BODY-LINE RADIO—SOMETHING NEW and PRACTICAL for the HIKER!

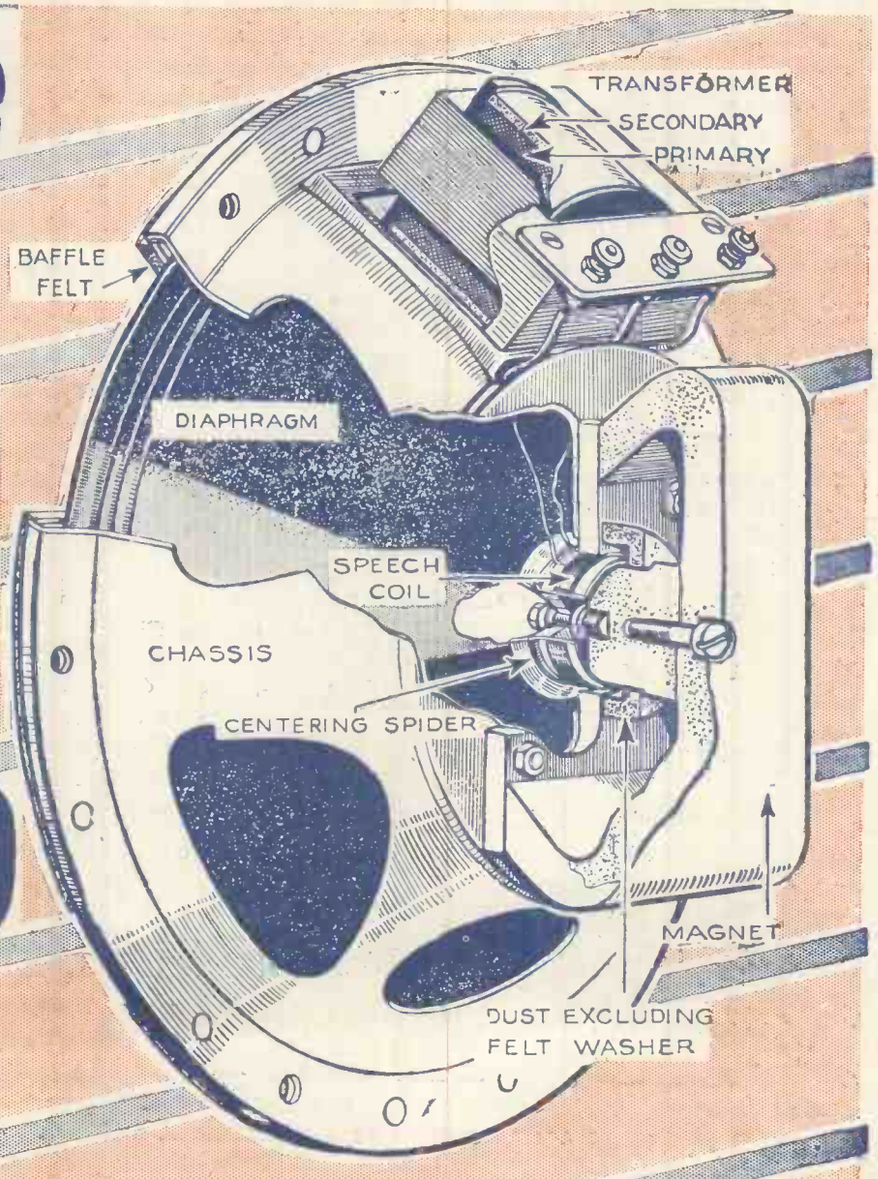
Amateur Wireless and Radiovision

3d Every Wednesday

EVERYONE IS TALKING ABOUT THE CONSTRUCTOR CRUSADERS!

How the LOUD-SPEAKER Has Been IMPROVED

We Tell the Whole Story



Vol. XXV. No. 652 Registered at G.P.O. as a newspaper July 21, 1934

FLUID-LIGHT TUNING

to get finest results from extreme selectivity

All Electric Superhet

PORTABLE FLUID-LIGHT SIX

This new "His Master's Voice" Mains Portable with automatic volume control and fluid-light tuning, works off the mains electricity supply and needs neither aerial nor earth. It is the answer to all who have waited for true to life "mains reception" in a portable set. Its selectivity is so acute that it is fitted with fluid-light tuning—the sensational new device that ensures accurate tuning always. In this model, two illuminated arrows gradually approach each other until they show the exact point of perfect reception. So that by sight alone, unassisted by ear, you can tell when this set is tuned to concert pitch.

MODEL 463. Mains Portable, with self-contained earth and aerial (six valves including rectifier). Fluid-light tuning incorporated in wavelength scale. Automatic volume control. For A.C. only.

All Electric Superhet

FLUID-LIGHT FIVE

A new five-valve superhet table model with automatic volume control and fluid-light tuning. It is a delight to look at, a joy to hear, and a pleasure to handle. Its range is extraordinary and every station is kept distinct. The fluid-light tuning device in this model is a thin column of light which rises and falls in a slender central window, indicating the exact spot at which perfect tuning is reached. Only by means of this fluid-light can the extreme selectivity of this set be fully appreciated.

MODEL 442. Superhet Table Model (five valves including rectifier). Fluid light tuning in central window. Automatic volume control. For A.C. only.

"HIS MASTER'S VOICE"

Write to-day for special illustrated leaflets.

THE GRAMOPHONE COMPANY, LTD., 108E CLERKENWELL ROAD, LONDON, E.C.1. (Prices do not apply in I.F.S.)

Editor-in-Chief: BERNARD E. JONES
Technical Editor: J. H. REYNER B.Sc. (Hons.), A.M.I.E.E.
Radiovision Editor: H. CORBISHLEY

Amateur Wireless and Radiovision

Editor: D. SISSON RELPH
Research Consultants: W. JAMES and PERCY W. HARRIS M.Inst.Rad.E.
Assistant Editor: ALAN HUNTER

Published by BERNARD JONES PUBLICATIONS, LTD., 58/61 Fetter Lane, London, E.C.4. Telephone: Central 4341 (four lines). Telegrams: "Beejapee, Fleet, London." Subscription, post paid to any part of the world: 3 months, 4s. 6d.; 6 months, 8s. 9d.; 12 months, 17s. 6d. Published on Wednesdays and dated for the following Saturday.

News and Gossip of the Week

30 Lines to Stay ?

THIRTY-LINE television enthusiasts will rejoice to hear of a change of front at the B.B.C.

Subject to the findings of the Selsdon Committee now sitting, the B.B.C. intends to keep going with 30-line pictures on medium waves.

Until such time, that is, as any rival system can take the air with as good a service for experimenters.

Another Possible Outlet

WHILE everyone is trying to think out a solution of the great television problem of where to put vision signals, a certain M.P. is proposing a bill that may offer a hope.

W. S. Liddall is the man—M.P. for Lincoln. He aims to get through a bill authorising electric light concerns to super-impose radio-frequency programme signals on the mains conduit.

Such a scheme might conceivably help television.

Dramatic Tests

EVERYONE is congratulating Howard Marshall, ex-B.B.C. announcer and very present commentator of the test matches. He deserves all praise for his graphic accounts.

Indeed, we might go so far as to say that he has given a new thrill to cricket for millions of people who were previously only casually interested.

Anyway, the B.B.C. is delighted with Howard. So much so that for all the remaining Tests he will be asked for frequent commentaries during the course of the games.

Royal Visit Probable

YET another change of idea over Droitwich to record this week. You remember we first suggested Royalty might open the high-power station? And then later told you this was not to be?

Well, well. Latest hints indicate that, although members of the Royal family will *not* be at the opening, they will certainly pay a visit to Droitwich before the end of the year.

Giant Signals

WHEN will you hear Droitwich going full out? During early September the new giant will be "sliding-in" with late dance music.

Then, probably during the first week in October, the Droitwich 150-kilowatter will take over the full service, and dear old Daventry 5XX will be no more.

Suggestion: why not a last round-up? A kaleidoscope of memories of the big things put over by 5XX during its pioneer years of broadcasting.

North Ireland Growing

AT last they are really getting a move on with the North Ireland high-power Regional.

Yes, believe it or not, the foundations are dug. There is a great gaping hole 120 ft. by 14 ft. by 15 ft. deep.

Before we know where we are the North Ireland Regional will be on the air—say in a year's time.

More "Picture People"

DID you enjoy that programme of sound-track entertainment recently broadcast from London? We thought so.

And now get ready for another such programme. The date is August 8. British Acoustic gear is even now being installed.

Last time, you will remember, it was Western Electric sound-track head. But the B.B.C. is nothing if not catholic. Besides, it *must* be careful not to favour any one system.

More "Music Halls"

EVERY Saturday night from the autumn onwards we shall hear a music-hall show from St. George's.

This will mean twice as many as we heard last winter, remember. Evidently the B.B.C. is preparing for a really big entertainment drive when the summer is over.

Well Named!

LOTS of suggestions poured into Broadcasting House for the naming of the new radio concert party mentioned here a week or two ago.

Here are three that did *not* satisfy—but they are typical of the sort of thing listeners imagined would be winners:

The Pier-airos the Radio Racketeers, and the Etherialists. But the B.B.C. decided—rightly so we think—to stick to the brain-wave of one of Maschwitz's boys—the Air-Do-Wells.

Re-fitting St. George's

NEW gear, new electric light points, new phone extensions—all sorts of improvements are going on in the St. George's Hall near Broadcasting House.

It is closed this week for the re-fitting work—ready for those music-halls we were talking about just now.

Whosoever. . . !

TO its coat of arms the B.B.C. rigidly adheres—but it seems to enjoy having fun with its motto.

The B.B.C. is fully entitled to alter its motto. But the latest effort is rather incomprehensible.

Latin, of course. *Quaecunque*—translated it means "whosoever."

"Nation Shall Speak Peace Unto Nation" is a bit out of joint with the time, apparently. But at least we can understand what it means.

Versatile Chris Stone

DID you get Christopher Stone from Luxembourg the other Sunday? Rather surprising to hear him from a *pirate*, we thought.

How does the good Chris do it?

Five Years' Record

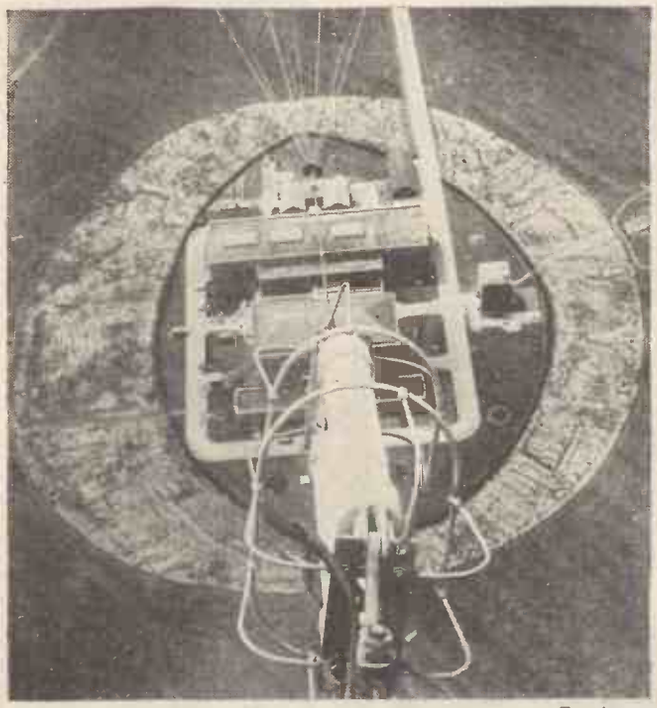
WHEN Joseph Muscant leaves the Commodore, Hammersmith, he will break a five-years' tradition for really enjoyable broadcast light music.

But he will not be lost to us. The B.B.C. is going to test the Troxy theatre acoustics, with the idea of relaying the newly formed combination, which will include some of the present Commodore Orchestra.

Now There Are Two

AT the same time the B.B.C. will test the re-constituted orchestra left at the Commodore, under the direction of Harry Davidson, who has been the organist of the theatre for some time.

Quite likely we shall hear Muscant and Davidson—the more the merrier



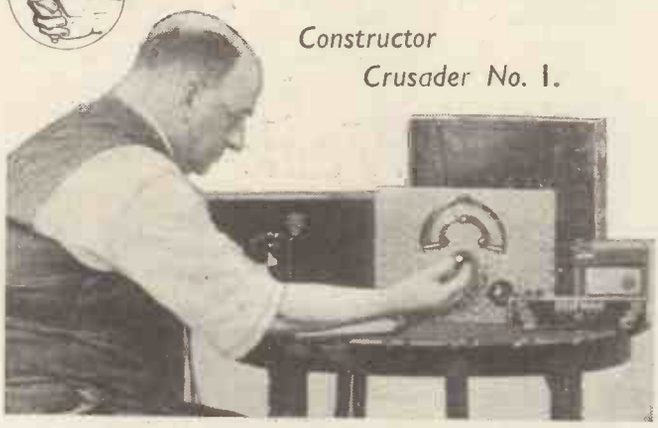
Fox photo

This giant insulator looks quite tiny from the ground—but from this view from the top of one of the 800-ft. masts it is the Rugby station below that looks small. Just imagine—the insulator is 8 ft. long and weighs 8 cwt. !

Constructor Crusaders' Corner

A Special Page for the Discussion of Mutual Problems

Constructor Crusader No. 1.



This keen Cornish experimenter (who prefers that his name should not be disclosed) sent a preliminary request for membership of the Constructor Crusaders by telegram!

THICK and FAST!

IMMEDIATELY on the publication of last week's issue of AMATEUR WIRELESS—in which the first announcement of the Constructor Crusaders was made—enrolments began to come in thick and fast.

The honour of becoming Constructor Crusader No. 1 goes to the keen Cornish experimenter whose photograph you see above. So keen was he that he sent a preliminary request for membership by telegram! For personal reasons he desires to remain anonymous.

Now if you didn't complete the membership application form published last week, fill in that to be found on the inside back cover this week. You will never regret having become a Constructor Crusader—and you will want your badge when you go to Olympia!

◆ ◆ ◆

We explained last week that one reason for organising the Constructor Crusaders is to get together ideas on receiver design for amateurs all over the country so that the AMATEUR WIRELESS Technical Staff can interpret everybody's needs in a practical way.

At the time of going to press with this issue it is too early for Constructor Crusaders to take advantage of this page—set aside every week especially for them to express their opinions—so we are starting the ball rolling with a discussion about straight sets.

Don't forget that we want to hear your views as a Constructor Crusader!

◆ ◆ ◆

There will be so much talk about Constructor Crusaders during the next few weeks that some of your friends—who, perhaps, don't read AMATEUR WIRELESS—will be asking you what it is all about.

Well, you will be able to tell them that every Constructor Crusader gets a free full-size real photographically produced blueprint of each of the four star AMATEUR WIRELESS designs for the coming season.

More than this, every Constructor Crusader is entitled to free technical advice on any matters relating to these four free blueprint sets.

This is of interest to every constructor, so don't forget to tell you friends about the Constructor Crusaders.

WHAT IS THE BEST TYPE OF "2 H.F." SET?

DURING the past year hundreds of set designs have made use of the super-het principle. The idea that selectivity can only be obtained with this type of set has a firm hold on most designers.

That the inherent selectivity of a super-het is of great value cannot be denied, but is it worth while getting 9-kilocycle selectivity if the signal strength drops to a low level, particularly during daylight?

It is agreed that a four-valve super *does* fall down when it comes to daylight reception. Even if the signal strength is fairly good the background noise and intermediate-frequency hiss usually spoil the programmes of weak stations.

The efficiency of the modern receiver has made most people use a very small aerial, which only *after dark* is ample to bring in most of the European stations at good strength.

One of the few sets that will bring in the European stations on a *small aerial* without background noise is one that has at least two high-frequency stages. This type of set will give excellent quality and ample selectivity for most people, although not of the 9-kilocycle order; but, anyway, who really wants such selectivity and how many really get it?

So many sets are claimed to give this degree of selectivity, but very few people ever trouble to see whether or not such is the case. If trouble is experienced the first thought is: "I must have better selectivity." Very few sets give 9-kilocycle selectivity so that the super-het must not be boosted too much on that account alone.

Just consider for a moment what can be done with modern components in a two high-frequency receiver using, say, two of the latest high-frequency pentodes. Coils have been designed that will get the most out of this type of valve, while the high-frequency output is ample to provide an efficient form of self-adjusting volume control.

A double-diode-triode or a simple double-diode as a detector will look after the quality, for most of the diode detectors will handle 200 volts input.

Variable-mu's or Straight

The point arises as to the valves to be used in the high-frequency stages. They will probably be pentodes; should they be variable-mu's or straight? So far the variable-mu's have it for without them S.A.V.C. would not be possible, and that appears to be a very important point.

When we come to the output stage the problem becomes even more acute. Class B, Q.P.P., or a plain pentode?

Class-B amplification means a second low-frequency stage, which is rather a snag and rules it out for many people, so we come to Q.P.P., which seems to be getting very popular. This arrangement gives over 1,000 milliwatts output with fairly low anode current, but it needs a special intervalve transformer and carefully matching to the loud-speaker.

Readers who buy their radio parts from the Peto-Scott Co., Ltd., will be interested to know that they can enrol as Constructor Crusaders at this Company's showrooms at either 62 High Holborn, W.C.1, or at 77 City Road, E.C.1.

Membership forms can also, of course, be filled in at the "Amateur Wireless" offices—58/61 Fetter Lane, E.C.4. Enrolment by this means will save postage and the trouble of addressing and posting a letter.

These keen students, who are taking a radio course at a London Polytechnic, are pretty certain to join up as Constructor Crusaders! And what about yourself?

Power pentodes that will give 1,000 milliwatts without any special components seem to foot the bill; the only snag is high-tension current.

Many people believe that the ideal set, to give a high degree of selectivity, the very best quality, lowest possible background level, good daylight range and good results without having to play about with detector and oscillator voltages, *cannot* be a super-het.

This being so we think that the set for the job will have two good high-frequency stages with variable-mu pentodes (that do not have to be damped down to be stabilised), a double-diode-triode detector, self-adjusting volume control and pentode output. What do *you* think about it?

