POPULAR WIRELESS, July 31st, 1937. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

HOW THE B.B.C. REBUILDS HISTORY

Popular Wireless & Television Times

MARCONI—THE MAN AND HIS WIRELESS
Authorised Life-Story
Appearing Exclusively in "P.W."

EVERY WEDNESDAY PRICE 3D

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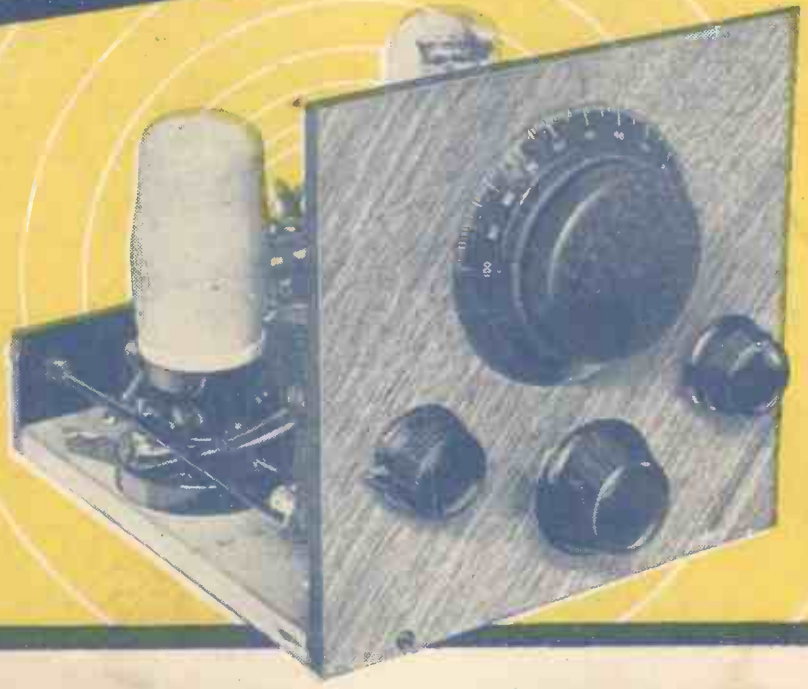
AN ALL-WAVE "MIDGET"!



The All-Wave "Midget," full constructional details of which appear inside, is a highly efficient two-valve set covering from 19-48 metres on the short waves as well as the usual medium and long wavebands. There is no coil-changing, and it is a set that anyone can operate.

ALSO THIS WEEK:—

LATEST TELEVISION NEWS :: SPECIAL SHORT-WAVE FEATURES

Editor: G. V. Dowding Asst. Editors: A. Johnson-Randall, A. S. Clark

MODERN BABEL
DEPRESSIONS
THEY SAID IT

RADIO NOTES & NEWS

PERSONALIA
PEN-PALS ABROAD
JUST DROPPED IN

Coming Events.....

DESPITE our natural preoccupation with holidays and other flim-flam we must soon face the fact that summer won't last much longer, and the annual Wireless Exhibition at Olympia, London, W. is getting mighty close. It opens on August 25th, and runs till September 4th.

The trade expects to spend about £50,000 on the Show this year, and the attractions will include a radio museum to remind us of the progress we have made, and to show us once again the awful old junk that we used to think so wonderful.

The financial experts expect that about £20,000,000 worth of business will follow this year's Show, and it is confidently predicted that 2,000,000 sets will be sold —600,000 to new customers and the rest replacements.

Television at Olympia

INSTEAD of arranging for only two stage shows a day, there will be several special programmes daily, and the Exhibition's theatre is being enlarged to accommodate 4,000 people. The stage will be a replica of a B.B.C. studio, while the side-shows will include sixteen special television theatres, each containing two receivers and capable of holding an audience of seventy at each performance.

In general it looks as though past reproaches about lack of television facilities have borne fruit, and this year's Show should be more than memorable on this account alone.

It is reckoned that about 100,000 people will be getting acquainted with television at this Show, and the Trade's idea is, knock 'em back with delight, one and all.

Modern Babel

THE extent to which radio propaganda among the nations has grown is well shown by the following reply by Lord Cranborne to a question in the House of Commons.

He said that according to the information available to the B.B.C., wireless programmes directed to listeners outside the country of origin and given or announced in languages other than that of the country of origin are at present being broadcast from Austria, Bulgaria, Czechoslovakia, France, Germany, Holland, Hungary, Iceland, Italy, Japan, Latvia, Luxembourg, Poland, Portugal, Rumania, Spain, Switzerland, U.S.S.R., U.S.A., and Jugo-Slavia, also Vatican City.

So if the B.B.C. decides to take a turn, nobody can say we began it!

My Word — By the Editor

A GREAT MAN

IT is seldom that genius receives a full measure of contemporary appreciation. History records an unending succession of scientists, inventors, musicians and men of letters whose work met with little but indifference, if not active opposition, during their life-times, and who were given their rightful seats in the Hall of Fame only by posterity.

But our sadness at the passing of Marconi, great man and good fellow, is to some extent lightened by the knowledge that he lived to achieve full recognition for his immeasurably important contributions to science and civilisation.

His was a good life. He enjoyed it. And through it all he remained essentially the same simple and modest man that he was before his universal lionisation.

His death occurred on the Fortieth Anniversary of the formation of the Marconi Company. When this Company was formed the maximum range of wireless was ten miles. To-day radio spans the earth. And all of its myriads of incessant ether vibrations form a mighty requiem in honour and memory of this Great Man.

Get Your Mac Ready

THE long-range weather forecasters who probe the heavens to see what is coming to us haven't a good word to say for 1938. It is going to begin with rain and storms such as we haven't known for many a long day, and in their opinion it is going to play the very deuce with radio communications and telegraph systems, owing to unusual magnetic disturbances.

The prophecies are based on three discoveries reported to the American Association for the Advancement of Science: (*a*) Unusual sunspots; (*b*) remarkable change on the face of Mars, like fine dust sweeping across the planet; and (*c*) a huge new spot on Jupiter.

The sun-spots, well known as radio spoil-sports, are so numerous and large that they suggest that Old Sol has got the spatial equivalent of an attack of horse-measles.

They Said It.....

"B.B.C. broadcasts of plays are being given from as near as possible to the place mentioned in the script. We look forward with some eagerness to hearing 'Man and Superman'—with the Don Juan in Hell scene left in."—"Birmingham Daily Mail."

* * *

"To praise the B.B.C. in general is impossible to one who knows as much as I do about its work."—Mr. E. R. Appleton, formerly West Regional Director.

* * *

"It is possible that the installation of microphones and loudspeakers in our churches would encourage priests to become more natural in their speech, and to use the language of ordinary life; for the idea that there is a special form of speech behaviour appropriate to the Deity is a mediæval idea, and one which must be exploded."—Professor A. Lloyd James.

He Steadied the Wavelengths

THE 1937 award of the Duddell Medal of the Physical Society has gone to Professor W. G. Cady. You may as well confess it, you rascal—you had never heard of Professor Cady. Nevertheless, he well deserves the high distinction bestowed upon him, for he has done much for your radio enjoyment.

Slogging away in the laboratory of the Wesleyan University of Middleton, U.S.A., fifteen years ago, Professor Cady started the train of researches which led to modern piezo-electrics, and the system of crystal-controlled wavelengths which is in general use to-day.

It also led to the development of the quartz-clock, most accurate of all time-keepers, which strays less than a hundredth of a second over a working period of months. Pretty work, Professor.

(*Continued overleaf.*)

Next Week: AERO-RADIO FOR TRANSATLANTIC SERVICE

NEW AND OLD WAYS OF TESTING THE EMOTIONS

One Over the Eight

THE radio columnists of the U.S.A. are chuckling about the latest story of the courts in which the wireless set came into the evidence. It was a case in which a negro wife told how her husband came home drunk and disorderly but the judge insisted on the proof of this.

"Are you sure he was drunk?" he asked.

"Shuah I'se shuah, jedge," was the reply. "He came indaws on his han's and knees, jedge, jest as the lady on the radio started her cookery talk. An' when he heard her, jedge, he chucked the whole radio out in the street, and sed: 'Didden Ah tell yo' mother to keep outa dis house?'"

Personalia

MR. S. D. SPICER becomes B.B.C. staff training director as from October 4th, in succession to Mr. G. C. Beadle, who will be the new Director of the West of England Regional.

* * *

Commander Stephen King-Hall had been broadcasting regularly since 1929, when he recently relinquished his microphone duties. His great success in the Children's Hour was, I consider, due to his perception of the first principle of getting along with children, which is to abandon condescending attitudes and treat them as seriously as though they were grown-ups.

* * *

Mr. E. L. Guilford, Director of the Newcastle station since 1932, is shortly to take up a new appointment as Programme Executive in the Midland Regional.

The Good Old-Fashioned Way

AN eminent Hungarian scientist, lecturing on the possible uses of ultra-short-wave radio transmissions, stated that by placing electrodes on suitable parts of the human body it is possible to detect variations of the emotions.

What's wrong with the older methods? Choosing a moonlight night, you place an arm round her waist and hold her as close as you know how: if she wriggles and tries to get closer there's no need to ask "How am I doing?" or to worry about radio.

The Three-Fold Cord

I HAVE just received some most interesting details of the Three-Fold Cord, the new Youth movement of the English-speaking peoples, from Mr. E. R. Appleton.

The movement started, romantically enough, in the ancient Guildhall of Barnstaple, Devon, when the freedom of the borough was presented to the Hon. Robert Worth Bingham, American Ambassador to the Court of St. James's. His ancestors had left this country 300 years ago to found a new Barnstaple, in Massachusetts, and friendly greetings exchanged between the old town and the new suggested possibilities of closer co-operation between the Youth of the English-speaking peoples. The idea has caught on, and applications for membership are now being welcomed from all parts of the English-speaking world.

Pen-Pals Abroad

THE first step towards Three-Fold Cord membership is the formation of links, each link to consist of three members of either sex, having similar interests; of these three one lives in Great Britain, another in the British Empire, and the third in the U.S.A.

"MIKE" SLIPS AND QUIPS

DURING A TALK

I wish to help as many of my dog listeners as possible—er—I mean dog lovers.

* * *

ADVERTISING A CLEANER

You just sprinkle it on, rub it in, and everything will disappear.

* * *

O.B. OF DOG-RACE MEETING

I don't know if the rain kept the crowds here away to-night.

* * *

IN AN APPEAL

Now don't forget the Legacy Club ball. The Legacy Club, as you know, looks after the deceased sons and daughters of soldiers.

* * *

DESCRIBING AN ASTHMA CURE

Will make you feel ten years younger. I wonder what would happen if a child of nine took it.

* * *

IN A TALK

You go through to Whitehall and there you see the small boys gaping as they have gaped for 100 years.

Members of each link get to know one another by correspondence, by exchanging periodicals, and so forth; and a system of groups within the movement aims at helping the study of the arts, sciences and sports.

Full particulars are obtainable from the Hon. Sec., Three-Fold Cord, Guildhall, Barnstaple, Devon, who will aid applicants to get into touch with potential pals abroad.

"Caledonia" and "Clipper"

MANY thanks to all who responded to my invitation to send particulars of the radio side of the experimental flights across the Atlantic between Foynes, I.F.S., and Botwood, Newfoundland. Not many sets will cover the wavelengths where the transmissions were to be heard, but those who could listen there were well rewarded.

In general, the messages were of the formal and matter-of-fact type that get on with the business in hand and care nothing for effect. But the U.S. radio commentators were not going to be put off with reticent official messages, so they were waiting for the "Caledonia" to arrive at Port Washington, to give a vivid word-picture to listeners of Boundbrook, N.J., and associated stations. They gave a first-class description of the landing, and then persuaded Captain Wilcockson to say a few words to the mike.

Sitting Up and Taking Notice

IN the ordinary way the visiting gipsy is not welcomed at the farmhouse.

Imagine, therefore, the surprise of the gipsies who walked past the dairy door without being turned back, and arrived at the back door of the farm to find a notice on it:

DON'T KNOCK.
We've Tuned-in
to the Wireless.

Imagine, too, the farmer's surprise when he found later that his notice was turned round back to front, and altered to read:

DON'T WORRY
We've Tucked in
to
the Butter.

Just Dropped In

LIKE most short-wave enthusiasts, the owner of amateur station G 2 N H is interested in aircraft. He was going home not long ago when somebody told him that an R.A.F. bomber had crashed in the New Malden district, where he lives. He quickened his pace.

When people told him that the crash was in his own road he accelerated further. And when at last he came in sight of his own house he found that a Vickers-Wellesley had called on him, stripped part of the roof off and flooded the garage with about 200 gallons of petrol.

G 2 N H himself was consequently far too busy to let me know, but K. W. K., one of the "P.W." reader Vigilantes, who was passing, kindly sent me the details, thinking you fellows would be interested. Many thanks, K. W. K., and Vy 73's.

"Hush Yo' Mou'"

REPROVING me for the light-hearted way in which I referred to the new police wireless station at West Wickham, Kent (now transmitting on about 140 metres, call-sign G W W), a reader who lives near by, at Hayes, asks if I realise the importance of this great mystery station.

"Surely you know," he said, "that, for secret reasons, nearly two hundred men were employed on this job? All sworn in."

I didn't know. On the contrary, I believe these yarns about the swearing of oaths arose when the ladder fell across Old Jack's shins. He has a remarkable fund of good old English adjectives, has Jack.

ARIEL

GALVANOMETERS GALORE

Some minute-to-make current-indicating instruments which will serve well in times of need

By J. F. Stirling

"OF the making of books," the sage said, "there is no end." And to the making of galvanometers, I add my humble observation, there is, also, no finality because, somehow or other, these ubiquitous current-indicating instruments seem to be capable of existing in a myriad different forms and patterns.

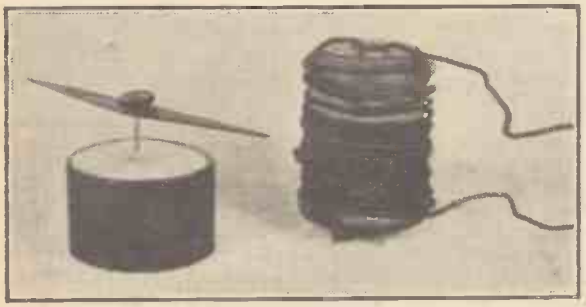
The very simplest galvanometer consists merely of a straight length of wire passing close by a compass needle suitably pivoted. On a current being passed through the wire the needle is set into motion. Even this crude form of instrument is surprisingly sensitive and it is capable of detecting a fraction of a volt. Nevertheless, there are better forms of current-indicators which are quite as easy to make and which can be really highly sensitive. Any of the galvanometers described in this article, although they can be made in a minute, are as sensitive as any orthodox linesman's instrument. Naturally, they will only indicate the presence of current. They will not measure its pressure or quantity like a voltmeter or ammeter.

Costing Practically Nothing

For emergency use, however, and even for more permanent employment, one of the galvanometer gadgets described below can form a convenient and efficient instrument. Moreover, such an instrument will possess the very decided advantage of costing practically nothing.

The first of our galvanometers is made by winding a number of turns of enamelled or cotton-insulated wire on an old cotton-reel. The wire should not be too thin, otherwise it will offer excessive resistance to the passage of the current. 22's gauge of wire is about the best.

PIVOTED ON A GRAMOPHONE NEEDLE



Here the current indicator consists of a compass needle pivoted on a gramophone needle, which is pushed through the lid of a pill box. Current passing through the cotton-reel coil causes the needle to move.

Wind from half a dozen to a dozen and a half turns of wire on the discarded cotton reel, securing the ends of the winding to the cotton reel by means of a dab of sealing-wax. The reel is now placed horizontally on the work-bench and made to remain in that position by a dab of "plasticine" or some other similar putty-like material placed under it. On the top of the reel a cheap magnetic compass is placed. This, also, may be fixed in position and prevented from sliding off by means of "plasticine," wax or other material placed underneath it.

The galvanometer is now complete. On passing a current through the coil the compass needle will be set into motion, its direction of movement depending upon the direction of the current through the coil. The slightest current will produce a movement of the compass needle, always providing that the latter is properly pivoted and does not tend to stick.

The more turns of wire which you put on the cotton-reel the more sensitive will your galvanometer become. Don't, however, make the mistake of putting too many turns on your reel, otherwise you will increase the resistance of the winding and so defeat your own object of increasing the instrument's sensitivity. About a dozen turns is, perhaps, a happy medium.

If the cotton-reel is placed vertically with the compass resting on the end of it, the compass needle will dip on the passage of a current instead of rotating. This arrangement, however, is not very sensitive.

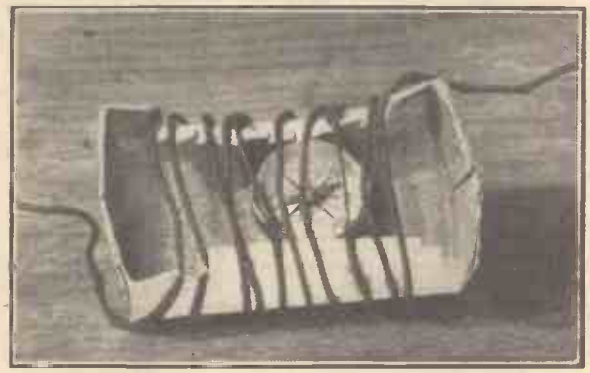
A still more sensitive home-made galvanometer may be constructed by removing the inner compartment from an ordinary matchbox, by fixing a small compass in it and by placing a dozen or so turns of wire around the matchbox drawer.

On passing current through the coil, the compass needle will be set into violent commotion. So sensitive, indeed, is this little galvanometer that it is better not to use it for detecting heavy currents, owing to the risk of the vigorous movements of the needle upsetting its pivoting.

A simple galvanometer consisting of a cheap compass and a number of turns of wire wound round a cotton-reel.

The only disadvantage of the matchbox galvanometer, if I may use that term of designation, is that it is rather difficult to see the compass needle movement, particularly when the latter is slight, owing to the turns of wire passing above it. You can, however, get over this difficulty to a large extent by widely spacing the wire turns just where they pass above the compass dial.

WOUND ROUND A MATCHBOX



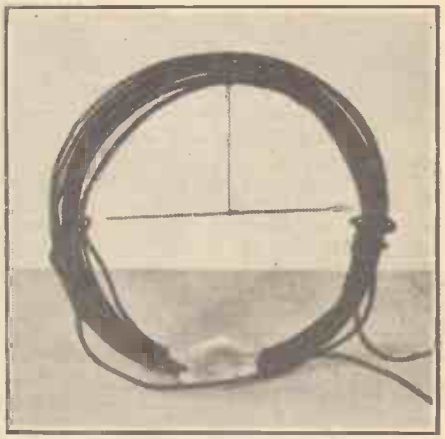
Here is another easily made "galvo." In this case the compass is placed in a matchbox and the turns of wire are wound round the box itself.

Question of Resistance

A small tuning coil with a compass placed in the centre of it forms another good galvanometer. Sometimes, however, in this case, the resistance of the coil is too high and thus the sensitivity of the instrument is not great.

If you possess a spare compass needle you can make a very large number of current-indicators with its aid. Push, for instance, a gramophone needle, point upwards, through the lid of a small pill-box, a match-box, or any other similar container, and pivot your compass needle upon this

CRUDE—BUT IT WORKS



A magnetised sewing needle, suspended from the coil by a short length of silk or cotton, is used in this arrangement.

upturned point. Now bring a small coil of wire, as, for example, half a dozen turns wound upon a cotton-reel, near the pivoted compass needle. Pass current through the coil and note the reaction of the needle.

Even if you haven't a compass needle, a substitute for this article can be made out of a flat piece of steel spring which has had

(*Please turn to page* 504.)

THE DIAL REVOLVES — By LESLIE W. ORTON

THE SEARCH FOR MISS EARHART

AMAZING FAKED REPORTS :: THRILLS ON 20 METRES
A WAR ECHO :: MY FAVOURITE SET "DYNAMITE"

DID a "pirate" transmitter broadcast some of the calls supposed to have originated from Miss Amelia Earhart's plane when it came to grief in the Pacific?

A genuine call for help was the first intimation that the world had of the plight of the fliers, and then, as warships, aeroplanes, and fishing boats rushed to the rescue, the voices of the fliers could be heard calling over K H A Q Q. The U.S. Navy station at Honolulu actually conducted two-way contact.

