of these to your existing set, joining the input terminals for the unit on to the existing loudspeaker terminals on your set, having first removed the loudspeaker.

These units comprise a driver transformer, a "Class B" valve, and a suitable output transformer; and are available, in many cases, with a built-on loudspeaker of the moving-coil type.

Such units are suitable for any normal type of circuit having one L.F. stage, and their addition does not necessitate any alterations to the set.

The receiver, of course, must not employ an output filter circuit, or output transformer, since the input terminals for the amplifier unit have to be joined in such a way that they are in series with H.T.+ and the output valve of the set.

Unwanted H.F. Impulses

A. J. (Crouch End).—"I have recently replaced my H.T. battery with a D.C. mains unit, and the results I obtain are perfectly satisfactory except that there is a trace of hum which is always present in the background.

"The unit itself is a very good one, and I do not think that the hum can be due to any fault in the design, especially since no hum was

audible when I have tried it on another set of similar type to my own.

"My set is a straight 'four,' having an S.G. H.F. stage, a grid-leak detector and 2 L.F. valves."

This is a very difficult question for us to answer in the absence of certain vital details. Presumably the D.C. unit is working well within its capacity, and that you are not trying to take more current from its tap-pings than they are intended to supply?

gauge of wire in series with the mains leads. One choke can be tried to commence with, and this should be joined first in the positive mains lead, and then in the negative lead, in order to find out which gives the best results.

Or, alternatively, one choke can be inserted in each lead, and a large condenser of 1 or 2 mfd. connected across the mains unit side of the two chokes.

There are commercial chokes available which are specially designed for this job, and ordinary H.F. chokes, such as are used for reaction or shunt-feed purposes are, of course, not suitable, owing to the thin wire used. These special D.C. chokes are called upon to carry the whole of the current passing into the D.C. mains unit, and therefore have to be robustly constructed.

Class B and G.B.

A. J. (Southsea).—"Am I right in supposing that a Class B valve operates without negative grid bias, and that in a Class B receiver no grid bias whatever is employed?"

You are right in one respect—and that is that the Class B valve, with the exception of two makes, is designed to work without any negative grid bias, the centre point on the winding of the driver transformer being joined direct to the "earth line," i.e. L.T.—, H.T.—.

On the other hand, the driver valve requires grid bias, the amount necessary depending upon the type of valve used, but generally being between 3 and 6 volts.

Hence the use of Class B does not eliminate the grid-bias battery altogether. On the other hand, the grid battery need only be a small one—about half the size of that normally used in the case of super-power output valve. The great advantage of Class B is its power and H.T. economy, the saving in G.B. being a minor matter.

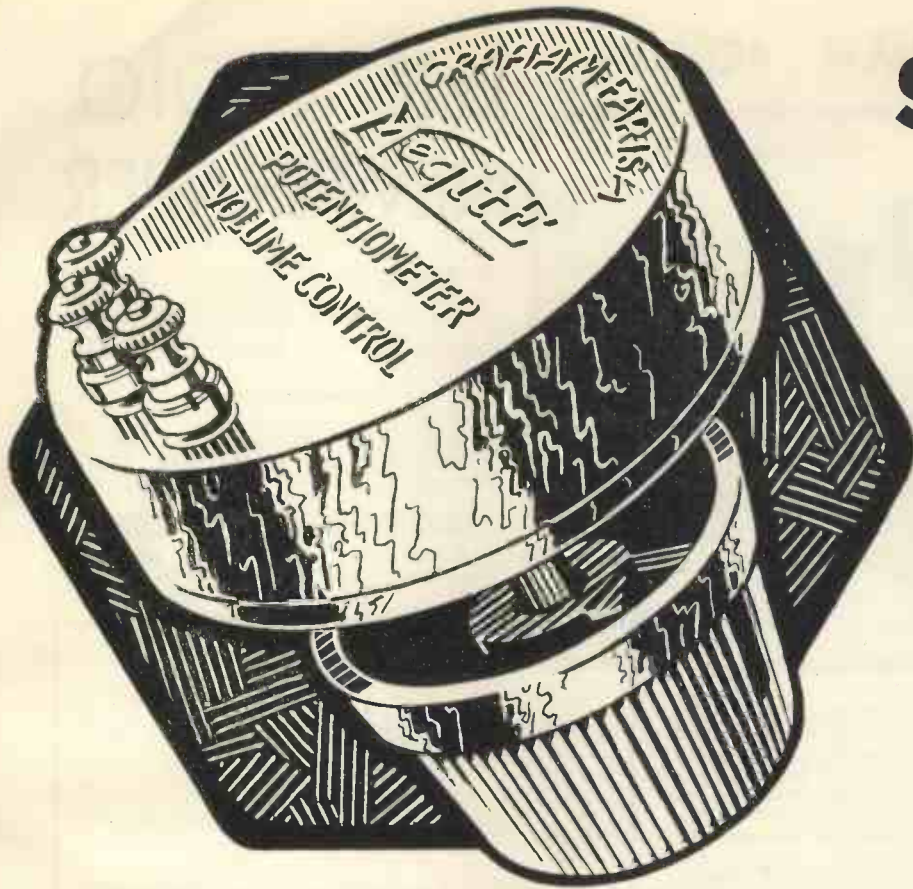
TECHNICAL QUERIES DEPARTMENT

Are You in Trouble With Your Set?
 The MODERN WIRELESS Technical Queries Department is in a position to give an unrivalled service. The aim of the department is to furnish really helpful advice, in connection with any radio problem, theoretical or practical. Full details, including the revised scale of charges, can be obtained direct from the Technical Queries Department, MODERN WIRELESS, Fleetway House, Farringdon Street, London, E.C.4.
 A postcard will do. On receipt of this all the necessary literature will be sent to you, free and post free, immediately. This application will place you under no obligation whatever. Every reader of MODERN WIRELESS should have these details by him. An application form is included which will enable you to ask your questions so that we can deal with them expeditiously and with the minimum of delay. Having this form you will know exactly what information we require to have before us in order to solve your problem.
 London Readers, Please Note: Inquiries should not be made in person or by phone to Fleetway House or Tallis House.

Assuming that you have chosen the correct model for the job and that your valves are properly biased, there is just a possibility that a certain amount of H.F. is being picked up by the mains, and subsequently modulated by the D.C. ripple in the supply.

Any H.F. picked up in this way may appear in the output circuit of the receiver, since it is liable to be induced into the set's wiring.

The most satisfactory remedy is to insert one or two well-insulated H.F. chokes wound with a substantial



**Smooth—
silent—
perfect**

MEGITE

POTENTIOMETER VOLUME CONTROL

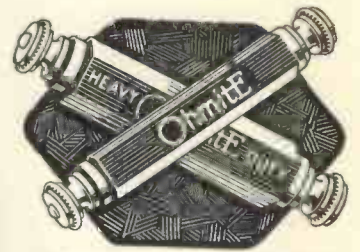
The element is of fine nickel-chrome wire embedded in bakelite. The action is through a slipper plate, giving a smooth, positive contact, absolutely silent operation and making broken contacts impossible. Three terminal type. Single hole fixing. Complete with operating knob.

PRICE

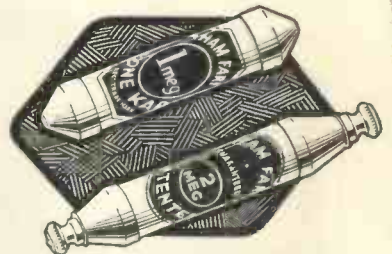
3 1/6

Resistances 25,000 ohms and over, 4/6

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OHMITE RESISTANCES
The most popular and efficient type of fixed resistance for all general purposes "Better than wire wound."
All values, 50 ohms to 5 megohms. 1 1/2 watt.
Heavy Duty Type, 2/3, 3 watt.



KONE KAP GRID LEAKS
A good grid leak of the carbon type, fits most condensers and holders. Supplied in values of 1/2, 1, 2, 3, 4 and 5 megohms. Price **9d.**
STANDARD GRID LEAKS
Counterpart of the Kone Kap, but fitted with Terminal Ends for easy and sure contact. Made in values of 1/2, 1, 2, 3, 4 and 5 megohms. Price **10d.**

Ensure a safe and efficient Aerial and Earth. The new **AEROFICIENT KIT** 6/6 provides all you need. Complete

Send a postcard for new catalogue describing all our products.



AN EXCLUSIVE "M.W." ARTICLE—

THE RADIO NEWSPAPER

A description of how the German R.R.G. Company provides its news service for the Regional stations.

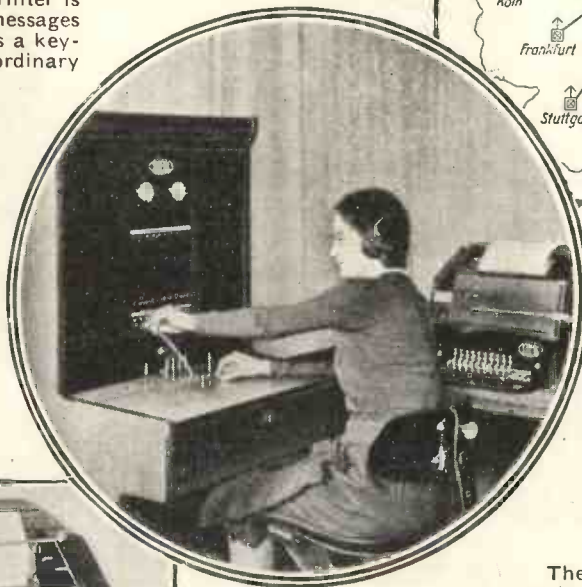
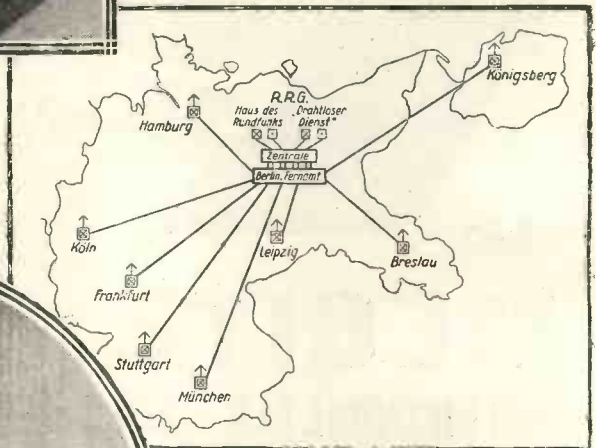
is able to send messages to the central office and to any of the other local companies.

USED BY BRITISH POST OFFICE

A teleprinter service was recently made available by the British Post



THE German Central Broadcasting Company, the R.R.G., carries on a very active news service for the benefit of the various local broadcasting companies of Germany. Political and other news is sent out from Berlin to be broadcast by stations all over Germany, and Berlin receives in turn local news from these stations. An English invention, the teleprinter, has been installed by the R.R.G. to handle this news service. The teleprinter is a machine for sending messages by telegraph and contains a keyboard like that of an ordinary typewriter. As the operator of the sending machine types a sentence the receiving machine types the same sentence simultaneously letter by letter, whether anyone is in attendance at the receiving machine or not. Thus information typed on the teleprinter in Berlin is instantaneously in type at, say, Leipzig. A switching system permits any number of local stations to receive the same message simultaneously. Or the local station



Office to private subscribers, who can dial through to any other subscriber and type a message. If the other subscriber is away the message remains ready typed until he returns. The German machines are manufactured under the same patents by a German firm. An amusing evidence of their English origin is the German name for the teleprinter—the "Start-Stop Fernschreiber," "start" and "stop" being in English.

THE MACHINES EMPLOYED

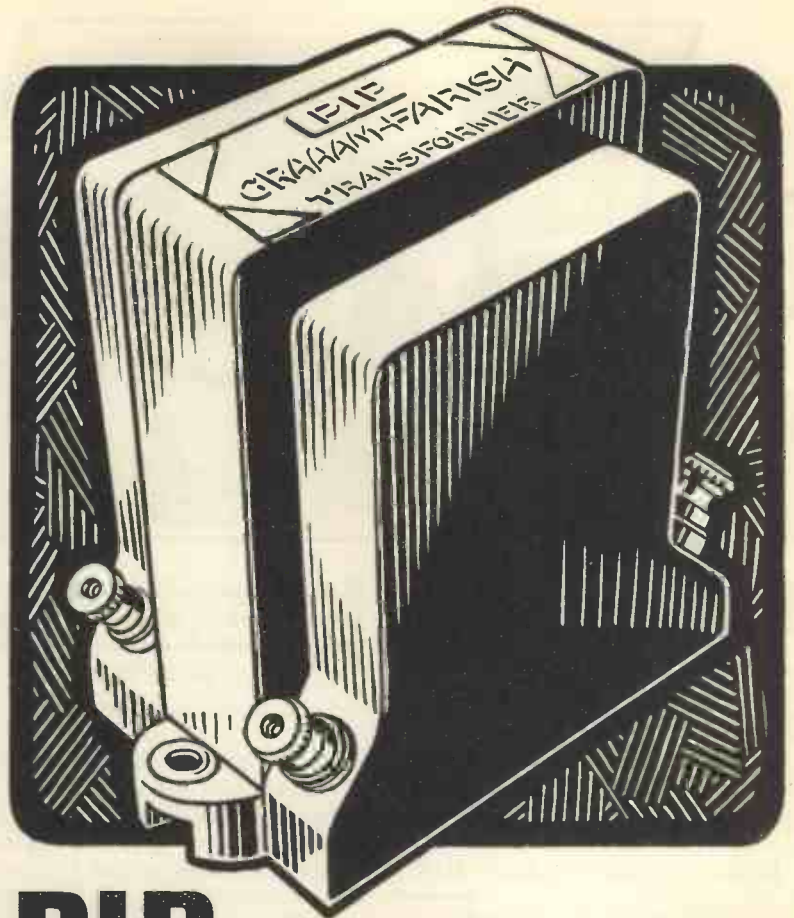
The bottom photo shows the machine which both transmits and receives messages. In the circle is the switchboard being operated, and on the right of it a transmitter-receiver. The top picture is a general view of the installation, and shows the switchboard, the fuse-board (on the wall) and three smaller machines for speeding-up transmission. The two smaller machines, with keyboards, are operated in the same way as the transmitter-receiver, but instead of transmitting the message direct they punch it in code on a paper tape. This paper tape can be fed through the transmitting machine on the extreme left of the picture at more than twice the speed at which an operator can type. This special type of transmitting machine can therefore send on one pair of land-lines twice as much matter in a given time as the ordinary transmitter-receivers.

The general arrangement of the whole system is outlined in the map. The various sources of news are connected to a central office where the news is sorted out and the bulletins forwarded to the distributing section. The latter is directly in contact with the important stations throughout Germany, and is able to put one station in touch with another should this be desired.

A. BROWN.



**NEW—
and better
than many
at double
its price**



PIP TRANSFORMER

The PIP transformer is thoroughly sound in construction and design and gives a result equalling and often better than others at a much higher price.

In distinctive red case with nickel terminals.

Made in 3:1 and 5:1 ratios.

PRICE

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Ensure a safe and efficient Aerial and Earth. The new **6/6** AEROFICIENT KIT provides all you need. Complete

Send a postcard for our new Catalogue, which describes all our products.

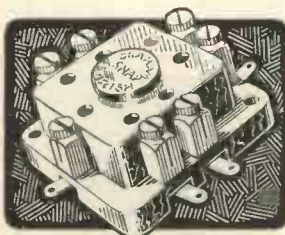


MEGITE POTENTIOMETER VOLUME CONTROL

The element is of the fine nickel-chrome wire embedded in bakelite. The action is through a slipper plate, giving a smooth, positive contact, absolutely silent operation and making broken contacts impossible. Three terminal type. Single hole fixing. Complete with operating knob.

PRICE 3/6

25,000 ohms. and over 4/6



VALVE HOLDERS

These Valve Holders have exceptionally low loss moulded bases, the insulating material between sockets being reduced to a minimum. Contacts are of phosphor bronze, sturdy in design.

Four Pin Type, 6d Five Pin Type, 8d Seven Pin Type 1/3





By
G. V. DOWDING,
 Associate I.E.E.

IT is extremely easy to add a pick-up to almost any radio outfit, but it is by no means easy to make it give really good results.

And, generally speaking, the "gram" reproduction of the average set compares very unfavourably with that of the radio side.

But I will deal with the question of quality later on; first the pick-up

RESISTANCE VARIATION

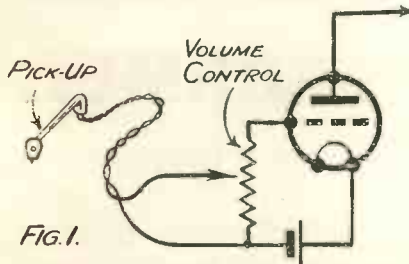


FIG. 1.
 If the volume control is connected in this way the value of resistance across the pick-up will alter every time an adjustment is made.

must be made to work. And that is not so simple as it sounds.

Apparently, quite stable receivers will develop the most rabid of squeals the moment a pick-up is switched in.

There are certain external specifics widely recommended for stopping such squeals, but my experience is that they do little good in really bad cases.

Remedies to Try

For example, it has frequently been said that to insert a transformer between the pick-up and the set is an almost certain cure.

I am not sure what the purpose of the transformer is supposed to be, but I write from first-hand experience when I say that it is hardly worth trying. I have never yet known it to do any good.

Here are some valuable hints and tips for radiogram enthusiasts, including practical methods of avoiding pick-up instability.

On the other hand, lead screening is sensible and satisfactory and will kill an incipient howl.

As a matter of fact, this and other things of a similar nature I regard as almost essential for all pick-up installations. Perhaps I had better describe them in detail.

The leads which run from the set to the pick-up should be of shielded wire, with the shielding connected to the earth terminal of the set by means of the shortest lead possible using stout wire.

(Note that I say "earth terminal of the set"; the reason is that it may be desirable to dispense with an earth connection from the receiver.)

The pick-up arm ought also to be connected to the set's earth terminal, and in the case of a clockwork turntable motor this needs the same treatment.

Even when the pick-up leads are shielded, however, they must still be kept as short as is possible.

All this having been done, the theory is howling ought not to occur. But it often does! And the constructor probably feels quite hopeless about it.

It is true that he can still try the simple expedient of changing over the pick-up leads. Nevertheless, it is seldom that that does the trick.

Now let us pause for a moment and study the conditions that probably exist.

No doubt the pick-up has been switched into the detector circuit and this now becomes an L.F. input stage. If there were two ordinary L.F. stages

in the set we now have three L.F. valves and that constitutes a very powerful amplifier. And, as such, it will prove extremely sensitive—far more sensitive than is desired for the average modern pick-up.

This will be proved by the necessity of applying drastic volume controlling, or, if there is no volume control, by excruciatingly loud squealing and roaring.

A Complicated Ideal

Obviously, then, an input volume control for the pick-up is essential.

And if, when this is applied, the squealing leaves off and there is still plenty of volume, it may not be necessary to do anything further.

Alternatively, the amplification of the "detector" valve can be cut down,

THE CORRECT METHOD

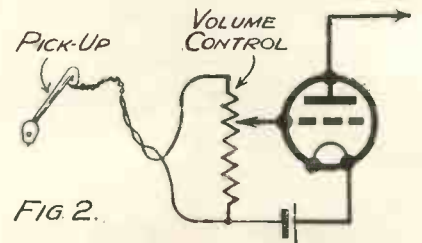


FIG. 2.
 With this method the resistance value is constant, the position of the slider simply determining the voltage applied to the grid of the valve.

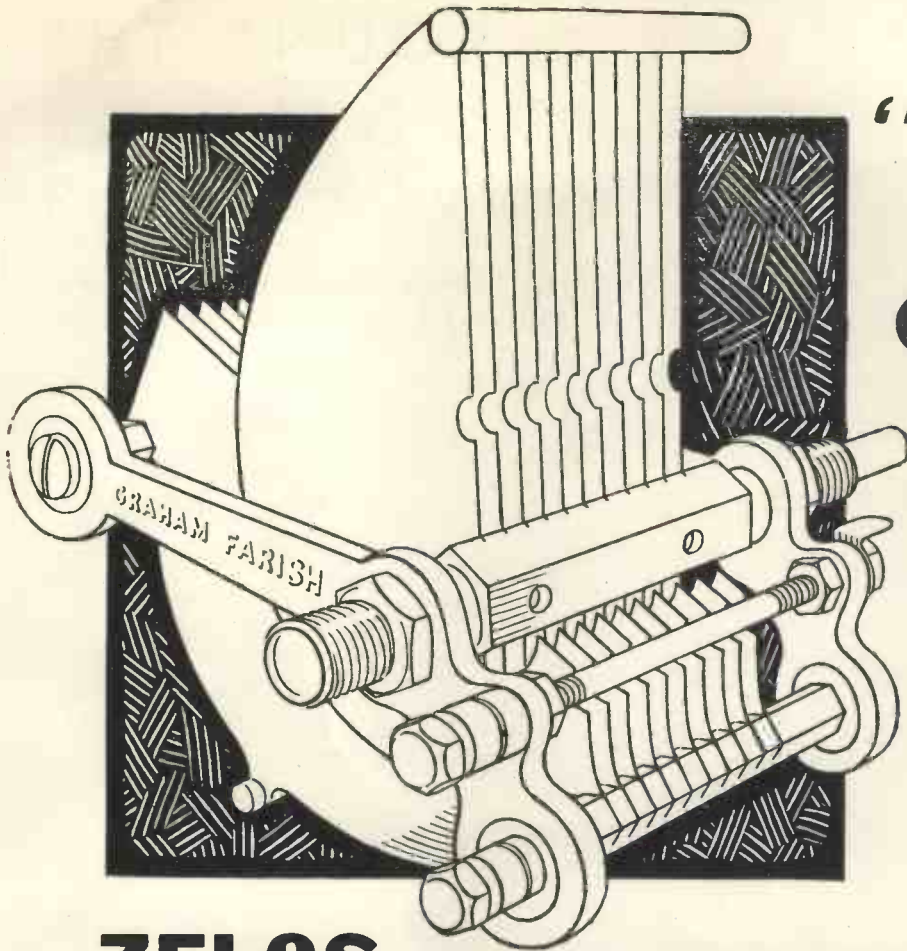
but such a scheme is not to be recommended to the inexpert constructor.

Of course, the ideal is to have an input volume control for each of the valves, so that the input to each valve can be independently adjusted.

But that is not making for simple radio!

A better method for general use would be to take the pick-up direct to the first L.F. valve and ignore the

(Continued on page 388)



**“When
better
Condensers
are
possible
I’ll
build
them”**

Graham Farish.

ZELOS VARIABLE CONDENSER

A superb component, possessing extreme rigidity of construction, mechanical perfection of moving parts and high electrical efficiency. Negligible H.F. loss, large accessible terminals, shaft provides easy ganging. Capacity .0005. mfd. EACH

5!

GRAHAM FARISH PRODUCTS



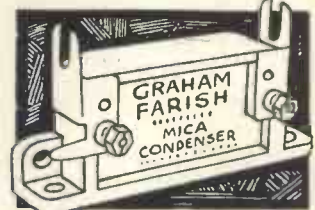
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LITLOS VARIABLE CONDENSER

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6/6 Complete.