How the Loud-speaker Has Been Improved

By WELLINGS W. WHIFFIN

WITH the exception of the piezo-electric loud-speaker, there has been little fundamental change in design during the past two years, but practically every part of the conventionally designed loud-speaker has undergone some modification, either to increase its efficiency or to reduce the manufacturing cost.

The sum total of these improvements has resulted in a far better loud-speaker than we were privileged to hear at Olympia in 1932. The direction of these improvements will be discussed in more detail later.

Moving Coils Are the Order of the Day

Looking round the commercial receivers, it is at once evident that the moving-coil type of loud-speaker is rapidly gaining in popularity over the inductor and the various forms of armature loud-speaker. Even in inexpensive battery receivers, the permanent-magnet moving-coil loud-speaker is common.

For one thing, the manufacturer has realised that the moving-coil loud-speaker adds a definite selling value to the receiver. The public has accepted it as the best form of reproducer and gives this consideration when buying a set.

Another reason is that the moving-coil loud-speaker has a larger undistorted output for its size than other types. This feature is of great value nowadays when the trend of receiver design is to compress as much material as possible in the smallest of cabinets.

The vogue for midget sets is likely to continue and may bring about loud-speakers with a cone diameter of only 4½ in. to 5 in.

Increased Efficiency Has Reduced Size

The reader must not think that the smaller loud-speaker brings about a greater efficiency. It would be more accurate to say that the increase in efficiency of the modern loud-speaker has made possible a reduction in size. If the loud-speaker of two years ago was made in miniature size, it would be a very poor affair without the latest improvements.

The question of space has already been considered, but another important reason for the development of the small reproducer is that of cost. If it is to take the place of an armature type, it is obvious that its cost should bear some comparison with it, if the receiver is to be sold at about the same price.

The large part-sectional drawing (Fig. 1) gives a good idea of the construction of an up-to-date loud-speaker. The chassis, or cone bucket, is stamped and pressed from a flat steel blank in one operation. When it has been removed from the press, it is complete with the fixing holes for the magnet, output transformer and the eyelet holes for fixing the U-shaped strips into which the baffle felt is glued.

Note the dust-excluding felt washer arranged to cover the gap in which the speech coil is fitted. The permanent magnet is extremely powerful and without this cover would collect tiny specks of iron and steel which, once in the gap, would scrape the coil, ruin its insulation and cause serious rubbing and distortion.

Some manufacturers enclose the entire unit in a dust-proof bag, which should not be removed.

The improvements in the material and in design are important. One forward step is the introduction of the moulded cone. Look at Fig. 1 at the spot where the chassis is cut away to reveal the edge of the cone. Notice that the flexible wash-leather disc which surrounded the edge is gone.

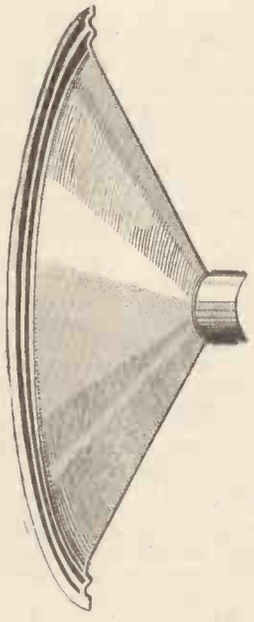


Fig. 2.—Showing how the edge of the cone is moulded

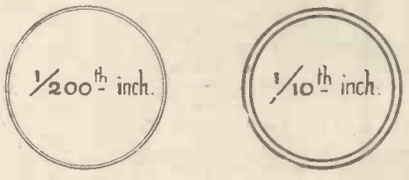


Fig. 3.—How the size of the air gap has been reduced, resulting in an increase of power

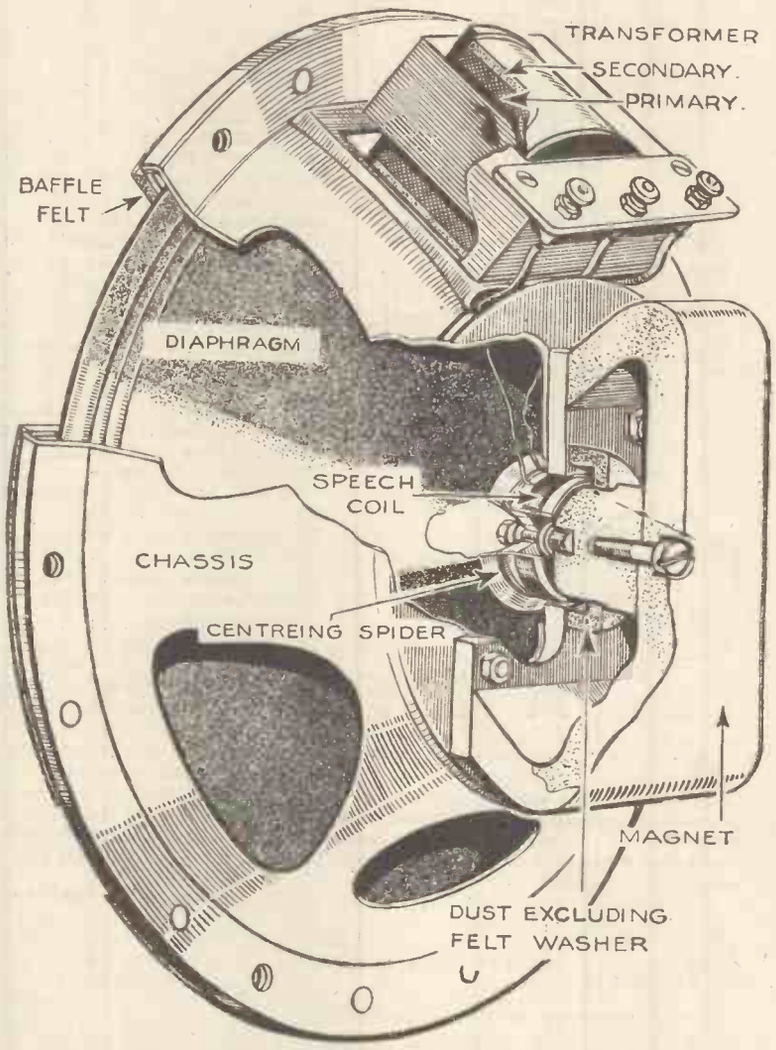


Fig. 1.—Dissected diagram showing all the principal features of a good modern moving-coil loud-speaker

Its purpose was to give flexibility to the outer edges so that the whole cone could respond to movement. In place of this soft surround, the edge is now moulded with two or more corrugated rings. This construction is shown in the drawing in Fig. 2, which is a sectional view of the cone and speech coil across the centre.

This improvement is far reaching. Not only is the cone under better control to the movements imparted to it by the speech coil, but the latter is restricted to an "in-and-out" piston-like movement. With a flexible surround, the speech coil had a tendency to sag downwards or move sideways and foul the gap.

Making the Air Gap Much Smaller

Because of this tendency to pivot round on the centring spider, the speech-coil gap had to be kept large for the sake of clearance. Gaps of 1/10 in. were quite common. With the moulded cone, the speech-coil gap in modern loud-speakers has dropped to 1 millimetre or about 5/1,000 in. The two rings illustrated in Fig. 3 give an idea of the difference in gap widths between old and new reproducers.

This means a big increase of power because the magnetic lines of force are much more crowded round the gap. For the same efficiency, a smaller magnet has become possible.

To the advantages of the small gap can be added the improvements in the quality of magnet steel. Recent research has produced a much better magnet of aluminium alloy. To take an example, a present-day

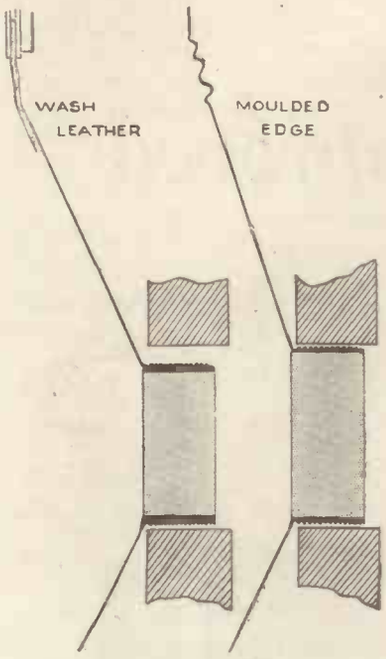


Fig. 4.—How the moulded cone holds the coil in position

permanent magnet weighing only 2 lb. may have as much as 10,000 lines.

Realising the importance of a thin gap, manufacturers and designers have given attention to the tube on which the coil is wound. Moulded-bakelite formers were discarded because they were too thick and heavy, and paper formers of 15/1,000 in. thickness were substituted. Even the paper has now been reduced in thickness to about 5/1,000 in.

In certain loud-speakers, known as "tweeters," the speech coil is wound on air. The turns of wire have, literally, no support other than the strong celluloid cement with which they are impregnated. The "tweeter" is a monitoring horn or local loud-speaker which indicates to the operator how the main loud-speakers of a large installation are working.

They are used in the control room of the cinema operator, who canot hear those working in the body of the hall.

Speech coils and cones have become much lighter in weight. Buckram and other forms of reinforced material have become obsolete and their place taken by a tough yet light paper which can be moulded without buckling. In loud-speaker design, one improvement often brings about another. We have seen the advances in design due to the moulded cone and in the lighter speech coil and smaller diameter cone; it follows naturally that the cone can be made of lighter material.

As the loud-speaker becomes smaller it is less able to respond, in true proportion, to the lower notes or the bottom of the register. Fortunately, this defect can be allowed for in the design of the receiver by providing a certain amount of cabinet resonance "to put in the bass," and by correctly designed filters to cut off an excess of high notes.

For all-round reproduction, a cone diameter of 10 in. with a speech coil of just over 1 in. in diameter gives the best results. Speech coils are mainly of low resistance (of 1 to 5 ohms) used in conjunction with a step-down output transformer.

A method of overcoming the somewhat limited audio range of a loud-speaker is by using two separate reproducers of different cone diameters. A small one gives emphasis to the upper register and a large cone provides a larger proportion of the bass notes. Heard together, the effect is very realistic.

By no means can it be said that the loud-speaker has reached finality in design. It has not even kept pace with the forward march in amplifiers and receiving apparatus. Recent experiments in the electrostatic and the piezo-electric loud-speaker may yet revolutionise the whole section of sound reproducers and call our attention to the shortcomings and failings of our receivers.

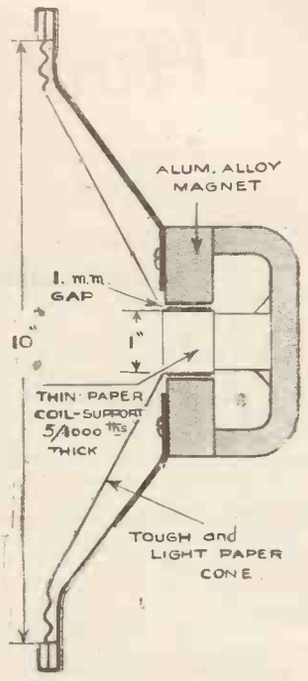


Fig. 5.—Essential details of a modern moving-coil reproducer

What Comes Next?

ON THE TRACK OF INVENTION

A FEW years ago, when it was easier to pick and choose one's programmes than it is now, most of our troubles were centred around the battery problem. The high-tension "pack" was in those days a poor thing, at best, whilst the low-tension supply was even a bigger nuisance.

When each valve was drawing the best part of an ampere for heating the filament, the four-valve set ranked as a luxury, whilst the eight- or nine-valve superhet could hardly be said to exist except on paper.

Competing on Equal Terms

The coming of the dull-emitter valve—and the use of the electric mains—has changed all this for most of us. Even listeners who are not connected up to the electric supply can now compete on more or less equal terms with those who are—thanks to the new high-mu valves and the use of Q.P.P., which cuts down high-tension consumption to a minimum.

At the same time when one considers what has already been done in the matter of filament "juice"—it has been cut down from three-quarters of an ampere in the case of the old bright-emitter to about one-seventh that amount for the modern battery-driven valve — one is tempted to wonder whether it is not possible to make still further progress in the same direction.

The production of the first dull-emitter valve was due to the discovery of certain oxides which contained electrons that could easily be shaken off. That is to say they could be liberated by using less heat than was required in the case of the bare filament.

Also it was found that the addition of a little thorium greatly increases the ordinary emission of electrons from a tungsten wire. The thorium acts in such a way as to keep a layer of electrons always near the surface of the tungsten cathode, ready to be shaken free by a little heat and to jump off under the combined pull of the grid and plate voltages.

As soon as the first layer is exhausted another is immediately formed, ready to replenish the stream through the valve.

Somewhere here it seems there should be room for still further improvement. Certain metals, as we already know, are able to produce free electrons under the very feeble impulse of a ray of light. Again there are all sorts of radioactive substances which simply insist on producing them at all times.

Whatever method he uses, the inventor who first produces a practicable "cold-emitter" valve will earn the gratitude of a large number of battery users. In addition he will make the portable set really worthy of its name.

Even supposing the absolute "cold-emitter" to be out of the question, it is well on the cards that we shall one day be presented with a four-valve set which can be driven for six months from a single dry-cell battery.

That is so far as the low tension is concerned. But what of the high tension? This at first sight seems more of a snag—particularly with the present high-mu high-resistance type of valve.

Possibilities of Gas-filled Valves

At the same time, valves have been used to receive signals with no higher voltage on the plate than that provided by the low-tension battery. And although our present fancy is to use valves with a very high vacuum inside, that doesn't necessarily rule out of court others of the gas-filled type, which are able to pass ample current using only a small plate voltage.

Or there is the plan already adopted for motor-car sets, where the low tension is first cut up into A.C. by a make-and-break contact, and in this form is raised to a higher voltage across a step-up transformer, before being rectified and smoothed ready for the plate supply.

Naturally the problem isn't simple, or we should have had the solution already. But it should not surpass the wit of man to design a set before long which will be capable of working for months on end drawing both high tension and low-tension from, say, a couple of small dry cells. When this does come to pass, we shall probably take it for granted, refuse to be astonished, and develop the habit of carrying

Continued on page 62

Acme photo

In the United States, they are building midget radio sets into kitchen cookers for the entertainment of the housewife

Ganging Is Not So Difficult!

And Here HARRY HAWKE Explains Why

MANY constructors imagine that to adjust their circuits for accurate ganging is a job beyond their capabilities. They are under the impression that it is a task which demands a considerable amount of skill.

As a result of this mistaken belief there are many enthusiasts who are reluctant to tackle a receiver which employs more than a two-gang tuning condenser, that is, two tuned circuits. On the other hand, we often hear of the veriest novice undertaking the construction of a receiver employing four tuned circuits and aligning his circuits quite successfully.

Why Ganging Is Necessary

Let us explain why adjustment of the circuits in a receiver employing ganged tuning condensers is necessary. We all know that tuning is effected by means of inductance and capacity, the former fixed and the latter variable. It is therefore natural to assume that if the coils and condensers are accurately matched, no further adjustment will be necessary. Unfortunately we have omitted to take into consideration the stray capacities which are in parallel with each tuned circuit. These consist of grid-cathode capacity of valve, capacity of valve holder and wiring. In the case of an aerial coil we have the wiring capacity and the transferred aerial capacity.

Compensating for Strays

Now, in order to arrange that all the capacities are equal, it is necessary to devise some means of compensating for the unequal stray capacities in parallel with each circuit. To achieve perfect ganging, therefore, three conditions must be fulfilled :—

1. Every coil must be equal in inductance.
2. When the position of the rotor of the tuning condenser is varied, the value of the capacity of each section of the condenser must be equal, in other words, the capacity of each section of the tuning condenser must be equal for every angular displacement of the moving vanes.
3. All the stray capacities in parallel with each tuned circuit must be equal.

With accurately matched coils and condensers, conditions 1 and 2 will be fulfilled; it is, therefore, only necessary to equalise all the stray capacities in order to achieve our object. This is carried out by means of an additional small capacity placed in parallel with each section of the ganged tuning condenser. This additional capacity or trimmer is semi-variable and enables us to add a small amount of capacity to a circuit in order to equalise it.

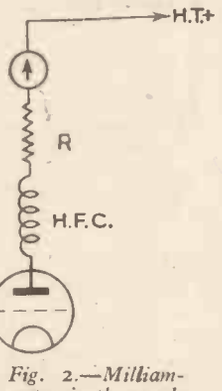


Fig. 2.—Milliammeter in the anode circuit of the detector valve for visual ganging

All we have to do is to adjust these trimmers accordingly and once set no further adjustment is necessary ; not a very difficult task. There are two methods of carrying out this adjustment of the trimmers, and either system or both may be employed.

By the aural method we ascertain when the circuits are aligned by means of the strength of the signal as reproduced in the loud-speaker.

First of all select a fairly weak station operating on the lower wavelengths of the medium waveband. Do not select a powerful transmitter, as in this case considerable manipulation of the trimmer will be possible without reducing sufficiently the strength of reception.

Now, having tuned in our station, adjust each trimmer in turn until maximum response is obtained. Some of the trimmers may be found more critical than others, and it will therefore be found necessary to adjust carefully as otherwise the critical point may be passed over.

With visual ganging a milliammeter is placed in the anode circuit of the detector valve. It should be arranged as near the high-tension supply end of the circuit as possible. The trimmers should be adjusted in the same manner as for aural ganging; but in this case, the circuits will be in resonance when the milliammeter in the anode circuit of the detector shows its maximum deflection.

In the case of an anode-bend detector it will indicate an increase of anode current, but in the case of leaky-grid detector it will show a decrease in anode current. By observing the meter whilst adjusting the trimmers, it is easy to notice the point at which maximum deflection occurs.

When no signal is being received, the milliammeter will read the standing anode current ; as soon as a current is impressed on the grid of the detector the anode current will decrease. The stronger the signal the greater will be the deflection of the needle.

As each section of the gang condenser is correctly adjusted, the effect on the needle of the meter can be noted. We should adjust each trimmer until the maximum needle deflection is obtained.

If the station being received is the local or a strong foreigner, care should be taken to reduce the input so that detector overloading is avoided, otherwise a steady detector-current reading cannot be obtained on the meter.