"Fake" Reports

A rather unusual aspect of the affair was the number of obvious "fake" reports received from this country and America. Whether a "pirate" was impersonating the lost fliers or whether too zealous listeners imagined they heard the words, I don't know, but I'm inclined to believe the first theory correct, for one of the calls heard was K H A Q M, whereas the plane's call was K H A Q Q.

Whatever may be the truth of the matter we cannot tell, but this search gave listeners a chance of realising the news-carrying power of radio as well as its value in mobilising search-parties. Honolulu and coastguard vessels were heard by listeners in this country, whilst several reported hearing K H A Q Q itself.

Unexpected Thrills

Remember the old game of banister sliding? Reception on the 20-metre band reminds me of that, one long thrill with perhaps an unexpected surprise at the end!

Just as the early bird catches the worm, so does the early DX-er pull in a batch of worth-while catches. Conditions between 5 and 7.30 a.m. are marvellous, and I've logged V K 2 L Y, Canberra, C O 2 E G, Havana, and quite a batch of other fellows. How about paying the band a little attention, then? It will give you an appetite for breakfast if you find time to eat it once you get going!

At more reasonable hours, from 11 p.m. to 2 a.m., stations shower on one like leaves during the autumn, and I've logged S A 1 A H, Warsaw, V E 3 H D, V E 2 D Q, V E 2 A A, K 4 S A, Porto Rico, L U 7 A P, Argentina, etc., at excellent strength.

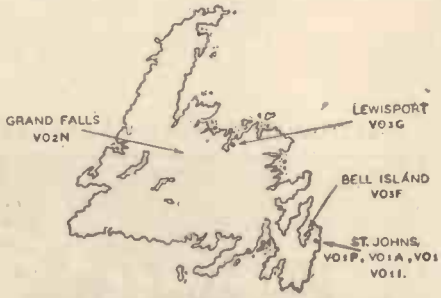
A "hot spot" was W 3 X C A, a forest-fire station! Other "Yanks" heard were W 2 G I Z, W 2 I S Q, W 3 O E, W 3 D Q, W 3 F S D, W 4 M D, W 4 K U, W 4 C Y C, W 4 B B R, W 5 C Y D, W 8 N S F, W 8 G L Y, and W 8 K B L, etc.

Incidentally, I've been surprised at the number of Miami stations coming in—seems this part of the world is favoured at the moment. All told, an exciting week. Fortunately, unlike the banister slider, we can sit down in comfort!

War

The stark reality of war was brought into the homes of many listeners the other night when a Spanish station with the call Radio Santander was heard calling American amateurs from near the fighting lines. I picked him up at 1.30 a.m. recently, and shortly afterwards heard W 2 E T I and W 1 A C E calling, and later in contact with him.

There are many Spanish stations to search for, a few being Valladolid and



"V O's" (Newfoundland) are worth logging. Several of the above amateurs work on 20 metres and are coming in well around 2 a.m.

Madrid on approximately 42 metres; Barcelona on 40 metres, an unknown station on approximately 25 metres (luck never favours me with his call!), and Radio "Nacional" on approximately 20 metres—a fine batch to search for. But, a warning, don't believe everything you hear!

"Dynamite"

"What set do you use?" inquires J. P. of Edinburgh, echoing a query of many readers. Well, my favourite is "Dynamite," so called because it blows the "blues" sky high. When "The Dial Revolves" I can get almost anything but a drink from it.

Years ago, when I was young and innocent (*sic!*), I used to see lists of stations, and promptly set about trying to tune them in. Failure hardened me! I quickly realised that "the other guy" had a far superior set, and so I decided that I would use a set equivalent to the average DX-er's. And that's how "Dynamite" came into the world—no stork brought *him!*

The circuit is simple. A straight two-valver with capacity-coupled aerial and a plain transformer-coupled low-frequency stage. Nevertheless, Dick Turpin couldn't have had more thrills with Black Bess than I with "Dynamite."

Drake the DX-er

If Drake had lived at the present time he would have forsaken his game of bowls, let the Armada go to—where it liked!—and have turned to his radio. And very wisely, too, for conditions are marvellous.

All the old friends, W 2 X A F and so on, are coming in well, whilst V K 3 L R, Lyndhurst, often comes in at reasonable strength in the mornings. On Sundays the Laughing Jackass may be heard serenading listeners from V K 2 M E, Sydney.

But if you want a real thrill, turn to J Z K Tokyo on 19.75 metres after 9 p.m. any night. Volume is amazing.

SHORT-WAVE STATION IDENTIFICATION — By F. A. BEANE

MORE STATIONS OF THE U.S.A.

IT is strange that the West Coast and Southern States of the U.S.A. are not represented by any short-wave broadcaster. Admittedly Memphis has its **W 4 X C H** on 31·6 megacycles and Los Angeles its **W 6 X K G**, a 100-watt relay of K G F J, operating to a 24-hour schedule on 25·9 m/cs., or 11·7 metres, but apart from these rarely heard experimental high-frequency stations there is nothing else to search for.

A few years ago **W 4 X B**, of Miami, Florida, was heard quite well in the early mornings on 49·67 m., but this has, apparently, since been discontinued. However, should it reappear it may easily be recognised by its regular station announcement which, if I remember correctly, is given something like this: "W 4 X B and W 1 O D, owned and operated by the Isle of Dreams Broadcasting Corporation, Miami Beach, Florida." Actually W 4 X B is an experimental transmitter situated on Collins Island in Biscayne Bay.

Chicago presents **W 9 X F** and the lesser-known **W 9 X A A**. The former, operating on 49·18 m., is frequently well heard in the early mornings until 07.00 or so, B.S.T. It relays the N.B.C. programme with 10 kw. power. The station announcement is given often, usually as "W 9 X F, Chicago, Illinois," and repeated, at the commencement and conclusion of broadcasts, in various languages. W 9 X A A, which is usually heard on 25·34 m., is a much rarer catch, and styles itself as "W 9 X A A, The Voice of Labour, Chicago, Illinois." This station normally relays W F C L, but in emergencies, such as floods, radiates instructions on 49·34 m.

Cincinnati can only boast of **W 8 X A L**, a relay of W L W, operating on 49·5 m., where it is often a good signal in the mornings. When W 9 X F is well heard one can almost be certain of hearing **W 8 X A L** also, broadcasting the Blue Network N.B.C. programme. The announcement is generally given as "W 8 X A L, operated by the Crosley Radio Corporation, Cincinnati, Ohio."

There are few other broadcasters, operating on the S.W. bands, in the U.S.A., with the exception of **W 1 X K** (31·35 m.), the Millis relay of W B Z-W B Z A, which are Westinghouse stations; **W 3 X A U** (31·28 and 49·5 m.), Philadelphia, the inconsistent C.B.S. programme outlet, and a number of U.S.W. broadcasters, which are not audible at the time of writing due to the seasonal conditions. However, when good conditions again prevail we will "re-visit" the U.S.A. in order to "discover" and to introduce ourselves to these newcomers.

I am afraid that I have still neglected the DX-er, despite my promise of a week or two ago. However, Canada lies before us and, as I stated previously, presents the listener with a number of low-powered broadcasters which may truly be described as DX!

ON THE SHORT WAVES

MORE ABOUT MAINS L.T.

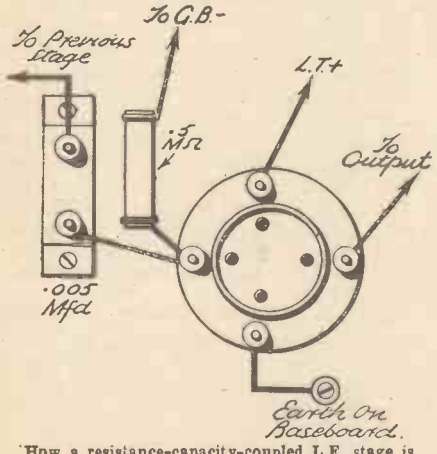
By W.L.S.

CONTINUING our campaign in favour of electrification, we must go into the important subject of converting H.F. and L.F. amplifying stages to an A.C. filament supply. Last week I described the conversion of a detector stage, so that most of you enthusiastic users of single-valvers will have gone ahead and done the first stage of the conversion by now.

Users of larger sets need not imagine that they have a lot of pitfalls in front of them, however, for the procedure with other stages is just as simple—in principle, at least—as that for the detector.

For the sake of simplicity, and also with the idea of helping the greatest number, I have shown in my diagrams a resistance-coupled L.F. stage. The first diagram shows it as it will probably be wired up in its battery-operated state. One of the L.T. wires goes off to the positive terminal, and the other goes to an "earth" point on the metal or metallised baseboard. The lead from the anode doesn't concern us at all; it may go to a choke or straight to the loudspeaker terminals, but it won't be altered when we convert to A.C.

AN R.C. STAGE



How a resistance-capacity-coupled L.F. stage is likely to be wired in the average battery set.

The grid condenser comes along from the preceding stage, and the grid leak is taken to the negative side of a bias battery, the positive side of which (we hope!) goes back to L.T. negative.

Now it's sheer waste of an opportunity to change the L.T. supply over to 4 volts A.C. and to continue to use battery bias. Admittedly, grid-bias batteries don't give any trouble, and they don't need renewing frequently; but you might as well be *all* mains when you get your conversion under way. Automatic bias is so easy to provide that I have included it in the conversion.

As before, you will remove all connections from the filament terminals of your valve holder, and will replace the four-pin type with one of the five-pin variety. Nothing should be connected to the filament pins of the new valve holder except the twin flex or twisted wires supplying the L.T. Their remote ends, of course, will go to the 4-volt secondary winding of the transformer, which may possibly be supplying H.T. as well. That doesn't matter, as long as the ends of your L.T. or "heater" wiring get 4 volts of A.C. across them.

Providing Grid Bias

Your grid leak, at its far end, is now removed from the bias battery and connected instead to a point on the earthed baseboard. The bias is provided, now, by making the cathode positive instead of making the grid negative, so that the grid assumes the same potential as the earthed baseboard and the centre-tap on the heater winding.

The bias is arranged by connecting a fixed resistance between the cathode and earth. I have shown 1,000 ohms in the diagram, and this is a good round figure that applies to many types of valve in common use. But you must study the valve-makers' pamphlets and use the value that they recommend for whatever particular valve you are using. It may be as low as 300 ohms; you must find out for yourself and see that you are using the correct value. The higher the value of the resistance, the higher the bias applied.

By-pass Condenser Values

Short-wave enthusiasts who use a general-purpose type or a small power valve in their L.F. stage will find a 1-watt bias resistance suitable. Larger power valves, working on high H.T. voltages, may necessitate the use of a 2- or 3-watt resistor.

This resistance must be by-passed by a suitable condenser. I have shown an ordinary 1-mfd. variety in the diagram; this is perfectly suitable for a headphone receiver, and, indeed, for most short-wavers in which a little bass-cutting on the L.F. side does no harm. For real quality reproduction, however, you are recommended to use an electrolytic condenser of 50 mfd. or so; and make sure you connect it the right way round!

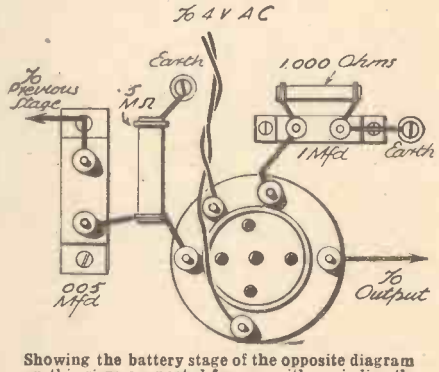
As I mentioned in last week's article, you will probably need to play about with centre-taps and things to get dead silence; but if you have already converted your detector, you will have done the deed. If the centre-tap—actual or artificial—of your 4-volt L.T. winding is already connected to earth, you simply take the L.T. leads from your L.F. stage to the same 4-volt winding and everything is complete.

An H.F. stage is treated in precisely the same way as the L.F. stage, even in the matter of bias. The point that formerly went to grid-bias negative now goes to earth instead, and bias is arranged by making the cathode positive with a resistance, just as in the case of the L.F. stage.

Now, however, you won't need to bother about a large by-pass condenser. One of ·005 or so will be suitable, but if you have a 1-mfd. in stock, use it.

I advise you to take separate pairs of wires from the heater terminals of each stage to the L.T. terminals on the back of the baseboard. By that I mean don't wire them all together underneath the baseboard and take one pair of wires off to the terminals at the back. That will mean that there will be a much greater voltage drop by the time you get to the last valve on the wiring than there is at the first one.

THE MAINS VERSION



Showing the battery stage of the opposite diagram on this page connected for use with an indirectly heated valve.

Don't forget that a three-valve set will take 3 amps. Your 4-volt winding should be designed accordingly, and your heater wiring should be *heavy*. Many a user of a home-built A.C.-operated set will probably find that his heaters are getting something nearer to 3 volts than to 4. And it *does* matter, so don't let anyone tell you it's unimportant.

You should find a most noticeable gain in efficiency when you have finished your conversion, and I assure you that you won't want to go back to battery valves again.

ON THE SHORT WAVES—Page 2.

"EAST IS EAST . . ."

How the Amateur Transmitters Differ

I PRESUME that it is unnecessary for me to finish the quotation which begins in the title. It is untrue, nowadays, to say "never the twain shall meet," because they do that, by radio, day in and day out through the years. The conditions by which radio is guided on the two sides of the Atlantic, however, are so completely different that the time has come when a few explanations should be made.

Many of my readers who are very keen on listening to long-distance amateur contacts have asked me why it is that the "Yanks" go on so differently from our own stations. As some listeners say, they seem so much more friendly and informal over the air than the British amateurs.

Licensing Conditions

The answer to that, of course, is that they are licensed under completely different conditions. Here, for instance, is one of the clauses in the British transmitting licence: "The only stations with which messages may be exchanged shall be stations (whether in this country or abroad) of persons co-operating with the licensee in his experiments . . ."

The same clause continues: "Messages sent and received by means of the stations shall relate solely to the licensee's experiments or to his personal (other than business) affairs or those of the person with whom he is communicating and shall be in plain language . . ."

This goes on: "The use of the station for advertising or business purposes, for the sending of news *or the messages of third parties* . . . is expressly forbidden."

And here is the famous "divulgence" clause: "If any message which the licensee is not entitled to receive is unintentionally received the licensee shall not make known or allow to be made known its contents, its origin or destination, its existence, or the fact of its receipt to any person. . . ."

You will see from the above that the British transmitter is not hedged round with unreasonable restrictions, as he is supposed to be in some quarters. Messages that he sends may apply to his personal affairs—such as the weather and where he is going for the week-end—and need not be 100 per cent. concerned with the type of grid condenser he uses, or whether his modulator is a triode or a pentode! Once upon a time the wording was far more strict than that of the paragraph I have quoted.

Third-Party Messages

You will see, however, that the handling of messages for third parties is completely ruled out—and this is the huge difference between British and United States transmitters. The latter are allowed—and even encouraged—to accept a message for Mr. Blank of Blankville, Ill., and to call up a transmitter as near to that city as they can get, hand on the message, and even wait for a reply while the other man delivers the message over the 'phone.

If a British transmitter did that he would certainly find an O.H.M.S. envelope on the mat next morning.

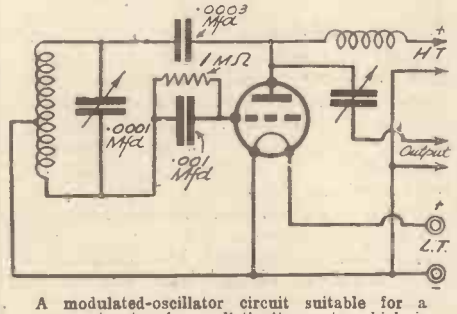
The Americans are compelled to pass a technical test and a Morse test, in the same way as the British amateurs, but once they have qualified for their licence in that way there is no suggestion that the station shall be used for experimental work. And the vast majority of U.S.A. "hams" make no pretence of doing experimental work. They come on the air to get all the fun they can out of a fine hobby.

Broadcasting Their Parties

Thus you can hear some of the high-powered fellows over there "broadcasting" their little parties, and inviting all their guests to come on the air and speak to the crowd at the other end—and so they go on for hours, just chatting about any old thing and not worrying at all about the experimental aspect of radio. Their gear is just a means to an end; they make it as efficient as they can, but then they get some pleasure out of using it, before they scrap it and go one better.

Restrictions vary in every country, but it is safe to assume that the amateurs are allowed more latitude in the U.S.A. than anywhere else in the world. Their marvellous work in times of national emergency has been largely responsible for this state of affairs; they are thought very highly of by the Federal Government, and they are powerfully organised.

FOR DISTINCTIVE NOTE



A modulated-oscillator circuit suitable for a wavemeter to give a distinctive note which is easily picked out on the receiver.

Let it be added, however, that no one has a higher opinion of the work of the British amateur than his brother "across the Pond." Those that have been over here have expressed themselves as amazed at the work that some of the "G's" do with low power, and at the general high standard of operating.

Efficiency versus Brute Force

That leads us on to another important difference between British and American amateurs. By far the most common transmitting licence in Great Britain is the "10-watter." Quite a large number of transmitters use 50 watts, and comparatively few are licensed for 250 watts. Anything above this is rare.

In the States, however, amateur transmitters of 1 kilowatt are as common as flowers in spring. In California there are several "hams" using 6 and even 10 kilowatts—and this with efficiently designed beam aerials! No wonder some of those Californian signals are so beefy.

The Britisher, however, puts some pretty good signals into the States with his 50 watts, just by virtue of sheer efficiency and hard work. When one uses a kilowatt, the transmitter may be quite inefficient without the results being poor. With 50 watts one has to squeeze the last drop out of everything.

POINTS from the POST-BAG

W.L.S. Replies to Correspondents

TWO or three readers want the Q R A of Y I 2 B A, Iraq. I published it a few weeks ago—will they please turn back?

Several more want books dealing with amateur transmission. I recommend, to start with, "The Guide to Amateur Radio" (6d.), obtainable from the R.S.G.B., 53, Victoria Street, S.W.1.

R.D.E. (Sawbridgeworth) suggests that a good task for readers is the identification (and verification) of U.S. Police Radiophones in all the nine districts of U.S.A. He has heard all districts except the 5th and 7th, including 25-watters in the 2nd and 4th districts (W 2 X I O and W 4 X C E). All these stations, of course, are round about 33 m/c. (approximately 9 metres). R.D.E., by the way, remains the only reader to own the "18" Club Certificate with *five* gold seals. How about it, someone?

An Unusual Call

B.C. (Bristol) mentions a funny one—O Q 5 A A. B.C. has received his verification, giving his Q R A as G. W. Westcott, Tondo, via Irebu, Belgian Congo. He works on 75 watts with a beam antenna.

H.N. (Burnage, Manchester) wants to know whether there is a club in the Levenshulme and Burnage district. Can anyone oblige? How about starting one, if there isn't one in existence already? He mentions that he recently heard the Coronation of the Gipsy King, relayed from Warsaw *via* W 8 X K and W 3 X A L. He remarks that one could hear both ends of the transatlantic 'phone before and after the broadcasting of the actual ceremony.

D.H. (Portsmouth) wants to know whether it is possible to make a heterodyne wavemeter which has a "distinctive note," and is therefore easy to pick out on one's receiver. If he rigs up the circuit shown in the diagram on this page I think he should be pleased. It is a modulated oscillator, i.e. as well as producing a local radio signal it generates a low-frequency oscillation which modulates this signal, making it sound like the interrupted C.W. used by most modern ships and several commercial stations.

The frequency of the musical note is governed by the size of the grid condenser and leak. The higher the value of the grid leak, the lower the frequency of the musical tone. The oscillator circuit is an ordinary Hartley.

Considerations of Accuracy

Incidentally, this scheme can be applied to any oscillating circuit. The wavemeter circuit that I recently showed can be made to give a modulated output if you use a larger grid condenser and a higher value of grid leak.

Personally, I don't think it is possible to take such accurate readings with a modulated oscillator of this type, but it certainly has a characteristic note that you can't confuse with the hundreds of signals that come from outside!

W. L. S.

MY SHORT-WAVE ADVENTURES

By L. CHESTER

TRYING A PENTODE DETECTOR

Mr. Chester describes the differences he found between triode and pentode rectifiers

HAVING graduated from one to three valves, I began to realise why so many fans spend a great deal of time, if not money, on "hotting up" the simplest of outfits. For there is surely a greater satisfaction in getting Australia, for example, on a one-valver than on three?