ROUND THE WORLD OF WIRELESS

Items of interest in Germany, Austria and Switzerland reviewed in pictures



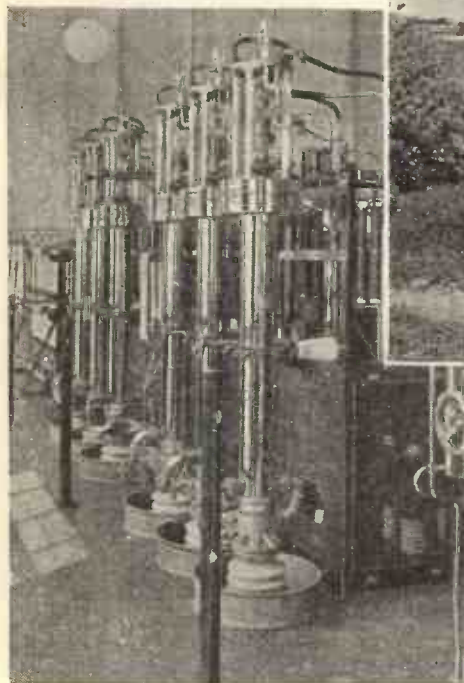
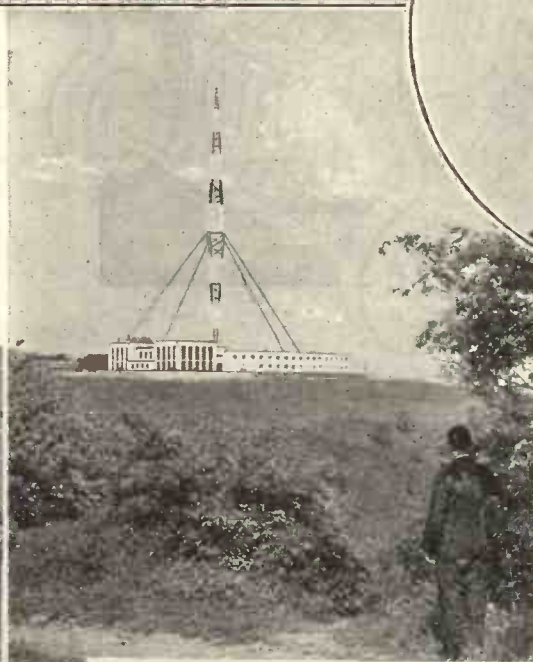
THE STATION IN A FORTRESS

Monte Ceneri, the new high-power regional station of Switzerland, is situated inside a fortress, which accounts for the barbed wire and the sentry-box. Visitors to the station are met at the gate and firmly forbidden to enter.



THE MAN WHO MATTERS

in Germany is Eugen Hadamowsky, who is responsible for the future of Nazi broadcasting. On the left is a general view of the mast, station buildings and staff house at Bisamberg, the Austrian station which works on a wavelength of 517 metres, with an aerial power of 100 kilowatts.



BISAMBERG'S 300-KW. VALVES

on show for the first time at the opening of the new Austrian high-power station. Right, is the new German national receiver, the result of co-operation between several manufacturers and the Government.



REFLECTIONS

*The B.B.C.'s Lady Announcer—
A Great Scientist—Those "How-
to-Listen" Reformers—Harking
back to Writtle.*

By "PROSPERO"

The Mistress of the Microphone

THE B.B.C. is simply amazing. That organisation is crammed with gallant ex-officers of all branches of his Majesty's forces, professors, experts, possibly even *savants*, not to mention literary young men.

Somehow, by what agonising process we shall never know, it decides to appoint a woman announcer to the London station, and then it fails miserably by appointing a married lady.

This shows less imagination than a Dutch cheese. As a salesman, the B.B.C. is much less successful than Thomas Carlyle would have been at hawking lip-sticks.

Its understanding of human nature is not so profound as that of the chief numismatist at the British Museum. So it appointed a *married* lady as

A NINE-CENTIMETRE TRANSMITTER

For heaven's sake, let us not divulge this to the Latin races, lest we lose Portugal as an ally, France as a place in which to learn Russian from waiters, Spain as an onion-bed, and Italy as a source of hair-dressers.

Think, just think, of the thrill with which the B.B.C. might have titivated the nerves of many of its clients had it planted a maiden, heart-whole and fancy-free, before



the "mike"! The married lady's voice is intoxicating, but hubby alone has the patent rights.

To worship that voice, as I have worshipped Cecil Dixon's, is to verge on the actionable. It isn't done. Give me liberty or male announcers.

The plain truth is that the B.B.C. feared that the elect lady would inflame the hearts of her listeners unless she had the damping protection of a wedding-ring. They do not encourage "fan mails" at Broadcasting House. John Knox wouldn't like it.

An Adventurous Inventor

My admiration for Sir Ambrose Fleming now knows no bounds. He was married in July. And why not? After all, he is only 83.

Having invented the thermionic valve, he has now hit upon a device

for living for another umpteen years. What an inspiring gesture, ye senile wrecks of sixty who doze over the fire or potter aimlessly in a greenhouse, clad in carpet slippers and shapeless garments. I'll wager that Sir Ambrose will celebrate his new lease of life by putting out a further thesis on side-bands, embellished with some of the most profound mathematics.

If there is one thing that he enjoys, it is a rollicking battle with another scientist over something full of cosines and $\sqrt{-1}$. May he have plenty more of them, for his services to the world are immeasurable and he deserves all the mathematics there are. He can have all my $\frac{dy}{dx}$ and a partly-used logarithm for which I have no further use.

"Rather Like Drinking"

The kindly reformers who of late have been telling the public "how to listen" understand little of human nature, I fear, if they hope that people are going to use broadcasting other than as it pleases them.

Listening is rather like drinking. You may drink with discrimination, making all the motions of the connoisseur, sniffing the wine, rolling the brandy round a huge goblet, inquiring anxiously about vintages, corks and the like.

Or you may take a good load of liquor aboard every day, not



This radio apparatus, shown at the Century of Progress Exposition in Chicago, has been aptly christened the "Beamcaster." The waves employed are only nine centimetres long and are projected by the parabolic reflector behind the short aerial to which the engineer is pointing.

Radio as a Running Accompaniment

caring greatly what it is so long as it is a drop of summat good. Or you may swill all day and half the night, neither knowing nor caring what it is, how much, when or why, until the stuff has no power to stimulate or please you and becomes merely a bad habit.

So it is with listening, and pretty little books will not alter it. Just imagine grandma turning up, say, page 39 in order to see how to listen on Wednesdays!

Listen As You Like It

Why, bless the old noblewoman, she only uses the radio as a running accompaniment to her endless tales of fire and flood, diseases she has known, notable operations, selected deathbed scenes and, over all, the aura of Queen Victoria, Mr. Gladstone, Dickens, the Crimea and *The Silence of Dean Maitland*.

Listen as you like it. You pay for the stuff. Squandered electric power and worn-out valves help business men to pay for their golf.

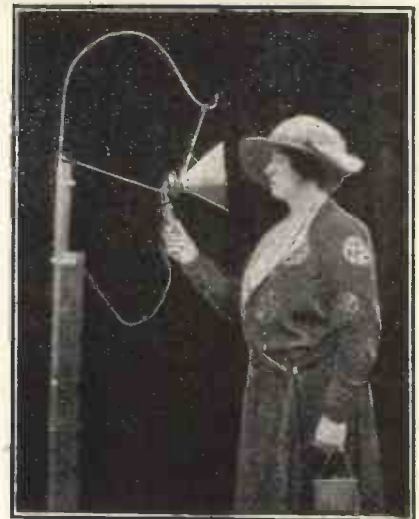
You will find that practice in listening while you read a book or play cards will train your ears to swivel about like those of a horse—a useful accomplishment if you have lots of females in your family. You can hear 'em all at once!

There is no department of our lives which some uplifter will not try to teach us to manage, and the answer to his horrified questions is eternal—“I like it.”

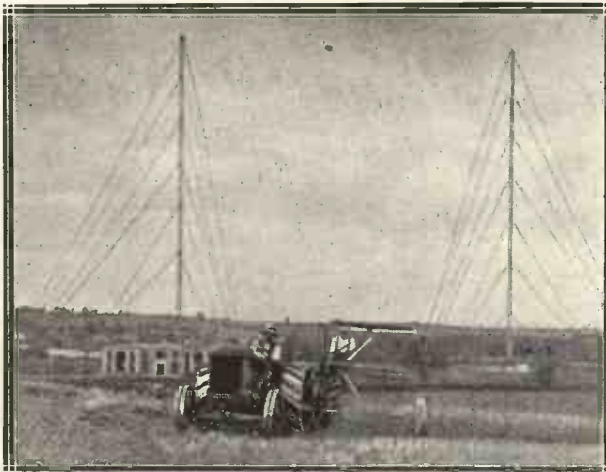
This Month's Fable

Once there was an Interfering Person who went about advising Inferior Folk to improve their minds. He had large red ears and a wife who said that she adored Poetry and Old Masters and things. He tried to improve *her* mind, but she hurled a lamp at him, and quite Spoiled his Beard.

One day he began to interfere with a Cooper's Mate who was listening to some Jazz.



DAME NELLIE MELBA singing into the microphone of the first British broadcasting station at Writtle, to which the writer refers in his reflections.



HARVESTING AT WASHFORD CROSS, near Minehead, Somerset. In the background are the 500-foot masts of the B.B.C.'s new West Regional station which radiates both National and Regional programmes.



PHYLLIS LAUGHTON, who has gone to Hollywood as a “director of diction” for a film company, shows an airline pilot how to speak clearly into a microphone.

“My good fellow,” said he, “why do you not give ear unto the Works of the Masters and Read Good Books, so that you may Develop your Mind and become as a Pillar of Light and a Fount of Wisdom?”

“Are you a Pillar and a Founting?” replied the Cooper's Mate, recoiling slightly but with space for more.

“In my humble way . . .” began the Interfering Person, briding with pride.

But the Cooper's Mate interposed. “And if I do what you say, is there any chance of my growing like you?”

“Certainly! Why not?” answered the Pillar, in a tone of Hearty Encouragement.

“Then,” said the Cooper's Mate, “buzz off! I am going to buy another

loudspeaker and listen to Jazz on both sides at once!”

Moral: Don't try to teach lions to eat boiled celery.

Performing Lions

And speaking of lions recalls the attempt, which took place in Parliament last session, to interfere with the training of wild animals to perform those feats which have pleased circus-goers for ages. If the education of

lions involves discipline it cannot be worse for the lion than for the school-boy.

After all, is there such a vast difference between a four-legged lion and a piano-playing one? Consider!

Leo has a mane; but so has Moses Wosselstraum, the pianist. Leo's nails are nicely trimmed; so are Moses'. Both have to go through the hoop, and both are expensive to maintain.

When Leo is temperamental and reluctant to perform he is subjected to the cracking of a whip, and when Moses threatens to break his contract and marry the manicurist, by gum! his manager cracks the whip.

The only vital difference between them is that Moses can run his fingers through his mane and wind up the piano stool. But then, Leo could eat his manager!

On a television screen their own mothers could not distinguish between

(Continued on page 378)

9,000 "HANDS"—MORE THAN EIGHTY ACRES OF FLOOR-SPACE... THE GREAT HIVE OF INDUSTRY WHERE COLUMBIA SETS ARE BORN!

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THE C.O.A. BATTERY RADIOGRAPH FOUR, Model 1003—the battery Radiogram with an all-mains performance: three-stage band-pass receiver. Columbia Constant Quality Amplification. 65 amp. hour L.T. battery. 175 v. H.T. battery including 9 v. G.B. Automatic flood-lighting of scales from switch M.W.-L.V.-Gram. Permanent magnet moving coil speaker. Marconi valves. Walnut cabinet of fine workmanship. 20 Gns. (Prices not valid in I.F.S.)

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3-VALVE BATTERY SET, Model 1005. A highly selective set with band-pass tuning, at an unusually low price. Inductively coupled band-pass aerial circuit. Screen grid, high-frequency amplifier. Permanent-magnet moving coil speaker. Single tuning knob for three gang condenser. Marconi valves. £8.15.0

ALL-ELECTRIC RADIOGRAPH FOUR, Model 620—a low-priced all-mains radiogram, embodying every modern development. Band-pass aerial circuit. Screen-grid high frequency amplifier. Energised moving-coil speaker Wave range, 200-550 med. and 1000-2,000 metres. Single knob tuning for three gang condenser. Volume control operating on radio and gramophone. Marconi valves. Fine walnut cabinet. 23 Gns.

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Please send me particulars of the new Columbia models without obligation.

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KENDALL'S CORNER



In this section Mr. Kendall will discuss month by month those topics which strike him as requiring his attention. If one may judge by his opening remarks, we shall see fireworks here before long.

This month's subject is the vexed one of "dressing-up" sets, and some strong views are expressed on the question. Mr. Kendall explains his general policy in the matter of cabinet work.

I've been told that I can have this corner of MODERN WIRELESS all to myself, and do just what I like with it, so long as I don't let the paper in for a libel action or try to start a political argument. Well, it is more than ten years since I wrote my first article for "M.W.," and in all that time I've never had such a chance, so, believe me, I am going to make the best of it!

A Promise!

When, as I must confess happens pretty often, I feel that I want to heave a metaphorical brick at someone else's glass house, this is where I shall do it.

When I get up on one of those dreary November mornings, take a look at the world, and decide that it is all wrong, this is where I shall tell the radio part of it what it ought to do about itself.

When I come to the conclusion that some specially whiskery piece of technical conventionality cannot be endured any longer, this is where I shall announce a crusade.

One thing, however, I do promise, and that is that I will voluntarily add a third to the pair of Editorial taboos which I mentioned in my first sentence: I undertake that in no circumstances will I discuss the B.B.C. programmes!

What the K4 Means

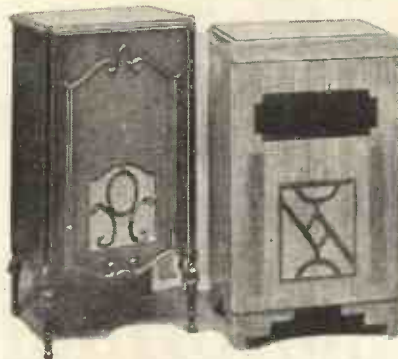
That is a promise which I shall find very much easier to keep than you might think, for I gave up getting all hot under the collar about the subject a long time ago. After all, it's really no use, and it is such a simple matter to build a set like the K4 and then invite the home authorities to watch your dust as you depart on a tour of Europe in search of fare to suit the mood of the moment. You will get it, too, if you are using a K4!

This month I am not going to make very full use of my "Corner," and it

will not occupy the whole of the space which I have been allotted, simply because I feel that I must not run the risk of distracting the reader's attention from the one thing that matters. The K4—and all that the K4 means to the world of home construction.

I am convinced that this set heralds such a revival of enthusiasm in home construction that the man who holds back and goes jogging on with some old set from last year, or even the year before, will quickly find himself just as hopelessly left behind as if he had stuck to that ancient crystal set which now lies forgotten in the attic. I therefore feel that it is my imperative duty to do everything in my power to make it as certain as I possibly can that every one of my

WHO SHOULD CHOOSE?



Mr. Kendall strongly maintains that the choice of cabinet work, especially if it is to be elaborate, should be left to the constructor.

readers realises to the full the importance of the occasion.

Just think: at the outset of this season we have seen such a flood of new developments of a purely technical nature that it was obvious from the first that 1933 would be remembered as a year in which radio

achieved one of the greatest forward strides in its history. New valves, new components, new circuits. Class B and quiescent push-pull amplification, super-efficiency tuning coils, hosts of other important new things.

Increased Efficiency

These developments alone would have made it imperative for every constructor who wants to keep up to date to build a new set this season, and they do so definitely mean that better radio is within the reach of everyone that I cannot see how we could fail to be fired with a fresh access of enthusiasm for "the finest hobby in the world." Only one thing was lacking to make this season completely memorable, and that was a development in the efficiency of our methods of set construction comparable in importance with the other new things.

Here there had been a condition of stagnation for many years, to which it has been my privilege to put an end by the invention of the Step System. In this we have an improvement in ease of construction, efficiency of layout and certainty of correct wire-spacing, which is fully equal in importance to the other developments which the season has brought us.

A New Set Essential

Either the Step System or the wonderful profusion of new valves, components and circuit improvements, would alone have made it imperative for every live constructor to treat himself to a new set this year. The two together mean that even a faint-hearted one (if there is such a person among the readers of "M.W.") must do it, for to be out of the swim this year means to fall most hopelessly behind the times.

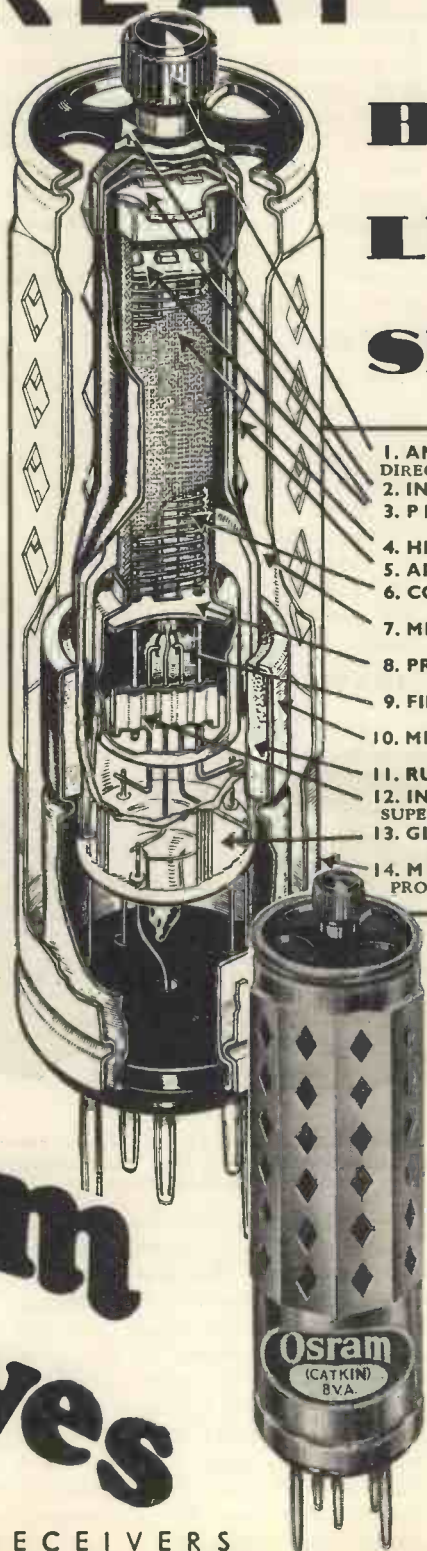
And that is why I don't want to divert attention from the K4 by talking about general matters, even

of GREAT strength

BUT LITTLE SIZE

OSRAM "CATKIN" VALVES are essential for modern receiver practice. Immensely strong yet compact in design they are constructed to microscopically precise limits and therefore allow for greatly improved set performance. A set equipped with OSRAM "CATKIN" VALVES gives the highest quality reception.

The all-metal construction of OSRAM "CATKIN" VALVES is a radical departure and results prove beyond dispute that they definitely give more uniform results, complete freedom from microphonicity and more effective screening. A change to OSRAM "CATKIN" VALVES is a change to faultless radio reception.



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DIRECTLY CONNECTED—LOOSE CAP IMPOSSIBLE
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6. CONTROL GRID
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7. METAL ANODE TO GLASS
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8. PRECISION INSULATOR
LOCKING ELECTRODES
9. FILAMENT CONNECTIONS THE ONLY WELDS
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- MH4 High Magnification Detector A.C. Mains Valve - 13/6
- MPT4 Power Pentode A.C. Mains Valve - 18/6

(Other types to follow)

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FOR A.C. MAINS RECEIVERS

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Trenchant Comments on Topics of the Day

though there are some things I'm burning to say about the bewildering variety of output load requirements of the Class B valves we are being offered, the ingeniously inconvenient way the anode, grid and filament terminals are mixed up on the new seven-pin holder, and other grievances of the moment.

The Designer's Task

All that must wait for another time. This month I am going to content myself with just one little fling on a subject which is actually connected with the K4, and the way I have presented it purely on its technical interest, without what I call furniture appeal. This is rather a sore point with me, for I cannot for the life of me see why designers should think that they must show a set all dolled-up when they have it photographed.

I maintain that a technical designer's job is to design the technicalities of the set, and he should not waste his energies on the purely artistic questions of cabinet design. That, too, is a specialist's business, calling for quite different gifts, and the technical man does not, as a rule, shine at it.

In any case, the choice of a cabinet design is a matter in which tastes differ enormously, and it seems to me that it is one which should be left to the man who is going to build and live with the set—in other words, the home constructor. To me it appears that this is purely a furniture question, which is right outside the scope of the technician. His part, I consider, is just to see that his set has the over-all dimensions to permit it to be housed in a cabinet of one of the standard sizes, and then leave the constructor to choose the particular design which appeals to him.

A Technical Achievement

That, at any rate, is the principle on which I have worked in presenting the K4. I put it forward entirely on its merits as a technical achievement,

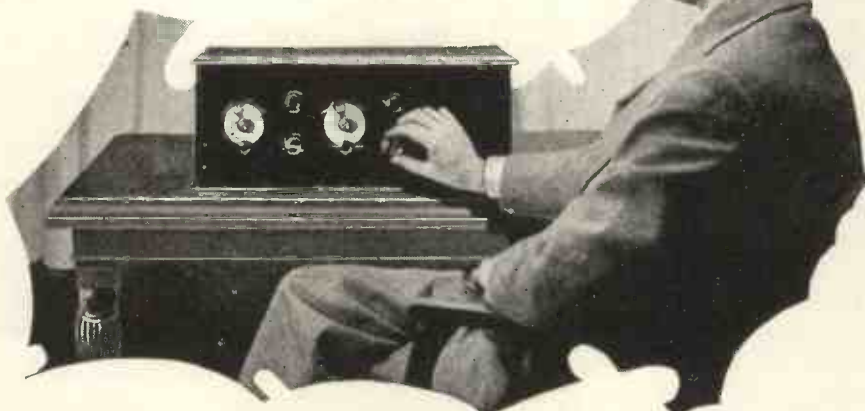
and at no point in my articles do I show it all dressed-up in a pretty-pretty cabinet. On the contrary, every photo was taken to illustrate its technical features, in which alone I am interested.

The one and only exception is the picture which you will find on the cover of this issue. Here it was necessary for purely pictorial reasons to enclose the receiver in some sort of a case, so I chose the plainest and simplest rectangular wooden box which I could find!

Not a Suggestion!

Do not, please, think that this is my suggestion of the kind of cabinet which should be used, for it is nothing of the kind. The K4 is worthy of a really handsome cabinet, but I am not going to presume to tell my readers what sort of design will best harmonise with the rest of their furniture, and I am leaving the choice entirely in their own hands.

TO ILLUSTRATE THE POINT!



This photo was taken at the same time as the one seen on the cover of this issue, and is reproduced here because it shows more clearly the "plain rectangular wooden box" to which Mr. Kendall refers.

By the by, I was not strictly correct when I referred to the picture on the cover as being the one and only exception to the rule I made in having the set photographed; actually two views were taken for the cover design, and only the most suitable of these was used for the purpose. The other one, I fancy, will be used to illustrate this page, and it was a sudden recollection of its existence that made me add this explanatory paragraph.

That being done, I can return to my point, which is just this: the importance of the K4 is such that special cabinets will no doubt be

designed for it by the specialist firms, and from amongst these I suggest that the constructor should make his choice. I have already heard that Messrs. Peto-Scott have such a cabinet in hand, and although I have not yet seen it I expect that it will be well worthy of consideration.