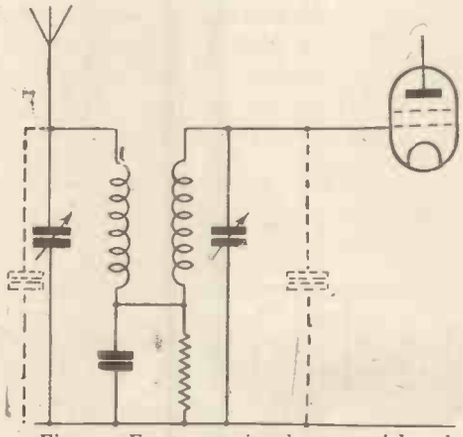


Fig. 1.—Extra capacity due to aerial and valve circuit shown by dotted lines

The diode detector is now becoming popular, particularly for use in automatic volume control circuits. To check the ganging of the various circuits when a diode valve is employed, a slightly different method has to be adapted.

Usually automatic volume control circuits operate by controlling the bias on one or more high-frequency or intermediate-frequency valves, the grid bias varying with signal strength; the greater the strength of the signal the higher the grid bias applied to the high-frequency valves.

This increase in grid bias will cause a reduction in the anode current of the controlled valves, and it will fall as signal strength is increased. By inserting a milliammeter in the anode circuit of the controlled valve, it is therefore possible to check the ganging.

Use of Tuning Indicators

Many receivers employing automatic volume control incorporate a tuning indicator, which may take the form of a special neon lamp, or miniature cathode-ray tube; there are also other types of indicators. In these circumstances ganging can be carried out without the addition of a milliammeter.

Sometimes after aligning your circuits you may experience difficulty in tuning in stations transmitting on wavelengths of about 200 to 220 metres or even higher.

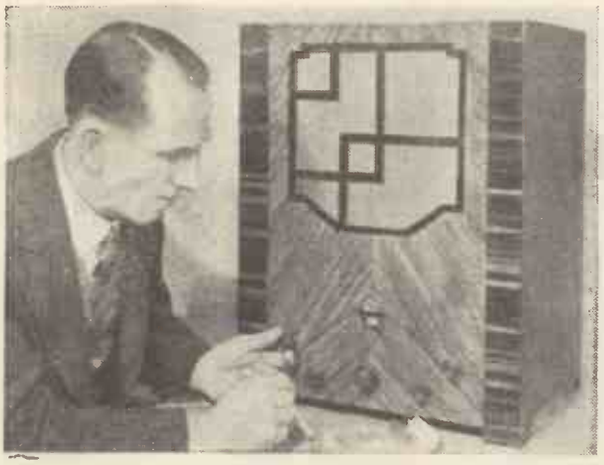
There are several reasons for this.

1. Your trimmers may have been adjusted so that an excessive amount of additional capacity has been added to one or more of the tuned circuits. Try reducing the capacity in parallel with each circuit by the same amount. To do this increase the main tuning capacity slightly, afterwards re-trimming. By careful adjustment it will be found that one of the trimmers will be near its minimum capacity or fully unscrewed position.

Maximum Tuning Response

2. Occasionally it is difficult to get a distinct point of maximum response at one particular setting of the trimmer. The strength of reception may still be on the increase when the trimmer has been screwed up to the point of maximum capacity. Turn the main condenser knob slightly in order to slightly increase the capacity of the main tuning condenser, and then re-adjust the trimmers.

3. If one trimmer happens to be screwed up to maximum capacity while one of the others is fully unscrewed, this is probably due to some excessive stray capacity being in parallel with the latter. This may be caused by a screened lead or one of undue length.



Making a Simple Multi-purpose Switch

By A. L. JACKSON

THERE has been mentioned in AMATEUR WIRELESS recently the matter of trouble-free switches, and no doubt many readers have experienced snags with certain types, owing to springs getting weak, contacts getting dirty, and various other troubles.

The writer was up against this problem a year ago, and probably a description of a switch designed then, and used ever since without any trouble, will be of interest.

The points considered in the design were, firstly, that it must be self-cleaning; next, the lift of the springs must be small to avoid them losing tension; the positions must be definitely located; and, lastly, by a suitable number of contacts it should be capable of all the switching requirements likely to be wanted; in addition, it had to be cheap to construct.

"Fit and Forget"

These requirements were all embodied in the design under consideration and, like a certain motor-car accessory, it has been possible to "fit and forget."

Figs. 1 and 2 give all the details. Four contacts are shown but any number can be used, as will be seen later. It consists of an ebonite or bakelite strip E, carrying a bracket B, screwed to the centre of the ebonite with screws and nuts. The bracket carries at one end a "one-hole" fixing bush if required, or can be bent over as shown by the dotted lines to provide baseboard mounting.

A spindle passes through the bush and through a hole in the other end of the bracket, with an ebonite rod ½ in. or ⅝ in. diameter, secured to it by a pin passing through ebonite and spindle.

This ebonite rod has fixed to it suitable strips for the contacts; the position, etc., of these varies according to the switching required, so will be left till later.

The contact springs S in Fig. 1 are secured to the ebonite by means of terminals as shown; if required the ends of the springs can be made into soldering tags, thus doing away with one joint in the wiring.

Arrangement of Springs

The springs themselves are arranged alternately on the ebonite, one on each side of the roller. They are also staggered so that their actual contact points underneath the roller form a straight line. The end view in Fig. 1 illustrates this.

It will now be apparent that by arranging suitable strips on the roller we can connect or disconnect any spring from another by rotating the roller.

Now let us look at the means for positioning the roller and giving it that "definite-position" feeling when turned.

A look at Fig. 1 will show a square filed on the ebonite roller, and a look at Fig. 2a gives a view of this end of the switch; it will be seen that bracket B has a projection with a small hole in the end, and pivoted in this hole a stout wire arm. If the end of this wire is looped round and a screw put through into the bracket this will do the trick nicely.

The other end of this wire is bent as shown, and has a spring between it and the ebonite platform, this giving the necessary tension to keep the wire pressed against the square.

The spring in the writer's case was a piece of curtain spring obtained from a sixpenny stores. As the roller is turned, the wire lifts and comes down very definitely on the next flat giving four certain positions. A spot of vaseline makes it work easily, and, contrary to expectations, wear on the ebonite square is practically nil.

A switch of this type can be used as on-off as well as for wave-changing; in fact, it is better to make it do both jobs, because every time you switch on you clean the contacts.

For battery sets two of the contacts can be used for "on" and "off", but for mains this is not suitable as it is not Q.M.B. type.

Therefore for a mains set, a small Q.M.B. switch, advertised by a number of firms in this journal, can be mounted up at the end as illustrated in Fig. 2b. The Q.M.B. switch is clamped to an extension of the ebonite platform and is operated by the disc D which has a pin in it for the purpose; incidentally, the slot shown in the Q.M.B. switch can be made with a small file, or switches are obtainable with this slot already made.

This would also be suitable for an eliminator if care was taken to see that the low tension was switched on first and off last, the other contacts being used for high tension.

The only other point requiring consideration is the contact strips on the roller. It is best here to take an example, assuming we wish to switch a battery screen-grid set with tuned-grid coupling; a look at the switch will show that the contact springs form a straight line along the bottom of the roller.

As the filaments are earthed one side, if we disconnect accumulator from earth the set is switched off; likewise for medium waves we must short-circuit the long-wave part of each coil to earth.

If we fasten a strip of metal on the roller running the whole length of it, when the switch is in this position the set will be switched to medium waves.

The wiring would be as follows: Contact 1 to aerial coil; contact 2, high-frequency coil; contact 3 to earth; contact 4 to low tension. If we turn the roller through 45 degrees and a short strip connects 3 and 4, leaving 1 and 2 disconnected, we shall have the set switched on to long waves.

Tuned-anode or transformer couplings would require more contact springs, but a little thought will show that almost any switching can be done with a suitable number of springs.

For changing over an aerial tap, three springs would be wanted; in one position centre and left would connect, and in the other centre and right, one tap each going to the outers and the aerial to centre.

The description on this page of a multi-purpose switch will interest many experimenters. If you have developed some simple gadget for your own convenience, why not let fellow-constructors have the advantage of your work by sending details for publication in AMATEUR WIRELESS? All contributions will, of course, be paid for at our usual rates

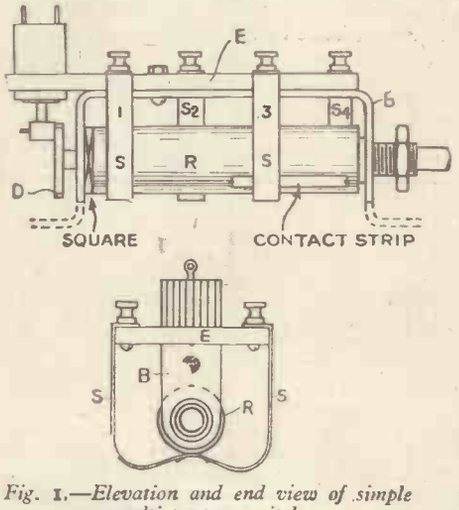


Fig. 1.—Elevation and end view of simple multi-purpose switch

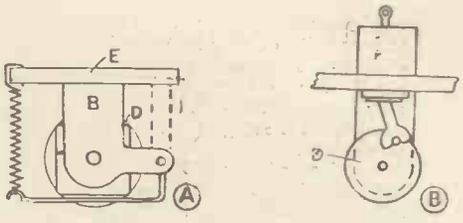


Fig. 2a.—End view of switch with square filed on roller. Fig. 2b.—Mounting a Q.M.B. up at the end

The switches could be built into a base with the coils on top, as is done with the gang-coil units. With regard to the springs, these should be of reasonably stout metal and bear with a fair tension on the roller; they should keep their tension indefinitely as the lift is only about $\frac{1}{32}$-in. at the most.

In the writer's case the contact strips were about ⅛-in. wide with the ends a little thinner. They were bent over at right angles and pushed into holes in the roller, the holes being filled with small plugs, the edges of the strips being bevelled to allow the spring to go on without jumping.

In conclusion, a word of warning: do not push the contact pieces so far through that they all short-circuit on the roller spindle.

On Your Wavelength

By THERMION

Hail! Crusaders

WHOEVER conceived the idea of the Constructor Crusaders had a brain-wave of considerable amplitude. I hope that every reader who is a keen constructor—and most readers of "A.W." must be that—will join, for by banding together we can probably accomplish a great deal.

First and foremost, there is the interchange of ideas which is going to be most valuable. In this way the "A.W." designers will be able to discover just what sets we want and to give them to us.

And then there's the free service of replies to technical questions. All of us get up against it at one time or another when we are building sets, and that technical service is going to be a really good thing.

Build and Be Up-to-date

MYSELF, I foresee the possibility of a big revival in home construction during the coming season. One of the strongest of strong points about building your own sets is that you can always keep right up to date at very small cost.

Buy a set ready made and you are tied to it until such time as you can afford another; but build your own and you can incorporate all the latest improvements as they come along.

Further, you can make your set suit your individual tastes. Ready-made sets have always to be designed so as to give fair satisfaction to the largest possible number of people. But, however good they may be, few of them please everybody. Certainly I have never yet come across one which was exactly what I wanted.

Build your own and have precisely what you want!

◆ ◆ ◆

The Radio-vuo-gram

BY the time this note appears in print, a rather remarkable piece of apparatus should be on the market. This is the Plew Neutorn Televuer, which can be obtained in several types. Though it is designed for 30-line television, it is claimed to be convertible very simply for the reception of anything up to 300 lines.

Another particularly interesting development is the recording on gramophone records of complete sound and vision programmes lasting for about ten minutes. The records have a double track and a dual pick-up with two heads is used, one for sound and one for vision. Best of all, the records will be remarkably low priced. The cost of the 10-in. size is to be about 3s. 6d. and that of the 12-inchers 5s. 6d. or so. These records are expected to make their appearance at an early date.

There seems to be no reason why we should not soon have a triple receiving instrument—the radio-vuo-gram. With it you could receive ordinary broadcasting or both the sound and the vision of television transmissions. You could also play "plain" records or those which carry both sound and vision items.

◆ ◆ ◆

"Teas," Wireless And the Test

IT was mid-afternoon, the Test Match at Old Trafford was in progress, and with a couple of friends, I found myself in a car unprovided with wireless and miles from anywhere.

We were all dying to hear how the game was progressing, but there seemed to be no possibility of doing so. Then, as we bowled along, a cottage hove in sight with a perfectly good aerial mast in the garden and at the gate a notice bearing the magic word "Teas."

This seemed a good pull-up for motorists thirsting both for tea and for cricket news. Could we have tea? We could. Could we tune-in 5XX to hear the 4.30 Test Match bulletin? The good lady of the cottage was most willing, but she feared that her accumulator was just about run down.

A Charging Brain-wave

FIRST of all, blank despair. Then a sudden brain-wave. There was a full half-hour to go before the bulletin was due. Could we put some juice into that accumulator?

There was a length of flex in the tool box and we had a 45-watt headlamp bulb. Using that as a resistance, we "milked" the car battery and fed juice into the wireless accumulator at 4 amperes.

At the end of the half-hour, it had so cheered up that we were able to get every word of Mr. Howard Marshall's thrilling report. Not bad work, what?

◆ ◆ ◆

Heaviside Cross-modulation

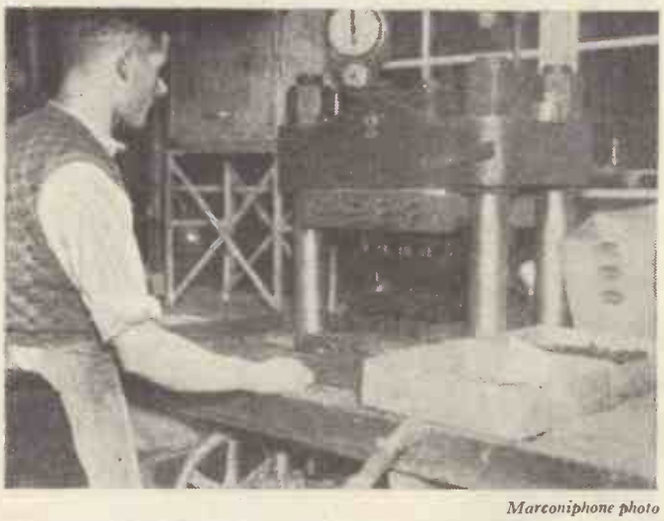
THERE is a considerable difference of opinion between experts as to the advantages and disadvantages of broadcasting on high power. One side says bluntly that the only chance of making oneself heard in a crowd is to shout, whilst the other side retorts that using increased power only tends to make the ether more of a pandemonium.

Without taking any active part in the quarrel, I should like to draw attention to an interesting statement made by Dr. van der Pol at a recent meeting of the Institute of Radio Engineers at Philadelphia.

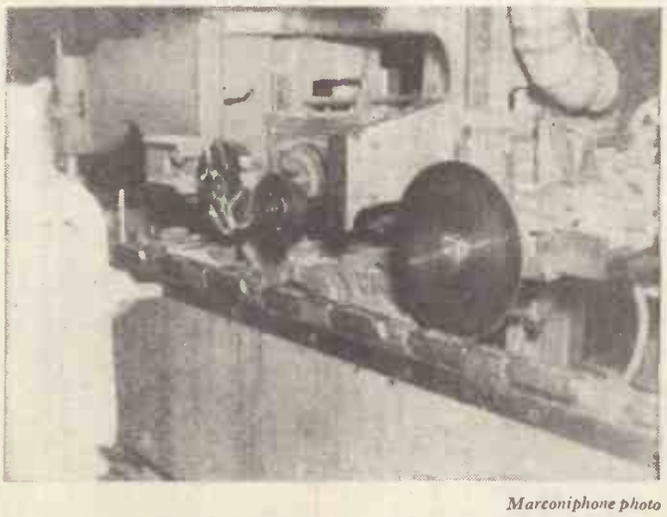
He says he has found definite proof that when two high-powered stations send their waves simultaneously through the same part of the Heaviside layer, a very curious kind of cross-modulation occurs—apparently owing to the fact that the layer is not homogeneous.

Once this happens, the two programmes cannot be separated by any amount of tuning—even if one signal is transmitted on a medium and the other on a long carrier-wave. In other words each acquires a "background" of the other, which is there for keeps.

Dr. van der Pol adds that such interference increases very rapidly with the power-rating of the transmitter. This, it seems to me will soon call a halt in the race for more kilowatts.



Marconiphone photo



Marconiphone photo

Can you guess what the machine on the left is? A giant press for condenser bakelite mouldings. The machine presses thirty condensers at one operation! No wonder Marconiphone sets are turned out so quickly these days. Actually, there are four of these presses at the E.M.I. factory, where the sets are made, using up half a ton of bakelite powder every day. The output of condensers is well over a quarter of a million per week. On the right you see a machine in the cabinet factory—where Marconiphone sets are so handsomely housed, you know! The machine is known at Hayes as the Five-cutter, because there are actually five cutting heads in it. In one cycle of movements five distinct operations are carried out by one man and an assistant. With this machine a piece of wood can be grooved on one edge, tongued on another, the surface planed, the edges all squared, and the corners taken off as and when needed. No less than 4,000 pieces of wood a day are dealt with, comprising 24,000 feet of wood. What a lot of work goes to the making of a radio receiver

H.M.V. photo

Sir Cedric Hardwicke, the famous actor, listens to the radio while making up for his part in "The Late Christopher Bean." Even dressing-rooms are no longer sacrosanct!

Wireless from the Mains

SOME weeks ago, I told you a little of the new relaying scheme which makes it possible to transmit two or more alternative programmes over the electric-lighting mains. The only apparatus required for reception is a selector which picks out the desired programme and loud-speaker which reproduces it.

Though the system has been completely worked out and demonstrated in the most satisfactory way, it cannot be used until the necessary authority is given by Parliament for the employment of the mains in this way.

A Bill is now before the House of Commons to authorise the relaying of wireless programmes *via* the mains. If it goes through, I foresee some interesting developments.

◆ ◆ ◆

A Programme Protest

HAVE listeners, I wonder, noticed a recent innovation in the B.B.C.'s programmes which seems to call urgently for their attention?

Last week there were no alternatives whatever in the evening programmes between 6.30 and 8 p.m. The same programmes were sent out by every station, Regional and National alike, on every wavelength belonging to the B.B.C.

You might not have tumbled to this unless you actually tuned-in the stations, for the official programme lists were a trifle misleading. If, for instance, you turned to the London Regional's programme announcement for Wednesday, July 11, you found that it was billed to give the Midland Regional programme. Under "Midland Regional" this programme was given in full detail. But it wasn't the Midland Regional programme at all; it was the National. It was, in fact, the sole and only programme.