That is how I feel about it, anyway. While admitting the advantages of multi-valve hook-ups for "dead cert." reception of remote programmes, I still believe more sheer fun can be derived from making one valve do the almost impossible.

My little portable one-valver mentioned in the last article could hardly be simpler—either in circuit or layout. I have been

CHANGING FROM TRIODE

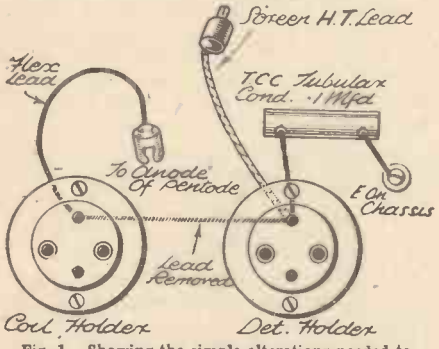


Fig. 1. Showing the simple alterations needed to change over the type of detector used.

trying to make it even more lively than it was when it so magically brought in Wayne on a bit of wire slung on a tree.

Does the type of detector valve make much difference to the results one can obtain from a one-valver on short waves? That was a question I felt needed answering by a few practical tests. And so I have been trying out three different valves: (1) Hivac D210, (2) Hivac H210, and (3) Hivac HP215.

The first two are, of course, triodes, the third a high-frequency pentode. Normally I use the D210, which is a nice valve specially designed for detection, having a metallised bulb and an internal electrode construction that certainly avoids microphonic noises. The impedance is 12,000 ohms, the amplification factor 16.

Smooth Oscillation

What pleases me about the D210 is its smooth oscillation. The easy way the valve slides into oscillation enables it to pull in amazingly weak signals. I think this is an asset far above any slight gain in amplification factor—as given by, say, the H210.

Here's a valve with an amplification factor of 25 for an impedance of 22,000 ohms. Is there any gain in signal strength? Not that I can notice. Whatever gain there may be seems to be offset by a slight loss in the nicety of reaction control.

For example, on Schenectady W 2 X A D I could follow every word with the D210—and no "hold your breath" reaction adjustment. With the H210 signals seemed stronger *when* reaction was just right—but it never stayed put long enough to benefit reception.

And so came the change-over from triode to pentode. An easy enough structural alteration, certainly, as Fig. 1 shows.

All I had to do was to remove the short wire going from the "anode" terminal of the four-pin coil holder to the anode terminal of the valve holder—making this instead a flexible lead to join to the contact on top of the valve. And then the extra high-tension lead for the screen voltage was taken to the erstwhile anode terminal of the valve holder.

Decoupling Needed

Full of hope, as usual, I switched on—and the most awful squawk hit my ear. Then I remembered about decoupling—and quickly connected a ·1 microfarad condenser of the non-inductive type between the screen high-tension lead and the earth terminal—a simple job with one of those wire-ended TCC tubular condensers.

End of squawk! It is always gratifying, I think, to discover that a given effect can be nailed down and a cure not merely specified but carried out. Encouraging to anyone blundering along as I am, certainly!

I sensed an improvement in sensitivity at once. Unhappily, the reaction was so bad I could not enthuse over the change. For one thing, oscillation was decidedly "ploppy." For another, there seemed to be quite a lot of backlash—oscillation did not stop at the same scale setting it started, but several points back.

Voltage Settings

All very distressing—until you find out why. And that need not take long if you study the valve leaflets before using the valve! I see the Hivac HP215 needs only 60 screen volts even with 150 volts on the anode. And I was using 90 volts on the screen with 120 volts on the anode!

I cut down my screen voltage to 60—and reaction smoothed wonderfully. At 45 volts I had oscillation as silkily smooth as with the D210. And the question remained: "Was it worth while?"

A lot of concentrated listening had to be done to answer that. It is so easy to arrive at wrong conclusions by a spasmodic turn at the set. On the whole I have come to the conclusion a pentode or screen-grid valve of some kind can be and is worth while as detector.

For two reasons: First, because signal strength definitely has a "lift." As an example, I might quote my 7.30 a.m. reception of Melbourne, through V K 3 L R on the 31-metre band. With the D210 I could hear the carrier but not the words. With the HP215 I could hear every word—very faint, but a hundred per cent. continuity.

Secondly, the pentode seems to work more evenly over the three main short-wave bands covered by my four-pin coils. Up to now I have got excellent results on the 12-to-26-metre coil and on the 22-to-47-metre coil—but the 41-to-94-metre coil has been somewhat "dud."

Improvement on 40 Metres

Now, with the pentode detector, I find the 40-metre fone signals come through at very good volume on the largest of these coils, at around 20 degrees on the scale of the Polar ·00016 microfarad tuning condenser. The amateurs on the 40-metre band are undoubtedly much louder at low readings of the condenser with the 41-to-94-metre coil than at high settings of the condenser with the 22-to-47-metre coil.

There can be no argument, I imagine, as to the relative merits of pentode and triode for sheer signal strength in a one-valver. But of course it is easy to lose one's sense of perspective over a thing like this.

What I mean is, you have to consider whether the extra cost of the pentode as against the triode—as well as the extra drain of milliamperes—is worth while for a one-valver. Might it not be better to spend the money and current on a O V 1 with triode and resistance-capacity-coupled amplifier?

It well might, of course. I am simply concerned here to report what I found in practice. Given the choice of any one valve for a simple-as-possible set, I think I should plump for a pentode detector. And I should use the circuit shown as Fig. 2 this week—a circuit that has the vast merit, as you will agree, of having brought in Australia.

A SIMPLE CIRCUIT TO USE

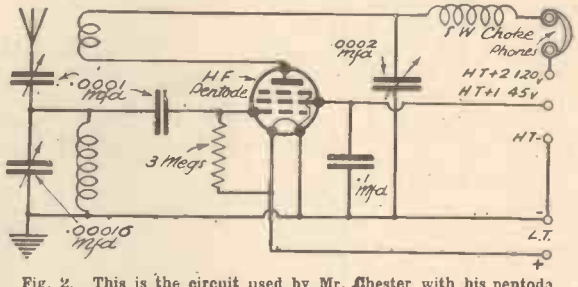


Fig. 2. This is the circuit used by Mr. Chester with his pentode valve.

Used in a simple metal-chassis layout, as I have done, you will get perfectly stable control, beautifully smooth reaction—and signals from the other side of the world. I don't see how you could ask more of any one-valver. Unless, maybe, a message from Mars!

And so, for the time being at any rate, I seem to have reached the ultimate in one-valvers.

MARCONI—THE MAN AND HIS WIRELESS

CONTINUING CHAPTER X—ON BOARD THE PHILADELPHIA
and
CHAPTER XI—MARCONI AT GLACE BAY AND CAPE COD

Last straws of the sceptics—The magnetic detector appears—Italy loans Marconi a cruiser for tests—Glace Bay selected as site for a powerful station—Sending the first west-to-east messages—Sir George Parkin describes a memorable scene—The drama of wireless shifts to Massachusetts—The "voice" of South Wellfleet—Roosevelt and King Edward exchange greetings—A personality sketch of Marconi—The electrolytic and crystal detectors are introduced—The first international radiotelegraphic conference at Berlin—A tiff with the Germans—Fleming invents the valve detector—Wireless when it was ten years old.

THE Poldhu transmitter was practically the same as used in the Newfoundland test, a Marconi engineer explained. The dynamos generated from six to forty horse-power, creating a voltage of 20,000, and this was stepped up to 250,000 volts of high-tension energy. When the operator pressed the long-handled key, a snake-like spark a foot long and as thick as a blacksmith's wrist sprang across the gap. The very room, decorated with danger signs, seemed to quiver and crackle with power. But despite all the power only an infinitesimal amount of the radiated energy struck the Philadelphia's antenna. That was what made the trick of reception so wonderful; it was making something invisible and inaudible talk after the mysterious whisper of science was plucked from space.

"Before I sailed from England," Marconi continued, "instructions were given to the operators at Poldhu to send signals at stated intervals during the week of our voyage. They were to operate two hours out of every twelve, or one hour out of every six, sending messages and test signals in periods of ten minutes, alternating with intervals of five-minute rests.

"This merely confirms what I have previously done in Newfoundland. There is no longer any question about the ability of wireless telegraphy to transmit messages across the Atlantic. As to distance over which messages can be sent, I will say that it is a matter depending solely on the strength of the apparatus used.

"As for the curvature of the earth affecting the currents, as the cable people thought it would, that has been proved untrue. That objection on their part, though, I think, was rather imaginary, than a real one. The wish was probably father to the thought."

"Do you think a message could be transmitted around the world from the same place, the sending apparatus facing in one direction and the receiving apparatus in the other?" a reporter inquired.

"Well, it's possible," was the reply, "but I do not think it is what you would call a paying investment."

This authorised life-story of the Great Radio Pioneer, every paragraph of which was read and corrected by Marconi himself, is running exclusively in Popular Wireless in serial form. The opening chapter appeared in Popular Wireless for June 5th, and those who missed the first parts may obtain copies for 4d. each, post free, from The Amalgamated Press, Ltd., Back Number Dept., Bear Alley, Farringdon Street, London, E.C.4.

When asked what he thought the speed of wireless was, Marconi replied, "I have made no calculations as to that, but assume it travels at the same speed as light, 186,000 miles a second."

Jubilantly, Mr. Saunders of the Marconi Company declared the Philadelphia voyage "a grand triumph for Marconi wireless."

"It confirms," he said, "all that Mr. Marconi has claimed for it and more, too. We are prepared to meet anyone who may dispute our claims on this trip, and confront them with incontrovertible proof of what has been done."

Marconi was asked what Lord Londonderry, the Postmaster-General of Great Britain meant by saying that the operation of the Marconi Company might interfere with the experiments of the British Admiralty.

"Well," he replied, "the British ships are using my instruments. The Government is paying £5,000 per annum for the use of the apparatus on a very few vessels. If the Powers should decide to make me take away my stations and would pay, as they would have to, for the privilege of making my experiments themselves, then I would think I had made a good bargain. The sum they are now paying shows the basis on which they would pay to do what I am doing. The Admiralty's instruments are of the old style and were put in before I solved the problem of attuning to prevent intercommunication. So you see, we might interfere with the Government, but they cannot interfere with us.

"England is not the proper field in which to make great strides in testing the land advantages of the system, which is as adaptable to inland and short-distance service as it is to transoceanic service."

"How about that station in South Africa?" a reporter asked as a parting shot as the interview ended.

"Let's finish the Atlantic first," was Marconi's answer, given with a smile.

It was evident in the Press over the next few days that Marconi by his use of the Atlantic as a laboratory had "challenged attention to the rapid movement of wireless in the direction of complete commercial utility"; signals across 2,099 miles left little room for scepticism.

There was agreement on all

INSIDE THE PHILADELPHIA CABIN

Courtesy Marconi's Wireless Telegraph Co., Ltd.

Marconi's gear in a cabin of the Philadelphia, on which he conducted his long-distance shore-to-ship tests, which proved so conclusively the big distances that wireless could cover.

sides among scientists and laymen, that "the waves of etheric disturbance launched into space from the transmitting mechanism may be compared to a giant voice crying in the wilderness, and needing only an ear sufficiently sensitive to hear it at any distance to which the ever-widening circles of its undulations may reach."

The problem of wireless now resolved itself into making the "voice" loud enough to traverse the Atlantic, and the ear sensitive enough to catch its message—but that riddle no longer belonged to the discoverer; it was on the work-bench of the mechanician and electrician.

The evolution of wireless was seen working radical changes in international business relations and closer political alliances, and the newspapers vouchsafed that "what Marconi has already done will be of lasting benefit," or in the words of the *Electrical Review*, "His work is great in achieved results and greater in its potentialities of new usefulness." Mariners and newsdom were delighted that soon the Nantucket Shoals Lightship would be reporting news of incoming craft fully ten hours earlier than formerly possible, and in storms and fog as well as clear weather.

Those who saw the dots and dashes streaked across the tape from the Philadelphia read more than the actual messages; even greater significance was found in reading "between the lines." There were rumours of lower cable rates, but in the same breath it was predicted that such a move was sure to spell ruin for the undersea lines. However, this figuring on disaster was not sustained by arithmetic, according to those who believed the cable tariffs had been held up too long because of freedom from competition.

"It will be without precedent in the history of progress," said *The New York Times*, "if this step (lower rates), which the cables now affect to regard as disastrous, does not so increase the volume of business to be handled that instead of hurting them competition will result to their immediate and permanent advantage."

There was yet much to be done; but the lessons learned on board the Philadelphia were most valuable sign-posts to new advances.

"It was during the trials on the Philadelphia that I discovered a marked and detrimental effect of daylight on wireless transmission, and the greater ease with which messages could be sent over long distances at night," said Marconi.[1] "I was of the opinion that weak signals during the daytime might have been caused by the loss of energy at the transmitter due to the diselectrification of the highly charged elevated aerial under the influence of sunlight.

"I am now inclined to believe that the absorption of the electric waves during the daytime is due to the ionization of the gaseous molecules of the air effected by ultra-violet light. As the ultra-violet rays, which emanate from the sun, are largely absorbed in the upper atmosphere, it is probable that the portion of the earth's atmosphere which is facing the sun will contain more ions or electrons than that portion which is in darkness. Therefore, as Professor J. J. Thomson of the Royal Institution has shown, this illuminated and ionized air will absorb some of the energy of the electric waves. The fact remains that clear sunlight and blue skies, though transparent, act as a kind of fog to powerful Hertzian waves."

Now the question was how to penetrate the "sunlight fog," but the Marconi men were fully confident that they would succeed completely in putting an end to the age-old isolation and dangerous solitude of the sea. Already they had whirled an invisible electric halo around King Neptune.

Because of Marconi's scientific proof that "there are more things in heaven and earth than are dreamt in our philosophy," man was fast beginning to think in terms of the globe; oceans and continents were shrinking. Wireless was preparing to tap an inexhaustible traffic between the Old and New Worlds, for "all that a man hath will he give for his life, and pretty near all that a man could afford has hitherto been asked for the privilege of lengthening life by saving time which composes it." Wireless, by its annihilation of distance, saves delay; it saves time.

[1] Paper read by Marconi before Royal Institution, London, on June 12th, 1902.

TAKEN AT SIGNAL HILL

Courtesy Marconi's Wireless Telegraph Co., Ltd.

This photograph of Marconi with Mr. Kemp (left) and Mr. Paget (right) was taken at Signal Hill, Newfoundland, where the first transatlantic signals were received.

CHAPTER XI

MARCONI AT GLACE BAY AND CAPE COD

DESPITE the copious evidence that wireless had conquered the Atlantic from continent to continent and from shore to ship, there were some who grasped for the last straws of scepticism by pointing out that the historic signals had travelled from east to west as the sun, but would they go in the opposite direction?

Marconi said, yes.

He would prove that the whirl of the earthly sphere had little or no influence on the waves. Glace Bay, Nova Scotia, was selected as the site for a transmitter to demonstrate that wireless could travel east as well as west.

While installation work was in progress at Glace Bay, Marconi patented a new receiving set. The coherer was still used, but other parts of the circuit were greatly improved. For example, he used earphones, a tuning transformer and variable condensers to vary the capacity of both the primary and secondary circuits of the tuner. This made tuning more selective; stations could be separated more easily to avoid overlapping.

Mindful that the coherer was the weak link in the circuit he turned to develop a detector based on a discovery of Sir Ernest Rutherford in 1895. He had observed that a small, permanently magnetised needle, when suspended at the end of an electro-magnet, was deflected by the rise and fall of the current in the coils of the electro-magnet. In this principle Marconi saw an opportunity to sensitise his receiving set, and he utilised it in designing a magnetic detector. He used a pair of horseshoe permanent magnets, slowly revolved over an electro-magnet, the coils of which were connected to earphones. Fluctuations in the current caused by the incoming signals were audible in the headphones.

Since the engineers supervising the erection of the station at Glace Bay were not ready for Marconi to appear on the scene, he took advantage of the time by accepting an offer of the Italian Government to loan him the cruiser Carlo Alberto to facilitate long-distance tests of the magnetic detector, which had been officially introduced on June 25th, 1902. On the ship a young lieutenant was specially detached, the Marquis Luigi Solari, who assisted Marconi, eventually to associate himself with the inventor and follow him throughout the romance of his career.

During the summer months with the inventor on board, the ship cruised across the North Sea to Kronstadt; to Kiel and along the Scandinavian coast, then to Portugal and southward to Africa, and back to Italian waters. While the cruiser was at Cape Skagen, the novel detector throbbed with signals from Poldhu, 800 miles distant, and at Kronstadt, 1,600 miles away. In fact, the Poldhu signals were never missing at night, but the daylight range was never more than 500 miles.

The Carlo Alberto turned westward with its sensitive "ear" when reports from Canada indicated the stentorian spark of a second-hand 75-kilowatt alternator at Glace Bay was ready for Marconi to be tested. He arrived at Sydney, Cape Breton, on October 31st.

The first transmissions at Glace Bay were disappointing, and Marconi was forced to make numerous modifications. The work was difficult because there was no instrument to measure the length of the waves. Out of the frustration, however, daily the engineers learned something new about wireless.

The first attempt to reach Poldhu from

(*Continued overleaf.*)

MARCONI—THE MAN AND HIS WIRELESS—*Continued*

Glace Bay was made on November 19th, 1902, but the operators in England failed to hear even the faintest tick; on the 28th unreadable dots and dashes were intercepted. Changes were made in the equipment, and on December 5th the signals were deciphered across the ocean.

"Let us see if we can raise Cornwall," said Marconi, as he reached to the pump-handle lever of the sending key, fully three feet long. "Better put your hands over your ears," he warned, just before he pressed the key for the preliminary test.

The noise was deafening—like a machine-gun being fired so rapidly that the sound was almost continuous. Long sparks jumped from the knobs of the immense Leyden jars that filled the centre of the room, and illuminated the surroundings like lightning.

Crash! Crash! Crash! Four or five times Marconi flashed the signal, three short, sharp, staccato dots—"S" in the Morse code. The silence was tomblike when the noise stopped. He turned from the sending key and picked up a telephone receiver mounted on a headpiece. There he stood patiently, with both ears covered by the headphones, listening for signals while others in the room watched the unwinding tape.

"Here they are!" he cried a few minutes later, smiling as the tape confirmed his statement. The inker's needle pressed upon the paper strip for an instant, lifted, pressed again, once more lifted and again transcribed a dot. Then a pause, then a dash, then another dot. That meant "S N," which in the language of the telegrapher means, "I understand."

"The wireless works very much better at night than by day," said the inventor, as he tore off strips of the tape as souvenirs for his visitors. "This is the first really clear signal we have had from the other side in the daytime."

Leaving the station Marconi led the way down the bluff that gives the name of "Table Head" to this outlying corner of North America. As the party stood on the bank of the precipice, facing eastward, 2,150 unobstructed miles of ocean lay between them and the English coast. The smoke of a steamer, hull down below the horizon, was the only thing visible except the sky and restless water.

"A freighter, probably sailing the Great Circle route to a British port," was Marconi's comment. "It is not much beyond where she is now that the La Bourgoyne sank, with a loss of almost all her passengers, less than five years ago. Had she been equipped with wireless, aid could have been summoned from Sydney, from Newfoundland or from other ships, close to the Grand Banks at the time. The day will come when every ship will carry wireless and every port will have a wireless station. When that time comes there will be no more catastrophes as the wreck of the La Bourgoyne. If my invention never accomplishes anything else than to save the passengers and crew of one ship it will amply pay me for all the money I have spent on it."

It was December 17th, 1902. Two weeks had passed since the inventor of wireless celebrated the first anniversary of the transatlantic triumph. A busy year had fled, and it was time for another feat—the inaugural west-east broadcast.

Sir George R. Parkin, a professor at Upper Canada College and correspondent of the London *Times*, was at Glace Bay. Marconi had invited him as the guest of honour, privileged to send the first message, one of congratulations to England and to Italy. Several naval officers delegated by the Italian Government were also there to watch the tests.

Sir George boarded a train for New York as soon as the opening ceremony was over. En route he wrote a complete story of the event. He took his article to the office of *The New York Times*, where two typewritten copies were made, one to be mailed to London, and the other to be published in New York simultaneously with its publication in London.

The "release" of the story from London was anxiously awaited, but weeks passed and it did not come. At last *The New York Times* received, from the dead letter office in Washington, the article which had been mailed to London. Bearing the return address of *The New York Times* on the envelope, it had been sent back because Sir George had underpaid the postage by five cents. With a penalty of the same amount, that made ten cents due on the letter in London, and at that time the London *Times* had an iron-bound rule that all underpaid postage matter should be refused.