Self-Contained Receivers

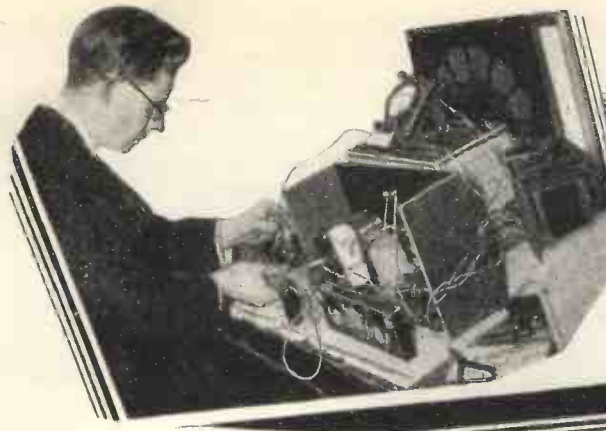
There is a rather obvious exception to my argument about cabinets in general which I should perhaps mention, lest the reader should some day think he has caught me breaking my own rules! I am referring here to the treatment of those designs wherein the cabinet really forms an integral part of one scheme, such as the entirely self-contained mains set.

In these cases the assembly of the various units and their proper spacing from one another is of some importance, and so the cabinet work really constitutes a part of the mechanical and electrical design. In these circumstances it is difficult to see what the designer can do except to work on the basis of some particular cabinet.

On Another Occasion

Whether this is or is not the proper way to design a mains set for the home constructor is a matter on which I have views of my own which I propose to ventilate more fully on another and more suitable occasion. There is one other type of self-contained outfit, however, in which I must admit it seems essential for the designer to choose the cabinet work, and that is the radio-gramophone.

Here the mechanical design of the outfit is more than half the battle. The run of the leads to the pick-up, the placing of the motor in relation to the amplifying circuits, the position of the speaker, and many other points, must all be taken into account if the best results are to be obtained.



TROUBLE TRACKING

As the Query Editor of MODERN WIRELESS, I meet with a wide variety of faults, and I have recently had quite a number of letters on these lines:

"I am using dry batteries for my H.T. supply, and I cannot understand why they run down so quickly. The batteries I use are of the 120-volt type, and when I first connect them up the results are all that can be desired. After about a week I notice that the volume commences to decrease, and a particularly nasty form of distortion sets in.

"The reproduction sounds harsh, and the loudspeaker emits noises which sound like a fault in the instrument itself, although I have proved that my particular speaker is in perfect order.

Overloaded Cells

"Replacing the battery with a new one immediately remedies matters, and a voltmeter test reveals a drop of as much as 40 volts in the old batteries which, I am told, could quite easily account for the symptoms I have just described.

"Can you give me any idea why these batteries should last such a short time, when my friends are able to make theirs last for several months?"

This type of query is by no means easy to deal with, owing to the fact that the same trouble may be produced by a variety of causes.

Obviously, the battery is being asked to give out more current than it can do economically; or, in other words, it is being overloaded.

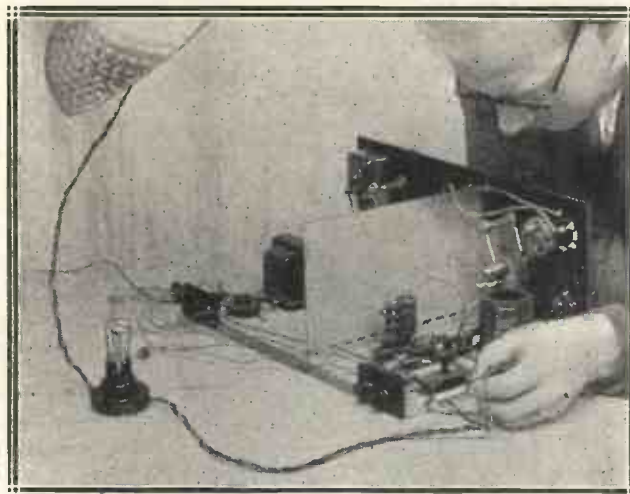
If, for example, you have an H.T. battery whose cells are intended

Under this heading the Chief of the "M.W." Query Department discusses some of the difficulties which can often be so troublesome. This time he deals with an H.T. battery problem.

to deliver currents up to 10 milliamps. and you try to make it supply, say, 20 milliamps., then you are putting a 100 per cent overload on the cells, thus decreasing the life of the battery enormously.

But the main point is, what is

A USEFUL FAULT FINDER



Those who have A.C. or D.C. mains will find that a neon lamp provides a convenient means of testing for continuity. The lamp is joined in series between the mains and the component to be tested. A glow indicates continuity, and an absence of glow a fault in the winding or component under test.

causing the set to take so much current? In the first place, readers who come up against trouble of this description must ask themselves whether the battery they have installed is up to the work demanded of it. That is to say, does the set, when working properly, take more

current than the makers of the battery intend the cells to give?

Dry batteries are made in different capacities, the discharge rates depending upon the size of the cells. The popular type of battery with the smallest size cell may perhaps be rated at 10 milliamps., the double capacity at 15 milliamps., and the very largest at 20 to 25 milliamps. I give these figures merely as example, and I have not any particular make of battery in mind; but reference to the catalogue of any one of the leading battery manufacturers will at once reveal the effect of battery capacity upon current output.

Now if you take one of the smallest batteries and connect it to a set which consumes 20 milliamps. or more, you are expecting far too much from the cells and, in consequence, you have to make frequent renewals; whereas, if you purchased a battery of the right capacity, you would get much more economical working.

Something Wrong

But let us take a case, not where a small capacity battery is harnessed to a set whose anode current demand is fairly high, but one in which the correct type of battery is being used. In a case such as this, obviously the battery can only run down rapidly when there is a fault somewhere in the set.

Grid bias is one of the first items that should be checked up. The total anode current taken by any receiver is dependent upon the value of the negative bias applied to the grids of the various valves, and the valve that should at once come under suspicion is that in the output stage,

(Continued on page 380)

"M.W.'s" RECORD REVIEW



Here is a selection of the latest releases, including a batch of six opera recordings and two brilliant examples of pianoforte technique.

THE first of the good things which the gramophone companies have been saving up for us against the longer evenings indoors have appeared. The lighter fare to which we have very properly been treated is quite overshadowed by the impressive banquet now announced. Here are the chief items of the "menu."

Opera

First—an abridged *Il Trovatore* on six Columbia records. This idea of "concise opera" is one of the finest things which has been done for the gramophone enthusiast for a long time. The whole conception is indeed lavish. Everything is of the very best. Artists and orchestra with international reputations (from the Scala, Milan)—superb performance in every department—magnificent recording—and the best and most popular arias and choruses only, hand-picked with a fine sense of what the public wants.

There are few operas which contain music which lingers so long in the memory as this, and I say without qualification that the singing of the Anvil and Soldiers' Choruses on these records is at once magnificent artistry as captivating to the trained ear as to that of the whistling errand-boy. The catholicity of musical appeal could not be better illustrated. But all these records are as good as can be, so why discriminate?

There are six 12-inch records in the free album (Nos. DX486-91), with a leaflet, for 24s. On no account miss them; you will be bound to buy at least one or two.

For Mozart Lovers

From Verdi to Mozart. This work (*Concertante Sinfonie for Violin and Viola* [K.364]) has perhaps a some-

what terrifying sound for the ordinary folk. Never mind the title—the music is most attractive, shapely and graceful, really Mozart at his best. As a violinist he knew how to write for the instrument, and the soloists—Sammons and Tertis—interpret him magnificently. An interesting feature is in the fact that the orchestra (the London Philharmonic) plays so large a part, the actual solos being few. But always, so good is the recording, the instruments of the two soloists are clearly heard. There is a real musical treat on these four Columbians (DX478-481).

Drama

Now for something more dramatic—a stirring symphonic poem. This is the *Mazeppa Symphony* (Liszt) on Parlophone R1579-1581. The adventures of the hero would make an

COMPLETELY EQUIPPED



This car, used by Mr. Borlase Matthews in connection with political work, is provided with a public address amplifier and loud-speaker, the amplifier being built into the luggage container. The constructional work was carried out by Mr. Matthews in his own workshop.

exciting film, and, if it were made, the music under review would thrill the most sophisticated audience.

The story is well-known; the music belongs to the school of realism, and will perhaps shake many theories to death. But now and again, realism is healthy and invigorating, and so we fly to realism in art. Well, here it is—real full-blooded stuff. Absorb the story and hear the Berlin Grand Symphony Orchestra re-tell it to you in music. If Schubert's *Erlkönig* makes you shiver, this will thrill you too.

For Lesser Occasions

It would not be fair to overlook some of the orchestral pieces of less substantial texture. I cordially welcome a fine performance of the *Secret Marriage Overture* by Cimarosa on H.M.V. DA4404. Gay music this, easy of understanding, dashingly played by the Berlin Philharmonic. You will like *Vienna Memories* recalled by Edith Lorand's Orchestra on Parlophone R1588. They are not the tunes the title might suggest.

Two excellent up-to-date numbers—*Whistling Under the Moon* and *She's Everybody's Sweetheart Now* (Columbia DB1169)—are finely played theme songs from "Heads We Go" by Columbo's Tzigane Orchestra. Perhaps the most attractive of all is H.M.V. B4466. Here Marek Weber's Orchestra plays *Beethoven Menuett in G* and the *Entr'acte Gavotte* from "Mignon." Gems, anyway, but more sparkling than ever in this performance.

Song and Choral

The best of the vocal records this month are the choral ones. Especially delightful is that by the Choir of St. Mary's School, Bridgnorth, on Columbia DB1166. These young children sing most charmingly Arne's *Lass With The Delicate Air* and Handel's *Oh! Had I Jubal's Lyre*. This choir shows evidence of magnificent training and the cultivation of a remarkable musical sense.

The recent festival of English Church music at the Crystal Palace has given an impressive record in Columbia DX498. Some 4,000 voices sign *O God, Our Help in Ages Past* and *How Goodly Are Thy Tents with Hail! Gladdening Light*. The latter two are exceedingly beautiful.

As to solos, try Essie Ackland's singing of Somerset's *Song of Sleep*—one of the best we have. The other side is *Danny Boy* (H.M.V. B4465). Tauber sings *Ma Curly-Headed Baby* in German with astonishingly pleasant
(Continued on page 380)

YOU BE THE JUDGE



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... I place before you the actual EVIDENCE of where your set is right or wrong. I am giving you conclusive and all-inclusive evidence of radio faults and efficiency. I give you—not just the circumstantial evidence of amperes, volts and ohms, no mere hypothesis, but proved and tested ACCURACY. I present the precision of the AvoMinor, a younger brother of the famous Avometer, the instrument that is so accurate and efficient that it is preferred and insisted upon by the world's foremost technical experts and service engineers. This in itself is evidence enough that nothing less than the AvoMinor is dependable enough for you."

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TRADE MARK

TELLS THE WHOLE TRUTH

Now YOU can test YOUR set—examine it, locate the faults, get first-class results from it—with the ease and precision of the technical expert. You can test ACCURATELY with the AvoMinor—test circuits, valves, components, batteries and power units. There is no test you need that you cannot make with the AvoMinor. It gives **TEN different ranges of readings in milliamps, volts and ohms.** It is a moving-coil combination testing instrument with a total resistance of 100,000 ohms. Full scale deflection is obtained with only 3 milliamps. No other instrument in the world gives you, at such a convenient price, so many tests with such dependable accuracy.

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CURRENT
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0-30 ..
0-120 ..

VOLTAGE
VOLTS
0-6 volts
0-120 ..
0-300 ..

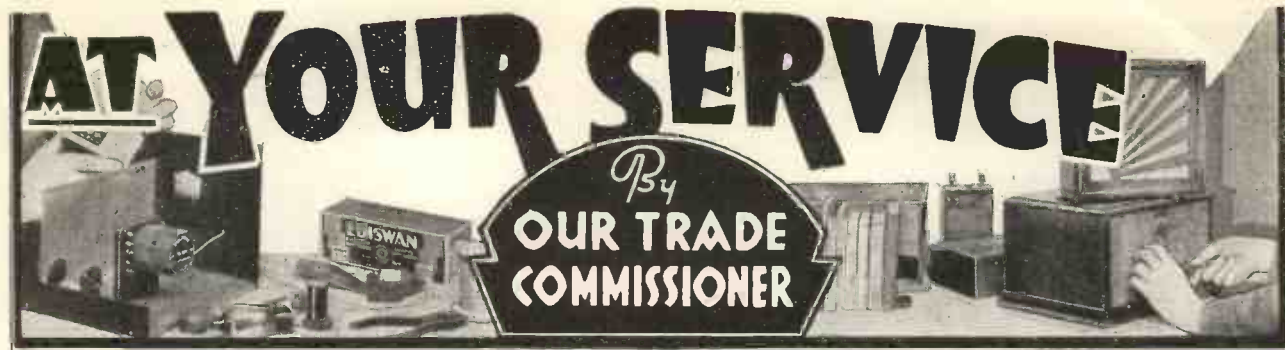
RESISTANCE
OHMS
0-10,000 ohms
0-60,000 ..
0-1,200,000 ..
0-3 megohms

40%

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Seeing is Believing

MORE and more radio manufacturers are publishing performance curves of their products. This is a wise move, for there is much truth in the saying that "seeing is believing," and not nearly enough use has been made heretofore of the graphical method of giving visual indication of a component's or even a set's characteristics.

The use of curves to illustrate and prove visually the goodness of any product is sound publicity, and if it continues to become popular the public will expect to see curves of all types of components.

Unjust Criticism

I am fully in accordance with the idea, for the purchaser of a transformer, for instance, has a right to be told by the makers exactly how it will behave—not expected to buy it and find out for himself. At the present moment the position is a little hard on the non-curve firms, perhaps, for the excellence of their components may be unjustly criticised simply because they do not bear graphical evidence of their quality; but in time I hope all radio manufacturers will come into line and label their goods clearly with efficiency curves.

Those who are first with this method of publicity are bound to reap reward in the form of enhanced prestige, as well as of increased sales.

An Excellent Book

The latest move in curve publicity that has come to my notice is an excellent book issued by Dubilier, in which the full range of condensers and resistances are not only described and priced, but are accompanied by hints as to their use and with many valuable curves showing clearly their performances under working conditions.

Some trade news and views that will prove of interest to readers, whether or not they are connected with the radio industry. Members of the trade are invited to send items of interest or photographs to be included under this heading.

Several pages are devoted to the description and illustration of the metallised resistances under load. Permanence curves are given, and humidity, temperature and voltage characteristics also figure in the very full details provided.

The colour code resistances, with the necessary code for translation purposes, are listed; while the latest ignition interference suppressors for car radio reception, and other anti-

AN INGENUOUS DEVICE



The "snatch" thief will have a thin time if this device shown by the American Westinghouse Co. at the Chicago World's Fair comes into general use. As the hand is passed through the opening in the grille it interrupts a beam of light directed upon a photo-electric cell and so causes a barrier to be raised.

interference devices, complete a most fascinating book.

It is well worth every MODERN WIRELESS reader getting a copy of the book, which is gladly supplied on receipt of a card to Dubilier Condenser Co. (1925), Ltd., Ducon Works, Acton, W.3. The title of the book is

"Choosing Your Condensers and Resistances."

The Oldham "Wakes"

Much as the Lancashire worker looks forward to the yearly "Wakes" in his district, twenty thousand people who are affected by the trade successes of Ferranti Ltd. have agreed to miss the Oldham Wakes this year owing to the enormous business done by the famous transformer manufacturers at the Radio Exhibition at Olympia.

As far as I know, nothing approaching this has ever occurred before, for the Wakes are part of the life of Lancashire, and it must mean a tremendous sacrifice for such a vast number of people to give them up.

The Latest "Radiomag"

"Number 5," the best, so far, of all the Telsen "Radiomags" has appeared, and I should like to congratulate the editor on the contents. It covers in excellent fashion a wide aspect of radio, and is particularly generous in its contents.

Beside the full list of Telsen components, beautifully presented in colour, there are numerous practical articles on such vitally interesting subjects as "Class B," the new Telsen iron-cored coil, the choice and care of H.T. batteries, and so forth.

Also, complete details are provided for the construction of six up-to-date home constructor receivers, and for three of these full-size blue-prints are included with every copy. At 3d. the Telsen "Radiomag" represents wonder-

ful value, and a production of which Telsen Electric Co. can rightly be very proud.

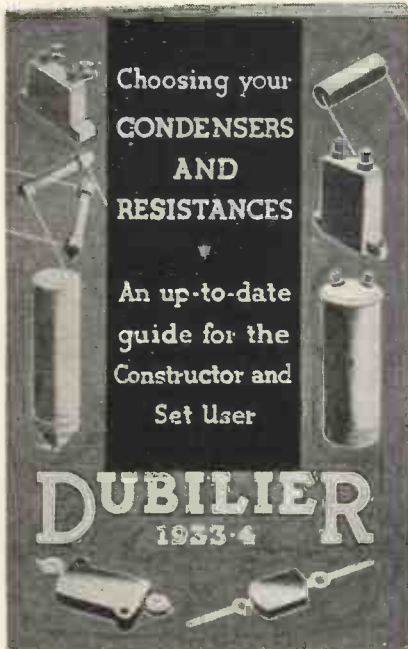
A New Output Valve

The term "maximum undistorted output," as applied to a valve, has probably been the source of more

The Latest News from the Radio Trade

misunderstanding than any other term in radio. The public have been told often enough that something of the order of 500 milliwatts is ample

A VALUABLE GUIDE



The new Dubilier book described on the previous page bears the attractive cover illustrated here. The book contains practical data of value to every set builder.

for "ordinary" listening, and yet many sets use valves capable of providing four or five times that amount. Why this discrepancy?

The reason is really simple. While a general level of some 500 milliwatts is ample for domestic purposes, this does not take into account loud passages, such as big bangs on the drum, which come along every now and then. To cope with these, larger output-carrying powers are necessary than are provided by 500 milliwatt valves. Thus often valves having a capability of 2,000 milliwatts are used to take care of these peaks without overloading.

For all normal purposes the usual triode or pentode output valve will look after the peak passages satisfactorily, but where a little larger volume is required something very much "bigger" in the way of a valve is necessary. To meet this requirement Mullard have produced a new output valve of the 400-volt anode potential class which is to take the place of the DO.25, for long a favourite among amplifier constructors.

The new valve is the DO.26, and

it takes 4 volts on the filament against the 6 volts needed by the DO.25, thus making the valve very much more useful, bringing it into line with the other A.C. valves.

The amplification factor is of the order of 3.8, and the impedance is 600 ohms. With an optimum load of 4,000 ohms the valve will give up to 5 or more watts output from a maximum "signal" input of 65 volts R.M.S.

Still Growing

Pifco Ltd., of High Street, Manchester, have a most attractive range of radio meters designed to cater for wireless users. Among them the expert will find instruments that can be relied upon to give accurate readings for a whole host of tests, whilst the novice whose interests are limited to the building of a radio set will find low-price meters which cannot fail to save him both time and money in construction.

The new Pifco Rotameter at 29s. 6d. is the star performer in the range. This sensational meter gives 100 radio tests—no other single instrument so easily covers all the tests the Pifco Rotameter undertakes. One needle pointer operates on eight different dials, the dials being so arranged as to be instantly available by the turning of an octagonal knob.

There are other Pifco products

worth consideration, including moving-coil Radiometers and Electrometers; in fact, there is a meter for every radio purpose.

Bravo, Scotland!

When this appears I hope to be at Manchester at the Northern National Radio Exhibition, following on the London and Scottish Shows, and before I go I should like to wish all trade friends the very best of business in the North of England.

London and Glasgow have had well-attended exhibitions, and I do not think that Manchester will fail in that regard.

Glasgow took its first official radio show to its heart in enthusiastic fashion, and I must compliment the Corporation on their liveness in publicising the show. All over the city we were confronted with neat, but highly visual, blue notices showing the way to the Kelvin Hall, wherein was the exhibition, and these indicators were invaluable to those who did not know Glasgow very well.

Following this an illuminated tram-car paraded the various tram routes advertising the show, and announcing its presence by means of two loud-speakers pushing out gramophone music. The idea was an excellent one, and was particularly applicable to Glasgow, where the trams are the main means of locomotion.

COMPARING THE OLD WITH THE NEW



Here is an interesting comparison—a horn type gramophone of thirty-five years ago and the latest H.M.V. radio-gramophone, which plays up to eight records continuously.

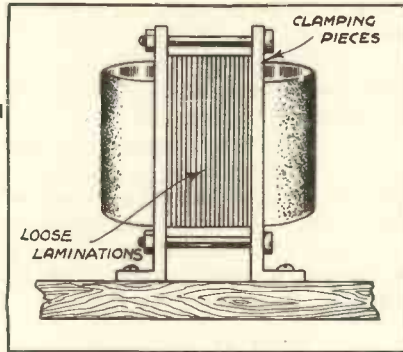
HINTS AND TIPS FOR THE RADIO HANDYMAN

Ideas that are well worth remembering by all constructors. Some of them are bound to provide just the help you need one of these days.

Loose Laminations

Loose laminations in an output filter choke or a smoothing choke are often responsible for strange noises emitted from a receiver—even with the loudspeaker disconnected these noises still continue.

In several types of chokes the stalloy stampings are held together by the moulded case; with this type of choke loose laminations are difficult to cure, and should a re-



Strong clamps should be used to stop loose laminations from "talking" or humming.

moulding bulges and eventually breaks, and usually results in the breaking of internal connecting wires.

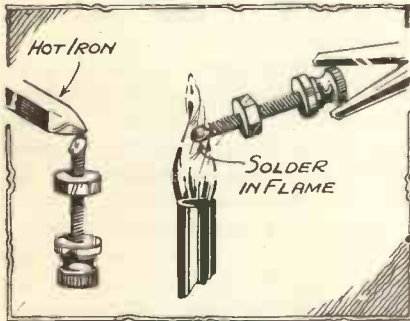
Removing Unwanted Solder

Difficulty may be found in removing the nuts from terminals to which wires have been soldered.

If the terminal is held in a vice, and a very hot soldering iron is held on it, the solder will melt and the nut will be easily run off.

Noisy Laminations—Removing Solder—The Earth Connection—Avoiding Dust—Cutting Bolts,

THE TWO METHODS

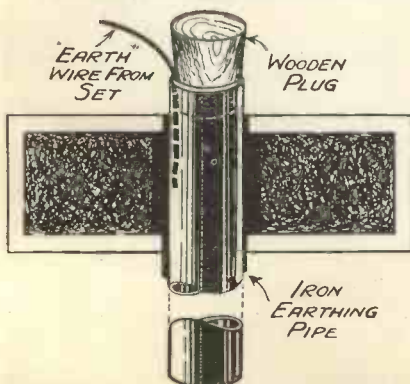


How to remove surplus solder. The method on the left may be used with terminals that are still mounted.

placement by a similar make and type fail to cure the trouble, the only solution is to remove the complete choke from its case and construct angle pieces so that the laminations may be clamped together.