This kind of thing is definitely not good enough, and I hope that listeners will not take it lying down. The whole essence of the high-power twin-station scheme is that alternative programmes shall be provided, and I can see no good reason why we should not have them.

It would be an audacious chef who offered onions and steak as an alternative to steak and onions on his menu.

All-station Broadcasts

IS there ever any excuse for sending the same item from all stations simultaneously? Only, I think, if it is one that nobody would care to miss—and these are very few and far between.

It is conceivable that if there were alternatives at three o'clock on the afternoon of Derby Day, some people might miss the thrills of the running commentary—and kick themselves afterwards for having done so—because whilst listening to the other programme they forgot all about the great race.

But there cannot be any good reason—from the listener's point of view, at any rate—for the transmission of perfectly ordinary items with nothing like a universal appeal on all wavelengths during the early part of the evening.

If the Nationals cannot have programmes of their own at those times, it would be better to close them down altogether, thus giving listeners a better chance of obtaining real alternatives from foreign stations without interference.

◆ ◆ ◆

Loss of Emission

THERE are few more annoying—or illusive—faults than what the valve makers call loss of emission, particularly for listeners who are not particularly "knowledgeable" about the ways of a wireless set. For instance, during a recent holiday visit to a rather remote village I was called in to "vet" a receiver which was obviously not up to the mark. Signals were coming through all right, but with absolutely no pep. Having no proper means for testing the circuit I tinkered about for a time, but finally had to retire without gaining any laurels.

After sleeping on the problem I was seized with an inspiration, and returned to the task armed with a spare valve borrowed from another local listener. A couple of exchanges and the trouble was found—a rascally detector which, although outwardly quite O.K., was producing practically no output of electrons.

Of course we had to send to town for a new valve, but I persuaded my friend to give an order for two, on the principle that a spare valve always more than earns its keep.

◆ ◆ ◆

Car-radio Point

PERCY HARRIS did a good day's work when he got down to the brass tacks of the car-radio set. He has had something to say on the subject in "A.W."

In my humble opinion, some makers made a very great mistake in claiming heaven knows how many stations for their car-radio outfits. It is perfectly true that you can get heaps of stations after *dark*; but probably 99 per cent. of listening with these sets is done in broad daylight.

But even with the biggest of superhets and the finest of aerials there are very few medium-wave foreigners that you can receive in daylight at present; at any rate, in such a way that they are really worth listening to. Car-radio sets are jolly good, but they cannot perform the impossible.

Marconiphone photo

What more could anyone ask for? A calm sea, a gentle breeze, a sunny sky, two weeks' holiday ahead—and a good portable radio on board for entertainment!

The Pentode Case

THOUGH it hasn't been reported by many of the lay papers because of its highly technical nature, there has been a very important wireless case before the courts recently. The Mullard Valve people sued Philco on the ground that certain pentodes made by the latter infringed patents.

In the end, Mr. Justice Farwell decided that there had been no infringement and the action was dismissed. I hear, though, that Mullards are to appeal against this decision. Whatever happens, the appeal will be a most interesting one, for many issues of great importance are involved.

There is another action coming on soon. Some time ago, Philips Lamps offered makers a complete manufacturing licence under their numerous patents. Now the companies which form the opposition Patents Pool allege certain infringements.

What a lot of big wireless actions there have been—and what thousands upon thousands of pounds have been spent on them. It seems rather a pity that we can't have a super pool, controlling all the useful wireless patents, instead of rival concerns.

◆ ◆ ◆

This Year's Battery Sets

IT is much to be hoped that this year manufacturers will not repeat one big mistake that they made over battery sets last season. Many of last year's big battery sets were fitted with stupid little high-tension batteries of the standard-capacity size.

There were two evil results. One was that the quality of reproduction rapidly began to suffer when the set had been used for a week or two. The second was that purchasers were disgusted by having to spend good money on high-tension renewals at far too frequent intervals.

This year's big sets must have big batteries if they are to be successful. Here are the cold hard facts. A big set requires about 10 milliamperes of high-tension current. The very best of the many standard-capacity batteries that I have tested out this year has a life of seven weeks under this load for four hours a day.

Marconi photo

Echo of the Horse Show! Ultra-short wave receiving station in the announcer's box at Olympia. It picked up telephone messages from the official with the judges in the arena and enabled the results of every competition to be announced within a few seconds of the decisions being made

On the other hand, a triple-capacity battery, costing less than one and a half times as much, has only just come to an end after twenty-five weeks of excellent service.

Paying one and a half times as much for a battery and getting more than three and a half times as much service from it seems to me to be pretty sound finance.

What Are the Barriers to REAL QUALITY?

By NOEL BONAVIA-HUNT, M.A.

LOVERS of sweet sounds are all in search of real quality. What are the barriers? Let us take the more obvious ones first.

1.—If we want high-quality reproduction from radio signals, there is one very obvious condition that has to be fulfilled right away before even the set is built, and that is the quality of the transmitting station signals sent out to us for reception.

This is never ideal : it is often good : at times positively excellent : at other times it is quite bad. There are real difficulties in making a perfect transmission, which need not be enumerated here. The quality is well known to vary from one studio to the next.

At Mercy of Transmitter

If the signals are suffering from wave-form distortion at their source, then it is obvious that the receiving set is at the mercy of the transmitter. A stream cannot rise higher than its source.

Gramophone reproduction falls under another category. Yet everyone knows how variable in standard the quality of recordings can be. A very common fault is a certain degree of *hardness* that characterises the quality, largely due to tracking problems. Another familiar difficulty is that of obtaining the correct balance of reproduction below a definite volume level.

As a rule, records softly played reveal surface faults which mar the purity of the upper register. We are then tempted to cut down the treble response, and this in its turn presents a noticeable deviation from the standard quality of the original.

For Frequency Testing

On the other hand, the record as a frequency-testing appliance is more consistent than radio transmission, since we do not know what we are going to get in the way of signals.

2.—Another barrier to real quality which only the favoured few are able to avoid is the interference of unwanted radio signals. In some districts the degree of selectivity required to cut out interference is so high that it is not possible to preserve the higher frequencies of the original performance. For real-quality reproduction a receiver should be capable of responding to a 6,000-cycle note at least. If it can respond to a higher frequency still, so much the better.

What *is* bad is a cut-off at 4,500 cycles. Yet a highly selective set may be forced to do this. The very idea makes a musician shudder. The high-quality designer is then faced with an insoluble problem. There must be a definite limit to the frequency separation between two adjacent channels.

3.—A further barrier is that set up by man-made interference. Flat dwellers are frequently victimised by this nuisance. Coast dwellers are worried by morse signals. Mains users are too often harassed by the 100-cycle hum, and sometimes the most ingenious technician is baffled by this problem.

The three barriers above mentioned are the more obvious kind that present themselves to the quality seeker. Alas ! Would that this represented the complete list. But even if each one of these difficulties were suddenly disposed of by some magician's wand, there would still remain two further obstacles which the quality-seeker must overcome.

They should both be obvious enough to anyone, but judging by the silence of technical engineers they do not appear to be as obvious as they ought to be.

The first of these is the sad fact that a large number of listeners are compelled to accept a *modified version of the original*. That is to say, they live in comparatively small rooms, and the volume level of the reproduction has to be reduced in accordance with their particular requirements.

It must be remembered that *speech* is the only item that can be said to be reproduced at the same intensity in both studio and reception room.

A vocalist or a violinist or a pianist *can* be not only tolerated but even listened to with pleasure in a small room (provided the quality of the performance is in itself satisfactory), but if we attempt to reproduce the same volume from a loud-speaker in that room, the result is utterly different. Why is this?

The reason is that the sounds emanating from the vocalist's mouth, from the violin or from the piano, radiate naturally and gracefully into space and *do not select any particular route in that space*. This, unfortunately, is not so in the case of the loud-speaker : hence the output readily becomes out of proportion to the space of the room. Consequently, we are compelled to modify the output to some extent.

G.P.A. photo

One of the earliest gramophones alongside a modern automatic record-changing radio gramophone

Different People—Different Intensities

It is, however, a notorious fact that different people prefer different intensities from their radio and gramophone sets. One man will tolerate double the volume, so to speak, that another will : not by any means because one is deaf while the other is not, but because people's nervous organisms vary enormously, the degree of sensitivity possessed by one person being far greater than that possessed by another.

Even so, it is assumed that in a small room about 15 ft. square the majority of listeners would find an orchestra playing at full strength beyond endurance. And it must be remembered that the slightest deviation from the original intensity inevitably alters the response characteristic of the performance.

The problem before the set designer is to *re-capture the proportions of the original at the lower intensity*. Where previously the response characteristic was a straight line one, now *it is no longer so*.

One would suppose that the technical engineer would see this and cater for it. But he proclaims the infallibility of the straight-line amplifier and ignores the altered conditions brought about by a reduced and modified version.

It is true that any deviation from the straight-line standard in amplifier design is fraught with difficulties and snares. It sounds too much like suggesting the introduction of faults in the receiver to atone for faults in the transmitter.

Recently "Amateur Wireless" published a series of articles on real quality from the pen of Noel Bonavia-Hunt, M.A. These articles aroused a storm of controversy—but many readers asked for further guidance on the subject. Now Noel Bonavia-Hunt discusses the difficulties in the way of real-quality reproduction and explodes the fallacy of the straight-line amplifier for this purpose. His article will be appreciated by all those who want a review in small compass of the main difficulties that beset the real-quality designer

Gullil and photo

Electron-musical instruments have a close relationship with real-quality reproduction. Here is Professor Trautwein with some of his Trautonium pupils at the Berlin State Academy of Music

For the same reason some designers strongly object to the introduction of any kind of compensating device in amplifiers employed for gramophone reproduction. To all of which the answer is best made in the words of the familiar saw: "Nothing venture, nothing have."

The second great obstacle to high-quality reproduction is the many deficiencies of the microphone and the loud-speaker. Engineers go on gaily designing straight-line amplifiers knowing that up to the present no loud-speaker has been produced capable of a straight-line response.

Ever-changing Wave-forms

But let us suppose that such a loud-speaker were suddenly sprung upon us at next Olympia's show; it would have to be demonstrated that this particular reproducer is capable of dealing with ever-changing wave-forms under any conditions, transient or continuous.

Engineers seem to bury their heads in the sand and forget that they have this ugly monster to deal with. The straight-line amplifier must not be disturbed : it is far too sacred. The joke of the whole matter is the extraordinary ease with which a straight-line amplifier can be designed. One has merely to specify pure resistance-capacity coupling throughout, using suitable and well-known values of resistances and condensers.

Just think of it ! A series of special articles is published in a well-known radio magazine in which a real-quality amplifier is described. Let us suppose that this amplifier consists of resistance-capacity coupling exclusively, with the possible exception of the output transformer, and that the measured characteristic is a straight line from 50 to 8,000 cycles, with a very slight droop below 50 and above 8,000 cycles.

Accepted As Foolproof

It thereupon elicits the approval of all the experts and technical engineers of Great Britain ! The amateur reader accepts the circuit as foolproof. He purchases the components and assembles them in accordance with the specification.

Result : keen disappointment? Well, that depends on his taste. If he was looking for the bass response of the original (in its correct proportions), and perhaps the warmth of tone that the original presumably possesses, and certain other things which he knows he wants but cannot describe in so many words, then he is bound to be disappointed.

His immediate comment will be : "Where is the straight line? Is the original like this?" Thousands of amateur constructors have made up resistance-capacity amplifiers and have fed them into imperfect loud-speakers. Are they satisfied? How *can* they be? This straight-line fetish is fast becoming a curse.

A straight-line amplifier may be suitable for a large dance hall, though I doubt it. It is most unsuitable for working a loud-speaker in a living room. In fact, it seems impossible to reproduce the exact proportions of the original at reduced volume even by introducing compensating circuits in the amplifier. All that can be done, in the present stage of development, is to bring the proportions appreciably nearer to the ideal by abandoning the straight-line standard.

Let the engineer produce a straight-line loud-speaker responding uniformly from 256 down to 50 cycles. *Then* we will consider the claims of the straight-line amplifier. But whatever is the sense of deliberately preserving an inadequate bass register rather than lay sacrilegious hands on the straight-line amplifier?

One last point. We are told that the single frequency response test applied to an amplifier is an adequate one for determining its proficiency. All that one has to make sure of is the linearity of output to input. We are assured that each single frequency can take care of itself and is unaffected by any other frequency.

Where Fallacy Lies

The fallacy of these assurances is at once seen when we realise that the testing engineer substitutes a valve voltmeter for the loud-speaker. He also substitutes a pure sine-wave oscillator for the microphone. Is it not too absurd for words?

Again, be it noticed that he is dealing with *continuous* oscillations and not with transient ones, to say nothing of rapidly changing wave-forms. He quietly ignores all possibility of interaction effects. The conditions under which a single frequency test is made are utterly different from those of broadcasting.

Moreover, no allowance is made for the fact that complex wave-forms and ever-changing combinations of massed frequencies of varying amplitudes and time constants cannot at present be properly handled by either microphone or loud-speaker. These two components govern the whole situation. So long as either or both of these are imperfect, the mathematically perfect amplifier is useless as a real-quality production. It merely irritates.

Adjusting the Amplifier

Pending the arrival of the perfect microphone or its substitute, and the perfect loud-speaker, it would appear to the unbiased observer that it might be an advantage to tamper with the amplifier and adjust it to fit in more gracefully with present conditions.

If the engineer cries "Hands off the amplifier," then either we must sit and wait as patiently as we can for his next move, whatever it may be, or else the musician and the acoustician must be asked to come to the rescue, so that in combination with the engineer they may make some attempt to deliver the science of quality reproduction from the stagnation in which it has been too long allowed to remain.

A Remarkable Discovery

THE modern tendency in all branches of wireless engineering is to produce and use ether waves of an increasingly higher frequency.

From short waves, through to ultra-short waves, we have now progressed to micro-waves having a wavelength of less than one metre, yet comparatively little has been done in the direction of ultra-*long* wireless waves.

A technician at the Russian Academy of Science, however, has been experimenting with ether waves of an ultra-long wavelength, and he recently made the astonishing statement that in the process of thinking the human brain emits wireless waves of a length of about 3,000 kilometres, or 3,000,000 metres.

An Italian neurologist, hearing of this statement, and convinced of the fact that the brain does emit wireless waves—by reason of his long experience and wide knowledge of the brain and nervous system—constructed a metal-lined cabinet, and placed therein a powerful wireless receiver, fitted with extra large coils to enable it to receive such a high wavelength as 3,000 kilometres.

A student was then placed within the cabinet and told to think of a number of listed articles, one at a time, at certain stated times, when the neurologist would be listening to the sounds picked up by the wireless receiver via a pair of phones, connected to the set but placed outside the cabinet.

Whenever the student thought of any particular object, a sound was heard in the headphones which was entirely different from the sound heard when he thought of any other subject.

Each Thought Its Own Sound

Each object that the student thought about had its own individual sound and after a little practice the neurologist was able to state with great accuracy what the student was thinking about, merely by noting the sounds heard in the phones.

After some time, the neurologist invited other students to sit within the cabinet, and it is interesting to note that if one student thinking of a specified subject produced a definite characteristic sound in the phones, the sounds produced by the other students thinking of the same subject were entirely different.

At present the neurologist's experiments are in their infancy, but the results he has already obtained are certainly very surprising.—*G.R.W.*

What the Crystal Will Do To-day

Why is the crystal not given more attention in these days of super-power transmitters? Here J. H. REYNER, B.Sc., A.M.I.E.E., gives the results of some interesting tests he has made recently for AMATEUR WIRELESS

IN these days of high-slope output pentodes and speech outputs measured in watts, talk of crystals and crystal sets may sound somewhat antediluvian. Actually the increased power of modern broadcasting stations has increased the range of crystal sets quite appreciably and there is no little interest in the subject.

As an indication of the possibilities to-day with a well-designed set, I listened one Sunday evening on a good aerial and had no difficulty in tuning in six Continental stations, which, after making due allowance for fading, represented programme value.

Tests Under Modern Conditions

I do not want to suggest that the crystal set is in any sense a long-range affair, but rather to indicate that it has capabilities beyond the mere reception of the local station at five miles distance. It was when I had realised this that I decided to make a few tests to gauge the possibilities of this type of set under modern conditions.

First of all we have to consider what crystals are available. There is the Mighty Atom, which is a crystal of the galena type, using a small catwhisker contact. This is sold at 6d., but has to be mounted by the purchaser. There are a number of other crystals of this type obtainable at various shops.

Then there is the Lion Micro crystal, which appears to be arsenite in contact with a metal. This is housed in a small glass tube and is provided with means of adjusting and locking the contact. This also requires to be mounted on some form of base, but is in a more complete state than the previous one mentioned. It costs 1s. 6d.

Thirdly we have the Jewel Pen crystal, which is a totally enclosed perikon detector. The perikon detector has two crystals,

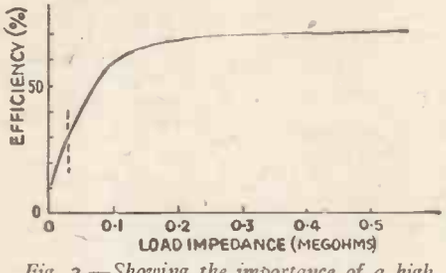


Fig. 2.—Showing the importance of a high load impedance

usually zincite and bornite, in contact. This crystal again is provided with the means of adjustment. The two crystals are held together by a spring, but it is possible to withdraw the crystals and rotate one slightly so that the best rectifying spot may be obtained.

Finally there is the carborundum crystal. This type is rather more stable than the others in that a fairly firm pressure may be obtained and it does not easily go out of adjustment.

It has the disadvantage that it requires a small polarising voltage of about 1 volt, except for strong signals, but its main advantage is its high internal resistance. This form of crystal is rather difficult to get hold of nowadays, particularly in a completely assembled form, but supplies are available from Caradio Services.

Having collected a variety of crystals from various sources the next move was to test the efficiency. For this purpose the circuit shown in Fig. 1 was connected up. Voltage was supplied from a signal generator and the circuit tuned in.