Finally the story was printed, and the newspaper files yellowed and made brittle by age have preserved Sir George's account of Glace Bay:

"A little after midnight our whole party sat down to a light supper. Behind the cheerful table talk of the young men on the staff, one could feel the tension of an unusual anxiety as the moment approached for which they had worked, and to which they had looked forward so long. It was about ten minutes to one when we left the cottage to proceed to the operating room. I believe I was the first outsider allowed to inspect the building and machinery.

"It was a beautiful night—the moon shone brightly on the snow-covered ground. A wind, which all day had driven heavy breakers on the shore, had died away. The air was cold and clear. All the conditions seemed favourable.

"Inside the building, and among its somewhat complicated appliances, the untechnical observer's first impression was that he was among men who understood their work. The machinery was carefully inspected, some adjustments made, and various orders carried out with trained alertness. All put cottonwool in their ears to lessen the force of the electric concussion, which was not unlike the successive explosions of a Maxim gun. As the current was one of most dangerous strength those not engaged in the operations were assigned to places free from risk.

"It had been agreed that at the last moment before transmission I should make some verbal change in the message agreed on, for the purpose of identification. This was now done and the message thus changed was handed to the inventor, who placed it on the table where his eye could follow it readily. A brief order for the lights over the battery to be put out, another for the current to be turned on, and the operating work began.

"I was struck by the instant change from nervousness to complete confidence which passed over Mr. Marconi's face the moment his hand was on the transmitting apparatus—in this case, a long wooden lever or key.

"He explained that it would first be necessary to transmit the letter 'S' in order to fix the attention of the operators at Poldhu, and enable them to adjust their instruments. This continued for a minute or more and then, with one hand on the paper from which he read and with the other on the instrument, the inventor began to send across the Atlantic a continuous sentence.

"Outside there was no sign, of course, on the transverse wire from which the electric wave was projected of what was going on, but inside the operating room the words seemed to be spelled out in short flashes of lightning. It was done slowly, since there was no wish on this occasion to test speed. But as it was done one remembered with a feeling of awe, what he had been told—that only the ninetieth part of a second elapses from the moment when he sees the flash till the time when the record is made at Poldhu.

"What gives it direction? 'We send it into space,' Mr. Marconi had remarked during the afternoon, 'and it must find its way to a point in Cornwall.' Mountains in the path of the current do not affect it, the inventor told us, and when we remember that between the point of departure and the point of reception the curvature of the earth represents a mass of land and water more than a hundred miles high, this may be understood better.

"The first west-east message had been sent across the Atlantic. What that means to mankind no one can even guess," said Sir George. "The path to complete success may be long and difficult. Between George Stephenson's Puffing Billy and the great mogul engine which swings the limited express across the American continent, there lies three-quarters of a century of endeavour, experiment and invention. In the great original idea lay the essential thing which has revolutionised the world and the conditions of human intercourse."

(*Please turn to page* 501.)

NEXT WEEK

Chapter XII

WEDDING BELLS—AND WIRELESS

Marconi is married—Names of his children and dates of birth—The cable celebrates its jubilee unafraid of wireless—Wild exaggerations of an Arabian tale—How McKinley's re-election was flashed around the world—Newspapers urge wireless Press service across the Atlantic—Legal battles for wireless begin—De Forest institutes a suit—News by wireless is featured—Marconi plans high-power transmitters for oversea service—The first sheaf of public messages—Marconi praised for his work—A triumph for Empire and Science—What Peter Cooper Hewitt said about it—An indispensable aid to commerce and civilisation.

RANDOM RADIO REFLECTIONS

By Victor King

THE "PERPETUAL MOTOR" :: NEAR AND FAR :: THOSE ANNOYING DUST SHADOWS

MYSTERIOUS INVENTIONS

NO doubt you read about that poor chap who committed suicide—the inventor of a marvellous new radio receiver that, needing neither batteries nor valves, could produce full volume loudspeaker results.

Well, I had some correspondence with him; about two years ago, I believe it was. There was to have been a demonstration for my benefit, but it never came off.

Must admit I was highly sceptical. I still am. It was too reminiscent of another scheme which had crossed my horizon a little while previously, and that was merely just one more successor of a whole spate of "valveless, batteryless radio receiver revolutionary inventions."

A Rumanian with an English manager.

Which didn't cause any of the battery and valve makers to lose any sleep as far as I remember.

I am afraid I grow more and more cynical regarding these wonderful and mysterious inventions which the daily papers seem to delight in publishing. You see, I've made a point for years of following many of them up, and my experiences have proved depressingly similar.

On rare occasions one must admit that the presentation has been interesting. I recollect a new electric motor invented by a Rumanian (romantic touch, that). His manager was English, and the pair of them were wandering about giving demonstrations to all whom they could interest.

They gave me one. The model was quite small. Just a little toy motor and a 1½-volt cell. The idea was that this new electric motor could be driven by an extremely small current. But it developed, proportionately, an extremely small power so what, I asked, was the advantage?

Where, too, was the invention? After long discussion, which wandered all over the place, it emerged that the motor had a separate winding on its armature in which current was generated and fed back to the battery.

"The iron waves about under his nose."

In short, another version of that oldest of all electrical perpetual motion ideas whereby an electric motor drives a dynamo which develops current for driving the motor!

I gave the Rumanian inventor and his manager a little lecture in elementary electricity and mechanics. But my words fell on deaf ears. It was plain to see that they considered me a spoil sport. They may have even thought I was jealous of their brilliant conception.

Inventors are suspicious folk as a rule. Read what Mr. Hardman, an inventor himself, says in his book "Advice to Inventors."

"Reference has been made to the 'Inventor Bug,' but perhaps the title of 'Inventor Bunny' would be nearer the truth. For that is exactly the way to look upon the average inventor—as a rabbit surrounded by many hunters, all armed with vested-interest shot-guns. When the various sportsmen have finished popping at poor little bunny-rabbit, with good eyesight you may be able to find his tail and his whiskers. Frequently, not even those remain." Still, Mr Hardman *has invented*, and made money at it, so we can give *him* his point.

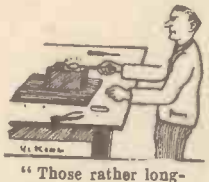
STYLE IN SOLDERING

THE moment I saw my friend Blogson with a large blister on the end of his nose I knew exactly what had happened.

"You ought to wear glasses," I said, "particularly when you are soldering."

I've watched him at it several times. He's so near-sighted that the iron waves about under his nose in an alarming fashion. But he is able to accomplish some really first-rate work—especially on small jobs.

But as a spectacle his style is not so good. Not comparable, for example, with that of one of those rather long-sighted, long-range exponents who stand well back from the work and apply the hot-point with something of the supercilious manner of a medicine-man conducting a mystic rite.



"Those rather long-sighted, long-range exponents."

All the same, I'd back a Blogson joint against anyone of theirs.

By the way, talking about eyesight reminds me of a curious thing I heard the other day. A short-sighted lady told me that when she removes her spectacles her hearing seems to be adversely affected as well as her vision.

Naturally, I at once suggested that this was probably due to the fact that she was unable to see so clearly the moving lips and facial expressions of people talking to her.

But no, she insisted that even in the case of the radio where, often mercifully, faces aren't to be seen anyway without television, the effect was still most marked.

Subsequently, I asked other wearers of thick lenses if they experienced the same sort of thing, and they said that they did.

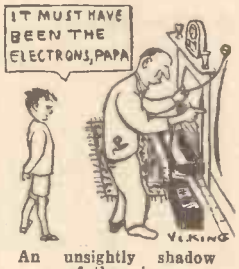
Well, if the effect is, in fact, a common and lasting one, then I suggest that the partially deaf who use deaf-aids might well have their eyes carefully examined. But, personally, I incline to the theory that it is merely a temporary psychological effect. That the sudden dimming of the vision occasioned by the removal of the glasses causes a general momentary bluntening of other senses.

WRITING ON THE WALL

HERE'S something lots of you have come across. For others its telling here constitutes a warning. If you let a wire dangle down close to a wall and that wall has spread upon it a nice wallpaper, there will in time be drawn down that wallpaper an unsightly shadow of that wire in indelible dirt.

It'll even be drawn down it if the wallpaper isn't nice—but that wouldn't be so bad.

No, it's not an electrical effect. Unhappily, I am afraid I cannot say that here is some weird and crafty work on the part of the busy little electrons which are flowing through that wire.



An unsightly shadow of the wire.

You'd get exactly the same kind of unwanted mural decoration even if it were a piece of string.

You see, the air, especially in towns, always contains a certain amount of dust, soot, sulphuric acid, gnats' eggs and what not. This solid content of an otherwise tenuous medium tends to deposit itself on objects. ("Mary, you can write your name on the piano." "Thank you, mum, I've always wanted to do that.")

And, of course, there are always currents in the air which make it go round and around and up and down, normally distributing its largesse in the way of dust, soot, sulphuric acid, gnats' eggs and what not, more or less impartially over pianos, radio sets, tables, curtain rods and all those things which *never* get dusted.

The walls, too, will get their fair share, but not so much will stick on them. And then the drifting air meets an obstruction such as a dangling wire, behind which it will swirl, eddy, blind spot, and so forth. And so the dirt piles up, in a manner of sweeping—speaking, I mean.

And thus the "shadow" which will be noticeable after a time near switches, brackets, and other things as well.

That is, of course, if you don't run an air-conditioning plant in your house. But that's not as cheap as having new wallpaper every now and then.

SHRINKING AERIALS

I recently lent a mains set to a friend who is ill in bed. A mains superhet. I found that it was quite unnecessary to fix up any kind of aerial.

As much volume as was needed could be obtained from the B.B.C., anyway, without a single inch of antenna or even an earth.

Yet only a few years ago a "good aerial" was the prime essential of radio reception. But modern sets are so much more sensitive. Supposing a craze for "good aerials" springs up for all-wavers of 1960. Will listeners pick up the same programmes six times or more on their successive trips round the earth? Who cares, anyway?

HOW THE B.B.C. REBUILDS HISTORY

Researching and Sleuthing for "Scrapbooks"—Summer Work for Winter Programmes

AT his desk in a quiet room high up in St. George's Hall, Leslie Baily is spending the summer months on research work that inevitably precedes every broadcast of a "Scrapbook" programme.

He and Charles Brewer, B.B.C. Assistant Director of Variety, have already been responsible for fourteen "Scrapbooks" in which they have rebuilt and dramatised the history, recalled the songs, and brought back many of the celebrities of the years between the beginning of the century and the present day.

Much Data Needed

"During these weeks in the summer," Leslie Baily said to "P.W." "I have to find out what events in the various years lend themselves to reconstruction in 'Scrapbook,' what songs were popular, what shows were playing to 'capacity' houses, and what personalities who were then prominent are still available and willing to take part in a broadcast. Obviously, it is necessary to collect data for several years before Charles Brewer and I can sit back, review it, and decide which year we shall cover; choice depends, naturally, on the material as well as the people whom we can get to the microphone.

"During the research stage I spend a lot of my time in the Reading Room at the British Museum, going through newspaper files and volumes in search of 'copy'; I have casually collected during past years a large amount of material 'to be used one day.' The B.B.C. library is very useful, too, and stacks of old songs reach me from the Music Library.

"Then I usually listen to about fifty gramophone records before finally choosing the music for one programme—quite often records of celebrities who are now dead.

"One always has to decide in the case of these records whether the value of the celebrity and the value of the sentimental associations recalled by the song that he—or she—is singing is outweighed—or not—by the scratchiness of the record!

When the Gold Cup was Stolen

"Now and again it is necessary to do a bit of private sleuthing, too. For instance, in 1907 the Ascot Gold Cup was stolen, and I have recently been hunting up the facts for a future 'Scrapbook.' We shall want, of course, to cover the theft. That has meant first of all contacting Scotland Yard, getting in touch with the jewellers who were responsible for the custody of the cup, and going to Buckinghamshire to meet the man—he is now living in retirement—who was then their private detective.

"Now and again we have been asked if the celebrities in 'Scrapbooks' are merely recorded voices. The answer is emphatically 'No.' Recorded material of this kind is only used on rare occasions when, for some reason or other, it is impossible to secure the presence of the celebrity or personality concerned. Then we make it quite clear to listeners that they are listening to a recording.

"Let me give you an example: While we were preparing the 'Scrapbook for 1901,' the Marchese Marconi came to England and left again a few days before the programme was due for transmission. Well, it was really important that he should be in the programme, for it was in 1901 that he sent the first radio signal—the letter 'S'—across the Atlantic from Poldhu in Cornwall to St. John's, Newfoundland.

"So we had to record him or not have him at all. We just could not let the opportunity slip by—and he was so busy that the only way in which we could record him was by sending a recording van to his offices on the Embankment, running a microphone into his suite, and getting him to talk without even coming to Broadcasting House.

"Wherever possible we like to get hold of people who actually played some part in an historic event, and with their help present a dramatised reconstruction of the scene. Much depends upon the microphone ability of the people concerned; most of them have never spoken into a microphone before. Nevertheless, we have been able to get quite a number of them to re-live their parts rather than merely to talk about them.

Reconstructing a Great Air Race

"Claude Grahame-White in the 1910 'Scrapbook' played the part of Claude Grahame-White twenty-five years younger, during a dramatised reconstruction of the great air race from London to Manchester in which he and Paulhan competed.

"When we were dealing with the death of Sir Henry Irving in 1905—you remember he collapsed on the stage at Bradford and died later in his hotel—Sir Seymour Hicks played Irving's last part during the programme, and we got down from Bradford an electrician from the theatre who, seeing Irving collapse, dropped the curtain and switched on the back-stage lights.

"But let's keep the sequence of the story. After getting hold of celebrities and personalities, interviewing them, getting their material down on paper, and selecting music, there is 'continuity' to be written and a number of artists have to be engaged for the programme.

"And here some really hard work begins—the production of the whole thing by Charles Brewer. 'Scrapbooks' are the most complicated of all shows to rehearse. You have dramatised material, vaudeville, serious music, straight narrative, gramophone records, all linking up and merging together. Four studios at least are used for each broadcast—often more.

The Biggest Scoop

"Scoops? Yes, we have had several.

"The biggest, I suppose, was when we recaptured the scene at the signing of the Armistice in Marshal Foch's railway carriage in 1918. After a lot of sleuthing we ran to earth the only verbatim note which was taken at that meeting between the Germans, British and French. It was a unique record made at the time by Captain J. P. R. Marriott, R.N., who very kindly lent it to us. . . ."

The next "Scrapbook" programme will be broadcast in October—the fifteenth programme of its kind.

CHARLES BREWER

The B.B.C. Assistant Director of Variety, who, with Leslie Baily, is responsible for the production of the popular "Scrapbook" programmes.

FOR RADIOGRAM USERS

How to keep a clockwork motor running smoothly.

THE vital necessity of maintaining the motor of a spring-driven radiogram in an efficient state of lubrication is recognised by all, since not only does a well-lubricated motor run far more sweetly but it also undergoes much less wear than one which is habitually allowed to function almost in a "dry" condition.

It is not always an easy job to lubricate the various gears and bearings of a radiogram spring motor, since many of these are more or less inaccessible to the nozzle of an ordinary oil-can.

The Best Method

By far the best and certainly the most economical mode of lubricating the bearings of a spring motor is to procure an old steel knitting needle and, about an eighth of an inch from one end of it, file a fairly deep U-shaped notch. Now dip the notched end of the knitting needle in the oil bottle and then touch the bearing to be lubricated with the end of the needle. It will be found that just the requisite amount of oil will be accommodated in the notch of the needle and that when the end of the latter touches the bearing, the oil will at once flow out of the notch on to the bearing. In this simple manner, oil may be conveyed with certainty to the area at which it is required and, what is more, the lubricant will not be wasted on areas on which it is not needed.

Use a good quality freely flowing machine oil and remember that one notch-full is ample at any one time. Little and often is the golden rule to be followed in lubrication.

J. F. S.

AN ALL-WAVE "MIDGET"

By the "P.W." Research Department

An efficient three-band receiver—compact in size—that will give you world-wide station reception. Easy to make and simple to operate.

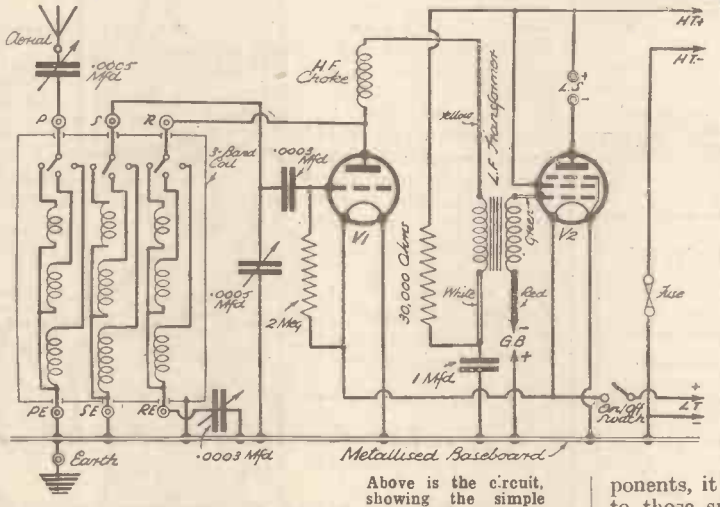
A back view of the completed receiver. Its appearance from the front is shown by our cover photograph this week.

EVEN to-day the two-valve set has its uses, although it may be capable of receiving only the medium and long-wave bands. If the short waves are added to those capabilities, then the little two-valver becomes, in some respects, even more interesting than a more ambitious receiver which is unable to receive the short waves. The little set which is the subject of this article tunes not only to the normal broadcast bands, but also covers the most important short wavebands. Its ranges are: medium, 200 to 500 metres; long, 900 to 2,100 metres; and short, about 19 to 48 metres.

It will be seen that the 19, 25, 31 and 48-metre broadcast bands may be received, and also the 20 and 40-metre amateur bands. Quite a good selection for such an obviously simple set, with no coil-changing to be done.

Stations Receivable

On the medium and long waves the number of stations which this set will receive free of interference will depend upon the locality in which it is used. If used within twenty-five miles or so of a regional transmitter, the signals from this station will, of course, spread over a fair number of degrees of the dial. Even so, it should be possible to receive several of the more powerful foreign stations on wavelengths not too close to that of the "local." Should the set be used in a locality where the local station is about fifty or more miles away, then more stations will be received free of interference from the "local." Now that it has been stated what the set will do, we will proceed with a description of the circuit employed.



Above is the circuit, showing the simple arrangement and the internal connections of the all-wave coil. To the left are the drilling dimensions for the four controls on the panel.

The coil is a new Wearite "Triogen," which is controlled by a three-position wavechange switch. Its secondary is tuned by a ·0005-mfd. condenser. The aerial is coupled to the primary by means of a ·0005 variable condenser, to control volume and selectivity. Reaction is applied in the normal way, the condenser being in the earth side of the reaction winding to prevent hand-capacity effects on the short waves. A triode detector is used, and is coupled to an output pentode by means of a "midget" L.F. transformer.

Although the construction of this set is extremely simple—it really can be made in an evening quite easily—there are several points which should be observed.

The lay-out should definitely not be altered. In such a simple set the lay-out is not likely to affect the broadcast bands, but it probably will affect the short waves. So stick to the diagrams. Regarding components, it is ever so much safer to stick to those specified. If you don't, please don't blame us if the set fails to give satisfaction!