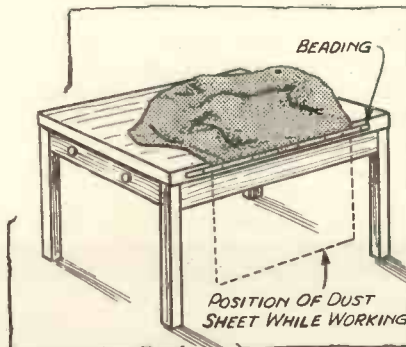
It has been found by experience that it is very unwise to attempt to force packing pieces between the core and the side of the case, for the

A FIRM CONNECTION



Soldering to an iron pipe already buried in the earth is not easy, but the alternative method of connection illustrated here is quite satisfactory.

KEEPS OUT THE DIRT



This simple tip will keep your set perfectly clean while undergoing repairs or alterations.

Alternatively, the terminal may be held in a gas flame with a pair of pliers. The latter method is only applicable to all-metal terminals.

Iron Pipe Earth

When a length of iron piping is buried into the ground as a means of providing a satisfactory earthing point, it is a difficult matter to ensure a perfect electrical contact with the connecting wire, owing to the fact that soldering is out of the question and drilling a hole for a nut and bolt is not always convenient.

A simple remedy, however, is to fix the connecting wire in one end of

the iron tube and plug firmly with a clothes peg, or piece of wood cut for the purpose.

Avoid That Dust

Dust often has no effect on a set, which makes many constructors careless about it. They leave a receiver standing without its cabinet until a thin film of grime covers it.

True, most of the dirt can be removed easily; but it's the little bit left that does the harm. This works its way into the components, and may cause the most obscure of troubles.

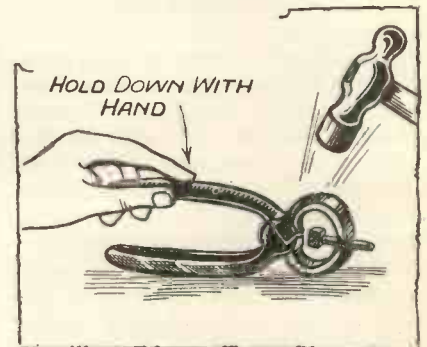
A dust-sheet fixed along the front edge of the bench or table on which your experiment will keep your apparatus spick and span. Hem the sheet round the edges, and use a length of beading to secure it.

When you are at work the dust-sheet hangs out of the way down in front of the table.

Cutting Without a Hacksaw

To cut thick material with pincers is almost impossible in the ordinary way, because sufficient power cannot be supplied by the hand.

SHORTENING BOLTS



A sharp tap with the hammer—the pincers will cut quite stout-sized bolts.

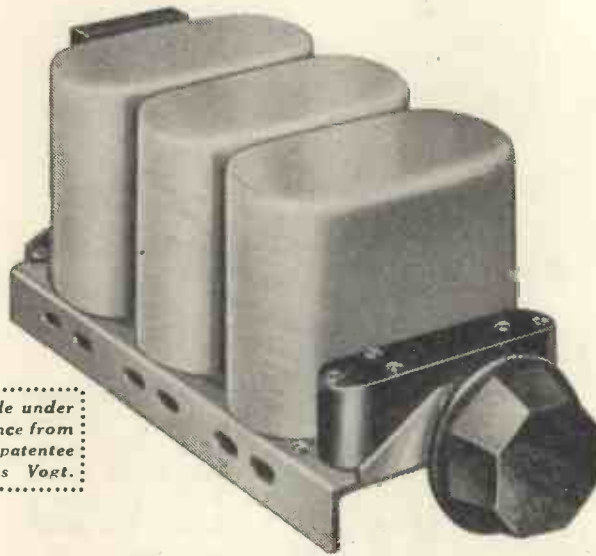
The necessary power is forthcoming, though, from a short blow with a hammer. The rod or bolt is first held at the point at which the cut is desired.

The pincers holding the material to be cut are then placed on a hard surface, such as a concrete floor, and hit with a hammer, as shown in the illustration. One sharp, powerful blow is all that is necessary.



*“ . . . and performance
proves there’s none as
good as*

**COLVERN
FERROCART COILS”**



Made under
licence from
the patentee
Hans Vogt.

There are very definite reasons for the efficiency of Ferrocarrt Coils. Their advantages are fully explained in a booklet which we have written. May we send you a copy? It’s free.

**Mr. G. P. Kendall used FERROCART Coils
in the “K4” described in this issue.**

One F10. One F3.

Mounted on aluminium base @ 25/- pair.

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AT

Opening of our Radio

clink like a common snatcher! 'Is 'Igh and Mightiness, lying in the corner of 'is cell like a drunk! Too prahd to speak, eh? Well, you won't look so 'igh and mighty when they take yer out ter swing. Didn't I tell yer we'd get yer one day? Didn't I swear the day yer rolled me over in the mud that I'd get even with yer?"

There was a pause, and then the

voice shrilled suddenly on a new note, a note of terror.

"What's this? Keep away! Good 'eavens! You——" The voice broke off, dwindled to a ghastly, choking gurgle. Then silence.

"For goodness sake, Madge, turn it off, and let's have some light on the subject. That sort of stuff fairly gives me the horrors."

Madge Spears laughed, got up from her chair by the fire, switched on the lights, and snapped off the switch of the wireless set.

Her sister-in-law blew her nose vigorously, and then helped herself

The introduction of a serial story tainly an innovation, but one which the story has not only been written by but centres round an imaginary crime

Consequently, the authors are atmosphere and describing the scene to detail.

I wish to emphasise, on behalf of sake of verisimilitude, the description tectural features of Broadcasting not mean that in the story presented to there is portrayal in the characterisa- the B.B.C. with whom the story is characters are entirely products of been made of designations officially B.B.C. staff.

to another piece of Turkish delight.

"I don't know why you wanted to listen to the beastly thing," she said. "You're getting morbid, Madge; but I suppose it's natural for you to be interested in crime, Simon's job being what it is. You ought to have got him to explain it. I never can follow those radio plays—they're too complicated."

"Oh, you like to see the blood, Jane," said Mrs. Spears laughingly. "You'd better stick to the talkies. They're more your linc. But you must admit it does help to listen in the dark. It was perfectly clear to me what happened."

"Well, what?" asked Jane. "Blessed if I could follow it."

"The scene before was plain enough. They'd arrested the Scarlet Highwayman and put him in a cell. Then

I.

"BROADCAST OF DEATH"

THE whining Cockney voice, vibrant with passion, echoed weirdly through the darkened room. Beginning as a whisper, it rose until it was almost a scream. It was the unmistakable voice of a man with a grievance; a man who had been given an opportunity to take his revenge; the snarl of an under-dog turned at last to bite.

"So we've got yer at last! Who'd 'ave thought it would 'ave come to this? The bloke who fancied 'e could trick the whole lot of us, shoved into

BROADCASTING HOUSE

Chapters
great, new
"Thriller"

By **VAL GIELGUD**
and **HOLT MARVELL**

.....
into MODERN WIRELESS is certain we feel our readers will welcome, for two very well-known B.B.C. officials, at Broadcasting House, thoroughly at home in creating an of the crime with the greatest fidelity

the authors that although, for the of some of the technical and archi-House are strictly accurate, this does readers of MODERN WIRELESS tion of those members of the staff of concerned. Both the events and the the imagination, although use has applied to certain members of the
THE EDITOR.

the other man—you know, the gaoler—was sitting there and swearing at him; but actually it wasn't the high-wayman in the corner of the cell, but simply a bundle of his clothes. He crept up to the gaoler from behind and strangled him, as you heard."

"I see," said Jane, munching placidly. "But what I like on the wireless is a nice military band, and, of course, Henry Hall and Christopher Stone and his gramophone records. I don't believe in these plays. They're either Shakespeare and all talk, or else they're like this Scarlet Highwayman stuff, and give you nightmares."

"Well, I suppose some people like them," said Madge Spears, "or they wouldn't do them so often. After all, they did that one awfully well. I wish Simon had heard it. He's been

so gloomy lately, it might have cheered him up."

"You'd better have a bit, my dear," said Jane inconsequently, "before I eat it all. Besides, it's so bad for the figure. But I know that if I was a Scotland Yard Central Inspector I'd have something better to do than listen to plays about murders. They have enough trouble with the real ones, poor dears. Isn't Simon awfully late, Madge?"

"Oh, he's been at it day and night lately. That dreadful business down at Wapping. You know, Jane, I think the B.B.C. ought to do a lot more——" But Mrs. Spears' opinions as to the shortcomings of the British Broadcasting Corporation were not for the present to be revealed.

The front door of the little Norwood villa slammed; there was a clatter in the umbrella-stand and a click of the latch, and Central Inspector Simon Spears stood in the doorway.

He was a young man for a Central Inspector, but with an excellent record of service behind him. This evening he looked dog-tired, and his shoes and trouser-legs were splashed with mud. Just over six feet tall, with broad shoulders and narrow hips, he looked something of a mixture between a soldier and an athlete.

"Sorry I'm so late, Madge," he said. "Kept at the office as usual—that Wapping business! Hallo, Jane. I didn't expect to see you to-night."

He dropped wearily into the nearest chair.

"I hope you've got some dinner left for me, old girl. I'm dead beat."

"The girl'll have it ready in five minutes, Simon," said his wife.

"Have you had any luck to-day?"

The detective took an empty pipe out of his pocket and stared at it gloomily.

"Not a thing. They've got away with it this time. We'll never catch 'em now. Clever; I hand it to 'em."

"Well, you couldn't help it, Simon. You've done all a man can."

"Perhaps a good bit more than some men," said Spears gloomily. "And all I've got for it has been an hour on the carpet in front of the Assistant Commissioner, no less. He seems to think I can work miracles. The soldier!"

"Let's talk about something else, Simon," said his sister brightly. "Madge has been giving me the creeps with her brand-new wireless set."

"Oh, that thing! What have they given you to-night? How to cook earthworms against a background of chamber music?"

"Shut up, Simon! It was jolly good, wasn't it, Jane? One of those romantic plays, all about a famous highwayman the Bow Street Runners couldn't catch. There was a wonderful murder in it, too. I turned off the lights, and Jane couldn't bear it. I had to switch the set off again; it was so life-like when the gaoler was strangled!"

Central Inspector Spears snorted. "Life-like, my foot! These playwright chaps have all the luck. They can invent their murder, commit their murder, and solve their murder, and have everybody telling them how clever they are! Perhaps the Assistant Commissioner would like a few of them at the Yard."

"It was the realest thing you ever heard, Simon."

"Oh, rats, Madge! Give the wireless a rest and get that girl to hurry up with my food. I've had all the stuff about murders that I want for to-day."

"You're an old bear with a sore head," said his wife.

But she went to the door all the same, ruffling his hair affectionately on the way, and disappeared in the direction of the kitchen.

"I wish you'd heard it, though, Simon," persisted Jane.

Spears got out of his chair.

"Oh, for Lord's sake, Jane," he said, "chuck it. I'm going to wash my hands."

Left alone, his sister picked up the box of Turkish delight, and delved into its messy interior. She was still holding it when the telephone rang.

"Hallo!" she said, picking up the receiver in her other hand. "Yes, this is The Laurels—yes, he's just got back. Who wants him? Oh!" And she drew in her breath rather sharply. "Scotland Yard? I'll tell him."

II.

"THE PLAY'S THE THING"

At precisely twenty minutes past ten on the same evening, the red light—indicating a broadcast transmission in progress—on the wall of the Dramatic Control Panel Room on the eighth floor at Broadcasting House went out. The three men sitting in front of the Dramatic Control Panel gave simultaneous sighs of relief; the atmosphere, so tense until a moment ago, eased perceptibly as for the first time for more than an hour the men "on the panel" (as B.B.C. slang has it) were able to relax.

A curious room, this, much photographed by the Press and much sought after by visitors to Broadcasting House. Rather like a control tower in some ultra-modern submarine—a complication of electrical gear standing out in stark simplicity against the ship's grey of walls, ceiling and carpet.

The most important object in the room was the Dramatic Control Panel itself, a long, grey desk holding the switchboard that is the brain-centre of a modern radio play; a double row of volume control knobs, each capable of amplifying the voice of its particular studio to a roar or diminishing it to a whisper; a single row of switches, each connected with a green lamp in a studio below so

that the operator might flash the cue-signals to the scattered actors, orchestra, announcer, effects-men, and so on, who go to make up the play.

The transmission of such a play, which might employ as many as twelve studios, was always a "nervy" business.

"Exactly on the minute," said Hancock, the Balance and Control engineer, rubbing his hands together and flexing his fingers.

For an hour and five minutes he had sat at the Panel, "mixing" the output of the various studios in the transmission of the radio play, "The Scarlet Highwayman"; and for an hour and five minutes his fingers had played with these knobs and switches much after the fashion of an organist at an organ.

On his right, Julian Caird, B.B.C. Dramatic Director and producer of this particular play, wiped his forehead with his handkerchief and stood up.

"Thanks, Desmond," he said. "You did very well. Lord, what an evening! Once, I thought we should never get through. This play's taught me a thing or two, at any rate. This elaborate technique of ours is amusing for the playwright and interesting for the producers—helps to

keep the story moving, too, but at times it's too tricky. The more mechanism you introduce, the greater the risk of something going wrong. I must go down and say a word to the cast, and pull Rodney Fleming out of the 6A Listening Room; and then, what do you say to a drink, Desmond?"

"Nothing more you want, Mr. Caird?" asked the third man, the engineer on duty.

"No, thanks," said Caird. "But I wish your people would make sure that those return-lights from the studios don't fail again."

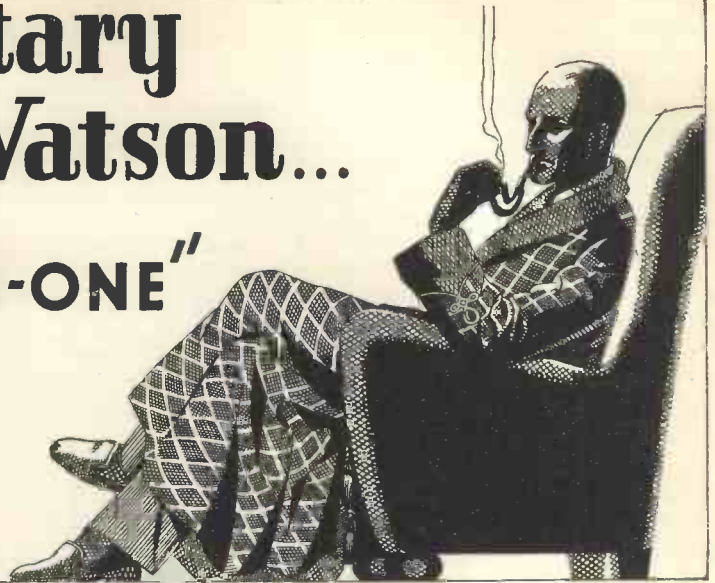
He jerked his thumb towards the indicator on the wall.

"I nearly broke my neck dashing down to 6A on that infernal corkscrew staircase between the sixth and seventh floors, and for all I know Hancock may have messed up the whole play during those minutes I was away." And he grinned at Hancock, whom he knew to be absolutely reliable.

"As a matter of fact, Julian," said Hancock, "that scene went considerably better than it ever did at rehearsal. Parsons really got it this time. He 'died' like a good 'un. He really did what you told him. Must have been influenced by

DRAMATIC DEPARTMENT.						
D.C. PANEL No. 1	GROUPING					
2	4	11	7	8		
ECHO		6D		6E		
8A		ECHO				
1	3	5	Group Control	6	9	10
7C		8A	6A	6B	6C	
OPERATED BY M ^r HANCOCK (DRAMATIC - BALANCE AND CONTROL)						
FROM:	Stage Manager	Transmission (Nat. June 30 th 1933 - Time 8.0 - 8.55 Reg. JUNE 29 th 1933 - 9.30 - 10.15)				
		Title THE SCARLET HIGHWAYMAN				
		Producer M ^r CAIRD				
REHEARSALS						
June 21st) 2.30 - 5.00 (Any single studio)						
" 22nd)						
TO:						
E. I. C. (Control Room)						
Balance & Control						
Announcers' Executive						
House Superintendent						
Programme Routine						
June 23rd)						
" 24th)						
" 25th) All studios except) 10.30 - 1.30 June 29th 10.30						
" 26th) 8A) 5.00						
STUDIO ALLOCATION						
8A	Theatre Orchestra		6B	Subsidiary		
6D	Effects		6C	Cast Studios.		
6E	Gramophone Effects		7C			
6A	Main Cast Studio					
NOTES						
E.N.I. Microphone in 6A essential.						
I.M.						
This is the memorandum, initialled by Ian Macdonald, the studio manager, and circulated to all responsible for the broadcasting of "The Scarlet Highwayman," which shows how the studios were allocated.						

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the atmosphere. It was pretty murderous during that mess-up with the lights. You looked as though you were going down to strangle someone!"

Hancock was joking—but Caird didn't laugh.

"I'm sorry, Mr. Caird," said the engineer. "But everything was tested as usual. Just a bad luck breakdown."

"Yes," said Caird. "You always say that. Well, as a transmission's here to-night and gone to-morrow, no one cares. Good-night." And he and Hancock went out of the room.

As they strolled down the staircase and through the swing doors on the seventh floor which led into the inner tower of the building, in which all the studios were grouped, Hancock took Caird's arm.

"You know, Julian, I think you want a holiday," he said. "I've never seen you get so worked up. You've been on the jump all the evening."

Caird stopped, and for a moment leaned his back against the wall in the narrow passage. Even the carefully subdued modern lighting did not conceal the shadows under his eyes and the hard lines of jaw and cheek bones under the tightly-drawn skin. As he took out a match to light a cigarette, his hands were shaking.

"Oh, I'm all right," he said abruptly. "It's only this infernal play. I can't remember a worse ten days in all the four years I've been here. First, all the trouble about the Drydens, with Rodney Fleming at me all the time to throw 'em out of the cast because they couldn't, or wouldn't, act together. Then that row with Evans, who won't remember that he's here to do what I tell him and not to push his oar into what doesn't concern him. I didn't mean to go for him, but just when we were due to start he came barging into my office and started a long rignmarole about the psychology of acting and what a mistake it was to expect Isabel Dryden to give a good performance when she and her husband were always fighting. It's time that man did a straight job of his own work and left others to do theirs!"

The Balance and Control man smiled and took Caird's arm again.

"I bet you'll find it's been a cracking success. Come on, let's butter up the cast and tell them all how good they were. Where did you say Fleming was?"

CAST			CHARACTER			ARTIST			STUNDS		
Isabel Dryden	Isabel Dryden	1.0	Leoald Dryden	Leoald Dryden	1.0	Star's Fee					
Isabel Dryden	Isabel Dryden	1.0	Isabel Dryden	Isabel Dryden	1.0	to be featured in Radio Three lay-out					
Captain George Prescott	Frankie Moore	1.0	Steve Donnell	Steve Donnell	1.0						
Cynthia Hardinge	Emily Desmunt	1.0	Billy Pearson	Billy Pearson	1.0						
John Brighton	Stanley Croome	1.0	Stanley Croome	Stanley Croome	1.0						
John Conier	Walter Parnham	1.0	Charles Richmond	Charles Richmond	1.0						
The New Street Dramas	Gregory Abbott	1.0	Harold Sprague	Harold Sprague	1.0						
John Jung	William Hamilton	1.0	George Sennitt	George Sennitt	1.0						

820/7/29/33

The dramatis personæ of "The Scarlet Highwayman," who found themselves unwilling actors in a real life drama!

"In the 6A Listening Room."

"What the deuce is he doing there?"

"Well, I didn't want him in the D.C. Room," said Caird. "Actors are a curse, but authors are intolerable. Besides, he wanted to be able to see some of it going on, and as most of the big scenes were in 6A, he could watch through the glass panel. And he was expecting a telephone call, so I arranged with Control Room to put it through to the telephone in the Listening Room, where he couldn't disturb anyone else. I wonder if Dryden's all right?"

"Dryden?" asked Hancock. "Why?"

"Oh, of course," said Caird, "I didn't tell you. You remember when I got the message through from Control Room that the return-lights had failed and bolted down to warn Ian Macdonald in the studio?"

"Yes."

"If you remember, it was just before the big ballroom scene in Studio 6A. Just as I got to the top of the spiral staircase on my way back to you, almost exactly where we are now, I ran into Leo Dryden. Of course, he ought to have been down in 6A getting ready for his scene. Instead, he was coming towards me from the direction of the lifts."

"What the devil was he doing there?"

"Exactly what I asked him. He was looking frightful—white as a

sheet about the gills. He muttered something about our rotten synthetic air in the studios and going outside the tower for some fresh. I hadn't time to do more than swear at him, but I noticed he was looking seedy when he came this evening."

"Well, he finished his part all right, anyhow," said Hancock. "You go first."

III.

THE BODY IN THE STUDIO

JULIAN CAIRD started down the corkscrew staircase, then turned suddenly.

"Oh, Desmond," he said, "just have a look in 7B and 7C in case there's anyone still there. A good many of this cast have never broadcast before, you know. They may have stayed where they were to the end."

Hancock nodded, and moved back along the passage. As he did so, the door on his right at the head of the stairs opened, and a dark young man in a dinner jacket, with very smooth black hair brushed straight back, came out of the 6A Listening Room.

"Hallo, Julian," he said. "Had you forgotten all about me? I thought it went terribly well. I couldn't have asked for it to be better done."

"I couldn't have done it if you hadn't written it, Rodney," said Caird. "Coming down? I want to see the Drydens. Leo was looking awfully seedy, but I thought perhaps we could get him and Isabel to come out to supper. I'm just waiting for Hancock. You might congratulate him—he did marvels on the Panel."

"Of course," said Fleming. "By the way, thanks awfully for fixing that telephone call for me."

"It was against all regulations and instructions," said Caird. "But I'm glad—"

He was interrupted by the shouting of his own name which came, rather muffled, from a studio farther along the passage.

"That's Hancock," said Caird. "What on earth—"

The door into 7C was flung open, and Hancock burst into the passage. "Come here, Julian, for God's sake!" he said. "Quickly. There's been an accident!"

Fleming and Caird stared at each other for a moment; then joined Hancock in the studio doorway.

In the far corner, almost under the microphone standard, lay a man's body.

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Caird started forward.

"I suppose he's fainted," he said. "Give me the water-jug, Desmond."

Behind the three of them the door shut automatically.

7C was a studio with special acoustic treatment removing all natural echo, and at that moment Rodney Fleming felt acutely the oppressive, almost sinister atmosphere of the room, with its single shaded light, its thick carpet and queerly padded walls. The ventilation was perfect, but he felt he wanted to draw unusually deep breaths.

"It's no use, Julian," said Hancock. "And you'd better not touch him, or anything else."

"What do you mean?" said Caird.

"It's Sidney Parsons," said Hancock. "He's dead. Strangled. No wonder that scene was so well played!"

IV.

THE GENERAL TAKES CHARGE

NINE floors below, in the special Vaudeville studio at Broadcasting House, professionally known as BA, the evening's hour of variety was going unusually well. No "act" had rung up from one of the Halls to say that they were very sorry but they would be bound to be two or three minutes late; no comedian had wandered from his carefully censored script to insert a doubtful joke and shock thousands of suburban listeners. The new Director of Variety, always an enthusiast for experiments, had introduced a small chorus who sang and kicked with gratifying vivacity; and more than one listener remarked that the studio audience sounded less mechanical than usual that evening.