The actual high-frequency voltage developed across the condenser was measured with a valve voltmeter and the low-frequency voltage developed across the load resistor was measured with a second valve voltmeter.

A high-frequency choke was inserted in series with the load and a condenser by-pass connected across the whole circuit to make sure that no high-frequency currents were passing through the load.

Now if we are using, say, 33 per cent. modulation, then the voltage developed across the load should be one-third of the high-frequency voltage across the tuning circuit. In practice it is not as much as this because the rectifier is not completely efficient.

Some of the voltage developed is used up in the rectifier itself and, secondly, the rectifier is not perfect, but allows some current to flow in the reverse direction. This obviously cuts down the efficiency.

In the extreme case, where current flows just as well in both directions, no rectification at all takes place and the efficiency is zero.

As a standard of reference, a diode was inserted in the circuit first of all. This gave 98 per cent. efficiency with a .5-megohm load resistance. This corresponds to an internal resistance of the diode itself of 10,000 ohms, which is of the right order. Since the diode passes no reverse current at all, it is a highly efficient proposition, and the next move was to see how close to this we could get with the ordinary crystal.

The results proved to be tolerably good. hertzite gave an efficiency of 70 per cent., perikon gave as much as 78 per cent., while carborundum gave a value in between the two, around 72 or 73 per cent. The average

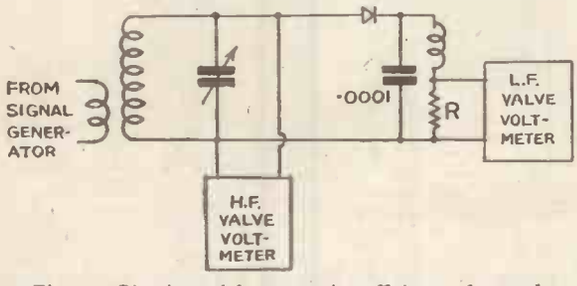


Fig. 1.—Circuit used for measuring efficiency of crystals

Wide World photo

A German inventor with his crystal set in a walking stick. Signals are picked up through the earth

crystal, therefore, may be taken as being reasonably efficient provided it is used under satisfactory conditions.

All these figures were taken with a load of .5 megohm. Now this is not a practicable value. A load usually consists of a pair of telephones, which has a relatively low impedance.

A pair of 2,000-ohm phones (the 2,000 ohms, of course, refers to the resistance) has an impedance at 1,000 cycles of about 30,000 ohms. This is a very considerably lower value than the .5 megohm chosen in the test.

Variation with Load

The next step was to find how the efficiency of the crystals varied in terms of the load, keeping a constant voltage across the rectifying circuit. This effect is shown in Fig. 2 and it will be seen that the efficiency remains reasonably good down to about 100,000 ohms, but below this point it falls off very rapidly. With a 30,000-ohm load, the efficiency is only 30 per cent.—less than half of what it might be.

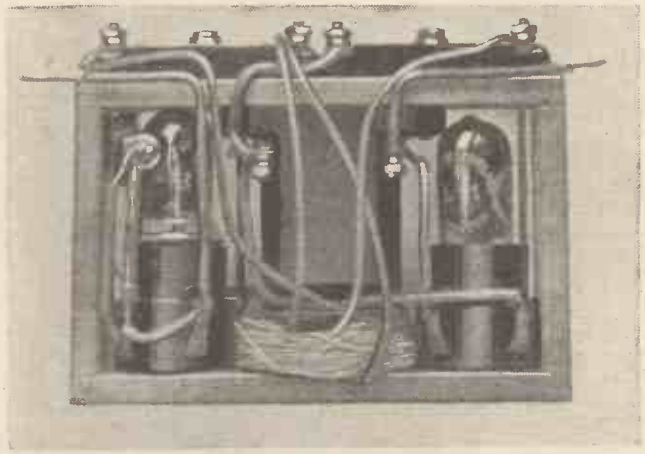
Various remedies suggest themselves, but there is only one really satisfactory one and that is to use a pair of telephones having a higher impedance. Telephone bobbins are wound to a total resistance of 4,000 ohms and with such a winding the impedance is about four times as great as a 2,000-ohm telephone.

This brings the load impedance up to something over 100,000 ohms, which gives over 60 per cent. efficiency. It means over double the signal strength and is distinctly worth while.

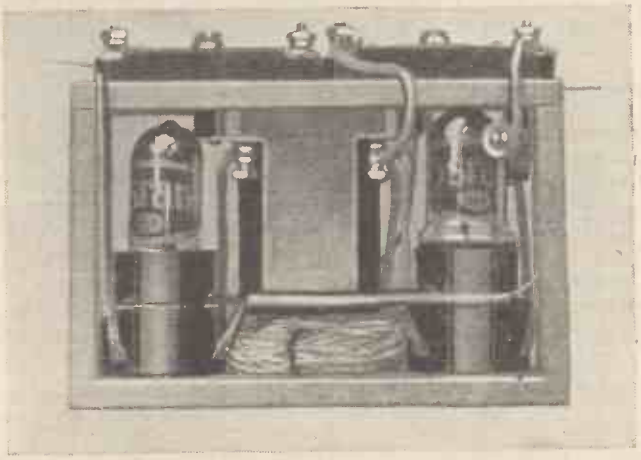
Continued on page 72

We Introduce Our BODY-LINE

A Really Novel Two-valve Midget Set for the Hike
Designed by the "Amateur Wireless" Technical Staf



Cute is the word, we think you'll agree. A real tom-thumb set—a Lilliputian effort made possible by the introduction of midget valves. Here are two of them, a detector and a low-frequency



Looking from the other side of the little wooden framework, you gain a good idea of the neat way the two midget valves are arranged within the wooden framework

"REAL midgets for the battery user!" That was the title with which we introduced a type of valve destined to make possible a new sort of radio—BODY-LINE radio.

Possibly you recall the story? It was in the April 7 issue of AMATEUR WIRELESS. Midget valves, taking .1 ampere at 1 volt—designed by the Marconi-Osram Valve Co., Ltd., for police radio, deaf-aid sets—and amateurs.

Police Radio

"Can the amateur learn from police radio?" asked Alan Hunter later—in the May 19 issue, to be exact. He concluded amateurs *could* learn, especially if they took advantage of the midget valves. Tom-thumb tubes were patted on the back, even though their price of 15s. apiece was on the high side—still is, for that matter.

So a somewhat ingenious member of our Technical Staff began to amuse himself with the tiniest set imaginable. Just a "four by two" framework, it was, with a couple of the Osram midgets as the nucleus. The set worked amazingly well on headphones.

From that moment, the idea of a really *personal* portable naturally evolved, until to-day we have pleasure in giving you the full details of a set that can vie with police equipment for ingenuity and effectiveness.

We are not suggesting that you should hit the trail and hunt down crooks. But there are other, more pleasant trails—to the country, the camp and the sea, on which a little radio equipment such as this ought to be useful. For hikers, accustomed as they are to carrying most of their worldly goods on their backs, this belt radio ought not to prove the last straw—it won't break any backs.

Anyway, whether you consider midget valves are worth 15s. each or not, the description of the first "body-radio" set for the amateur ought to amuse you.

Let us start then. Midget valves make the set possible, we emphasise once again. A couple of these valves with their filaments in series form the basis of the set design. Around the two valves in their little holders is tacked together a wooden framework; inside and outside are fitted the very few parts that go to make up the receiver.

This framework is housed inside one of the pouches of a scout's belt. One of the other two pouches takes the battery supply for the filaments, the other a home-made 36-volt high-tension battery.

The aerial? The phones? Indeed reduced to the limit. The aerial is a "trailer" of flex hanging down from the belt—or even down the leg of your trousers! The phones are split from the head band and one of them hung on a wire hook from the belt.

Sound in Design—and It Works

Perhaps stated thus the installation takes on a sort of Heath-Robinson tinge—but actually it is perfectly sound in design—and it works.

We have given you plenty of illustrations to work upon, so that our description need only back them up. No need, we mean, to labour points that are quite obvious from the drawings and photographs.

The set, then: From the blueprint you get the dimensions of the little wooden framework. The top strip has two little holes cut away to take the pips of the midgets—yes, there *are* pips, that being part of the secret of the small size of these valves.

By the way, if you do want to refresh your memory about the midgets, there is quite a good article on page 355 of the April 7 issue of AMATEUR WIRELESS.

Inside the framework are fitted the two valves, an H11 and an L11, together with the miniature low-frequency transformer and the home-made coils.

Pre-set Condensers for Tuning

For tuning there are two preset type condensers on the top of the framework—essential for space economy.

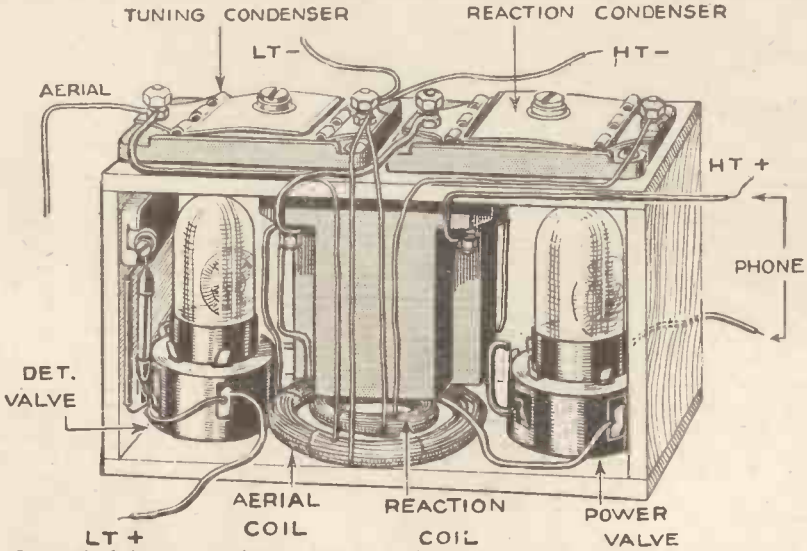
For the same reason hank-wound tuning and reaction coils have been designed—more about them in a moment.

In the circuit diagram you will see what a simple set it is. Just a plain detector with reaction, transformer coupled to the power output valve—hardly any "power" about it, but you know what we mean.

Don't miss the important point about this circuit, though. The valve filaments are wired *in series*. This enables them to be heated from a 2-volt accumulator; of course as each takes .1 ampere current that is the *total* current—the battery will last twice as long as it would with the usual .1-ampere parallel-connected valves.

Tuning and reaction windings are continuous, though two separate coils are made up. Across the big coil is shunted the .0005-microfarad preset for tuning. In series with the smaller coil is a .0003-microfarad preset for reaction—the coil and condenser being in series between the earth end of the tuning coil and the anode of the valve.

There is no high-frequency choke in the anode circuit,



Our artist brings you a picture of the body-line set that ought to clear up quite a lot of doubts. Study this with the blueprint on page 62—it will help

E RADIO!

r
ff

the transformer coupling being utterly plain. Likewise, the phone is connected straight into the anode circuit of the output valve.

Any other point? Oh, yes—see you connect that grid leak to the positive side of the accumulator; it makes a difference.

Hallo, what's this? London Regional, by Jove! Clear as a bell. Body-line radio really does its stuff!

When you come to make up the set, you are advised to solder the wires to the valve holders before you fit them into the framework. The wires for the battery and phones are brought out at the top and left ready for the soldering of the external flexes for subsequent connections.

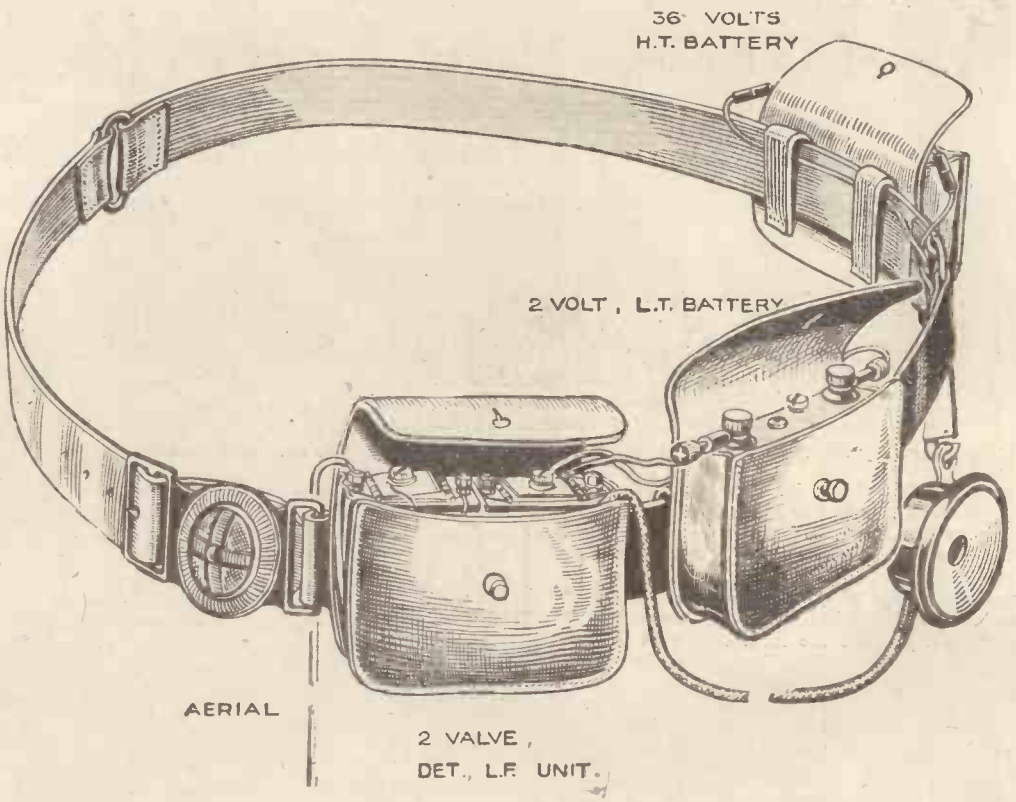
This wooden framework is fixed together with in. panel pins—but don't put the top on til you have fitted those valves, or you'll have to take it off again—the valves won't go in.

Winding the Hank Coils

About the coils. The aerial coil is wound round a broom-handle or piece of dowelling about 1 in. diameter.

For our London Regional coil we used 55 turns of No. 26 gauge cotton-covered wire. This wire is put on in hank fashion and held together with short pieces of cotton.

The reaction coil is similarly wound, only this time you need only 40 turns, and on a former about ¾ in. diameter. The two coils are connected together in one continuous



Graphic idea of the three pouches on the belt—the secret of body-line radio at a glance. See the set in one pouch, the accumulator in the second, the high tension in the third. And the phone on a wire hook. Oh, yes, and the aerial "trailer" on the extreme left-hand end of the assembly

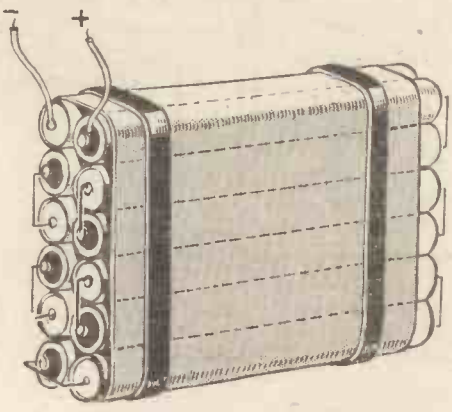
winding, the earth connection being made at the junction.

By the way, the tuning coil turns vary according to the local station you expect to keep in touch with. The preset condenser has a fairly limited variation in capacity, which means you cannot expect to tune in over a wide range of wavelengths. But that is a simple matter for personal experiment—try anything between 40 and 60 turns, putting on the greater number of turns the higher the wavelength of the wanted station.

Then you must tackle the battery supply. For the low tension there is no difficulty. Just a standard jelly-acid type 2-volter that fits nicely into its pouch.

The size of the pouch is not suitable, though, for any standard high-tension, which we have therefore made up from 3-volt torch-type batteries. A dozen of these batteries are needed to give the wanted 36-volt maximum supply.

Carefully assemble the cells in two lots of half a dozen each. With short lengths of bare wire, solder positive on one to negative of the next



With these twelve cells, actually 3-volt torch batteries, you assemble the 36-volt high tension

and so on, leaving a positive and negative at each end. Then join up the two sections in the same way, with a piece of cardboard between them for insulation. Solder two stout flexes to the remaining positive and negative ends of the cells, so that later on you will be able to connect them to appropriate points in the little set.

Securing with Rubber Bands

Cardboard around the outside of the cells will complete their assembly, and the packing can be held securely in place with one or two rubber bands.

Now about the earpiece. We cannot discover a maker of a single earpiece, so we suggest you break up an old pair, using one phone with newly wired flexible leads to connect to the rest of the apparatus. You can hang the phone on the clip of the belt by fashioning a simple hook from a thick piece of insulated wire—as we have done.

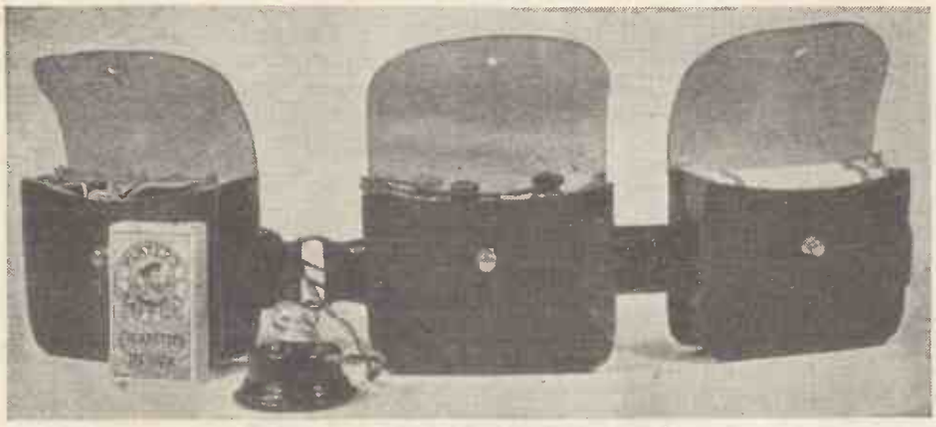
Possibly you are dubious about the aerial. All we can say is that the police forces of many countries—including the Brighton police of this country, don't forget—make use of the most inefficient types of aerial and yet they get perfectly good headphone reception.