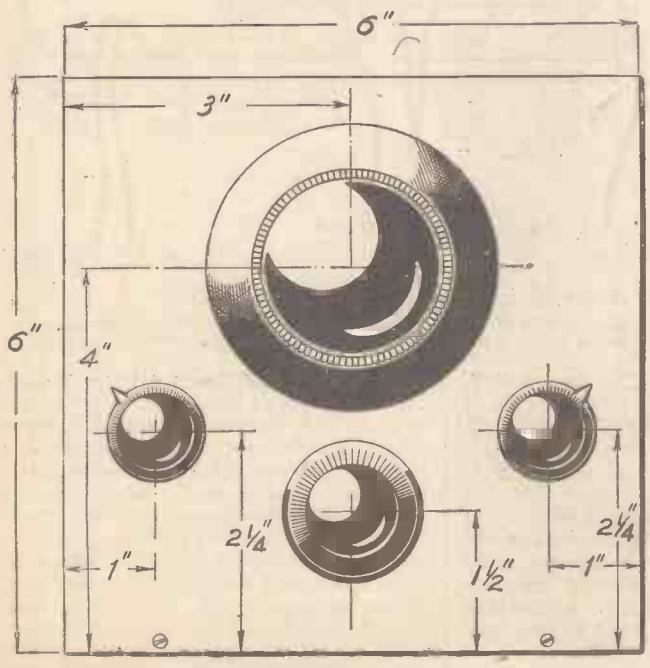
We will now describe briefly the construction, pointing out particularly the various things which are not obvious. First, prepare the panel by drilling according to the front-of-panel diagram. The hole sizes for the panel controls are as follows: Tuning condenser, $\frac{7}{16}$ in.; reaction condenser (on the right), $\frac{3}{8}$ in.; aerial coupler, $\frac{5}{16}$ in.; wavechange control (below tuning), $\frac{3}{8}$ in.; fixing holes at the bottom, $\frac{1}{8}$ in. Next, drill the terminal strip The holes for the terminals are $\frac{5}{32}$, and for the on-off switch, $\frac{1}{4}$ in. Drill two $\frac{1}{8}$ in. fixing holes, $\frac{7}{16}$ in. from bottom edge and 1 in. from the ends.

Mounting the Switches

Fit the terminals and switch to terminal strip. The switch should be mounted so that the "ON" mark is towards the earth terminal. The switch is for universal on-off switching, and is double-pole. Actually only one pole is used in this case. Screw the terminal strip to the baseboard.

Mount tuning condenser, reaction condenser and aerial coupler on the panel. Mount components on the baseboard. Place knob on wavechange control

(*Continued overleaf.*)



Panel Layout.

AN ALL-WAVE "MIDGET"

(Continued from previous page.)

assembly. Grasp the plate and, with knob towards you, turn knob fully clockwise. Now insert the rod of the wavechange control assembly in the coil, and turn as far as possible clockwise. Screw out trimmers on top of coil two turns. Offer panel to baseboard, and see that the wavechange spindle slips through its appropriate hole in the panel. Screw panel to baseboard. Lock bush of wavechange assembly to panel. Everything is now ready for wiring, which is quite straightforward. The wiring is carried out in 18-gauge tinned copper wire and insulating sleeving. Keep all leads as short as possible, as shown in the diagram.

Preparing for Test

When the wiring has been completed, insert the valves, connect the aerial and earth, loudspeaker and batteries. The connections of the loudspeaker and aerial and earth call for no comment, except that the loudspeaker ratio must be set (if it is adjustable) for pentode output. The actual optimum load of the valve specified is 11,500 ohms.

The battery connections are as follows: L.T. + to positive terminal of 2-volt accumulator, L.T. — to negative terminal, G.B. + to positive of G.B. battery, G.B. — to — 3 volts, H.T. — to negative of H.T. battery via fuse, H.T. + to + 120 volts.

THE PARTS YOU WILL NEED

1 Polar No. 2 S.M. ·0005-mfd. tuning condenser.
1 Polar ·0005-mfd. "Compax" condenser.
1 B.T.S. ·0003-mfd. solid dielectric reaction condenser.
1 Wearite "Triogen" 3-band coil.
1 T.C.C. 1-mfd. fixed condenser, type 50.
1 T.C.C. ·0003-mfd. fixed condenser, type M.W.
1 Polar N.S.F. 2-meg. 1-watt grid leak.
1 Polar N.S.F. 30,000-ohm 1-watt resistance
2 W.B. 4/5 pin, A.C. type, valve holders.
1 B.T.S. all-wave H.F. choke (unscreened).
1 B.T.S. L.F. transformer, midget type.
1 B.T.S. toggle switch, type S.W.2.
4 Clix terminals, type A.
3 Belling & Lee wander plugs.
1 Belling & Lee wander fuse.
2 Belling & Lee accumulator spades.
1 Polished wood panel, 6 × 6 × ¼ in.). (Peto-Scott).
1 "Metaplex" baseboard 6 × 6 × ⅜ in.) (Peto-Scott).
1 Ebonite terminal strip, 6 × 1½ × ⅛) (Peto-Scott).
18-gauge T.C. wire and sleeving for wiring (Peto-Scott).
Screws, flex, etc. (Peto-Scott).

VALVES, ETC.

V_1	V_2
Mazda L2	Hivac Y220

H.T.—120 volts, Drydex.
L.T.—2-volt accumulator, Exide
G.B.—4½ volts, Drydex.
L.S.—W.B. Stentorian.

The on-off switch should be thrown towards the earth terminal to switch on the set. There are three positions on the wavechange switch (below tuning dial), to the left (anti-clockwise) is long waves, central is medium waves, and to the right (clockwise) short waves.

First set the wavechange switch to medium waves, and see if you can pick up the local station. If so, you can be fairly certain that all is well—at least, with the wiring. Now turn to the long waves and try for Droitwich. For both of these tests the aerial coupler (left-hand knob) should be turned fully clockwise. If you find the medium and long waves in order, turn now to the short waves For these you will have to turn the aerial coupler nearly fully anti-clockwise. If you do not do this there may be some difficulty in obtaining reaction, due to the aerial damping being too high. If you can obtain reaction (right-hand knob) on the short waves, on rotating the dial at practically any time of the day or night, you should hear innumerable carriers. This will denote that everything is working satisfactorily.

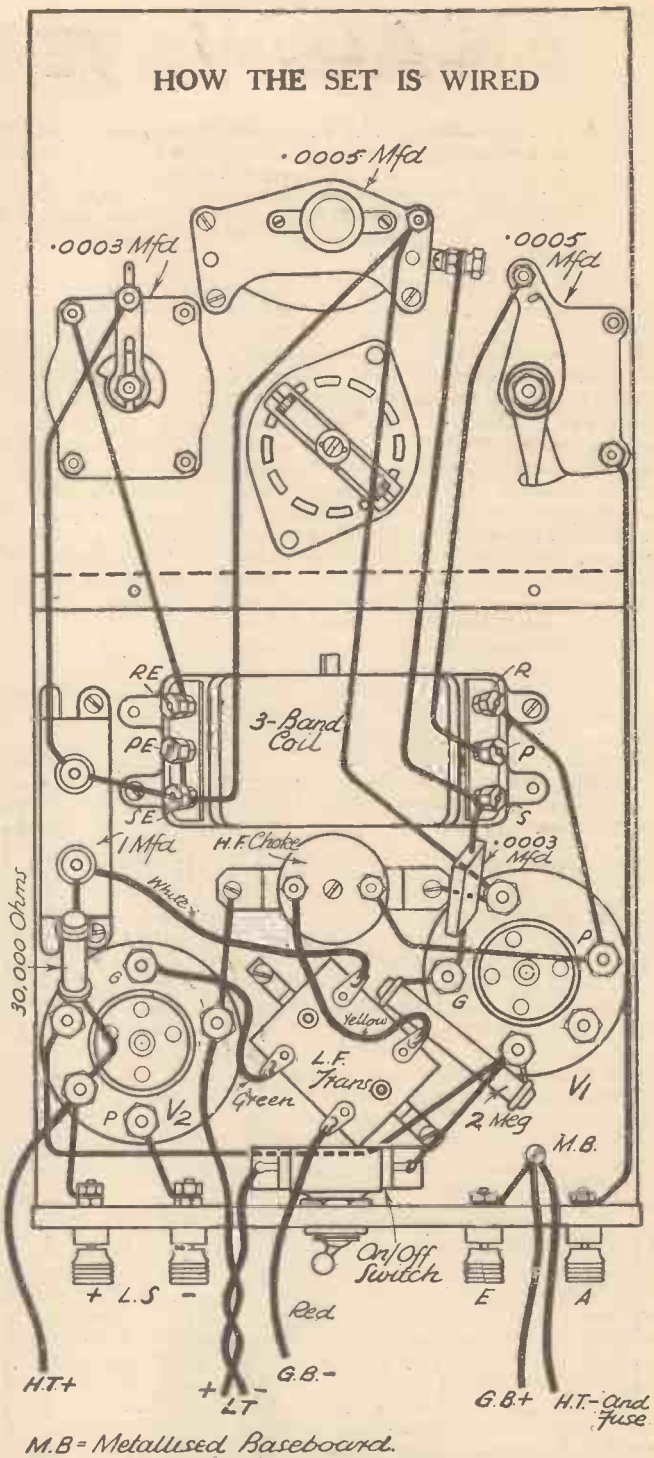
The actual operation of a set of this type has been described so many times that it is unnecessary to repeat it. However, just a few words about the aerial coupler. This serves two purposes. It acts as a volume control on powerful local signals, and also as a selectivity control. The nearer it is to the fully anti-clockwise position, the greater will be the selectivity.

Output Valves

Regarding the short-wave stations, it should be pointed out that stations will not be received on all bands at the same period of the day. Certain bands are received at certain times. Details of these times have appeared in "P.W." frequently in the past.

Whilst almost any type of output valve (V2), triode, tetrode, or pentode may be used in this set, the valve specified gives about the best results as regards quality, sensitivity, and economy. The actual H.T. consumption of the whole set is only about 8 or 9 milliamps. with 120 volts H.T. Of course, if you require a bigger volume, a Z 220 valve of the same make may be used. It should be pointed out, however, that the H.T. current will be nearly doubled, and sensitivity will be decreased somewhat.

The detector valve (V1) has no really satisfactory alternative. The L2 certainly gave the best results of all the valves that were tried. Consequently you are strongly advised to stick to specification here. It may be found difficult to obtain reaction over the whole of the short-wave band, if a different detector is used. There may be an excess of "top" in the reproduction, due to the tetrode output valve. This is common to all tetrodes and pentodes. To overcome this trouble, it will be necessary to shunt the loudspeaker by a condenser and resistance in series. Their values must be found by experiment. Suggested values, for a starting-off point, are ·01 mfd. and 10,000 ohms respectively. This tone-balancing device has not been incorporated in the set, as various loudspeakers require different values. The values suggested above are suitable for the loudspeaker specified.



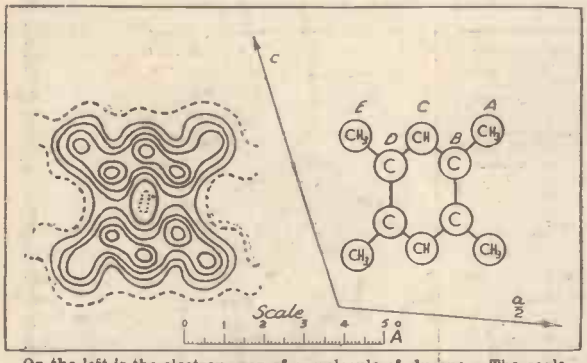
The complete wiring is shown in this diagram. Note that the wavechange switch spindle is broken to enable it to be shown in "plan" on the panel.

WHY IS AN INSULATOR?

Recent advances in electrical science have given us methods of examining the actual molecular and atomic structure of substances, and in this way we have been able to find out some extraordinarily important information which governs the properties of materials used for electrical and other purposes. The method of X-ray spectroscopy has been particularly useful in this direction, and in the following article our Scientific Adviser, Dr. J. H. T. Roberts, gives you a popular account of this very difficult and complicated subject. The Paper is based upon a Kelvin Lecture by Sir William Bragg, the eminent authority on the subject of X-ray examination of molecular structures

TO most people a dielectric is just another name for an insulator, a substance which refuses to conduct electricity. Of recent years, however, with the immense advances in electrical science, we have learned that all manner of effects are due to what takes place in a dielectric medium, and we have found it very important to give attention to the mechanism and functioning of the dielectric. It has turned out to be an extremely complex and in some respects an intractable problem, and we have yet a long way to go before we can claim to understand truly the nature and properties of dielectrics. But we have gone a little way and we have begun to explore the structure of insulating media and to compare them with the structure of better understood, and perhaps more ordered, substances, such as crystals and electrical conductors.

A DURENE MOLECULE



On the left is the electron map of a molecule of durene. The scale is in Angstrom Units (1 Angstrom unit = 10^{-8} cm.)

The X-Ray Spectrometer

These problems—for they are many—have been attacked by a great variety of methods; but one which is singularly beautiful in its technique and which has yielded, over a period of years, the most remarkable results, is the method of the X-ray examination of molecular structure by means of the instrument now known as the X-ray spectrometer. With this science—and it has now become of such importance as to be entitled to be described as a science in itself—the name of Sir William Bragg, Professor of Natural Philosophy at the Royal Institution, is the most prominently associated, and it was therefore very appropriate that Professor Bragg should have chosen the subject of "The Molecular Structure of Dielectrics" when he was invited by the Institution of Electrical Engineers to deliver the Kelvin Lecture for the year 1935.

It is impossible in this short space to give you anything like a comprehensive account of this extremely interesting lecture, and furthermore the subject, as you can imagine, is apt to become very abstruse. I will do my best, however, to give you a short outline of the discourse in as simple and popular way as I can.

A Crystalline Substance

First of all, it would perhaps be best to explain that a crystalline substance, or perhaps I should say a substance in the crystalline form, is differentiated from all other substances by the very definite and orderly way in which its molecules or groups of molecules are arranged. Without going into the details of the reasons for this, it is due to certain forces which operate when such a substance is separating itself out from the state of solution, and, as most of my readers no doubt know, different crystalline substances separate out in definite well-designed geometrical crystalline forms which are characteristic of the substance.

In the earliest investigations into molecular structure by means of the X-ray spectrometer, crystalline substances were generally used, for the reason indicated above. But whilst the X-ray methods are at their best when dealing with the bodies we call crystals, wherein the atoms and molecules are arranged in perfect order, following some pattern which repeats itself in all directions in the space within the bounds of the crystal, at the same time we now find that this orderly arrangement which is carried out to the full in the perfect crystal, is very common, though in less degree, within bodies which show no outward trace of it; for example, in resins, in rubber, and in wool.

There are, in fact, very few bodies in which there is not *some* degree of order, and so long as this is the case the X-ray method of analysis finds greater or less opportunity for employment. Liquids lend themselves to X-ray investigation much less readily than solids.

One of the most useful ways of presenting the results of X-ray analysis is that which depends on the construction of what we may call an "electron map," of which examples are given in the accompanying figures. The molecule in this particular case is that of "durene," an organic molecule consisting of a "benzene ring" in which four of the hydrogens have been replaced by methyl groups, as shown in the ordinary chemical diagram alongside, with which the map is to be compared. Each atom appears as an electron cloud. The positive nuclei do not appear, because they have no appreciable action on the X-rays, and the map is put together from observation of X-ray effects in a special manner. Electron maps have been made of several other important organic molecules, and durene has been chosen as an example here simply because the molecule stands out so well from its neighbours.

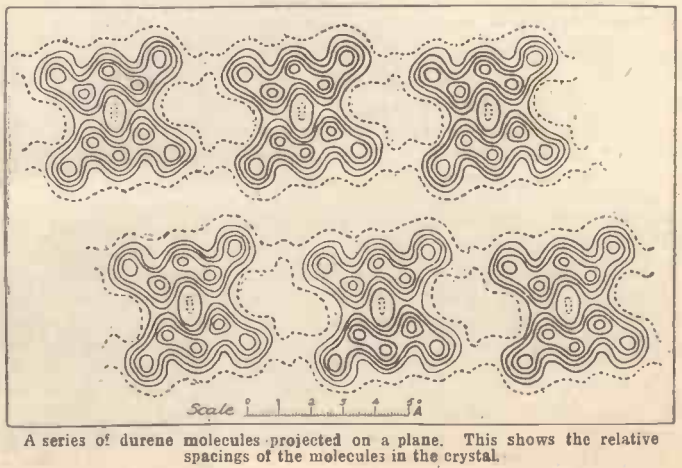
The "Benzene Ring"

By means of investigations like these it is possible to determine with great accuracy the space relations of atoms and molecules. There are, of course, as I have already indicated, other methods than those based on the use of X-rays; such methods are those depending on the determination of di-pole moments, or moments of inertia, or on the use of molecular beams, or again on electron diffraction. The X-ray methods, however, differ from most of the others in that they reveal the arrangement in the interior of the solid body where the molecules are linked up with their neighbours and so give the solid the characteristic peculiar to it.

I have referred to the "benzene ring," which means an arrangement of atoms frequently found in organic compounds and of great importance both in organic chemistry (in which category is included the chemistry of most dielectrics) and in X-ray analysis, and it is interesting and very important to note that in whatever structure the benzene ring occurs it is always found to possess the same form and

(Continued overleaf)

SPACING IN THE CRYSTALS



A series of durene molecules projected on a plane. This shows the relative spacings of the molecules in the crystal.

WHY IS AN INSULATOR?

(Continued from previous page.)

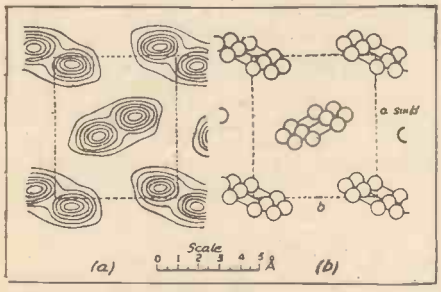
dimensions, the form being uniformly a regular hexagon lying in a plane, the length of each side being 1·41 Angstrom units (one Angstrom unit equals 10^{-8} cm., —that is, one hundred-millionth of a centimetre).

We have to think of this ring (which is only one example of many such arrangements) as a strong framework, unyielding in form and dimensions, no matter of what structure it forms a part. Those of you who have a knowledge of chemistry will remember the single, double, and treble " bonds " of the chemist, that is, particular linkage systems of atoms, and will be interested to know that these are found by X-ray analysis to correspond to differences in atomic distances. Thus a single bond which, in diamond, governs the whole structure, corresponds to a distance of 1·54 Angstrom units between each pair of carbon neighbours. The same bond and the same distance are found in the saturated chains of the paraffins, fatty acids, alcohols and the like.

Organic Origin

These illustrations of electron projection have been chosen from the organic field because, as I have already mentioned, the substances used as dielectrics are so largely of organic origin. The organic molecules are in a great number of cases clearly defined and separate. Their distances from one another in the solid, that is, the distances of closest approach of atoms belonging to one molecule to atoms belonging to another molecule, are generally two to three times the distances between atom and atom in the one molecule. When an organic substance melts, the molecules part company, but not the atoms in the molecules.

IN NAPHTHALENE



Projection along an axis, showing naphthalene molecules almost end-on. The contour lines are here graded by differences of 2 electrons per A³.

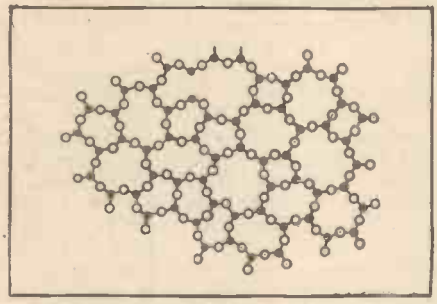
Dielectric materials in ordinary use are generally composed of molecules far more complicated than that of durene, which was taken as an example above, and the arrangement of the molecules is far less regular. Nevertheless, we are able to make a useful study even of such cases.

In Professor Bragg's original Paper an account is given of the method of constructing an electron map, and in the accompanying illustrations you will see the reproduction of X-ray photographs which serve as illustrations of crystals of different degrees of regularity and different composition.

Structure of Glass

It will be noticed that vitreous silica gives a very poor photograph, consisting only of diffuse rings. Many of the substances which are used by the electrical engineer, such as glass or bakelite, give photographs nearly or quite as indistinct. It might therefore be thought that the X-ray methods would consequently have little to say in such cases; but, on the contrary, it has been found that much useful information can still be obtained by X-ray analysis notwithstanding the formidable difficulties met with.

THE ATOMS IN GLASS



A diagram, due to Zachariasen, of the probable ways in which silicon and oxygen atoms are linked together in glass. The diagram does not show the extension in three dimensions, each silicon in the material being linked to four oxygens, whereas only three linkages are shown. The main point is the irregular lacing of the atoms together. (*Journal of the American Chemical Society*, 1932, *vol.* 54, *p.* 3846.)

X-ray methods have been remarkably successful in revealing details of many complicated structures, including particularly those of cellulose and related substances and of the proteins. To these substances many of the materials used in the electrical industry are closely related, or at least are similar in behaviour.

Apart from the practical importance of finding out more and more of the structure, and consequently of the behaviour, of dielectric substances when used merely for the purpose of electrical insulators, it must be borne in mind that we are realising more and more, as science advances, the intimate part played by the dielectric in many electrical phenomena.