Prominent amongst the audience, in the centre of the gallery, sat General Sir Herbert Farquharson, the Corporation's Administrative Controller. Tall, distinguished-looking, and white-haired, with a cropped moustache, and an eyeglass immovably fixed in his

left eye, he viewed the proceedings with that slightly aloof geniality which was characteristic of him.

The hands of the big black and green clock facing him on the wall at the back of the tiny stage pointed to twenty-eight minutes past ten. The last turn, a famous Cockney cross-talk pair, delivered their final wise-crack into the grey, torpedo-shaped microphone suspended between them and the band-conductor, smiled and bowed at the audience, and walked off the stage. The limes at each corner of the gallery went out; the studio lights went up; and the band crashed into its final number. At that moment the general felt a hand on his shoulder.

It was fortunate that the number in question was American and "hot," for no one had tapped General Farquharson on the

shoulder for about twenty-five years, and though genial he was a disciplinarian and choleric.

"What the devil——" he said, turning sharply in his seat. "What is it, Caird?" Then he remembered that the red transmission lights were still on, and noticed the astonished glances of the occupants of the adjoining seats. But before he could lower his voice to repeat his question Caird had whispered urgently:

"Might I speak to you alone, sir, outside? It's rather important," and led the way towards the door of the gallery.

General Farquharson frowned, stumbled over the quite exceptionally large feet of the lady in the seat next to him—who happened to be the mother of one of the chorus girls—apologised handsomely, and followed Caird out into the passage.

"Well, Caird, what is it? Are you ill? You're as white as a sheet."



Fleming and Caird stared at one another for a moment; then joined Hancock in the studio doorway.

In the far corner, almost under the microphone standard, lay a man's body.

Julian Caird seemed to have some difficulty in replying. He stood against the wall, his throat moving convulsively.

"I'm sorry, sir," he stammered at last, "but I thought you should know at once. There's been an—an accident up in 7C!"

"An accident?"

"One of my actors," Caird went on. "We've just finished a play on the other wave-length, sir—'The Scarlet Highwayman.' One of the fellows in the cast was a man called Sidney Parsons. Hancock found him in 7C at the end of the show. He was dead."

"Dead?" echoed the general. And for the first time in his life Caird saw

the general register surprise, so that his eyeglass fell to the floor with a tinkle of broken glass.

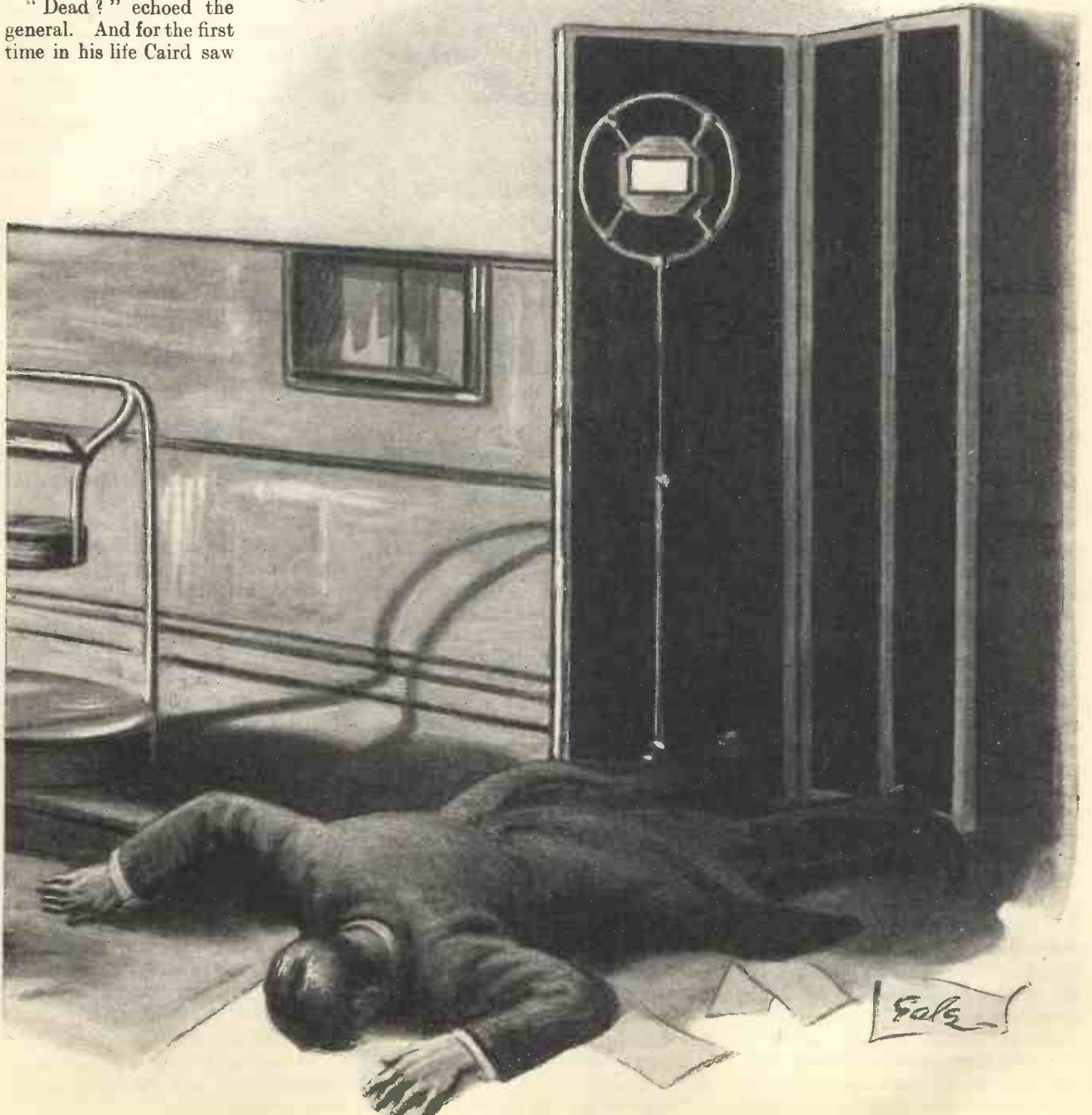
Through the heavy rubber-sheathed door behind them came a final chord from the band and the sound of the audience applauding.

Said Caird: "They'll be out of BA in a minute, sir. Would you mind

coming upstairs with me? I know it sounds absurd, but there's every reason to suppose that he's not only dead, but murdered."

"Murdered! This is fantastic, Caird. What have you done?" The general was surprised. No doubt about that!

"I put a studio attendant on the door of 7C, sir, and warned my studio



manager, Macdonald, and Bannister."

"Bannister, your 'Effects' man?"

"Yes, sir. Guy Bannister. I warned them to keep the sixth and seventh floors clear, and told the house superintendent to telephone to the police. It was only then that I heard you were in the Vaudeville studio, sir. I came straight to you as soon as I knew."

"You seem to have been pretty sensible, Caird. We'll go up."

The general leading, they went up into the main entrance hall, where they met the house superintendent emerging from his office.

"I'm glad you're here, sir," said the latter. "This is a terrible business. Scotland Yard are sending along a detective and a police surgeon."

The general glared.

"Are you sure this is necessary?" he said sharply. "All this means the most distressing kind of publicity."

"I don't see what else we can do, sir," said the house superintendent defensively. "I've seen the body. It's a clear case of a killing, sir. I didn't touch anything."

"A killing! In Broadcasting House, of all places! Good heavens!" said General Farquharson. "How was it the thing wasn't discovered until the end of the play?"

"Parsons was murdered while playing a character in the course of the play. He was alone in 7C," said Caird. "Great Scott, sir, do you realise that everyone who heard that play *must have heard him die*? Pretty unique in the annals of crime!"

"We don't know yet that it is a crime," snapped the general. "Don't jump to conclusions!" He turned to the house superintendent: "Have this detective fellow sent straight up to the studio as soon as he comes. Don't let the news spread. Above all, don't talk to reporters if they get wind of it. Caird, you come with me. I'm going up there now. No, damn it all, we won't wait for the lift! If I can walk up seven flights of stairs, so can you. You're thirty years younger than I am."

The audience from BA was surging into the hall, some of them laughing and chattering, most of them staring about with unabashed curiosity at the Eric Gill statue of the Sower, flanked by the mahogany reception desk on the one side, and the book-stall for Corporation publications on the other. And as Julian Caird followed the general's long legs up the stairs, it seemed to him incredible that that audience should be wandering out to the normal trains and buses which would bear them to their nor-

ABOUT THE AUTHORS

Mr. GIELGUD, besides being the B.B.C. Productions Director, is himself the author of several radio plays and successful books, including the thriller, "The Broken Men."

Mr. MARVELL, the recently appointed Director of Light Entertainment, is also a radio dramatist of repute, and is well known to listeners for his "Good-night, Vienna."

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mal homes; that they should be completely unconscious that "sudden death" (from which they prayed so regularly to be delivered) had struck within the very walls of the building in which they had watched a variety programme being radiated on the National wavelength.

V.

PECULIAR CONDUCT OF HIGGINS

TO Julian Caird's relief not even the general's abounding energy could withstand the effort of taking seven flights of stone stairs two at a time. On the fifth floor he was merely walking quickly, and on the sixth floor landing he even paused for a breather.

It was during that momentary check that there was a surprising interruption. Heavy boots clattered down the stairs from the seventh floor, and an elderly man in a brown overall, with his head ducked forward so that he could hardly see where he was going, bumped into the Controller and almost flattened him against the wall. Between shock and indignation the general was momentarily speechless. But Caird recognised the man as the studio attendant whom he had set on guard outside the door of 7C after the discovery of Parsons' body.

"What the devil are you doing here, Higgins?" he snapped. "Didn't I tell you to stay by the studio door?"

The man mumbled something apologetically. He was tall and weedy, with an untidy fair moustache and an unhealthily white face deeply lined. His pale eyes slid from side to side in their sockets like a cornered cat's.

"What's the meaning of this, Higgins?" rasped the general, recovering his breath. "Why have you disobeyed orders?"

Higgins did not answer; and Caird added sharply:

"Did you go into the studio?"

"No, sir, of course not," stammered Higgins. And for the first time looked his questioners in the face. "I'm sorry, sir. I didn't know it was important. I misunderstood you, Mr. Caird. I was off duty at the end of the play, and I've an important engagement. That's how it is."

"You must have understood," persisted Caird. "I was perfectly definite. You weren't to leave till I came back."

"I'm sure I'm very sorry."

"Well, it can't be helped," said the general testily. "Let's get on."

But Caird had remembered something.

"Just a minute, sir. There's something else. Look here, Higgins, you were on duty during the play, weren't you?"

The studio attendant nodded.

"Just exactly where?"

Higgins moistened his lips with his tongue.

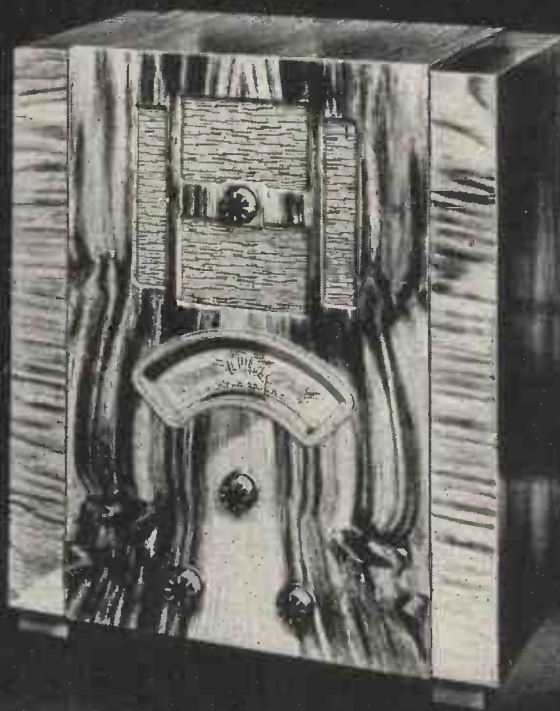
"I was at the north end of the studio corridor on the seventh floor, sir. On the door leading into the passage that takes you out of the tower."

"Why was that?" asked the general.

"I remember I asked Macdonald to put someone there," said Caird. "If that door's not watched you get people going through the tower corridor, using it as a short cut, during the transmission. We've often had trouble that way. It was essential in a complicated play like to-night's to keep the corridors clear. That's just what I was getting at. I had to go down to 6A from the Panel Room during the transmission because one of the return-lights failed. I went along the seventh floor studio corridor. Higgins wasn't on that door when I went through it. Where were you, Higgins?"

"I was on the door all through the transmission," said the studio attendant sullenly.

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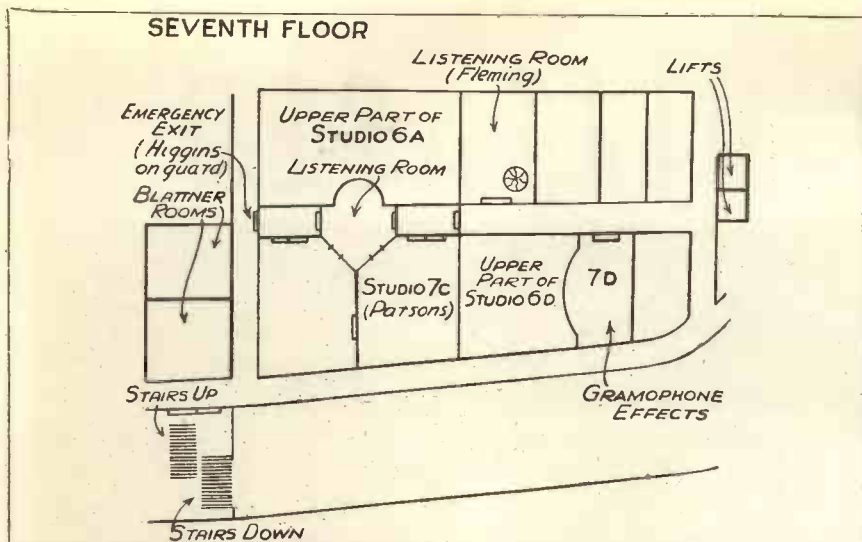
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"Damn it, Higgins, I've got eyes in my head!" began Caird angrily, but the general interrupted him.

"Now, Higgins," he said quietly. "Don't make things worse by lying. You've obviously been neglecting your duties this evening. This is a serious matter, and you may find yourself in a very awkward position if you aren't completely frank. Where were you when you should have been on duty at that door?"

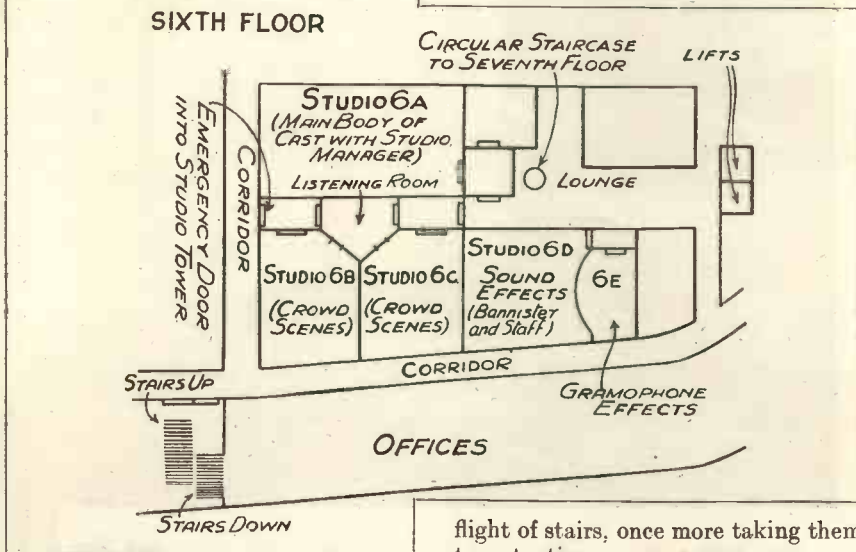
Higgins fidgeted miserably; and suddenly Caird was struck with an overwhelming feeling of pity for him. The man looked so ill and thin and miserable, facing the magnificently authoritative figure of the general. And he could have sworn there were tears in those shifty eyes.

For about thirty seconds longer, Higgins faced it out. Then his nerve failed him.

"I'll tell you, sir," he said. "I suppose you'll give me the sack, but I'd have got that anyhow, after to-night. It's a girl, sir. One of those girls who work in the canteen in the basement. We've been sweet on each other for some time, but it was coming to no good, what with me being married and everything. And yesterday she wrote me a letter and gave me the chuck. Well, it isn't easy for me to go down there, sir, as you know. I've no business in the basement, and the house superintendant had spoken to me about it, anyway. So I wrote her a note and asked her to come up and meet me in one of the offices on the seventh floor during the transmission to-night, while I was on duty. I gave her ten o'clock as the time in my note, and that was when I went to the office."

The general snorted. But Higgins went on hurriedly:

Ground plans of the studios on the sixth and seventh floors at Broadcasting House, showing Studio 7C where the body of Parsons was found and the Listening Room, where Rodney Fleming was waiting for his telephone call and watching the actors in Studio 6A.



"But she didn't come, sir. It's nothing to do with her. I swear she didn't come."

"Very proper of her," said the outraged general. "Well?"

"I waited as long as I dared, sir, till a minute before I knew the play ended, at twenty minutes past ten, and then I went back to the door. So I was there when Mr. Caird and Mr. Hancock came down from the Panel Room."

"That's true," said Caird. "He was clearing up oddments in the corridor, emptying ash-trays, and so on. That's why I told him to wait outside 7C till I got back."

"Did he know anything about the—" said the general, and then suddenly stopped.

"Not unless he went into the studio, sir."

The general gnawed his moustache. "We'll discuss your conduct later, Higgins," he said at last. "Caird, take him down to the house superintendent's office. See that he waits there and that there's somebody with him until we want him again. I expect the police will wish to have a word with him."

Higgins' jaw dropped.

"Did you say the—police, sir? I've not done nothing."

"I'm not saying you have," said the general. "I've no time to discuss it now. Take him down, Caird. I'm going up to 7C and will wait there."

"Very well, sir," said Caird. "If you don't mind, I'll come up by way of the 6th floor artistes' waiting-room. The Drydens, Rodney Fleming, MacDonald and Bannister are still waiting there."

"All right. Keep 'em there!" And the general bounded up the final

flight of stairs, once more taking them two at a time.

VI. MR. LEOPOLD DRYDEN IS ANNOYED

IT was a strange group that Caird found on his return to the waiting-room on the sixth floor. On the extreme end of the long, fawn-coloured couch sat the author of the play, Rodney Fleming, his expression a mixture of boredom and exasperation. He was smoking a cigarette and watching Leopold and Isabel Dryden under slightly lowered lids. Leopold Dryden was fretting up and down the narrow space between the couch and the wall. With his rather long fair hair in disorder and his magnificent

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SE 2118	700	3'0	V/mu steep slope S.G.	14/6
S 2018	400	1'2	S.G.H.F.-Det.	10/6
SE 2018	400	1'4	V/mu S.G.H.F.	10/6
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physique, his undoubted good looks seemed a little too theatrical to be quite genuine. He was acting a part with his usual brilliance—the part of the baffled temperamental artist. Isabel, his wife, sat next to Fleming, watching him closely. She was a very pretty girl, not more than twenty-six, with that unusually attractive combination of fair hair and dark brown eyes.

"I wish they'd let Leo go," she whispered anxiously to Fleming. "He's been so seedy all the evening, and he wasn't a bit himself even at dinner."

Meanwhile Dryden was delivering a speech *con brio* at the unresponsive head of Ian Macdonald, the studio manager. That impassive Scot, with a head that looked as if it had been carved out of teak, who had never

disreputable chorus girls, without so much as a by-your-leave? I appreciate your position, Mr. Macdonald. You have to do as you're told, but I have myself to think of—my standing and my reputation. Suppose this got about as a story! It might do me infinite harm. Perhaps now you'll be good enough to——"

"Oh, I'm so glad you've come, Julian," said Isabel, jumping up. "You mustn't mind Leo. But do let him go now, even if you want to keep me. I'm so afraid he's going to be ill."

"Nonsense!" said Dryden violently.

towards Caird, looking more leonine than ever.

"I won't stand for it," he almost shouted. "All this mystery-making and humbug! I only did your infernal broadcast to oblige Isabel. She made such a point of it. And you, too, Fleming, of course, as you were good enough to say you'd written the play for me. I've never believed in broadcasting for plays. I wish I'd never touched this one with the tongs. I'm not used to this kind of treatment, Caird, I tell you. If this is the way in which you're in the habit of treating artists——"

He broke off. Over Caird's shoulders he could see two men walking slowly along the passage towards them. The first was General Farquharson, looking very grim, and behind him was a lean individual in a dark blue serge suit, carrying a bowler hat.

They halted, and there was a moment's silence.

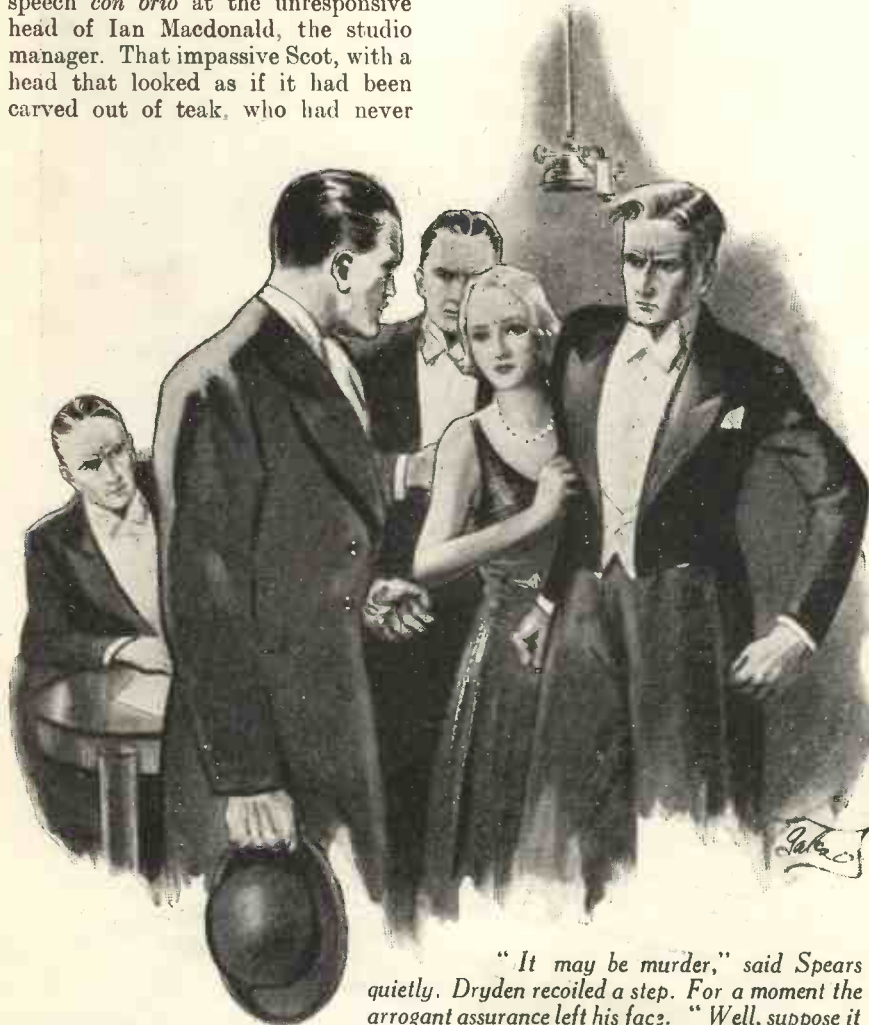
"I'm extraordinarily sorry that you should all have been inconvenienced," said the general gravely. "But it was unfortunately necessary that you should wait for the arrival of this gentleman. He has a few questions to ask all of you."