Wire Over a Tree or Fence

The trailing piece of flex is not perhaps the best possible—but again we say, it works. So will many other temporary arrangements you can think out for yourself. And please remember that when you are in camp or resting anywhere it is the easiest thing in the world to sling a length of flex over a tree or fence.

No earth is needed, though of course if you are using the set in a fixed location, the addition of an earth will bump up the signal strength quite a lot.

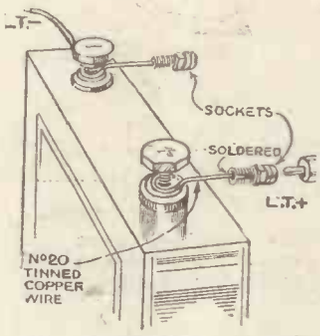
Having made all the constituent parts you can wire them up as indicated by the blueprint. Fit the flexes neatly behind the belt out of sight—but take care to get them right. Study the theoretical circuit and the blueprint,



How body-line radio appears in practice ! *This belt holds a complete two-valve receiver*

as well as the artist's drawings. Then we don't think it is likely that you will go wrong.

Operation, now. Not very difficult. Hold the earpiece to your ear—it doesn't matter which ear, we find !—and then adjust the presets with a wood-handled screw-driver until the set is oscillating. Twiddle the tuning one until you hit the local carrier, and then slacken off reaction in the usual way.

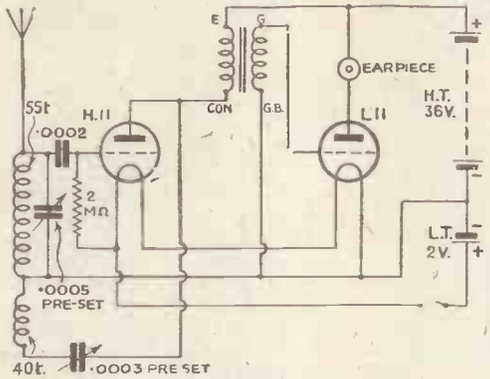


How the leads are connected to the accumulator

We have obtained very good phone strength from London Regional in our London offices with the 55-turn coil; and a few turns off gave us London National just as well.

When you go around with the set, don't forget to take your little screw-driver with you for tuning and reaction—better still make a little niche for it in the belt.

Experiment with this amusing radio side-line, will you? And write to us about your fun and games with it. We shall be intrigued to hear what sort of a show you are able to make.



Circuit of the body-line two-valver

What Comes Next ?

Continued from page 52

midget sets about in our coat pockets. Another promising opening for the near future is the design of a long-range single-valve set, capable of standing up to modern conditions in the ether. The old single-valve "flivver" or super-regenerator would appear to offer a good starting off point for this quest. Amplifier, detector, and "quenching frequency" all combined in one.

A bit noisy perhaps, but plenty of reach, and, as for selectivity, why that of course is where the inventor comes in.

As an alternative, there is another possible one-valve circuit to be considered. In recent years we have seen the super-het come down from ten valves to four, and even three. The high-frequency pentode and the new pentagrid are partly responsible for this development, though it has also been helped forward by the fact that with the modern high-mu valve there is practically no necessity for using any intermediate-frequency stage.

Two-valve Super-het in Sight

The combination of a pentagrid converter with a Westector, and a single-valve push-pull amplifier has already brought the two-valve super-het within sight. This being so, why not add another electrode or two to the pentagrid, and limit the whole circuit to a single valve?

Meanwhile there is plenty of scope for improving matters on the transmitting side. We badly want more elbow room in the ether, and any new development which will help towards this end should be worth a lot of money.

It all depends upon the inventor !

MORTON BARR.

COMPONENTS NEEDED FOR THE BODY-LINE TWO-VALVER

BELT
1—Leather, with swivel hook for phone support (give waist size when ordering) (Boy Scouts' Association).
CASES
3—Despatch type, largest size (Boy Scouts' Association).
CONDENSERS, FIXED
1—Dubilier, .0002-microfarad (type 665).
CONDENSERS, VARIABLE
1—Colvern preset, .00025-microfarad.
1—Colvern preset, .0005-microfarad.
HOLDERS, VALVE
2—Wearite, midget type.
PLUGS, SOCKETS, ETC.
1—Clix miniature wander plug, red.
2—Clix parallel sockets.
RESISTANCE
1—Siemens 2-megohm.
TRANSFORMER
1—Bulgin low-frequency, Senator type.
SUNDRIES
3—Rubber bands and piece of cardboard for high-tension battery assembly.
2 oz. No. 26-gauge D.C.C.
4 yd. twin flex for battery connections, aerial lead and earpiece connection.
1—Wood strip, 14 in. by 1¼ in. by ¼ in., for chassis assembly.
2—6BA screws and nuts, ¼ in. long
1 doz. ⅝-in. panel pins.
2—Lengths of thin sleeving.
2 yd. tinned copper wire, No. 20 S.W.G.
6—¾-in. countersunk wood screws, No. 4 gauge.
2—½-in. ditto.
Thread for binding coils.

ACCESSORIES

BATTERIES
12—Pen-torch type 2T5 3 volt batteries for high tension.
1—Exide 2-volt accumulator, type LCVI.
HEADPHONES
1—Pair Lissen, type LN173.
VALVES
1—Osram or Marconi, midget type H11.
1—Osram or Marconi, midget type L11.

Pentode Battle

THE action taken by the Mullard Valve Co. (as registered owners of patent No. 287958) against the Philco Co. for infringement of the well-known pentode valve was dismissed by Mr. Justice Farwell after a hearing which lasted over eight days.

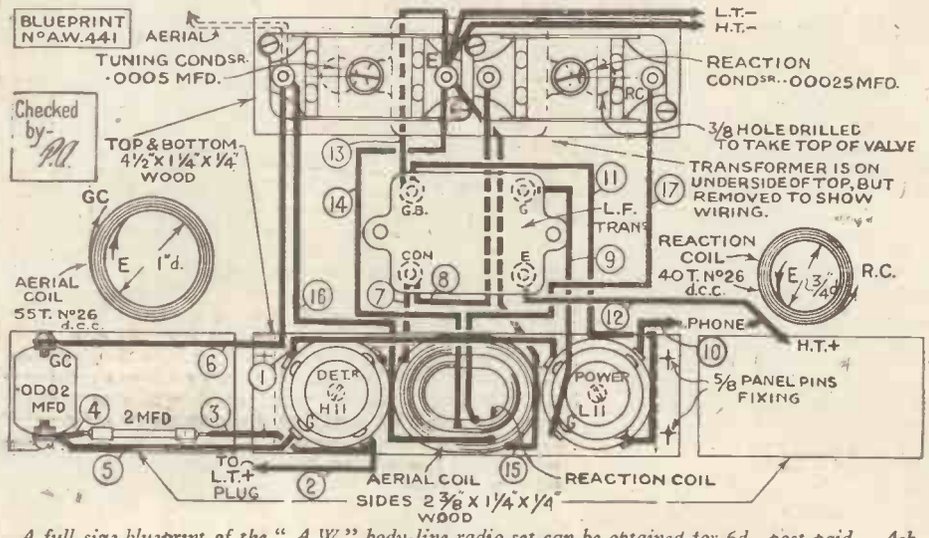
An appeal against his decision has already been entered by the Mullard Valve Co.

In his decision, the learned Judge said that the pentode used a suppressor grid, kept at a low potential, and interposed between the anode of the valve and a screening grid varying a high positive voltage.

This undoubtedly served a useful purpose in preventing secondary emission from the anode back to the screening grid. In his opinion the invention was a good and valued one, so long as it was used in the manner described in the plaintiff's claim, namely as the last stage in a series of cascade-connected amplifiers.

But the defendants had not so used it. He could not agree that the plaintiff's invention went so far as to cover the use of any four-electrode valve, in which the electrode nearest the anode was connected to the cathode.

Valves having four or more electrodes were known before the date of the pentode patent.



A full-size blueprint of the "A.W." body-line radio set can be obtained for 6d., post paid. Ask for No. AW441. This reproduction is half scale

How Variable Selectivity Would Help Us

By PERCY W. HARRIS, M.INST.RAD.E.

IN several quarters recently the question of variable selectivity for broadcast receivers has been discussed, and it is known that the B.B.C. engineering department considers it a desirable feature. Variable selectivity has two main advantages—provided the set is designed to make good use of it—the first being that a very high quality of tone is obtainable from powerful stations which are free from interference, and the second that good clean-cut reception can be obtained from stations in congested portions of the ether, even if it is with some little sacrifice of tone quality.

Possibilities—and Limitations

Unfortunately at the present time it is not possible economically to get the highest selectivity with the most perfect tone quality, although in suitably designed circuits extreme selectivity (far greater than that given by any commercial set now sold) is obtainable with a quality in no way inferior to that of a good modern gramophone.

Personally, I hold the view that the average set now sold is a long way behind what it ought to be with regard to tone quality, and could be improved much in this direction without sacrifice of selectivity. Certainly it *is* an advantage to be able to receive all frequencies up to 8,000 or 9,000, and as we have it on the authority of the B.B.C. that all of the regional transmitters and their associated apparatus in the control room are capable of reproducing a frequency range from 50 to 9,000 cycles with a loss of less than about 3 decibels, many people will be asking why they cannot get all this on the modern receiver.

With ordinary technique and with reasonable care it is possible to make a receiver to reproduce faithfully all those frequencies mentioned. It is less easy to find a loud-speaker to suit, but it can be done. The trouble is, however, that such a receiver will prove to be as flat as ditch-water when tuned to distant stations. Nowadays stations are placed 9,000 cycles apart, so that the sidebands of the higher frequencies overlap badly.

What Are We to Do?

Without a highly specialised technique, which cannot be introduced into the reasonable-priced receivers, it is impossible, as I have said above, to have the highest quality with the necessary selectivity to separate stations of this frequency difference, so what are we to do about it?

Variable selectivity affords the answer, and it is interesting to see in what ways it can be worked out. Strangely enough, variable selectivity was used a good deal in the early days of wireless when such selectivity was not really required. In those times we had two tuned circuits with variable coupling between them, the weakest coupling giving the highest selectivity. In ordinary wireless receivers, however, we cannot be bothered with a multitude of controls therefore we must consider what methods are available without increasing the controls for tuning.

The first and simplest way is to flatten the tuning by introducing a resistance into the tuned circuit or circuits. This has the disadvantage, of course, that the amplification falls off considerably and it also upsets such adjustments as band-passing and tone correction. The second method—sometimes used in commercial sets—is to cut down the number of tuned circuits prior to the detector, for the selectivity in many receivers is due not to that of any one circuit but to the cumulative effect of a number.

At this point it should be made clear that the kind of selectivity you get—expressed more scientifically, the shape of the selectivity curve—may be quite different for two different kinds of receiver, although the apparent sharpness may be the same. In a single feebly-damped circuit adjusted for very high selectivity there may be an extremely sharp peak to the curve, making accurate tuning to a signal difficult. When a number of fairly flat circuits are used in series the peak of the combined resonance curve may be much blunter, but the sides of the curve may be much steeper, so that the diminution of signal strength 2,500 cycles away from the point of resonance may be much greater with the blunt topped curve than with the sharp peaked curve at the same distance from resonance.

Wide World photo

A German radio engineer checking up the wavelengths of German and other Continental stations with a special tester

Wide World photo

This gear is an automatic radio fire alarm developed in Berlin. By touching a switch a shrill alarm is put into operation

For this reason, quality of reception without tone correction is frequently better in a multi-circuit receiver using a number of blunt circuits than in a receiver with fewer tuned circuits but these individually sharper. But on the other hand with one very feebly damped circuit and extremely sharp resonance it is comparatively easy to correct for tone quality without losing the benefit of this sharpness. Tone correction of a multi-circuit receiver is a much more difficult problem.

Damping the I.F.'s

But to return to our variable-selectivity idea. It is probable that in a superheterodyne receiver this scheme can be best applied by having one of the intermediates very feebly damped (and therefore extremely sharply tuned) with adequate tone correction applied afterwards.

Flattening of tuning could be done by introducing damping into this circuit, simultaneously bringing up the gain to compensate for the loss introduced by the resistance and at the same time altering the tone correction to suit. Such a scheme should give us just what we require with a minimum of expense and complication, and without sacrificing simplicity of operation.

This Short-wave Lead-in Keeps Out Noises!

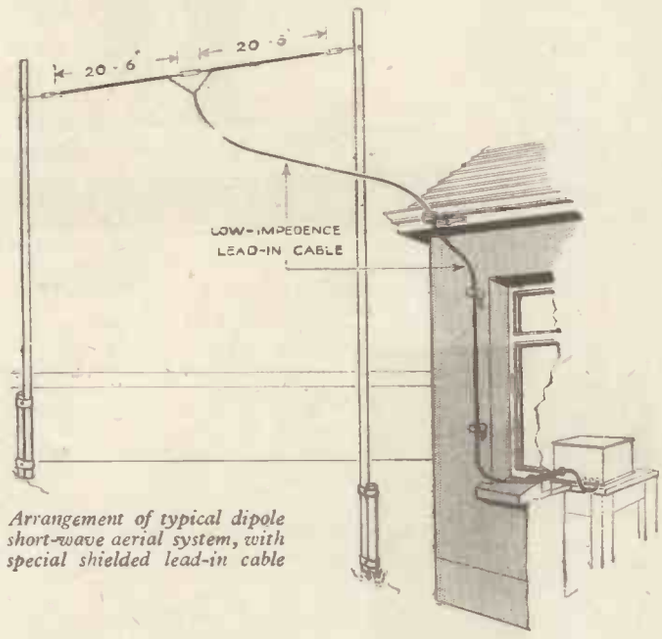
AS soon as you drop down to the short waves—and who isn't doing that these days?—you come up against *noises*. Every conceivable sort of modern time- and labour-saving device seems to have been inadvertently invented to produce electrical noise—which to the town-dwelling short-wave fan is sometimes almost unbearable.

Even in the Country

Why, even Kenneth Jowers, our short-wave correspondent, living in the country as he does, is thinking of moving to get away from noises, which are seriously interfering with his short-wave research work!

Cars, dialling telephones, vacuum cleaners, neon signs, hairdressing apparatus, doctor's X-ray gear—all are willy-nilly snakes in the grass where wireless reception is concerned.

But you know most of this already. What you possibly don't know is that in America they have been tackling the problem very seriously, for over there the short waves are much used by the ordinary broadcast listener. And, of course, there is a terrific "ham" interest in short waves.



Arrangement of typical dipole short-wave aerial system, with special shielded lead-in cable

Engineers have discovered that most of the "noises off" of wireless reception—even on short waves—can be cured or cut down simply by using a suitable aerial. In other words, the technique of shielded-cable lead-in we already capitalise on medium waves can now be adopted—with modifications—for successful short-wave work.

Losses Too High Till Now

This is great news. Because up to now any attempt to apply the medium-wave palliative to short waves has been a dead failure—the losses have been too high.

In America, we hear, amateurs are now listening to England, Germany, Russia, France, and even the Antipodes with real programme satisfaction; with no more noise, that is, than on the home-town radio signals.

No doubt a lot of this success is due to the growing realisation that any old bit of wire slung round the picture rail is not good enough for the short waves. Real fans have proved that consistently good results can be obtained only if good attention is paid to that "antenna," as the Yanks call the aerial.

What they looked for in the great noise round-up was a transmission line—call it lead-in, if you like!—that would carry all the energy picked up by the aerial wire itself, but nothing *en route* to the set from the aerial.

After the usual crop of trial-and-error experiments a new system of short-wave leading-in was evolved. It consisted of two lead-in wires in place of the usual one.

These two wires were separated by about 2 in., and changed over every 15 in. by transposition insulators. This system has proved extremely effective, but it has never been claimed to be ideal. For one thing, cheap insulators produced very high losses. Moreover, the assembly of such a lead-in system was apt to be somewhat tedious for the impatient amateur.

Twisted pairs of wires have been tried to get the same noise-free results—twisted lamp cord, telephone wire, and even heavy lighting flex all having given surprisingly good results—without all the trouble of inserting the transposition insulators.

Unfortunately, though, the continuous exposure to the elements of such a makeshift lead-in arrangement played the deuce with efficiency, and after a very short time the wires suffered very much from loss of signal strength.

So there evolved the necessity for a special type of transmission line. Light, flexible, moisture proof, good high-frequency conductivity and low impedance—that was the desired specification.

Arthur H. Lynch worked on the problem with the help of the American Steel and Wire Company. They decided to start from scratch, working on the theory that a line good enough for the short waves would also work extremely well on the less tricky medium waves, thus ensuring a good sale for the stuff once it had been evolved.

As a basis, Lynch decided to use for the two conductors American Litzendraht wire—stranded wire of low ohmic resistance.

Then he tackled the low-impedance problem. Rubber, the usual insulating wall, was replaced by a very thin varnished cambric; cotton was entirely avoided. The Lynch Giant Killer cable resulted.

All the Properties Desired

This is claimed to have all the properties desired, plus an advantage that was not really sought. It so happens that the varnished cambric, used to cut down impedance, has the additional advantage of a very high breakdown voltage. For this reason the new cable, originally designed only for reception, is now being used by transmitters.

For instance, at the radio show held by the Hudson division of the American Radio Relay League at the Pennsylvania Hotel, New York City, the cable was used to couple both transmitter and receiver. Stanley McMinn, the station operator, says:

"Despite the fact that the lead-in was about 350 ft. long, necessitated by the aerial being located on the hotel roof, the percentage of contacts completed to calls made was extraordinarily high."

The lead-in is specially useful for the popular dipole short-wave aerial, consisting of two 20 ft. 6 in. spreads, with the two leads from the cable connected as shown by the diagram. For use where a lead-in of predetermined length is needed the cable is supplied with a marker, every foot, on the outside of the cable.

A. H.

Short Waves in the West

By J. GODCHAUX ABRAHAMS

THESE notes are penned whilst staying at a lesser-known resort in a beautiful land-locked estuary on the coast of Devon. I have often wished to test the south-west coast for reception, in view of the fact that during the past few years I have seen and handled so many reports of distant transmissions logged when conditions in London appeared to starve my daily log, and most certainly from the outset I have noticed that whereas the possessor of a broadcast receiver in Devon at times had cause to be dissatisfied, the addition of a short-wave instrument to his station provided ample compensation.