Energy in a Condenser

Time was when we thought that the energy stored in an electrical condenser, for example, consisted merely of electrical charges held in some way on the metal plates of the condenser. We know now that the energy resides in some obscure way in the field in the dielectric, and we begin to see why the amount of the energy thus stored or, in simpler language, the electrostatic capacity of the condenser, depends so much upon the electrical properties of the dielectric medium.

A great amount of attention has been given to the study of electrical *conductors*, and our knowledge in this field has advanced immensely during the past decade. The opposite side of the picture, the dielectric or *insulator*, has, however, been somewhat neglected; but with the advances in science, and particularly in radio science, where high-frequency and capacity effects are so important, we have found the need to study and understand the properties of dielectrics and the molecular and atomic structure upon which such properties ultimately depend.

Those of you who are interested in this subject should read Professor Bragg's Paper, which you will find in the Journal of the Institution of Electrical Engineers, Volume 77, No. 468, December, 1935. It is apt, as I have hinted before, to be rather abstruse in parts, but those of you who have some knowledge of chemistry and of atomic physics will find it extremely fascinating.

A FLASHLAMP PRECAUTION

A simple method of preventing the accidental running down of torch batteries.

RADIO servicemen and other technical workers who go out " visiting " ailing receivers and who habitually carry a flashlamp in their pockets for the purpose of inspecting the internals of such sets, will find that a broad rubber band slipped around the body of the flashlamp just above the operating " button " of the latter will entirely obviate the possibility of the flashlamp being inadvertently switched on as a result of being jostled about in the pocket.

When the rubber band is in this position the flashlamp can be safely carried in the pocket.

Wasted batteries will thus be prevented, since the operating button or lever of the flashlamp cannot possibly be moved upwards accidently owing to the presence of the rubber band.

When the flashlamp is wanted for use, it is the occupation of a second to push the rubber band upwards and out of the way of the operating button. Similarly, when the lamp is slipped back into the pocket, the rubber band is instantly pushed back into the " safety " position, as illustrated in the photograph.

VARIETY FROM WORCESTER

On August 3rd theatre variety will be broadcast from the Royal, Worcester (Midland programme), where the bill will include: The Four Aces, harmony vocalists; Mary Fuller, in comedy songs; the Geddes Brothers, musical clowns; and Peter White, comedian.

TELEVISION TOPICS—*Collected by A. S. Clark*

"TELEFRAMES"

Items of general interest

MORE AND MORE SETS

IT would be most unsafe to attempt to estimate the number of firms who will be showing television sets at Olympia, for every day one seems to hear of some new firm going into this market. Invicta Radio has recently announced its intention in this direction.

No doubt the time is not so far distant when almost every maker of radio receivers will list one television outfit amongst his range.

* * *

KEEP STILL, PLEASE !

Miss Elizabeth Cowell had a butterfly settle on her head when announcing the other day. Unpleasant as it may have been, she just ignored it and carried on.

But suppose it had been a big spider dropping from the roof, to say the least, that would not have been so easy to ignore. The possibility conjures up thoughts of some nervous person being televised when a mouse runs up on to the table with her speech notes on ! Or what about one of those who are in fear of their lives where cats are concerned, when the studio moggy peeps round the corner of the door ?

* * *

GREATER SENSITIVITY

We are all hoping for big things from the B.B.C.'s new and super-sensitive television cameras. It is stated that they can be adjusted, possibly by filters, to deal with colours in their subjects better than at present, when two widely different colours can have almost the same monotone value.

Progress is certainly not at a standstill.

* * *

HOW TO PAY FOR IT

It seems that the provision of a television service in America is now held up for the settlement of just one question. How can it be made to pay ?

Those concerned seem pretty certain that sponsored programmes by manufacturers and other firms will be the method. That being so, television, when it is launched, must be done in a big way, otherwise advertisers will not get value for their money.

Interesting discussion surrounds the possible way in which advertisers' announcements will be made. It is considered that, in view of the medium, an aural announcement would not be considered sufficient. Would the sponsors expect their goods to be displayed on the screen ?

Such a break would be more of an intrusion than the verbal announcement ever is. But if the displaying is done by some celebrity it would not be so bad, but expense would again be increased.

* * *

WHERE DOES IT SCORE ?

A scheme for the dissemination of news lines to subscribers by means of television has been developed in America. News items are typed on tape strips at the transmitter, and then run before the television gear. The news is eventually reproduced by mechanical means at the receiver.

But what is the advantage of the scheme ? Surely a telewriter in which the received tape is made to operate letter keys would be just as effective but simpler ?

* * *

THE SCIENCE MUSEUM EXHIBITION

The television exhibition at the Science Museum, South Kensington, is doing useful publicity work for television. It is stated that over 2,500 people have been visiting the show each day.

The crowds attracted have been fifty per cent. greater than those which have been attracted by any other special display staged at the museum.

* * *

SPECIAL TELEVISION PLAYS

Original material specially prepared for the television medium will be more in evidence next Autumn. Already several script writers are busy and at any rate one murder mystery is being evolved in which the television studio is the scene of the crime. Another original play will be concerned with the discovery of chloroform and particularly the dramatic occasion on which a group of doctors, led by Dr. James Simpson, experimenting with the new anæsthetic in 1847, endangered their lives while taking notes on each other's reactions.

Some radio personalities around one of the latest Ferranti television receivers. Seated on the left and second from right are Mr. Loughran and Mr. Lewis, respectively, of the Hazeltine Corporation of America, who recently paid a visit to the Ferranti organisation. The others from left to right are : Mr. Taylor, Dr. Searby (Ferranti television engineers), and Mr. Hall (Chief Radio Engineer of Ferranti's).

TIME-BASE EFFECTS

THOSE who have handled the controls of a double time-base and noted the effects produced on the screen of the cathode-ray tube will soon have found out that there is considerable interdependence of these on one another. This applies whether the double time-base is intended for high-definition television or for purely experimental purposes.

To some it may have seemed puzzling since it is usually stated that the controls of a good time-base should be entirely independent. But it must be remembered that this does not apply to the effect of the controls.

There are normally two principal controls, one varies the rate at which current flows into the "charge" condenser, and the other the voltage to which the "charge" condenser is charged before the discharge system comes into operation. When the *rate* of charge is varied it must not affect the voltage at which discharge takes place, and similarly, altering the voltage reached by the "charge" condenser must not affect the rate at which current flows into it.

Bearing that in mind, we can consider the effect on the screen of these two controls. First of all we will assume that we are dealing with the line or high-speed time-base and that the other is functioning normally.

The object of the control that varies the voltage at which discharge occurs is to vary the length of the lines on the screen. And the object of the rate-of-charge control is to alter the number of lines on the screen, since the quicker the spot moves (quicker charging rate) the less time each line will take, and the more that can be drawn during the fraction of a second taken by the slow time-base "charge" condenser to become charged and discharged again—at which point, of course, it starts a fresh frame.

The Rate of Charge

Bearing in mind that we have only a certain fixed time for each frame, we can consider the effect of the two controls further.

If we increase the rate of charge, each line will be drawn quicker and we shall get more lines, but the length of these lines will not vary, since the same voltage is still attained before discharge occurs. But suppose we lengthen the line by requiring the condenser to charge up to a higher voltage.

The rate of charge will remain as before, so that each line will take a little longer, and consequently we shall reduce the number of lines as well as lengthen them. If we want to increase the length of line and retain the same number of lines, then not only must we charge to a higher voltage, but we must charge at a quicker rate also, in order that the longer line will take just the same time as the previous shorter line.

Thus we see that the number-of-lines control is quite independent of the length control if used first or by itself, but that the length control can never be independent of the rate-of-charge control (number of lines).

Now, if you have followed that you can spend an interesting evening getting clear in your mind how alterations of the slow time-base can also affect the number of lines by giving a shorter time for each frame.

When you have thoroughly appreciated these effects you will be well on the way to a complete grasp of cathode-ray-tube operational technique, and will appreciate why the original setting of the time-bases of a television receiver is such a critical job.

METAL CABINETS

Reviewing some useful lines for the radio constructor

THE illustration shows two Ridco Semi-metal cabinets, and a Ridco Standard Chassis. The cabinets are extremely useful for housing oscillators, small amplifiers, power packs, and other such apparatus, whilst the chassis is suitable for the construction of all types of receivers and amplifiers built on the chassis principle.

The two top items in this photo are metal cabinets, one with ventilating grids, while the lower item is a metal chassis.

Both cabinets are similar in construction, and consist of black enamelled metal sides, clamped, by means of screwed rods, between a base and top of ebonite. In the case of the larger cabinet (type R/C2), two opposite sides are provided with ventilating grids, whilst the smaller one (type R/C1) is unventilated. Consequently, it is desirable to use the larger type when the apparatus to be housed generates any appreciable amount of heat. The metal sides of the cabinets may be earthed if it is desirable to screen the enclosed apparatus. Incidentally, in the case of mains apparatus, earthing the cabinets is a safeguard against shocks when handling.

Type R/C1 measures 6 in. × 5 in. × 5 in., and is priced at 4s. 6d., and type R/C2 measures 12 in. × 6 in. × 6 in., and costs 8s. 6d.

The Chassis

The Standard Chassis measures 12⅝ in. × 8¾ in. × 3 in., and is well made from 20g. aluminium, finished in grey cellulose. The ends are reinforced by heavy brass "U" brackets, and the whole job is perfectly rigid. Normally it is supplied undrilled at a cost of 6s. 6d., but it may be obtained ready drilled to individual specification for an extra charge of 2s. 6d.

All three of these accessories represent very good value for money. We feel that such professional-looking jobs—especially the cabinets—are very welcome to the constructor, who, in the past, has found it very difficult to procure such things.

The manufacturers are Messrs. Radio Industries Development Co., Birch Street, Hanley, Stoke-on-Trent.

A SCREW-SAVING HINT

SMALL screws have an annoying habit of getting lost, or, at any rate, of becoming misplaced just when they are wanted for a job of radio woodwork.

There is, however, one infallible way of overcoming this nuisance. Procure an odd piece of soap and, before commencing the job in hand, stick in the soap all the small screws which you are likely to require.

Safely secured in this manner, screws cannot possibly go astray and lose themselves among the miscellaneous odds and ends of a busy radioman's work-bench.

Keeping the screws together.

There is another advantage, also. The screw threads become lubricated with the trace of soap which adheres to them. Thus they are inserted and screwed up into the woodwork with much greater ease than would otherwise be the case. There is, too, when such "soaped" screws are used, rather less danger of any thin portions of the woodwork splitting. **J. F. S.**

TECHNICAL JOTTINGS

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

Items from the notebook of a radio technician

Applications of Radio Apparatus

THE apparatus of radio is continually finding new applications in different directions. Perhaps the most universally useful are the valve amplifier and the photo-electric cell. These are used for all manner of purposes, some closely and some only distantly related to the science of radio. I have several times in these Notes mentioned different applications of photo-electric cells and, as regards valve amplifiers, you will have no difficulty in thinking up numerous applications of these, some of them not directly connected with radio at all.

The Speaking Clock

A very recent and important service which depends largely upon radio apparatus in this way is the "speaking clock" which has been introduced by the G.P.O. for providing an accurate time service to telephone subscribers in the London area. A subscriber in this area, and connected to an automatic exchange, dials the code TIM and is routed to the clock and hears the time announced every ten seconds. Each note is followed by three audio-frequency pips, the third of which indicates the time mentioned to within errors of plus and minus $\frac{1}{10}$th of a second.

Recording the Phrases

Many of you who have used this service may have wondered how the announcements are recorded and reproduced. They are made, as a matter of fact, by photo-electrically reproducing words or phrases which are selected in the correct sequence from recordings made photographically on four glass discs. The mechanism for rotating the discs for building up the announcement and for changing from one announcement to another is driven by a low-speed synchronous motor. The frequency of the A.C. supply to this motor is directly controlled by a seconds-beating free pendulum. Every hour the clock is checked automatically against a signal transmitted from Greenwich Observatory and any small error is corrected. Should the error exceed the prescribed limits the service is transferred to a duplicate standby clock. Facilities are provided to connect up to 100 simultaneous calls to the installation.

The Development of Timekeeping

As modern conditions of living have created a widespread need for a much more accurate knowledge of the time-of-day than existed a comparatively few years ago, it may be interesting to trace very briefly the development of various time services in this country up to the introduction of the talking clock.

It was not very long ago that in most towns the time was taken from public clocks of some kind, disagreement between which was the rule rather than the exception. This was an obstacle to the smooth working of postal services, amongst other things, and led to the practice on mail coaches and trains of carrying chronometers to synchronise local post-office clocks with a standard clock in London. When the electric telegraph was introduced, various electro-mechanical devices were tried for automatic synchronisation of local clocks by means of telegraphed signals. About the year 1850 experiments began in connection with the synchronisation of the London post-office clocks with the Standard Mean Time clock in Greenwich Observatory. The logical development of this service is the International Time Signal which was introduced in 1927 and is transmitted from Rugby radio station at 10.00 and 18.00 G.M.T. daily.

A Popular Service

From the public point of view these services have the disadvantage of not being readily available where most needed, that is, in the home. This need was partially satisfied when the telephone subscriber could learn "the time by the exchange clock" by asking the local operator. This service was never claimed to be highly accurate, although its popularity may be judged from the fact that in the London area alone over 100,000 inquiries per month were received.

Those B.B.C. "Pips"

The well-known six pips transmitted by the B.B.C. at certain times of the day are, of course, very accurate and are useful for checking the domestic clocks. The B.B.C. time signals, in fact, represent a great step

(*Continued on next page.*)

TECHNICAL JOTTINGS

(*Continued from previous page.*)

forward in providing accurate time in the home.

The best of all way for accurate domestic time-keeping is the electric synchronous clock which keeps in step with time-controlled A.C. mains. The use of these clocks is far from universal at present, although it is rapidly increasing.

In the meantime there was abundant evidence of the desirability of an accurate time service *via* the telephone, and this is what led to the introduction of the speaking clock. This had already been introduced with success in certain Continental towns. A speaking clock was inaugurated in connection with the Paris telephone service early in 1933 and at present calls are made to this speaking clock apparatus at the rate of over 10,000 per day.

Accuracy

I have not the space at the moment to say more about this subject, but if any of you would like more technical details of how the recordings are made and reproduced and how the system is made accurate I will give you some further details in a week or two.

In the meantime, those of you who are seriously interested will find a very comprehensive description of all this in a Paper read before the Institution of Electrical Engineers and published in the May volume of the Journal. The Paper is by Dr. Speight and Mr. Gill, well-known Post Office engineers, who have been largely responsible for the technical development of this service.

Too-Loud Speakers

In spite of much advice to the contrary, there is no doubt that a large percentage of listeners—I think one might almost say the majority—favour a fairly loud reproduction. It is difficult to say just why this is. I suppose it is the same sort of thing as the desire to have a fast and powerful car, even though the conditions on the roads to-day generally make it impossible to utilise the abilities of the car to anything like their full extent. The radio set has to be used, as a rule, in a relatively small room where small power is quite adequate and much more pleasant, but in spite of that people just will have enough power to be heard half-way down the street, when the window is left open—or even when it isn't.

Every owner must be the best judge of the volume he requires from his set. Personally, I prefer a set to be nicely toned down, no louder than is necessary for just hearing it clearly. Your ears soon get used to this, and you hear it quite as effectively as if it were very much louder and, of course, much more pleasantly.

Power-Grid Detection

In their desire for extra loudness many amateurs turn to power-grid detection instead of the ordinary detector stage. Before saying anything further about this, I should warn you that there is often a snag in it in this sense, that the power you are going to get from your loud-speaker depends primarily upon the input signal energy and upon the amplification provided at the various stages of the set. The incoming signal is increased in strength by the H.F. amplifying stages, and eventually a signal of a certain strength is delivered to the detector stage. Assuming the detector stage is well able to handle this strength then all is well, and this is passed on to be further amplified, after rectification, in the low-frequency stages. In circumstances such as this the substitution of a power-grid stage for the ordinary grid stage will not increase the loudness of reproduction from the speaker, because the present detector stage is doing all that can be done.

The Bottle-Neck

Where the power-grid stage will prove an advantage is in the case where the signal energy delivered to the detector is more than the detector can efficiently handle. In this case you have a kind of bottle-neck which not only prevents the proper passage of the energy available, but also introduces distortion in the process. Here is a clear case for the substitution of power-grid for ordinary grid detection.

You will see from this that the power-grid stage does not *produce* more power. It merely enables more power to be *handled* if such power is available. In the same way the ordinary grid stage does not prevent power from getting through, provided the power is within the handling capacity of the stage.

So that the question as to whether a power-grid detector stage is called for or not depends more than anything else upon whether the present detector stage is able to handle properly the power which is delivered to it.

Values of Components

You probably know that the power-grid circuit is practically the same as the ordinary grid-leak-detector arrangement but using different values of grid leak and condenser. These values are usually much lower, the value of the leak, say, ½ megohm, and the condenser ·0001 mfd. The power-grid detector works on a different part of the characteristic curve from the other, and for this reason it is important that a relatively high anode voltage should be applied to it.

Unless you have sufficient high-frequency amplification or unless you are dealing with a powerful local station it is quite possible that you do not require power-grid detection at all.

A Question of Signal Strength

Before deciding to alter your circuit by this substitution you want to consider carefully whether, with the particular aerial you have and the strength of the stations you generally receive, and also with the screen-grid–high-frequency amplifier stages on your set, you are likely to be delivering to the detector an amount of power which is beyond its handling capabilities. If the power delivered is within the capacity of the detector stage, then leave it alone, but if, on the other hand, you calculate that the detector is being overloaded, then it may be worth while to think about a change-over to the power-grid arrangement. But remember that taking a pint out of a pint pot and putting it into a quart pot doesn't make it a quart. Generally speaking, the average broadcast set will give all the volume needed without overloading of the ordinary grid-leak detector.

FROM OUR READERS

A NEW METHOD OF STATION REPORTING

A reader puts forward an interesting scheme for the real enthusiast.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have been extremely interested in reading through the medium of your paper the various letters from S. W. Ls. complaining of the failure of many stations in giving the said S.W.L.'s replies to the reports they are submitting.

I think I can rightly say that the majority of S.W.Ls. are really an enthusiastic lot, and I am sure they would readily understand and accept a possible solution to their present problems. With this in mind I have written the following.

I must at least say that the scheme I am about to suggest will involve considerable time and work, and in view of this will lend itself suitably to the serious listener. The scheme, by reason of the extra trouble involved, will serve to eliminate the S.W.L. who considers it too much trouble and will resultantly leave a clearer course for the listeners who will adopt this method.

There are two items required for this in addition to the usual equipment of the S.W.L.'s den, and that is a good log book, which, unfortunately, many of the S.W.Ls. of to-day don't seem to keep, and in addition a copy of the Radio Amateurs' Call Book, the more up to date the copy the better. An old copy of this is also useful, because by comparison you will be able to find out whether certain stations are newcomers or the old hands.

Making a List

Then commence by logging as many stations as you can, strength and quality to make no difference, detail your log out as far as possible to include stations heard, calling, frequency, time, WRT mod. quality, QRM, QRN, QSB, conditions, and general remarks. Then after a few days, or say about every week-end, list all these calls under their respective countries on special sheets. One sheet will contain perhaps 50 W. stations, another perhaps 25 V.E. stations, and so on. Taking the American sheet, for example, of these 20 different stations were heard, some of them perhaps as many as six times in the week.

Then what you have to do is print 20 copies of this report sheet by means of a typewriter or any other means you have. Then after printing these copies send one to each of the stations heard, if you are able to afford it; if not, just send them to the stations appearing on the sheet the most.

Of course, if you are able to make a sheet of each separate district heard, all the better, but this you will have to decide for yourself. But by means of the QRAs in the call book you will be able to send these direct, and so be certain that they won't be delayed in the bureaux; in any case only cards are dealt with by the QSL bureaux, so these logs wouldn't be accepted. By this means the station to whom you submit a sheet will be able to compare his station's strength, etc., over certain periods, and also be able to compare them with other stations in his locality, by means of the other stations logged on the sheet, and perhaps by means of these sheets he can refer back to any particular adjustments he may have made within that period and note any variations they may have made in his strength.

You will, of course, realise that very few reports of this nature are submitted, and yet you will be well able to appreciate the fact that in most cases they will be well received. You will be rather surprised at the response you will get to your reporting if you adopt this method, and in addition you will find it a pleasant diversion making the comparisons yourself.