"And who the devil——" began Dryden.

"No, no, not quite as bad as that!" said the newcomer, putting down his bowler hat. "My name is Spears—Central Inspector Spears of Scotland Yard."

To Rodney Fleming, who thought of himself not only as a young man-about-town and a most promising author, but also as a student of human psychology, the reaction among the little group in the waiting-room to Inspector Spears' arrival was of absorbing interest. Even he himself, though he knew of the murder and had anticipated the appearance of the police, would have confessed to a tautening of his nerves when face to face with a representative of Scotland Yard.

Isabel Dryden put one hand to her breast and went so white that he was afraid she was going to faint; but Ian Macdonald only said, "I'm glad to see you, sir," in precisely the same way as he had been known on a former occasion to greet a dusky potentate paying a visit of inspection to the studios. It was a little disappointing that Leopold Dryden should so ostentatiously have taken the cue for his next "scene," for take it he did, with unexceptionable technique. He paused just long enough to allow Spears' introduction to "register" in the minds of the



"It may be murder," said Spears quietly. Dryden recoiled a step. For a moment the arrogant assurance left his face. "Well, suppose it is murder," he said. "Do you suggest that I or my wife have anything to do with it?"

been known to be disturbed by any crisis in the history of broadcast drama, gave the impression of listening with the greatest interest and sympathy.

"But I tell you it's an outrage," Dryden was declaiming as Caird came along the passage. "I insist upon some sort of explanation, at any rate. Are my wife and I to be kept here all night as if we were a couple of

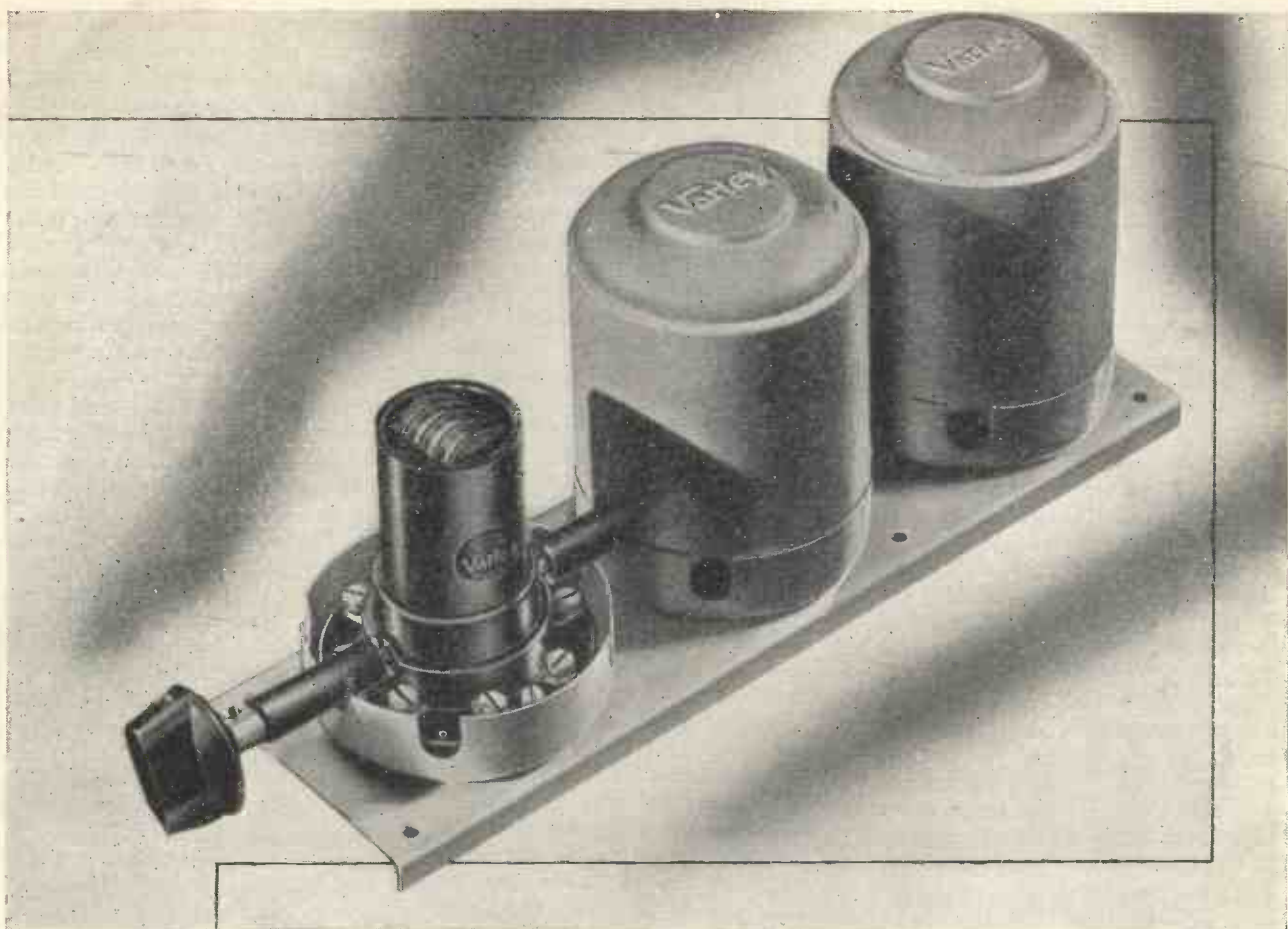
But his face twitched suddenly as if with a spasm of pain, and he sat down on the sofa.

"Can I tell them yet, Julian?" asked Rodney Fleming quietly from his corner.

"Tell us what?" said Isabel.

"Not just for a minute, please," said Caird. "We won't be long now."

Dryden got up again and strode



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others; then walked up to General Farquharson and looked him very straight in the eyes.

"Scotland Yard," he repeated witheringly. "Indeed. Most interesting. So I've been kept waiting about here to be questioned by the police, because some lady has mislaid her handbag, or a ten-shilling note is missing from the gentlemen's lavatory! Luckily, one of the Board of Governors of this Corporation is a member of my club. You've not heard the last of this, I can tell you."

The general did not blink an eyelash.

"Mr. Dryden," he said. "I have apologised to you for the inconvenience to which you have been put. You will realise the necessity for it, perhaps, when I add that a man, one of the company engaged in the play which you have just performed, met his death in one of the studios to-night."

Isabel stifled a little cry, and Fleming caught her sharply by the wrist.

"Steady, Isabel," he whispered.

But Leopold Dryden was not to be daunted or thrown out of his stride.

"Needless to say, I am more than distressed to hear of such a thing," he said, throwing back his head. "But it seems to me that you are doing your best here to turn tragedy into farce. Am I to understand that my wife and I have been kept to be questioned by the police because some poor devil has been unlucky enough to die on your premises?" His tone changed from indignation to deepest sarcasm. "Or perhaps you believe it to be a case of murder, and propose to arrest me on suspicion? Is that it?"

"It may be murder," said Spears quietly.

Dryden recoiled a step. For a moment the arrogant assurance left his face.

At that moment Isabel got up from the sofa, and put her hand through his arm. The touch of her fingers seemed to act upon him like the voice of a prompter, for he patted her hand and turned back almost fiercely to the detective.

"Well, suppose it *is* murder," he said. "Do you suggest that I or my wife have anything to do with it? Do you propose to question us at this time of night, just after a performance, when we are both dead-beat? I didn't know you'd been driven to fall back on third degree methods at Scotland Yard. I can tell you this, Inspector Spears, you've no right

whatsoever to detain us unless you choose to put us under arrest. And I don't imagine you're impudent enough or stupid enough to do that. I shall be glad to be at home to you to-morrow morning, if you call upon us at our flat, at a reasonable hour—I mean not before eleven o'clock in the morning. You'll find the address in the telephone book."

And holding Isabel's arm tightly within his own, he walked past the general and Spears along the passage to the lift without looking back.

"Should I hold them?" inquired Ian Macdonald impassively.

Spears shook his head.

"I think I'll let him cool off. There's plenty to see to here. I'd best get myself familiar with your box of tricks, Mr. Caird, and find how the land lies. I can do my questioning in the morning."

Rodney Fleming stood up and brushed cigarette ash off the lapels of his dinner-jacket.

"Then can I go home?" he inquired.

"If you don't mind, I'd like you and Mr. Caird with me," said Spears. "As I understand it, you were on two of the loose ends of this play, and I'd like to know how it looked from the various points of view. But, first of all, I'll go back to the studio where the body was found. They should have finished taking the photographs by now."

"Just as you like, inspector," said the general. "I'll leave you in charge, Caird. I think the inspector should see that man Higgins before he goes. I shall want you in my office first thing in the morning, before I see the Director-General. What a thing to have happened here! I can hardly believe it, even now. Good-night."

And he walked briskly down the corridor.

VII.

THE TORN SCRIPT

LIKE most busy men with only limited time for reading, Julian Caird was a great reader of detective stories. Brought up on "Raffles," "Arsène Lupin," "Sherlock Holmes," and "Trent's Last Case," he now devoured the exploits and debated the respective merits of Inspector French, Colonel Gore, and Lord Peter Wimsey. But somehow not all his familiarity with the fiction of crime had prepared him for the extraordinarily matter-of-fact methods with which Spears, his sergeant, his divisional surgeon, and a couple

of photographers dealt with what had once been Sidney Parsons.

Studio 7C, with its artificially padded walls, its uniform grey colour, was clearly appropriate for the setting of the scene. Leopold Dryden, thought Fleming, would have appreciated it. The only furnishing consisted of a sofa, three or four small metal and canvas chairs, a round black table on which stood a water carafe and a glass, and a microphone fixed head-high on a four-legged stand.

When Spears and his companions entered the studio the photographers were just packing up their apparatus. There was a strong smell of magnesium, and smoke was still curling about the ceiling. The body of Parsons lay where it had been found, almost under the microphone, but now it was decently covered with a rug. The sergeant stood by the little table, on which he was sorting out with deliberation the contents of the dead man's pockets. The divisional surgeon, a lantern-jawed individual with pince-nez, a shock of white hair, and quite astonishingly shiny trousers, was sitting on the sofa scribbling on the back of an envelope with a pencil.

"Hallo, Spears," he said, looking up. "You hardly need have bothered to spoil my beauty sleep for this. I suppose there'll have to be an autopsy as a matter of form, but the thing's clear as daylight."

"Well?" asked Spears.

The medical man peered at his pencilled scribble.

"Strangled from behind," he said. "The fellow who did the strangling wore gloves. I don't need you to tell me that, Spears. I'm sure there's not much argument about when he was killed—"

"We must have heard him die!" said Caird excitedly.

"No jumping to conclusions, please, Mr. Caird," said Spears reprovingly. "You *think* you heard him die in your play, don't you? Suppose he didn't play his death scene himself?"

"By Jove, that's an idea!" said Rodney Fleming.

"We don't *know* anything yet," said Spears. "I'm just looking for facts at present. How long's he been dead, Arbuthnot?"

"I've told you before, Spears," said the surgeon, "only fools pretend to answer that question accurately. But he's not been dead more than two hours, I can tell you that. He didn't take much killing, poor little brute

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Wretchedly under-nourished; poor physique; and the worst set of teeth I've seen for years."

"I knew Parsons was in rather a bad way," said Fleming. "I knew him slightly—recommended him to Caird for the part, because I knew he was so hard up."

"Thanks," said Spears. "You can tell me more about that later. Anything else, Arbuthnot?"

"I don't think so—nothing useful."

"Have you got your photographs?" asked Spears, turning to the other two men.

"Yes, sir."

"Very well. You can get along. Send the two men you will find in the hall up for the body. Now, sergeant, have you searched the studio?"

The detective-sergeant—Ring, by name—was a thin foxy-faced man, with bulging pale blue eyes and slim hands which looked as if they should have belonged to a pianist rather than to a policeman.

"You can see for yourself, sir," he said. "This room's as bare as a board. The carpet's too thick to take any impression, and whoever did this job knew too much to leave anything behind him. Here are the contents of the pockets, sir."

Spears walked over to the table, and as Caird watched the detective fingering dispassionately one little object after another, he was again conscious of that strange sense of the pathetic which had struck him when he and the general had confronted the studio attendant on the staircase. There was something indescribably wretched and forlorn about the little pile of coppers, the paper packet of ten cigarettes, three-quarters empty, the inevitable pawn-ticket, the soiled handkerchief, the three loose keys on a piece of knotted string, the chewed stump of pencil, and the shabby pigskin pocket-book, so obviously sole relic of very distant better days—containing a few grubby papers and a solitary ten-shilling note. Who on earth, thought Caird, could have found it in his heart to strike down such an insignificant weakling, an opponent so blatantly ill-equipped? What motive could there possibly be for the sudden throttling of a creature so patently set towards the Embankment and the doss-house? He turned to Fleming with a shiver.

"I suppose you find it interesting, Rodney?" he muttered. "But, personally, it gives me the creeps to see Spears fingering that poor devil's things as if he was choosing kidneys for breakfast."

"You've got a note of the contents of the pockets, sergeant?" said Spears.

"Yes, sir."

"Very well. What's this, Mr. Caird?" He held out a wad of typed sheets, tied together with tape at the top left-hand corner. There were about fifty sheets of this paper, which had something of the substance and feel of blotting-paper.

Caird raised his eyebrows.

"That's a script of the play," he said. "Our actors read their parts, you know. They don't have to learn 'em."

"It was lying just beside the body, sir," put in Sergeant Ring.

Spears sat with the script in his hands, staring at it.

"That's my play all right," said Rodney Fleming lightly. "There's the title on the outside page, and everything."

"Exactly," said Spears. "Perhaps you can tell me, Mr. Caird, if it is usual for your actors to mutilate their scripts?"

"Mutilate them? They scribble on them sometimes—make notes or cue marks in the margin. Why?"

Spears held out the script.

"Either Mr. Parsons or someone else," he said slowly, "has torn half the outside sheet of this away. It was torn in a hurry, for the edges are jagged. I wonder why?"

VIII.

INTRODUCES EVANS—AND THE BLATTNERPHONE

RATHER more than an hour later, when Caird and Fleming were almost reconciled to spending the rest of the night as initiators of the detective into the mysteries of Broadcasting House, Spears slipped an elastic band round his notebook and put it into his pocket.

"I won't bother you any more now, gentlemen," he said. "I think you've shown me about as much as I can absorb."

They had visited the D.C. room and studios; they had explored passages and examined mechanism, until Rodney Fleming for one was heartily sick and tired of the whole performance.

Now once more they were standing outside the door of Studio 7C.

"I'll begin my questioning of individuals as to their separate movements to-morrow morning," said Spears. "I'll begin with the Drydens, as they were good enough to give me an appointment. Perhaps I could see you two gentlemen after lunch?"

"I'll be quite free at half-past two," said Caird.

"Thank you, Mr. Caird. And perhaps Mr. Fleming will come along between three and half-past?"

Rodney Fleming nodded, and lit the last cigarette from his case.

"I suppose," Spears went on, "it wouldn't be possible for me to get something to eat? I was home late and got called out again before I could get at my supper."

"My dear inspector," said Fleming, "there's one advantage about having to detect crime in this sort of wholesale establishment. I doubt if you'll get champagne, but the canteen's excellent; I know it well."

"I'll tell you what," said Caird. "We don't want to go down to the canteen and eat under the eyes of a lot of Variety Artists waiting for an Empire transmission. We'll go into one of the Listening Halls and I'll have some coffee and sandwiches sent in to us."

The night-service lift dropped them to the basement floor, and Caird led the way into Listening Hall No. 1. Rodney Fleming threw himself into one of the deep armchairs with undisguised satisfaction. Spears stared about him, frankly bewildered by this queer room with its modern furniture and decoration, its lighting so self-consciously subdued, and its big loud-speaker raised on a platform in front of a carefully designed modernist scene indicating two blocks of skyscrapers and a stretch of river.

"Make yourself comfortable, inspector," said Caird. "This is where we put distinguished listeners, Press representatives and other swells, when we want them to hear our stuff as it really ought to sound. I'll go along to the canteen and order the food."

He turned right-handed along the passage towards the canteen, and stopped abruptly.

"Hallo, Evans!" he said. "What the deuce are you doing here at this time of night?"

"I happened to be working late," said Stewart Evans, without troubling to disguise the insolence in his voice.

He and Caird disliked each other heartily, and unfortunately Evans was one of Caird's departmental subordinates. He was older than Caird, and took few pains to conceal the fact that he had little respect for Caird's authority and none for his judgment. He was a tubby little man, already growing bald; undoubtedly clever; emphatically ambitious; but cursed with a record of failure in various lines of activity, all of which could be traced to his temperamental inability to get on

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1 TELSEN type No. 151 preset condenser (compression)	1	3	0
2 GRAHAM FARISH 50,000-ohm wire-wound potentiometer controls	9	0	0
2 T.C.C. type 50 .5-mfd. fixed condensers	4	8	0
1 T.C.C. type 54 .002-mfd. fixed condenser	1	6	0
1 T.C.C. type 54 .0005-mfd. fixed condenser	1	3	0
1 DUBILIER type 620 .01-mfd. fixed condenser	3	0	0
1 DUBILIER .0002-mfd. fixed condenser	1	3	0
1 DUBILIER .0003-mfd. fixed condenser	1	3	0
1 GRAHAM FARISH "Ohmite" 500-ohm resistance and holder	2	0	0
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3 W.B. 4-pin valve holders	2	6	0
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4 PETO-SCOTT wood strips for K4 framework	1	6	0
1 PETO-SCOTT ebonite panel, 18" x 7" ready drilled	6	6	0
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"Death at Broadcasting House."
—continued

with his fellow men. He belonged to a specialised section of Caird's department, whose members devoted themselves to the composition and production of programmes which did not come within any of the usual categories of drama, music, talks, and so forth. Members of Programme Research, as they were called, had considerable latitude in methods and hours of work. They were extremely valuable members of the Programme Branch, and were equivalently difficult as an administrative problem, as Caird, with whom departmental responsibility for their work lay, knew to his cost.

"I heard your play to-night," Evans went on. "I'll admit you can handle that stuff, Caird. But how you reconcile it with your conscience to put it on at all, beats me. Why the devil not give 'em East Lynne and have done with it?"

"My dear Evans," said Caird, "I don't want to be offensive, but sometimes—and particularly when I'm very tired, as I am now—I wish you'd mind your own business. I put on 'The Scarlet Highwayman' because I believe there are a lot of listeners who like it. But if it's any satisfaction to you, I wish to heaven I'd never touched the damned thing."

"Conscience pricking?" inquired Evans.

"Oh, rot!" snarled Caird. "You'll know all about it in the morning. What have you been working on? You aren't usually in the habit of burning this amount of midnight oil."

"I like to work in my office at night," said Evans. "The atmosphere's sympathetic. No telephone calls; no idiots coming in to ask me why I haven't initialled a lot of tomfool forms. I can get something done. Good-night, Caird."

And he trotted away.

Caird ordered some sandwiches and coffee, and went back to the Listening Hall. Rodney Fleming was lying back in his chair almost asleep. Spears was sitting very upright in a tubular steel chair, studying his notes.

"Food in a minute," said Caird, with a joviality he was far from feeling. "Hallo, Gerald. What is it?"

The door had burst open and a distracted looking young man in a dinner-jacket came into the Listening Hall.

"Hallo, Julian. I didn't know

you were staying up to hear the result of your efforts."

"What do you mean?" said Caird. "Oh, Rodney, this is Mr. Rylands, one of our Empire Service announcers—Mr. Fleming, and—er—Mr. Spears."

"All," said Rylands, "must be forgiven to the artistic temperament. We blattnerphoned the transmission of 'The Scarlet Highwayman' and we are transmitting it to the Empire in"—he glanced at his wrist-watch—"exactly seven minutes' time. I just wanted to see that the loud-speaker had been plugged-in in here. I must telephone to Control Room," and he vanished into the telephone-box in the corner of the Listening Hall.

Spears looked puzzled.

"Blattnerphone?" he said.

"Yes," said Caird slowly. "It's a way of recording a programme on a steel tape so that it can be re-transmitted. We have to do a good deal of it for Empire work."

"Re-transmitted?" repeated Spears. "Do you mean to say that—"

Rodney Fleming sat up.

"By Jove!"

"Of course," said Julian Caird. "I never thought of it. What a fool I am! I was only thinking how maddening it was that here you had a crime with almost any number of witnesses, and as none of them would have known it was a crime, their evidence wouldn't be an earthly. But as it is—"

Spears smacked his fist down on the desk in front of him.

"You mean you've got the play recorded?" he said, and even in his voice there was a thrill of excitement. "You mean we can hear that actual scene over again?"

"We can hear that scene," said Caird, "not only over again, but over and over and over again. As often as you like. I wonder if the murderer thought of that?"

(Next month's long instalment of "Death at Broadcasting House" will be no less exciting. Here is a sample:—

"... Almost furtively, Caird looked round at the faces. Which of them, he wondered, shared his own feeling of horror as they listened to this voice of a dead man—a man most of them had seen alive little over twenty-four hours ago, and whose corpse now lay on a mortuary slab...."

Don't miss next month's issue of MODERN WIRELESS, on sale November 1st.)

HOW TO BUILD THE K4

—continued from page 304

just as you like. The only point to observe is to see that you keep some sort of check to ensure accuracy, but this is a very obvious precaution. Probably the easiest way is just to work by Steps, as I did myself, wiring first the valve Step (No. 1), then the underside of No. 2, the top surface of No. 2, and finally the leads which run merely between the various Step surfaces.

In wiring up the valve holders, by the way, you will find that the filament leads do not run very straight from point to point, but must make their way round intervening obstacles. There is consequently no very great point in pulling them quite tight like the other leads in more important circuits. If a little slack is left in them they can be pushed down a little out of the way.

Only three leads call for holes to be bored in the wooden frame for them to pass through, and of these one (from '0005 condenser on top of Step 2 to '0003 underneath) has already been mentioned. The other two are those from the speaker terminals to the secondary terminals of the output choke. (I call them secondary terminals, by the way, because this component really acts as an auto-transformer.)

These leads need not actually be taken through holes, because they could be brought up round the edge of the Step nearest to the panel, but a somewhat neater appearance is obtained by drilling holes for them, so I did it. These connections, by the by, should not be made permanent until the right ratio which suits your particular speaker has been found by test, so just attach them temporarily to the choke terminals when first wiring up the set.

A point to which I would particularly direct the reader's attention concerns the earthing of the screening cases of the coil units and their wave-change switching rods and the ganging link. All this metal work must be properly connected to earth, and the way to do it is clearly shown on the construction chart wiring diagram. Note the connections to certain of the fixing screws of the coil units and the short flex lead to the connecting arm of the ganging link.