From B.S.T. 2200 onwards many of the American stations could be heard at good volume and, obviously owing to geographical position, there was no difficulty in securing signals regularly from more powerful and nearer broadcasters such as Madrid (EAQ), Paris-Pontoise, Zeesen, and others. But it is the Transatlantic stations which prove of major interest.

The efficiency of valves and coils to-day is such that no expensive receiver is called for, and on this coast the modest two-valver with a mere headphone output can give you many hours enjoyment. News bulletins, both from home and abroad, are a regular feature of the day and, in view of the recent political disturbances in Germany, are of great interest.

Possibly the stillness of the surrounding country, the lack of electrical tramway or railway systems, and the absence of noisy cars, has much to do with the ease with which the faintest signals can be picked up.

Enviable Proportions

It is an established fact that notwithstanding the recurring periodical talk about sunspots, unfavourable conditions, atmospheric interference, and so on, my log during the past few days has assumed enviable proportions.

That most short-wave transmissions are still of an experimental nature is confirmed by the fact that any new broadcasting or other station set up takes some time in finding a suitable channel for its particular purpose. Jeloy, which has been trying out many wavelengths and for some weeks has been using 31.45 metres will shortly, I am informed, be testing on 48.94 metres (6,130 kilocycles); 60.85 metres (4,930 kilocycles), and 73.17 metres (4,100 kilocycles).

Television Is on the Short Waves!

By KENNETH JOWERS

ALL those fans who have made up 5-metre sets will have a decided pull over the ordinary broadcast listener when high-definition television starts up. At last there are definite signs that television is really getting somewhere.

Perhaps this is rather misleading, for although the Germans and Americans are actually doing something, I am not quite so sure of the position in this country. Anyway, if a really good system is evolved elsewhere, the B.B.C. cannot but help follow suit.

In the U.S.

The I.R.E. Convention that was held in Philadelphia a little while ago brought to light many interesting points about television which had not been given publicity. Why, I do not know, for the Americans are usually very quick to advertise new ideas.

At this Convention were the brains of the American radio industry, including a number of R.C.A. television engineers, and the accounts they gave of their years' work and progress is certainly very interesting.

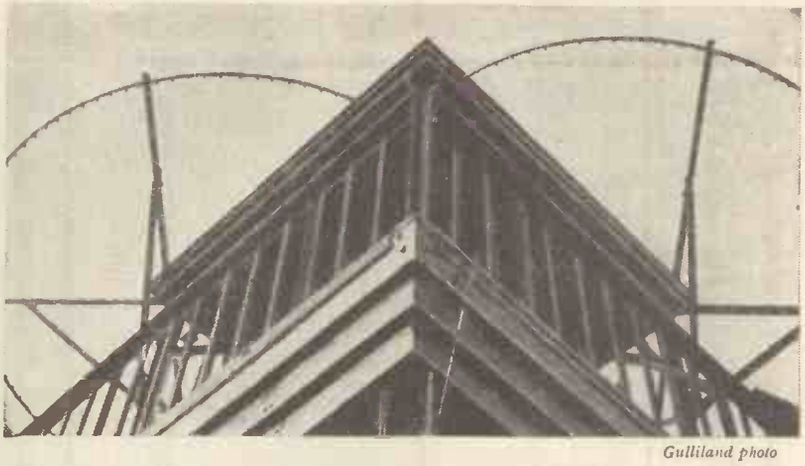
A transmitter and receiver were erected on top of the Empire State Building in New York City, which was in communication with a transmitting station at Camden, New Jersey, a distance of 96 miles.

This, in itself, is quite a good achievement; but in addition it is claimed that at present the detail is equal to that obtainable with an 8-millimetre home movie. This is one-quarter of that of the 16-millimetre camera when the pictures are presented at the same size.

At this Convention a very large screen used for lantern slides was filled with pictures made from photographs of the cathode-ray tube, when it was covered with actual scenes or portraits.

The wavelength used for the transmitter was 4.9 metres and 5.1 metres for the receiver; under these conditions synchronisation was almost perfect.

At Camden the transmitter was situated over a mile from the scene of action and the pictures sent to New York were amazingly clear and well defined.



Gulliland photo

New German dipole aerials which it is hoped to use for both sight and sound transmissions. Regular television transmissions are scheduled to start soon.

As it is possible to broadcast television pictures on the ultra-short waves when the actual scenes take place at a distance from the transmitter, it does show that much progress has been made and the time is not far distant when vision will accompany the evening news bulletins to illustrate the events of the day.

In America they have also found that, should the transmitting distance be too great, the signals can be picked up by an intermediate station and amplified and re-transmitted.

It is interesting to note that for both vision and sound di-pole aerials were used, similar to those erected by the B.B.C. at Broadcasting House for their 7-metre experiments.

The Germans were among the first to use a di-pole aerial on ultra-short waves, and such an aerial can be recommended for amateur use for receiving or transmitting. Actually, it consists of two half-wave aerials with inverted-L feeders, spaced apart by about 8 in. to 10 in.

With a transmitter the output from the power amplifier is connected to the feeders, while with a receiver one feeder is used as an aerial and the other as a counterpoise earth.

In Berlin they are of the opinion that the most suitable wavelength is between 6.8 and 7 metres, and they are, as a matter of fact, using these wavelengths for both vision and sound. The Berlin transmitter has been in operation now for about two years, and the service area has turned out to be about sixty miles.

Relays on 7 Metres

As this range, although quite good, is of little value commercially, the Germans have come to the conclusion that it would be better to have a higher-wavelength sound transmitter, which could be picked up over the whole of Germany, and a number of 7-metre relay transmitters in or around the large towns, all of which should be linked and synchronised with the master transmitter in Berlin.

In this way the limited range of an ultra-short wave transmitter would be overcome and the snags —such as fading, static interference, and field strength variations—would be overcome.

Great Advances

Anyway, television is very much advanced in comparison with this time last year and it will no doubt not be long before we in this country are able to buy combined vision and sound receivers, such as those sold by Loewe in Germany or by R.C.A. in America.

Gulliland photo

Placing one of the valves in the new Loewe short-wave combined sound and television receiver

Where They Make Everything!

The "A.W." Technical Staff Looks Round the Cossor Factories

This test panel for ganging super-het receivers, makes use of a cathode-ray oscillograph

Stamping out hundreds of vanes for variable condensers on a 25-ton hydraulic press

MANY years ago I remember seeing, what was at the time a very modern valve with an anode like a mushroom. I was told it was made by Cossors, but that didn't convey very much. Two years later I happened to go along to this factory and saw a small-sized building, a few machines packed away here and there, and a large buying department where all the outside materials were ordered—in fact, just an ordinary little factory.

Introducing a Kit Set

Then came a big change, for this firm introduced a kit set—quite a novelty in its way—which enabled the home constructor to build up a receiver that gave almost commercial-set performance. In those days the sale of a few thousand sets at a time was a huge number, so they had to make expansions.

In the years following more kit sets were introduced and, later, complete receivers, which were a lot cheaper than those of a similar type then on the market. To-day Cossors are one of the largest set and valve manufacturers in the country—and are still building new factories to cope with the business.

A considerable area of the surrounding neighbourhood—mostly private houses—has been bought up so that new factories can be erected when they are needed.

Manufacture of Battery Valves

What was the original factory, offices and other bits and pieces, is now devoted entirely to the manufacture of battery valves. In this section one sees the most up-to-date machinery, developed solely with the object of increasing the output and precision of the valves made. All of these machines are arranged in the most orderly manner.

One of the most interesting machines, which has been used for a number of years, is for making the grids employed in every valve. These grids consist of two side supports and a number of spirals—some of them are an inch long with twenty or thirty spirals, others are wider and have ten or eleven spirals, but each time a wire turns over a side support it has to be spot welded.

This special machine completely dispenses with the old hand-welding machines. Three large reels of wire are fed automatically to it and out of the other end, like sausages, comes a continuous stream of perfectly made and welded grids.

Another machine that interests all visitors is the rotary pump, which consists of a colossal wheel on to which are mounted a number of separate little pumps. These pumps are connected to valves immediately they have been assembled, and each bulb is completely evacuated and automatically sealed off—that is, the glass stem is cut and sealed by means of a high-pressure flame.

At the same time the magnesium, which had previously been fitted to the magnesium pan on the side of the anode, is fired by means of an eddy-current heater, so that any remaining gases in the bulb are absorbed into the magnesium or getter, which sticks to the inside of the bulb in the form of that familiar silvering.

The ageing machine is probably unique. It consists of a multiple-head machine on a revolving track, which will take some hundreds of valves at a time. The valves on the track are supplied with anode, filament and grid voltages, slightly higher than the voltages for which they have been designed, so that they go through the effect of a few hours' life in a few minutes. The idea is to stabilise the characteristics.

They are then passed on to semi-automatic test benches which make it impossible for the operator to pass a valve that is not strictly within the specification. After this come tests of a different nature, all before the valves are boxed ready for distribution.

Another factory was erected for the production of mains valves, and this is again completely equipped so that it is independent of outside help.

The main Cossor offices can be seen from the road—a four-storey building of modern design in which are all the offices, the experimental laboratory, where they are doing great things in television, and so on. Last year, about half a mile up the road, they built some entirely new factories for the production of receivers, and these represent the last word in modern efficiency.

In one large building, where all the cabinets are made, on the ground floor there is a balcony, so that the number of operatives can be almost doubled when required. Here one can see cabinets develop from the raw wood to a polished job in a very short time.

Another factory has been devoted entirely to service, for Cossors realise that sales are dependent upon giving the buyer every possible help.

In the set factory, where they make components of every description and, after they have been tested, assemble them in their own receivers, one really has to be there to appreciate the idea behind the production of the new season's Cossor sets. So that delivery can never be held up through lack of supplies, a very high percentage of the parts used in the receivers is manufactured internally.

One interesting section is where grid leaks and resistances are made. Here carbonised rods of low value are fitted to a machine and a knife-edge cuts a thread in the carbon deposit. Naturally the more threads the less will be the amount of carbon deposit and the higher will be the resistance. In this way a resistance can be adjusted to an exact value.

A machine that I had not seen before was

This "multiple-head" machine winds ten transformer secondaries at a time

used for the semi-automatic testing of mains transformers, and it really is a remarkably interesting piece of apparatus. Mains transformers are dropped over a permanently fixed iron core and the connections taken to some spring clips. By switching on the mains, the primary wattage, secondary output and all the other little points that are so important were automatically shown up by the meters on the test board.

Mass-producing Variable Condensers

Remembering the early days of making variable condensers, by slipping on plates and spacing pieces over a screwed rod, I was highly amused to see a 25-ton press stamping out condenser plates from some sheet metal. Perfect plates were turned out at the rate of some thousands per hour. After this the moving plates were put into a press and at a touch of a lever the whole were clamped together.

The same operation was done to the fixed plates, so that the manufacture of the condenser took but three automatic operations.

In addition to the speed of manufacture, the variation in capacity between the condensers is negligible, so that the receivers into which they finally go are accurate.

Cathode-ray tubes, in the manufacture of which Cossors are pre-eminent, play an important part in the test gear used, besides being supplied to numerous other manufacturers for similar purposes. All Cossor receivers are ganged up by means of a cathode-ray tester, which does not permit of any error whatsoever.

A similar type of instrument using a cathode-ray tube is used for the testing of valves. In this the characteristic curve of the valve under test is shown up on the face of the cathode-ray tube, up against the drawing-office curve. A certain percentage error is allowed, and should the valve not fall within the prescribed limits it is rejected.

Neon-lamp Department

A large section which is not usually associated with the name of Cossor is the neon-lamp department.

Just recently a new idea has been produced, a neon-gas tuning indicator. This type of indicator is a minute neon tube which, when connected in the anode circuit of a high-frequency amplifying valve, gives a glow proportionate in strength to the incoming signal, so that the strength of the station or the accuracy of the tuning causes the glow to be greater or less as the case may be. M. H.

Endless escalator on which battery valves are "aged"

Marconi photo

Telephone receiving-room on board s. s. Empress of Britain. *The monitoring switchboard in front of the operator's chair enables the wireless-telephone equipment to be used from the ship's telephones*

A New System of Television

From a Special Correspondent

A NEW television system for transmission and reception is being investigated by the government's Television Committee. It has been patented by a young Plymouth wireless engineer, R. W. Hughes.

After experiments over a period of many years, Mr. Hughes applied for the patent last September, but since that date he has introduced a number of improvements. He informs me that the experimental set he has constructed with rough materials is capable of 100-line reproduction, but he sets a practical limit to the principle, using more efficient materials, of 300 lines, which will give ten times the definition of the system at present being used for B.B.C. transmissions.

For transmitting, the system consists basically of a vibrating mirror, oscillator controlled to give horizontal scanning, a similar mirror and oscillator to give vertical scanning, and an optical arrangement of mirrors to condense the subject picture into a small area.

Light rays from the subject are focused on the first mirror, which is a silvered metal strip suspended on a stretched phosphor-bronze wire, and with minute moving coils at its ends in the fields of two magnetic poles. By controlling the tension in the wire by an adjusting screw, the system can resonate at the desired frequency, and vibrations are set up and maintained by an audio-frequency oscillator.

Minute Adjustments Possible

In this circuit, capacity and inductance values are pre-arranged, but by means of a small variable capacity minute adjustments can be made.

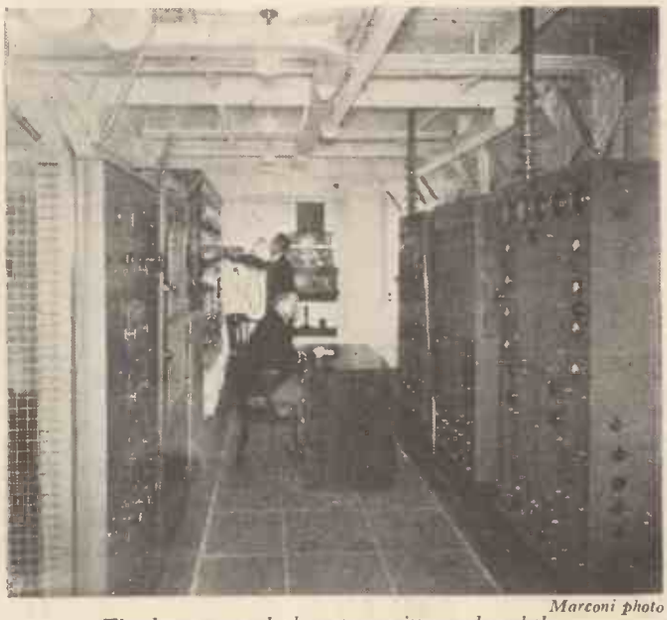
Because of the concentration of the light input to a small area, the amplitude of vibration is small, and the mirrors can therefore operate at a very high frequency, sufficient to give 300-line scanning. The absence of iron in the magnetic circuits avoids hysterisis.

There is no appreciable amount of lag in the frequency control compared with a motor scanning system, and because of the lightness of the moving parts, it is only necessary to make occasional adjustments for synchronisation.

After leaving the second mirror, the light values are applied to a photo-electric cell in the ordinary way. The system possesses the great advantage that the photo-cell is not subjected to rapid and intermittent pulses of light, but merely to a fluctuating illumination, which is strictly proportional to the light values of the various sections of the subject.

For receiving purposes, the arrangement is reversed. Light fluctuations from a Kerr cell or neon lamp are applied to the first and second mirrors, which re-establish them in their proper sequences and positions for the picture. Parallel reflectors then carry the image to the screen, and in doing so magnify it to appropriate dimensions.

American and German manufacturers have approached Mr. Hughes for the production rights of this system. He believes that the complete scanning apparatus, without the neon or Kerr cell, can be produced for about £5. He is negotiating with an English firm, because he wishes the principle to be retained, if possible, in this country.



Marconi photo

The short-wave telephone transmitter on board the s.s. Empress of Britain

Putting the £ in Wire£ess!

WHEN MONEY TALKS—BY RADIO

EVERY year a vast fortune is spent on sending radio messages.

Who spends it?

Why, you and I and the man next door, and other members of the public!

Nearly all day and most of the night, morse stations are busy tapping out radiotelegrams—and those dots and dashes that you hear cost money.

The actual charges vary according to the facilities offered, the stations handling the message, and so on; but, in general, radiotelegrams to ships, for example, cost between 11d. and 1s. 6d. per word. An excellent cure for verbosity!

Day and night, many telephony transmitters are handling conversations between telephone subscribers over the wireless links employed in the long-distance public telephone services, and each of these phone calls represents an expenditure of anything from £1 7s. to £9 12s. for the first three minutes' conversation.

Importance of Short Waves

One of the most useful of the long-distance public telephone services is the ship-shore service, in which short-wave wireless plays an essential part.

This service enables passengers on certain big liners to hold ordinary telephone conversations with the shore while still at sea.

The photographs illustrating this article show you the short-wave telephone transmitting and receiving equipment on board the s.s. *Empress of Britain*.

In this service, £ s. d. again looms large! The cost of direct ship-shore calls in the North Atlantic service is £1 16s. od. for the first three minutes if the ship is within 500 miles of Land's End, and double that amount if farther away.

Those French Stations

By JAY COOTE

THAT radio is far from losing its popularity in the summer time, even when the thermometer registers above 80 degrees in the shade, is proved by the fact that in my wanderings over the southern portion of England strains of music can be heard in every village and hamlet passed.

I have noticed how, to a great extent, the dweller on the south coast of England is closely in touch with France in regard to radio transmissions; in fact, so far as I can see, it is difficult to get away from them. As one travels further west the volume at which these broadcasts are received increases and the reception of B.B.C. entertainments becomes more difficult.

Trial Trips on High Power

What will happen when the full development programme started by the French state is completed is not difficult to realise, for within the next few months many of the French high-power stations in the medium waveband will be taking a trial trip through the ether.

So far, according to the latest reports, the position is as follows: PTT Lyons on 100 kilowatts should be heard towards the end of July; possibly also Rennes-Thouries (120 kilowatts), Limoges (100 kilowatts), Toulouse (120 kilowatts), and Bordeaux PTT (60 kilowatts). The other new transmitters are not so far advanced in construction and Paris PTT (Villejust) on 120 kilowatts, Marseilles (100 kilowatts), Strasbourg (60 kilowatts), Nice (60 kilowatts), Montpellier (30 kilowatts), and Grenoble (20 kilowatts) may not be ready before the end of the autumn.