Of course, the actual carrying out of this plan is left entirely to you. And the more detailed you can make these sheets the better. If you could make one sheet for W 2, one for W 3, etc., so much the better. But it is left to you to decide this.

The addresses in the call book will help you to work out the various localities, and if you find they are fairly new stations by means of the call book, the chances are the reports will be more useful still. I might add that I tried this plan myself some time ago and achieved quite good results from it, and for that reason I am anxious that you should have a chance to try it also.

C. E. SPILLANE.

22, Burns Road, Harlesden, London, N.W.10.

WIN A GUINEA!

By simply writing to us about any radio subject you like. This sum is awarded each week to the writer of the letter which, in the opinion of the Editor, is the best of the week's batch. Your letter may be long or short, practical or otherwise. It may give an opinion or describe an experience. Why not let us have your views or experiences? This week the guinea goes to Mr. C. E. Spillane.

INCREASED SENSITIVITY

The Editor, "Popular Wireless."

Dear Sir,—A year or so ago I constructed the "P.W." "All-in" frame assembly, a 3-valve portable set consisting of H.F. pentode stage, triode detector, and pentode output. The design was, I believe, published in June, 1935.

Having recently been transferred to a greater distance from the local station, I found that results were extremely weak, Droitwich being the only station received at comfortable listening strength, so I am passing on my experiences for the benefit of those readers who have had the same difficulty.

On substituting an H.F. pentode, viz. Mazda S.P.210, metallized, for the existing triode detector, sensitivity was greatly increased, enabling me to bring in at good strength stations which had hitherto been very weak. A 100,000-ohms resistance and 1-mfd. by-pass condenser were used in the usual way in connection with the auxiliary grid of the H.F. pentode.

Wishing your paper every success.

R. W. COOMBS.

24, Old Tiverton Road, Exeter, Devon.

USING INGENUITY

The Editor, POPULAR WIRELESS.

Dear Sir,—I am fourteen years old and became interested in wireless about four years ago when I built a single-valve broadcast receiver with plug-in coils which I wound myself. Then I became a short-wave fan and, not being well off, I could not afford to buy components, so I made my own.

I made my own coils with the helpful advice of W. L. S.; these, by the way, were wound on cardboard tubes. My fixed condensers were made from silver paper out of cigarette packets. I had to experiment to find the best sizes. My short-wave choke I wound on a test tube, and I did not know how many turns, so I looked in a shop window and counted the number of turns on a short-wave choke they had there.

All these components were mounted on, and in, a cocoa tin.

My aerial consists of a piece of spring curtain wire stretched across my window with a lead-in of flex and insulators consisting of bottle necks.

This set which I made from home-made parts worked, and I listen-in at half-past two, when everyone is asleep. My earphones consist of half a pair, and so as to be able to use both hands I put a strap round my head and jam the earphone under this.

I can remember the first time I got America. Boy, was I excited! I'll say! The person I heard was an amateur from Quebec who was transmitting with a 50-watt transmitter.

F. E. NASH.

28, Wilton Crescent, Shirley, Southampton.

WHERE ARE THEY?

The Editor, "Popular Wireless."

Dear Sir,—Three weeks ago you published a letter of mine in which I made the following request—"I should like to get in touch with any reader in my district interested in S.W. work." I also made a similar request in another wireless weekly a few weeks ago.

Perhaps you will be interested to know that I have received exactly TWO replies, one from a 15-year-old S.W. enthusiast and the other from a local "ham."

According to articles written in various wireless mags., etc., this country is supposed to be bubbling over with S.W. enthusiasts, especially of the younger generation. ARE WE BEING LED UP THE GARDEN? or are the so-called enthusiasts so full up with enthusiasm that they have no time for anybody except themselves? I rather fancy that this is where their enthusiasm is lacking. What do you and other readers think?

Perhaps this letter will bring to life some of the enthusiasts in my district (if there are any). I am anxious to start a short-wave DX-ers' club, so would all interested please write or call at my QRA? I should be more than pleased to meet them. My shack is an ever-open door for anyone interested in radio.

Thanking you for the fine S.W. articles, etc., and wishing "P.W." all the success it deserves.

WILLIAM (BILL) COLCLOUGH.
(Member B.S.W.L. 316.)

31, Lancaster Gardens, West Ealing, W.13.

ALL'S WELL

The Editor, POPULAR WIRELESS.

Dear Sir,—I thought perhaps you would be

(*Continued on next page.*)

SOUND-ON-FILM RECORDING

An interesting German portable recording outfit. It is a sound-on-film system and employs ultra narrow gauge film.

FROM OUR READERS

(Continued from previous page.)

interested in the opinion of a very old reader of your magnificent paper.

When I say an old reader I mean it, because I have been reading radio journals ever since the first issues of the "Wireless World," actually in 1912, and I may say that I was one of the very few persons to own a receiver in the Manchester district at this period. So you see my radio experiences are of long standing and I have read every manner of paper published on this subject, but, believe me, your POPULAR WIRELESS is in my opinion the "top" of the weekly issues. The War put "paid" to my activities, but I started again on resuming my civilian status. Eventually the short-wave "bug" bit me, and now I cannot keep away from the never-ending entertainment and surprises one gets with S.W. radio.

By the way, the article "The Dial Revolves," also the tests made by Leslie W. Orton, are really enjoyable and looked forward to by me. Being a motorist myself I know that with the gear they must have to carry in a car comfort and pleasure must be the very last thing he expects, and he really is a "swell guy" doing this for the benefit of your readers and S.W.Ls. as a whole.

F. A. Beane's articles are also very helpful to all S.W.Ls., and in fact the whole of POPULAR WIRELESS is brimful of interest and help in this wonderful hobby.

ALBERT PARK.

423, Bury Old Road, Prestwich, Manchester.

THE TELEVISION EXHIBITION

The Editor, "Popular Wireless."

Dear Sir,—We have read with interest your contributor's (K. D. Rogers) article, dealing with the Science Museum Television Exhibition, in "Popular Wireless" dated 3rd July. With reference to his criticism of the Baird Cathode-Ray Tube demonstration equipment, however, he has made a gross error.

If he had taken the trouble to read the explanatory caption, and noted the section in which this equipment was housed, he would have seen that its object is to demonstrate the principles of scanning. A rotary switch enables the picture to be built up from a stationary spot, and the number of lines for picture dissection and reconstitution can be adjusted as required. To suggest that it is a "museum piece" of apparatus shows a complete lack of understanding by Mr. Rogers, and we shall be glad if you will correct this in an early issue.

BAIRD TELEVISION LIMITED.

Crystal Palace, Anerley Road, London, S.E.19.

MR. ROGERS' REPLY

The "museum piece" referred to was, during the whole of the evening while I was at the exhibition—some two and a half hours—doing nothing but show a crude 30-line image on a cathode-ray tube. There was no one operating any control to show the build up of an image and the card on the apparatus, as I remember it, stated that the exhibit showed how a cathode-ray image was formed. In view of the fact that there was no demonstration of "forming," one was forced to the conclusion that there, before one, was a formed cathode-ray image, and with that impression was also registered the accompanying one that it was pretty poor.

It was not until one saw other cathode-ray images that one realised (and I am trying to look at it from the point of view of the layman) that the 30-line image must have been a "museum piece," and that it was certainly not an example of how a modern cathode-ray image looked.

I trust that for the rest of the exhibition a demonstrator will be in attendance to show the actual build up from spot to line and from line to frame, with the final modulation which I learn is the purpose of the exhibit. With such a demonstration it is valuable, for 30 lines can show more clearly what takes place than can 240 or more. But as I saw the exhibit it was a misleading affair and the card certainly did not tell one the whole truth.

K. D. ROGERS.

MARCONI—THE MAN AND HIS WIRELESS

(Continued from page 490.)

After that memorable night the atmosphere did not favour wireless for several days, and some difficulties developed in the alternator, so it was not until December 21 that a message from Marconi to the King of Italy and a greeting to England's King were intercepted on the other side of the sea.

Sandy Cape Cod was the scene of the next big act in the drama of wireless.

While Glace Bay far to the northward was winning new laurels for Marconi, lattice-like towers had been rising above the sand dunes overlooking the Atlantic, sixteen miles from the tip of Cape Cod's hook. This was South Wellfleet, Massachusetts, known by its call letters C C.[1] Built to communicate with England it was the first high-power station in the United States. About three weeks after Glace Bay went on the air Marconi left the northland to play the leading rôle in wireless on the Cape.

(Chapter XI to be concluded next week.)

[1] Station C C opened by Marconi Wireless Telegraph Company of America, January 19th, 1903. Call changed to M C C in 1910 and to W C C in 1913, the apparatus of which was dismantled in 1918, hopelessly out of date.

BECAUSE OF THE BIG DEMAND TO READ MARCONI'S LIFE STORY IN POPULAR WIRELESS YOU ARE ADVISED TO PLACE AN ORDER FOR YOUR COPIES.

SEEN ON THE AIR

NEWS AND VIEWS ON THE TELEVISION PROGRAMMES BY OUR SPECIAL RADIO-SCREEN CORRESPONDENT

L. MARSLAND GANDER

SO the television holiday of the B.B.C. is to be a "half holiday" only. Yielding to pressure from the trade and from manufacturers, the B.B.C. have agreed to broadcast special transmissions between July 26th and August 14th.

But viewers are requested not to look! That is the only possible interpretation of the official pronouncement. It is explained that there will be daily transmissions during this period on most days between 11 a.m. and noon, and 2 and 3 o'clock. These will consist of sound films and exterior shots, with records as an accompaniment. All will be prefaced with a caption card saying: "Test Transmissions for the Radio Industry."

Only Gilbert or Lewis Carroll could do justice to the B.B.C., 1937. I do not intend to try except that I should like to ask the rhetorical question: "What becomes of the argument that the holiday was necessary to rest and overhaul the apparatus at Alexandra Palace?"

Improved Programmes

I suppose we must commend the B.B.C. for retreating from an unfortunate decision, and regret that they have not retreated far enough. The worst feature of it all seems to be that the gap again creates the suggestion that the service is experimental.

I dislike continual anti-B.B.C. grousing which, moreover, is apt to become boring. I also have the greatest admiration for the work of Mr. Gerald Cock and his associates at Alexandra Palace. Programmes have improved in entertainment value out of all knowledge. Britain not only leads the world technically, but is unchallenged in television programme building. More is the pity, then, to take any backward step—even a temporary one.

I can hardly credit the current report that a close-down was decided upon to avoid the necessity for appointing deputies to the programme staff. The television staff needed a holiday badly, but it is fantastic policy to give them one all together. We must not have a close season for television. Enough!

Increased Mobility

Among the most interesting of new developments is what I might call the increased mobility of television. For the Wimbledon transmissions the vans were actually 400 or 500 yards away from the Centre Court, in a sports ground, and there were cable connections to the cameras. This means that provided the connecting cables can be controlled and protected properly, cameras may be placed and used anywhere within a very wide radius of the vans. One of the difficulties with outside television has been that the vans are very large and cumbersome. When an encampment has been made and the aerial set up, it becomes a job of some magnitude to move the whole outfit to another point.

Therefore it is most important that the B.B.C. engineers have been able to run out so many yards of cable without appreciable loss of signal strength and quality. Also, of course, it makes possible inter-related relays from a number of scattered points.

A Tour of the Zoo

I hear that the first experiment in this direction is likely to be at the Regent's Park Zoo. It has already been announced that in connection with the B.B.C.'s coming transmissions to Radiolympia between August 25th and September 4th there will be daily transmissions from Pets' Corner. The idea has now been expanded into a tour of the Zoo.

Viewers may expect to see elephants and camels carrying their loads of children, and many others of the Zoo's familiar sights. The *pièce de résistance* is likely to be feeding the sea-lions. Lighting difficulties will probably prevent relays from inside the houses.

By the way, the cable used is not the same as that which connected Apsley Gate with Alexandra Palace for the Coronation Procession television, and the technical problem is a different one. I can see great possibilities in this type of programme.

A second development of equal interest is the enormous improvement in the film transmissions from Alexandra Palace. For a long time the difference between the film and studio shows has been markedly to the disadvantage of the films. Now there has been a sudden change, and sometimes I think that film is better than direct transmission.

New Transmitting Tube

When I first asked the B.B.C. about the improvement they were, for some inscrutable reason, mysterious and attributed it largely to the fact that the films were being taken under summer conditions, for the most part in brilliant sunshine. However, I now learn that a new transmitting tube has been installed. This is not greatly different from the standard types already in use at A.P., except that it has an improved "gun." Still the effect on the film reproduction has been startling.

I have heard the expert opinion that the tube is capable of 1,200-line definition.

Since I was able to reveal, exclusively in these notes, that the B.B.C. synchronising signal was to be adjusted to make possible reception of the programmes by the Scophony system, the statement has been officially confirmed by Mr. S. Sagall, managing director of Scophony.

Personally, I hope that the adjustments can be made in time for demonstration at Radiolympia.

A Good Programme

In my earlier references to the coming Zoo transmission I should have taken the opportunity of congratulating the B.B.C. on the first performance by the larger animals in Alexandra Park. The friendliness of the programme was its principal charm, and it demonstrated once again how actuality scores over the studio item.

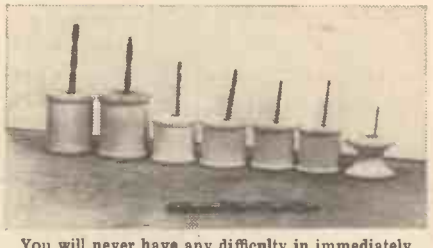
Babar, the young elephant, newly arrived from Calcutta and no doubt bewildered by his week of new experiences, was the "star." Children were seen riding on the llama, the chimpanzees "did their stuff." Elizabeth Cowell, slightly worried by the attempts of the penguin to peck her, nevertheless bore it calmly in the interests of television.

I do not know whether the B.B.C. rehearsed the programme at all, but it had the appearance of "presenting itself" with the easiest informality.

HANDY DRILL-HOLDERS

ONE may, perhaps, be excused for calling the notion illustrated in the accompanying photograph a "reel-ly" good one!

Take half a dozen—or more if you wish—empty cotton reels and glue them down in a row in some convenient position on the permanent radio workbench. Alternatively, the reels may be screwed down to the bench by two screws per reel passing upwards from the underside of the bench.



You will never have any difficulty in immediately putting your hand on the drill you require if you arrange them in this fashion.

A row of reels set up in this fashion makes an extremely handy set of holders for the smaller-sized drill bits employed in radio constructional work. The cotton reels should be marked with the sizes of the bits they hold. The bits may be withdrawn quickly from their holders, and as readily replaced.

The correct size of bit needed for any work in hand is instantly ascertainable; for the bits, supported by the reels, stand upwards in a row, and may be seen at a glance.—J. F. S.

QUESTIONS AND ANSWERS

By K. D. ROGERS

GETTING RID OF THE DOUBLE HUMP

TACKLING THE PROBLEM

J. F. B. (Exeter).—*I cannot get rid of a double hump in the tuning of my set (three gang band-pass) when tuned to the Western Regional and to Droitwich. How should one trim the set to avoid that? I start with the detector and then find that I cannot properly trim the aerial and other trimmer. They have to be all in to give effect, and then I get the double hump referred to.*

Band-pass tuning and trimming are noted for giving one, the hump—metaphorically, I mean. It is not easy to trim unless you know exactly what you are doing. In the first place I would like to get hold of some of the makers who claim to give correct wavelength calibration with their tuners. That is, I believe, one of the main causes for torn hair and shattered married lives among home constructors who try to trim ganged tuners.

On an oscillator unit the tuner may be quite O.K. as regards wavelength calibration, but it is certainly not when it is put into a home-made set.

What happens is this: You blithely go to the tuner to trim it. You know that you should trim the detector section first—that is right and proper—and you are told to trim it so that the wavelength readings on the scale are correct for some station in the middle of the scale. You do that.

Feeling pleased with yourself you proceed to trim the remaining trimmers. You screw and screw and screw. The final result is that either they won't come *out* far enough to let you get the thing in trim, or they won't go *in* far enough.

Hair is torn, the wife rushes home to mother, and the kids hide in the coal shed. What is the matter with the adjectival thing?

Probably nothing! Ten to one it has been designed with insufficient latitude to enable a home constructor to trim it when in a high capacity set. Probably either the detector or the other parts of the set have high capacity wiring and so forth, and the trimming is thrown out. What has happened is that you have had to have more or less than the expected trimming capacity in the detection section in order to get the unit to read correctly on the wavelength scale, or your aerial and H.F. circuits are of lower or higher capacity than expected.

There are two remedies: One is to load those trimmers which will not go in far enough with small condensers; the other is to say a rude word about the wavelength scales, fit a degree scale, and trim to any reading you like.

I prefer the latter method. The rude word is relieving, and the degree scale is just as good as the other when you get to know it. In any case the loading of trimmers with additional capacity is an unclean practice, and is not recommended from the point of view of efficiency and of enabling the tuner to remain in trim over the whole of its range.

In your case I cannot say that this has happened for certain. But it seems possible. You could send your unit back to the makers for test, but the trouble is more likely to be that you have a high capacity detector circuit which is upsetting things, than that the unit is faulty. I am not clear from your letter whether you do get into trim on your aerial and other trimmer, or whether you just do not. What happens on distant stations?

That double hump may not be due to bad trimming. It may be due to detector overloading when you are tuned-in right. Your best test is to trim on distant stations, and then if you get the double hump on the locals, *while being properly trimmed on the distant transmissions*, you can be sure that the trouble is overloading of valves, and not the unit at all.

What happens is that your detector grid becomes too negative when the set is fully tuned-in to the local, so it chokes up a bit and the strength drops. Then, when you go slightly out of tune on either side of the point the strength of the H.F. to the detector drops enough to unchoke the valve and it functions properly, giving as a result louder signals than it did when it was fully tuned-in.

The result is a double hump effect, the detector working to full capacity and giving loudest results on either side of the correct tuning point, and being choked when the set is dead in tune, with the result that at that point the valve is not giving so big an output.

Make sure that it is not what is happening by trying the set's trimming on distant stations. If they are dead in tune you need not worry about the locals. What you must do then is to fit an aerial volume control to avoid overloading when Western Regional and Droitwich are tuned-in. You will get better and louder results on them in that way, for you will avoid the detector overloading.

On the other hand, you may be a victim of that "won't trim" business I have mentioned, in which case it is either a matter for trimmer loading or getting a degree scale instead of the wavelength calibrated dial.

The Editor cannot accept responsibility for manuscripts or photos. Every care will be taken to return MSS. not accepted for publication. A stamped, addressed envelope must be sent with every article.

All Editorial communications should be addressed to the Editor, "Popular Wireless," Tallis House, Tallis Street, London, E.C.4.

All inquiries concerning advertising rates, etc., to be addressed to the Advertisement Offices, John Carpenter House, John Carpenter Street, London, E.C.4.

The constructional articles which appear from time to time in this journal are the outcome of research and experimental work carried out with a view to improving the technique of wireless reception. As much of the information given in the columns of this paper concerns the most recent developments in the radio world, some of the arrangements and specialties described may be the subjects of Letters Patent, and the amateur and the Trader would be well advised to obtain permission of the patentees to use the patents before doing so.

OLD COPIES FREE

C. Hillman, 4, Sprowston Road, Forest Gate, London, E.7, *writes to say that he has copies of "P.W." dating back to 1934, which he is willing to let readers have provided they will pay postage. Those who want copies should get in touch with Mr. Hillman to see if he can supply the copy and should forward the necessary postage when "ordering" the copy.*

WORKS WITHOUT SPEAKER

V. P. P. (Liskeard). —*I took the speaker off my receiver the other day to test something, and was surprised to hear the set going on without it. Though the noise was weak I could still hear a programme coming through, the sounds coming from the output terminals. What was happening?*

I do not want to contradict you, but I am afraid the noise was not coming from the terminals. It was probably coming from that end of the set and was most likely coming from the L.F. transformer.

I have often heard that sort of thing, and it is fairly common in a powerful set which has an output choke. The noise is made in that case by the laminations of the choke vibrating in sympathy with the L.F. fluctuations in the winding of the choke.

After all, a pair of headphones is merely a piece of iron (in each earpiece) vibrating in sympathy with the L.F. fluctuations in the windings of the magnet of the phones. If you regard the choke laminations as the piece of iron of the phones, you have a rough-and-ready parallel. The laminations always try to vibrate with the L.F. impulses—they are bound to do so because they have their magnetic field varied by those self-same impulses. The reason why the laminations do not make a noise in every case is that they are too tightly clamped to be able to do so. And they should be tightly clamped, too!