The important point here is to see that a really good connection is

(Continued on page 378)



JUST ANOTHER WAY OF SAYING -

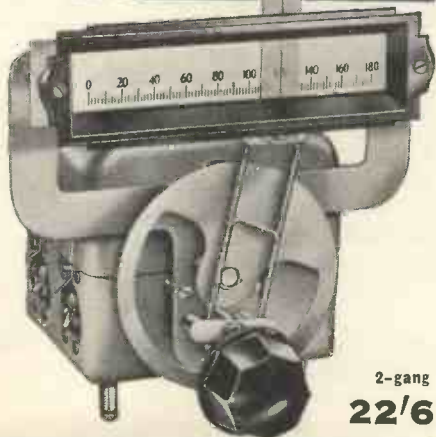
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Prices (with cover) 2-Gang .. 22/6
3-Gang .. 27/6



THE
NEW
"J.B."
LINATUNE
GANG



2-gang
22/6

PRECISION INSTRUMENTS

Advertisement of Jackson Bros. (London) Ltd., 72, St. Thomas Street
London, S.E.1. Telephone: HOp 1837.

Are you interested in

**MOTOR-CARS
AEROPLANES
INVENTIONS
HOBBIES?**

—Then you will most certainly revel in *Modern Boy!* For this is the paper for the youth of to-day, brimful of the things that interest you most, fascinating facts, absorbing articles and thrilling fiction—including adventure stories that will hold you spellbound and grip you every time. A clean, healthy paper that you'll read and enjoy from cover to cover. If you don't have it regularly, give yourself a treat and buy a copy to-day—it's the best two-pennyworth of all!

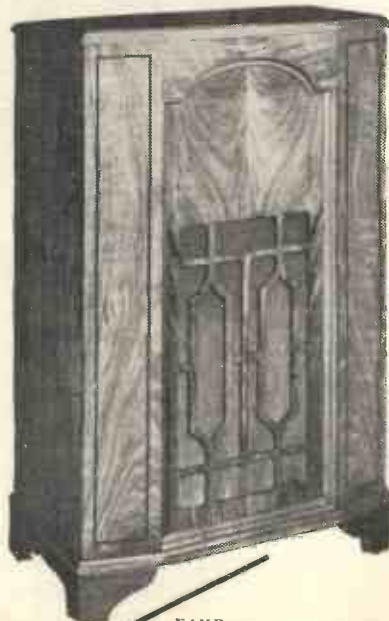
MODERN BOY

The Paper For the Boy of To-day.

2d.

Every Saturday

**A CABINET
MASTERPIECE!**



This new Camco Cabinet—The Oxford—is the result of years of practical experience in the design and manufacture of radio casework. It is designed on artistic lines to meet the present demand for improved radio cabinets. Suitable for housing Mains or Battery receivers, it is supplied finished in selected Walnut veneer. Price £3.17.6, complete with shelf, baffleboard and back.

See it at our Showrooms or send coupon for FREE copy of our new Cabinet Catalogue.
Carrington Manufacturing Co., Ltd. Showrooms: 24, Hatton Garden, London, E.C.1
Holborn 8202.
Works: 8, Croydon.



NAME

ADDRESS

M.W.14.

Post in 3d. envelope.

HOW TO BUILD THE K4

—continued from page 376.

obtained at each spot, and this means that you should carefully scrape away the enamel on the coil base around each place where a wire is to be connected. Note also that a piece of bare wire must be used for the lead which runs from a fixing screw of one unit to a fixing screw of the other one, because this lead passes under the lower edge of the screen and contact here is desired for the purpose of earthing the screen itself.

Perfectly Straightforward

All the rest of the wiring is perfectly plain sailing, and the constructor can go ahead with it by just following the construction chart preferably in conjunction with the verbal wiring instructions which I give in the pages of this article. The latter would really be sufficient without the diagram if gone through with just a little care, but the two together will be found to make everything very clear and easy to follow.

I should like to stress this fact a little, because the Step System is a new thing, and the form which the wiring diagram takes is naturally unfamiliar, hence the reader may at first glance be inclined to think it not so easy to follow as that of a set built on the older flat baseboard plan.

In actual fact it will be found that there is no such difficulty as soon as the new scheme becomes familiar, but to make quite sure that no one has the slightest trouble in following the connections I have added the "wiring in words" table.

Checking the Connections

I would suggest that a good method is to use the diagram to identify the particular wire, and then use the verbal key to check the exact connections which are concerned. In this way you will find all the leads become very easy to follow out, and if you cross out the reference letters of each in the table as you insert the wire in question, you will have a useful check on the completeness of the wiring when you have finished.

By the way, you will understand that the wiring chart is divided up into two parts merely for the sake of clarity. The actual wiring of the set contains all wires shown on either section of the diagram: the two sections have to be added together, so to speak.

I mentioned just now that certain screening cases require to be earthed, and it occurs to me that the reader may wonder whether it is by an oversight that no earthing connection is shown for the cases of the screened H.F. chokes and the screening of the anode lead of the S.G. valve.

This, as a matter of fact, is quite intentional, for such earthing was found to be quite unnecessary and served no useful purpose, so it was omitted. The anode lead of the S.G. valve, by the way, consists of a short piece of single flex, just long enough to reach to the top terminal of the valve, and encased in any of the usual metal screening materials. Great care must be taken to see that this screening material does not happen to touch the live terminal at either end, or it may cause slight instability instead of preventing it.

When the wiring has been completed as far as it possibly can be without the two terminal plates, which must not be fitted yet, the battery leads should be attached, and then the terminal plates can go on. You will see where the battery leads connect upon the diagram, but I should just explain that the H.T. negative lead is merely a short extension from the L.T. negative "spade" terminal, with the usual fuse plug fitted upon its end.

The L.T. Switch

Mr. Kendall likes his L.T. switches to go on upwards and off downwards. If you prefer the conventional arrangement, mount the switch the opposite way up. This makes no difference to the wiring.

In connection with the battery leads I must explain that the diagram makes no attempt to indicate suitable lengths for them, for the simple reason that this depends so much upon the kind of cabinet in which the set will ultimately be housed. For my own use I always make them quite short, because I like to have the batteries close up behind the set, where I can get at them easily for voltage adjustments, but those who use their sets under more domestic conditions will have different requirements.

With that I think I can leave the reader to get on with the building of his K4. I think he will get a pleasant surprise over the job, for I don't think he will be quite prepared for the extremely easy nature of the task, in spite of all I have said.

REFLECTIONS OF A RADIOTIC

—continued from page 346.

them unless Leo's tail became untied from his off hind leg, where it had been fixed so that he should not flick the studio furniture out of place.

Thoughts on Radiolympia

As I filtered my tortuous way through the other sardines on the opening day, one word constantly came to my mind: *Writtle*. Yes, *Writtle*, Essex, where was the first British broadcasting station, amateur stations not counted; the first studio complete with noise effects and uncles.

A far cry to this first-class London Show, packed with people, at which a radio trade employing hundreds of thousands collaborated with a huge Corporation numbering its clients by millions, at ten shillings a client.

The thought tempts me to commit one of the worst of journalistic sins by remarking that all this demonstrates that radio evidently *filled a long-felt want*. But I will not, because the Editor already wants to see me about a "*succulent bivalve*" and an "*it subsequently transpired*."

Our Way Best

This Show, though! Had it occurred in America the U.S.A. Press would have rioted in purple captions such as "*Radiocracy Return to Prosperity*"; "*Dial Bugs Hit Hay Happily After Huge Hear-feast*."

We, on the contrary, shall do our best to deprecate the whole matter, whilst bursting with satisfaction. I like our way, though. I've had too much fever in my time to hanker after fevered enthusiasm.

As Sam Pepys would have said, "*Lord, to see the women and the boys*." I began to wonder where papa was, till I bethought myself of the source of wealth, the City.

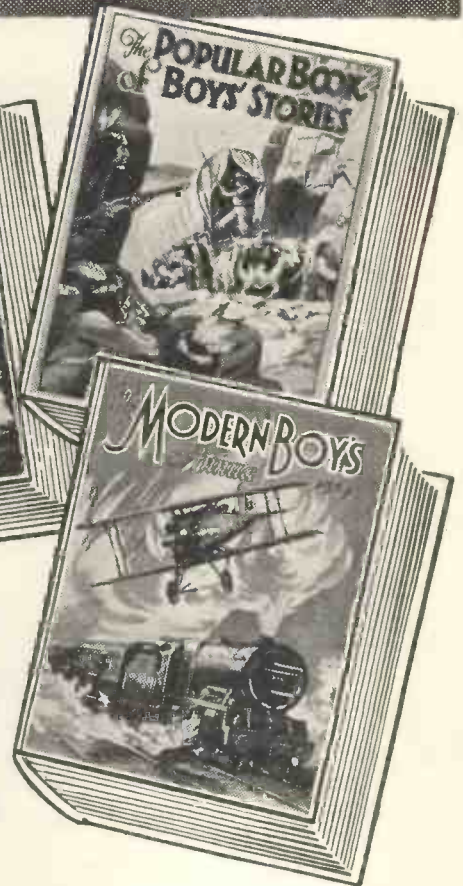
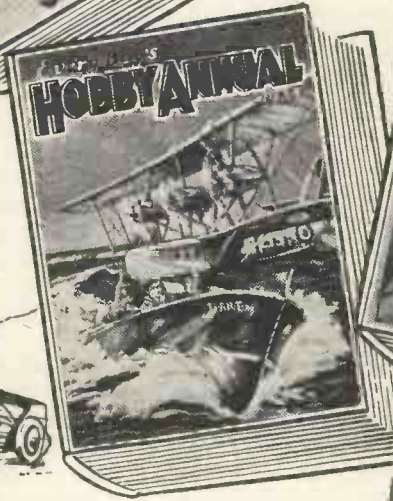
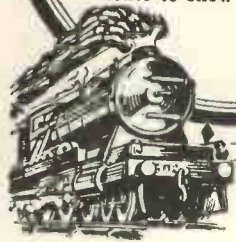
Earning the "Needful"

Papa was still there, in the dust and heat, earning the "needful" and hoping to get down to Olympia for an hour. Some idgit recently said that slavery did not exist in the Empire, too!

One last sinister reflection. Can the B.B.C. live up to the manifestations of the Show? That mighty surge of humanity needs and demands alimentionation from something greater than itself. Is the B.B.C. really greater than the British Public?

Wonderful GIFT BOOKS FOR BOYS

All these gift books are strongly bound in brightly coloured covers and contain features of interest to boys of all ages. They are splendidly illustrated with photographs and drawings, and some contain beautiful coloured plates. Ask your newsagent or bookseller to show you them all.



The World's Greatest Engineering Achievements

Here's a magnificent new Annual, which describes the wonderful romance of the world's greatest feats of engineering. Experts have written the intensely interesting articles which tell the fascinating story of Man's struggle with and conquest of the forces of Nature. This remarkable new book is crowded with hundreds of illustrations, photographs, drawings and four full-page colour plates.

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School and Adventure Tales For the Boy with a Hobby

Every boy will revel in the big budget of ripping school and adventure tales in the HOLIDAY ANNUAL. Here he can meet all the jolly school-boy characters of Greyfriars, St. Jim's, and Rookwood Schools, whose merry pranks cannot fail to entertain. There are lots of other interesting features, too, including pithy poems and puzzles, and four fine colour plates.

This splendid book is packed with brightly-written articles on practically every hobby and subject appealing to the boy of to-day. Every boy who is keen on making things and finding out how things work will want the HOBBY ANNUAL. It is profusely illustrated with hundreds of photographs and drawings that show "how" in the simplest way. There are also two large folding photogravure plates.

HOLIDAY ANNUAL 5/- HOBBY ANNUAL 6/-

Grand Stories of Gripping Adventure

The POPULAR BOOK OF BOYS' STORIES contains a magnificent collection of thrilling adventure stories that's too good to be missed. The 1934 edition of this famous annual has been enlarged to 192 pages of gripping mysteries, tales of the Wild West, and exciting stories of sport, etc. In fact, every phase of adventure is represented in this grand, all-fiction annual, which is splendidly illustrated.

POPULAR BOOK OF BOYS' STORIES 2/6

All About the Mechanical Marvels of To-day

The MODERN BOY'S ANNUAL is packed with fascinating articles on ships, aeroplanes, railways, racing cars and motor-cycles, the films, and other mechanical marvels of the modern world. What modern boy doesn't revel in reading about these fascinating subjects. There are also three complete adventure stories, two coloured plates and numerous photographs.

MODERN BOY'S ANNUAL 6/-

On Sale at all Newsagents and Booksellers.

AERIAL CIRCUIT SELECTIVITY

—continued from page 329

used in the experiments, the maximum strength of Daventry was 3. This reduction in strength from 21 to 3 is typical of the kind of reduction necessary to obtain the degree of selectivity demanded by modern reception conditions.

A similar series of observations on the medium-broadcast wavelength band, with North Regional as the powerful station, showed the same kind of results. The coil used consisted of 40 feet of No. 32 D.C.C. wire, and this coil was tuned by a .0003-mfd. variable condenser. The aerial-series condenser was variable and of .0001-mfd. maximum capacity.

More Serious Interference

With the aerial-series condenser at its maximum value, the "spread" of North Regional is shown by the figures given in Table 5. These figures are shown as a diagram in Fig. 5, and a tuning curve is drawn in the diagram. Interference was much more serious than in the case of the long-wave stations. North Regional made reception of Bero-

münster, Langenberg, Prague and Florence quite impossible. Stockholm and Vienna could be received with fair comfort, although North Regional was audible during the silent periods of these two stations. Munich was clear of North Regional, but the observations could not be continued at or beyond Belgrade's tuning, because Midland Regional came in.

At Half-Way Position

Next, the aerial-series condenser was put to its half-way position, the capacity being approximately .00005-mfd. The "spread" of North Regional is shown in Fig. 6, the actual strength figures being given in Table 6. There was a decided improvement in selectivity with the condenser at this setting. Although Langenberg and Prague were impossible, Beromünster and Florence could be heard with a fair degree of comfort, the interference from North Regional being there the whole time, of course. Rome and Vienna were quite good, the interference from North Regional being faint.

The aerial-series condenser was then turned to a setting of approximately .00025-mfd. Figures for the strength of North Regional are given in Table 7, and the figures are shown in the form of a diagram in Fig. 7. The

maximum strength of North Regional was reduced to 2, and even then, Langenberg and Prague were impossible, although there was only faint interference with Beromünster and Florence. To get this degree of selectivity, however, the maximum strength of North Regional had to be reduced from 23 (see Fig. 5) to 2 (see Fig. 7).

Summing up the results of the experiments now described, we arrive at an important conclusion. Where the aerial circuit of a wireless receiver is made to have, by means of an aerial-series condenser, the degree of selectivity demanded by modern reception conditions, that degree of selectivity is obtained at the expense of the strength of signals received in that aerial circuit.

Small Aerials Indicated

We, as listeners, cannot control the output of our broadcast stations and, if we could, it is doubtful if we should demand a return to the one-kilowatt transmitters of a few years ago. Hence, there remains the obvious suggestion that we should cease to erect large aerials of maximum efficiency and that, instead, we should content ourselves with small aerials which pick up far less strength and so give us a better chance to obtain selectivity.

"M.W.'s" RECORD REVIEW

—continued from page 352

results on Parlophone RO20223. Henley's *Invictus* is put over with great effect by Norman Allin on Columbia DB1157, with a splendid rendering of *The Blind Ploughman* to support it.

Pianoforte Performances

A new star has arisen in this sphere—Eileen Joyce, from Tasmania. Her childhood is so obscure that even her age is not accurately known, but her romantic upbringing and training has produced genius with as much emphasis as you care to give it. If you would know just how perfect and brilliant technique can become, hear her play two Concert Studies on Parlophone E11237.

One is Liszt's *F Minor* and the other De Schlozer's *A Flat Major*. The amazing facility leaves one gasping, but not only is this attribute so outstanding, but behind it, clear

and unmistakable, is that feeling which transfigures the performance into a thing of beauty. One may meet each separately; it is rare to find so glorious a blending of the two. Eileen Joyce will astonish you, just as she has astonished everybody who has heard her. *Please* hear this record.

TROUBLE TRACKING

—continued from page 351

assuming, of course, that the output is not Class B.

The grid-bias voltage should be checked over with a voltmeter, and the positions of the various plugs in the battery verified.

Too little grid bias increases the anode current consumption. A reversal of the grid-bias leads, so that positive is applied to the grid of the valve, will increase the anode current enormously; but such a fault is not likely to exist for long, because the valve itself would lose its emission.

Another possibility is that one of the by-passing condensers in the set has developed a leak, thus permitting a steady discharge to

earth. Those who are fortunate in possessing a milliammeter can easily test for a fault of this type by inserting the meter in the H.T.—lead, as if to measure the total anode current taken by the valves.

Then the valves should be pulled out of their holders, or, alternatively, the filaments switched off. In these circumstances no anode current should flow, and therefore the meter should not register. If the needle takes up a position along the scale, then this is proof that a leakage current is getting back to the earth line, and the various condensers can be disconnected, one by one, until the fault is found.

Due to Leakage

Readers will understand that when the valves are removed from their holders, or if the filaments are cold, such as they would be when the L.T. accumulator is disconnected at the on-and-off switch, any current which flows and causes the meter to take up a reading must be due to a leakage. Another possible source of leakage is a badly insulated lead which is allowed to rest upon a metal-covered baseboard or an earthed screen.

CHINA TAKES THE AIR!

The 75-kilowatt transmitter at Nanking is certain, in the opinion of A. Brown, to have an important influence on a civilisation which has been "frozen" for many centuries.

ONE of the principal disadvantages of being a Chinaman has been the impossibility of spending a really comfortable evening sitting cross-legged on the floor listening to the radio.

Floods, famine, civil war, and bandits—they are no more to a Chinaman than a rainy Saturday afternoon is to us. But imagine a rainy Saturday without a loud-speaker! And then you will realise why millions of Chinamen shouted "Hee-Pee-Poo-Ray!" when the big new broadcasting station at Nanking first said "Hallo, everybody!"—or, rather, the Chinese for it.

HOPES FOR PEACE

We may even hope that the programmes will be so good and begin so early in the morning that the generals will stay at home to listen-



A view taken from one of the masts of Nanking shows the Western style of architecture in the station buildings, with the broad valley of the Yangtze-kiang stretching away in the distance.

in instead of going out to do their day's fighting and that the bandits will settle down into amateur constructors.

As a matter of fact, Nanking is not the first broadcasting station in China. There have been a few low-powered stations with an input of 1 or 2 kw., but they have been scattered over a densely populated country nearly half the size of Europe.

MODERN PLANT

The history of broadcasting in China may be said to have begun with the opening of the Nanking station, which, with its 75 kw., will compare for range with Mühlacker or Breslau. That means that the majority of those 400 million Chinamen will be able to tune-in to their favourite announcer, and over a hundred million Chinese kiddies will smile gravely and politely at the honourable Uncle Ting and the honourable Auntie Sang.

The new station is up to date in both buildings and equipment.

The station develops its own power by means of a four-stroke Diesel motor of 600 horse-power coupled direct to an alternating-current generator. This generating plant is housed in the first of the three buildings. In another building are the transmitter, transformers, and switchboard.

PROGRAMME POSSIBILITIES

The transmitter is a quartz-controlled, seven-stage Telefunken valve transmitter with a modulated aerial output power of 75 kw. and a 70 per cent depth of modulation. The aerial system consists of two self-supporting masts 120 metres high, with a five-wire T aerial. The distance between the masts is about 250 metres.

The working wavelength is 440 metres. It is interesting to note that by means of supplementary apparatus the transmitter can be used also for radio telegraph work.

One wonders how the programmes of the Nanking station will be developed. Will they consist of those monotonous, high-pitched songs which some of us have heard on Chinese gramophone records? Or will the younger generation of Chinese listeners demand Western jazz?

Will the Nanking Director of Programmes follow the example of the B.B.C. and develop a special tech-



Five members of the native technical staff very proud of their station, which is the most powerful in China.

nique of radio drama? His problem will be somewhat similar to that encountered here in the broadcasting of music-hall performances, for Chinese plays consist mainly of interminable speeches which depend for their interest upon the accompanying dramatic gestures and posturings of the actors.

A NEW ERA DAWNS

One may guess that the new Nanking station will lead to the Westernisation of Chinese taste in music, drama, and entertainment generally.

The civilisation which has been frozen for thousands of years into traditional forms is bound to be profoundly affected by the cosmopolitan influence of broadcasting. Those millions of Chinese are on the threshold of a tremendous adventure.

THE DEMAND FOR "PLATE-LESS" ACCUMULATORS

In order to produce sufficiently large supplies, Messrs. Block Batteries, Ltd., have had to open the new factory mentioned in these notes describing the construction of their unique batteries.

THAT the interest in battery-driven receivers has not diminished, and the ability to meet big demands have surely both been demonstrated by Block Batteries, Ltd.

The demand for Block plate-less accumulators since their innovation only a few months ago has already outstripped the capacity of the original factory, and recently new works were opened at Barking, Essex, to cope with the situation.

The output from this new plant when in full swing will be considerable, but it was confidently predicted by the Managing Director of Block Batteries that the venture was but a preliminary to even greater undertakings.

The revolution in battery design represented by the "plate-less" type is the culmination of a search for a perfect battery continued through three generations of Fullers, finally perfected and patented by Mr.

Leonard Fuller, now Chairman of Block Batteries, Ltd.

In the new accumulator the active materials are so put together that they need no grid leads, glass case, etc., for support, the cylindrical negative electrode, with its bakelite "skin," itself holding together the entire battery.

The positive is a central core of paste formed solid with the electrode by a patented process.

Even Discharge

This circular grid-less formation compels an even discharge throughout the active paste, ensuring that no "buckling" can occur. In relation to size and weight almost double the ampere-hour capacity is obtained. Moreover, no "leakage" discharge can occur when the accumulator is off load.

The principles of the L.T. accumulator have been applied with equal success to the Block H.T. batteries.

In the manufacture of these batteries various specialised processes are involved and the machinery employed is naturally costly. In spite of these facts, Block Batteries, Ltd., are marketing L.T. and H.T. accumulators at prices which are to be commended.

WHAT ARE WAVES?

—continued from page 332

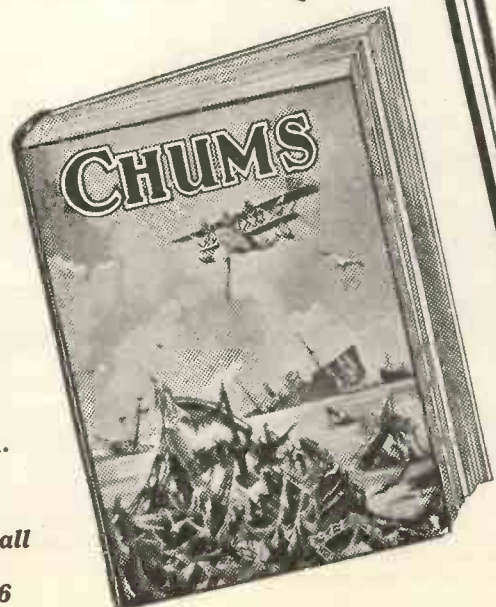
Wonderful pictures are obtained when inserting into the liquid an elliptic profile and causing the waves to start from one of its foci. The reflected waves then seem to start from the second focus, both trains being circular (Fig. 5).

Any other phenomena characteristic of the behaviour of waves may be illustrated similarly, e.g. the way they are diffracted around a narrow opening, their refraction on passing from water into mercury, etc. (Fig. 6).

Charbon's "Ondoscope," as already suggested, may as well be used in solving all sorts of problems, e.g. ascertaining the most advantageous form (from an acoustic point of view) of loudspeakers, the acoustic conditions of halls, wireless studios, etc.