Lille PTT, of which signals are already powerful on the coast, is promised for December; it will then operate on 60 kilowatts. As regards the Eiffel Tower, we cannot expect any alteration in wavelength for the present; from what I learn, it will maintain its present position in the long waveband until January, 1935, when it should go down to 206 metres.

Radio Paris, on the other hand, is seeing its plant rapidly transformed and will soon be boosted up to 150 kilowatts.

The result of these big increases in power of so many different units of the French broadcasting system will mean some portions of southern England will get a surfeit of radio entertainments from our nearest neighbour, and that for their reception of home broadcasts they will be forced to rely on Droitwich.

◆ ◆ ◆

Do you find that Radio Toulouse has benefited very much by its increased power? Curiously enough on many evenings I notice but a slight improvement in strength. The transmissions fade badly. Palermo and Athlone, although so far apart, are not good partners and, in spite of the fact that reception of the former may be satisfactory in many parts of the British Isles, in London I find that the Italian station can often be heard as a faint background.

◆ ◆ ◆

In these districts of England the capture of programmes from Italy is also an easy matter. Owing to their power, one expects to hear Rome and Milan; but it is an astonishing fact that Bari can be picked up at almost equal volume.

The German stations, on the other hand, are not all of equal value; distance must not be taken into consideration, for on several evenings I have listened to more powerful signals from Breslau and Munich than from transmitters which were situated closer to the British Isles.

◆ ◆ ◆

Reception, generally, in Devon and Cornwall as regards the British transmitters is not, on the whole, nearly as good as, say, in London or the Midlands, but "contrariwise" any possessor of a three- or four-valver can scour the Continent more thoroughly.

A radio holiday on our southern and south-western coasts implies long visits via ether to European cities. The impression is given that the distances separating the borders of the channel from the eastern frontiers of the central powers has been halved. In other words, if you want to reach out, make for some spot close to the English Channel.

◆ ◆ ◆

Better Programmes from Vienna

From July 1, we have been given a better opportunity of hearing the Vienna programmes, as the Ravag has decided to prolong its radio entertainments by one hour and to close down daily, barring special occasions, at 12.30 a.m. (0030 B.S.T.). The final part of the broadcast consists of a concert of light music.

A message from the Olley Air Service aircraft Dragon, G-ACPY, has been received by Mr. D. E. St. Ledger Grimes, at Torquay. The message was received over a distance of 360 miles.

The Dragon is fitted with a Marconi type AD6M combined transmitting and receiving set, and Mr. St. Ledger Grimes receiver is a five-valve (two-screened-grid) instrument.

Criticisms by WHITAKER-WILSON

My Broadcasting Diary

Monday

SIMPLIFIED SPELLING! I lissnd to Mistr Loid Jaymz tonyt and thort he torkd a lot ov tryp abowt orltring owr speling. Wel, orl I kan say iz thiss: if the wurdz kum owt enything lyk thyss I hope hooever publishs the furst edishn wil go bust.

He probably will. Mr. Lloyd James's enthusiasm for what is manifestly unattainable without indignity is surprising. Will he spell his name as I have suggested, or will he alter the first part of it to *Hloid* in order to retain the accurate Welsh sounds?

It is my duty to review all broadcast matter in the light of its entertainment value. In this instance I offer both Mr. Lloyd James and Mr. Faber my thanks, but to take seriously any attempt at phonetic English is more than I can honestly do.

Both speakers missed the real point. Sir Christopher Wren, one of the greatest of English scholars in his own or any age, wrote *it* and *itt* in the same sentence. Judge Jeffreys spelt his name in at least half a dozen different ways.

English spelling had not then been standardised. As far as my research goes the standardisation occurred towards the end of the reign of Queen Anne. One spelling out of four or five was chosen for each word and retained. Hence the irregularities.

To alter it now is unthinkable. And unnecessary. The less Mr. Lloyd James says about the matter in future the better. Interesting broadcast, all the same.

◆ ◆ ◆

I howled with mirth at Stanelli's Hornchestra. I should like to learn to play it, but if I couldn't get on any better with it than I did with that oscillating contrivance we had here I'm afraid it won't be much go.

I thought Navarre's imitations of various singers decidedly clever. Chaliapin singing the *Volga Boatsong* was remarkable. Navarre must be careful in imitating Tauber, though. He sang definitely sharp on his top notes. Tauber doesn't. As it happened, I had reviewed a record of Tauber during the afternoon and noticed how true his pitch is.

Nellie Wallace has a way with her. She was very vivacious in "I've Always been Lucky with My Lodgers"—quite a classic in its way.

A comedian of whom I want to hear a lot more is Claude Dampier, whose style is definitely good and exceedingly amusing. He may style himself a professional idiot but he is a very clever idiot. Billie Carlyle "encouraged" him admirably.

Tuesday

HONEYMOON IN PARIS, as a summer evening diversion, did not cut much ice with me. Not that there was much ice to cut, but I couldn't take to it nohow.

However, I lounged in a comfortable chair near the open window and let A. J. Alan intrigue me as much as he liked. I must say I think his stories recently are not quite so good as his earlier ones.

He still tells them in that same fascinating manner, but that is all there is to them. I much preferred him when he used to take me on right up to the end and then leave me to sort it all out for myself.

Recently he leaves so much to me that, unless I had his script and went through it thoroughly, I could stand no chance of coming to any definite conclusion. To-night I let him entertain me and then gave it all up as a bad job.

"I comforted my weary soul and overheated frame with the Theatre Orchestra under the control of Stanford Robinson"

Wednesday

THE *Entertainment Hour* began so weakly to-night that I decided not to go on with it. Probably it improved as it went on. I sincerely hope it did.

To tell the truth, it was such a gorgeous evening that I wanted to listen to Sir Landon Ronald and the London Symphony Orchestra, especially for the Strauss' *Don Juan* and Elgar's *Falstaff*. I extracted much pleasure out of both works and tested my loud-speaker's real powers. Reception was perfect.

Thursday

A CHARMING summer serenade to-night to which I listened in the garden. Evelyn Scotney, and Claude Biggs who began with the short sonata in F sharp by Beethoven. I followed him intently with a score and appreciated his method of dealing with the work.

I think he was a little unwise in his last group for he began with a Chopin study and ended with another. Also I think the studies he chose were mainly of interest to *students*. Another time I suggest he chooses works of more general appeal.

Miss Scotney sang beautifully, as she always does. I imagine the Gounod waltz song has never been sung with more finish or perfect execution. Vocal difficulties do not seem to exist for her.

Friday

MORE delightful music to-night. The New London Trio pleased me immensely in the Dvorak.

Walter Widdop sang German lieder in a most inspired fashion. As it happened, I played some of the songs he sang to-night in his own house yesterday morning. This added to my enjoyment, of course, because I knew beforehand what he was going to do.

Continued on page 71

Broadcast Wavelengths

This week we give details of the principal short-wavers and the European long-wave stations. Next week we shall publish a list of medium-wave transmitters

Principal Short-wavers

Metres	Kilo-cycles	Station and call sign	Country
16.86	17,790	Daventry (G5G)	Great Britain
16.87	17,780	Boundbrook (W3XAL) NJ	United States
16.83	17,770	Eindhoven (PHI)	Holland
16.89	17,760	Zeesen (DJE)	Germany
19.47	15,410	Riobamba (PRADO)	Ecuador
19.56	15,340	Schenectady (W2XAD)	United States
19.64	15,270	Wayne (N.J.) (W2 & E)	United States
19.67	15,250	Boston (WIXAL)	United States
19.68	15,243	Paris (Colonial) (FYA)	France
19.72	15,210	East Pittsburgh (W8XK)	United States
19.73	15,200	Zeesen (DJB)	Germany
19.82	15,140	Daventry (GSF)	Great Britain
19.84	15,122	Vatican (HVJ)	Italy
23.39	12,825	Rabat (CNR)	Morocco
24.53	12,230	Lisbon (CTICT)	Portugal
25.00	12,000	Moscow (RNE)	U.S.S.R.
25.25	11,880	Paris (FYA)	France
25.27	11,870	E. Pittsburgh (W8XK)	United States
25.3	11,860	Daventry (GSE)	Great Britain
25.40	11,810	Rome (2RO)	Italy
25.45	11,790	Boston (WIXAL)	United States
25.51	11,760	Zeesen (DJD)	Germany
25.53	11,750	Daventry (GSD)	Great Britain
25.63	11,705	Paris (Colonial)	France
26.83	11,181	Funchal (CT3AQ)	Madeira
28.98	10,350	Monte Grande (LSX)	Argent. Republic
29.04	10,330	Ruysselede (ORK)	Belgium
30.43	9,860	Madrid (EAQ)	Spain
31.25	9,600	Lisbon (CT1AA)	Portugal
31.28	9,590	Philadelphia (W3XAU)	United States
31.28	9,590	Sydney (VK2ME)	New South Wales
31.3	9,585	Daventry (GSC)	Great Britain
31.35	9,570	Boston (WIXAZ)	United States
31.36	9,565	Bombay (VUB)	India
31.38	9,560	Zeesen (DJA)	Germany
31.45	9,540	Jeloy (LKJI)	Norway
31.48	9,530	Schenectady (W2XAF)	United States
31.55	9,510	Daventry (GSB)	Great Britain
31.55	9,510	Caracas (YV3BC)	Venezuela
36.65	8,186	Rio de Janeiro (PRA3)	Brazil
37.48	8,035	Rabat (CNR)	Morocco
38.47	7,797	Radio Nations (HBP)	Switzerland
43.86	6,840	Budapest (HAT2)	Hungary
45.38	6,610	Moscow (RW72)	U.S.S.R.
46.53	6,447	Barranquilla (HJIABB)	Colombia
46.69	6,425	Boundbrook (W3XL)	United States
48.86	6,140	Pittsburgh (W8XK)	United States
49.02	6,120	Wayne (W2XE)	United States
49.08	6,112	Caracas (YV1BC)	Venezuela
49.18	6,110	Chicago (W9XF)	United States
49.18	6,110	Boundbrook (W3XAL)	United States
49.22	6,095	Bowmanville (VE9GW)	Canada
49.34	6,080	La Paz (CP5)	Bolivia
49.5	6,065	Nairobi (VQ7LO)	Kenya Colony
49.48	6,060	Byberry (W3XAU)	United States
49.48	6,060	Mason (W8XAL)	United States
49.5	6,060	Skamlebaek (OXY)	Denmark
49.59	6,050	Daventry (GSA)	Great Britain
49.67	6,040	Boston (WIXAL)	United States
49.83	6,020	Zeesen (DJC)	Germany
49.92	6,010	Havana (COC)	Cuba
49.96	6,005	Montreal (VE9DR)	Canada
50.0	6,000	Moscow (RNE)	U.S.S.R.
50.26	5,969	Vatican (HVJ)	Italy
50.42	5,950	Medellin (H,4ABE)	Colombia

Long-wave Stations

Metres	Kilo-cycles	Station and Call Sign	Country	Power (Kw.)
1,107	271	Moscow (RCZ)	U.S.S.R.	100
1,145	262	Madona	Latvia	15
1,154	260	Oslo	Norway	600
1,209.6	248	Scheveningen Haven	Holland	5
1,239	242	Leningrad	U.S.S.R.	100
1,250	240	Vienna (Exp)	Austria	3
1,261	238	Kalundborg	Denmark	30
1,293	232	Kharkov	U.S.S.R.	35
1,304	230	Radio Luxembourg	Grand Duchy	200
1,312.9	229	Ankara	Turkey	7
1,339	224	Warsaw	Poland	12
1,389	216	Motala	Sweden	30
1,395	215	Eiffel Tower (Paris)	France	8
1,442	208	Reykjavik	Iceland	21
1,442	208	Minsk	U.S.S.R.	35
1,500	200	Daventry National	Great Britain	30
1,570.7	191	Deutschlandsender	Germany	60
1,621	185	Istanbul	Turkey	5
1,648.3	182	Radio Paris	France	50
1,724.1	174	Moscow (1)	U.S.S.R.	500
1,807.2	166	Lahti	Finland	40
1,875	160	Kootwijk (Huizen prog.)	Holland	50
1,886.7	159	Brasov	Roumania	20
1,935	155	Kaunas	Lithuania	7

The Before-breakfast Club!

IN America they have formed a club for radio fans who have heard a certain number of DX stations before breakfast.

Although this club has no counterpart in Europe it does make one realise that after the hours of five or six a.m. a number of interesting stations are putting out good programmes.

Not counting the short-wave stations, anyone with a good three- or four-valve receiver can have a variety programme for two or three hours.

Hamburg generally relays a most amusing programme from one of the numerous liners in the harbour and at the unearthly hour of 6 a.m. Berlin gives physical jerks with a musical accompaniment for those who like that sort of thing. On the other hand Heilsberg invariably sends out some light gramophone records with a little news at regular intervals.

One of the best-known morning broadcasters is Hilversum, which comes on with a peal of bells at a little after twenty minutes to eight. This programme is one of the best on the air and is comparable with those given by Christopher Stone. It consists of light orchestral pieces, a few vocal solos and always plenty of English dance records.

Just before 8 a.m. Radio Paris starts up with some more light records followed by news. Although the latter is not of much interest to English listeners any English news is translated for our benefit. R. B.

My Broadcasting Diary

Continued from page 70

The first time I have ever had such an experience. I am only sorry we shall not have him for the Proms. He is off to Australia almost immediately.

Saturday

HEARD bits of the running commentary from Old Trafford and Wimbledon and realised their importance in the broadcasting sense.

Later, I caught Christopher Stone in an ecclesiastical mood, apparently. I happened to be playing deck tennis on the lawn, and played a game to a record of Liddle's "Abide With Me" and Mendelssohn's "Hear My Prayer." Didn't fit, somehow. Found things more suitable when Jack Hylton played to me from Manchester.

Later still, when dusk had fallen around me, I comforted my weary soul and overheated frame with the Theatre Orchestra under the control of Stanford Robinson. They played extremely well, I thought.

INFORMATION BUREAU

Will every querist please observe the following revised rules?

Please write concisely, giving essential particulars.

A fee of one shilling, postal order (not stamps), a stamped, addressed envelope and the coupon on this page must accompany all queries.

Not more than two questions should be sent at any time.

The designing of apparatus or receivers cannot be undertaken.

Slight modifications of a straightforward nature only can be made to blueprints. For more serious alterations the minimum charge is 2/6.

Blueprints supplied by us will be charged for in addition, but, of course, readers may send their own blueprints for alteration.

Modifications to proprietary receivers and designs published by contemporary journals cannot be undertaken. Readers' sets and components cannot be tested by us. Queries cannot be answered by telephone or personally. Readers ordering blueprints and requiring technical information in addition should address a separate letter to the Information Bureau and should see that their remittance covers the price of the Blueprint and the amount of the query fee.

We do not answer queries in cases where the fee is omitted.

Queries should be addressed to the Query Dept., "Amateur Wireless," 58/61 Fetter Lane, London, E.C.4.

What the Crystal Will Do To-day

Continued from page 59

I did make some attempt to obtain the necessary high impedance by using a transformer between the crystal and the telephones. If, for instance, one used the step-down ratio of 1 to 1.7, the effective primary impedance would be increased to 90,000 ohms and the voltage on the primary would be increased to practically twice.

But the voltage on the secondary would be stepped down 1.7 times so that there would be little over-all improvement. Moreover, the method does not work in practice because the primary impedance of the transformer itself is of the order of 30,000 to 50,000 ohms even at 1,000 cycles and therefore exercises a considerable shunting action.

Summing Up the Tests

We may sum up the first tests by saying that a crystal under proper conditions of use can give very good efficiency, but before these conditions are obtained, the telephones used must have a really high resistance. Even the ordinary 2,000-ohm phones restrict the efficiency to about one-half of what it might be and, of course, low-resistance phones are quite useless.

The importance of this question of the load will be further discussed in a further article, which deals with the question of the damping which the crystal introduces into the tuned circuit and the effect it has on the selectivity and sharpness of tuning.

Amateur Wireless FEE 1/-

INFORMATION BUREAU COUPON Available until Saturday, JULY 28, 1934

Printed in Great Britain for the Proprietors and Publishers, BERNARD JONES PUBLICATIONS, LTD., 58-61 Fetter Lane, London, E.C.4, by The Sun Engraving Co., Ltd., London and Watford. Sole Agents for South Africa: CENTRAL NEWS AGENCY, LIMITED. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A'SIA), LIMITED. Saturday, July 21, 1934.

You Must Join the CONSTRUCTOR CRUSADERS

THE PRIVILEGES OF MEMBERSHIP

1.—*Every Constructor Crusader will receive a full-size blueprint, immediately on publication, of each of the four star sets to be described in "Amateur Wireless" during the 1934-1935 season. These sets will be released on August 15, October 3 (1934), and January 23 and March 13 (1935).*

2.—*Every member will also be entitled to free technical advice in connection with any or all of the four special Crusader sets mentioned above (each query must be accompanied by a stamped and addressed envelope for the reply). In the case of queries regarding any other "Amateur Wireless" sets the usual rules of the Information Bureau must be observed.*

3.—*All Constructor Crusaders are invited to contribute ideas and suggestions to the Constructor Crusaders' Corner. Constructive suggestions will be especially helpful and will be interpreted by the "Amateur Wireless" Technical Staff as far as possible to the advantage of all set builders.*

4.—*Immediately his application for membership has been approved every Constructor Crusader will receive a certificate of membership. Note that the membership number must be quoted in all future correspondence.*

5.—*Constructor Crusaders will be authorised to wear the badge of membership. Badges for buttonhole wear can be obtained for 1s. extra each, post paid.*

FILL IN THIS FORM AND SEND IT TO US TO-DAY!

To Constructor Crusaders, "Amateur Wireless,"
58-61 Fetter Lane, London, E.C.4.

(Enclose in envelope bearing 1½d. stamp).

Please enrol me as a member of the Constructor Crusaders. I enclose postal order for 1s. to cover postage on four free blueprints and office expenses (and also an extra 1s. for buttonhole badge). It is understood that I shall be entitled to free technical advice on any matters concerning the four free blueprint sets. My name and address are:*

July 21, 1934

Value of Postal Order Enclosed	*For office use only.*			
	No.	C	B	L
**Delete if not required*				