In your case, if the laminations of the L.F. transformer are loose, or if one or two of them are loose, you may get the same thing happening. The variations of L.F. currents in the transformer will cause the iron core to vibrate, and any loose lamination will act as a miniature and inefficient loudspeaker.

There is one more possibility, but it is not likely to be the cause of the noise. That is the condenser across the plate and filament of the output valve. If that condenser has loose plates it may cause a noise, but the transformer laminations are far more likely to give rise to the phenomenon.

WORKS WITHOUT VALVE

"*Have you ever heard of a set working with a valve missing?*" challenges J. W. T. (Farnham). "*I thought the first L.F. valve of my three-valve short-waver was faulty, and pulled it out while the set was on. To my surprise the set went on working, though the signals were very faint. Why was this?*"

My correspondent suggests that the signals were fed from the anode of the detector valve (are you following?) to the grid of the L.F. valve, through the coupling condenser and then through the grid leak to the bias battery. As the output valve was plugged into the bias battery he assumes that impulses walked up through the bias lead of the output valve, through its transformer secondary to the grid, completing the chain of coupling.

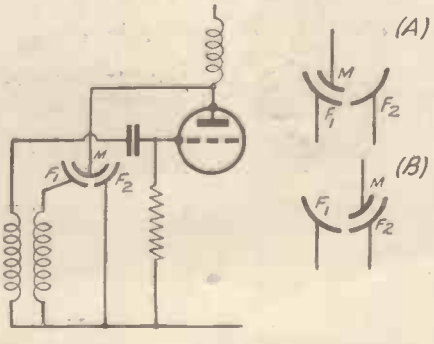
I don't think so. It might have some coupling effect that way if the bias battery were old and decrepit, having a high resistance which acted as a coupling resistance between the two grid circuits. But I fancy that the path was more likely to be through some capacity in the valve holder of the L.F. valve that was removed, and thence on to the grid of valve No. 3 in the usual way.

There is another possibility. That the H.F. from the detector valve was not completely got rid of on the output side and that some of it was applied to the grid of the first L.F. valve. As this valve is not in position, the H.F. (being of very high-frequency

(*Continued overleaf.*)

TECHNICALITIES EXPLAINED—No. 61

Differential Condensers



A variable condenser having two sets of fixed vanes between which the moving vanes move, starting from full mesh between one set and going into full mesh with the other. Intermediate positions constitute partial mesh with both sets of fixed vanes.

The result is that as the capacity between the moving vanes and one set of fixed vanes decreases the capacity between the moving vanes and the other set of fixed vanes increases. The total capacity of the condenser remains approximately the same throughout the whole procedure, the capacity being distributed between the two sets of fixed vanes and the moving vanes.

The condenser is useful in reaction circuits, as it allows the anode-to-earth capacity of the valve to remain constant even though the reaction coupling is varied by movement of the moving vanes.

In the diagram, A, I have shown the moving vanes totally coupled with the one set of fixed vanes, marked F1, to denote that they are in a reaction circuit with the active fixed vanes. In the second diagram, B, I have shown the moving vanes coupled to the other set of fixed vanes, those in a reaction circuit connected to earth.

The circuit diagram on the left shows the condenser marked M and F1 and F2, denoting the moving and the two sets of fixed vanes, and the marking is that usually employed by "P.W." in reaction circuits denoting by the lettering what may be called the "active" set of fixed vanes by the F1 and the earthed set of vanes by F2.

GALVANOMETERS GALORE

(*Continued from page* 483.)

a small depression punched in its exact centre and which has been carefully balanced on the gramophone needle point. The piece of spring is then magnetised by being stroked about twenty times with one pole of a magnet, care being taken to see that the strokes are all made in the same direction.

Set upon the gramophone needle pivot, the carefully balanced and magnetised strip will behave as a magnetic compass and its north pole will point due magnetic north. It will, also, react to the presence of an electric current in just the same manner as a commercially made compass needle.

A Suspended Needle

Another type of home-made galvanometer comprises ten or fifteen turns of insulated wire, the turns being about three inches in diameter. They are not wound upon anything, but are tied together at bottom and top. The coil is placed in a vertical position on the work-bench, being secured to the latter by means of a bent nail, a wire staple, or a small quantity of sealing-wax or "plasticine." Suspended from the top of the coil by means of a small piece of silk or cotton is a magnetised sewing needle, the latter having been magnetised by being stroked with a magnet in accordance with the directions given above.

It will not be found difficult to balance the magnetised needle so that it swings in a perfectly horizontal plane. Like the magnetised steel strip in the last type of galvanometer, the magnetised needle will point to the magnetic north. When, however, the slightest current flows through the coil, the needle will indicate its presence in a very decided manner. A strong current passing through the coil will probably serve to set the needle off its balance. Hence an instrument of this type should only be employed for detecting the presence of small currents.

An Alternative Pattern

The snag in the above instrument is that the needle takes a long time to come to rest and, also, that it is liable to be disturbed by the smallest current of air. Apart from these objections, however, this needle instrument can be made exceedingly sensitive.

Another pattern of the above-described galvanometer takes the form of an orthodox compass needle pivoted horizontally at the centre of the coil. This pivoting is effected by fastening down to the base of the coil a stick of sealing-wax of the requisite length and by sticking an upturned gramophone needle in the upper end of the sealing-wax stick. Upon the gramophone needle the compass needle is pivoted. If you haven't any sealing-wax, make use of a piece of candle as the supporting pillar. It won't look as well, but it will serve just as efficiently, and, after all, appearances are not always of primary import in a testing work-room!

There is one point which, perhaps, I ought to mention in connection with these compass needle pivotings before I leave the subject. That is, that if the pivot seatings are at all rusty (and they often are!), the needle will tend to stick. It is a good plan to place a tiny drop of thin oil in the cup-like depression which is formed in the centre of the compass needle. After you have done this, wipe as much of the oil away as you can. The pivot seating will now be adequately lubricated. It will not rust and, provided dirt does not get into it, it will not stick or resist the slightest tendency on the part of the needle to move under the current's influence.

Using a compass needle—orthodox or home-manufactured—and a few turns of wire, there is any amount of galvanometer patterns which can be treated. The current-indicators described and illustrated in this article are only a few of the current-revealing arrangements which are possible by such means. But printer's space is merciless and I must leave the devising of other galvanometer varieties to the individual ingenuity of my readers.

A CURE FOR DAMP ROT

Try this simple dodge and give your aerial mast a long life.

AERIAL masts and poles which are erected in damp ground very frequently suffer from a species of damp-rot which attacks their bases and gradually but surely brings about their ruin.

All such poles, however, can be rendered completely and *permanently* immune from damp-deteriorating influences of this nature by adopting the very simple procedure illustrated in the photograph.

JUST POUR IT IN

The creosote is poured into the hole in the base of the mast at intervals of a month or six weeks.

Drill obliquely downwards into the aerial mast a half-inch diameter hole, the hole being drilled from a spot about two or three inches above the ground-level. The hole should reach *downwards* to approximately the centre of the pole, and should not go beyond that point.

Take now a small funnel. Insert it into the hole and pour down it a small quantity of creosote until the latter completely fills the hole. Then remove the funnel and stop up the hole in the aerial pole with an ordinary cork.

The creosote will slowly penetrate downwards throughout the aerial pole, completely waterproofing and rot-proofing it. After about a week or so, a further quantity of creosote should be poured into the hole to replace the creosote which has penetrated into the wood.

By pouring a little creosote into the hole in the base of the aerial mast at intervals of, say, a month or six weeks, the pole will be maintained in a perfectly preserved condition for any length of time. Creosote is very readily and cheaply obtainable, and a creosoted base of an aerial pole is not only rendered permanently rot-proof, damp-proof and mould-proof, but it is also made immune from the many species of wood-destroying insects which love to feed upon damp wood near the soil-level.

QUESTIONS & ANSWERS

(*Continued from previous page.*)

at those short wavelengths) got through the capacity of valve holder No. 2 and so to the grid of the third valve. There it was rectified and caused weak signals.

You don't like it? Well, I won't argue. All three theories are possible. There are probably other coupling paths. I think that valve holder capacity is one that cannot be overlooked, however.

THE AMERICAN INVASION

C. K. (Bucks).—*Can you tell me how to use an American* 110*-volt receiver on my* 230 *A.C. mains? Can I use a resistance to break down the voltage?*

Yes sir, you can, but it would be a nasty method, and wasteful withal. (With all the heat dissipation necessary.) Sorry. The best way to do it is to make use of a little gadget called an auto-transformer, and available at various prices from such firms as F. C. Heayberd, of Finsbury Pavement, and C. Ward, of Farringdon Street, E.C.4. Practically any radio dealer will be able to get you a suitable transformer to step the mains down to 110 volts. It is a much cheaper and cleaner method than the resistance, and you will lose practically no power in doing it.

In the resistance scheme you lose the power represented by the difference between 110 volts and 230 volts multiplied by the current taken. Thus, if you take ·5-amp. from the mains at 110 volts, you will be losing 230 − 110 × ·5, which is a matter of 60 whole watts. That's a unit every 16 hours, gone right down the drain, or, more accurately, up the spout in the form of heat.

You get a transformer, and the waste will be the merest fraction of that.

AN "ADDER"

B. T. K. (Amersham).—*I want to add another stage to my S.T.*800, *making it a five-stager with a Q.P.P. or Class B output. Can I do this?*

You can, BUT—don't come to me afterwards and say it won't work. I will not say here that it won't work, but if I was not afraid someone would take me on I would lay ten shillings to a milliamp that when you had done it you would hate yourself, "P.W.," and particularly me for letting you do it.

If you want to mess about with a good set try adding a Class B stage externally. Don't for heaven's sake go and tear the innards of the 800 to bits to get the extra components in. And after you have tried the Class B and have gone back to the original set, drop me a line and let me know what you think of it with the Class B added.

You may think I am trying to put you off it. I am, I stand in fear and trembling at the results you may get. Note the MAY. It is possible to add such a stage, and it is possible to get good results. But I don't want you to try. You will not thank me if it goes wrong, and the cards are that it will. The set was not designed for such additions and—well, you would not try to add a motor bike engine to a car just to get a bit more kick out of it would you. Any kick you got would probably be directed against yourself, anyway.

You remember what happened to the bloke who carried the banner with "Excelsior!" on it, don't you. He was adding to his height up the mountain. You want to add to the length of your set. The result may be the same—metaphorically. So be warned.

The RADIO Bulletin

Up-to-the-minute news concerning the radio industry

THREE of the 1937/38 season's models have been released by the **G.E.C.** These are an A.C. mains receiver and two battery-operated sets.

Listed at £9 19s. 6d., **the A.C. model** is a powerful five-valve superhet, and is designed to give first-rate quality coupled with simple control. It has the new G.E.C. "Chromoscopic" dial—a sloping edge-lit black scale with the coloured station names standing out in sharp relief.

Another feature is a power-line noise shield which guards the set from mains-borne interference. Fully delayed A.V.C. is incorporated and the energised moving-coil speaker is capable of an output of three watts. On the short waves the waverange is 16–50 metres.

This attractive design is housed in a polished walnut cabinet.

Turning to the battery sets: We have **the Battery S.P.3**, which is a straight three-valve set designed for reception on the medium and long-wave broadcast bands. It has single-knob tuning with a full-vision station-name dial, and also preset reaction. The H.T. consumption is 7 milliamps, and it is priced at £6 15s.

The second battery set is on more ambitious lines and costs ten guineas. It takes in the short waves, covering from 16–50 metres, and utilises a four-valve superhet circuit. A "Chromoscopic" dial is fitted, as is also the new G.E.C. two-speed tuning control.

Other features are fully delayed A.V.C. and automatic grid bias. The H.T. consumption is nine milliamps. The list prices given for these two sets include the necessary Osram valves, G.E.C. batteries and accumulators.

* * *

TWO UNIVERSAL SETS

Those who are on D.C. mains are well catered for these days, since the majority of manufacturers list suitable universal mains models as alternatives to the standard A.C. designs. These universal sets have the advantages that they operate equally well on both D.C. or A.C. mains and, therefore, should the D.C. mains be changed over to A.C., the owner of the universal set is able to go on using his existing receiver exactly as before without any modification whatever.

In the **Ferranti** range the two latest additions are the all-wave model 1037 U, which is a seven-stage superhet with pentode output and an energised moving-coil speaker. It has full A.V.C., manual tone and volume controls, and also the well-known Ferranti "Magnascopic" dial. It costs 10½ guineas.

The other set is the model 1137 U, and is similar to the 1038 U, with the addition of an electric tuning indicator.

The reproduction is superior and the receiver is housed in an attractive wood cabinet finished with veneers of walnut, Australian silky oak and macassar ebony.

The price is 11½ guineas. On the short waves these two receivers tune from 19–51 metres, and, of course, cover the normal medium and long broadcast wavebands in addition.

* * *

OSRAM VALVE RELEASES

Readers may remember that some time ago the **G.E.C.** introduced a new Osram valve embodying an entirely new patented form of tetrode output. This valve, which was designed for A.C. mains, was styled the N 40.

There is now a 2-volt battery valve embodying the same construction as the N40, and it is known as the KT2.

In the A.C. mains range a new output tetrode embodying the same patented design and known as the KT42 replaces the existing N42 pentode. Further releases of output tetrodes to replace existing output pentodes in other types will be made from time to time.

Tests have conclusively established that the new tetrode valves designated KT will satisfactorily replace existing pentodes of equivalent types in sets already on the market, and it is expected that both KT tetrodes and output pentodes will run concurrently in receivers during the coming season.

A new "International" range of Osram valves is now available. The principal features are the adoption of a heater rating of 6·3 volts, ·3 amps., together with a new form of base known as the octal base.

The reasons for the choice of this heater rating and base are: (*a*) 6·3 volts and octal bases are regarded as likely to be adopted as the international standard throughout the world, and it is with the object of achieving standardisation that these have been chosen for this new range; (*b*) The medium slope characteristics of the range facilitate the design of multi-valve sets and should greatly extend the market for British made sets in all parts of the world.

A number of benefits are derived from the heater rating adopted. For instance (1) there is the very low heater wattage; (2) the valves are equally applicable to A.C. or A.C./D.C. sets, as well as in car radio receivers, embracing the 6-volt as well as the 12-volt car battery; (3) Small physical dimensions are made possible by the reduced size of cathode. Also the low heater voltage tends to reduce the level of hum in A.C./D.C. sets, and the octal base with its moulded key simplifies the insertion of the valve into its holder.

Output valves in this range embody the patented form of tetrode system already mentioned. The range also includes a visual tuning indicator operating on the electron beam principle. This will be known as the G.E.C. "Tuneray" indicator.

SOUND RECORDING ON FILM

The use of recordings by German stations for the broadcasting of political speeches has caused firms in that country to pay special attention to the development of systems suitable to all requirements. Sound on film has a number of advantages over the disc and over the steel-tape method, but the cost of films has been one of the great drawbacks in the past. Klangfilm, of Berlin, have now solved this by sub-dividing ordinary 35-mm. film into six strips; each of these takes one ordinary talkie-size sound track. This means a reduction of operating costs, if not by six, at least by a large margin.

The narrow strip does not require perforation, as there is no picture with which it has to be synchronised. Sound is recorded and reproduced in exactly the same way as for the talking film, except that suitable transportable apparatus has been evolved. The recording set is entirely battery-operated, to make it independent of current supplies. The reproducing equipment is mains-fed. A photograph of the apparatus appears on page 500.

A. A. G.

"P.W." LIST OF EUROPEAN BROADCASTERS

This list contains the more important European medium and long-wave stations which are likely to be received in this country. There are some relay stations working on very low power and sharing common wavelengths. These have been omitted because their programmes are usually too weak or badly interfered with to be of value to British listeners.

Wave-length.	Station Medium Waveband.	Country	Power kw.
203·5	Plymouth	Gt. Britain	0·3
203·5	Bournemouth	„	1
206	Eiffel Tower (Paris)	France	7
215·4	Radio-Lyons	„	25
233·5	Aberdeen	Gt. Britain	1
236·8	Nürnberg	Germany	2
238·5	Riga	Latvia	15
240·2	Saarbrucken	Germany	17
242·9	Cork	Irish Free State	1
243·7	Gleiwitz	Germany	5
245·5	Radio Marconi (Bologna)	Italy	50
247·3	Lille (Radio P T T Nord)	France	60
251	Frankfurt	Germany	25
253·2	Nice Cote d'Azur	France	60
255·1	Copenhagen	Denmark	10
257·1	Monte Ceneri	Switzerland	15
259·1	Kosice	Czechoslovakia	10
261·1	Scottish National	Gt. Britain	50
	North National	„	20
	London National	„	20
263·2	Trieste	Italy	10
265·3	Hörby	Sweden	10
267·4	Newcastle	Gt. Britain	1
269·5	Radio Normandie (Fécamp)	France	15
269·5	Moravska-Ostrava	Czechoslovakia	11·2
271·7	Kuldiga	Latvia	10
274	Vinnitsa	U.S.S.R.	10
278·6	Bordeaux-Lafayette	France	35
283·3	Bari (No. 1)	Italy	20
285·7	West Regional	Gt. Britain	50
288·5	Rennes-Bretagne	France	120
291	Königsberg (No. 1)	Germany	100
296·2	Midland Regional	Gt. Britain	70
298·8	Bratislava	Czechoslovakia	13·5
301·5	Hilversum (No. 2)	Holland	60
304·3	Torun	Poland	24
304·3	Genoa	Italy	10
307·1	Northern Ireland Regional	Northern Ireland	100
312·8	Poste Parisien	France	60
315·8	Breslau	Germany	100
318·8	Goteborg	Sweden	10
321·9	Brussels (No. 2)	Belgium	15
325·4	Brno	Czechoslovakia	32
328·6	Toulouse	France	60
331·9	Hamburg	Germany	100
335·2	Helsinki	Finland	10
338·6	Linz	Austria	15
342·1	London Regional	Gt. Britain	70
345·6	Poznan	Poland	16
349·2	Strasbourg	France	100

Wave-length.	Station Medium Waveband.	Country.	Power kw.
356·7	Berlin	Germany	100
360·6	Kiev (No. 2)	U.S.S.R.	35
364·5	Bucharest	Rumania	12
368·6	Milan (No. 1)	Italy	50
373·1	Welsh Regional	Gt. Britain	70
	Penmon	„	5
377·4	Lwów	Poland	50
382·2	Leipzig	Germany	120
386·6	Toulouse (P T T)	France	120
391·1	Scottish Regional	Gt. Britain	70
	Burghead	„	60
400·5	Marseilles (P T T)	France	100
405·4	Munich	Germany	100
410·4	Tallinn	Estonia	20
415·4	Kharkov	U.S.S.R.	10
420·8	Rome (No. 1)	Italy	50
426·1	Stockholm	Sweden	55
431·7	Paris (P T T)	France	120
443·1	Sottens	Switzerland	100
449·1	North Regional	Gt. Britain	70
455·9	Cologne	Germany	100
463	Lyons (P T T)	France	100
470·2	Prague (No. 1)	Czechoslovakia	120
476·9	Lisbon	Portugal	15
476·9	Trondelag	Norway	20
483·9	Brussels (No. 1)	Belgium	15
491·8	Florence	Italy	20
499·2	Sundsvall	Sweden	10
499·2	Rabat	Morocco	25
506·8	Vienna	Austria	100
514·6	Madona	Latvia	50
522·6	Stuttgart	Germany	100
531	Athlone	Irish Free State	100
539·6	Beromunster	Switzerland	100
549·5	Budapest (No. 1)	Hungary	120
559·7	Wilno	Poland	50
569·3	Viipuri	Finland	10
	Long Waveband		
1107	Leningrad (No. 1)	U.S.S.R.	100
1153·8	Oslo	Norway	60
1250	Kalundborg	Denmark	60
1293	Luxembourg	Luxembourg	150
1339	Warsaw (No. 1)	Poland	120
1379	Novosibirsk	U.S.S.R.	100
1389	Motala	Sweden	150
1500	Droitwich	Gt. Britain	150
1571	Deutschlandsender	Germany	60
1648	Radio-Paris	France	80
1744	Moscow (No. 1)	U.S.S.R.	500
1807	Lahti	Finland	150
1875	Radio-Rumania	Rumania	150
1875	Hilversum (No. 1)	Holland	150

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