CHUMS ANNUAL is a regular book for a regular fellow. It contains over 700 pages of gripping fiction and articles. And its pictures—there are hundreds of them, and all first-class—so are its beautiful coloured plates. **CHUMS ANNUAL** is good—boys will never tire of reading it. If you're in doubt what to give this year, the problem is easily solved if you get this splendid gift book.

A REGULAR BOOK for a REGULAR FELLOW!



Now on Sale at all Bookstalls and Newsagents, 12/6

SCOPHONY TELEVISION
—continued from page 336

Mr. Walton has been able to design various optical systems to produce the effect he desires. In one arrangement he uses an "echelon" mirror, that is, a mirror in which the surface is broken up into a number of steps, each "step" reflects a corresponding strip of the original picture, and throws it into one straight line with the strips reflected from the other steps.

The Transmitting End

In another arrangement the stepped mirror is replaced by a complex lens having various angles of refraction, so that a picture focused on one surface emerges from the opposite surface as a single straight line.

At the transmitting end the picture is first automatically converted into a single "line" of varying light and shade values in the manner already described, by a stationary "stepped" mirror or by special lenses. In this form it is scanned by a second small vibrating mirror, which is the only moving element in the system.

In reception the process is reversed. The incoming signals when applied to the neon lamp cause it to "flicker" continuously. The flickers are then thrown on to a special mirror or lens system, which automatically transforms them into a two-dimensional shape and so reproduces the original picture on the viewing-screen.

Vest-Pocket Scanner

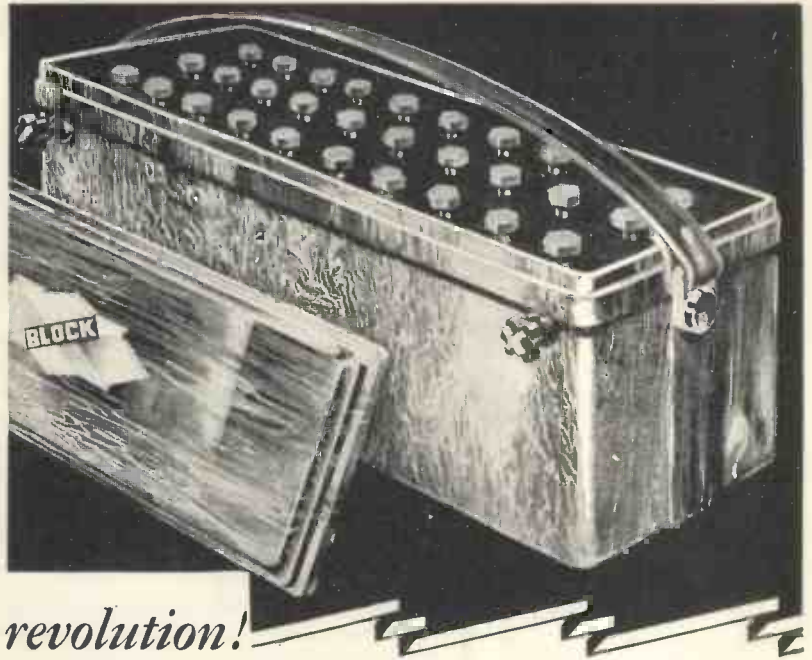
The advantage of the system lies in getting rid of the usual rotating-disc scanner—which must necessarily be far larger in size than the picture to be reproduced—and replacing it by a comparatively small and easily-controlled vibrating mirror.

For instance, the moving mirror used in the Scophony receiver is so small that it can be carried in one's waistcoat pocket, whilst the driving motor used to operate it consumes only a small fraction of a watt.

GOOD NEWS FOR CONSTRUCTORS

A guarantee of performance and a real after-sales service will be the principal features of the new "Ace" sealed kits which Messrs. Marcus, Overton Radio Ltd. are now producing. Kits of parts and accessories of all MODERN WIRELESS receivers will be available, and Mr. Marcus, who has for many years been connected with the home constructor's interests, will be personally responsible for the prompt despatch of every order. Only the highest quality components will be used in these new "Ace" kits.

The address of the new firm, to which inquiries may be sent, is 62, Borough High Street, London, S.E.1.



revolution!

Now★

You CAN GIVE UP
dry battery

MANCHESTER
STAND
54

EXPENSE



PLATE-LESS-NESS REMOVES ALL OBJECTIONS TO H.T. ACCUMULATORS



Double capacity
L.T. 80 a.h. **11/6**
2 v.

1. YOU endured the constant expense of dry batteries — because H.T. accumulators were so unwieldy. Or perhaps you put up with the existing type of accumulator ?

2. To-day there is no need for either. The invention of the Block plate-less cell, with its double capacity, permits a H.T. accumulator that is half the usual bulk—60 v., 5,000 m.a.h. from a coloured bakelite casket hardly bigger than a dry battery !

3. Give up the old expense, the old nuisance. Give yourself the economy (and comfort) of H.T. in its modern, most perfect, cheapest form.

This Block L.T. accumulator is no bigger than an ordinary 40 a.h. type, yet lasts twice as long per charge! As in all Block cells, its cylindrical negative is also the cell's container, the positive being a central column. No grids needed, therefore more "active material" and less weight; also its circular form ensures far more thorough action.

60 v. 5000 m.a.h. 14 $\frac{3}{8}$ " x 4 $\frac{5}{8}$ " x 5 $\frac{1}{4}$ " lid. **37/6**
Weight 16 lbs.

30 v. 5000 m.a.h. 8-3/16" x 4 $\frac{5}{8}$ " x 5 $\frac{1}{4}$ " lid. **21/=**
Weight 8 lbs.



Block Batter'es Ltd., Abbey Rd., Barking, Essex. Tel: Grangerwood 334617



**Here's the
NEW 1934
Handbook!**

New blue-prints and circuits for the construction of Mains Units, Battery Chargers, and Units for energising low voltage M.C. speakers. Helpful hints and technical data for those interested in mains working. Complete details of the wide range of mains units, transformers, chokes, battery chargers, amplifiers and condensers manufactured by Heyberd—the Mains Specialists! All completely revised and up to date. Fill in the coupon below and send with 3d. stamps for your copy **NOW!**

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One minute from Moorgate Und. Sta.

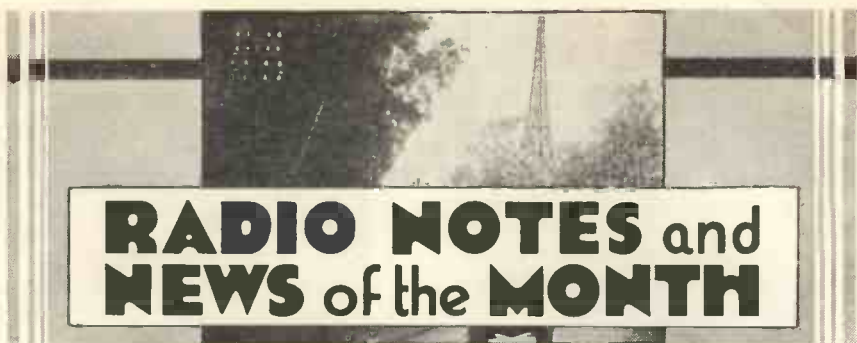
HAVE YOU HAD?
particulars of the famous
"Magnum" Short Wave Adaptor,

which is now available for every type of receiver? Full particulars, with a list of short-wave stations and free trial offer, on request.

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296, Borough High St., London, S.E.1.

ADVERTISEMENTS

As far as possible all advertisements appearing in "Modern Wireless" are subject to careful scrutiny before publication, but should any reader experience delay or difficulty in getting orders fulfilled, or should the goods supplied not be as advertised, information should be sent to the Advertisement Manager, "Modern Wireless," 4, Ludgate Circus London, E.C.4.



**RADIO NOTES and
NEWS of the MONTH**

THE Public Affairs Institute in New York has formed a committee on international broadcasting under the chairmanship of Dr. Nicholas Murray Butler, President of the Columbia Broadcasting System which controls ninety-two stations in the United States.

Members of the Committee include the Marquis of Lothian and Sir Evelyn Wrench.

The Committee will aim at providing an intelligently-planned interchange of ideas throughout the world via the medium of trans-oceanic broadcasting.

Linking the World

It also plans to form world-wide links between persons prominent in European, American, and Asiatic affairs by means of broadcast talks, debates, etc., and it is hoped that the collaboration of broadcasting companies in all three continents will be obtained.

Autumn Talks

Among the new autumn talks will be an ambitious series under the title of "Taking Stock." Various speakers will survey a whole range of British achievements in literature and art, Government, social services, and industrial resources.

Describing His Experiences

Mr. S. P. B. Mais will travel from end to end of the United States, starting at Jamestown and travelling via San Francisco and back to New York. Each week a talk by Mr. Mais describing his experiences will be relayed across the Atlantic.

The Scottish Exhibition

This year's Radio Exhibition at the Kelvin Hall, Glasgow, was the most successful of its kind ever held in Scotland. During its eight days, nearly 80,000 people visited the Exhibition, and orders have been booked which will keep manufacturers and dealers busy for many months ahead.

Wireless or Radio?

A correspondent to the "Northern Dispatch" asks why the stupid and meaningless term of "wireless" as used for broadcasting is not entirely discarded in favour of the vastly more suitable word "radio."

This particular correspondent thinks that wireless seems particularly inappropriate as there are probably more wires used in this than any other modern invention; whilst "radio" is a much more descriptive term, shorter, nicer-sounding, and—last but by no means least—accurate.

Unique Tribute to "A.T.B."

Six months after its exclusive introduction to home constructors in "Popular Wireless" and MODERN WIRELESS, Automatic Tone Balance has been acquired by Marconi's Wireless Telegraph Co., Ltd.

This tribute to the importance and originality of "A.T.B." emphasises once again the service rendered to the home-constructor public by these two journals.

"A.T.B.," the invention of Mr. G. V. Dowding, Associate I.E.E., our Technical Editor, was created especially for "P.W." and "M.W." home

(Continued on page 385)

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RADIO NOTES AND NEWS OF THE MONTH
—continued from page 384

constructor set designs, and the fact that the patent is now to be included in the British Licensing Pool after having been purchased for a considerable sum of money, is, we believe, an event without parallel in radio journalism.

A Russian Giant

There seems to be no doubt to-day that the most powerful station in the European ether is Moscow, for the new 500-kilowatt transmitter, when operating on the long waves, can be heard clearly in London, even in daylight.

It is said that its tremendous increase in power will make it audible throughout practically the whole of Europe.

Another Power Increase

Plans are being made for increasing to 120 kilowatt the present 8-kilowatt station known as P.T.T. Paris. Although the studio will be in Paris itself, the new transmitter will be erected in a suburb some twelve miles away. When the new station is on the air in the middle of next year it will probably have cost somewhere about £1,000,000 to construct.

Absolutely Soundproof

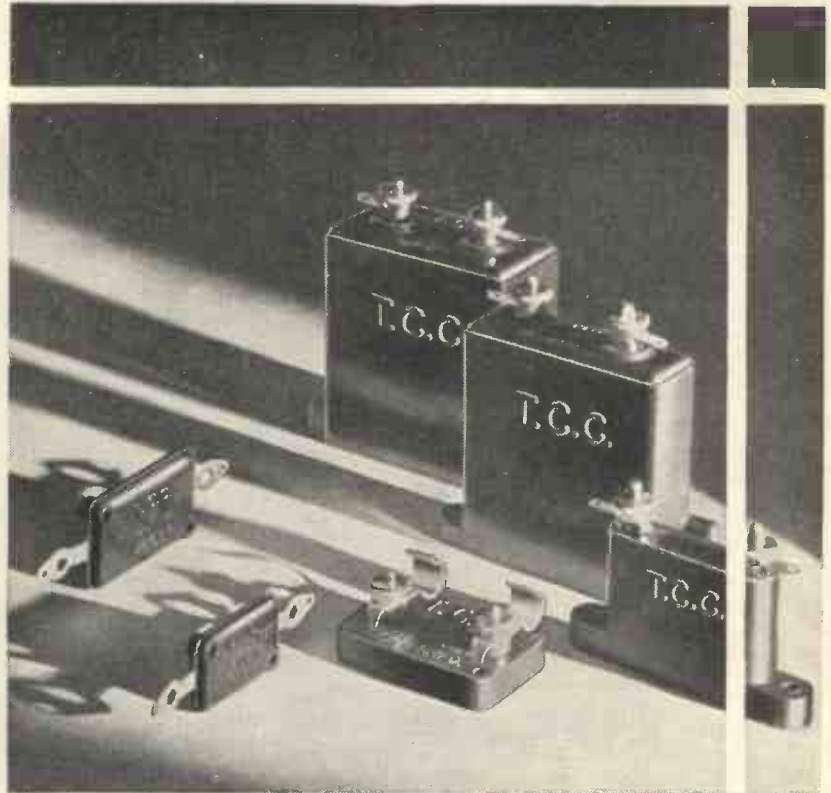
The B.B.C. has made arrangements to use the largest of the H.M.V. studios at St. John's Wood for a series of orchestral concerts. Anybody passing by this studio, however, need not expect to hear the London Symphony Orchestra, either practising or when it is broadcasting, for the walls of the studio are over fourteen inches thick.

No Letter Box!

The Radio Correspondent of the "News Chronicle" let loose to an astounded world the other day the fact that there is no letter-box in the B.B.C.'s headquarters at Portland Place. It appears the other morning a holiday relief postman paid his first visit to Broadcasting House with a nice big bundle of letters, and for some minutes stood scratching the back of his head trying to find out where to put them.

It is rather amazing that the £1,000,000 headquarters of British broadcasting has not got a letter-box!

(Continued on page 386)



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RADIO NOTES AND NEWS OF THE MONTH
 —continued from page 385

With Lawrence of Arabia

Colonel Dawnay, the new Controller of Output at the B.B.C., who recently took up his duties, has had a distinguished career, and while in the Army he was associated with the famous Lawrence of Arabia. It is said that Lawrence once remarked, "I would sooner have Dawnay with me than a thousand camels."

Let's hope the B.B.C. staff eventually agree that Colonel Lawrence was right!

Mr. Roger Eckersley

Mr. Roger Eckersley, who has hitherto been known as Director of Programmes, has had his title changed and will be known in future as Director of Entertainments. His new title means that he will concentrate on lighter programmes, and will be responsible for this section to Colonel Dawnay.

Besides Mr. Roger Eckersley, there are also a Director of Variety, a Director of Light Entertainment, and a Director of Radio Productions.

Broadcasting Politics

Sir Austen Chamberlain, Mr. Lloyd George, and Mr. Winston Churchill recently addressed a joint letter to Mr. J. H. Whitley, the Chairman of the B.B.C., on the question of the broadcasting of political addresses. The three distinguished politicians protest that the exclusion from the list of political speakers of all but speakers nominated by the Party Leaders or Party Whips denies fair expression to independent and non-official views, and they ask for independent speakers to be added to the list.

Mr. Whitley's Reply

Mr. Whitley, in his reply, stated that while the B.B.C. had no desire to curtail freedom of speech, it could not guarantee that all shades of opinion could be given in any series.

This led to another letter from Sir Austen Chamberlain, Mr. Lloyd George, and Mr. Churchill, in which they regretted to receive Mr. Whitley's refusal of their request and expressed the opinion that a precedent had been established by the effective exclusion, from the point of view of broadcasting, of all persons not nominated by the Party Leaders or Party Whips.

Divided Opinions

This controversy seems to have raised a considerable amount of argument. Some newspapers side with the B.B.C. and some with Sir Austen Chamberlain, Mr. Lloyd George, and Mr. Churchill; but despite all the arguments and the brickbats which have been thrown, nobody seems to have raised the question as to whether the average listener wants to hear these leading lights of politics one way or the other.

After all, perhaps one day somebody will wake up to the fact that the B.B.C. is an institution supported by public money, and that however admirable Sir John Reith's dictum may be in theory—that the public must not expect what it wants—inevitably the B.B.C. will find that the public will demand and get what it wants. If it wants to hear Sir Austen Chamberlain, Mr. Churchill, and Mr. Lloyd George, they will be heard!

How Many Are There?

We have often asked the question in these columns: How many people are there to-day who have television sets, and who really make a habit of looking-in to the B.B.C.'s television broadcasts?

Guesses have been made from time to time, some people saying that there are at least 50,000 television sets in use in Great Britain alone; but, despite repeated invitations to the Baird Company, and to others concerned, we have never yet received an authoritative answer to the question.

On What Authority?

The "Sunday Dispatch" reported the other day that there are 3,000 people in the British Isles now conducting television research work of an extensive nature. What is the authority for this statement?

Television in Germany

German scientists are also concentrating on the television problem, and at the recent German Wireless Exhibition, in Berlin, images of 40,000 "picture points" and 180 lines deep were shown. It is even reported that the engineers at the Witzleben station hope very soon to be able to reach this high standard for general transmission purposes.

A Queer Charge!

Three high officials of the old Reich Broadcasting Company—Dr. Magnus and two colleagues—were recently taken to a concentration

(Continued on page 387)

RADIO NOTES AND NEWS OF THE MONTH
—continued from page 386

camp near Berlin. They were charged, among other things, with accepting excessively high salaries!

They have now been removed to a prison on a further charge of committing a breach of trust while in office. It is also declared that the corruption alleged in Berlin broadcasting circles is to be found in Leipzig, Breslau, and Cologne.

Charming and Capable

Some two years ago we met Dr. Magnus in Berlin, and found him a very charming and extraordinarily capable man. It is hard to believe that these far-fetched charges will be proved against a man of his type.

Herr Dr. Schaffer

Whilst in Berlin we also had an opportunity of meeting the late Herr Dr. Schaffer, who was, of course, the

France's Plans

France is out to have the most powerful wireless system in Europe. The French Minister of Posts and Telegraphs recently gave an indication of the rather grandiose plans France has in mind—plans which, if put into effect, would cost the nice little sum of £10,000,000.

A B.B.C. Rumour

A recent rumour concerning re-organisation at Broadcasting House has it that Colonel Dawnay is looking into the question of B.B.C. employees devoting their time to writing plays, lyrics, music, etc., for the microphone.

It is said that this practice has got to cease, and that full-time employees must concentrate all their ideas and energies on their regular jobs.

This will be rather a pity, for there is no doubt that some of the regular employees at Broadcasting House have been responsible for many of the best programme items. For example, Holt Marvell, who is, of course, Eric Maschwitz in real life (the B.B.C. Director of Variety), has written

ORDER YOUR NOVEMBER "MODERN WIRELESS" NOW

There will be further long articles about G. P. Kendall's Great New Set next month.

And more chapters of "Death at Broadcasting House." Also we are presenting a comprehensive guide to the **VALVES OF 1934**

in which all modern valves, including the many new special types, will be interestingly and informatively described.

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brilliant Chief Engineer at Berlin Broadcasting headquarters. Dr. Schaffer was a Jew, and a few months ago our readers will remember seeing in the Press that, on being deprived of his position of Chief Engineer, and because he was so worried by the persecution of his race, he committed suicide.

American Influence

The French Wireless Exhibition, which was held recently in Paris, showed the remarkable influence of American design. The French manufacturers have been badly bitten by the superheterodyne bug, and hardly a single French set of any importance used a straight circuit. Five- and seven-valve sets ranged in price from about Frs. 1,400 to Frs. 2,500 (£17 to £31 approx).

many good things for the microphone, including "Good-night, Vienna"; whilst "Red Tabs," one of the best of all broadcast plays, was written by Val Gielgud, the present Director of Dramatic Productions.

Good Material Essential

Should this creative output be stifled because some of the successful writers for the microphone happen to be employees of the B.B.C.? One would have thought that Colonel Dawnay would have been only too anxious to get good microphone material, even if it was contributed by the office boy. Heaven knows, good programme material is hard enough to come by, without unnecessarily restricting the creative output of the staff at Broadcasting House.

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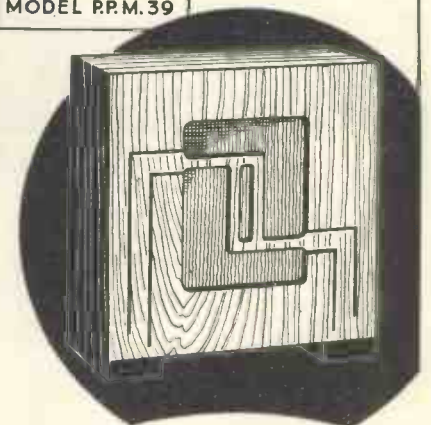
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THE FOREMOST NAME IN SOUND REPRODUCTION

**THE PICK-UP
IN PRACTICE**

—continued from page 342

detector. Two valves are ample for the majority of pick-ups.

The achieving of apparent stability does not necessarily mean that good quality is assured. There is a condition where, although there is no squealing, L.F. retroaction is occurring and causing severe distortion.

The need for good decoupling assumes vital proportions in pick-up work, and any shortcomings in this direction are almost certain to cause trouble.

I like a radiogram to be decoupled "up to the eyebrows," every anode circuit on the L.F. side (including the detector) having its separate decoupling circuit.

NEXT MONTH

**MORE ABOUT
THE K4**

and another long instalment of

"DEATH AT BROADCASTING HOUSE"

Amateur record results at their best seldom quite equal good radio results, and so it is very important to remove any distortion-causing obstacles in the set.

Here is one thing that is often done but which can easily be avoided: a volume control is wired up so that it imposes a varying resistance on the pick-up. Which means to say that, as the volume is varied, so the pick-up tone is altered.

There is definitely a right and a wrong way of connecting up a pick-up volume control. And the right way is so that the resistance across the pick-up does not alter.

It may or may not be widely known

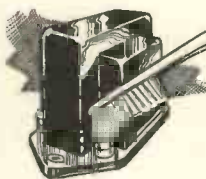
that pick-up makers commonly design their instruments to give certain results when a specific value of resistance is connected across them. That is why it is desirable to purchase a pick-up either with a built-in volume control, or to adhere to the maker's specification regarding it, though, generally speaking, the values are fairly standard.

Anyway, this is practical proof of the incorrectness of connecting a pick-up, as in Fig. 1.

FOR CONSTRUCTORS

Details of a convenient dusting-brush and useful dial-light scheme.

CONSTRUCTORS who utilise old parts when rebuilding receivers are very often confronted with the difficulty of removing dust from behind the terminals of components. This dust is likely to cause crackling and similar noises if allowed to remain.



A simple method of avoiding this is to make use of an old toothbrush, which will be found useful for dusting both the terminals and the mouldings.

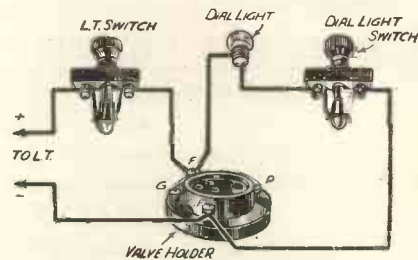
Double Switching

The advantages and attractions of illuminated tuning dials are many, but with battery receivers the question of economy of low-tension current

has to be considered. The usual solution is for an on-off switch to be provided so that the lights can be turned on and off independently of the set's on-off switch.

The drawbacks to this scheme are that two switches have to be in the off position when the set is turned off, and also the possibility that the dial-lights might be left burning when the set was not operating.

Both these are avoided if the connections are made as in the diagram. No current can pass through the dial-lights when the set is switched off, but the lights can be extinguished independently of the turning-off of the set.



The dial-light cannot get left on

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